ICARDA in the Arabian Peninsula

Ties that Bind

ICARDA

International Center for Agricultural Research
in the Dry Areas (ICARDA)

ABOUT APRP, ICARDA and CGIAR

The Arabian Peninsula Regional Program (APRP) of ICARDA serves the seven countries of the Arabian Peninsula, namely, Bahrain, Kuwait, Qatar, Saudi Arabia, the Sultanate of Oman, the United Arab Emirates, and the Republic of Yemen. The program addresses three priority themes: (i) rangelands, forage and livestock; (ii) protected agriculture; and (iii) water resources management. These themes are supported by research in agroecological characterization and stress physiology. Emphasis is also placed on institutional strengthening and capacity building, human resource development, and promotion of the use of information technology. APRP is financially supported by the Arab Fund for Economic and Social Development (AFESD), the International Fund for Agricultural Development (IFAD), and, more recently, the OPEC Fund for International Development.

ICARDA

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 15 centers supported by the Consultative Group on International Agricultural Research (CGIAR). ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean: all dry area developing countries for the improvement of on-farm water-use efficiency, rangeland and small-ruminant production; and in the West and Central Asia and North Africa (CWANA) region for the improvement of bread and durum wheats, chickpea, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national, regional and international agricultural research and development systems.

The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural Centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all. The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD) are co-sponsors of the CGIAR. The World Bank provides the CGIAR with a System Office in Washington, DC. A Science Council, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

ICARDA

International Center for Agricultural Research in the Dry Areas
(ICARDA)
Arabian Peninsula Regional Program (APRP)

ICARDA in the Arabian Peninsula

Ties that Bind
No. 25

Twenty years of collaboration in scientific agricultural research
for development between
the National Agricultural Research Systems of Arabian Peninsula
countries and ICARDA

2007

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Program Partners

Bahrain: Ministry of Municipal Affairs and Agriculture
United Arab Emirates: Ministry of Water and Environment
Kuwait: Public Authority for Agriculture Affairs and Fish Resources
Oman: Ministry of Agriculture and Fisheries
Qatar: Ministry of Municipal Affairs and Agriculture
Saudi Arabia: Ministry of Agriculture and Water
Yemen: Ministry of Agriculture and Irrigation

Program Donors

Arab Fund for Economic and Social Development (AFESD)

International Fund for Agricultural Development (IFAD)

OPEC Fund for International Development (OFID)

Gulf Cooperation Council (GCC)

French–Yemen Food Aid Program

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ICARDA's Regional Office in the Arabian Peninsula

ICARDA

ICARDA's activities in the Arabian Peninsula are coordinated by its regional offices in Dubai, United Arab Emirates and Muscat, Oman. Activities include on-farm water management, irrigated forage and rangeland management, highly intensive production systems (protected agriculture) and date palms. The emphasis is on strengthening national institutions, enhancing human resource capacity, technology development and transfer, and promoting information technology and networking. For detailed information please see www.icarda.org/aprp.

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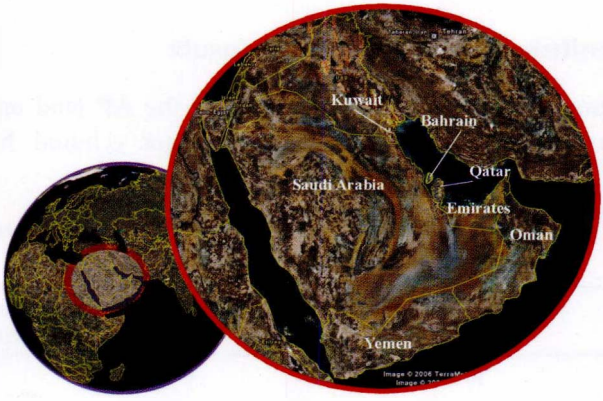
Our thanks are given to the Ministry of Water and Environment, United Arab Emirates and the Ministry of Agriculture and Fisheries of Oman for hosting ICARDA-APRP offices in Dubai and Muscat, respectively.

The valuable financial support of the Arab Fund for Economic and Social Development (AFESD), the International Fund for Agricultural Development (IFAD), and OPEC Fund for International Development (OFID) to ICARDA-APRP is gratefully acknowledged.

Thanks are also due to the French–Yemen Food Aid Program and the Gulf Cooperation Council (GCC) for their financial contribution to protected agriculture (greenhouse) projects in Taez, Yemen and the Date Palm Development Project, respectively.

1. The Region

The Arabian Peninsula (AP) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates or UAE, and Yemen) have a total land area of 3 million km2. They are characterized by arid and semi-arid climates. Rainfall is highly spatially and temporally variable, with annual precipitation of < 50 mm to 250 mm, although some areas in Oman and Yemen receive much more. Temperatures are generally high; some locations reach 50°C in summer when the relative humidity is also high. The soils of the region are fragile and subject to wind and water erosion, and degradation through salinization. Over 95% of the AP land area suffers from some form of desertification, and > 80% is classed as degraded due to wind erosion.



The region's population was 32 million in 2002 (WB[1] 2004), and with current annual growth rates of 2.0–6.9%, it is estimated to reach 64 million by 2025 and over 123 million by 2050 (Population Bulletin June 2007[2] ; Figure 1). The total commodity demands resulting from AP population growth has led to a rapid increase in

1 World Bank database (www.worldbank.org).

2 Population Bulletin, Vol 62, No.2 June 2007. Population Reference Bureau, Washington, DC, USA

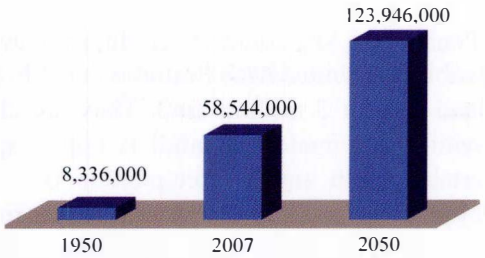


Figure 1. The population of the Arabian Peninsula, 1950 to 2050.
Source: Population Bulletin. June 2007.

food imports. Food imports are expected to more than double by 2010, if per capita consumption and domestic production do not change.

2. Agriculture in the Arabian Peninsula

Agricultural areas are limited to < 1% of the AP land area but consume about 86% of the available water (United Nations

Table 1. Water withdrawals in the year 2000 in the Arabian Peninsula (in 10^9 m^3/year)

	Agricultural	Domestic	Industrial	Total (summed by sector)
Bahrain	0.17	0.12	0.01	0.30
Kuwait	0.23	0.20	0.01	0.45
Oman	1.23	0.1	0.03	1.35
Qatar	0.21	0.07	0.01	0.29
KSA	15.42	1.70	0.20	17.32
UAE	1.57	0.53	0.20	2.31
Yemen	6.32	0.27	0.04	6.63
Total	25.12	2.99	0.50	28.65

FAOSTAT | © FAO Statistics Division 2007 | 24 September 2007

Table 2. Agricultural land in the AP countries (1000 ha)

	Agricultural area	Arable land and permanent crops	Country area
Bahrain	10	6	71
Kuwait	154	18	1,782
Oman	1080	80	30,950
Qatar	71	21	1,100
KSA	173,983	3,798	214,969
UAE	559	254	8,360
Yemen	17,734	1,669	52,797
	193,406	5,846	310,029

FAOSTAT | © FAO Statistics Division 2007 | 24 September 2007

Environment Programme[3]). On the peninsula as a whole, 80% of the cultivated area is irrigated. In this sub-region, with the exception of Yemen, the whole cultivated area is irrigated (FAO[4]). Water withdrawals in 2000 are presented in Table 1.

