

THE INTERNATIONAL CENTER FOR AGRICULTURAL RESEARCH IN THE DRY AREAS (ICARDA)

MEDIUM-TERM PLAN 2002-2004

SUMMARY

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**A. OVERVIEW: HIGHLIGHTS OF 2000 RESULTS AND 2001 DEVELOPMENTS**

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The presentation of ICARDA's Medium Term Plan 2002-2004 in this overview is based on the CGIAR principal outputs of (1) Germplasm Improvement, (2) Germplasm Collection, (3) Sustainable Production, (4) Policy and (5) Enhancing NARS. In its MTP 1998-2000, following its 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)**

During 2001/2 ICARDA will take the lead within CWANA in developing the priorities for CG activities in the region with AARINENA, CAC NARS forum, sister Centers and other stakeholders. 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) part of CWANA are highlighted because of the recent and continued growth of ICARDA's engagement within the framework of the CGIAR Program for CAC. During 2000 projects were continued on 'Germplasm Conservation, Adaptation, and Enhancement for Diversification and Intensification of Agricultural Production' on barley, forage legumes, food legumes with ICRISAT, winter wheat with CIMMYT and genetic resources with IPGRI - all within the CGIAR Program. In 1999 a senior barley breeder was transferred to the ICARDA CAC Office, Tashkent to work on winter cereal improvement in CAC and the Highlands of WANA. In the CAC there are on-going projects on On-farm Water and Soil Management funded by ADB and on On-farm Soil and Water Management for Sustainable Agricultural Systems in CAC (ICARDA & IWMI) within the framework of the CGIAR Program. A project funded by IFAD on integrated feed and livestock production in the steppes of Central Asia started in 2000 to expand livestock productivity research in Central Asia, and ICARDA has joined with ILRI in exploring and proposing new livestock research initiatives in the region. An international workshop on 'New approaches to Water Management in Central Asia' jointly organized with UNU, Japan was held at ICARDA in November 2000.

**1.2. South Asia**

ICARDA is providing major support to integrated research on dryland resource management within the IFAD-funded Barani Areas Village Development Project in Pakistan. ICARDA's cooperation in South Asia on lentil improvement is supported by ACIAR through a project with Bangladesh and another in Nepal due to start in 2001. 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 and Sri Lanka.

### **1.3. Eastern and Southern Africa**

Focusing on the poor in sub-Saharan Africa (SSA) and in congruency with the evolving CGIAR Strategy in SSA, ICARDA initiatives include the following: Continued support to Ethiopia in its research programs on cool season food legumes funded by the Netherlands and research on neurotoxin-free grasspea in Ethiopia funded by DFID, UK. In Eritrea, in collaboration with DANIDA, barley improvement has developed into a participatory mode and a project on integrated disease management to enhance wheat and barley production will be initiated in 2001. A project on the improvement of cool season cereals and legumes is planned in Eritrea for 2001. Kenya, South Africa & Zimbabwe participate in the "Optimizing Soil Water Use" (OSWU) theme, coordinated by ICARDA and ICRISAT, of the System-wide Program on Soil Water and Nutrient Management (SP-SWNM).

### **1.4. Central and West Africa**

Several projects developed with the NARS of Mauritania on natural resource management and germplasm enhancement are planned to become operational in 2001. Burkina Faso, Mali & Niger participate in the "Optimizing Soil Water Use" (OSWU) theme, coordinated by ICARDA and ICRISAT within SP-SWNM.

### **1.5. Latin America**

ICARDA's cooperation in Latin America has focused on provision of germplasm of its global mandate crops. ICARDA is expanding its activities in Latin America, particularly in lentil, barley, faba bean and kabuli chickpea, which are primarily subsistence crops grown by resource poor farmers and also offer possibilities for crop diversification in dry areas. ICARDA is broadening its collaboration to include genetic diversity and conservation, farming systems and crop-livestock interactions in dry areas of Latin America. ICARDA posted a Regional Coordinator for Latin America at CIP, Lima in 1999 to develop a joint program of research with Latin American NARS. A new post-doctoral barley breeder was appointed at CIMMYT, Mexico, to continue the genetic improvement work in barley for Andean region and for favourable environments.

### **1.6. Systemwide Linkages**

ICARDA continues to participate in the seven system-wide programs listed in its MTP 2001-2003 (SGRP, SLP, SWIM, SP-SWNM, CAPRI, SP-PRCA, and SP-PRGA).

## **2. Research Outputs**

### **2.1. Germplasm Enhancement**

- Farmer participatory plant breeding research continued to expand during 2000 and now covers such NARS as Ecuador, Egypt, Eritrea, Jordan, Morocco, Syria, Tunisia and Yemen on barley and the food legumes chickpea and lentil in Bangladesh, Syria, Turkey and Yemen. Further expansion is planned to Bolivia in 2001 on barley. A research paper on participatory barley breeding received the CGIAR Chair's Award for Outstanding Scientific article at ICW-2000.
- 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. In a collaborative project with other CG Centers, it is proposed to start work on improving the nutritional quality of food crops for the benefit for the poor, particularly women and children.
- Research on the genetic transformation of food legumes continued in 2000 in partnership with ARIs for chickpea in cooperation with the Universities of Hanover (funded by GTZ) and Naples, and for lentil with CLIMA, Australia (funded by ACIAR) through a scientist posted to the Agricultural Genetic Engineering Institute (AGERI) in Egypt, where biosafety legislation is enacted and containment facilities are available. In September 2000 a workshop on 'Developing and Harmonizing Biosafety Regulations for Countries in WANA' was held in Aleppo in cooperation with FAO and AGERI. In 2001 increased attention to functional genomics is anticipated in partnership with ARIs.

- With the identification of more linkages between DNA markers and economic traits in several mandate crops, the use of marker-assisted selection increased in 2000.

## **2.2. Germplasm Collection**

- In a collaborative project started in 1999 on 'Conservation and Management of Agrobiodiversity in the Fertile Crescent' with the NARS of Jordan, Lebanon, the Palestinian Authority and Syria, and IPGRI, ACSAD (Arab Center for Studies of Arid Zones and Dry Lands) and UNDP/RBAS funded by GEF, ICARDA has the responsibility for regional coordination. A major thrust of the project is the development of *in situ* and on-farm conservation of biodiversity through the appropriate management of habitats. Through funding from the CG program, ACIAR and GRDC, major focus in agrobiodiversity research in 2000 was on the CAC region with collections in two CAC countries and others planned for 2001 and assistance given to Uzbekistan in documentation. Additionally, in 2000 ICARDA continued its collaboration with the N.I. Vavilov Research Institute of Plant Industry, Russia.
- The holdings of plant genetic resources of mandate crops and their wild relatives at the Center exceeded 125,000 accessions in 2000, with the majority designated as 'In Trust' germplasm under the auspices of FAO. Activities in germplasm collection, characterization (including molecular characterization), evaluation, maintenance and distribution continued during the year.

## **2.3. Sustainable Production**

- To support an expansion of research on water, ICARDA recruited senior staff in Agricultural Hydrology, Marginal Quality Water Use, and Plant-Soil-Water Relations in 1998. Since 1999 research on water harvesting and renewable groundwater resources; 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 has increased. In 2000 ICARDA expanded its water research in the CAC region particularly through projects on on-farm water and soil management. Also in 2000 a workshop on 'Integrating Indigenous and Scientific Knowledge for Ground Water Use' was held at ICARDA in cooperation with Kiel University, Germany. In 2001 continued efforts to fund the eco-regional project on On-farm Water Husbandry in WANA will be made. A workshop on drought mitigation will be held in May 2001.
- Small ruminant research in 2000 focused on a market orientation including value-added dairy products, on-farm adaptive research and toward breed characterization. In 2000 there was an expansion of livestock productivity and feed resources research in Central Asia supported by IFAD, and ICARDA joined with ILRI in exploring and proposing new livestock research initiatives in that region. In 2000 there was also an expansion of activities in Syria on market opportunities and on-farm adaptive research for small dairy sheep producers with Japanese and Swiss support.
- Based on the strategy for rangeland research in non-tropical dry areas, research in 2000 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 in 2000. Work continued in Central Asia on measuring CO<sub>2</sub> flux in selected rangeland sites to monitor carbon sequestration potential of rangelands. In 2001 in cooperation with USDA-ARS new techniques using remote sensing to monitor arid rangelands will be assessed. Collaborative research with NARS within a major regional project in West Asia has focused on developing technical and institutional rangeland management options in selected communities.
- Complementary to participatory plant breeding, ICARDA is developing a repertoire of participatory approaches in natural resource management. In 2000, 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. A regional workshop on 'Marginal Land Degradation and Rehabilitation' was held in Cairo, Egypt with CEDARE. In 2000 we focused on the community development of natural resources in the Yemeni mountain terraces, and the link with food security through IDRC support. In 2001 a BMZ-financed project on an integrated approach to sustainable land management in dry areas, focused on an integrated research site, will commence emphasizing participatory approaches with the community 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. Together with NARS and ARIs, ICARDA is participating in a network of sites to monitor carbon sequestration under different land management conditions in Central Asia. ICARDA is utilizing data from its long-term rotation trials to assess organic carbon increases in soil subject to different cropping patterns and will lead a project of the Inter-Center Working Group on Climate Change on the topic. Many other aspects of the Center's research contribute to build the scientific knowledge base on mitigating against climate change such as policy research, rangeland rehabilitation, water harvesting, conservation tillage, land use planning and watershed management. The research on selection for drought tolerance in the mandate crops and its role in adapting to the anticipated effects of climate change has already been mentioned. A workshop is planned in November 2001 on "Agriculture, the Environment, Climate Change and Livelihoods".
- In parallel the Center has increased its engagement with NARS and other regional and international organizations to prepare action plans for implementation under the UN Convention to Combat Desertification (UNCCD) to control desertification and mitigate the effects of drought. ICARDA participated in the Third Regional meeting of the UNCCD National Focal Points in Asia in Thailand in Nov 2000 and in the UNCCD Conference of Parties in Bonn, Germany in Dec 2000, acting as the CGIAR focal point for UNCCD. In 2001 we anticipate the activation of UNCCD action plans and the completion by ICARDA of an inventory study for Thematic Network 1 (TN1) of the subregional program for West Asia.
- There was on-farm evaluation of Integrated Pest Management packages in Morocco, Syria and within the Nile Valley in 2000. A new project on the integrated management of Sunn Pest in West Asia will start in 2001 with DFID support.
- Agroecological characterization at ICARDA made substantial progress in 2000. 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 2000. A country almanac on the agroecological characterization of Syria was also completed in 2000 in cooperation with USDA, and progress made in the characterization of the Arabian Peninsula and the development of a land suitability map of Morocco.

