

## SUMMARY

### A. OVERVIEW: HIGHLIGHTS OF 2002 RESULTS AND 2003 DEVELOPMENTS

In this overview ICARDA's Medium Term Plan 2004-2006 is presented according to the CGIAR's principal outputs of (1) Germplasm Improvement, (2) Germplasm Collection, (3) Sustainable Production, (4) Socioeconomics and Policy and (5) Enhancing NARS. In its MTP 1998-2001, following an in-house priority assessment, ICARDA identified research areas for increased research attention. These included on-farm water management, rangeland rehabilitation and management, small ruminant nutrition and management, agroecological characterization, land and water resource management, resource economics, pre-breeding and biotechnology, farmer participatory approaches, end-use quality and added value, and faba bean pre-breeding. Highlights of progress and developments in each of these areas and other shifts in emphasis are summarized by region and then by CGIAR output below.

#### 1. Regional Highlights and Plans

##### **1.1. Central and West Asia and North Africa (CWANA)**

ICARDA together with AARINENA, and the CAC NARS Forum undertook a priority setting process for agricultural research in the CWANA region with NARS, sister Centers and other stakeholders, which included sub-regional brainstorming workshops and a widely circulated questionnaire survey and culminated in a regional meeting in May 2002 at ICARDA.

In 2003 ICARDA hosted a Regional Consultation on a Rural Development Strategy for CWANA, one of a series of regional workshops sponsored by the World Bank. The purpose of the workshop was to review the Bank's new strategy and provide a forum for dialogue and consultation among experts on rural development in the region and staff from CGIAR Centers, the World Bank and other agencies involved in the region.

ICARDA's extensive activities in West Asia and North Africa (WANA) are explained later under the CGIAR principal outputs. Activities in the Central Asia and the Caucasus (CAC) region of CWANA are highlighted because of the continued growth of ICARDA's engagement within the framework of the CGIAR Consortium for CAC. During 2002 projects continued on 'Germplasm Conservation, Adaptation, and Enhancement for Diversification and Intensification of Agricultural Production' on barley, forage legumes, food legumes including groundnuts with ICRISAT, winter wheat with CIMMYT and plant genetic resources with IPGRI - all within the CGIAR Program. In CAC there were on-going projects on 'On-farm Water and Soil Management' funded by ADB and on 'Integrated Feed and Livestock Production in the Steppes of Central Asia' funded by IFAD to expand livestock productivity research in Central Asia. Through funding from ACIAR and GRDC, major focus in agro biodiversity research in 2002 was on the CAC region with collections in two CAC countries and others planned for 2003 and assistance given to Uzbekistan to upgrade its gene-bank documentation through USDA. Additionally, in 2002/3 ICARDA continued its collaboration with the N.I. Vavilov Research Institute of Plant Industry in St. Petersburg, Russia tied in to the above CAC program.

During 2002, a pre-proposal for a Challenge Program for the CAC region was submitted by ICARDA to the iSC/CGIAR and not recommended for further development.

Following the war in Afghanistan, ICARDA convened a meeting of stakeholders in January 2002 to launch the Future Harvest Consortium to Rebuild Agriculture in Afghanistan (FHCRAA), attended by representatives of 34 organizations. With support from USAID, FHCRAA led by ICARDA embarked on a major program of seed sector development as well as needs assessments in Seeds and Crop Production; Livestock, Feed and Range; Soil and Water; and Horticulture in 2002/3. IDRC granted additional funding for studies of the consequences for crop genetic diversity and local seed systems of

the conflict and drought in Afghanistan. This major development in 2002 also reflected in the distribution of the Center's financing in 2003.

### **1.2. South and East Asia**

ICARDA is providing major support to integrated research on dryland resource management within the IFAD-funded Barani Village Development Project in Pakistan. ICARDA's cooperation in South Asia on lentil improvement is supported by ACIAR through a project in Nepal, which started in 2002 with the Centre for Legumes in Mediterranean Agriculture (CLIMA), Australia. Strong links with NARS in germplasm improvement of cereals (barley and wheat) and food legumes (lentils, kabuli chickpea, faba bean and low-neurotoxin grasspea) continue through germplasm exchange and training activities in Bangladesh, India, Nepal and Pakistan, and to a lesser degree with Bhutan, China, South Korea and Sri Lanka.

### **1.3. Sub-Saharan Africa**

Focusing on the poor in sub-Saharan Africa (SSA) in line with the CGIAR 'Plank' emphasizing SSA, ICARDA initiatives include the following: research on enhancing food security in the Nile Valley region through the generation and dissemination of sustainable production technologies for cereals and cool season food legumes, supported by IFAD; support to Ethiopia in its research on grasspea with low neurotoxin content funded by DFID, UK concluded in 2003; and in Eritrea, in collaboration with Danida, a project on integrated disease management to enhance wheat and barley production. A project developed with the NARS of Mauritania on natural resource management started in 2003 from the CIDA 'Africa' funding, which is also being used for specific interventions in Eritrea, Ethiopia and Sudan.

ICARDA has been actively participating in the process to launch the SSA Challenge Program.

### **1.4. Latin America**

ICARDA's cooperation in Latin America has focused on the provision of germplasm of its global mandate crops. In 1999 ICARDA posted a Regional Coordinator for Latin America at CIP, Lima to develop a joint program of research with Latin American NARS particularly through an expansion of natural resources research. However following a review of outreach in 2001, as recommended by our EPMR, it was decided to reduce activities in Latin America. The regional office was closed in early 2002 and the Coordinator re-located. A barley breeder operates from CIMMYT, Mexico for the genetic improvement of barley for the Andean region and for favourable environments globally. In 2003 an IFAD-funded project on strengthening institutional capacity to improve marketing of small ruminant products and income generation in dry areas of Latin America was started in partnership with FAO and NARS.

## **2. Research Outputs**

### **2.1. Germplasm Improvement**

- Farmer participatory plant breeding research continued to expand during 2002 and has now included collaboration with NARS in Egypt, Eritrea, Jordan, Morocco, Syria, Tunisia and Yemen on barley and in Bangladesh, Nepal, Syria, Turkey and Yemen on chickpea and lentil.
- The major thrust of germplasm enhancement in the mandate crops continues to be towards improving water use efficiency by exploiting our major holdings of dry-areas germplasm through selection and (pre-) breeding for drought tolerance. A wide range of approaches is employed including the use of molecular techniques and biotechnology. Increasingly this is recognized as contributing, together with thermo-tolerance, to adaptation to the anticipated effects of climate change. A project to screen our extensive germplasm collections to identify and use new sources of heat and drought tolerance has started with BMZ funding in 2003.
- Given the increasing attention to the important role of barley as a food of the poor in highland dry areas, ICARDA hosted an international workshop on food barley in Tunisia in January 2002. Within the Biofortification Challenge Program, we aim to improve the nutritional quality of barley, lentil and durum wheat for the benefit of the poor, particularly women and children.
- In mid-2003 CIMMYT withdrew support from the joint CIMMYT/ICARDA improvement program on durum and spring bread wheat, for which ICARDA has now to carry full cost.
- Research on the genetic transformation of food legumes continued in 2002 in partnership with ARIs: for chickpea in cooperation with the Universities of Hanover and Naples, and for lentil with CLIMA, Australia (funded by ACIAR) through a scientist posted to the Agricultural Genetic Engineering Institute (AGERI) in Egypt. A major initiative to increase the capacity of NARS in biotechnology is under consideration for a second phase with the Arab Fund.

- Since 2002 increased attention is being given to functional genomics through a BMZ-funded project on food legumes. Through active participation in the Challenge Program for Unlocking Genetic Diversity in Crops for the Resource-Poor and the Comparative Cereal Genomics Initiative, we aim to increase our research on functional genomics in 2003. With the identification of more linkages between DNA markers and economic traits in several mandate crops, the use of marker-assisted selection increased in 2002.

## **2.2. Germplasm Collection**

- ICARDA has the responsibility for the regional coordination of a collaborative project started in 1999 on 'Conservation and Sustainable Use of Dryland Agrobiodiversity in Jordan, Lebanon, Syria and the Palestinian Authority' with the NARS of the respective countries and with IPGRI, ACSAD (Arab Center for Studies of Arid Zones and Dry Lands) and UNDP/RBAS funded by GEF. A major thrust of the project is the development of *in situ* and on-farm conservation of the biodiversity of agriculturally useful species through the appropriate management of habitats.
- The holdings of plant genetic resources of mandate crops and their wild relatives at the Center exceeded 128,000 accessions in 2002, with the majority designated as 'In Trust' germplasm under the auspices of FAO. As part of the CG-wide Gene Bank upgrade, ICARDA is constructing additional cold store facilities to house our collections in 2003. Activities in germplasm collection, characterization (including molecular characterization), evaluation, maintenance and distribution continued during the year, with collection activity focused in the CAC region during 2002.

## **2.3. Sustainable Production**

- Research on water at ICARDA remains high priority for this water scarce region. The research is focused on water harvesting and renewable groundwater resources, the use of non-conventional water sources including saline water and treated effluent, and farm-level management practices for improved water-use efficiency in both rainfed and irrigated conditions. In 2002 ICARDA continued water research in the CAC region particularly through projects on on-farm water and soil management. A regional network on drought mitigation sponsored by ICARDA, FAO and CIHEAM was launched in 2002. ICARDA is a partner in the Challenge Program on 'Water and Agriculture'. A major project on 'Options for coping with increased water scarcity in agriculture in the WANA region' co-funded by the Arab fund started in 2003.
- Small ruminant research in 2002 focused on the development of market-oriented production and on adding value to dairy products, on-farm adaptive research and breed characterization. Research on small ruminant productivity and feed resources in Central Asia supported by IFAD continued and activities in Syria on market opportunities and on-farm adaptive research for small dairy sheep producers also continued with Japanese support. ILRI and ICARDA are now seeking a Project Coordinator to manage the new joint IFAD-funded project "Small Ruminant Health – improved livelihoods and market opportunities for poor farmers in The Near East and North Africa Region". The market focus is also present in the new small ruminant project for dry areas of Latin America.
- Based on the strategy for rangeland research in non-tropical dry areas, research in 2002 focused on the assessment and spatial characterization of rangeland plant resources in key representative sites in North Africa, West Asia, and Central Asia. Key to this research was the application of GIS and remote sensing technologies and major efforts were made to transfer this technology within special projects with a rangeland component. Collaborative research with NARS within a major regional project in WANA has focused on developing technical and institutional rangeland management options in selected communities, particularly in SDC-sponsored initiatives in the arid margins of Syria and North Africa.
- ICARDA is developing a repertoire of participatory approaches in natural resource management. In 2002, participatory techniques continued to be applied in natural resource valuation exercises with farmers, particularly for soil erosion, water resource depletion, agro-ecological characterization and in estimates of water use efficiency. In 2002 we focused on the community development of natural resources in the Yemeni mountain terraces and the link with food security through IDRC support. A BMZ-financed project on developing an integrated approach to sustainable land management in dry areas has been established at an integrated research site in Syria and uses participatory community approaches and model building to assist decision-making on options for resource users and planners.
- ICARDA is paying increased research attention to climate change in response to the increased magnitude and confidence of the predictions of warming and drying in dry areas in general and CWANA in particular. ICARDA is utilizing data from its long-term rotation trials to assess organic carbon increases in soil subject to different cropping patterns. ICARDA is a partner in the Challenge Program pre-proposal on climate change deemed 'meritorious' by iSC/CGIAR. Many other aspects of the Center's research contribute to building the scientific knowledge base on mitigating the effects of climate change such as policy research, rangeland

management and rehabilitation, water harvesting, conservation tillage, land use planning and watershed management. An international workshop was held in May 2002 on 'Agriculture, the Environment, and Livelihoods', which focused on climate as a major driver of a change in the region.

- In parallel the Center has increased its engagement with NARS and other regional and international organizations in preparing action plans for implementation under the UN Convention to Combat Desertification (UNCCD) to combat desertification and mitigate the effects of drought. ICARDA is the CGIAR focal point for UNCCD. In 2003 we completed an inventory study for Thematic Network 1 (TN1) of the subregional program for West Asia (SRAP), initiated activities in pilot sites in four countries with OPEC funding, and also participated in the preparation of national action plans. ICARDA participated in a Ministerial Meeting on *Opportunities for Sustainable Investment in Rainfed Areas of WANA* in Rabat in June 2001, which recommended that ICARDA, together with other specialized regional organizations, develop a regional program to deal with problems of poverty, desertification and natural resources degradation. To follow-up ICARDA hosted a meeting in early 2002 to launch a rainfed agriculture network initiative and will host its facilitator in 2003/4. ICARDA with ICRISAT launched a Challenge Program pre-proposal on 'Agriculture to Combat Desertification and Poverty'. It was subsequently re-tooled for submission in 2002 in the light of comments received and following a stakeholders meeting held in August 2002 at ICARDA with support from IFAD and the Global Mechanism of UNCCD. Although it was rated 'meritorious' by the iSC/CGIAR, it has not been allowed to move to full project proposal development despite considerable donor encouragement.
- On-farm evaluation of packages of practices for Integrated Pest Management was continued in pilot sites in Morocco and Egypt in 2002. A project on the integrated management of Sunn Pest in West Asia is underway with DFID support.
- Agroecological characterization at ICARDA made substantial progress in 2002. ICARDA's meteorological database now contains over 5 million records. An overview of the agroecology of CWANA with thematic layers of soil, altitude/slope and land use/cover and agroecological zones was completed in 2002. A report of the characterization of the Arabian Peninsula was published and progress made to develop a land suitability map of Morocco.

#### **2.4. Socioeconomics and Policy**

- ICARDA's attention to the issue of poverty alleviation continued in 2002 and the foundations were laid for increased research efforts in 2003 to clarify the connections between the determinants of poverty and ICARDA's research. This is required to refine and strengthen the alignment of the Center's research agenda with the over-riding goal of poverty alleviation. A cooperative project with the University of Massachusetts on household food systems, poverty, and the nutritional status of women and children is nearing completion. After identifying the type of malnutrition in this project, we are examining the impact of lysine fortified wheat flour on the nutritional status of rural families. The results of a complementary project on the organization of female agricultural labor in areas where crop production has been intensified through new technologies and increased exploitation of land and water resources will be published in 2003. ICARDA is developing project proposals for research on the potential for improving livelihoods through improving the quality, post-harvest processing and marketing of primary crop and livestock products.
- In 2003 in concert with the SPIA germplasm impact group ICARDA reported on the impact of its improvement research on barley and lentil and the resulting contribution to poverty alleviation. A study on the spillover to Australia of ICARDA-led research, requested and funded by ACIAR, was completed in 2002.
- ICARDA in cooperation with IFPRI has worked with NARS in eight countries of WANA in implementing a community approach to the development of integrated feed/livestock management strategies. Research on increasing the role of women in resource management, household livelihood strategies and community level impacts of policy and property rights and technical options in the low rainfall areas of WANA continued in 2003.
- ICARDA is strengthening its capacity to address the human aspects of natural resource management at the farm and community levels. During 2002/3 a partnership with ESCWA (United Nations Economic and Social Commission for West Asia) continued on research on farmer allocation of pumped groundwater and the technical and economic efficiency of its use. Efforts focus on identifying ways and means, including local institutional arrangements, for the sustainable utilization of groundwater by farmers. In 2003 focus will remain on water as the principal natural resource constraint in the dry areas.

#### **2.5. Enhancing NARS**

- ICARDA continues to emphasize economic and policy issues affecting the seed supply system in WANA. A major training initiative is being undertaken in these aspects of seed. The situation in Afghanistan has focused the Seed Unit's activities there in 2002/3. These include a 'Code of Conduct' workshop to provide a

preliminary regulatory framework in the country, the injection of quality seed to kick-start the seed system, seed system development and considerable human resource development.

- ICARDA's research outputs are incorporated within national development projects such as in the Barani area of Punjab, Pakistan, and the Turkish South-East Anatolian Project.

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## **B. HIGHLIGHTS OF CHANGES IN PROJECT PORTFOLIO FOR 2004**

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The Research Project Portfolio for 2004-2006 is presented in the attached Annex.

In 2002/3, under the Future Harvest Consortium to Rebuild Agriculture in Afghanistan, ICARDA received substantial funding from USAID to support quality seed activities, and needs assessments of various agricultural sectors. This had an effect on the distribution of the Center's funding over the 19 projects, with the bulk of these funds being attributed to Project 5.1 on Strengthening National Seed Systems (see attached financial table). Another major injection of funding has come in 2003 to Project 3.3 on Biodiversity Conservation from the CG-wide gene bank upgrade which involves the construction of an additional cold store. By comparison in 2004 there will be relatively less emphasis in the research portfolio on these projects - Seed and Biodiversity - and commensurate shifts to other high priority themes in the research agenda (see attached financial plan for 2004-6).

Other than this, there are no major programmatic changes in the project portfolio compared with the MTP 2003-2005. With major structural changes made in 1998, in line with the thrusts laid out in the 1998-2001 MTP, the year 2004 will see a closer research focus at ICARDA on the determinants of poverty. The suite of projects has not changed (there are no new projects), but within projects there are shifts in emphasis or scale:

- Expansion in research on water management in Dry Areas as a key limiting natural resource (Project 3.1) since 2002.
- Expansion of research on mitigation and adaptation to the anticipated effects of climate change through the BMZ project (Projects 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.2. and 3.4).
- Increased support for socioeconomic research overall since 2002.
- Greater funding for small ruminant research in 2004
- Expansion of research on germplasm enhancement of barley and food legumes – world mandate commodities - through restricted project support in 2004.

ICARDA is a partner in activities in the Challenge Programs (CP) on Water in Agriculture and Biofortification and is involved in the new CP on Genetic Resources. ICARDA has been actively participating in the process to launch the SSA Challenge Program. These are mentioned above within our overall research agenda. ICARDA has submitted concept notes for competitive funding within the active CPs, but as of now the extent of finance from this involvement is unclear and has not been included.