Bahrain, Kuwait, Qatar, and UAE have modest agricultural sectors; their cultivated areas are relatively small (Table 2) and scattered, and support a small proportion of the total population. Per capita food imports are consequently higher than in the more agriculturally oriented countries, with all cereals being imported, particularly wheat and wheat products. Agricultural production depends mainly on groundwater irrigation and to a lesser extent on winter rainfall (November–February). As for the countries with more substantial agricultural sectors, their agricultural production is constrained by severe biotic and abiotic stresses that include heat and salinity, as well as a lack of improved cultivars, cultural

3 Global Environment Outlook 3 – UNEP ●2

4 FAO, AQUASTAT, General summary Near East Region, Http://www.fao.org/nr/water/aquastat/regions/neast/index6.stm

practices, and trained labor.

Due to rapid economic development in the latter half of the twentieth century, the agricultural systems of the AP have changed dramatically. Increased production of crops and livestock has been significant. Though economic growth has been substantial, the increased production has often been at the expense of sustainable economic development and has often degraded natural resources. Modern irrigation technologies, such as center-pivot and drip irrigation, have enormously increased the irrigated area.

Yemen and Saudi Arabia have by far the largest agricultural labor forces. Crops range from cereal grains, melons and other fruits, to aromatic herbs and spices, coffee, and the stimulant 'Qat'. The main livestock are cattle, asses, camels, sheep, and goats.

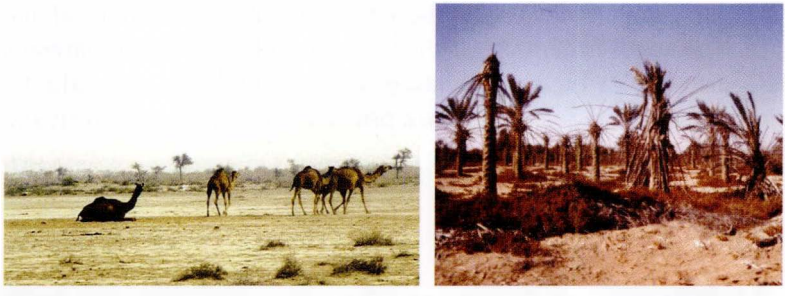
3.Challenges

The AP is a water-limited region with extreme aridity and limited renewable water resources. In most areas the annual precipitation is far below the potential crop water requirements. Hence, with the exception of a few areas in Yemen, all arable crop production requires irrigation. Another shortcoming of the region is that the renewable supply of water per capita is amongst the lowest in the world. According to World Bank , the average renewable water supply for the Middle East and North Africa is 1250 m^3 per capita per year; for the AP about it is 100 m^3, compared with a global average of 7260 m^3.

Of the 3 million km^2 land area of the AP, about 50% is rangeland, mostly in Saudi Arabia. Rangeland condition is very poor and in some areas well below the production potential. Large areas are classified as empty lands, and others have few species at very low densities. There are signs of deterioration of both the soil and plant

components of the rangeland ecosystem. Overgrazing is the main cause of rangeland deterioration, which is reflected in livestock feed shortages. In attempts to alleviate feed shortages, farmers have relied on growing exotic forages with high water requirements. Excessive use of groundwater has lowered water tables, increased salinity, and in severe cases led to croplands being abandoned. In 2003, the AP's arable and irrigated area was < 8 million ha (FAO 2004).

The AP is facing great challenges in developing more sustainable land use and efficient water usage, while preserving its environment and heritage with the current rate of population growth.



(Left) of valuable indigenous species and degraded much rangeland to low productivity. (Right) Extensive exploitation of groundwater has reduced water levels and caused saline intrusion in many coastal areas.

The issues of water management, productivity, sustainability, and environment are closely interconnected. If current inefficient practices continue, there will be rapid depletion of water resources, extinction of native species and knowledge of them, and rapid environmental destruction.

4. ICARDA in the Arabian Peninsula

Since its establishment in 1977, ICARDA has actively collaborated with the AP countries through technical backstopping with regard to its mandated crops and areas of research, exchange of germplasm, and human resource development through training and visits of scientists. In 1988, ICARDA began a special program for the AP countries; the emphases of this program are summarized below.

4.1. Strengthening Barley and Wheat Research and Training in the Arabian Peninsula (1988–1995)

The project concentrated on identifying cultivars of ICARDA's mandate crops suitable for the environmental constraints of the AP. The most important of these constraints are abiotic stresses associated with high temperature, water availability, and salinity. Although this project was aimed primarily at improving wheat and

H.E. Jassem Al-Bader (left) Public Authority for Agriculture A Kuwait and Dr Mahmoud Al-Solh (right) ICARDA Director General signing the Memorandum of Understanding between ICARDA and PAAAF on May 2007 during H.E. visit to ICARDA.

barley production, it served an important function in identifying priority needs and current gaps in agricultural research.

This project was supported financially by the Arab Fund for Economic and Social Development (AFESD).

4.2. Strengthening Agricultural Research and Human Resource Development in the Arabian Peninsula (1995–2000)

Goal: Increased food security in the AP, by increasing the productivity of field crops and livestock, based on the optimization of water use efficiency, conservation of natural vegetation, prevention of soil degradation and desertification, and strengthened cooperation among participating countries and relevant regional and international organizations.

ICARDA worked on the major agricultural problems facing the region, such as the scarcity of renewable water and inefficient water use; the degradation and resulting desertification of large rangeland areas of the region; and the need to develop an efficient protected agriculture industry for high quality high-value produce with reduced environmental and product contamination by agricultural chemicals.

The project was financially supported by the Arab Fund for Economic and Social Development (AFESD) and the International Fund for Agricultural Development (IFAD).

During this project, the program expanded its scope to the three themes of rangelands, water, and protected agriculture, in response to the collective priorities determined by the seven AP countries. Agroecological characterization was also emphasized, as it has a great impact on all three themes.

H.E. Dr. Mohammed Saeed Al Kindi (third from Water & Environment and Dr Solh (third from right) ICARDA DG during Dr Solh visit to UAE on Jan 07. Also presented at the meeting from right Mr. Mohamed Sager Al-Asam, Assistant Under Secretary for Water Resources Mr. Abdulla Ahmed Bin Abdel Aziz, Under Secretary (Acting), Dr Ahmed Mustaf
Range Ecologist, ICARDA-APRP.

In 1997, the ICARDA Office of the Arabian Peninsula Regional Program (APRP) was established. The office commenced with a senior scientist acting as regional coordinator, and was strengthened further in mid-1998 with the recruitment of the Protected Agriculture and the Water/Irrigation Specialists. In May 2001, a Rangeland Specialist was appointed. With this team of scientists in place more rapid progress was made toward the objectives of the three main research themes of (i) on-farm water use and irrigation management; (ii) rangeland, irrigated forages, and livestock; and (iii) protected agriculture.

4.3. Sustainable Management of Natural Resources and Improvement of Major Production Systems of the Arabian Peninsula (2000–2005)

Goal: Developing more productive and sustainable rangeland and irrigated production systems, including protected agriculture, through more efficient use of natural resources of the AP—in particular, water, energy, and indigenous plant species.

This Phase II of the APRP focused on the sustainable management of natural resources and improvement of the major production systems of the AP. The program was governed by a steering committee of representatives of the seven AP countries, ICARDA, and the donors. The program activities, which included research, were monitored through annual technical coordination meetings. During Phase II there were seven Regional Steering Committee Meetings (RSCM) and six Regional Technical Coordination Meetings (RTCM) in different participating countries and at ICARDA's HQ. The program was also assessed by a two-man IFAD mission in June 2005. The research outputs and activities during Phase II centered on applied research in the themes:

- Water resources management
- Forage/rangeland management
- Protected agriculture
- Agroecological characterization.