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

- ICARDA's attention to the issue of poverty alleviation increased in 2000 and the foundations were laid for increased research efforts in 2001 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 nears completion. Gender and the changing role of women in food production, particularly in drier areas where transhumant animal husbandry is the principal activity, is the topic of a project with Guelph University (Canada) begun in 1999. This is complementary to an on-going 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 to be published in 2001. ICARDA is developing project proposals for research on the potential for improving livelihood through improving the quality, post-harvest processing and marketing of primary crop and livestock products.
- In 2000 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.
- ICARDA in cooperation with IFPRI is implementing a community approach to ensure management, feed/livestock strategies and technology transfer in eight countries of the region. Research on increasing the role of women in resource management, household livelihood strategies and community level impacts of policy property rights and technical options in the low rainfall areas of WANA continued in 2000.
- ICARDA is strengthening its capacity to address the human aspects of natural resource management at the farm and community levels. During 2000 partnerships with ESCWA (United Nations Economic and Social Commission for West Asia) and the University of Kiel (Germany) 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.

With the support of the Netherlands, the study on village-level institutions for managing shared water resources continued in 2000. In 2001 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. Funding is being sought to support activities in the WANA Seed Network and a regional CAC seed initiative.
- Activities continued in 2000 to strengthen biotechnology in WANA and to transfer proven biotechnological techniques to NARS in WANA through finance from the Arab Fund.
- ICARDA's research outputs are incorporated within national development projects such as in the Northwest Coast of Egypt and the Barani area of Punjab, Pakistan.

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## **B. HIGHLIGHTS OF CHANGES IN PROJECT PORTFOLIO AND/OR PROJECT MILESTONES IN 2002**

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The Research Project Portfolio for 2002-2004 is presented in the attached Annex. There are no major programmatic changes in the project portfolio compared with the MTP 1998-2000. With major structural changes made in 1998, in line with the thrusts laid out in the 1998-2000 MTP, the year 2002 will see a closer research focus at ICARDA on the determinants of poverty. The suite of projects has not changed (no new projects), but within projects there are shifts in emphasis or scale:

- expansion in research on water as the key limiting natural resource from both management (Project 3.1) and institutional aspects (Project 4.1) and also germplasm enhancement (Projects 1.1, 1.2, 1.3, 1.4, 1.5 and 1.6);
- expansion of research on mitigation and adaptation to the anticipated effects of climate change (Projects 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.2. and 3.4);
- increase in support for socioeconomic research on natural resource management (additional staff).

Project milestones for 2002 through 2004 are given within the Research Project Portfolio for 2002-2004 in the attached Annex. With restricted projects now accounting for 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: quality characteristics of barley as food in Project 1.1, soil carbon measurements as related to climate change in Project 2.2, and the inventory study for Thematic Network 1 in Asia under the UNCCD in Project 3.1.

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## **C. HIGHLIGHTS OF 2004 PROJECT PORTFOLIO AND IMPLICATIONS FOR 2003 AND 2004**

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No programmatic shifts are intended in 2004. New milestones reflect changes in emphasis or relative effort within projects. ICARDA will continue to implement the strategic shifts indicated in its 1998-2000 MTP and under Section A above.

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## **D. PROJECT COST**

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Based on current estimates of anticipated funding the research agenda requirement in 2002 is US\$ 27.0 million, an increase of 4% over that proposed for 2001 in the 2001-2003 MTP.

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

Non-financial contributions include two scientists outposted to ICARDA from CIMMYT, and seven junior/associate professional officers/associate experts (see E below).

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

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#### **E. 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 1998-2000 MTP. In 2000/1 staff turnover occurred in several positions without any overall change in emphasis. In 2001 ICARDA aims to recruit a senior natural resources economist to support changes in emphasis in the research portfolio as also requested by the External Program and Management Review (EPMR). The EPMR also requested increased staffing in fungal pathology and genetic resources capacity; for these positions recruitment is contingent upon new restricted funding. In 2001 ICARDA anticipates hosting a total of seven associate experts/junior professional officers from Australia, Belgium, Denmark, Italy, Japan and the Netherlands.

Several new modalities are being explored to support critical mass in specific areas of research, as indicated in the 1998-2000 plan. Short-term consultants are being used to supplement core staffing in priority areas including fungal pathology. Senior Scientific Advisors appointed as 'mentors' provided support on biotechnology and water research in 1999 and on stress physiology and climate change in 2000. NARS scientists have been, and will continue to be, appointed, as needed, as Affiliate Research Fellows to conduct specific activities.

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#### **F. CENTER FINANCIAL INDICATORS AND CAPITAL INVESTMENTS**

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In submitting the agenda for 2002-2004, 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 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:* 90 new varieties in 10 countries, adopted by 30% of the farmers 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:

- 2002: 50% 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 with improved feed and food characteristics obtained and distributed.
- 2003: 80% of the barley breeding for Latin America and 50% of barley breeding for China decentralized.  
New barley lines with various combinations of abiotic and biotic stress resistance and with improved feed and food characteristics obtained and distributed.
- 2004: Decentralization for Latin America completed and 80% of barley breeding for China decentralized.  
New barley lines with various combinations of abiotic and biotic stress resistance and with improved feed and food characteristics obtained and distributed.

**Output 2:** Methodology to enhance adoption developed.

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

### Milestones:

- 2002: Participatory breeding initiated in at least one country in Latin America.  
Seed multiplication activities promoted in five villages in Syria.  
The quality characteristics for barley as human food defined.
- 2003: Second cycle of participatory breeding concluded in Syria and in North Africa.
- 2004: 1000 farmers involved in participatory plant breeding.  
Adoption of at least 15 varieties in 5 countries.

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

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

### Milestones:

- 2002: 70% of International Barley Information System (IBIS) developed.  
Markers for osmotic adjustment developed.  
Mapping populations developed by DH technique and tested for suitability for genetic mapping (segregation distortion).  
Marker assisted selection (MAS) for traits identified in mapping populations routinely used.  
Use of molecular markers extended to physiological traits associated with drought tolerance.
- 2003: 100% of IBIS developed.  
First improved barley lines produced with MAS.
- 2004: IBIS used as standard information management system in the project.

**Output 4:** New methodologies disseminated.

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

#### Milestones:

- 2002: 5 NARS start using Restricted Maximum Likelihood (REML) methods in their data analysis.  
Three new publications on methodological issues.  
Breeding methodologies presented in international conferences.  
Lectures on breeding methodologies for biotic and abiotic stresses at three training courses.
- 2003: 20% of NARS have changed their methodologies.  
At least 10 varieties produced as consequence of new methodologies.  
Breeding methodologies presented in international conferences.  
Lectures on breeding methodologies for biotic and abiotic stresses at three training courses.
- 2004: 50% of NARS have changed their methodologies.  
At least 10 new varieties produced as consequence of new methodologies.  
Breeding methodologies presented in international conferences.  
Lectures on breeding methodologies for biotic and abiotic stresses at three training courses.

#### **Output 5:** NARS Research capabilities improved.

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

#### Milestones:

- 2002: 10 scientists trained in PPB; 5 scientists trained in molecular marker technology; 5 scientists trained in REML analysis; 5 scientists trained in IBIS; 5 scientists trained in breeding for stress environments; 10 scientists trained in breeding for biotic (diseases, insect, virus) stress resistance.
- 2003: 10 scientists trained in PPB; 5 scientists trained in molecular marker technology; 5 scientists trained in REML analysis; 5 scientists trained in IBIS; 5 scientists trained in breeding for stress environments; 10 scientists trained in breeding for biotic (diseases, insect, virus) stress resistance.
- 2004: 5 scientists trained in PPB; 10 scientists trained in marker assisted selection; 10 scientists trained in REML analysis; 10 scientists trained in IBIS and data management; 25 scientists trained in breeding for abiotic and biotic stress resistance.

**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 in Latin America, China, Russia, Vietnam, Korea, India, Nepal, Kenya, Spain, South Africa, New Zealand.

University of Jordan; Jordan University of Science and Technology; for Agricultural Research and Technology Transfer (NCARTT), Jordan; University of Damascus, Syria; Krasnodar Research Institute; All Russian Institute of Agricultural Biotechnology; National Laboratory Risoe, Denmark; University of Hamburg; Germany; University of Hohenheim, Germany; Scottish Crop Research Institute, UK; University of Brisbane; North Dakota State University; Oregon State University; Texas Tech University. University of Adelaide; Colorado State University; Kansas State University; Oklahoma State University, Montana State University, CRC for Molecular Plant Breeding, Waite Campus, Adelaide.