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## **C. MEASURES OF PROGRESS/ACHIEVEMENT**

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Project milestones to measure progress for 2004 through 2006 are given within the Research Project Portfolio for 2004-2006 in the attached Annex. With restricted funding now accounting for around two thirds of the budget, the timely attainment of milestones is increasingly contingent upon successful project funding. Some activities may be re-scheduled because funding did not materialize as anticipated, whereas new partnerships have led to specific activities being initiated within projects, which are indicated as new milestones. Examples of such new milestones are: evaluation of conservation tillage systems in Project 2.2; testing of alternative models of range management for protected and "common" range areas in Project 2.4 (jointly with Project 4.3); shift to community-based research on markets and analysis of complementarities and conflicts among production systems in Central Asia in Project 2.5; development of decision support system for sustainable land management in Project 3.2; characterization of accessions for agromorphological traits, photothermal response and drought tolerance in Project 3.3; establishment of a methodology for multi-scale land degradation assessment in Project 3.4; an international workshop on community-based natural resources management research, and case studies of the impact of lentil germplasm on rural livelihoods in Project 4.2; evaluation of returns to public investments in dry areas, and identification of marketing niches for dryland products in Project 4.3.

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## **D. COLLABORATION**

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ICARDA continues to participate in the system-wide programs listed in its MTP 2002-2004 (SGRP, SLP, SP-SWNM, SP-IPM, CAPRI, and SP-PRGA). ICARDA is a partner in the Challenge Programs on Water and Food, and Biofortification and also Genetic Resources. ICARDA is co-convening with ICRISAT a pre-proposal on Desertification, Poverty and Drought. The Center is also a partner in several other CP pre-proposals. The Center has a joint appointment with IFPRI; had two scientists from CIMMYT in the joint CIMMYT/ICARDA wheat improvement program until mid-2003; and is recruiting for joint positions – one with IWMI for a scientist on marginal quality water and the other with ILRI for a small ruminant epidemiologist.

## **E. COSTING CENTER PROJECTS**

ICARDA's current estimate of 2003 financing of US\$ 26.72 million is just 5 % lower than the previous estimate for 2003 of US\$ 28.05 million submitted in the financial plans in August 2002 (see attached financial table). Based on current estimates of anticipated funding, the research agenda requirement in 2004 is US\$ 22.99, which represents a 14 % decrease from our current estimated 2003 expenditure. This is the result of the conclusion in 2003 of the special project from USAID for quality seed multiplication and seed system development in Afghanistan and also funding from the CG-wide gene bank upgrade.

In computing project costs, ICARDA's overhead is 24% which is allocated across all nineteen projects in the project portfolio, on a proportional basis.

The project annual cost changes represent an increase to account for inflation. ICARDA does not expect any significant changes in local currency exchange rates.

Non-financial contributions include 50% of one joint appointment with IFPRI and 50% of another with IWMI, a visiting scientist from France, and eight junior professional officers/associate experts. During 2003 CIMMYT withdrew its support for the joint CIMMYT/ICARDA improvement program on durum and spring bread wheat and removed two scientists out-posted to ICARDA.

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## **F. CENTER STAFFING**

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Major changes were made in 1998 with staff recruited for priority research thrusts, balanced by reductions in staff in areas of reduced emphasis in the 1998-2001 MTP. In 2003 staff turnover occurred in several positions (Director of International Cooperation; Rangeland Scientist; Forage and Feed Legume Production Specialist) without any overall change in emphasis. In 2003 ICARDA aims to recruit a senior socio-economist and a legume pathologist to support changes in emphasis in the research portfolio, as also requested by the External Program and Management Review (EPMR) and also a wheat breeder in response to the withdrawal of CIMMYT staff out-posted to ICARDA. In 2004 ICARDA anticipates hosting a total of eight associate experts/junior professional officers from Australia, Denmark, France, Japan and Switzerland.

Several modalities are being explored to support critical mass in specific areas of research, as indicated in the 1998-2001 plan. Short-term consultants are being used to supplement core staffing in priority areas including faba bean breeding. Senior Scientific Advisors appointed as 'Mentors' provide support on biotechnology, water research, stress physiology and climate change. NARS scientists have been, and will continue to be, appointed, as needed, as Affiliate Research Fellows to conduct specific activities.

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## **G. CENTER FINANCIAL INDICATORS**

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In submitting the agenda for 2004-2006, it is assumed that the mode of project financing is not a constraint. Assuming full funding, ICARDA does not foresee any constraints on project activity due to financial reasons.

# Annex

## Research Project Portfolio

### **Theme 1: Germplasm Enhancement**

- Project 1.1 Barley Germplasm Improvement for Increased Productivity and Yield Stability
- Project 1.2 Durum Wheat Germplasm Improvement for Increased Productivity, Yield Stability and Grain Quality in West Asia and North Africa
- Project 1.3 Spring Bread Wheat Germplasm Improvement for Increased Yield and Yield Stability in West Asia and North Africa
- Project 1.4 Winter and Facultative Bread Wheat Germplasm Improvement for Increased Yield and Yield Stability in Highlands and Cold Winter Areas of Central and West Asia and North Africa
- Project 1.5 Food Legume Germplasm Improvement (Lentil, Kabuli Chickpea, Faba Bean and Pea) for Increased Systems Productivity
- Project 1.6 Forage Legume Germplasm Improvement for Increased Feed Production and Systems Productivity in Dry Areas

### **Theme 2: Production Systems Management**

- Project 2.1 Integrated Pest Management in Cereal and Legume-based Cropping Systems in Dry Areas
- Project 2.2 Agronomic Management of Cropping Systems for Sustainable Production in Dry Areas
- Project 2.3 Improvement of Sown Pasture and Forage Production for Livestock Feed in Dry Areas
- Project 2.4 Rehabilitation and Improved Management of Native Pastures and Rangelands in Dry Areas
- Project 2.5 Improvement of Small Ruminant Production in Dry Areas

### **Theme 3: Natural Resource Management**

- Project 3.1 Water Resource Conservation and Management for Agricultural Production in Dry Areas
- Project 3.2 Land Management and Soil Conservation to Sustain the Agricultural Productive Capacity of Dry Areas
- Project 3.3 Agrobiodiversity Collection and Conservation for Sustainable Production
- Project 3.4 Agroecological Characterization for Agricultural Research, Crop Management, and Development Planning

### **Theme 4: Socioeconomics and Policy**

- Project 4.1 Socioeconomics of Natural Resource Management in Dry Areas
- Project 4.2 Socioeconomics of Agricultural Production Systems in Dry Areas
- Project 4.3 Policy and Public Management Research in Central and West Asia and North Africa

### **Theme 5: Institutional Strengthening**

- Project 5.1 Strengthening National Seed Systems in Central and West Asia and North Africa

## **Project 1.1: Barley Germplasm Improvement for Increased Productivity and Yield Stability**

**Goal:** Productivity of barley in marginal areas increased.

*Indicator:* 20-30% increase in barley production in 15 countries.

**Purpose:** Adoption of improved varieties by farmers in marginal areas.

*Indicator:* 30 new varieties adopted by 30% of the farmers in 10 countries in 10 years.

**Output 1:** Germplasm with higher and stable yield, better biotic and abiotic stress resistance, adaptation for global climate change and better quality.

*Indicators:* 30 different nurseries/year distributed to NARS  
30% of lines selected by NARS  
50% of lines used as parental material by NARS

### Milestones:

- 2004: 80% of the barley breeding for Latin America decentralized.  
Decentralization for China started.  
New barley lines with various combinations of abiotic and biotic stress resistance and improved feed, food, and malt characteristics obtained and distributed.  
Decentralized screening for specific diseases established in Morocco (net blotch), Tunisia (scald), and Eritrea (spot form-net blotch).  
Variation for Fe, Zn, and  $\beta$ -carotene content in the grain described.
- 2005: Decentralization for Latin America completed.  
50% of barley breeding for China decentralized.  
New barley lines with various combinations of abiotic and biotic stress resistance and improved feed, food, and malt characteristics obtained and distributed.  
Decentralized screening for specific diseases completed in Morocco and Tunisia.  
Germplasm with high concentration of  $\beta$ -carotene, iron, and zinc in the grain identified and used in the crossing program.
- 2006: New barley lines with various combinations of abiotic and biotic stress resistance and improved feed, food, and malt characteristics obtained and distributed.  
80% of barley breeding for China decentralized.  
Breeding for micronutrient-dense grain started.

**Output 2:** Methodology to enhance adoption

*Indicators:* 50 farmers/country participating in selection  
20 countries using participatory plant breeding (PPB)

### Milestones:

- 2004: At least ten new varieties identified through PPB in five countries.  
Scaling-up of PPB started by adding two provinces and more villages.  
Barley lines for malt use identified and used by local industry.
- 2005: Participatory plant breeding institutionalized in five countries.  
Scaling-up of PPB continued to other provinces in Syria and begun in Jordan.
- 2006: Marker assisted selection (MAS) routinely used in the breeding program.  
Doubled haploid (DH) breeding integrated into the breeding program.  
Scaling-up of PPB to other countries continued.

**Output 3:** Breeding methodology for stress environments

*Indicators:* New design and techniques used by 10 NARS and at ICARDA

### Milestones:

- 2004: 100% of IBIS (International Barley Information System) developed.  
Molecular markers for physiological traits associated with drought tolerance identified.  
Mapping populations for micronutrient density developed.
- 2005: IBIS used as standard information management system.  
Molecular markers for micronutrient content in the grain developed.  
Molecular markers for physiological traits associated with drought tolerance identified.  
First populations with a high frequency of outcrossing field-tested.
- 2006: IBIS used by at least five NARS.  
MAS for physiological traits associated with drought tolerance used.

2006: MAS for micronutrient content in the grain used.  
Barley molecular database linked to International Crop Information System (ICIS) (GMS & DMS).  
Barley molecular database linked to other external barley genomics databases.

**Output 4:** New methodologies disseminated

*Indicators:* 20 NARS adopted methodologies  
Number of better varieties generated

Milestones:

2004: 50% of NARS have changed their methodologies.  
2005: 80% of NARS use methodologies developed at ICARDA in the national breeding program.  
2004-2006: Breeding methodologies presented in international conferences.  
Lectures on breeding methodologies for biotic and abiotic stresses in three training courses.

**Output 5:** NARS research capacity strengthened.

*Indicators:* 50 NARS scientists trained in 5 years  
Post training employment assignment in NARS

Milestones:

2004: Five scientists trained in PPB; ten scientists trained in MAS; ten scientists trained in restricted maximum likelihood (REML) analysis; ten scientists trained in IBIS and data management; 25 scientists trained in breeding for abiotic and biotic stress resistance; 2 graduate students conducted their research activities in the project.  
2005: Five scientists trained in PPB; ten scientists trained in MAS; ten scientists trained in advanced statistical techniques; ten scientists trained in IBIS and data management; 25 scientists trained in breeding for abiotic and biotic stress resistance; two graduate students conducting their research activities in the project.  
2006: Ten scientists trained in PPB; ten scientists trained in MAS; ten scientists trained in advanced statistical techniques; ten scientists trained in IBIS and data management; 25 scientists trained in breeding for abiotic and biotic stress resistance; two graduate students conducting their research activities in the project.

**Duration:** 5 years.

**Users:** National programs will benefit from improved efficiency of germplasm enhancement through a decentralized breeding program. The income of farmers, especially resource-poor farmers in marginal areas, will improve from improved varieties, specifically adapted to their conditions, either directly by the sale of seed, or indirectly by increasing animal products. Where barley is used for human consumption, nutritional status will also improve. Breeders of other commodities in the international research system will benefit from the experience gained through ICARDA's initiatives in decentralized breeding and gender-sensitive farmer participatory approaches to germplasm enhancement.

**Collaborators:**

NARS associated with ICARDA's North Africa Regional Program, Latin American Regional Program, West Asia Regional Program, CAC Regional Program, Highlands Regional Program, Nile Valley and Red Sea Regional Program; NARS of China, Russia, Vietnam, Korea, India, Nepal, Kenya, Spain, South Africa, New Zealand.

Australia: University of Brisbane, University of Adelaide, CRC for Molecular Plant Breeding, Southern Cross University, Denmark: Risoe National Laboratory; Germany: University of Hamburg, University of Hohenheim; Jordan: University of Jordan, Jordan University of Science and Technology (JUST), National Center for Agricultural Research and Technology Transfer (NCARTT); Russia: All Russian Institute of Agricultural Biotechnology; Spain: University of Barcelona, University of Lerida, CIHEAM-IAMZ; Syria: Aleppo University, Damascus University, Tishreen University; UK: Scottish Crop Research Institute; USA: North Dakota State University, Oregon State University, Colorado State University, Kansas State University, Oklahoma State University, University of Missouri.

**Cost:**

2004: US\$ 1.53 million

2005: US\$ 1.59 million

2006: US\$ 1.65 million

**System Linkages:**

Output 1: Germplasm Improvement: 60%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 10%

Output 5: Enhancing NARS: 20%

The project participates in the Systemwide Program on Participatory Research and Gender Analysis (SWP PRGA).

**Financing Plan:** Unrestricted core. Donor attributed funding from Italy; attributed funding from France; cooperation with Iran financed by Iran; cooperation with USA supported by USAID linkage funds; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; restricted funding from BMZ; EC; GRDC, Australia; IDRC; IFAD; the OPEC Fund and the Challenge Program on Biofortification. Training supported by the Arab Fund. Research Fellow supported by SDC, Switzerland. Anticipated funding from the US Cereals Comparative Genomics Initiative, the Challenge Program on Water and Food, the Arab Fund and Morocco.

## **Project 1.2: Durum Wheat Germplasm Improvement for Increased Productivity, Yield Stability and Grain Quality in West Asia and North Africa**

**Goal:** Increased productivity of durum wheat in the WANA region.

*Indicator:* 10 % increase in durum production in 5 countries.

**Purpose:** Development of improved durum varieties with NARS in the WANA region

*Indicator:* 10-15 new varieties identified by NARS in 5-7 countries in 5 years.

**Output 1:** Genotypes with high and stable yield, resistance to biotic and abiotic stresses, adaptation for global climate change and better grain quality.

*Indicators:* 10 nurseries distributed to 20-25 NARS  
Number of lines selected by NARS  
Number of lines used as parental material by NARS

### Milestones:

2004: Introgression of resistance to blackpoint and scab.

2005: Introgression of high micronutrient status in durum grain

2006: Release of lines containing quantitative trait loci (QTL) for blackpoint and scab tolerance

**Output 2:** Efficient breeding methodology for Mediterranean drylands

*Indicators:* Stress physiological and molecular markers tools and marker assisted selection are adopted.

### Milestones:

2004: QTLs for parameters of abiotic stress tolerance.

QTLs for resistance to yellow and leaf rust.

2005: QTLs for high carotene and micro-nutrient (Zn, Fe, Cu, Mn) content in durum grain.

2006: MAS implemented for grain quality and abiotic stress tolerance

**Output 3:** Breeding methodology for temperate, continental, and high elevation areas

*Indicators:* New designs and tools adopted in the 3 main agro-ecological areas

### Milestones:

2004: Genetic stocks with high yield and stability available.

2005: Genetic stocks with high grain content of B-Carotene, Zn and Fe.

2006: Mapping populations designed for highlands distributed to NARS

**Output 4:** Identified improved varieties for commercial production

*Indicators:* On-farm trials established with NARS in the durum growing areas of five countries.  
High yielding varieties in dry lands available

### Milestones

2004: 5-10 genotypes with resistance to drought, cold and heat tested in on-farm trials with five NARS.

5-10 genotypes with improved grain quality tested in on-farm trials with five NARS.

5-10 genotypes with broadened genetic base for resistance to rusts, Hessian fly, Septoria and abiotic stresses tested in on-farm trials with five NARS.

2005: 5-10 genotypes with biofortified grains developed.

2006: 5-10 genotypes with enhanced blackpoint tolerance tested with five NARS

**Output 5:** Enhancement of NARS research capacity

*Indicators:* NARS scientists trained over 5 years: 30 at HQ and 50-60 within NARS  
Expertise in advanced breeding techniques (10 PhD)

Milestones: 2003-2006 (per year):

One trainee from each of five NARS on breeding for broadening the genetic base for abiotic stress resistance.

PhD students on quality, stress physiology or molecular markers.

**Duration:** 5 years.

**Users:** National programs will benefit from the availability of improved germplasm with drought, cold and heat resistance, and through them farm households, especially resource-poor farm households in marginal areas, will benefit from improved varieties which require to grow less inputs and no chemicals for diseases and pests control. The ultimate beneficiaries are consumers, both rural and urban consumers, from improved grain quality and agro-processing.

**Collaborators:** ICARDA's Durum Improvement Program is conducted in collaboration with CIMMYT.

- Resistance breeding for drought, cold, terminal stress, diseases, insects, viruses: ITGC, Algeria; ARC, Egypt; NCARTT, Jordan; INRA, Morocco; Morocco; ARC, Syria; University of Aleppo, Syria; University of Tichreen, Syria; INRAT, Tunisia; FCRI, Turkey; CCI-Tamworth, Australia; Plant Breeding Institute, Cobbity, Australia; University of Sydney, Australia; Agriculture Canada; Laval University, Canada.
- Molecular markers, genome mapping, double haploids: CIMMYT; Cornell University, USA; Mc Gill University, Canada; Paris-Sud University, France, Bologna University, Italy.
- Grain quality: Hassan II University, Morocco; Tuscia University, Italy; Cordoba University, Spain.
- Moisture stress: Barcelona University, Spain; IRTA-Llerida, Spain; Spain.

**Cost:**

2004: US\$ 0.98 million

2005: US\$ 1.02 million

2006: US\$ 1.06 million

**System Linkages:**

Output 1: Germplasm Improvement: 70%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 5%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Donor attributed funding from Italy; attributed funding from France. Cooperation with Iran financed by Iran; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; restricted funding from BMZ, EC and IFAD. Training supported by the Arab Fund. Anticipated restricted funding from the Arab Fund and Morocco; anticipated attributed funding from EC.

### **Project 1.3: Spring Bread Wheat Germplasm Improvement for Increased Yield and Yield Stability in West Asia and North Africa**

**Goal:** Increased productivity of spring bread wheat in WANA.

*Indicator:* 10% increase in bread wheat production in five countries.

**Purpose:** Development of improved bread wheat varieties with NARS in the WANA region

*Indicator:* Five new varieties identified by NARS in 5 countries in 5 years

**Output 1:** Spring bread wheat genotypes with high and stable yield, resistance/tolerance to biotic and abiotic stresses in targeted environments, adaptation to global climate change and better grain quality.

*Indicators:* 8 nurseries distributed to 20-25 NARS

Number of lines selected by NARS

Number of lines used as parental material by NARS

#### Milestones:

2004: Elite germplasm combining high yield with resistance to Hessian fly and Septoria, tolerance to drought, cold and heat and improved grain quality developed.