The project was financially supported by the Arab Fund for Economic and Social Development (AFESD), the International Fund for Agricultural Development (IFAD) and the OPEC Fund for International Development (OFID).

Dr Mahmoud Solh, Director General, ICARDA (left) receiving Dr Mohamed Ben Zaid Al-Julifi, Director General, National Agriculture Research Center; and Dr Khalifa Al-Melhem, HRD Consultant, Ministry of Agriculture, Kingdom of Saudi Arabia during the Saudi delegation visit to ICARDA in Dec. 2006 to pave the way for a major expansion of research collaboration.

Mar 2006, H.E. Sheikh Salim bin Hilal Al Khalili, Minister of Agriculture and Fisheries, Oman cutting the ribbon to inaugurate ICARDA office in Muscat with Prof Dr Magdy Madkour (right), ICARDA former ADG-IC; Dr. Ahmed Al Bakri, ADG for Agriculture Research and Extension, MAF Mr. Khatim bin Khamis Al Ma'amari, Director General of Agriculture, MAF and Dr Ahmed Moustafa, ICARDA-APRP Regional Coordinator.

4.4. Evaluation and Restructuring of Agricultural Research Systems in the GCC Countries (2004)

This evaluation was conducted in response to a request to ICARDA from the Gulf Cooperation Council (GCC) and was conducted by ICARDA-APRP. The study analyzed the current status, structure, and strategies of NARS in the Arab States of the Gulf. The outcome is especially important for national and international organizations concerned with agricultural research and development in the region for three main reasons:

- To enable NARS leaders to better assess their present research system and identify gaps, in comparison with other countries.
- To promote regional cooperation among the NARS of the GCC and with the international scientific community.
- To realistically present the weaknesses, constraints, and challenges facing the existing NARS structures.

4.5. Development of Sustainable Date Palm Production Systems in the GCC Countries of the Arabian Peninsula (2004–2009)

Goal: Developing productive date palm production systems that utilize modern technologies.

Date palm cultivation in the GCC countries has a long history, yet research efforts on this important crop are insufficient. There are several potential problems and constraints for the future of the GCC date industry: (1) plant density and cultivars, (2) crop management, (3) pests and diseases, (4) harvesting, processing, and marketing, and (5) researchers and technical staff

Research on date palms was ranked as a priority by the GCC countries during the ICARDA study on setting agricultural research priorities for the Central and West Asia and North Africa (CWANA) region, in March 2003. ICARDA organized the "Regional Workshop on Date Palm Development in the Arabian Peninsula", in response to a request from the six GCC countries. During the workshop the need emerged for an integrated regional research

Mar 2007, H. E. Khalf
of Agriculture and Fisheries (right) received Dr Mahmoud El- Solh, DG, ICARDA at his o

program to address problems with date palm production systems and to establish greater collaboration among the participating countries. Thus, a project proposal was developed with the following three components: (a) problem-solving research, (b) technology transfer, and (c) capacity building.The three components are interrelated, with the major objective being to improve the quantity and quality of date palm production.

The project is financed from Gulf Cooperation Council (GCC) contributions to the CGIAR.

4.6. Supporting Rural Development and Food Security in the Terraces of Yemen: Adoption of Sustainable Protected Agriculture Technology for the Production of Cash Crops in Taez Region (2005–2007)

Goal: Rural development by adopting sustainable production tech-

May 2006, visit to ICARDA biotechnology lab. From left H.E. Dr Abdelrahman Saeed, Minister of Science and Technology, Sudan; Dr Mouin Hamze Ex-ICARDA Board member, H.E. Mr Sultan Al-Dosari, Minister of Municipal Affairs and Agriculture, Qatar; H.E. Dr Adel Safar, Minister of Agriculture and Agrarian Reform, Syria; Mr. Abdullah Salem Al Sulaiteen Chairman of SAIC, Qatar; Eng. Abdul Aziz Al Harthy, Director of Crop Production Research Center, Oman; H.E. Khalfan bin Saleh Al Na'abi, Undersecretary of the Ministry of Agriculture and Fisheries, Oman and Dr. Dr Michael Baum, ICARDA Biotechnologist.

H.E. Sheikh Abdul-Rahman Ben Khalifa Ben Abdul Aziz Al Thani, Qatar Minister of Municipal Affairs Agriculture (right) met with Dr Mahmoud El Solh ICARDA Director General (left) H.E. visit to ICARDA on Mar 2007.

niques that utilize marginal lands and less water to produce high value crops, to increase rural incomes and employment opportunities.

Rainfed terraces are major producers of Yemen's food crops, but the returns to farmers are low. The low income from farming has contributed to a rural exodus, particularly by men seeking other employment, and consequently the maintenance and productivity of terraced lands has declined. Encouraging farmers to remain on the land has been successful only where irrigation water is available and cultivation of cash crops is possible.

Sheikh Dr Faleh bin Nasser Al Thani Director General of Agricultural Research and Development, MMAA, Qatar (center) discussing collaboration between ICARDA and Qatar on the establishment of Biotechnology and Protected Agriculture Centers in Qatar with Dr Mahmoud El Solh, ICARDA-DG (left Moustafa, Regional coordinator, ICARDA-APRP (Jan 2007)

The project promotes the adoption of affordable and sustainable protected agricultural systems in the mountain terraces of Yemen. Thirty-five simple greenhouses were installed at selected pilot sites with participating farmers. These use water more efficiently to produce high value crops.

Delegations from
May 2003. The GCC countries became a member of the CGIAR in 2003 and assigned their contribution to ICARDA for the development and implementation of Date Palm project. (Top photo) from right: Prof. Dr Adel El Beltagy former ICARDA Director General met with H.E. Mr. Mohamed Bin Fahad Al Fihani, Ass. Under secretary for Agricultural Affairs and Mr. Awaid Al Kawary, Director of Extension;, Ministry of Municipal Affairs
Al Na'abi, Undersecretary of the Ministry of Agriculture and Fisheries, Oman.
(Bottom photo) from right: Dr Abdulah Al Hindi, Director General, Agricultural Research and H.E. Dr. Abdullah Bin Abdullah Al-Obaid, Deputy Ministry for Agricultural Research, Ministry of Agriculture,Saudi Arabia.

The main objectives were to increase farmers' incomes through cash crop production in greenhouses and to increase water use efficiency, thereby enhancing the returns to farming, promoting the maintenance of terraced lands, and conserving the environment and natural resources. This will provide the basis for rural development and food security, among the main policies of the Government of Yemen. The main components are:

- Market and community surveys
- Technology transfer and adoption
- Socio-economic assessments
- Capacity building and training.

The project is financially supported by the French–Yemen Food Aid Program.

4.7. Technology Transfer to Enhance Rural Livelihoods and Natural Resource Management in the Arabian Peninsula (2007–2012)

Goal: Improved livelihoods of poor farmers and pastoralists in the

H.E. Dr Galal Ibrahim Fakirah former Minister of Agriculture and Irrigation, Yemen(left) Dr Mahmoud Solh, ICARDA Director General (right) in his office 2006) .

AP through the adoption of sustainable production and natural resource management technologies.

This project was designed to build on the results of the previous research projects on water use efficiency, irrigated forage, rangeland rehabilitation, and protected agriculture.