#### **Cost:**

2002: US\$ 2.22 million  
2003: US\$ 2.31 million  
2004: US\$ 2.40 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. Allocated core contribution from Italy; grant from SWP-PRGA for participatory plant breeding; financing from AFESD for biotechnology; collaboration with Australia supported by GRDC; germplasm enhancement in Iran financed by Iran; cooperation with USA supported by USAID linkage funds; IDRC grant for participatory plant breeding; grant from Danida, Denmark for disease management of barley in Eritrea; BMZ funding for molecular marker research; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; anticipated support from Netherlands for barley research in Ethiopia; anticipated annual grant from the OPEC Fund.

## **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 West Asia and North Africa (WANA).

*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:

2002: Broadening the genetic base for improving grain quality traits.

2003: Broadening the genetic base for resistance to rusts, Hessian fly, BYDV, Septoria and abiotic stresses.

2004: Introgression of resistance to black point and scab.

**Output 2:** New breeding methodology for Mediterranean drylands developed.

*Indicators:* Stress physiological tools are used such as carbon isotope discrimination and spectral radiometry.  
Molecular marker techniques; marker assisted selection.

### Milestones:

2002: Genome mapping of the population for cold and boron toxicity in the Atlas and Anatolian plateaus accomplished; QTLs for grain quality and stress tolerance determined.

2003: Genome mapping of the population for continental and temperate dry lands accomplished; QTLs for grain quality and tolerance to drought determined.

2004: QTLs for parameters of abiotic stress tolerance; QTLs for resistance to yellow and leaf rust.

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

*Indicators:* New designs and tools used by 3 NARS programs.  
Enhanced scientific expertise.

### Milestones:

2002: Genetic stocks with multiple resistance to abiotic and biotic stresses for temperate dry lands available.

2003: Genetic stocks with multiple resistance to abiotic and biotic stresses for highlands available.

2004: Genetic stocks with high yield and stability available.

**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 2002-2004 (per year):

- 20-30 genotypes with resistance to drought, cold, and heat tested per year in on-farm trials with 5 NARS.
- 20-30 genotypes with improved grain quality will be tested per year in on-farm trials with 5 NARS.
- 20-30 genotypes with broadened genetic base for resistance to rusts, Hessian fly, Septoria and abiotic stresses will be tested per year in on-farm trials with 5 NARS.

**Output 5:** Enhancement of NARS Research capabilities.

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

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### Milestones:

- 2002: 1 trainee per country for 5 NARS on breeding for broadening the genetic base for biotic stress resistance.  
PhD students on quality, stress physiology, and molecular markers.
- 2003: 1 trainee per country for 5 NARS on breeding for broadening the genetic base for abiotic stress resistance.  
PhD students on quality, stress physiology, and molecular markers.
- 2004: 1 trainee per country for 5 NARS on breeding for broadening the genetic base for abiotic stress resistance.  
PhD students on quality, stress physiology, and 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:** The Durum Improvement Program at ICARDA is conducted in collaboration with CIMMYT; a CIMMYT Durum Wheat Breeder is outposted to ICARDA headquarters.

- 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, Cobby, 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.
- Grain quality: Hassan II University, Morocco; Tuscia University, Italy; Cordoba University, Spain.
- Moisture stress: Barcelona University, Spain; IRTA-Llerida, Spain; Grenada University, Spain; ENSA/INRA Montpellier, France.
- Adoption studies: NCARTT, Jordan; ARC, Syria; LARI, Lebanon; ARC, Iraq, INRA-Morocco.
- Crop modeling/GIS: Wageningen University, Netherlands.

### **Cost:**

2002: US\$ 1.15 million  
2003: US\$ 1.20 million  
2004: US\$ 1.25 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:** Core funds of ICARDA and CIMMYT. Allocated core from Italy; restricted funding from Italy supports collaboration on grain quality; allocated funds from France; restricted funding from Spain; germplasm enhancement in Iran financed by Iran; BMZ restricted funding for DNA marker assisted breeding and genetic engineering; financing from AFESD for biotechnology. Anticipated funds from IFAD for on-farm trials and socio-economic studies in WANA.

### **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 West Asia and North Africa (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, resistant/tolerant to biotic and abiotic stresses, 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:

2002: Broadening the genetic base for resistance to rusts, Hessian fly, Septoria and for abiotic stresses.

2003: Broadening the genetic base and improving grain quality traits.

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

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

*Indicators:* New designs and field plot techniques used.  
Stress physiological and morpho-physiological tools are used.  
Utilization of biotechnological techniques in the breeding program.

#### Milestones:

2002: Physiological and morpho-physiological adaptive traits associated with wheat adaptation under drought identified.

Commencement of the development of mapping populations for drought and heat tolerance by doubled haploid (DH) technique.

2003: Physiological and morpho-physiological adaptive traits utilized in the selection program.

Increase (20%) in the use of synthetics to broaden the genetic base of spring bread wheat.

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

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

*Indicators:* New designs and tools used by 3 NARS programs.  
Number of better varieties generated.

#### Milestones:

2002: New designs and breeding methodologies discussed in three Regional Research Coordination Meetings and three Regional traveling workshops.

2003: Three NARS start using new designs and breeding methodologies.

New breeding methodologies will be presented in international conferences and workshops.

2004: Routine utilization of new designs and breeding methodologies in National Programs.

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

*Indicators:* On-farm trials in 3 NARS are established in bread wheat growing areas in each country.  
Number of improved spring bread wheat varieties adopted.

#### Milestones:

2002: 20-30 genotypes with improved grain quality tested in on-farm trials in three NARS.

2003: 20-30 genotypes with broadened genetic base for resistance to rusts, Hessian fly and Septoria and abiotic stresses tested in on-farm trials in three NARS.

2004: A new variety is released in each of at least 3 NARS.

**Output 5:** Enhanced NARS research capabilities.

*Indicators:* NARS scientists trained in 3 years: 20 at headquarters and 30-50 within NARS programs.  
3-5 workshops/courses organized with NARS.

Milestones:

2002: 1 trainee per country for 4 NARS on breeding for broadening genetic base for biotic stress resistance.

2003: 1 trainee per country for 4 NARS on breeding for broadening genetic base for abiotic stress resistance.

2004: 1 trainee per country for 5 NARS on breeding for drought, cold, and heat tolerance.

**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:** The Spring Bread Wheat Improvement Program at ICARDA is conducted in collaboration with CIMMYT; a CIMMYT Bread Wheat Breeder is out posted to ICARDA headquarters.

- 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.

**Cost:**

2002: US\$ 0.65 million

2003: US\$ 0.68 million

2004: US\$ 0.71 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:** Core funds of ICARDA and CIMMYT. Grant from Danida, Denmark for disease management of wheat in Eritrea.

**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:

2002: Doubled haploid (DH) lines from specific crosses field tested.

2004: Improved bread-making quality realized in new cultivars.

**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:

2002: DNA markers for cold tolerance identified.

2004: DNA markers for cold tolerance used in marker assisted selection (MAS).

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

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

Milestones:

2002: Genetic stocks for Russian wheat aphid (RWA) produced and made accessible to NARS.

2003: DNA markers for Yellow Rust resistance identified.

Genetic stocks for cereal leaf beetle (CLB) developed and made accessible to NARS.

2004: DNA markers for RWA tolerance identified.

Genetic stocks for cereal cyst nematode (CCN) produced.

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

*Indicator:* Percent of farmers growing new cultivars.

Milestones:

2004: NARS release varieties based on joint activities.

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

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

Milestones:

2002: Network of pathologists in CWANA established, focused on yellow rust management.

**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 operated from Ankara, Turkey. An important component of ICARDA breeding work is also conducted in collaboration with Iran, with a special emphasis on rainfed winter wheat in dry areas, and on yellow rust.

- *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. University of Sydney, Australia.
- Root rot: NARS in Turkey, Morocco, and Iran.
- Nematodes: NARS in Turkey; INRA, France.
- International facultative and winter bread wheat nurseries: Oregon State University, USA; NARS.

**Cost:**

2002: US\$ 0.84 million

2003: US\$ 0.87 million

2004: US\$ 0.91 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. Collaboration with Iran supported by Iran. Collaboration with Central Asia and the Caucasus supported by restricted funding through the CGIAR approved Collaborative Research Program.

## **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 levels.

*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.

Adoption of late winter or early spring sowing of chickpea in Mediterranean environments with mild winters and extended 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.  
Marker for key stresses identified and marker assisted selection (MAS) is in use.  
Key pathogen variability characterized.  
Improved screens for selection for stress tolerance developed.

### Milestones:

2002: Pathogenic variability for Fusarium wilt characterized.

Key markers identified for various traits and tested.

CAC Legume Network operative.

2003: Screening methodologies for Ascochyta blight, Fusarium wilt, and cold improved and marker assisted selection for these traits initiated.

CAC Legume Network nurseries initiated.

2004: Breeding for southerly latitudes decentralized.

Marker assisted selection for key stresses in use.

CAC Legume Network nurseries operative.

**Output 2:** 20 researchers/year trained on breeding methodologies, selection methods and techniques in food legume germplasm enhancement in project target areas.

*Indicator:* Number of researchers trained

### Milestones:

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

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

*Indicators:* 200 crosses/year followed by selection for key stresses in partnership with NARS.  
Elite breeding material and nurseries with stress resistance sources supplied to NARS.  
Elite winter-hardy materials with resistance to ascochyta blight for winter sowing in high lands developed.  
Suitable DNA markers identified for winter-hardiness, vascular wilt, rust and ascochyta blight.  
Mechanical harvest system adopted by the farmers in Syria.  
Additional sources of resistance to Fusarium wilt, rust, Ascochyta and drought identified.  
Farmers identified promising lines through participatory breeding.

### Milestones:

2002: Seed for suitable combinations of genetic stocks with high biomass and resistance to key stresses increased for distribution to NARS.