2005: Elite germplasm combining high yield with resistance to Hessian fly and Septoria, tolerance to drought, cold and heat and improved grain quality developed.

2006: Marker assisted selection (MAS) for quality and biotic stress initiated

**Output 2:** New breeding methodology for stress environments.

*Indicators:* Mapping populations use by national programs.

QTL datasets developed and exchanged.

#### Milestones:

2004: Mapping populations for marker-assisted selection (MAS) for resistance to Hessian fly and yellow rust developed.

2005: Maps constructed and QTL analysis performed.

2006: MAS initiated with national programs.

**Output 3:** Improved breeding methodologies disseminated.

*Indicators:* New designs and tools used by three NARS programs.

Number of better varieties generated.

#### Milestones:

2004: Routine utilization of mapping populations by national programs

2005: National program staff have improved understanding of genetics of local adaptation

2006: Marker-assisted selection implemented

**Output 4:** Enhanced adoption of improved cultivars

*Indicators:* On-farm trials in three NARS are established in bread wheat growing areas in each country.

Number of improved spring bread wheat varieties adopted.

#### Milestones:

2004: A new variety is released in each of at least three NARS.

2005: Farmers adopt new varieties.

2006: Bakers begin paying premium for specific varieties

**Output 5:** Enhanced NARS research capabilities

*Indicators:* NARS scientists trained in 3 years: 16 at headquarters and 30-50 within NARS programs.

3-5 workshops/courses organized with NARS.

#### Milestones:

2004: Four trainees trained in QTL analysis, quality analysis and marker utilization

2005: Four trainees trained in marker-assisted selection and breeding techniques

2006: Four trainees trained in haplotype analysis and associative genetics

**Duration:** 4 years.

**Users:** National programs will benefit from the availability of improved germplasm with drought, cold and heat resistance, and through them farm households, especially resource-poor farm households in marginal areas, will benefit from improved varieties which require to grow less inputs and no chemicals for diseases and pests control. The ultimate beneficiaries are consumers, both rural and urban consumers, from improved grain quality and agro-processing.

**Collaborators:** ICARDA's Spring Bread Wheat Improvement Program is conducted in collaboration with CIMMYT.

- Breeding for Hessian fly and Russian Wheat Aphid resistance: INRA-Morocco.
- Breeding for Septoria Leaf Blotch resistance: INRAT-Tunisia.
- Networks on foliar diseases, heat tolerance and water use efficiency: Nile Valley and Red Sea Regional Program, ARC-Egypt, EARO-Ethiopia, ARC-Sudan and AREA-Yemen.
- On-farm and adoption studies: ARC, Syria and LARI, Lebanon.
- Millers and bakers of Syria and Lebanon

**Cost:**

2004: US\$ 0.56 million

2005: US\$ 0.58 million

2006: US\$ 0.61 million

**System Linkages:**

Output 1: Germplasm Improvement: 70%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 5%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Attributed funding from France. Cooperation with Iran financed by Iran; restricted funding from BMZ and IFAD; training supported by the Arab Fund. Anticipated funding from Morocco.

**Project 1.4: Winter and Facultative Bread Wheat Germplasm Improvement for Increased Yield and Yield Stability in Highlands and Cold Winter Areas of Central and West Asia and North Africa**

**Goal:** Increased and sustainable productivity of wheat in highland and continental areas of Central and West Asia and North Africa (CWANA).

*Indicator:* Yield level raised and maintained.

**Purpose:** Increased adoption of improved bread wheat varieties in highland and continental areas of CWANA.

*Indicator:* Adoption by farmers of improved varieties.

**Output 1:** Wheat germplasm with improved yield potential, enhanced adaptation to local environments, and better grain quality developed for use by NARS.

*Indicators:* Superior germplasm performance confirmed.  
New varieties released by NARS for the target region.

Milestones:

- 2004: Improved bread-making quality realized in new cultivars
- 2005: Broadening the genetic base for earliness and yield potential
- 2006: Elite germplasm combining high yield and improved grain quality developed

**Output 2:** Improved understanding of cultivar response to abiotic stresses achieved, used in breeding, and made accessible to NARS.

*Indicators:* Mechanism of adaptation to drought and cold documented.  
Effect on yield of cold and drought reduced.

Milestones:

- 2004: Heat and salt tolerant segregating materials distributed to CAC and Iran.
- 2005: DNA markers for cold tolerance identified.
- 2006: Marker-assisted selection implemented

**Output 3:** Genetic diversity for enhanced tolerance to biotic stresses.

*Indicator:* Incidence of biotic stresses and their effect on yield reduced.

Milestones:

- 2004: Genetic stocks for Russian wheat aphid tolerance produced and made accessible to NARS.
- 2005: Genetic stock for yellow rust resistance distributed to NARS
- 2006: Elite germplasm combining high yield with resistance to yellow rust and RWA tolerance developed

**Output 4:** Strategies to improve technology adoption.

*Indicator:* Percent of farmers growing new cultivars.

Milestones:

- 2004: NARS release varieties based on joint activities.
- 2005: On-farm trials in Afghanistan result in adoption of new varieties
- 2006: Seed multiplication of promising advanced breeding lines in CAC, IRAN and Turkey

**Output 5:** NARS capacity for wheat research in highlands strengthened

*Indicator:* Number of skilled wheat researchers working in highland areas

Milestones:

- 2004: In-country workshop in Morocco highlands
- 2005: Four trainees from CWANA trained in Tel Hadya
- 2006: Four trainees from CWANA trained in Tel Hadya

**Duration:** 6 years.

**Users:** National Programs will benefit from training, and improved germplasm; and through them, farm households in the highlands and cold-winter areas of CWANA will benefit from the improved varieties,

specifically adapted to their conditions and needs. Consumers will benefit from improved nutritional quality of bread wheat products.

**Collaborators:** ICARDA's winter and facultative bread wheat improvement work is conducted in collaboration with CIMMYT and Turkey through the Turkey/CIMMYT/ICARDA program. An important component of ICARDA's breeding work is also conducted in collaboration with Iran, with a special emphasis on rainfed winter wheat in dry areas, and on resistance to yellow rust. Other cooperation includes:

- *In situ* germplasm evaluation for adaptation to specific agroecologies: NARS associated with ICARDA's North Africa Regional Program, West Asia Regional Program, Highlands Regional Program, and the Regional Program for Central Asia and the Caucasus (CAC).
- Exchange of specific germplasm of winter wheat: China; Russia; Bulgaria; Hungary; Romania; France; and several US universities (Oregon, Kansas, Colorado, Oklahoma, etc)
- Cold tolerance: NARS of Turkey and Iran.
- Drought tolerance: NARS of Iran, Uzbekistan, and Turkey.
- Yellow rust: NARS in West Asia and CAC.
- Root rot: NARS in Turkey and Iran.
- Nematodes: NARS in Turkey; INRA, France.
- International facultative and winter bread wheat nurseries: Oregon State University, USA; NARS

**Cost:**

2004: US\$ 0.73 million

2005: US\$ 0.76 million

2006: US\$ 0.79 million

**System Linkages:**

Output 1: Germplasm Improvement: 65%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 5%

Output 5: Enhancing NARS: 20%

**Financing Plan:** Unrestricted core. Attributed funding from France. Collaboration with Iran supported by Iran. Collaboration with Central Asia and the Caucasus supported by restricted funding through the CGIAR Collaborative Research Program for CAC; training supported by the Arab Fund.

## **Project 1.5: Food Legume Improvement (Lentil, Kabuli Chickpea and Faba Bean) for Increased Systems Productivity**

**Goal:** Increased production of food legumes through a reduction in the ratio of cereal to legume sown areas in sub-tropical dry areas, enhancing the profitability and sustainability of cereal based farming systems and contributing to global climate change mitigation through increased organic soil carbon level.

*Indicators: Increased production and improved per capita availability of food legumes  
Increased profitability and sustainability of the cereal based farming system.*

**Purpose** Development and delivery to NARS of lentil production technology, particularly genetic material with appropriate combinations of increased biomass for food and feed, and resistance to key stresses.

Development and delivery to NARS of chickpea production technology, particularly genetic material with appropriate combinations of seed size, plant height and stress resistance for targeted environments with special emphasis on late winter or early spring sowing of chickpea in Mediterranean environments with mild winter and its extension to high altitude areas.

Faba bean improvement to reduce the losses from biotic stresses through host-plant resistance in a targeted pre-breeding program in close partnership with NARS.

*Indicator: Germplasm and production technology developed by ICARDA is utilized by NARS.*

**Output 1:** Improved methodologies for food legume breeding i.e. decentralized breeding, identification of DNA markers for key stresses, durable disease resistance breeding and automation.

*Indicators: Participatory breeding initiated and breeding decentralized to target areas.  
Markers for key stresses identified and marker assisted selection (MAS) in use.  
Key pathogen variability characterized.  
Improved screens for selection for stress tolerance developed.*

### Milestones:

2004: Decentralization of activities in North Africa in progress.

Mapping populations for various stresses developed.  
CAC Legume Network nurseries initiated.

2005: Breeding for Fusarium wilt resistance for North Africa decentralized.

CAC Legume Network nurseries operative.  
Mapping populations for various stresses developed.  
Gene mapping for various stress traits initiated.

2006: DNA markers identified for MAS and MAS initiated.

Screening techniques for drought tolerance under laboratory conditions developed.

**Output 2:** NARS research capabilities improved: 20 researchers/year trained on breeding methods, selection and screening techniques, data management and analysis.

*Indicator: Number of researchers trained*

### Milestones:

Annually: 20 persons per year from different national programs trained.

**Output 3: Lentil:** Improved genetic stocks with increased biomass for food and feed and resistance to key stresses (winter-hardiness, drought, vascular wilt, rust, Ascochyta blight, viruses and Sitona).

*Indicators: Elite breeding material and nurseries with stress resistance sources supplied to NARS.  
Development of populations for molecular marker studies.  
Elite winter-hardy materials with resistance to Ascochyta blight for winter sowing in highlands.  
Weed control and mechanical harvest system adopted by the farmers in Syria.  
New sources of resistance to wilt, rust, Ascochyta blight, Sitona, winter-hardiness and drought.  
Promising lines identified through participatory breeding.  
Micronutrient-rich genetic stocks identified.  
International Lentil Information System (ILIS) developed.*

#### Milestones:

- 2004: Germplasm for various agro-ecological conditions developed and delivered to national programs. Genetic stocks with combined resistance to key stresses identified by NARS and used in national trials for future release.  
Farmer participatory variety selection in full operation in Syria, Bangladesh, Nepal, Pakistan, Ethiopia, and Turkey.  
New sources of resistance for drought, winter-hardiness, wilt root rot complex, rust, Stemphylium blight identified.  
Development of mapping populations for molecular markers for rust, drought, Ascochyta blight. MAS for winter-hardiness initiated.  
Adoption of weed control and harvest mechanization in CWANA region documented.  
Winter lentil production expanded in highlands of Turkey, Iran, Afghanistan and Pakistan.  
Impact assessment completed in Bangladesh and initiated in Morocco.  
Micronutrient-dense germplasm identified.  
ILIS development in progress.
- 2005: Germplasm with suitable combinations of characters targeted for various agro-ecological conditions developed and delivered to national programs.  
National programs expand participatory selection and identified lines made available to farmers.  
Combined sources of resistance for drought, winter-hardiness, wilt root rot complex, rust, Stemphylium blight identified and constructed through cross breeding.  
Gene pyramiding for key diseases initiated.  
Molecular markers for rust, drought, and Ascochyta blight identified.  
20% replacement of spring planting by winter cultivation in Anatolian highlands of Turkey.  
Improved varieties/technologies adopted by national programs and impact assessment conducted in major lentil-producing countries.  
Micronutrient-dense elite lines delivered to national programs.  
ILIS distributed to the national collaborators.
- 2006: Suitable genetic materials for changing agro-climatic conditions in various regions developed and delivered to the national programs.  
Farmer participatory varietal selection institutionalized in 6/7 national programs.  
Sources of combined resistance to key stresses identified and used by national programs.  
Marker assisted selection for rust, ascochyta blight, and drought is practiced.  
Winter lentil technology used in 30% of west Asian highlands.  
Impact of improved lentil technologies assessed by various national programs.  
Micronutrient-dense lentil cultivars with phenological adaptation identified by national programs.

**Output 4: Lentil:** Transgenic lentils with the appropriate Bt toxin gene to control Sitona weevil and herbicide resistance for Orobanche control.

*Indicators: Production, testing and use of transgenic lentils through collaboration with other institutes.  
High yielding varieties with resistance to Sitona and Orobanche.*

#### Milestones:

- 2004: Transgenic lentils to control Sitona tested.  
Search for herbicide resistance source from private industry.
- 2005: Transgenic lentils to control Sitona available.  
Herbicide resistance gene incorporated.
- 2006: Herbicide resistance incorporated lentils tested for resistance.

**Output 5: Kabuli chickpea:** Germplasm with large seed and durable sources of resistance to Ascochyta blight, Fusarium wilt, leaf miner, cold and drought in those combinations required by the target environment.

*Indicators: DNA markers used to tag genes for Ascochyta blight resistance.  
Transformation and regeneration protocol for ascochyta blight resistance developed.  
Screening techniques to identify durable resistance to Ascochyta blight developed  
Newly developed breeding materials and genetic stocks shared with NARS in targeted breeding approach.  
Improved techniques to screen for resistance to leaf miner.  
Activities decentralized to NARS with high capacity.*

#### Milestones:

- 2004: Breeding materials with combined resistance to Ascochyta blight and Fusarium wilt developed and demonstrated to farmers in different countries.  
Populations for Ascochyta blight available for Pathotype I and II mapped.  
Inbred populations for Pathotype III, Fusarium wilt, cold and drought under development.  
Genes for increased abiotic stress tolerance introduced by genetic transformation.
- 2005: Late winter/early spring sowing technology in use.  
Breeding materials with combined resistance to Ascochyta blight and Fusarium wilt shared with NARS.  
Breeding materials with resistance to chickpea leaf miner shared with NARS.  
Introduced genes for increased abiotic stress tolerance tested.  
Inbred populations for Ascochyta blight, Fusarium wilt, cold and drought developed and ready for use for mapping.
- 2006: Late winter/early spring sowing technology in use by farmers.  
NARS identify elite materials with combined resistance to Ascochyta blight and Fusarium wilt.  
Molecular markers identified for various stress traits and tested for MAS.

**Output 6: Kabuli chickpea:** Widening the genetic base of chickpea cultigen and introgression of desirable traits from wild to the cultigen.

*Indicators: Transfer of genes for resistance to biotic and abiotic stresses from wild to the cultigen.  
Genetic stocks with winter vigor and the ability to flower and pod at low temperatures.  
Genetic stocks with high biomass and other important traits.*

#### Milestones:

- 2004: Widely diverse advanced chickpea breeding materials with high level of tolerance from wild species developed.  
Hybridization between cultigen and wild annual species continued and new breeding materials developed.  
Crossing of among various polyploids initiated.
- 2005: The elite lines from derived crosses shared with NARS for direct and indirect use.
- 2006: New breeding materials developed from crosses with polyploids.

**Output 7: Faba Bean:** Gene pools with high yield and biotic stress resistance developed for target areas in West Asia, North Africa, the Nile Valley, and China for recurrent selection and adaptation.

*Indicators: Sub-programs established in Tunisia for North Africa, Egypt for Nile Valley, and ZAAS for China.  
Regional sub-programs and gene pools with specific adaptation developed.  
Stress resistance germplasm (including multiple stress resistance) developed in a decentralized, pre-breeding system.  
Identified sources of resistance for Orobanch, viruses, aphids and stem nematodes and additional sources of resistance for Ascochyta blight, rust, and chocolate spot.  
Recombination of sources of resistance for Ascochyta blight, rust, and chocolate spot, Orobanch and stem nematodes*

#### Milestones:

- 2004: Lines with low tannin content and improved level of resistance to foliar diseases developed for use by NARS.

**Output 8: Faba Bean:** Alternative plant types (independent vascular supply system, determinate and auto-fertile populations) of Faba bean for NARS and their recombination with biotic stress resistance.

*Indicator: Gene pools for independent vascular supply system, determinate, and high auto-fertile populations and their recombination with multiple disease resistance developed.*

#### Milestones:

- 2004: Development of elite materials with combined resistance for ascochyta blight and chocolate spot and identified sources shared with NARS for testing in sub-regional programs.  
Development of elite materials with resistance to Orobanch, and developed populations shared with NARS.  
Development of genotypes with resistance to ascochyta blight and chocolate spot and with improved water use efficiency.
- 2005: Development of faba bean tolerant/resistant to high doses of glyphosate initiated.

Development of faba bean lines with improved heat tolerance initiated.

2006: Faba bean tolerant/resistant to high dose of glyphosate in progress and developed populations evaluated for herbicide resistance.

Development of faba bean lines with improved heat tolerance in progress.

**Output 9:** Knowledge management in food legumes research and development.

*Indicator: Research findings in food legumes disseminated through publications, conferences, leaflets, mass media, farmers days, networks, training etc.*

**Milestones:**

2004-06: Information on food legumes disseminated through publications, conferences, leaflets, mass media, farmer days, networking, training, traveling workshops, etc.

**Duration:** 10 years.

**Users and beneficiaries:** Direct users will be NARS legume improvement programs and, through them, farm households in cereal/food legume production systems, with priority given to resource-poor farm households in marginal environments. The ultimate beneficiaries are consumers of food legumes, who tend to be the poorer consumers.

**Collaborators:**

- Food legume improvement: NARS associated with ICARDA's regional programs in North Africa, Latin America, West Asia, Central Asia and the Caucasus, and Nile Valley and Red Sea; NARS in South Asia and China; North America, Southern Europe, Caribbean countries.
- Marker assisted selection: Washington State University, USA; University of Frankfurt, Germany.
- Lentil transformation and chickpea for Mediterranean environments: Center for Legumes in Mediterranean Agriculture (CLIMA), Australia.
- Transformation with chickpea: University of Hannover, Germany.
- Transformation protocols: AGERI, Egypt.
- Food legume nematology: Institute of Nematology Bari, Italy.
- Lentil adaptation: Victorian Institute of Dryland Agriculture, Australia.
- Faba bean improvement: New South Wales Department of Agriculture, Australia.
- Screening chickpea for Chickpea Ascochyta blight with Tamworth, Australia.
- Screening chickpea for Chickpea Ascochyta blight with University of Saskatchewan, Canada.
- Wide hybridization in chickpea with CLIMA, Australia.