The technology packages developed during the previous projects (see Section 12 "Future collaboration and transfer of technology") would have positive impacts on welfare of poor farmers in the region and on the management of the natural resource base and the environment. The immediate project objectives are to:

- Test, evaluate, and disseminate improved technology packages that increase crop and livestock production and productivity, increase water use efficiency, and conserve rangeland resources.

Dr Ismail Muharram (left), Chairman of Agriculture Research and Extension Authority (AREA, Yemen and Dr. Ahmed T. Moustafa (middle), ICARDA-APRP Regional Coordinator presenting the GFAR Merit Award to H.E. Hassan Omar Swuid (left), former of Agriculture & Irrigation, in Yemen. The GFAR Merit Award (2003) was received during the Global Forum for Agricultural Research meeting held in Dakar, Senegal from poster presentation on successful partnerships in agricultural research for development, "Protected Agriculture in Yemen Mountain Terraces".

H.E. Rashid Khalfan Al Shariqi, former Under Secretary, Ministry of Agriculture and Fisheries, UAE discussing the collaboration between UAE and ICARDA with Dr Magdy Madkour (center), former Assistant Director General for International Corporation, ICARDA and Dr Ahmed Moustafa (Left)

- Enhance the capacity of national research and extension programs to promote both the adoption of the targeted technologies and communication among stakeholders.

Mr. Abdullah Salem Al Sulaiteen (left cultural and Industrial Complex (SAIC), Qatar and ICARDA former Director General Prof. Dr Adel El Beltagy (right) signing the Memorandum of Understanding between ICARDA and SAIC on May 2007 during Mr Al Sulaiteen visit to ICARDA

Strengthening the Cooperation

Through out the years, ICARDA and NARS in the seven Arabian Peninsula counties have built up a strong relationship among scientists and researchers.

This was strengthened by number of signed agreements (Ag) and Memorandum of Understandings (MoU).

May 2007	*MoU* with the Public Authority for AgriculturalAffairs and Fish Resources, Kuwait;
May 2006	*MoU* with Al Sulaiteen Agricultural and Industrial Complex, Qatar;
Jul2005	*MoU* with University of Sana'a, Yemen;
May 2005	*MoU* with Ministry of Agriculture, Saudi Arabia (for establishment of seed technology unit);
Dec 2004	*Agreement* with Ministry of Agriculture and Fisheries, UAE;
Aug 2004	*MoU* with Ministry of Agriculture and Fisheries, Oman (for establishment of seed technology unit);
May 2004	*MoU* United Arab Emirates University, UAE;
Apr 2000	*MoU* with Biosaline Agriculture Center;
Mar 2002	*MoU* with Ministry of Agriculture and Fisheries, UAE (for establishment of seed technology unit);
Jan 1999	*Agreement* with Kuwait Institute for Scientific Research, Kuwait;
May 1995	*Agreement* with Government of the Republic of Yemen;
Dec 1992	*Agreement* with Government of the United Arab Emirates; UAE.

5. Research Priorities of the Region

During the ICARDA-APRP Regional Technical Coordination Meeting in March 1996, NARS identified and ranked research priorities. The research priorities were ranked in the order presented in Table 3.

Table 3. Ranking of research priorities by national agricultural research systems

Activities	Countries							Rank
	Bahrin	Emirates	Kuwait	Oman	Qatar	S.Arabia	Yemen	
Water issues	1	1	1	1	1	1	1	1
Abiotic stress	2	2	7	2	2	2	2	2
Irrigated forages	4	3	2	4	3	3	3	3
Protected agriculture	3	4	3	3	5	4	4	4
Diseases/pests	5	5	4	5	4	5	5	5
Livestock	6	6	6	6	6	6	6	6
Agronomy	7	7	5	7	7	7	7	7

ICARDA-APRP Regional Technical Coordination and Steering Committee Meeting, ICARDA, Aleppo in March 1996

In 2002, ICARDA conducted a study entitled "Setting Agricultural Research Priorities for the Central and West Asia and North Africa Region". During this study, NARS of AP countries emphasized the importance of water, on-farm water use efficiency, protected

Table 4. Common priority research areas and themes in the Arabian Peninsula (in order of priority)

Priority research areas	Priority research themes
1. Water	• Water use efficiency; • Use of marginal water (treated waste water, brackish water); • Water harvesting.
2. Date palm	• Improving productivity/production; • Varieties – quality; • Pest management; • By-product utilization (feed, etc.); • Processing/post-harvest technologies; • Marketing (packaging for value-addition).
3. Protected agriculture	• Greenhouse design and efficiency (climate control, etc.); • IPPM* (production systems and soil-less culture); • Crop diversification (vegetables, fruits, herbs, and medicinals); • Production costs and marketing.
4. Genetic resource management and biodiversity	• Crop improvement (use of biotechnologies); • In-situ and ex-situ conservation; • Indigenous knowledge; • Bio-safety regulations.
5. Rangelands and forages	• Conservation of indigenous species; • Forage species with high water use efficiency and feed quality; • Rangeland rehabilitation and management; • Seed production; • Indigenous knowledge; • Agro-forestry.

6. Livestock	• Breed characterization; • Improvement (breeding); • Nutrition; • Health; • Marketing; • Production (milk, meat, by-products); • Feed calendar.
7. Crop–livestock integration	• Alternative sources of feed (feed blocks, cactus, etc.); • Integration of crop–livestock production systems.
8.Cross-cutting issues	• Information/dissemination and transfer of technology; • Indigenous knowledge; • Public awareness; • Environmentally-friendly operations/interventions; • Human resources development; • Socioeconomic studies (economic feasibility); • Policy.

** Integrated Production and Protection Management*

agriculture, genetic resource management, and rangelands/forages as high priorities for agricultural research and development. The responses are presented in Table 4.

6. Research Highlights

ICARDA has emphasized sound research techniques across the region. The importance of good experimental design and accurate measurements of parameters were incorporated in all experiments. All research and development activities were in close collaboration with the NARS of the seven AP countries. ICARDA put great ef-

fort into establishing a regional network through annual meetings, seminars, and workshops to connect local researchers and scientists, and also to attach them to other regional and international networks.

6.1. Germplasm development and exchange

During 1988–1994, the APRP provided AP countries with more than 700 sets of international and regional cereal, legume, and forage nurseries to evaluate under prevailing biotic and abiotic stresses. These nurseries were developed according to specific country needs.

Testing and evaluating the germplasm enabled the release of seven improved barley cultivars (two in Qatar, one in Saudi Arabia, two in Oman, and two in Yemen), nine bread wheat (one in UAE, one in Qatar, two in Oman, and five in Yemen), two durum wheat (one each in UAE and Saudi Arabia) and one chickpea in Oman.

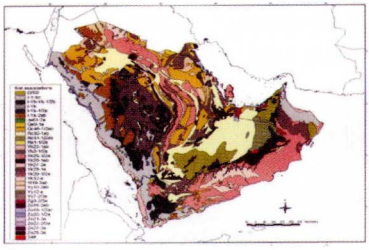
After the 1990/91 Gulf crisis, and upon a request from Kuwait, the wheat, barley, chickpea, lentil, and faba bean germplasm that was lost was replaced by ICARDA. Combined analysis of two seasons and two locations, for the wheat and barley trials grown at Al-Abdally and Al-Wafra in Kuwait in 1988–90 was performed with ICARDA's assistance.