Improved methods of weed control and harvest mechanization demonstrated at few sites in West Asian countries.

Suitable DNA markers identified for ascochyta blight resistance.

Farmer-participatory breeding initiated in Bangladesh, Nepal, Pakistan and Turkey.

Expansion of winter-technology in several sites in Turkey, Iran, Afghanistan and Pakistan.

2003: Suitable combinations of genetic stocks with high biomass and resistance to key stresses distributed to NARS.

Farmer-participatory breeding will be initiated in Morocco and expanded in Bangladesh, Nepal, Pakistan, Turkey and Syria.

DNA markers for wilt, rust, and Ascochyta blight identified and MAS initiated for winter-hardiness.

Improved methods of weed control and harvest mechanization documented and in use.

Dissemination of winter-technology in highlands in Turkey, Iran, Afghanistan and Pakistan.

2004: NARS evaluated the improved genetic stocks with high biomass and resistance to key stresses and identified superior lines for local use.

Participatory approach followed in major lentil-producing countries.

DNA markers for wilt, rust, Ascochyta blight and winter-hardiness tested for MAS.

Adoption of winter-sowing technology in countries of West Asian high elevations.

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

*Indicators: Production of transgenic lentils through collaboration with other institutes, their testing and use in breeding.*

*High yielding varieties with resistance to Sitona and Orobancha are available.*

#### Milestones:

2002: Transformation and regeneration protocol developed and tested in collaboration with other institutes.

2003: Transgenic lines for control of Sitona weevil under development.

2004: Transgenic lentils to control Sitona available.

**Output 5: Kabuli chickpea:** Germplasm with large seed, 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 with other institutes.*

*Screening techniques to identify durable resistance to Ascochyta blight developed.*

*Newly developed breeding materials and genetic stocks screened for different stresses and new sources of resistance to various biotic and abiotic stresses identified, their seed increased and shared with NARS in a targeted breeding approach.*

*Improved techniques to screen for resistance to leaf miner used.*

*Activities decentralized to NARS with high capacity.*

#### Milestones:

2002: DNA molecular markers for Ascochyta blight tested.

The genetics of leaf miner studied and strategy to improve leaf miner resistance established.

Large seed size and stress resistance combined in Kabuli Chickpea.

Demonstrations of late winter sown or early spring sown technology, and seed multiplied.

2003: Farmers start growing late winter sown or early spring sown chickpea and increase the seed for their own use.

Transformation and regeneration protocol tested.

Breeding for Fusarium wilt resistance decentralized to North Africa in Tunisia.

International nurseries with large seed size and stress resistance made available to NARS.

Genes for resistance to cold, and cyst nematodes transferred from wild to the cultigen in large seed size background.

2004: Genes for resistance to Ascochyta blight and high biomass transferred from wild to the cultivated chickpea.

Late winter or early spring sowing technology transferred to NARS.

MAS for key traits in use.

**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 developed.  
Genetic stocks with high biomass and other important traits developed.*

Milestones:

- 2002: Hybridization between cultigen and wild annual species continued.  
Selected mutants evaluated for stress resistance traits and resistant plants identified.
- 2003: Genes for large seed size from cultigen and cyst nematode resistance from wild combined in Kabuli background.  
Hybridization between cultigen and wild annual species continued and new breeding materials developed.  
Seed of the desirable mutants increased.
- 2004: Widely diverse advanced chickpea breeding materials with high level of tolerance from wild species developed.

**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.  
Identification of 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:

- 2002: Gene pools for combined resistance to biotic and abiotic stresses distributed for testing in sub-regional programs.
- 2003: Gene pools with adaptation to sub-regions established for use in development of sub-regional nurseries.
- 2004: Development of faba bean lines with low tannin content and improved level of resistance to foliar diseases 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:

- 2002: Selection of different plant types with stress resistance from the populations developed through hybridization for combining these traits.
- 2003: Elite materials of different plant types with resistance to various stresses identified for testing in sub-regional programs.
- 2004: Development of genotypes with resistance to diseases and water use efficiency to cover areas with relatively less availability of water.

**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:** The Kabuli Chickpea Improvement Program is conducted in collaboration with ICRISAT.

- 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 & chickpea for Mediterranean environments: Center for Legumes in Mediterranean Agriculture (CLIMA), Australia.
- Transformation with chickpea: University of Hannover, Germany.
- Transformation protocols: AGERI, Egypt.
- Mapping WANA chickpea wilt races: University of Cordoba, Spain.
- 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.

**Cost**

2002: US\$ 2.14 million

2003: US\$ 2.23 million

2004: US\$ 2.32 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 of ICARDA. Allocated core funding from UK; allocated core funding from Italy for chickpea; GRDC grant supports collaboration with Australia on chickpea; restricted funding from Spain for chickpea; financing from AFESD for biotechnology; collaborative research on cool season legumes in Ethiopia supported by the Netherlands; collaborative research on germplasm enhancement in Iran financed by Iran; collaboration with Central Asia and the Caucasus supported by restricted funding through CGIAR Collaborative Research Program; restricted project grant from BMZ for DNA assisted breeding and genetic engineering; funding from ACIAR for research on lentil in Nepal. Anticipated restricted program funding from BMZ for legume genomics; anticipated funding from ACIAR for collaborative research with Australian institutes on disease management in legumes.

## **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. & *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 chicklings (*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 population with sufficient diversity for use in different environments.

*Highly adapted cultivars and populations of forage vetches and chicklings 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:

2002: Cold tolerant genotypes identified and selected.

2003: Cold tolerant wooly-pod vetch, Hungarian vetch and common vetch available.

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.

**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:

2002: On farm testing of low neurotoxin lines.

Performance of the crop under different cultural practices.

2003: Adoption of low neurotoxin lines by NARS, especially Bangladesh and Ethiopia.

2004: Number of NARS using improved lines increased.

The socioeconomic factors affecting farmer's practices, use of improved germplasm, processing, consumption patterns of grasspea qualified and understood.

**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:

2002: *In situ* selection for high biomass.

2003: Distribution of improved underground vetch for testing in selected site of marginal lands.

2004: Grazing trials, natural reseeding, survival under grazing, seed-bank dynamic studied.  
Natural self-regeneration in rotations with barley finished.

**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:

2002: Two individual trainees from Ethiopia trained on methods of estimation of the neurotoxin in grasspea grains and straw by chemical and NIR methods.

Two individuals trained in germplasm enhancement and somaclonal tissue culture techniques.

Traveling workshop on grasspea in Ethiopia involving socioeconomists and nutritionists along with breeders and agronomists conducted.

2003: Five individual trainees on germplasm enhancement, and quality assessments.

One M.Sc thesis finished.

2004: Number of in-country training courses, and visiting scientists for CWANA increased.

**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 suitable adapted self-regenerated forage legumes in rehabilitating non-arable grazing lands. Development 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 areas, or under environmental conditions where 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:**

2002: US\$ 0.85 million

2003: US\$ 0.89 million

2004: US\$ 0.92 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; use of forage legumes in development of integrated crop-livestock production in Mashreq and Maghreb financed by IFAD and AFESD and in Central Asia by IFAD; grant from DFID CRF for improving nutritional quality of grasspea in Ethiopia; funding from ACIAR for research on Lathyrus in Nepal; collaboration with Central Asia and the Caucasus supported by restricted funding through the CGIAR Collaborative Research Program.

## **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:

- 2002: Six pest surveys in six countries.  
Yield loss experiments in three countries.  
Variability of six pests in six countries characterized.
- 2003: Five pest surveys in five countries.  
Yield loss experiments in three countries.  
Variability of five pests in five countries characterized.
- 2004: Four pest surveys in four countries.  
Yield loss experiments in three countries.  
Variability of four pests in four 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:

- 2002: Sources of resistance for seven pests identified.  
Effects of at least three practices on five pest populations in three countries evaluated.
- 2003: Sources of resistance for seven additional pests identified.  
Effects of at least four practices on three pest populations in three countries evaluated.
- 2004: Sources of resistance for seven additional pests identified.  
Effects of at least five practices on five pest populations in three 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:

- 2002: Four IPM options developed.
- 2003: Additional five IPM options developed.
- 2004: Additional six IPM options developed.

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

*Indicator:* Number of pilot sites developed.

### Milestones:

- 2002: Three pilot sites in three countries.
- 2003: Five pilot sites in five countries.
- 2004: Seven 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:**

2002: 10 NARS scientists and 50 farmers trained in IPM practices.

2003: 20 NARS scientists and 100 farmers trained in IPM practices.

2004: 30 NARS scientists and 200 farmers trained in IPM practices.

**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; Directorate of Agricultural and Scientific Research (DASR), Syria; Exchange of resistant germplasm: CIMMYT, ICRISAT, NARS of CWANA.
- Study of population dynamics of powdery mildew: Risoe National Laboratory, Denmark.
- Ecology and biological control of soil-borne pathogens: University of Bonn, Germany; KVL, Denmark.
- Viral pathogens and virus resistance: ARC, Egypt; German Federal Research Laboratories for Agriculture and Forestry, Germany; CNRS, ISV, France; NSW Agriculture, Australia.
- Monitoring of leaf and stem rust variability: IAVHII, Morocco; ARC, Egypt; University of Aleppo, Syria; SPII, Iran; FCRI, Turkey.
- Yellow rust: University of Sydney, Australia; FCRI, Egypt; USDA/ARS, USA; DIAS, Denmark, INRA, France.
- Study of variability of lentil Fusarium wilt pathogen: DIAS, Denmark.
- Characterization of variability of chickpea Fusarium wilt pathogen: University of Cordoba, Spain.
- Characterization of pathogenic variability in Scald: University of Adelaide, Australia.
- 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.
- 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, Syria.
- Russian wheat aphid and legume pests: Washington State University, USA; Colorado State University, USA; ARC, Egypt; Aphid Lab, USDA/ARS, Stillwater, Oklahoma.
- Wheat stem sawfly, cereal diseases: 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; Simon Fraser University, Canada.
- Nematode control in legumes: CNRS/Bari, Italy.
- Diseases in chickpea: International Mycological Institute, UK; University of Frankfurt, Germany; University of Cordoba, Spain.