**Cost**

2004: US\$ 2.03 million

2005: US\$ 2.11 million

2006: US\$ 2.19 million

**System Linkages:**

Output 1: Germplasm Improvement: 70%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 10%

Output 5: Enhancing NARS: 10%

**Financing Plan:** Unrestricted core funds. Donor attributed funding from UK; attributed funding from Italy for chickpea. Restricted funding from ACIAR and GRDC, Australia; University of Saskatchewan, Canada; BMZ, Germany; and IFAD. Cooperation with Iran financed by Iran; cooperation with USA supported by USAID linkage funds; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; funding for lentil from the Challenge Program on Biofortification; training supported by the Arab Fund. Anticipated attributed funding from EC; anticipated funding from the Arab Fund and Morocco.

## **Project 1.6: Forage Legume Germplasm Improvement for Increased Feed and Food Production and System Productivity in Dry Areas**

**Goal:** Enhanced production from mixed crop/livestock farming systems based on improved productivity and nutritional content of forage legumes (*Vicia* spp. and *Lathyrus* spp) for livestock feed in marginal low rainfall areas; and improved sources of dietary protein in areas where grasspea (*Lathyrus sativus*) is a major food crop.

*Indicators:* Livestock feed resources increased; reduced incidence of neurolathyrism.

**Purpose:** Adoption by farmers in marginal low rainfall areas of improved varieties of forage legumes and associated technologies.

*Indicators:* Improved germplasm with desirable traits introduced into cereal-based systems and utilized in the development of integrated crop-livestock production systems.  
Improved grasspea (*Lathyrus sativus*) with low neurotoxin ( $\beta$ -ODAP) content adapted to the areas where the crop is an important human food (Afghanistan, Bangladesh, China, Ethiopia, India, Nepal, and Pakistan).  
Increased use of improved underground vetch (*Vicia amphicarpa*) in marginal non-arable lands.  
Increased genetic diversity of cultivated forage legume species.

**Output 1:** Improved cultivars and populations of forage vetches (*Vicia* spp.) and grasspea (*Lathyrus* spp.) adapted to low rainfall areas, resistant to biotic and abiotic stresses and suitable for different end-uses (direct grazing, hay making, grain & straw).

*Indicators:* NARS supplied with breeding populations with sufficient diversity for use in different environments.  
Highly adapted cultivars and populations of forage vetches and grasspea used by NARS.  
High yielding non-shattering types of vetches free from anti-nutritional factors (ANFs) such as Beta-Cyanoalanin in common vetch and tannins in narbon vetch.  
Adapted lines of common vetch (*Vicia sativa*), Hungarian vetch (*Vicia panonica*), narbon vetch (*Vicia narbonensis*), and grasspea (*Lathyrus sativus*) introduced to Central Asia and the Caucasus (CAC).

### Milestones:

- 2004: On-farm feed production improved and promoted in monoculture cereal rotation.  
Community-based on-farm production and distribution of seed of improved germplasm promoted (in collaboration with NRMP).
- 2005: Adapted lines of vetches and grasspea for CWANA and China identified and selected.  
Sustainable field cropping of vetches and chick lings under run-off strip water harvesting in Syrian badia at two sites.  
Integration of improved germplasm and management techniques to mitigate the adverse effects of salinity and water-logging on forage quality and yield.  
Quality parameters of herbage, grain and straw assessed.
- 2006: Release and adoption by mixed crop/livestock producers of underground vetch in Iran and Afghanistan.  
Distribution of improved quality vetch germplasm to forage producers throughout CWANA.

**Output 2:** Improved cultivars of grasspea (*Lathyrus sativus*) with high yield potential under low inputs and with low or zero neurotoxin ( $\beta$ -ODAP) and improved amino acid complement.

*Indicators:* 50 target crosses/year followed by in situ selection with NARS for low neurotoxin  $\beta$ -ODAP.  
10 somaclones variants/year from locally adapted land races of Bangladesh, Ethiopia, Nepal, and Pakistan.  
Laboratory techniques for the estimation of the neurotoxin.  
Improved lines of grasspea with minimal neurotoxin content in the grains & straw and improved amino acid complement, adapted to zero or minimum input conditions.  
Improved production practices for grasspea such as optimum land preparation, planting time, seed rate, disease and insect control, harvesting time, and methods.  
The relationship between soil micronutrients (zinc and iron) and macro nutrients (phosphorus) status and neurotoxin content established.

### Milestones:

- 2004: Number of NARS using improved lines increased. Trials in farmers' fields expanded.  
Study of the socioeconomic factors affecting farmer's practices, use of improved germplasm, processing, consumption patterns of grasspea completed.  
Seed multiplication of adapted low neurotoxin lines. Appropriate strategies developed for maintenance of genetic purity of low neurotoxin lines developed.

- 2005: Molecular markers for low neurotoxin identified and utilized.  
Regional varietal trials of promising low neurotoxin varieties established in collaboration with NARS
- 2006: Low neurotoxin grasspea produced on 30% of total acreage.  
Community seed production systems for low neurotoxin grasspea seed in more than 200 villages in Afghanistan.

**Output 3:** Improved lines of amphicarpic type legumes such as underground vetch (*Vicia amphicarpa*) for rehabilitation of marginal non-arable lands.

*Indicator:* Increase in productivity and carrying capacity of marginal lands.

**Milestones:**

- 2004: Grazing trials, natural reseeding, survival under grazing, and seed-bank dynamics studied.  
-Natural self-regeneration monitored.
- 2005: Assessment of the tolerance of *Vicia amphicarpa* to grazing at Khanasser Valley integrated research site.  
Use of *Vicia amphicarpa* in marginal land improvement extended.
- 2006: More than 200 Afghan community seed enterprises in Afghanistan producing seed of improved vetch varieties.  
Marginal land productivity improved using underground vetch in Afghanistan and Iran.

**Output 4:** Strengthened capacity of NARS in forage germplasm collection, evaluation, enhancement and quality assessments.

*Indicator:* Number of trainees and MSc and PhD research students

**Milestones:**

- 2004: Number of in-country training courses and visiting scientists from CWANA increased.
- 2005: Training for Central Asian NARS in selection criteria in quality assessments of forage legume crops.  
Number of graduate students increased.
- 2006: Training of Afghan NARS in forage legume selection techniques.  
Training of Afghan NARS in seed production technologies.

**Duration:** Four years

**Users:** The project is targeted at farm households and particularly livestock owners in marginal lands where interruption of continuous cereal cropping with forage crops will increase feed supplies for livestock. Similarly, feed resources can be augmented through the use of suitably adapted self-regenerating forage legumes in rehabilitated non-arable grazing lands. Deployment of grasspea germplasm with safe neurotoxin content that will reduce the incidence of neurolathyrism will benefit small farmers relying on grasspea land races as a major component of their diet in times of famine when other legume crops fail.

**Collaborators:**

- Germplasm evaluation & utilization: NARS associated with ICARDA, Regional Programs, West Asia Regional Program, Highlands Regional Program, Central Asia and Caucasus Countries (CAC), Latin America (Brazil), China, Aleppo University.
- Low neurotoxin grasspea: National Programs of Bangladesh, China, Ethiopia, India, Nepal, Pakistan, University of Ghent, Belgium, University of Alberta, Canada.
- Anti-nutritional factors (ANFs) and nutritional aspects: International Food Policy Research Institute; International Livestock Research Institute; Center for Legumes in Mediterranean Agriculture (CLIMA), Australia; University of Addis Ababa, Ethiopia; Institute of Food Research, Norwich UK; University of Alberta, Canada; University of Ghent, Belgium; Washington State University, Grasslands Research Lab, USDA-ARS; Indian Agricultural Research Institute, New Delhi, India.

**Cost:**

- 2004: US\$ 0.52 million  
2005: US\$ 0.54 million  
2006: US\$ 0.57 million

**System Linkages**

Output 1: Germplasm Improvement: 70%

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 10%

Output 5: Enhancing NARS: 10%

**Financing Plan:** Unrestricted core funds. Cooperation with Iran financed by Iran; collaboration with Central Asia and the Caucasus supported by restricted funding through the CGIAR Collaborative Research Program; training supported by the Arab Fund.

## **Project 2.1: Integrated Pest Management in Cereal and Legume Based Cropping Systems in Dry Areas**

**Goal:** Improved productivity of cereals and legumes and reduced variability in production attributable to disease and pest attacks.

*Indicators*    *Reduction in the yield losses and the variability of production currently due to disease and pest epidemics*

**Purpose:** Adoption by farmers of integrated pest management practices.

*Indicator:*    *Integrated pest management (IPM) options developed by ICARDA in collaboration with NARS partners are included in national extension and demonstration programs.*

**Output 1:** Improved understanding of occurrence, spread, variability and losses caused by pests in CWANA.

*Indicator:*    *Number of surveys conducted.*  
*Number of studies conducted on pest variability and yield loss*

### Milestones:

- 2004: Four pest surveys in four countries.  
Yield loss experiments in four countries.  
Variability of five pests in five countries characterized.
- 2005: Three pest surveys in three countries.  
Yield loss experiments in four countries.  
Variability of five pests in five countries characterized.
- 2006: Two pest surveys in two countries.  
Yield loss experiments in two countries.  
Variability of five pests in five countries characterized.

**Output 2:** IPM options for the different cropping systems and agroecological zones comprising (i) host resistance, (ii) crop rotation and other agronomic practices, (iii) chemicals, (iv) biological agents, and (v) healthy seed.

*Indicators:*    *Establishment of IPM options by NARS and their adoption at the farm level.*  
*Increased demand for treated seed of improved crop cultivars from seed supply systems.*  
*Diversification in farming systems through varied cropping patterns and management practices*

### Milestones:

- 2004: Additional sources of resistance for seven pests identified.  
Effects of at least five practices on five pest populations in five countries evaluated.
- 2005: Additional sources of resistance for seven additional pests identified.  
Effects of at least five practices on five pest populations in five countries evaluated.
- 2006: Additional sources of resistance for seven additional pests identified.  
Effects of at least five practices on five pest populations in five countries evaluated.

**Output 3:** IPM options for the different cropping systems and agroecological zones developed.

*Indicators:*    *IPM options developed for more than two of the components*  
*Verification of IPM options by NARS*

### Milestones:

- 2004: Six IPM options evaluated.  
2005: Six IPM options evaluated.  
2006: Six IPM options evaluated.

**Output 4:** IPM pilot sites established with farmers' participation at selected sites in CWANA

*Indicator:*    *Number of pilot sites developed*

### Milestones:

- 2004: Seven IPM pilot sites in seven countries.  
2005: Seven IPM pilot sites in seven countries.  
2006: Eight IPM pilot sites in seven countries.

**Output 5:** Expertise of national scientists and farmers in IPM research and implementation improved.

*Indicators: Increase in number of NARS scientists collaborating with ICARDA in developing and testing IPM packages in their respective countries.  
Number of NARS staff that receives IPM training at ICARDA and number of NARS staff trained on site  
Number of Farmer Field Schools established.*

**Milestones:**

2004: 30 NARS scientists and 400 farmers trained in IPM practices.

2005: 30 NARS scientists and 400 farmers trained in IPM practices.

2006: 30 NARS scientists and 400 farmers trained in IPM practices.

**Output 6:** Information on IPM research disseminated

*Indicators: Number of scientific articles published  
Number of manuals/brochures published  
Number of regional/international workshops/meetings held*

**Milestones:**

2004: 10 journal articles; 10 abstracts; 10 field days; two international conference.

2005: 10 journal articles; 10 abstracts; 10 field days; one international/regional meeting/workshop.

2006: 10 journal articles; 10 abstracts; 10 field days; one international/regional meeting/workshop.

**Duration:** 10 years

**Users:** The project will promote the concept of an IPM research approach in national research programs, and will work in partnership with NARS in developing the components of IPM packages and in making the adjustments where necessary to meet the conditions of different locations and cropping systems. The main beneficiaries and users of the IPM technology are the resource-poor farmers of the different agro-ecological zones of CWANA.

**Collaborators**

- Testing options of IPM in selected sites of West Asia and North Africa: Institute National de la Recherche Agronomique (INRA), Morocco; Agriculture Research Center (ARC), Egypt; Ethiopian Agricultural Research Organization (EARO), Ethiopia; General Commission for Scientific Agricultural Research, Syria; Directorate of Agricultural Research and Human Resources Development (DARHRD), Eritrea;
- Exchange of resistant germplasm: CIMMYT, ICRISAT, NARS of CWANA.
- Study of population dynamics of powdery mildew: Risoe Laboratory, Denmark
- Viral pathogens and virus resistance: ARC, Egypt; NSW Agriculture, Australia.
- Monitoring of leaf and stem rust variability: IAVHII, Morocco; ARC, Egypt; University of Aleppo, Syria; SPII, Iran; CREFCI, Turkey.
- Yellow rust: University of Sydney, Australia; FCRI, Egypt; USDA/ARS, USA; DIAS, Denmark, SPII, Iran; CREFCI, Turkey.
- Characterization of pathogenic variability in Scald: University of Adelaide, Australia; Risoe Laboratory, Denmark.
- Hessian fly resistance and molecular biology: INRA, Morocco; Kansas State University, USA; Purdue University, USA.
- Screening for scab resistance in barley and wheat: North Dakota State University; Minnesota State University.
- Study of blotch diseases in barley: Agriculture & Agri-Food Canada, Winnipeg Manitoba, Canada.
- Study of blotch diseases in wheat: University of Manitoba, Canada.
- Cereal Cyst Nematode (CCN) ecology and control in cereals: INRA-Rennes, France, University of Adelaide, Waite Campus South Australia, CIMMYT, University of Aleppo.
- Biological control of insect pests: INRA-Rennes, France.
- Molecular characterization of chickpea Ascochyta blight: University of Adelaide, Waite Campus South Australia.
- Russian wheat aphid; legume pests: ARC, Egypt; Aphid Lab, USDA, ARS, Stillwater, Oklahoma.
- Wheat stem sawfly, cereal diseases: USDA-ARS, Sydney, Montana, USA; Montana State University, Bozeman, USA.
- IPM of Sunn Pest: Plant Protection Research Institute, Turkey; Cukurova University, Turkey; University of Aleppo, Syria; University of Vermont, USA; CABI, NRI, UK; Plant, Pest and Diseases Research Institute, Iran.

- Nematode control in legumes: CNRS/Bari, Italy.
- Integrated Cereal Disease Management (ICDM): Danish Institute of Agricultural Sciences (DIAS), Denmark; RISOE National Laboratory Plant Biology and Biogeochemistry Department, Denmark; and Department of Agricultural Research and Human Resource Development (DARHRD), Eritrea.
- Improved understanding and management of faba bean, chickpea and lentil diseases: NSW Agriculture, AGWEST, DNRE Horsham and the University of Adelaide, Australia.

#### **Cost**

2004: US\$ 1.55 million

2005: US\$ 1.61 million

2006: US\$ 1.67 million

#### **System Linkages**

Output 1: Germplasm Improvement: 25%

Output 3: Sustainable Production: 60%

Output 5: Enhancing NARS: 15%

Linkage to the System-wide Programme on IPM (SP-IPM).

**Financing Plan:** Unrestricted core funds. Support for collaboration with University of Vermont from USAID linkage funds; restricted funding from DFID, UK; restricted funding from ACIAR, Australia; support for IPM pilot sites from SP-IPM; cooperation with Iran financed by Iran; restricted funding from IFAD for collaboration with Nile valley countries; support from CRC Molecular Plant Breeding, Waite Campus, Australia; training supported by the Arab Fund. Anticipated funding from the Arab Fund, Denmark and Morocco.

## **Project 2.2: Agronomic Management of Cropping Systems for Sustainable Production in Dry Areas**

**Goal:** Increased productivity and productive capacity, and mitigation of the effects of climate change, through improved soil and crop management, appropriate crop rotations, improved water use efficiency, and the maintenance of soil fertility.

*Indicators: Production levels.  
Condition of natural resource base (soils and soil water).*

**Purpose:** Adoption by farmers of locally adapted arable systems for the biophysically and economically sustainable production of field crops that make efficient and conservative use of natural resources and externally derived inputs and mitigate the effects of climate change.

*Indicators: Information on soil, water and crop management technologies utilized by NARS.  
Adoption rate of appropriate soil, water and crop management technologies  
Efficient and conservative use of soil, water and external inputs.*

**Output 1:** Management principles for choice of crop, crop rotation, input use and husbandry practices, with respect to rotational output, resource-use efficiency and long-term soil and crop productivity.

*Indicators: Technically feasible, economically viable, and environmentally sound sustainable production systems management developed in collaboration with NARS  
Participation of farmers in technology testing and long-term effects of dynamic farming systems on sustainability of production monitored.  
Promising techniques in soil, water and crop management that increase water use efficiency adopted by farmers.*

### Milestones:

2004: Criteria for ongoing and future long-term trials refined and a mechanism for the extension of findings to target agroecological zones identified.

Evaluation of the impact of tested technologies on productivity, profitability and sustainability.  
Report on the use of Phosphogypsum to improve soil properties.

2005: Continued refinement of criteria for ongoing and future long-term trials and development of a mechanism for extension of findings to target agroecological zones.

Evaluation of the impact of tested technologies on productivity, profitability and sustainability

2006: Long-term trial network could be operational.

Continued refinement of criteria for ongoing and future long-term trials and development of a mechanism for extension of findings to target agro ecological zones.

Evaluation of the impact of tested technologies on productivity, profitability and sustainability.  
Report on assessment of alternative crops on the systems sustainability in CWANA.

**Output 2:** Conservation tillage systems for nutrient, water and energy use efficiency and C sequestration

*Indicators: Awareness of conservation tillage created  
Participation of farmers in testing these technologies  
Promising soil management technologies adopted by farmers.*

### Milestones:

2004: Review of conservation tillage practices in CWANA

Report on 'straw management/compost application on systems productivity

Report on no-till and minimum tillage on water use efficiency and systems productivity in Turkey

2005: Report on effect of contrasting tillage practices on productivity.

2006: Publication on the comparison of conventional vs conservation tillage and no-till planting.

Publication on straw management/compost application with respect to systems productivity.

**Output 3:** Management strategies for the enhancement of soil fertility (macro- and micro-nutrients) in cropping systems.