Furthermore, based on another request from the University of Kuwait, special wheat and barley nurseries of germplasm adapted to drought and heat stresses were provided to initiate a graduate research program.Wheat and barley cultivars, germplasm tolerant to salinity and heat (including varieties 'Sakha 8' and 'Sakha 9'), and a barley variety tolerant to salinity were provided to Bahrain on request in May 1994.

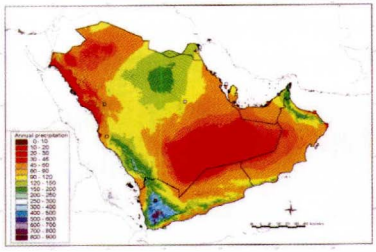
6.2. Agroecological characterization of the Arabian Peninsula

This work facilitated the other main research components within

the program. Because the environments and land use systems of the AP are so diverse, it is important that site-specific research is underpinned by adequate agroecological characterization in order to upscale the research results. The status of agroecological characterization in the AP countries was reviewed by ICARDA's Senior Agroclimatologist, to identify NARS research interests, potential



AP mean annual precipitation



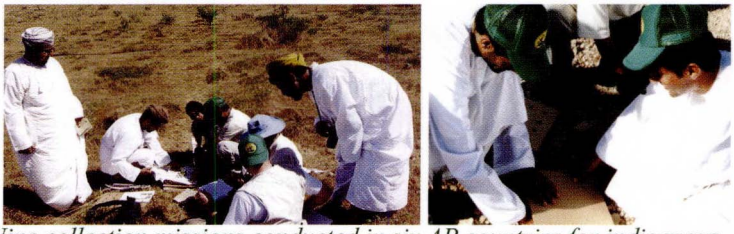
AP soil associations

partner institutions, training needs, and the available data. Based on this study, work was planned for exploratory agroecological characterization of the AP and for the development of a meta-database of land and water resources information. ICARDA published a book of the outcomes of the exploratory agroecological characterization of the AP, with a large number of color maps, figures, and information. The book is available on the ICARDA-APRP website at http://www.icarda.org/aprp/Agroecological_Exploration.htm.

6.3. Indigenous species of the Arabian Peninsula

The main aim of these activities was to arrest desertification, primarily caused by overgrazing, and also to conserve valuable natural resources. The AP native plant biodiversity of over 3500 species (Ghazanfar and Fisher 1998) is being rapidly depleted. Over 90% of the land area suffers from some form of desertification and 44% is severely or very severely degraded (UNEP 1992).

There were nine collection missions for major indigenous forage grasses, legumes, shrubs, and trees in UAE in 1998, in Oman in 1998 and 2001, in Bahrain in 2002, in Qatar from 1998 to 2004, in Saudi Arabia in 2002 and 2003, and in Yemen 1998. The ultimate objective was to utilize the most promising germplasm for rangeland rehabilitation and irrigated fodder production. The mission outcomes were collated in the book "Collection of Valuable Indigenous Plant Species of the Arabian Peninsula", which is available at http://www.icarda.org/aprp/ForgColl.htm.



Nine collection missions conducted in six AP countries for indigenous plant and shrub species

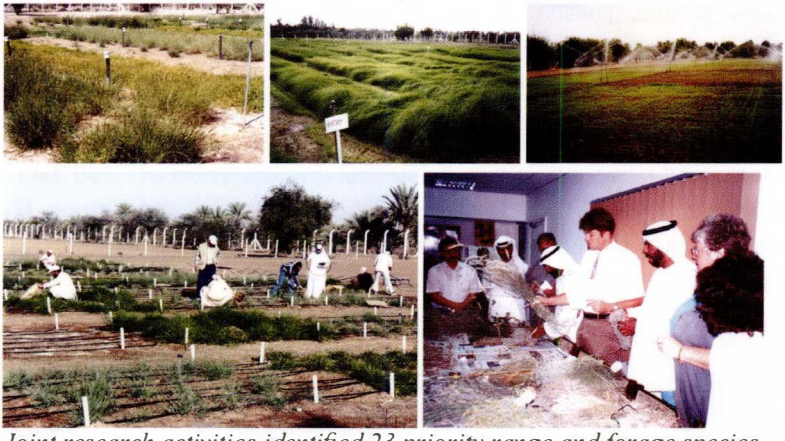
Collection and identification of 190 indigenous plant and shrub species.

6.4. Irrigated indigenous forage species and seed multiplication to increase water use efficiency and rangeland rehabilitation

A potential solution to water and rangeland problems in the AP is developing production and rehabilitation systems based on indigenous species, because they are already well adapted to the regional environments. Water use for irrigated forage may be reduced, compared to conventional forage species. Conventional species are

likely to suffer significantly if irrigation is reduced, in comparison to indigenous species.

Priorities of rangeland and forage grass species were identified in most AP countries following collection missions. These were as follows: *Panicum turgidum* and *Pennisetum divisum* in Bahrain; *Cenchrus ciliaris*, *Coelachyrum piercei, Lasiurus scindicus,* and



Joint research activities identified 23 priority range and forage species in AP countries

Shrub species were identified in northern Saudi Arabia. These included *Atriplex leucocladа*, *Salsola velosa, Salsola tetrandra, Atriplex halimus,* and *Tragnum nudatum.*

Buffel grass or Lebid (*Cenchrus ciliaris*) was identified as forage of high feed quality and high water-use efficiency; the forage can be harvested ten times a year, with an average annual dry matter yield of up to 20 t/ha. The water use efficiency of Lebid (the amount of water needed to produce 1 kg of dry matter) was 0.81–1.88 m^3 compared to Rhodes grass with 1.18–2.13 m^3.

The constraint of seed availability from these species was ad-

dressed in Bahrain, UAE, Oman, Saudi Arabia, and Yemen. UAE have made significant steps in seed production of *Cenchrus ciliaris* and *Lasiurus scindicus*, which allowed for forage demonstrations in farmer fields. Similarly, in Oman adequate seed production of *Cenchrus ciliaris* and *Coelachyrum piercei* enabled reseeding of rangelands in the interior region. Sixteen sites of 0.25 ha each were seeded. These sites will be monitored in the coming seasons for the effect on rangeland improvements. In the Al Jouf area of northern Saudi Arabia over 10 t of 40 species of shrub seeds were produced.

Seed production was enhanced by the establishment of Seed Technology Units (STU) in UAE, Oman, Saudi Arabia, and Yemen. By end of 2005 The STU in UAE produced more than 1000 kg of Buffel grass and more than 700 kg of Da'e seed.

Three Seed Technology Units were established in UAE, Oman, and Saudi Arabia.

6.5. Integrated production and protection management (IPPM) for high quality and healthy products from protected agriculture

The extensive use of chemicals to control diseases and pests in greenhouses results in complex problems of insect resistance, and health and environmental hazards. Crops can be protected by control measures that avoid heavy reliance on pesticides, thereby re-

Growing healthy cucumber plant using IPPM techniques, Rumais Agricultural Research Center , Oman

ducing use of hazardous chemicals. These control measures are part of an Integrated Production and Protection Management (IPPM) program developed by APRP and implemented in all AP research stations and in pilot private farms.