- 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.
- NSW Agriculture, AGWEST, DNRE Horsham and the University of Adelaide, Australia on management of faba bean, chickpea and lentil diseases.
- NSW Agriculture and GRDC, Australia on Coordinated Improvement of Chickpeas in Australia.

#### **Cost**

2002: US\$ 1.52 million

2003: US\$ 1.58 million

2004: US\$ 1.65 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:** Core funds. Support for collaboration with University of Vermont from USAID linkage funds; grant from DFID, UK, for IPM of Sunn pest; grant for integrated cereal disease management in Eritrea from Danida, Denmark; grants from GRDC, Australia, for research on resistance to viruses in legumes, improved understanding and management of legume diseases, and coordinated improvement of chickpeas in Australia; support for IPM pilot sites from SP-IPM. Anticipated funding from ACIAR for collaborative research with Australian institutes on legume disease management.

## **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.  
–Network of long-term trials in the region established.*

### Milestones:

- 2002: Carbon and nitrogen dynamics in long-term trials monitored, and practices that enhance carbon sequestration and thus mitigate the effects of global warming identified.  
Cropping system options developed using results from on-station and on-farm trials.  
Report on the assessment of compost use on productivity and carbon sequestration.  
Report on supplemental irrigation on the productivity of faba bean, chickpea and lentil crops.  
Workshop on direct sowing and conservation tillage in CWANA together with AARINENA.  
Tillage effects on soil physical properties in Northern Syria reviewed.
- 2003: Analysis of long-term monitoring of farmers' dynamic systems with NARS for trends in changes in productivity and sustainability.  
Relationship of monitored C and N values to crop production identified and modeled with a view to transferring technology to mitigate climate change.  
Analysis of the dynamic nature of C and N in complex agroecosystems and with respect to climate change.  
Role of oilseed crops in the region reviewed.  
Proceedings of the workshop on direct sowing, conservation tillage in CWANA.
- 2004: The extent of greenhouse gas emissions identified and quantified .  
Criteria for ongoing and future long-term trials refined and a valid mechanism for extension of such findings to target agroecological zones identified.  
Orbanche control and management in forage crops reviewed.

**Output 2:** 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:

- 2002: Crop simulation models tested in selected sites in CWANA.  
Production risks with different management options quantified and mapped in Syria.
- 2003: Continued evaluation of crop simulation models in selected sites in CWANA.  
Production risks quantified in additional countries in CWANA.  
Cropping systems simulation models evaluated for the spatial extrapolation of site-specific findings on the optimization of soil water use and related management options in Syria.

2004: Continued evaluation and reporting of crop and cropping system simulation models in selected sites in CWANA.  
Production risks quantified in additional countries in CWANA.

**Output 3:** Field-tested technologies and strategies for more efficient water use in dry-area cropping systems.

*Indicators:* Improved technologies for soil water conservation and its efficient use developed with NARS.  
—Promising techniques in soil, water and crop management that increase water use efficiency adopted by farmers.

Milestones:

2002: Reports on efficient soil, crop and water management practices tested under farmers' conditions with NARS.

Reports on SWNM-OSWU projects implemented by NARS.

Report on minimum and no-tillage study in Turkey.

2003: Reports on efficient soil, crop and water management practices tested under farmers' conditions with NARS.

Reports on SWNM-OSWU projects implemented by NARS.

2004: Evaluation of the impact of tested technologies on productivity, profitability and sustainability.

**Output 4:** Management strategies for the enhancement of soil fertility in cropping systems.

*Indicators:* Literature on nutrient management for efficient use is upgraded.  
—Soil sampling and laboratory analysis procedures for fertilizer recommendations developed.  
—Biological, chemical and physical soil quality indicators developed.  
—Training manuals and guidelines in soil quality produced.

Milestones:

2002: Appropriate soil fertility indicators available.

Manual for N-fertilizer use in cropping systems in Syria.

Completion of publications on long-term trials.

2003: Monograph on long-term trials at ICARDA.

2004: Effective Soil Fertility Network established.

**Output 5:** Distribution and severity of soil micronutrient imbalances identified and awareness increased.

*Indicators:* Soil micronutrient database developed with NARS.  
—Climate and soil-type patterns identified.  
—Maps and reports on micronutrient stresses affecting plant, animal and human health produced.

Milestones:

2002: Distribution of micronutrient stresses mapped.

2003: Climate and soil-type patterns in micronutrient stresses identified.

2004: Climate and soil-type patterns in micronutrient stresses identified in additional areas in CWANA.

**Output 6:** 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.  
—Training manuals and guidelines produced.  
—Workshops and symposia attended by NARS and their papers published.

Milestones:

Annually: Relevant training courses in CWANA.

Dissemination of knowledge to researchers, extensionists and farmers during field visits. .

**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 <sup>15</sup>N: 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**

2002: US\$ 1.71 million

2003: US\$ 1.78 million

2004: US\$ 1.85 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, IBSRAM, 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 NARS in Egypt in long-term trials and farm monitoring supported by EC; support to consortium on Optimizing Soil Water Use through the SP-SWNM; collaboration with Iran financed by Iran; support for collaboration on crop diversification, soil water and nutrient management in Central Asia from Asian Development Bank.

### **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 forage legumes and sown pastures 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 pasture and forage legumes in crop rotations or to rehabilitate native pastures.

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

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

#### Milestones

2002: 100 accessions collected and conserved in gene bank and/or nursery.  
1 cultivar of range species selected.

1000 kg of vetch and 10 kg of range species distributed to NARS.

Four NARS scientists trained in collection and selection of forage and pasture species.

A report on the potential of mulberry produced.

2003: 100 accessions collected and conserved in gene bank and/or nursery.  
1 cultivar of range species selected.

1000 kg of vetch and 20 kg of range species distributed to NARS.

2004: 100 accessions collected and conserved in gene bank and/or nursery.  
1 cultivar of range species selected.

1000 kg of vetch and 50 kg of range species distributed to NARS.

Key species to overcome winter feed shortages in Central Asia and the Caucasus and for research identified.

A CD-ROM including photos and description of major useful forage and range species produced and distributed.

**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

2002: 1 machine for harvesting Atriplex species developed.

Several farmers at the village level produce local forage or range seed/seedlings.

Four NARS scientists trained in seed production.

2003: 1 machine for harvesting Artemisia species tested on-farm.

Four NARS scientists trained in seed production.

2004: Solutions to overcome shortage in forage seed in Central Asia and the Caucasus identified.

1 machine for harvesting Salsola species developed.

Sufficient quantity of local forage or range seed/seedlings are produced in the informal sector.

Four NARS scientists trained in seed production.

**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:

Annually: At least two field days organized on rotation trials per year.

Two papers published on rotation trials.

Four NARS scientists trained in rotation trials.

**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

- 2002: Analysis of two trials to assess the potential use of forage and pasture crops as hay, grazing or mature seed and straw to suit land use and market opportunities.  
Four NARS scientists trained in management of feed resources.  
Two issues of Newsletter produced.
- 2003: Assess the potential use of wastewater to irrigate forage crops.  
Analysis of one rotation trial established in cooperation with NARS in three countries analyzed for economic ranking of treatments.  
Four NARS scientists trained in management of feed resources.  
Two issues of Newsletter produced.
- 2004: Analysis of one trial integrating rangeland into rotation trials.  
Four NARS scientists trained in management of feed resources.  
Two issues of Newsletter produced.

**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: AUB/AREC, Lebanon; SMAAR, Syria, Aleppo university
- Forage and pasture management: NARS of Algeria, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Pakistan, Syria, Tunisia, Turkey and Central Asia; USDA-ARS; GL-CRSP; INIA, Spain.
- Fodder shrubs germplasm: INIA Spain.
- Pasture rehabilitation and vetch in Turkey: GAP Project, Field Crops Research Institute, Ankara.
- Feed resources in Central Asia and the Caucasus: National Programs of Armenia, Azerbaijan, Georgia, Kyrgyzstan, Kazakhstan, Turkmenistan and Uzbekistan.

#### **Cost:**

2002: US\$ 0.98 million

2003: US\$ 1.02 million

2004: US\$ 1.06 million

#### **System Linkages:**

Output 2: Germplasm collection: 5%

Output 3: Sustainable Production: 80%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Restricted grant from Spain. Funding for collaborative research with NARS in Mashreq and Maghreb from IFAD and the Arab Fund; grant from IFAD for integrated feed and livestock production in Central Asia; Dryland Pasture, Forage & Range Network Newsletter co-sponsored by IPGRI-CWANA, FAO (Near East Regional Office), CIHEAM, CLIMA (Australia), GL-CRSP, and IDRC; support from Systemwide Livestock Program for increasing feed resources in the Caucasus.

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

**Goal:** Rehabilitation of native pastures and restoration of the contribution of rangelands to national livestock feed demands. Rangelands also contribute significantly to global carbon sequestration; revegetation can contribute to reducing global warming as well as 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 and marginal lands, which 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 two test sites in CWANA.

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

### Milestones

2002: Guidelines for proper management of fodder shrub plantations established with users.

2003: Develop and test a management plan for rangeland natural resources in two sites.

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

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

*Indicator:* Techniques tested and utilized by NARS.

### Milestones

2002: Three range species increased.