*Indicators: Biological, chemical and physical soil quality indicators.  
Climate and soil type patterns identified  
Maps and reports on micronutrients stresses affecting plant, animal and human health produced.  
Management strategies for enhancing soil fertility.*

#### Milestones:

- 2004: Monograph on Nitrogen research at ICARDA  
Fertilizer application guide.  
Publication on plant nutrient and environmental implications of waste water use for irrigation-  
Climate and soil-type patterns in micronutrient stresses identified.
- 2005: Effective Soil Fertility Network established.  
Monograph on long-term trials at ICARDA.  
Climate and soil-type patterns in micronutrient stresses identified in additional areas in CWANA.
- 2006: Publication on Monograph on micronutrients in soils of WANA.  
Report on P-dynamism in relation to no-till.  
Report on microbial biomass with respect to compost and conservation tillage.

**Output 4:** Validated cropping systems simulation models for the spatial extrapolation and generalization of site specific results through use of GIS.

*Indicators: Maps of production of specific crops, water use and its efficiency, evaporation and transpiration, soil fertility build-up, nutrient dynamics under different soil, water and crop management practices. Guidelines and decision support systems developed..*

#### Milestones:

- 2004: Ph-D thesis outputs from the use of APSIM model.  
Evaluation and reporting of crop and cropping system simulation models tested in selected sites in CWANA.  
Production risks quantified in additional countries in CWANA.
- 2005: Continued evaluation and reporting of crop and cropping system simulation models in selected sites in CWANA.  
Production risks quantified in additional countries in CWANA.
- 2006: Production risks quantified in additional countries in CWANA.

**Output 5:** Strengthened capacity of NARS

*Indicators: NARS scientists collaborating in joint research with ICARDA. NARS personnel trained in standardized analytical techniques, soil, water and cropping system management, the development of productive and sustainable technologies, and in using cropping systems simulation models for developing decision support systems. Workshops and symposia attended by NARS and publications by NARS.*

#### Milestones:

Annually: Relevant training courses in CWANA  
Dissemination of knowledge to researchers, extensionists and farmers through on-the job training, workshops, conferences, field days in CWANA.

**Duration:** 5 years.

**Users and beneficiaries:** The project works directly with national research and extension personnel with responsibility for agronomic management of cropping systems and with farmers in ICARDA's mandate area.

#### **Collaborators**

- *Long-term trials for resource management:* NARS of Algeria, Egypt, Jordan, Lebanon, Iran, Morocco, Syria, Turkey, CAC;
- *Farm surveys and on-farm experimentation:* NARS of Algeria, Egypt, Jordan, Iran, Morocco, Syria and Turkey, CAC;
- *Optimizing soil water use:* NARS of Egypt, Jordan, Iran, Morocco, Syria, Turkey, Niger, Zimbabwe, Mali, Kenya, Burkina Faso, South Africa; and ICRISAT as co-convenor.
- *Soil fertility trends; systems modeling and use of 15N:* University of Reading, UK; Atomic Energy Commission of Syria; International Atomic Energy Agency (IAEA), Austria.
- *Testing and validation of simulation models:* NARS of Egypt, Iran, Jordan, Morocco, Syria and Turkey; Washington State University, USA; Hohenheim University, Germany
- *Soils laboratory standardization:* NARS of Egypt, Iran, Jordan, Lebanon, Morocco, Pakistan, Syria, Turkey and Yemen; Wageningen University.
- *Soil chemistry:* International Atomic Energy Agency (IAEA); IMPHOS; International Fertilizer Association (IFA).

**Cost**

2004: US\$ 1.33 million

2005: US\$ 1.38 million

2006: US\$ 1.44 million

**System Linkages:**

Output 3: Sustainable Production: 85%

Output 5: Enhancing NARS: 15%

Linkage to the Systemwide Programme on Soil Water and Nutrient Management (SP-SWNM) with CIAT, TSBF: Optimizing Soil Water Use (OSWU), with ICRISAT.

Participation in Inter-Center Working Group for Climate Change (IWG-CC) with the lead on the project on "Carbon and nitrogen dynamics in long-term trials".

**Financing Plan:** Unrestricted core funds. Collaboration with Iran financed by Iran; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; restricted funding from Arab Fund, IFAD; restricted funding from OPEC Fund for activities in Afghanistan; training supported by the Arab Fund. Anticipated support for collaboration in Central Asia from Asian Development Bank; anticipated funding from SDC Switzerland for cooperative research in mountain areas of North Africa.

### **Project 2.3: Improvement of Sown Pasture and Forage Production for Livestock Feed in Dry Areas**

**Goal:** Sustainable system productivity, maintenance of soil fertility, and improved small ruminant feed and nutrition by increased use of sown pasture and forage crops in farming systems.

*Indicator:* Increased production of forage and pasture and its utilization in livestock production systems.

**Purpose:** Development of options for adoption by farmers of forage and pasture species in crop rotations or to rehabilitate native pastures.

*Indicator:* Area grown to annual pastures and forage legumes in crop rotations or to rehabilitate native pastures.

**Output 1:** Identification of species and selection of adapted cultivars of pasture and forage species (in cooperation with Projects 1.6 and 3.3)

*Indicators:* Cultivars released to NARS  
On-farm testing by farmers of selected cultivars.

#### Milestones

- 2003: 100 medicinal plants species collected and conserved.  
One cultivar of range species selected.  
Assessment of the biodiversity of the Khanasser Valley Integrated Research Site (KVIRS) in Syria published.  
Draft report and data base of technology for restoring degraded pasture in KVIRS.  
Seedlings of introduced new fodder shrubs and perennial grasses produced in Syrian steppe.  
Rangeland germplasm including perennial grasses established in Turkey (GAP) Syria, and Talelah project with FAO.  
NARS trained on taxonomy of forage legumes.  
Seeds of medicinal plants that were collected from Lebanon and Syria planted in a seed nursery.  
Annual legumes paper and key published.  
Biodiversity of GAP project area in Turkey completed.
- 2004: Significant diversity of forage and range species native to CWANA collected and conserved in gene bank and/or nursery.  
At least one cultivar of forage crop released by NARS.  
A CD-ROM including photos and description of major useful forage and range species for CWANA produced and distributed.  
A list of herbaria specimen of major useful forage and range species collected in CWANA published.
- 2005: Adapted range germplasm tested by NARS.  
1000 kg of new forage germplasm and 10 kg of range species distributed to NARS.  
A list of major medicinal plants native in CWANA published.  
Four NARS scientists trained in collection and selection of forage and pasture species.
- 2006: Rangeland germplasm screening trials evaluated and recommendations published.

**Output 2:** Forage and pasture seed production technologies developed for small farmers.

*Indicators:* Small-scale farm machinery adapted or developed for pasture seed collection and production.  
On-farm demonstrations and published manual.

#### Milestones

- 2003: A low-cost technology for harvesting Artemisia species tested on-farm.  
Ten farmers grow and produce vetch seed in new areas of Lebanon.
- 2004: Solutions to overcome shortage in forage seed in Pakistan, Central Asia and the Caucasus identified.  
A low-cost technology for harvesting Salsola species developed.
- 2005: A low-cost technology for harvesting seed of Atriplex species adopted by NARS.  
A low-cost technology for harvesting Salsola species adopted by NARS.  
At least four NARS scientists trained in seed production.
- 2006: Final report on machinery development and testing

**Output 3:** Demonstration of higher and sustainable system productivity from barley in rotation with pasture or forage legumes, compared to continuous barley cropping or barley in rotation with other food legumes, clean fallow, weedy fallow, or other relevant crops.

*Indicator: On-farm trials*

Milestones:

2003: Results on plant productivity from the long-term trials in Lebanon and Syria published..

2004: Results on plant productivity from the long-term trial at Tel Hadya published.  
At least four NARS scientists trained in rotation trials.

2005: At least 10 field days organized to promote use of forage crops.

2006: Results of farmer participation trials in forage/barley rotation published.

**Output 4:** Management recommendations that provide the highest economic output at a minimum cost from pasture and forage legume rotation treatments.

*Indicator: Recommendations utilized by NARS in extension and demonstration programs*

Milestones

2003: The potential use of wastewater to irrigate forage crops assessed.

Rotation trials analyzed for economic ranking of treatments.

The environmental role of fodder shrubs and their contribution to animal feeding determined.

Two NARS scientists trained in management of feed resources.

Two issues of Dryland Newsletter produced.

2004: The potential use of drainage water to irrigate forage crops and range species assessed.

The potential use of forage and pasture crops as hay, grazing or mature seed and straw to suit land use and market opportunities assessed.

Two NARS scientists trained in management of feed resources.

Two issues of Dryland Newsletter produced.

2005: Carbon sequestration in the different rotations assessed.

Two NARS scientists trained in management of feed resources.

Exchange of information and germplasm of oat and vetch between NARS of North Africa..

Two issues of Dryland Newsletter produced.

2006: Two issues of Dryland Newsletter produced.

Two NARS scientists trained in management of feed resources.

**Duration:** 10 years.

**Users and beneficiaries:** The immediate users are ICARDA's NARS partners; the ultimate beneficiaries are farmers and their families, through the sustainability of production systems and livelihoods and, through provision of livestock feed, rural and urban consumers.

**Collaborators:**

- Pasture/forage rotation trials with cereals: American University of Beirut/Agricultural Research and Extension Center, Lebanon; Syrian Ministry of Agriculture and Agrarian Reform; Aleppo University, Syria.
- Forage and pasture management: NARS of Algeria, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Pakistan, Syria, Tunisia, Turkey, Caucasus and Central Asia; USDA-ARS; GL-CRSP (Global Livestock Collaborative Research Support Program).
- Pasture rehabilitation and vetch in Turkey: South Eastern Anatolia Project; Field Crops Research Institute, Ankara.
- Feed resources in Central Asia and the Caucasus: National Programs of Armenia, Azerbaijan, Georgia, Kyrgyzstan, Kazakstan, Turkmenistan and Uzbekistan; ILRI.

**Cost:**

2004: US\$ 0.83 million

2005: US\$ 0.86 million

2006: US\$ 0.90 million

**System Linkages:**

Output 2: Germplasm collection: 5%  
Output 3: Sustainable Production: 80%  
Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Restricted funding from Barani Village Development Project in Pakistan; from GAP Project in Turkey; from USDA-ARS for research on medicinal plants in Tunisia; from the OPEC fund for activities in Afghanistan; training supported by the Arab Fund. Anticipated funding for collaborative research on integrated crop livestock systems in Central Asia and the Caucasus from IFAD; anticipated funding from SDC Switzerland for cooperative research in mountain areas of North Africa.

## **Project 2.4: Rehabilitation and Improved Management of Rangelands in Dry Areas**

**Goal:** Rehabilitation of native pastures and restoration of the contribution of rangelands to national livestock feed demands. Rehabilitated rangelands increase contribution to global carbon sequestration and reduce global warming and desertification.

*Indicators:* Area of rangeland rehabilitation programs; biomass production in rehabilitated areas; contribution of rangelands to national livestock feed demands.

**Purpose:** Development of rehabilitation and management measures for rangelands that are sustainable, socially and environmentally acceptable and contribute significantly to increasing the supplies of feed for small ruminants and fuel wood in dry areas.

*Indicator:* Rehabilitation and management measures utilized by NARS in rangeland development programs.

**Output 1:** Management plans for rangeland natural resources in CWANA.

*Indicator:* National and community acceptance of management plans.

### Milestones

2004: A rotational grazing scheme with community involvement to restore seasonal rotational grazing in CWANA developed and tested.

Alternative models of range management for protected and "common" range areas tested (with Project 4.3).

2005: Principles of rangeland management to control livestock grazing extended to areas in neighboring countries of West Asia.

Alternative policies, social organization and models of range management tested.

2006: Recommended rangeland policies submitted to Governments.

Community grazing organizations established.

**Output 2:** Low cost techniques for rehabilitation of rangeland and marginal lands.

*Indicator:* Techniques tested and utilized by NARS.

### Milestones

2004: Direct seeding and micro-catchments tested for large-scale rangeland reseeding.

Perennial vegetation established on two low-lying high potential test sites.

Description of production system context for the management of rehabilitated low-lying high potential areas.

2005: Management plans developed and tested for sustainable management of rehabilitated low-lying high potential areas.

2006: Large areas of abandoned farmland direct seeded with tested perennial range species.

**Output 3:** Inventory of rangeland vegetation and key species for feed, fuel-wood, or erosion control.

*Indicator:* Documentation, databases and number of trained NARS personnel.

### Milestones

2004: Management practices developed for rehabilitated rangelands in the Arabian Peninsula.

Staff of Syrian Steppe Directorate trained and collect data on vegetation assessment, production (integrated in GIS), biodiversity on protected areas, livestock use.

2005: Procedures developed for rangeland management strategies based on a production systems approach.

2006: GIS map of range vegetation, condition, indigenous knowledge and use rights of three areas.

**Output 4:** Formulated measures for the introduction of fodder shrubs into rangeland settings based on assessment of success and failures in past projects.

*Indicator:* Documentation of measures made available to NARS.

### Milestones

2004: Report published.

Cooperative agreements between communities and Syrian Steppe Directorate developed for plantation grazing.

2005: Measures formulated for revegetation of rangelands in Central Asia and the Caucasus.

2006: Model plantation established and managed by local community under Syrian Steppe Directorate policy.

**Duration:** 10 years.

**Users and beneficiaries:** The research targets low potential areas, including rangeland within arable areas and the vast areas of rangelands, which support some of the poorest communities in the dry areas of the world. Users are agro-pastoral groups living in rangelands. Women and children will benefit in particular, because of their responsibilities in feeding and managing animals and the dependence of rangeland communities for a large proportion of their diet on the production from their own animals.

#### **Collaborators**

- Project 2.4 focuses considerable effort on the rehabilitation and improved management of rangelands in northern Syria, and therefore a key collaborator is the Steppe Directorate within the Syrian Ministry of Agriculture and Agrarian Reform, along with the new Directorate for Agricultural Research and the Badia Project.
- Characterization of range-dependent livestock production systems, and the development of sustainable improved resource management practices, will require the collaboration of NARS in Jordan, Iran, Turkey, Lebanon, Tunisia, Morocco, and the Central Asian countries participating in the project on Integrated Feed and Livestock Production in the Steppes of Central Asia.

#### **Cost**

2004: US\$ 1.58 million

2005: US\$ 1.64 million

2006: US\$ 1.71 million

#### **System Linkages**

Output 2: Germplasm collection: 5%

Output 3: Sustainable Production: 75%

Output 5: Enhancing NARS: 20%

**Financing Plan:** Unrestricted core funds. Restricted funding from SDC Switzerland; restricted funding from UK; training supported by the Arab Fund. Anticipated donor attributed funding from Japan; anticipated funding for rangeland management research in Central Asia from IFAD.

## **Project 2.5: Improvement of Small Ruminant Productivity in Dry Areas**

**Goal:** Improved productivity of small ruminants, increased supply and improved quality of livestock products, and optimal utilization of feed resources and the resource base.

*Indicators: National production and consumption of small ruminant products.*

**Purpose:** Development of technologies and opportunities for improving small ruminant production and adding value to small ruminant products in partnership with NARS and with participation of producers.

*Indicators: Estimated number of research sites and farmers where technologies are adopted and used.  
Production is improved by at least 20% among collaborating farmers in the research sites.  
Product quality improved by at least 50% among collaborating farmers in the research sites.  
Number of NARS that have increased their capacity to respond to research demands and to perform market-oriented participatory research.*

**Output 1:** Markets and market opportunities for small ruminant products, identifying niches where small ruminants have a comparative advantage, are assessed for a better orientation of the production systems with a community action focus.

*Indicators: Databases with market information on small ruminant products available and accessible to NARS and end-users.  
Country guidelines highlighting market opportunities and unused niches, as well as suggestions for reorientation of small ruminant production available to national programs and policy makers.*

### Milestones:

2004: Methodology of market analysis of sheep milk products is expanded to Jordan and North Africa. Shift to community-based research on markets starts in Central Asia.

2006: Market analysis for Jordan and North Africa completed and reported. Report on marketing issues at the community level in Syria.

**Output 2:** Small ruminant production systems are characterized and production constraints identified for better understanding of the processes involved and for improved targeting of research.

*Indicator: Results of the characterization of small ruminant production systems and constraint analysis, which will allow better targeting of small ruminant productivity improvement, are available to NARS, the scientific community and development programs.*

### Milestones:

2004: Analysis of complementarities and conflicts regarding the use of natural resources and market opportunities among production systems started in Central Asia.  
Models tested for market orientation of smallholders in Central Asia start in community-based research framework.  
International symposium on the new trends and changes in small ruminant production systems and their associated markets in the dry areas.

2006: Publication on the complementarities and conflicts regarding the use of NR and market opportunities in Central Asia and Syria.  
Publication on models for market-orientation in Central Asia as a result of a community-based research approach.

**Output 3:** Technologies to improve small ruminant productivity and farmers' income integrated in adaptive market-oriented research are tested and available, with emphasis on transformation of primary products (i.e. to process milk into milk derivatives and fattening) that capitalize on added value and community action.

*Indicators: Results of performance of monitored pilot communities, where small ruminant productivity increasing and resource conserving technologies are being tested, are accessible to the scientific community, development programs, and end-users.  
Tested low-cost technologies that improve small ruminant productivity made available to NARS and end-users.  
Manuals including suitable tested transformation technologies of primary products for different types of small ruminant production systems  
Prototype experimental unit at ICARDA's research station and community-based demonstrations..*

#### Milestones:

- 2004: International seminar on value added production technologies for small ruminants. Community-based research sites on the basis of production complementarities among production systems organized in Central Asia.
- 2006: Publication of results of technology testing with community action in Syria.

**Output 4:** Production and genetic characterization of small ruminant breeds in CWANA, along with characterization of their production and market environments, documented and databased, to allow a better matching of breed potentials with those of the resource base and markets. Particular consideration is given to traits involving milk production, resistance to parasites and capacity to produce under severe conditions.

*Indicators: Regional and FAO's Animal Genetic Resources databases updated with the characterization of small ruminant breeds.  
Guidelines for matching breed specializations with production and market potentials.  
Guidelines for improvement and conservation of small ruminant germplasm.*

#### Milestones:

- 2004: International seminar on the breed characterization of CWANA.
- 2005: On-farm characterization of main breeds of small ruminants in Central Asia and the Caucasus completed and published. Genetic characterization of breeds of WANA started.
- 2006: Publication on the genetic characterization of the small ruminant breeds along the silk route.