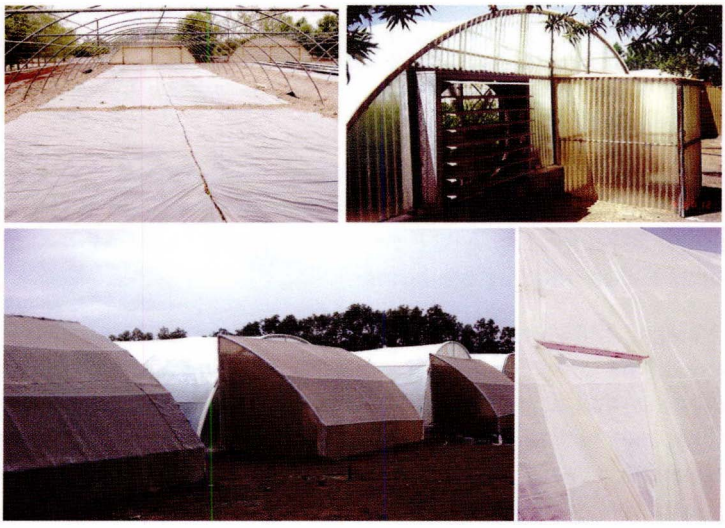
In Yemen, IPPM techniques were introduced and successfully practiced by growers, which involved keeping the relative humidity low and using irrigation sparingly. Plants were strong and healthy, and had low incidences of pests and disease. The crops were sprayed twice with a safe chemical, compared with the six applications typical in plastic houses without IPPM.

As a part of the IPPM program, soil solarization techniques were developed and simplified for growers and a techni-

cal booklet published. The technique was implemented on research stations and private farms with excellent results, avoiding the use of hazardous chemicals. The booklet is available at http://www.icarda.org/aprp/PDF/slz2.pdf.

Applying IPPM techniques for protected agriculture resulted in:

- 80% reduction on agrochemical use in protected agriculture greenhouses in Yemen
- 61% increase in yield in Oman
- 45% increase in greenhouse grower incomes in Yemen
- 15% increase in grower cucumber production in Oman
- > 50% water saving in all AP countries.



A number of IPPM techniques, (top left) soil solarization, (top right) using double doors and (bottom) using insect proof nets for cooling and ventilation openings

6.6. Increasing water use efficiency with soil-less culture in greenhouses

The quantity and quality of water required to produce high value crops is practically impossible to obtain in a dry region such as the AP. The underground water level has rapidly declined and the water has increasing salt content. Expensive desalination is necessary for good quality fresh water.

Producing high quality cash crops using an open system soil-less culture

Soil-less techniques can improve water use efficiency, and water and fertilizer management in crop production. The main objectives are to increase yield quality and quantity per unit of water, area, and manpower. The soil-less growing techniques developed and adapted by ICARDA are being adopted in AP countries.

Producing high quality cash crops using a closed system soil-less culture

High-density cropping or vertical soil-less cultivation is an excellent system for high-value production, such as herbs, green vegeta-

bles, and fruit. The system uses a tower of interlocking stackable Styrofoam pots, which have drainage holes and are filled with soilless media. Nutrient solution is collected in catchment channels under the lowest pot and re-circulated. The system was adapted for strawberry production in marginal and non-productive lands in Kuwait, Oman, Saudi Arabia, and Bahrain. The vertical expansion increases the productivity per unit area. Planting and harvesting is much easier and capital outlay per plant will progressively decrease.

Since the year 2000, ICARDA has conducted several collaborative adaptive research and agro-economic studies with NARS scientists in AP countries, with promising results. Yields were increased significantly and productivity per unit water increased by > 70% compared to soil-based systems. Thus growers could increase their production area without requiring more water.

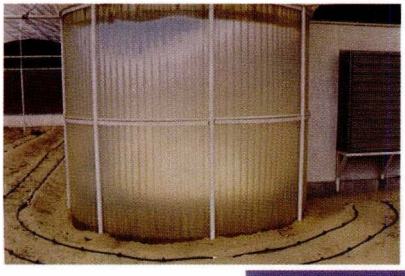
Transfer of this technique to growers has begun in Kuwait and Oman through on-farm research, with nine growers in Kuwait and one in Oman adopting the system. Strawberry production using the vertical hydroponics system was highly successful, with sev-

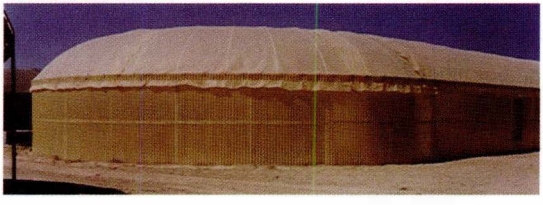
eral advantages over traditional soil-beds. In Kuwait the benefits were:

- 463% increase in yield
- 700% increase in crop density
- 98% reduction in water consumption
- 63% reduction in fertilizer consumption
- 59% reduction in production costs.

6.7. Improved greenhouse design for better cooling and saving water

A simple and new oval design of greenhouse was developed and constructed in Bahrain. This greenhouse was constructed from two single span greenhouses connected by a circular structure on both ends as a closed system. Cooled air from each house end is directed to the wet pad of the other house. To reduce relative humidity, air is condensed on copper pipes circulating relatively cold water. The oval shape provides extra crop protection, the ability to economically inject additional CO2, an improved cooling system, and recovery of fresh water from the enclosed area.

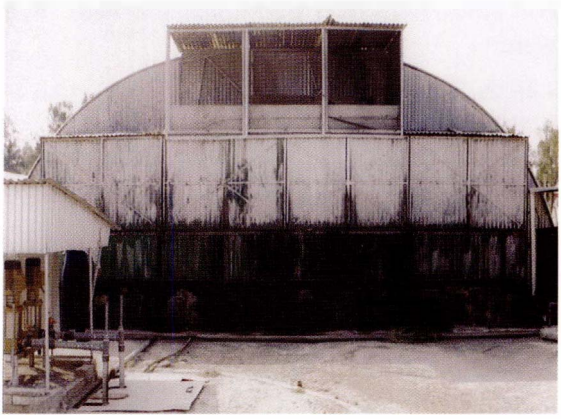




Testing of oval shaped greenhouses in Bahrain

To study different types of cooling system, another experiment was carried out at Al-Rabiya Research Facilities, Kuwait. Four cooling systems were tested: (1) positive pressure with lower air intake; (2)

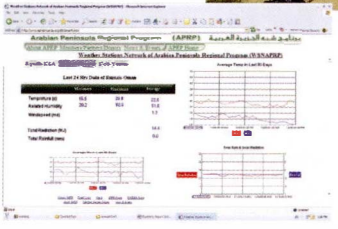
negative pressure with lower air intake; (3) positive pressure with upper air intake; and (4) negative pressure with upper air intake. The main objective was to evaluate evaporative cooling systems for climatic control at specific temperature and relative humidity. Economic analysis rated positive pressure with lower air intake cooling systems as most profitable followed by positive pressure with upper air intake.



Study to improve greenhouse cooling system structures

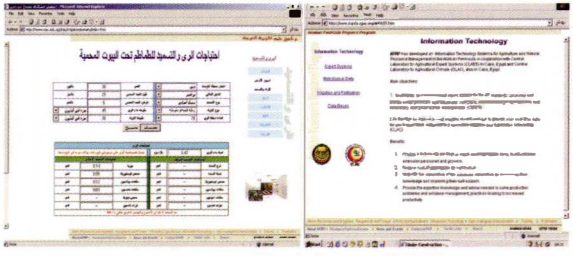
6.8. Development of an automatic weather station network

Eleven automatic weather stations were supplied and established across the AP countries at pre-specified locations. The units are linked in a network with live Internet access, providing water requirements and irrigation schedule information using near real-time data (see http://www.icarda.org/aprp).



6.9. An expert system for crop protection and fertigation management

An "expert system" is a computer program combining experimental and experiential knowledge with the intuitive reasoning skills of many specialists to aid growers, extension agents, and researchers in making decisions about crops and management. The benefits of expert systems include:



1. An easily understood technology package for researchers, extension agents, and growers.
2. A reduced cost of information dissemination.
3. Upgraded capacity of extension agents, by improving their knowledge and self-esteem.