One machine for rangeland reseeding developed.

Several farmers at the village level produce local forage or range seed/seedlings.

The pitting machine tested by the Badia Project in Syria for rangeland reseeding.

Four NARS staff trained on machinery operation and use.

2003: The machine for rangeland reseeding tested in a selected site.

Four range species increased.

Sufficient quantities of local forage or range seed/seedlings are produced in the informal sector.

Rangeland reseeding assessed in Marsa Matrouh, Egypt.

Four NARS staff trained on machinery operation and use.

2004: The pitting machine is used at large scale by the Badia Project in Syria for rangeland reseeding.

Four NARS staff trained on machinery operation and use.

**Output 3:** Inventory of useful native and exotic plants for feed, fuel-wood, or erosion control.

*Indicator:* Documentation, database and herbarium of useful species.

### Milestones

2002: Mapping of range resources in two sites initiated.

100 accessions collected and conserved in gene bank and/or nursery.

Fodder shrubs for cold environments released.

Four NARS staff trained in inventory, survey, and mapping of range resources.

2003: Mapping of range resources in two additional sites initiated.

100 accessions collected and conserved in gene bank and/or nursery.

Measurement of main vegetation types productivity in two sites completed.

Four NARS staff trained in inventory, survey, and mapping of range resources.

2004: A CD-ROM including photos and description of major useful species forage and range species produced and distributed.

Four NARS trained in inventory, survey, and mapping of range resources.

**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

2002: Literature analyzed.

2003: Report published.

2004: Measures formulated for a proper use of rangelands in Central Asia and the Caucasus.

**Duration:** 10 years.

**Users and beneficiaries:** The research targets low potential areas, including native pastures on non-cultivable lands 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**

- Nine countries where desertification is considered of serious concern are involved in the SLP Shrubs and Trees: Burkina Faso, Jordan, Mali, Morocco, Niger, Pakistan, Senegal, Syria and Tunisia, ILRI; ICRISAT; and ICRAF.
- Geographic Information System (GIS): INRA-Oujda, Morocco, JICA-JIRCAS, Japan; Maison de l'Orient, CNRS, France; IUED, Switzerland.
- Fodder shrubs and trees: ILRI; ICRISAT; ICRAF; Centro de Investigación y Desarrollo Agroalimentario (CIDA), Spain.
- Monitoring of range biomass production and carbon sequestration in Central Asia: USDA/ARS Range Sheep Production Efficiency Unit (RSPEU), Dubois, Idaho; USDA/ARS Forage and Range Research Laboratory (FRRL), Logan, Utah; University of California, Davis; Utah State University; National Programs of Armenia, Azerbaijan, Georgia, Kyrgyzstan, Kazakhstan, Turkmenistan and Uzbekistan.
- Rehabilitation of marginal land and range: Syria: Steppe Directorate; University of Aleppo. Lebanon: American University of Beirut; Lebanese University; Lebanese Agricultural Research Institute; Jordan: University of Jordan; National Centre for Agricultural Research and Technology Transfer; MARC, Egypt; GAP, Turkey.

#### **Cost**

2002: US\$ 1.59 million

2003: US\$ 1.65 million

2004: US\$ 1.72 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).

**Financing Plan:** Unrestricted core funds. Restricted funding from Spain; financing from Egypt for technical assistance to north-west Egypt, from Barani Village Development Project in Pakistan and GAP Project in Turkey; collaborative research with NARS in Mashreq and Maghreb financed by IFAD and AFESD; collaborative research with NARS of Arabian Peninsula funded by IFAD, the Arab Fund, and the OPEC Fund; collaborative work on fodder shrubs supported within the Systemwide Livestock Programme; financing from IFAD for integrated feed/livestock research in Central Asia; use of GIS and remote sensing in rangeland mapping financed by SDC, Switzerland.

## **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.

*Indicators: Databases of 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:

2002: Collection of data on markets of small ruminant products is completed in CWANA.

2003: Analysis of information on markets of small ruminant products is completed and market opportunities documented in CWANA.

**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:

2002: Characterization of small ruminant production systems and production constraints completed and documented in CWANA.

2004: Typologies of small ruminant production systems in CWANA are documented. International symposium on the new trends and changes in small ruminant production systems and their associated markets in the dry areas.

**Output 3:** Technologies to improve small ruminant productivity and farmers' income integrated in adaptive market-oriented research are tested and available. Technologies include efficient low-cost management strategies that optimize use of available feed resources, as well as reduce parasite loads, inbreeding and risks to the resource base.

*Indicators: Results of on-farm performance of monitored pilot farms, 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.*

### Milestones:

2002: Reports and manuals on successfully tested technologies to improve small ruminant production in CWANA.

Nine groups of farmers applying market-oriented resource efficient technologies to improve productivity and income.

Additional five Central Asian scientists trained at ICARDA and other international centers in integrated feed and livestock production disciplines.

Additional two workshops on integrated feed and livestock production conducted in Central Asia.

2003: Additional farmers applying market-oriented resource efficient technologies to improve productivity and income.  
International seminar on livestock production in Central Asia.

**Output 4:** Potential of technologies involving transformation of primary products (i.e. to process milk into milk derivatives such as cheese and yogurt) that capitalize on added value for farmer's income enhancement, is assessed.

*Indicators:* Database and reports on the role of milk production in small ruminant farmers' economies.  
—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 on-farm demonstrations.

Milestones:

2002: Manual on successfully tested technologies for milk transformation.  
Manual on lamb fattening techniques for West Asia and Central Asia.  
More farmers test transformation technologies to produce milk derivatives that enhance income.  
2003: Technologies to produce new milk derivatives with market opportunity are developed.  
2004: International seminar on production technologies for small ruminant that capitalize on added value.

**Output 5:** 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:

2002: Past on-station production characterization of main breeds of small ruminant is documented in 11 countries of CWANA.  
CD produced compiling the small ruminant breeds of CWANA.  
International seminar on the breed characterization of CWANA.  
2004: On-farm characterization of main breeds of small ruminants in Central Asia and the Caucasus is completed and documented.

**Output 6:** 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 in small ruminant feeding made available to farmers in on-farm adaptive research and to NARS.  
—Manuals on the use of non-conventional feedstuffs and by-products in small ruminant feeding for different types of small ruminant production systems.  
—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:

2002: Out-of-season lambing to target better market opportunities is tested and used by farmers in adaptive research trials.  
Experimental testing of the feasibility to use the capacity to deposit fat of fat-tail sheep in feeding strategies.  
2003: Farmers in Northern Syria incorporate the out-of-season lambing technology.  
Technologies based on the use of fat deposits in reducing costs of feeding are documented.  
2004: On-farm testing of technologies that use the capacity to deposit fat of fat-tail sheep in feeding strategies.

**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 agro-industrial by-products will reduce imports of feed concentrates.

**Collaborators:**

- Market studies: JICA, Japan.
- Characterization of production system: University of Gottingen, Germany; KVL, Denmark.
- Adaptive research: NARS of Central Asia, West Asia, North Africa and Egypt; FAO; GL-CRSP, University of California, Davis, USA; GL-CRSP, University of Wisconsin-Madison, USA; USDA; JICA, Japan.
- Transformation of primary products: FAO; University of Wisconsin-Madison, USA; Jordan Cooperative Corporation.
- Breed characterization: ILRI; IPGRI; University of Wisconsin-Madison, USA.
- Animal health: ILRI; JICA, Japan.
- Non-conventional feedstuffs and by-products: FAO; CIHEAM, Spain.
- Strategic research on biological feasibility of new production strategies: McCaulay Institute, UK; FAO; IAEA.

**Cost**

2002: US\$ 2.05 million

2003: US\$ 2.13 million

2004: US\$ 2.22 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. Collaborative research with NARS in Mashreq and Maghreb supported by IFAD and the Arab Fund; collaborative research with Egypt (Marsa Matrouh) financed by Egypt; grant from IFAD for integrated feed/livestock research in Central Asia; ~~financing of sheep and range research in CA from USDA~~; financing for integrated dairy sheep production from Switzerland and Japan; financing for the characterization of genetic resources from IPGRI's SGRP and ILRI's SLP.

### **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 a greater part of rain is captured and utilized in improved water use efficiency.  
Information on the socioeconomic constraints and potential policies and actions to overcome them are available to decision-makers.

#### Milestones:

2002: Workshop on the methodologies and recommendations of the regional project on "On-Farm Water Husbandry".  
Activities within UNCCD Thematic Program Network on Water (TPN4) for Asia initiated.

2003: Conference on water harvesting and WUE organized in the region.

2004: Final Workshop of the regional project on "On-Farm Water Husbandry in WANA", with concluding results and recommendations.

**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:

2002: Regional workshop on supplemental irrigation held.  
Research reports of Tunisia and Morocco published.

2003: Model for optimal management of supplemental irrigation evaluated and tested.  
Proceedings of the supplemental irrigation workshop published.

2004: Research results of supplemental irrigation in Tunisia and Morocco completed.  
Recommendations on the management of supplemental irrigation of legumes published.

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

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

#### Milestones:

2002: Regional Workshop on on-farm WUE held in which promising and effective alternatives for cropping strategies and management practices identified.  
Inventory and database on water resources in West Asia within the UNCCD Thematic Network on Water (TN1) of the sub-regional action program for West Asia completed.

2003: Conference on WUE and water harvesting research results and recommendations.  
2004: Proceedings of the conference on WUE and water harvesting published.

**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

2002: Workshop on advanced management strategies that facilitate the sustainable use of low quality water in agriculture.  
2003: Database on available and potential non-conventional water resources in CWANA operative.  
2004: Proceedings of the workshop on the use of low quality water 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

2002: Guidelines for model application for ground water sustainable management developed and published.  
2003: Recommended methodologies combining technical and socio-economical parameters for sustainable use of ground water in irrigation published.  
2004: Model for evaluating the sustainability of groundwater use in supplemental irrigation evaluated and adapted to Syrian conditions.