**Output 5:** Biological and economic feasibility of the utilization of feeding/management strategies to improve small ruminant feeding systems and target better market opportunities assessed in West Asia.

*Indicators: Tested technologies that involve the utilization of non-conventional feedstuffs and by-products for small ruminant feeding made available to farmers in community-based adaptive research and to NARS.  
Manuals on the use of non-conventional feedstuffs and by-products in small ruminant feeding.  
Technologies for out-of-season lambing are available for adaptive research trials.  
Technologies involving the use in feeding strategies of the capacity to deposit fat of fat-tail sheep.*

#### Milestones:

- 2004: Technologies based on the use of fat deposits in reducing feeding costs documented.
- 2005: On-farm testing of technologies that use the capacity of fat-tail sheep to deposit fat started. Publication on the effect of feeding unconventional feeds on milk quality.
- 2006: Publication on quality issues and levels of microbial contamination in sheep milk production in Syria.

**Duration:** 3 years.

**Users:** Beneficiaries are both producers and consumers of livestock products. Milk and meat from productive small ruminants are rich in protein and micronutrients, which are needed by the rural and urban poor, particularly infants, children and women. At the national level, the use of available crop residues and agroindustrial by-products will reduce imports of feed concentrates.

#### **Collaborators:**

- Market studies: JICA, Japan
- Characterization of production system: KVL, Denmark.
- Adaptive research: NARS of Central Asia, West Asia,; FAO; GL-CRSP (Global Livestock Collaborative Research Support Program), University of California, Davis, and University of Wisconsin-Madison, USA; JICA, Japan.
- Transformation of primary products: FAO; University of Wisconsin-Madison, USA
- Breed characterization: ILRI; IPGRI; University of Wisconsin-Madison, USA,;
- Animal health: ILRI; JICA, Japan.
- Non-conventional feedstuffs and by-products: FAO; CIHEAM (International Center for Advanced Mediterranean Agronomic Studies); Macaulay Institute, UK, and FAO.
- Strategic research on biological feasibility of new production strategies: McCaulay Institute, UK; FAO.

**Cost**

2004: US\$ 1.60 million

2005: US\$ 1.66 million

2006: US\$ 1.73 million

**System Linkages:**

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 75%

Output 5: Enhancing NARS: 15%

Linkage to the Systemwide Livestock Programme (SLP)

Linkage to the Systemwide Program for Genetic Resources (SPGR)

Linkage to Global Animal Genetic Resources Program (FAO).

**Financing Plan:** Unrestricted core funds. Restricted funding from Japan; Junior Professional Officers supported by Danida; collaboration in Tunisia supported by USDA; restricted funding from IFAD for research in Latin America; training supported by the Arab Fund. Anticipated donor attributed funding from Japan; anticipated funding from IFAD for integrated crop-livestock systems in Central Asia and livestock health in WANA.

### **Project 3.1: Water Resource Conservation and Management for Agricultural Production in Dry Areas**

**Goal:** Improved productivity and quality of the limited water resources currently and potentially available for agricultural use in dry areas.

*Indicators: Improved productivity of water (from rainfall, conventional and non-conventional sources) in agricultural production; quantity and quality of water available to agriculture.*

**Purpose:** Improved technologies and management options for rainfall, conventional and non-conventional water resources available to attain higher water use efficiency and sustainable agricultural production.

*Indicator: Improved technologies, methodologies, and recommendations are available to national programs*

**Output 1:** Methodologies, recommendations and information available to the NARS on efficient capture, storage and utilization of rainwater through water harvesting and integrated watershed management.

*Indicators: Improved methods for selecting appropriate sites reduce effort, time and cost of planning water harvesting.  
At pilot demonstration sites the efficiency of rain capture and utilization is improved.  
Information on the socioeconomic constraints and potential policies and actions to overcome them are available to decision-makers.*

#### Milestones:

2004: ICARDA's research on water harvesting published.

2005: Assessment of water harvesting potential and consequences in WANA completed.

2006: Benchmark site for dry areas water harvesting established and functional in Jordan.

**Output 2:** Optimal strategies and practices for using limited water resources conjunctively with rainfall in rainfed agriculture.

*Indicators: Major supplementary irrigation environments and their interaction with farm management documented.  
Technologies for efficient use of water in supplementary irrigation available to NARS for implementation.  
Water productivity and total farm production levels increased at farmers' demonstration sites in representative areas.*

#### Milestones:

2004: Research on supplemental irrigation in Tunisia and Morocco completed.

Recommendations on the management of supplemental irrigation of legumes published.

2005: Assessment of the consequences of implementing water saving strategies on water and the environment completed within the Central Asia program.

2006: Benchmark site for supplemental irrigation in CWANA rainfed areas established and functional in Morocco.

**Output 3:** Water management packages for sustainably optimizing on-farm water use efficiency particularly in irrigated areas.

*Indicators: On-farm water use efficiency increased at demonstration farms using developed packages.  
Recommended on-farm irrigation management strategies and techniques that improve water use efficiency and natural resource management are available to NARS.  
Research trials and monitoring sites for studying sustainability and improved water use efficiency established, in collaboration with NARS, in representative areas.*

#### Milestones:

2004: Proceedings of the conference on water use efficiency and water harvesting published.

2005: Regional workshop on water use efficiency held in which promising and effective alternatives for cropping strategies and management practices to improve on-farm water use efficiency identified.

2006: Benchmark site for improving water use efficiency in irrigated areas established and functional in Egypt.

**Output 4:** Strategies, methods and techniques for the safe and sustainable use of non-conventional water resources in agriculture.

*Indicators: Research trials established in collaboration with NARS in representative locations to adapt improved packages.*

*Guidelines and recommendations for the safe, productive and sustainable use of non-conventional water resources available to NARS.*  
*Awareness of the potential and limitations of the use of non-conventional water resources increased.*

#### Milestones

- 2004: Database on available and potential non-conventional water resources in CWANA operative.  
2005: Proceedings of the workshop on the use of low quality water published.  
2006: Recommendations on the cropping systems feasible under various qualities of water in the dry areas published.

**Output 5:** Methods for assessing the safe utilization of renewable groundwater resources in agriculture.

*Indicators: Guidelines for the assessment and the management of renewable groundwater resources in agriculture available to NARS.*  
*Recommendations for improved management of renewable ground water resources available to decision-makers.*

#### Milestones

- 2004: Recommended methodologies combining technical and socio-economic parameters for sustainable use of ground water in irrigation published.  
2005: Model for evaluating the sustainability of groundwater use in supplemental irrigation evaluated and adapted to Syrian conditions.  
2006: Review of groundwater management success stories in WANA prepared.

**Output 6:** Strengthened capacity of national research, extension and management personnel and greater public and governmental awareness of the importance of water conservation and management issues.

*Indicators: Capacity of NARS personnel to conduct research on water management issues and application of results increased.*  
*Quality of NARS research in water management problems improved.*  
*Collaborative research and demonstrated sites produce required data and analysis.*

#### Milestones:

- 2004: Conduct regional training course (JICA supported) on water use efficiency in dry areas.  
2005: Training course on integrated watershed management in dry areas  
2006: Training course on integrated watershed management in dry areas offered for 2<sup>nd</sup> year

**Duration:** 6 years

**Users and beneficiaries:** The ultimate beneficiaries are farm households in rainfed, marginal areas and irrigated areas. The main users are national researchers; technicians, policy makers and others concerned with water issues.

#### **Collaborators:**

- *Water harvesting systems:* linkages through the benchmark sites to be established in Jordan with Saudi Arabia and Libya as satellite sites. Collaboration with Karlsruhe University in Germany on publication of a book on water. Collaboration with NARS within the Systemwide Initiative on "Comprehensive Assessment" led by IWMI and the Challenge Program on Water and Food, within the Karkeh river basin in Iran and the Nile river basin.
- *Supplemental irrigation:* linkages through the benchmark site on supplemental irrigation to be established in Morocco, with Tunisia and Syria as satellite sites. Collaboration with NARS of Iran, Morocco, Syria, Tunisia, Turkey and the Central Asian states. Collaboration with NARS within the Karkeh river basin in Iran and the Nile river basin through the Challenge Program on Water and Food.
- *On-farm water use efficiency:* linkages through the benchmark site on irrigated areas to be established in Egypt, with Sudan and Iraq as satellite sites. Collaboration with NARS within the Karkeh river basin in Iran and the Nile river basin through the Challenge Program on Water and Food. Collaboration with IWMI, ICRISAT, ESCWA (UN Economic and Social Commission for West Asia); collaboration with NARS in Nile Valley and Red Sea Regional Program, Morocco, Sudan, Syria, Turkey and the Central Asian states.

- *Use of remote sensing, GIS and the modeling of rainfall and water harvesting:* University of Karlsruhe, Germany; INRA-Avignon, France; General Organization for Remote Sensing, Syria; NARS of Tunisia, Morocco, Jordan and Turkey.
- *Non-conventional water sources:* Joint appointment of a senior scientist with IWMI. Collaboration with the Gulf States; NCARTT (National Centre for Agricultural Research and Technology Transfer) and Jordan University for Science and Technology, Jordan; Aleppo University, Syria; Tunisia; the Central Asian states; CIHEAM-Bari; INRA- Grignon-France.

#### **Cost**

2004: US\$ 3.16 million

2005: US\$ 3.29 million

2006: US\$ 3.42 million

#### **System Linkages:**

*Output 3: Sustainable Production: 80%*

*Output 5: Enhancing NARS: 20%*

Linkages the Systemwide Initiative on "Comprehensive Assessment" convened by IWMI. Anticipated linkage to the Challenge Program on Water and Food.

**Financing Plan:** Unrestricted core funds. Restricted funding from the Arab Fund for activities in benchmark sites; restricted funding from JICA for training; restricted funding from USDA-ARS for research on GIS in water management in Tunisia; restricted funding from the OPEC Fund within the sub-regional and regional thematic networks of the UNCCD; restricted funding from the systemwide initiative for rainfed areas assessment; funding from Barani Village Development Project in Pakistan; restricted funding from the OPEC Fund for activities in Afghanistan; cooperation with USA supported by USAID Linkage Funds. Training supported by the Arab Fund. Environmental Officer posted to Central Asia financed by IFAD/UNCCD. Anticipated funding for activities in Central Asia from the Asian Development Bank; anticipated funding from IFAD for the benchmark sites; anticipated funding within the Challenge Program for Water and Food for research in the Karkeh River and Nile River basins; anticipated funding from GEF for activities in sub-regional thematic networks of the UNCCD.

### **Project 3.2: Land Management and Soil Conservation to Sustain Rural Livelihoods in Dry Areas**

**Goal:** Improved livelihoods by sustainable management and conservation of land resources in the dry areas of Central and West Asia and North Africa (CWANA).

*Indicator:* Adoption of sustainable land management practices and approaches by land-users and communities.  
Reduced land degradation.  
Reduced livelihood vulnerability.

**Purpose:** Development of an integrated multi-scale approach and technologies for sustainable and productive land management in dry areas for utilization by NARS in CWANA.

*Indicator:* NARS, in close participation with rural communities, utilize the approach for developing site-specific conservation strategies and land management practices.

**Output 1:** An integrated multi-scale research approach for land degradation assessment and problem solving for degrading dry areas.

*Indicators:* Conceptual framework for land degradation in dry areas available.  
Method for integrated and participatory analysis of land degradation developed.  
Decision support system (DSS) for sustainable land management for dry areas available.

#### Milestones:

- 2004: Land degradation analysis method finalized.  
Land degradation test sites identified in CWANA region.  
DSS developed.
- 2005: Land degradation methodology tested in CWANA region.  
DSS tested.
- 2006: Cross-environmental evaluation of the land degradation analysis methodology.  
DSS for sustainable land management finalized

**Output 2:** Methods for assessing land degradation.

*Indicators:* Field assessment tools for land degradation assessment developed by water, wind and tillage erosion, and nutrient mining.  
Remote sensing techniques developed for land degradation assessment at meso-level (in cooperation with Project 3.4.).

#### Milestones:

- 2004: Water erosion survey method improved.  
Nutrient flow method improved.  
Wind erosion: Evaluation of different surface conditions and land-use types.  
Remote sensing assessment of land degradation by case study areas.
- 2005: Training manual developed for assessing water, wind, tillage erosion and nutrient flows.  
Remote sensing assessment of land degradation by case study areas improved.
- 2006: Training of NARS for assessing water, wind, tillage erosion and nutrient.  
Evaluation of remote sensing for land degradation assessment.

**Output 3:** Participatory and community-based (CB) sustainable land management techniques for dry areas.

*Indicators:* Approach for farmer participatory and CB development of land management technologies available.  
Land management options tested in a participatory and/or CB way.  
Physical, socio-economic and cultural criteria for sustainable land management technologies identified.  
Inventory of sustainable indigenous and introduced land management methods for the CWANA region.

#### Milestones:

- 2004: Participatory methodology summarized.  
Evaluation of focused technologies at the two test sites in Syria.  
Participatory methodology tested by two NARS in CWANA.  
Critical criteria for sustainable land management technologies identified at two Syrian test sites.  
Network for indigenous and introduced land management methods for dry regions established.
- 2005: Expansion and interim evaluation of the participatory methodology in CWANA.  
Testing of community-based technology development.  
Initiation of inventory of land management methods for dry regions
- 2006: Testing of community-based technology development.  
Completion of inventory of land management methods for dry regions.

**Output 4:** Strengthened capacity of NARS in land degradation assessment and integrated land development research for dry areas.

*Indicators: Inventory of institutions working on land degradation and soil conservation in CWANA.  
Linkage established with other CG centers and ARIs  
Active cooperation with selected NARS established.  
Training of NARS scientists of institutions in CWANA region.*

**Milestones:**

- 2004: Project collaboration with two NARS in CWANA, and active collaboration with two other CGIAR centers and/or ARIs.  
Expansion of NARS contacts in the region.  
Training of CWANA NARS staff.  
Workshop on land degradation and rehabilitation in marginal dryland areas.  
Public awareness materials
- 2005: Project collaboration with three NARS in CWANA, and active collaboration with two other CGIAR centers and/or ARIs.  
Most of the outputs 1, 2 and 3 available for use by NARS.  
Training of CWANA NARS staff.
- 2006: Project collaboration with three NARS in CWANA, and active collaboration with two other CGIAR centers and/or ARIs.  
Formal training in land degradation and rehabilitation in the dry areas for CWANA NARS

**Duration:** 5 years

**Users:** Primary users are researchers in national research institutions and extension agencies. Ultimate beneficiaries are land users in marginal dry lands.

**Collaborators:** Atomic Energy Commission of Syria (Syria); Olive Bureau (Syria); Extension Directorate (Syria), Jabel Al-Hoss Development projects (UNDP & IFAD); University of Bonn, Germany; WOCAT Consortium; University of Leuven (Belgium); Wageningen University (Netherlands).

**Cost:**

- 2004: US\$ 0.72 million  
2005: US\$ 0.74 million  
2006: US\$ 0.77 million

**System Linkages:**

Sustainable Production: 80%  
Enhancing NARS: 20%

**Financing Plan:** Unrestricted core. Donor attributed funding from UK. Restricted funding from BMZ/GTZ; training supported by the Arab Fund. Environmental Officer posted to Central Asia financed by IFAD/UNCCD. Anticipated funding from SDC.

### Project 3.3: Agrobiodiversity Collection and Conservation for Sustainable Production

**Goal:** Conservation and utilization of the biodiversity of ICARDA's mandate crops: wheat, barley, lentil, kabuli chickpea, faba bean and pasture, forage and rangeland species

*Indicators:* Number and area of target species sustainably conserved; utilization of genetic resources in national crop improvement programs.

**Purpose:** Expansion, conservation, characterization, preliminary evaluation and documentation of the current *ex situ* collections of the genetic resources of wheat, barley, lentil, kabuli chickpea, faba bean and pasture, forage and rangeland species, in order to support the quest for germplasm with useful characters to be utilized in crop improvement programs of ICARDA and NARS or in ecosystem restoration.

Development of approaches to the successful *in situ* conservation of the biodiversity of agriculturally useful plant species within the agricultural landscapes of CWANA.

*Indicators:* Number of accessions conserved, characterized and documented in the GRU/ICARDA gene bank.  
Number of accessions distributed to users at ICARDA and worldwide.  
Useful characters and traits from these collections utilized by ICARDA and NARS in their germplasm enhancement programs.  
Number and area of target species, and areas of associated natural habitat, conserved *in situ*.

**Output 1:** Expanded *ex situ* collections of the genetic resources to be utilized in crop improvement programs of ICARDA and NARS or in ecosystem restoration.

*Indicators:* Number of accessions in the active collection.  
More than 1000 seeds in the active collection.  
Seed viability higher than 80%.

#### Milestones:

- 2004: 200 accessions collected in strategic plant collection mission in a CAC country.  
15,000 seed samples distributed from ICARDA gene bank to users on request.  
New cold store construction finalized.  
Replacement of old storage equipment and upgrading of the old cold store finalized.  
20,000 accessions tested for viability.  
15,000 accessions processed for seed storage.  
7,000 accessions planted for regeneration/multiplication.  
10,000 accessions safety duplicated.
- 2005: 200 accessions collected in strategic plant collection mission in a CAC country.  
15,000 seed samples distributed from ICARDA gene bank to users on request.  
20,000 accessions tested for viability.  
15,000 accessions processed for seed storage.  
4,000 accessions planted for regeneration/multiplication.  
10,000 accessions safety duplicated.
- 2006: 200 accessions collected in strategic plant collection mission in CAC country.  
4,000 processed for seed storage.  
3,000 accessions planted for regeneration/multiplication.  
15,000 seed samples distributed from ICARDA gene bank to users on request.

**Output 2:** Germplasm characterization and preliminary evaluation for biotic and abiotic stresses as well as for morphological and agronomic traits using international descriptors. Genetic diversity analysis and assessment of the potential of conserved material for crop enhancement.

*Indicators:* Number of accessions characterized/evaluated  
Number of traits characterized/evaluated  
Number of accessions and traits documented in the GRU database

#### Milestones:

- 2004: 350 accessions from CAC countries or VIR characterized and evaluated in partnership with CAC NARS and VIR.  
Molecular characterization of wheat landraces from VIR, ICARDA and Australia germplasm collections.  
100 CAC wild relative/landrace materials screened for disease resistance/abiotic stress tolerance.  
500 Vicia accessions characterized.