4. The expertise, knowledge, and advice needed to solve production problems, enhance management practices, and so increase productivity.

ICARDA-APRP in cooperation with the Central Laboratory for Agricultural Expert Systems and the Central Laboratory for Agricultural Climate in Egypt developed two expert systems for crop protection in protected agriculture and fertigation management. These expert systems can be found at http://www.icarda.org/aprp/IT.htm.

7. Success Stories in Technology Development and Transfer

7.1. Production of valuable indigenous species for rangeland rehabilitation and animal fodder

The seed of indigenous plants and shrubs, collected in ICARDA-APRP missions, was multiplied. The quality and quantity of seed multiplication of indigenous plants was addressed by research activities, especially in UAE, Oman, Qatar, and Saudi Arabia.

Seed multiplication fields for indigenous rangeland species and

Seed multiplication in Oman and UAE

shrubs were established, particularly in Bahrain, UAE, Oman, Saudi Arabia, and Yemen. In 2003, > 10 t of seed from 40 shrub species was produced at Al Jouf in Saudi Arabia. In Bahrain, UAE, Oman, and Yemen the NARS produced 62 kg of seed of different indigenous species, in collaboration with ICARDA.

7.2. Indigenous species for rehabilitation of degraded rangeland in Oman, Qatar, and Saudi Arabia

The seed multiplication process enabled ICARDA and NARS to produce sufficient seed to commence rehabilitation activities at a number of degraded rangeland sites in Oman, Qatar, and Saudi Arabia. There were very promising results. In Oman, 2000 m^2 of an unprotected site in a wadi was re-seeded with Cenchrus ciliaris (Buffel grass) seed during December 2002. The average plant density was 2.79 and 6.78 plants/m^2, respectively, three and nine months after re-seeding. This experiment was extended to 20 more sites in the interior of Oman during winter in 2004.

7.3. Introducing Buffel grass to growers in UAE

Buffel grass or Lebid (*Cenchrus ciliaris*) was identified in UAE as a forage offering high quality feed and water use efficiency. The forage can be harvested ten times a year, with dry matter yield of up to 20 t/ha. The water-use efficiency of Lebid (the amount of water needed to produce 1 kg of dry matter) is 0.81–1.88 m^3, compared to Rhodes grass with 1.18–2.13 m^3. Irrigated Rhodes grass is widely used as forage in the UAE and other AP countries. To demonstrate the new forage to farmers, in September 2004 APRP and the Ministry of Agriculture started a collaborative program of field verification in the central agricultural region and the Al Ain area, where five farmers and three government farms grew the new forage in relatively large areas (2,000-10,000 m^2). The

Buffel grass as indigenous fodder in UAE

growers were provided with seed and a published field guide on producing the forage, and visited regularly by the APRP forage specialist and Ministry extension officers. After proving successful, increasing numbers of farmers in central agricultural region in UAE are requesting introduction of Buffel grass.

7.4. Rangeland rehabilitation in Wallan in association with the local community

In Yemen, rehabilitation efforts continue in Wallan community rangeland where 20,000 m^2 is being planted with four shrubs, uti-

Six rangeland sites in Oman reseeded by bulk seeds produced by Oman STU. In Wallan, Yemen, a community rangeland (20,000 m^2) planted with shrubs using different water harvesting techniques. The pasture productivity increased from 0.5 t/ha in 2003 to 1.8 t/ha in 2005.

lizing different water harvesting techniques. Pasture productivity has increased from 0.5 t/ha in 2003, to 1.8 t/ha by June of 2005. The dominant species are: *Andropogon greenwayi, Chrysopogon plumulosus, Cenchrus ciliaris*, and *Tetrapogon villosum*. The rehabilitation activity is carried out in close collaboration with local communities

7.5. Increasing farmer incomes in Yemen mountain terraces through protected agriculture

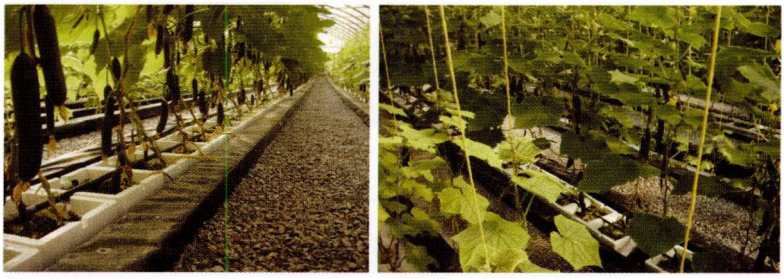
To elevate poor farmer incomes in the mountain terraces of Yemen, the cultivation of cash crops in simple greenhouses was introduced. Using a participatory approach, a number of greenhouses were established in farmers' fields in different locations. Drip irrigation was novel and of interest to farmers under terrace conditions, due

Thirty-eight small farmers adopted the protected agriculture techniques to produce high quality cash crops in Yemen, resulting in up to 400% increase in farmer incomes.

to water scarcity. The intensive production system allowed poor farmers to produce high quality vegetable crops with less water. Their income significantly increased, as well as production per unit of water and area. Cost–benefit analysis indicated that the total cost of greenhouses could be recovered within three seasons. Several farmers in each location were interested in investing in greenhouses.

7.6. Soil-less production techniques for high quality crops with less water

Simple soil-less closed systems were introduced and adapted for one grower in Oman, who had found that cucumber plants were dying prematurely or becoming very unproductive. A preliminary study showed salt contamination in soil was the cause. In collaboration with NARS, ICARDA established a soil-less system in the grower's three greenhouses. The result was promising, and after three seasons the grower is planning to increase the number of greenhouses with the soil-less system.



Producing high quality cucumbers with a soil-less closed production system in Oman

The vertical soil-less growing technique has been studied for the last four years in research stations in Oman and Kuwait. After proving successful, the technique is being transferred to farmer

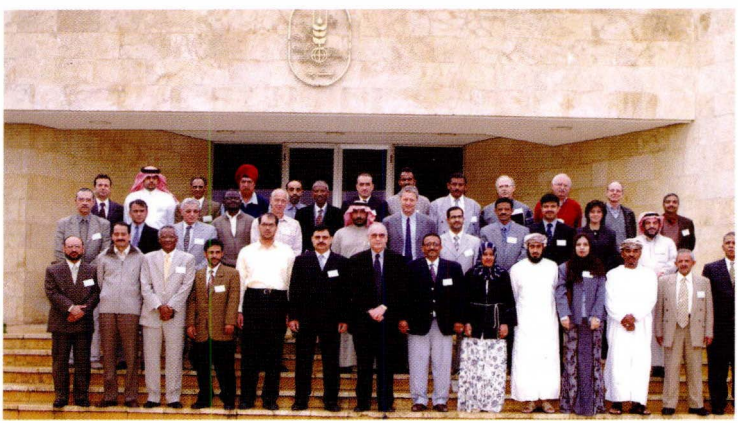
fields. ICARDA-APRP and NARS are collaborating in providing necessary support and technical backstopping for those growers wishing to adopt the system.