**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:

2002: Training courses on water use efficiency, watershed management and non-conventional water resources.  
2003: Training course on soil and water management in dry areas.  
Regional workshop on managing scarce water resources for combating desertification in Asia as part of UNCCD TPN4 and TN1.  
2004: International course on integrated watershed management in dry areas

**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: Continue linkages through the Ecoregional Programme: On-farm Water Husbandry in WANA in Algeria, Egypt, Iraq, Iran, Jordan, Libya, Morocco, Pakistan, Syria, Tunisia, and Yemen. Collaboration with IRD France.

- Supplemental irrigation: national institutes of Iran, Iraq, Morocco, Syria, Tunisia, Turkey, and the Central Asian states.
- On-farm water use efficiency: IWMI, ICRISAT, ESCWA (UN Economic and Social Commission for West Asia); collaboration through ICARDA's Nile Valley and Red Sea Regional Program and NARS of 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; Cemagref and IRD (Institut de Recherche pour le Développement), France; General Organization for Remote Sensing, Syria; NARS of Jordan and Turkey.
- Non-conventional water sources: 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-France; McGill University, Canada; USDA.

#### **Cost**

2002: US\$ 3.70 million

2003: US\$ 3.85 million

2004: US\$ 4.01 million

#### **System Linkages:**

Output 3: Sustainable Production: 80%

Output 5: Enhancing NARS: 20%

Linkages to the Systemwide Programme in Soil Water and Nutrient Management (SP-SWNM) convened by CIAT and the Systemwide Initiative on Water Management (SWIM) convened by IWMI.

**Financing Plan:** Unrestricted core funds. ~~CAllocated core funding from EC;~~ collaboration with NARS in Egypt financed by EC and Egypt; ~~technical backstopping provided to NARS financed by IFAD;~~ collaboration with NARS in the Arabian Peninsula funded by the Arab Fund, IFAD and the OPEC Fund; funding for activities in Central Asia from the Asian Development Bank. Anticipated funding from IFAD for a regional program in on-farm water management; anticipated financing within the sub-regional action program (TN1) of the UNCCD. ~~African Development Bank, IDRC.~~

### **Project 3.2: Land Management and Soil Conservation to Sustain the Agricultural Productive Capacity of Dry Areas**

**Goal:** Sustainable management and conservation of land resources is improved in the dry areas of Central and West Asia and North Africa (CWANA).

*Indicator:* Adoption by producers of specific improved technologies and land management practices; reduced erosion.

**Purpose:** An integrated and transferable multi-scale approach to sustainable and productive dryland management is available for utilization by NARS.

*Indicator:* Approach is utilized by NARS, in participation with rural communities, in developing site-specific land management and conservation practices.

**Output 1:** Appropriate degradation hazard assessment methodologies developed.

*Indicators:* Land evaluation available for two pilot areas and methodologies applied in two pilot areas.

#### Milestones:

2002: Degradation hazards assessed for first pilot area.

2003: Site characterization, land evaluation and degradation hazard assessment completed for second pilot area.

2004: Multi-scale land degradation methodology established and published.

**Output 2:** Participatory and integrated approaches for dryland-management and research developed.

*Indicators:* Farmers trained in two pilot areas.  
Approaches available for use by NARS.

#### Milestones:

2002: Interdisciplinary research and management teams -including land users- developed and operational .

2003: Second pilot area (integrated research site) established and functional.

2004: Methodology for participatory problem analysis, project development and implementation established and published.

**Output 3:** Options for sustainable dryland management developed and tested.

*Indicator:* Options available and described for two pilot areas.

#### Milestones:

2002: Preliminary 'land-use systems-package' developed for second pilot area.

2003: Preliminary land-users' assessment of packages available.

2004: Methodology for participatory technology evaluation and selection established and published.

**Output 4:** Decision-support tools for dryland management developed.

*Indicator:* Results of scenario simulations available for one pilot area.

#### Milestones:

2002: Links between biophysical and socioeconomic system model components established.

2003: Conceptual model of land-use dynamics for second pilot area developed..  
Preliminary systems model developed.

2004: Methodology for site-specific land management technology development established and published.

**Output 5:** Strengthened capacity of NARS in dryland degradation assessment and integrated dryland development research.

*Indicators:* NARS scientists of five institutions trained.  
Functional professional exchange between scientists of different institutions in the mandate region.

#### Milestones:

2002: Short-term training program on integrated dryland management and research for all stakeholder groups developed.

2003: Dryland Management Exchange Forum functional.  
2004: Two collaborative research proposals developed.

**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:** ICRISAT, FAO, UNEP, WOCAT Consortium (Switzerland), CIHEAM (Spain), CIDA (Spain), DRC (Egypt), IRA (Tunisia), RSRI (Turkey), University of Aleppo (Syria), Olive Bureau (Syria), Atomic Energy Commission of Syria (Syria).

**Cost:**

2002: US\$ 0.89 million

2003: US\$ 0.92 million

2004: US\$ 0.96 million

**System Linkages:**

Output 3: Sustainable Production: 80%

Output 5: Enhancing NARS: 20%

**Financing Plan:** Unrestricted core. Donor allocated core from DFID, UK; land conservation supported by grant from INIA, Spain; restricted program funding from BMZ/GTZ.

### 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 and forage species and their associated rhizobia.

*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 and forage species and their rhizobia, in order to support the quest for germplasm with useful characters to be utilized in crop improvement programs of ICARDA and NARS.

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

*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.

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

#### Milestones:

- 2002: 150 accessions collected in strategic plant collection mission in one CAC country.  
Acquisition of 200 unique landrace accessions from CAC collections and the Vavilov Institute.  
90% of accessions held at ICARDA meet the international standards of seed quantity and viability.  
90% of accessions are held in the long-term base collections.
- 2003: 150 accessions collected in strategic plant collection mission in second CAC country.  
Acquisition of further 200 unique landrace accessions from CAC collections and the Vavilov Institute.  
The first viability monitoring of ICARDA's long-term collections 50% completed.
- 2004: 150 accessions collected in strategic plant collection mission in third CAC country.  
Acquisition of further 200 unique landrace accessions from CAC collections and the Vavilov Institute.  
The first viability monitoring of ICARDA's long-term collections completed.

**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:

- 2002: Germplasm collected in 2001 CAC mission characterized and evaluated in partnership with CAC NARS.  
Revised core collection of cultivated barley characterized by molecular markers.
- 2003: 350 accessions from CAC countries or VIR characterized and evaluated in partnership with CAC NARS and VIR.  
Lentil core collection characterized by molecular markers.
- 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.

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

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

Milestones:

2002: Wild Triticum core collection developed.

2003: Durum wheat core collection developed.

2004: Kabuli chickpea 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:

2002: Bread wheat lines with genes introgressed from hexaploid synthetics developed by ICARDA.

2003: Genetic basis of the new stripe rust resistance derived from *Triticum dicoccoides* identified.

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

**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:

2002: Regional workshop on policy, economics and property rights.

Tripartite review.

2003: Tripartite review.

2004: Tripartite review.

**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:

2002-04: One short-term group training course.

Scientists from CAC to visit and work at GRU for short period .

2003: Functional genetic resources unit in each of the CAC countries.

**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:

2002: Central Asia genetic resources database.

2003: Molecular marker data documented in a computerized system.

2004: CD-ROM catalog 'Durum wheat II'.

Database of wheat landraces conserved by VIR, ICARDA and Australia.

**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:

2002: 100% of incoming and outgoing seed samples tested.

2003: 100% of incoming and outgoing seed samples tested.

2004: 100% of incoming and outgoing accessions tested.

PCR tools for seed health testing developed.

**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, or to utilize germplasm in breeding programs.

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: 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.
- Assessment of threats to gene pools: NARS; ICRISAT; CIMMYT.
- Germplasm collection: NARS; ICRISAT; CIMMYT; CLIMA.
- 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 – Global *in situ* conservation project.
- Molecular characterization: Southern Cross University, Lismore, Australia; University of Birmingham, UK; University of Kyoto, Japan; INRA-ENSAM, Montpellier, France .

**Cost:**

2002: US\$ 2.78 million

2003: US\$ 2.89 million

2004: US\$ 3.00 million

**System Linkages:**

Output 2: Germplasm collection: 85%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core funds. Grant from GDRC, Australia, supports preservation and utilization of the genetic resources of the Vavilov Institute (VIR); financing from Global Environment Facility (GEF) for a collaborative project with NARS on conservation of agro-biodiversity in the Near East; collaboration with NARS in the Arabian Peninsula supported by the Arab Fund, IFAD and the OPEC Fund; SGRP grant supports ICARDA's participation in SINGER. Anticipated funding from ACIAR for collection and conservation of plant genetic resources of Central Asia; anticipated funding from GRDC to extend collaboration with VIR.

### **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:

2002: Digital archive of country-level climate parameter maps established.

2003: Digital archive of country-level land use/land cover maps established.

2004: Digital archive of country-level agroecological zones maps 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:

2002: Land suitability assessment for different crops in different parts of CWANA.

2003: CWANA map of potential biomass productivity.

**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:

2002: Comprehensive GIS projects for some countries in CWANA.

Agroecosystem maps for some countries in CWANA.

2003: Agroecological zones study of CWANA completed.

2004: Land degradation assessment of CWANA completed.

**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:

2002: All NRMP integrated research sites characterized.

Agroecological Atlas of Syria completed.

2003: Guidelines for multi-scale agroecological characterization prepared.