Chickpea collection subset characterized for agro-morphological traits and by molecular markers. Eco-geographical characterization of 5000 bread wheat accessions from VIR, ICARDA and Australia collections completed.

1500 faba bean, 500 lentil, 500 chickpea and 1500 cereal accessions characterized using agro-morphological descriptors.

Subset of accessions collected from stressed environments characterized for photothermal response parameters.

'Clusters of common origin' of drought tolerant genotypes identified using SSR and SNP genetic markers.

2005: Faba bean core collection characterized for agro-morphological traits and by molecular markers. 1500 faba bean, 500 lentil, 500 chickpea and 1500 cereal accessions characterized using agro-morphological descriptors.

2006: Molecular characterization of a representative subset of CAC germplasm. Diversity studies of CAC germplasm using agro-morphological and molecular characterization data.

**Output 3:** Special purpose collections with multiplied seed for distribution

*Indicators: Number of collections and number of accessions.*

Milestones:

2004: Faba bean core collection developed.

2005: Bread wheat core collection developed.

**Output 4:** Wheat germplasm with new genes from wild relatives

*Indicators: Number of useful traits transferred; number of lines with useful genes introgressed.*

Milestones:

2004: Identification of introgressions from wild species using molecular markers.

2005: Abiotic stress tolerant germplasm with genes from wild relatives identified.

2006: Allelic diversity of genes introgressed into durum and bread wheat from wild relatives studied using advanced molecular tools.

**Output 5:** Conservation and sustainable use of dryland agro-biodiversity in GEF/UNDP project sites in Jordan, Lebanon, Palestinian Authority and Syria

*Indicators: No. of target species conserved in pilot areas*

*No. of pilot sites*

*Area of natural habitat in which wild species are conserved and sustainable managed in situ*

*Area of agricultural land on which landraces of crops and fruit and nut trees are conserved on farm*

Milestones:

2004: 6th Regional Technical and Steering Committee meetings.

Production of Project Implementation Review (PIR).

Technical backstopping provided to National Components.

Four issues of project newsletter and updating of project website.

One thematic meeting, two workshops and two project managers consultation meetings.

Final project evaluation.

Preparation of concept note for new project.

**Output 6:** Strengthened capacity of national and regional genetic resources institutes

*Indicators: Number of training courses and NARS staff trained.*

*Technical assistance provided to national genetic resource institutes and gene banks.*

Milestones:

2004: One short-term group training course.

Short-term visiting scientists from CAC.

CAC PGR unit coordination meeting.

Technical advice given for development of seed storage facilities in CAC.

Regional database development for ex situ collections.

Identification of national base collections in CAC.

CAC PGR unit coordination meeting.

Development of regional diversity studies of CAC PGR in CAC.

Capture of hardcopy evaluation data into national data bases.

- 2005: One short-term group training course.  
 Technical advice given for development of seed storage facilities in CAC.  
 Development of GIS and data management skills in CAC.  
 Development of regional diversity studies of CAC PGR.  
 CAC PGR unit coordination meeting.  
 Capture of hardcopy evaluation data into national data bases.
- 2006: CAC PGR unit coordination meeting.  
 Development of a regional catalogue of CAC PGR in ex situ collections.

**Output 7:** Documentation of ICARDA plant genetic resources collections available to users worldwide.

*Indicators:* Access to databases on-line via internet/local network and offline through CD-ROMs and printed catalogs.  
 Number of records in the documentation system.  
 Accuracy and completeness of the data.

Milestones:

- 2004: Database of wheat landraces conserved by VIR, ICARDA and Australia.  
 CD-ROM catalog 'Wild wheat relatives'.  
 Client-server software developed and entire data base populated.  
 Data base available on ICARDA Intranet.
- 2005: Inventory of main cereal and legume germplasm collection missions in CAC region with the database of material available in gene banks worldwide available on Internet.  
 Data regularly replicated to SINGER.
- 2006: Vicia catalog published in CD-ROM format.

**Output 8:** Healthy seed introduced to and distributed from ICARDA.

*Indicators:* Number of seed samples tested  
 Efficiency of the seed health testing methods and procedures

Milestones:

- 2004: 100% of incoming and outgoing accessions tested.  
 PCR tools for seed health testing developed.  
 25,000 accessions tested/treated for seed-borne pathogens.  
 2,000 gene bank accessions cleaned from seed-borne pathogens.
- 2005: 100% of incoming and outgoing seed samples tested.  
 25,000 accessions tested/treated for seed-borne pathogens.  
 2,000 gene bank accessions cleaned from seed-borne pathogens.
- 2006: 100% of incoming and outgoing seed samples tested.

**Duration:** 5 years

**Users and beneficiaries:** The conserved germplasm is and will be utilized by a diverse group of scientists from NARS and other institutions seeking to establish and/or enlarge their genetic resources collections, to research a particular aspect of biodiversity, to utilize germplasm in breeding programs or to use it in ecosystem restoration efforts.

Agricultural producers may be direct beneficiaries in "disaster" situations, when seed of traditional germplasm is lost and may be recovered from ex situ collections held by ICARDA. The ultimate beneficiaries are agricultural producers, who will have access to a more diverse spectrum of cultivars, and future generations who will be assured of the availability of agriculturally important biological resources

**Collaborators:**

- *Ex situ* collections: IPGRI (SGRP), ICRISAT; CIMMYT; Center for Legumes in Mediterranean Agriculture (CLIMA), Australia; University of Western Australia; NSW Agriculture, Australia; Vavilov Institute (VIR), Russia; Uzbek Research Institute of Plant Industry (UzRIPI), Uzbekistan, Australian Winter Cereal Collection (AWCC)
- Assessment of threats to gene pools: NARS; ICRISAT; CIMMYT.

- Germplasm collection: NARS; ICRISAT; CIMMYT; CLIMA; VIR; USDA; Agriculture West Australia, Agriculture South Australia, AWCC
- Germplasm acquisition from donor institutions: NARS; VIR; other major gene banks.
- Safety duplication outside ICARDA: National Board for Plant Genetic Resources (NBPGR), India; ICRISAT; CIMMYT; Federal Institute of Agrobiology (FIA), Austria; Federal Research Station for Plant Production (RAC), Switzerland.
- Germplasm characterization and evaluation: VIR, Russia; NARS; NSW Agriculture, Australia; CLIMA; University of Bristol, UK; University of Birmingham, UK. .
- Passport, site and evaluation database: NARS; ICRISAT; CIMMYT; CLIMA; NSW Agriculture, Australia; University of Adelaide, Australia.
- Classification, catalogs, information dissemination: NARS; IPGRI (SGRP); CLIMA.
- Gene transfer from the wild progenitors and relatives: University of California, USA.
- *In situ* conservation: IPGRI; ACSAD; NCARTT Jordan; LARI Lebanon; GCSAR Syria; Ministry of Agriculture, Palestinian Authority; UNDP; GEF; University of Birmingham
- Molecular characterization: Southern Cross University, Lismore, Australia; University of Birmingham, UK; University of Kyoto, Japan; INRA-ENSAM, Montpellier, France; University of California, Davis, USA; VIR; IPK, Gatersleben, Germany
- Global Register of Barley GR: IPK, Gatersleben, Germany; USDA; Australian Winter Cereal Collection, Tamworth; other major gene banks.

**Cost:**

2004: US\$ 3.02 million

2005: US\$ 3.14 million

2006: US\$ 3.27 million

**System Linkages:**

Output 2: Germplasm collection: 85%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Restricted funding from ACIAR and USDA for collection and conservation of plant genetic resources of Central Asia; restricted funding from GDRC for preservation and utilization of the genetic resources of the Vavilov Institute (VIR); restricted funding from the Global Environment Facility (GEF) for collaboration with NARS on conservation of agro-biodiversity in the Near East; restricted funding from BMZ for research on adaptation of genetic resources to climate change; restricted funding from the World Bank for gene bank upgrading; cooperation with USA funded by USAID Linkage funds; training supported by the Arab Fund. Anticipated attributed funding from EC and Morocco.

### **Project 3.4: Agroecological Characterization for Agricultural Research, Crop Management and Development Planning.**

**Goal:** Improved land use planning and environmental management of the agricultural production systems of Central and West Asia and North Africa (CWANA) guided by a better understanding of the specific potentials and constraints of agricultural environments.

*Indicators: Productive and diversified land use management based on potentials and constraints of local agricultural environments.*

**Purpose:** Assistance to NARS in the characterization of the diverse agroecologies and associated land use systems of CWANA through development and transfer of multi-scale approaches, methodologies and procedures for the quantitative assessment of agricultural environments.

*Indicators: Approaches, methodologies and procedures for agroecological characterization adopted by NARS. Information systems developed by the project used by NARS, the international research community and development planners*

**Output 1:** Digital databases on climate, land resources, land use/cover, ecological crop requirements and genetic characteristics, linked to databases describing the socioeconomic environments

*Indicators: CWANA climate database system developed  
CWANA land use/land cover spatial database established  
CWANA digital spatial datasets on land and climate resources compiled or generated*

#### Milestones:

2004: Digital archive of improved soil maps for CWANA available.

2005: Digital archive of country-level agroecological zones maps at 1 km resolution established.

**Output 2:** Knowledge systems based on modeling of the interactions between environments, crops or production systems and land management, linked to GIS, remote sensing and attribute databases.

*Indicator: Models of crop productivity, linked to geo-referenced datasets of land resources, used for spatial characterization of land potentials and constraints in actual studies.*

#### Milestones:

2004: Methodology established for region-wide land suitability mapping for different crops.  
Methodology established for multi-scale land degradation assessment.

2005: Map of drought vulnerability at 8 km resolution available.

2006: Satellite-based system available for CWANA to monitor drought and land degradation.

**Output 3:** Comprehensive physical frameworks of CWANA

*Indicators: Small-scale maps of agroecological zones indicating potentials and constraints for agricultural development, research priorities, and land use/management recommendations.  
Digital maps integrated into GIS-based land and water resource information systems.  
Maps of production systems and agroecosystems.*

#### Milestones:

2004: Agroecological zones study of CWANA at 1 km resolution completed.  
Production systems map of CWANA at 1 km resolution completed.

2005: Multi-scale land degradation assessment of CWANA completed.  
Agroecosystems study of CWANA completed.

2006: Land suitability maps available for major crops in CWANA at 1 km resolution.

**Output 4:** Case studies and methodologies for multi-scale agroecological characterization

*Indicators: Case studies available in the form of GIS projects  
Guidelines for multi-scale agroecological characterization*

#### Milestones:

2004: Agroecological zones study in NW Iran completed.

2005: Poverty mapping in Syria completed.

Methodology for climate change impact at 1 km resolution established.

2006: Guidelines for multi-scale agroecological characterization prepared.

**Output 5:** Methodologies and procedures for informal local-level agroecological characterization

*Indicator: Manual on guidelines for participatory agroecological characterization*

Milestones:

2004: Publication covering participatory agroecological characterization procedures for dryland areas

**Output 6:** Strengthening of NARS capacity in agroecological characterization.

*Indicators: National and regional networks in agroecological characterization established.*

*Training courses, workshops, etc.*

Milestones:

2004-2006: Training through joint research activities with several NARS and participation in ICARDA-led or outside training courses

**Duration:** 5 years.

**Users:** NARS of CWANA by the provision of (i) new methodologies and technology transfer through training and joint projects, and (ii) the provision of essential and multi-scale frameworks for the extrapolation of site-specific research. The international research community by provision of geo-referenced information on types and severity of abiotic stresses, land degradation, suitability for specified production systems, and recommendations for land management.

**Collaborators:**

- Meteorological Services of Iraq and Iran.
- Drylands Agricultural Research Institute and Soil and Water Research Institute, Iran
- General Commission for Scientific Agricultural Research, Syria
- Agroclimatology: USDA-ARS, Lubbock, USA
- Remote sensing: Center for Earth Observations, Yale University
- Poverty Mapping: FAO, CIAT
- Participatory agroecological characterization: Katholieke Universiteit Leuven, Belgium
- Characterization of agricultural systems and training: CIHEAM, Zaragoza

**Cost:**

2004: US\$ 0.54 million

2005: US\$ 0.56 million

2006: US\$ 0.59 million

**System Linkages:**

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 75%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Restricted funding from USDA for climatological analysis; training supported by the Arab Fund. Anticipated funding from Morocco.

## **Project 4.1: Socioeconomics of Natural Resources Management in Dry Areas**

**Goal:** Conservation and sustainable use of the natural resource base for improving the welfare of people both in current and future generations.

*Indicator:* Increased use of natural resource conservation practices.

**Purpose:** Analysis of the social, institutional and economic factors that influence resource management and a greater understanding of resource users' perceptions and objectives that will assist in the design of proposed technical interventions and reveal where opportunities may exist for community action and cooperative management of resources.

*Indicators:* Utilization of formal methods of natural resource and environmental valuation, and institutional options for supporting resource management decisions at farm, community and national levels.

*Increased utilization of these methods by NARS.*

*Increased public awareness of the costs involved in the mismanagement of natural resources, in terms of local livelihoods, national agricultural sustainability and the global environment.*

**Output 1:** Market and non-market valuation of natural resources and estimation of the economic and social costs of their degradation.

*Indicator:* Decision tools for sustainable natural resources management that take into consideration the environmental impact of agricultural practices.

### Milestones:

2004: Analysis of social and economic benefits of marginal water use in agriculture in Kazakhstan (MSc thesis) completed.

Economic analysis of policies affecting land use options and conservation practices in mountain terraces in Yemen.

**Output 2:** Economic assessment of the environmental impact of resource management strategies.

*Indicator:* Methods for the valuation of natural resources and the costs associated with their degradation developed and transferred to NARS in conjunction with other Projects involved.

### Milestones:

2004: Decision support tool for land use developed for Khanasser valley integrated research site, Syria. Bio-economic modeling of land use options in the Khanasser valley integrated research site completed.

2005: Economic impact of alternative water use options evaluated in three sites in Jordan, Morocco and Egypt.

**Output 3:** Socioeconomic evaluation of potential resource management options.

*Indicator:* Factors in the broader socioeconomic environment that influence individuals' resource management decisions identified, including the socio-cultural organization of communities.

### Milestones:

2004: Characterization of resource users' perceptions and attitudes towards resource use, institutional factors and natural resource conservation technologies in Kyrgyzstan completed.

2005: Characterization of resource users' perceptions and attitudes towards resource use, institutional factors and natural resource conservation technologies in Egypt completed..

**Output 4:** Institutionalized multidisciplinary and participatory approaches to natural resource management research in national systems.

*Indicator:* Users' perceptions and valuations of their resource base, which contribute to decisions regarding resource management practices determined.

### Milestones:

2004: Results of participatory NRM research transferred to all stakeholders (farmers, researchers, extensionists, NGOs and policy decision-makers) through workshops and seminars.

Adoption and impact of improved water management technology in selected CWANA countries assessed.

**Output 5:** Knowledge of NARS social scientists on the socio-economic research in NRM enhanced.

*Indicator:* Increased social science research capacity on NRM within CWANA NARS

**Milestones:**

Annually: On-the-job individual training and training workshops.

**Duration:** 3 years.

**Users and beneficiaries:** Immediate users of the valuation of natural resources and the social and economic costs of their degradation are ICARDA researchers in natural resource management, and national planners and decision-makers. Because of the problem-solving, participatory approach employed, the immediate beneficiaries are the resource users involved in the case studies. The approaches and methodologies developed in these studies will be disseminated for use by NARS and other researchers in natural resource management.

**Collaborators**

- NARS partners include the following institutes: Morocco: Centre Regional de Recherche Agricole/ INRA. Algeria: Institut Technique des Grandes Cultures; Haute Commission de Developement de la Steppe. Tunisia: INRAT; Institute des Hautes Etudes Commerciales; Institute des Regions Arides (IRA). Iraq: IPA Agricultural Research Center; Jordan: University of Jordan; National Center for Agricultural and Technology Transfer. Lebanon: Lebanese University; American University of Beirut; Agricultural Research Institute. Syria: University of Aleppo. Yemen: Aden University; Agriculture Research and Extension Authority. Pakistan: Water Resources Research Institute, Authority of Barani Agricultural Development (ABAD). NARS of Central Asia.
- Christian Albrecht University, Kiel, Germany; Systemwide Programme on Participatory Research and Gender Analysis (SP-PRGA) convened by CIAT.

**Cost**

2004: US\$ 0.45 million

2005: US\$ 0.47 million

2006: US\$ 0.48 million

**System Linkages:**

Output 3: Sustainable Production: 80%

Output 4: Policy: 10%

Output 5: Enhancing NARS: 10%

Linkage with the two Systemwide Programmes: Participatory Research and Gender Analysis (SP-PRGA) convened by CIAT, and Collective Action and Property Rights (CAPRI) coordinated by IFPRI.

**Financing Plan:** Unrestricted core funds. Restricted funding from Barani Village Development Project, Pakistan; restricted funding from BMZ; restricted funding from Arab Fund and anticipated funding from IFAD for benchmark sites in water management; Junior Professional Officer supported by France; training supported by the Arab Fund. Anticipated funding from Asian Development Bank for activities in Central Asia; anticipated funding from Challenge Program on Water and Food for activities in Karkeh River and Nile River basins.

## **Project 4.2: Socioeconomics of Agricultural Production Systems in Dry Areas**

**Goal:** Sustainable improvement of the welfare of poor people in dry areas through the identification of problems and the development, transfer and adoption of viable options.

*Indicators: Increased productivity, sustainable farming practices, and higher returns to farm resources.*

**Purpose:** A better understanding of the economic and social dimensions of rural poverty through micro-economic and social analysis of farm households and rural poverty improved targeting of technology transfer efforts.

*Indicators: Increased use of multi-disciplinary problem diagnosis by ICARDA and NARS scientists.  
Increased use of farmer participatory research methods by ICARDA and NARS researchers in technology development and evaluation and targeting of technologies.  
Adoption of formal methods of impact assessment for evaluating the potential impacts of ICARDA's research program.  
Adoption by national programs of effective methods (including participatory techniques) of problem diagnosis and constraint analysis of agricultural systems with noticeable impact on the technology development and transfer process.  
Adoption by national programs of formal and quantitative methods of impact (ex ante and ex post) assessment which takes into account the economic, social and environmental aspects of the technology in target agricultural systems.*

**Output 1:** Production problems of resource-poor farmers identified and their production systems characterized.

*Indicator: Diagnostic surveys carried out and production problems identified with in farming systems*

### Milestones:

2004: Production problem diagnosis and characterization of farm and household typologies of Punjab province, Pakistan, completed.  
Technological and management options described for the Khanasser Integrated Research Site in Syria.