2004: Comprehensive study of the agroecology of the Arabian Peninsula completed.

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

*Indicator: Manual on guidelines for participatory agroecological characterization.*

Milestones:

2002: Final guidelines prepared for participatory agroecological characterization.  
Methodology tested in different ICARDA research sites.

2003: Publication covering 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:

2002: Training course on agroecological characterization.  
Comprehensive range of course modules prepared.

2003: Training manual published.

At least 15 NARS scientists trained in agroecological characterization techniques through joint project activities.

**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, Kazakstan, Morocco, Syria, and Uzbekistan.
- Agroclimatology: USDA-ARS, Lubbock, USA.
- Remote sensing: Center for Earth Observations, Yale University.
- Participatory agroecological characterization: Katholieke Universiteit Leuven, Belgium; North African NARS partners of the Mashreq-Maghreb Project.
- Training: CIHEAM, Zaragoza.

**Cost:**

2002: US\$ 0.81 million

2003: US\$ 0.85 million

2004: US\$ 0.88 million

**System Linkages:**

Output 2: Germplasm collection: 10%

Output 3: Sustainable Production: 75%

Output 5: Enhancing NARS: 15%

**Financing Plan:** Unrestricted core. Activities in the Arabian Peninsula supported by the Arab Fund, IFAD and the OPEC Fund; collaborative activities with NARS in North Africa supported by the Arab Fund and IFAD; collaborative activities with CIHEAM supported by CIHEAM; collaborative activities with Yale University supported by USAID Linkage Funds. Two Junior Professional Officers supported by Belgium.

## **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:

2002: Economic modeling of ground water use and irrigation technologies in Syria.

2003: Economic analysis of water management options in Kyrgyzstan.

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

2004: Economic analysis of the land use options and conservation practices of mountain terraces in Yemen completed.

**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: Economic modeling of the land use options in the Khanasser valley, Syria, completed.

2004: Economic modeling of micro-dams in the Barani area of Punjab province, Pakistan, completed.

**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:

2002: Characterization of resource users' perceptions and attitudes toward natural resource conservation technologies completed in one agro-ecological zone in CWANA.

2003: Characterization of resource users' perceptions and attitudes towards resource use and the institutional factors completed in Barani area of Pakistan, Kyrgyzstan, Syria and Egypt.

**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:

2002: Community collective action in mountains of Yemen evaluated.

2002: Farmers participation on the testing new income generating and land conserving practices in mountains of Yemen evaluated.

2003: Guidelines on participatory NRM research developed and provided to NARS.

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

**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:**

One training course in applying natural resources valuation methodologies conducted every two years.  
On the job individual training and training workshops organized every year.

**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 Développement 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).
- Christian Albrecht University, Kiel, Germany; Systemwide Programme on Participatory Research and Gender Analysis (SP-PRGA) convened by CIAT; Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria (INIA), Spain.

**Cost**

2002: US\$ 0.84 million

2003: US\$ 0.87 million

2004: US\$ 0.91 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 Spain; collaboration with NARS in Egypt supported by EC; grant for participatory research in natural resource management in Yemen from IDRC; funds made available by the IFAD supported Barani Village Development Project (BVDP) in Pakistan; restricted program funding from BMZ.

## **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 jointly by researchers and producers.

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

### Milestones:

2002: Production problems diagnosis and farm typologies study completed in the dry land farming systems of Punjab province, Pakistan.

**Output 2:** 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:

2002: Guidelines and methods for farmer participation in research developed.

2003: Study on the effects of farmers' socioeconomic characteristics, including gender, on the quality and outcomes of farmer participatory research completed in Syria, Yemen and Jordan.  
Analysis of farmers' decisions on land use changes using 5 years monitoring data in different agro-ecologies in Egypt and effects of these changes on the environment.

2003: Training workshop series on participatory research and gender analysis methods for improving the impact of agricultural research on the livelihood of rural people.

**Output 3:** Documented adoption, and feedback of user evaluations into the technology generation process.

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

### Milestones:

2002: Adoption of chickpea technology in Syria assessed.

2003: Adoption studies completed in Egypt, Pakistan, and Central Asia.

**Output 4:** Determinants of rural poverty and the farm household circumstances that may constrain or enhance the adoption of potential new technologies identified.

*Indicator:* Household studies.

### Milestones:

2002: Determinants of rural poverty in selected cases in the dry areas of CWANA (including western Anatolian region of Turkey, Khanasser valley of Syria, Mountains of Yemen) analyzed.  
Effects of socio-economic factors on the incidence of Lathyrism in Ethiopia.

2003: Analysis of the gender dimension of rural poverty by disaggregating rural livelihood systems in selected areas in the CWANA region.

**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 CWANA.

—*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:

2002: Assess the impact of participatory research in one project.

2003: An *ex ante* impact study on one technology completed in one agro-ecology .

**Output 6:** Evaluation of the economics of livestock production in the low rainfall areas of West Asia and North Africa.

*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:

2002: Completion of a synthesis report .  
Study on livestock marketing in Central Asia.

2003: Analysis of the economics of livestock production in the changing agricultural systems in the CWANA.

**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:

2002-04: 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. University of Massachusetts, USA; Yale University, USA.

**Cost**

2002: US\$ 1.18 million

2003: US\$ 1.22 million

2004: US\$ 1.27 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. Linkage with CGIAR SPIA (formerly IAEG).

**Financing Plan:** Unrestricted core funds. Allocated core funds from DFID, UK; studies on the adoption and impact of specific technologies supported under the respective projects; collaborative research with NARS in Mashreq and Maghreb regions financed by IFAD and AFESD; research on nutrition financed by USAID linkage funds; activities in Egypt funded by EC and Egypt; collaboration with Barani project, Pakistan, funded by IFAD; research in Central Asia funded by IFAD and Asian Development Bank.

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

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

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

**Purpose:** Improvement of national policies and institutions that influence agricultural investment 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 6 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 8 monographs analyzing property rights policies and their effects on land improvements, productivity, and incomes in the low rainfall areas of WANA.*

#### Milestones:

2002: Country reviews and synthesis review.  
Published book.

**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 describing the model building and evaluation of selected policy, property rights and technological options in communities in Algeria, Iraq, Jordan, Lebanon, and Libya.*

*Effects of property rights on land improvement, technology use and livelihood strategies in 16 selected communities in Algeria, Iraq, Jordan, Lebanon, Libya, Morocco, Syria and Tunisia.*

#### Milestones:

2001: Identification of the feasible policy, institutional and technical portfolio options.  
Revised actions plans including the comments of the workshop.

2002: Publication of the three monographs.  
Synthesis report on the effects of the above research.

**Output 3:** Identification and evaluation of property rights and local institutions options for sustainable management of rangeland resources in Jordan, Morocco, and Tunisia.

*Indicator:* Synthesis reports evaluating the likely welfare effects of different rangeland management institutional options on subgroups within the community (gainers and losers under each option) and the importance of institutional and market based feed access options for sustaining production and livelihood strategies.

#### Milestones:

2002: Publication of the proceedings of the international conference on institutional options for rangeland management in WANA.

**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:

2002: Completion of the collaborative research with the School of Rural Development and Planning, University of Guelph, Canada on the growing role of women in household livelihood strategies in the rural areas of Syria.

**Output 5:** Updates of ICARDA commodities, resources and system trends for more effective research targeting and priority assessment.

*Indicators:*

- Brief on barley production in West Asia and North Africa.
- Brief on Wheat production in West Asia and North Africa.

Milestones:

2002: Synthesis report on commodity and system trends.

**Duration:** 2 years.

**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 Mograne, 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:**

2002: US\$ 0.43 million

2003: US\$ 0.44 million

2004: US\$ 0.46 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:** Collaborative activities with NARS supported by the Arab Fund, CAPRi, the Ford Foundation, IDRC and IFAD. Collaboration with University of Guelph supported by CIDA's CCLF (CGIAR-Canada Linkage 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

- 2002: Publication of one training manual in English and one in Arabic.  
Publication of information on Seed Quality Assurance.
- 2003: Publication of one training manual in Arabic .  
Regional meeting organized for University teaching staff.
- 2004: Preparation of a teaching module for University courses .

**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.*

### Milestones

- 2002: Initiate new regional targeted at policy issues affecting the provision of seed to poor farmers.  
Hold 4th Network Council meeting to review progress of activities.  
Prepare draft seed law for West Asia sub-region.
- 2003: Draft seed legislation circulated to Governments for comment.
- 2004: Review status of National Seed Associations and consider options for establishing regional seed associations.

**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:

2002: Regional meeting held to review country studies and results and synthesis published.

2003: Monitor adoption of seed system recommendations in WANA countries.

2004: Publish review of recent seed policy changes.

**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:

2002: Policy recommendations made to governments and NGOs on the informal seed system and its integration with the formal sector.

Collaborate with participatory breeding initiatives to maximize use of PPB outputs.

2003: Monitor adoption of recommendations and provide specific guidance.

Monitor use of small-scale seed equipment by farmers.

**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:

2002: Maintain contacts with relief agencies to collect information .

2003: Prepare practical recommendations for seed supply in emergencies and for resettlement areas.

**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

2002: Results published depending on progress of research projects.

**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

2002: Seed requests from ICARDA programs and NARS supplied.

Review of SeedMan database operation.

**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 CWANA 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**

2002: US\$ 0.69 million

2003: US\$ 0.72 million

2004: US\$ 0.75 million

**System Linkages**

Output 3: Sustainable Production: 35%

Output 4: Policy: 45%

Output 5: Enhancing NARS: 20%

**Financing Plan:** Unrestricted core funds. Project grant from GTZ for studies of cost effective seed delivery to small farmers. Support currently being sought for WANA Seed Network and continuation of training activities.