**Output 2:** Rural households and their livelihood strategies characterized and the circumstances that constrain or enhance the adoption of technologies and management practices identified.

*Indicator: Household studies*

### Milestones:

2004: Analysis of the socioeconomic determinants of poverty and child nutrition in three countries of completed.  
Analysis of the role of local (informal) institutions on rural livelihoods with emphasis on rural women.  
2005: Analysis of the socioeconomic determinants of poverty including child nutrition in three countries of CWANA published.  
Analysis of the economic potential of non-agricultural income-generating opportunities (trade, tourism) in Khanasser valley, Syria.

**Output 3:** Quality of farmer participation in agricultural research improved.

*Indicators: Guidelines and procedures for effective farmer participation in research provided to NARS.  
Guidelines and procedures for user participation in the dialogue and evaluation of improved technology provided to NARS researchers.*

### Milestones:

2004: A Workshop on community-based natural resources management research organized and proceedings published.

**Output 4:** Documented adoption, and feedback of user evaluations into the technology generation process.

*Indicator: Adoption studies and analysis of constraints to adoption of technologies identified in target agricultural systems*

### Milestones:

2004: Adoption studies of different commodity-based and NRM Techniques in Iran.  
2005: Studies of adoption of technologies in Egypt, Pakistan, and Central Asia completed.

**Output 5:** Quantified *ex ante* and *ex post* impact of new technologies and information for research priority setting and planning.

*Indicators:* Guidelines for identifying and assessing the different types of impacts of agricultural research made available to NARS of WANA.

*Ex ante and ex post impact assessments of agricultural technology and analysis of the returns to research supplied to research managers in ICARDA, NARS, the CGIAR, and the donor community.*

**Milestones:**

2004: The results of the impact of improved lentil germplasm on rural poverty in Ethiopia and Bangladesh published.

2005: An *ex ante* impact study of chickpeas in Turkey completed.

2006: Assess the impact of farmer participatory research in the Khanasser project, Syria.

**Output 6:** Evaluation of the economics of livestock production in the low rainfall areas of CWANA.

*Indicators:* Development of a database of the livestock surveys and experiments conducted by ICARDA

*Report of the preliminary analyses are conducted and knowledge gaps*

*Synthesis report on the economics of livestock production*

**Milestones:**

2004: Analysis of the profitability of livestock fattening in the agricultural systems of Khanasser Valley, Syria.

Analysis of the economic performance of sheep production systems completed.

2005: Study on the marketing system of sheep in Syria completed.

**Output 7:** Strengthened research capacity of NARS.

*Indicators:* Training of NARS personnel in research methods in the socioeconomic aspects of technology development and transfer.

*Thematic workshops on multidisciplinary and socioeconomic research*

**Milestones:**

Annually: Socio-economic training (including on-the job individual and group training and training workshops) organized for NARS in collaborating projects.

Contribution to training courses organized by other projects.

**Duration:** 3 years.

**Users and beneficiaries:** ICARDA and NARS researchers will benefit from the feedback provided by the project, through better targeting of their research and greater awareness of the problems and constraints faced by farm households. Farmers will, in turn, benefit from the development of appropriate technologies and solutions to production problems that take account of their needs and constraints. The information generated from the analysis of rural poverty and the micro-studies of farm households will ensure that technical solutions are developed that take account of the different needs of the rural poor.

**Collaborators:**

All activities are conducted in collaboration with NARS and universities in CWANA.

The System-wide Programme on Participatory Research and Gender Analysis (SP-PRGA) convened by CIAT, University of Massachusetts.

**Cost**

2004: US\$ 1.11 million

2005: US\$ 1.15 million

2006: US\$ 1.20 million

**System Linkages:**

Output 3: Sustainable Production: 50%

Output 4: Policy: 40%

Output 5: Enhancing NARS: 10%

Participation in the Systemwide Programme on Participatory Research and Gender Analysis (SP-PRGA) convened by CIAT.

**Financing Plan:** Unrestricted core funds. Donor attributed funding from DFID, UK. Restricted funding from International Nutrition Foundation, USA; restricted funding from BMZ; restricted funding from Barani Village Development Project, Pakistan; restricted funding from IFAD; training supported by the Arab Fund. Junior Professional Officer supported by France. Associate Expert supported by Switzerland. Anticipated funding from IFAD and Asian Development Bank for activities in Central Asia; anticipated funding from SDC Switzerland for activities in mountain areas of North Africa.

### **Project 4.3: Policy and Public Management Research in the Dry Areas of Central and West Asia and North Africa**

**Goal:** Improved policy and public management that promotes sustainable production systems and livelihood strategies in the dry areas of Central and West Asia and North Africa.

*Indicator: Policy and public management options adopted by policy-makers*

**Purpose:** Influence reforms of national and regional policies and institutions to promote agricultural investments and management decisions in dry areas with respect to efficiency, equity and environmental sustainability.

*Indicators: Governments and research institutions have clearly defined tools to evaluate the welfare and resource management consequences of different policy, institutional and public management options in the dry areas.*

*Improved information base to guide national policy formulation.*

*Research findings are included in the design of rural development policies, policy reforms and public management systems.*

**Output 1:** Identification of the policy and property rights environments under which rural producers and communities make their decisions and characterize the incentive and disincentive structures that shape their resource management, production and livelihood strategies

*Indicators: Two synthesis documents and six monographs analyzing the current policy environment in WANA and discussing the implications of policy reforms in terms of welfare changes and sustainability in the region.*

*Two synthesis documents and eight monographs analyzing property rights policies and their effects on land improvements, productivity, and incomes in the low rainfall areas of WANA.*

*Three studies evaluating policy processes and the decision making environments under which the projects for empowering the poor are implemented in Morocco, Tunisia and Sudan*

#### Milestones:

2004: Synthesis paper on the effects of property rights on biodiversity conservation and land degradation in selected CWANA countries.

Paper on tribal arrangement for rangeland management cooperation in risky environment.

Paper on utility function and cooperative aspects (Jordan).

2005: Paper on the development of land markets in selected CWANA countries.

Paper on linkages between rangeland characteristics and sheep producers' strategies

**Output 2:** Evaluation of the effects of policy, property rights and technological options on sustainable resource management and livelihood strategies of farming and herding communities in the dry areas.

*Indicators: Three studies identifying the feasibility of policy, property rights and technological options in selected communities in Morocco, Tunisia and Syria*

*Five community studies of selected policy, property rights and technological options in communities in Algeria, and Jordan.*

*Effects of property rights on land improvement, technology use and livelihood strategies in selected WANA countries.*

*Effects of policy on livelihood strategies of farming and livestock production in WANA.*

*Effects of policy on livelihood strategies of farming and livestock production in WANA.*

*Three studies identifying technological options and marketing strategies in selected communities in Maghreb*

*Three studies identifying technological options and marketing strategies in selected communities in Maghreb.*

#### Milestones:

2004: Training provided on community modeling.

2005: Published book on comparative effects of agricultural policies on technology adoption, land management, marketing strategy and household livelihood in four Maghreb communities.

2006: Report on poverty indicators in Mashreq and Maghreb countries.

Report on environment degradation indicators in Mashreq and Maghreb countries.

Report on welfare indicators at household and community levels in Mashreq and Maghreb countries.

**Output 3:** Identification and evaluation of property rights and local institutional options for sustainable management of rangeland resources

*Indicator:* Three synthesis reports evaluating the welfare effects of different rangeland management institutional options on sub-groups within the community and the importance of institutional and market-based feed access options for sustaining production and livelihood strategies.  
One Monograph analyzing the dynamic of tribal/community arrangement for rangeland management and their degree of efficiency on land degradation in Tunisia  
Two synthesis reports evaluating the factors that are hindering collective action and successful implementation of technical and institutional innovations in rangeland management and assess the trade-offs between technical and institutional options;

Milestones:

2004: Typology of different interventions in rangeland management.  
Identification and evaluation of factors contributing to success or failure of interventions.  
Guidelines for promoting collective action are developed and published.

2005: Pastoral organizations Conflict management in the dry areas.  
Monographs on rangeland management in Algeria, Iraq, Lebanon and Libya.  
Monograph on rangeland management of selected countries in Central Asia.

2006: Book on collective actions and institutional options and rangeland development in CWANA countries.

**Output 4:** Assessment of women's resource access and use, and household livelihood strategies in selected sites in Syria.

*Indicators:* Report of the Rapid Rural Appraisal (RRA) and focus groups of selected communities.  
Synthesis report on women asset building strategies and access to productive resources and identification of the women's constraints in conducting their activities.

Milestones:

2004: Published papers

**Output 5:** More effective research targeting and priority assessment based on analysis of commodities, resources and system trends in CWANA.

*Indicators:* Briefs on commodity and system production trends in West Asia and North Africa

Milestones:

2004: Concept note on proposed study  
2005: Analysis and reports  
2006: Analysis and reports

**Output 6:** Evaluation of returns to investments in the dry areas and their effects on poverty eradication and development of communities.

*Indicators:* Priorities of public investment to achieve growth and poverty reduction  
Simulation of optimal allocation of public investment among different types and among different dry regions.  
Strengthened national capacity in research of public investment issues.

Milestones:

2004: Synthesis paper on public investments

**Output 7:** Identification and promotion of marketing niches for dryland products, based on comparative advantages, and improved competitiveness of poor communities.

*Indicators:* Typology of marketing niches for dryland products.  
Marketing constraints are identified.  
Added-value products are identified and produced by farmers and private sector.  
Protection and conservation of medicinal plants.  
Improved and diversified income sources

Milestones:

2004: Database for Survey results  
Monographs for Mashreq/Maghreb countries  
Typology of marketing niches for dry areas

2005: Synthesis report

**Duration:**

**Users:** The primary clientele are policy makers in the target countries of North Africa and West and Central Asia; NARS partners and other researchers will benefit from research on the efficiency, equity and environmental consequences of policy, property rights and technological options.

**Collaborators:**

- NARS partners include: Ministries of Agriculture and Planning; Centre Aridoculture-INRA, and Hassan II University, Morocco; INRAT, University of Mognane, Tunisia; Lebanese Agricultural Research Institute (LARI), Lebanese University and American University of Beirut, Lebanon; NCARTT, the University of Jordan, and the Jordan University of Science and Technology (JUST), Jordan; Directorate of Agricultural Scientific Research and University of Aleppo, Syria; IPA Agricultural Research Center, Iraq; Station Experimentale ITGC, Algeria; ARC, Libya
- Other research partners: Environmental and Production Technology Division of IFPRI; School of Rural Development and Planning, University of Guelph, Canada; Land Tenure Center, University of Wisconsin-Madison, USA.

**Cost:**

2004: US\$ 0.39 million

2005: US\$ 0.40 million

2006: US\$ 0.42 million

**System Linkages**

Output 4: Policy: 90%

Output 5: Enhancing NARS: 10%

Linkage to Systemwide Programme on Collective Action and Property Rights (CAPRI), convened by IFPRI.

**Financing Plan:** Unrestricted core funds. Joint appointment with IFPRI of senior scientist. Restricted funding from EC FEMISE program; training supported by the Arab Fund.

## **Project 5.1: Strengthening National Seed Systems in Central and West Asia and North Africa**

**Goal:** Increased productivity and sustainable food security through improved seed security and access to quality seed.

*Indicators: Improved seed production and distribution.  
Accelerated introduction of new varieties from NARS*

**Purpose:** Strengthened capacity of formal and informal seed systems of CWANA countries to supply farming communities with quality seed of adapted varieties in a cost-effective and sustainable manner.

*Indicators: Information on how to improve the efficiency, reliability and quality of seed supply to farmers of all types, transferred to national seed programs and organizations.  
Improved availability of seed, increased productivity and improved farm incomes in crop production systems.*

**Output 1:** Enhanced knowledge and expertise in national seed programs.

*Indicators: Knowledge and skills acquired by trainers during 'train-the-trainer' courses adapted and transferred successfully through follow-up courses organized within countries in the region.  
Personnel from various levels in the national seed program participating actively in workshops, seminars and roundtable discussions organized by ICARDA's Seed Unit.  
Graduates of collaborative MSc programs active in solving problems in their countries using expertise acquired with the support of ICARDA.  
Collaborative links established with academic institutions in the region which are involved in teaching seed technology.*

### Milestones:

2004-2006: Training course on Seed Enterprise Development.  
Specialized training courses based on requests from specific national programs.

**Output 2:** WANA Seed Network providing close linkages between, and implemented by, the national seed programs in the region in collaboration with the ICARDA Seed Unit.

*Indicators: Published comparative information on national seed policies, quality control procedures, import/export regulations and quarantine measures used by member countries.  
Standardized seed production and control procedures adopted by Seed Network members.  
Committees guiding and coordinating privatization efforts in WANA countries.  
Countries receiving regular information through Network Newsletter, variety catalogues and other working documents using material compiled by member countries and widely distributed in the region.  
Establishment and operation of national Seed Associations with private sector participation.  
Integration of seed system in the region based on common certification scheme and regulations.*

### Milestones:

2004: Initiate harmonization studies on varieties and seeds for North Africa region  
One National Seed Association initiated in the region and options for establishing regional associations formulated.

2005: Seed systems in the region integrated on the basis of a common certification scheme and regulations.

WANA Seed Network transformed into a Regional Seed Association.

2006: Fully fledged and regionally integrated seed system become operational

**Output 3:** Strategies and methodologies for improving economic efficiency of formal and alternative seed delivery systems.

*Indicators: Options for increased cost efficiency of seed systems and policy recommendations for improvement of performance of the seed sector prepared and implemented by national seed programs.  
National seed programs participating actively in collaborative case studies on financial and economic analysis of national seed systems.  
Results and recommendations of country studies used by national programs.  
Ideas and experiences from successful cases extended to seed systems in several countries.  
Countries recognizing and applying different approaches to seed system development and adopting those that best suit their respective conditions.  
Regulatory barriers to new seed providers reduced or removed*

Milestones:

- 2004: Articles on economics studies prepared and published.  
Economic input into Afghanistan projects provided.  
Economic input into village-based seed systems in Afghanistan provided.  
A model seed systems project for forages developed in collaboration with the Syrian General Organization for Seed Multiplication.  
Consultancy provided for strengthening seed systems in Central Asia.
- 2005: Articles on economics studies prepared and published.  
Experiences from model forage seed system project in NE Syria applied to other countries in the region.  
Economic input into Afghanistan projects provided; including village-based seed systems provided.
- 2006: Articles on economics studies prepared and published.  
Experiences from model forage seed system project in NE Syria applied to other countries in the region.  
Economic input into Afghanistan projects provided, including village-based seed systems.

**Output 4:** Informal seed sector concerns reflected in national seed system development as a result of awareness created on this issue.

*Indicator: Published results and recommendations based on informal sector studies widely distributed and utilized by development agencies, NGOs and other interested institutions.*

Milestones:

- 2004: Publications prepared on seed supply systems (informal seed sector).  
Model alternative seed delivery systems in specific countries explored on the basis of information and knowledge from various studies and projects.
- 2005: Potential for establishing model alternative seed delivery systems in specific countries explored.
- 2006: Potential for establishing model alternative seed delivery systems in specific countries explored.

**Output 5:** Coping mechanisms enhanced in disaster prone countries through knowledge disseminated and regional cooperation in seed security

*Indicators: Countries aware of recommendations on (i) the establishment of national seed stocks, regional seed security reserves, community based seed initiatives, or strategic area seed reserves; (ii) appropriate means of reacting to disaster relief; (iii) linking seed relief with disaster preparedness and long-term development.  
Organizations using published guidelines as reference or training material.*

Milestones:

- 2004: Support to rebuilding Afghanistan's seed system continued.  
Support to other disaster affected areas provided.  
Information from seed security studies and initiatives published
- 2005: Support to rebuilding Afghanistan's seed system continued.  
Support to other disaster affected area provided.  
Information from seed security studies published.
- 2006: Support to other disaster affected area provided.

**Output 6:** Relevant new information available through applied research into practical seed-related issues, with particular reference to forage seeds.

*Indicators: Research results accepted for publication in relevant journals and media  
Citation and use of research results from similar studies undertaken in national seed programs.*

Milestones:

- 2004-2006: Practical research carried out  
Information from research projects published.  
Research findings applied in seed systems.

**Output 7:** Use of adapted germplasm in national programs promoted by transfer of promising lines through seed supplied by ICARDA and maintained by NARS.

*Indicators: Seed of promising lines used as start-up multiplication material in national programs and in trials.  
Procedures and facilities for producing high-quality breeder seed established within NARS to support the national seed sector.*

**Milestones:**

2004-2006: Seed production, processing, storage and testing services provided for ICARDA projects and NARS

**Duration:** 5 years.

**Users and beneficiaries:** In strengthening national seed systems, the immediate target groups are policy makers, managers and staff of formal sector seed organizations, as well as alternative seed producing groups such as NGOs, seed growers, cooperatives, and farmers' organizations. The ultimate beneficiaries are farmers who will benefit from access to, and use of, quality seed, farmers and consumers who use crops for food, livestock feed and other purposes.

**Collaborators:** NARS and seed programs of WANA countries through activities of WANA Seed Network and collaborative country studies. International Organizations involved in seeds including FAO; International Seed Testing Association (ISTA); International Union for the Protection of New Varieties of Plants (UPOV). University departments that include seed topics in their teaching curricula and graduate research, e.g., University of Jordan; University of Khartoum; Cukurova University, Turkey.

**Cost**

2004: US\$ 0.38 million

2005: US\$ 0.39 million

2006: US\$ 0.41 million

**System Linkages**

Output 3: Sustainable Production: 35%

Output 4: Policy: 45%

Output 5: Enhancing NARS: 20%

**Financing Plan:** Unrestricted core funds. Training supported by the Arab Fund. Anticipated continued funding from IDRC for seed system development in Afghanistan; anticipated funding through the CGIAR Collaborative Research Program for collaboration with Central Asia and the Caucasus; anticipated funding from Japan for activities in Afghanistan.