8. Coordination and the Network

All ICARDA's AP projects and activities are governed by Regional Steering Committee Meetings (RSCM). The RSCM involves the National Coordinators of AP countries, ICARDA's Assistant Director General-International Cooperation , donor representatives, the ICARDA regional coordinator, and ICARDA scientists. The RSCM are held once a year to review, amend, and approve annual work plans and budgets in one of the AP countries. The Regional Technical Coordination Meetings (RTCM) are also held annually in one of the participating AP countries. During the RTCM, the scientists, extension agents, and other end-users from national institutions and ICARDA review the past year's results and finalize work plans for the coming season. During the RTCM, annual work plans and budgets are developed jointly by ICARDA scientists and NARS, based on proposed action plans. ICARDA is responsible for reviewing the proposals and action plans, finalizing the annual work plans and budgets, and providing the final documents for RSCM approval.

Participants at the APRP Regional Technical Coordination Meeting in Kuwait in 2002

APRP Regional Technical Coordination Meeting held at Sana'a, Yemen in 2002



APRP Regional Technical Coordination Meeting held at ICARDA HQ, Aleppo, Syria in 2003

Participants at the APRP Regional Technical Coordination Meeting, Muscat (Oman) in Feb 2005

Participants at the APRP Regional Technical Coordination Meeting opening session, Muscat (Oman), in Dec 2005

A major program achievement was a strong network among scientists and researchers that has been continuously praised by the researchers and government officials of AP countries. During Phase II, ICARDA-APRP organized two consultation meetings, seven RSCM, and six RTCM. The program meetings, conferences, and workshops have been important in strengthening collaboration and understanding among NARS scientists and researchers in the AP.

9. Capacity Building and Human Resource Development

ICARDA has emphasized human resource development since its establishment in 1977. The human resource development program includes general training of members at ICARDA HQ in Aleppo, and specialized training programs in different regions or countries. Up to December 2005, ICARDA had trained 715 individuals from the AP in 142 training courses. These courses include short-term in-country and HQ training and on-the-job training, as well as MSc and PhD programs.

Based on program interests and NARS requests, ICARDA-APRP implemented 8 specialized training courses (1-2 weeks) for 107 and 9 individual on the job training program (1-3 months) for 29 AP scientists and researchers in 2001–2005. As a result, researchers' capabilities—in terms of designing and conducting experiments, writing papers, and presenting research results—have improved considerably.

Table 4- List of ICARDA-APRP training courses from 2001 to 2005

Training courses	No. Participants
1) Field Propagation and Management of Forage Cactus (Sep&Oct05)	15 *1 week*
2) Soilless Culture, Irrigation & Fertigation Management in Protected Agriculture (Jan05)	12 *1 week*
3) On-the-Job Training Course on Green House Management (Apr-Jun 05)	2 *2 months*
4) Development of Project Proposals , Scientific Writing and Data Presentation (Jan 05)	16 *1 week*
5) On-the-Job Training on Maintenance and Operation of a Seed Technology Unit (Sep 04)	1 *1 week*
6) On-the-Job Training Course on Green House Management, Muscat, Oman, Nov. 2005	2 *3 months*
7) On-the-Job Training Course on Protected Agriculture & Green House Management, Doha, Qatar, March - May 2004	2 *2 months*
8) On-the-job training course on vertical soilless growing systems for production of strawberry Oct04	5 *1 week*
9) Specialized course for on-line bio-computing Dec03	3 *1 week*
10) On-the-Job Training Course On Green House Management, Doha, Qatar, June-August 2003	2 *3 months*
11) Seed Production and Processing of Indigenous Forages Jul 02	15 *1 week*
12) Information Technology For Natural Resource Management In The Arabian Peninsula (ITAP) Weather Station Network And Expert Systems Jun 2002	14 *1 week*

13) Solarization & Integrated Management Of Green-houses Jun 01	22 *1 week*
14) Collecting and Utilizing of Local Plant Genetic Resources, Yemen Mar 01	13 *1 week*
15) Forage and range germ plasm collection in Dhofar, Oman Nov 01	10 *1 week*
16) On the job training course on GH management, Dubai, Nov 2000 to Feb 01	1 *3 months*
17) On the job training course on GH management, Dubai, Feb-May 01	1 *3 months*
Total Participnts	136

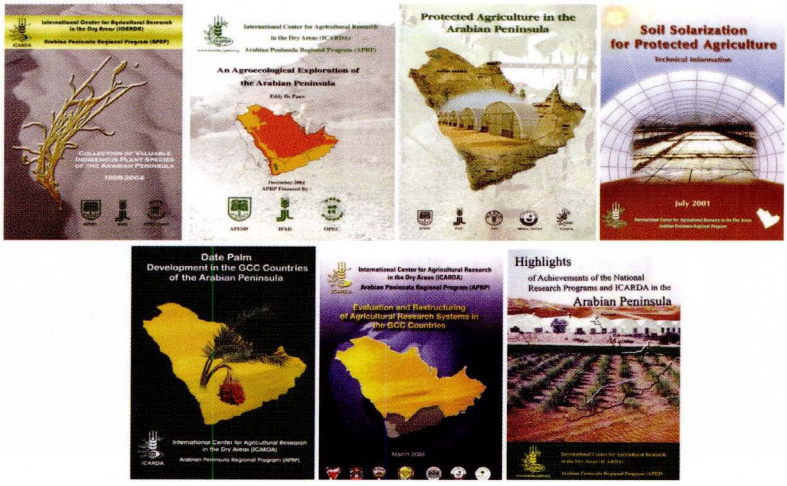
10. Publications

The ICARDA-APRP has published the following, and all are available on the ICARDA-APRP web site at http://www.icarda.org/aprp/Publications.htm:

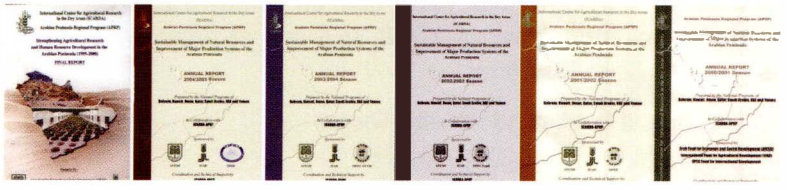
- 11 technical books and advisory notes
- 24 scientific papers and articles

- 5 posters
- 4 training manuals
- 6 multimedia and CDs
- 10 work plans, project documents and annual reports
- 7 steering committee proceedings
- 34 consultant reports
- 168 reports by NARS to RTCM.

Technical Books and Advisory Notes



Annual and Final Reports



Posters

11. Workshops and Expert Consultation Meetings

ICARDA implemented several important workshops and meetings in the AP, which originated new ideas, changes, or projects for the region. These events are outlined below:

11.1. International Workshop on Protected Agriculture in the Arabian Peninsula, 15-18 February 1998, Doha, Qatar

This workshop was the first of its kind, and addressed the limitations, constraints and potential of protected agriculture in the region and reviewed the state-of-the-art of the technology. It was organized by the APRP and financially supported by AFESD and IFAD. International experts in different aspects of protected agriculture, together with AP-country regional experts, research-

ers and specialists attended, exchanged information, and discussed the present and future for AP protected agriculture.

There were 16 national scientists and 15 international and regional experts that attended. The participants gave 21 presentations, in four themes:

- Greenhouse design, structure, and covering materials
- Water-use efficiency, fertigation, and post harvest technology of growing systems
- Integrated plant production and protection
- Regional networking to exchange experience and information.

Participants in the first International Workshop on Protected Agriculture in the Arabian Peninsula, 15–18 February 1998, Doha, Qatar

11.2. Expert Consultation Meeting on Integrated Production and Protection Management (IPPM), 16 –18 Oct 2001, Dubai, UAE

Thirty-five scientists and researchers from different international and regional organizations, as well as NARS of seven AP

countries attended this meeting to discuss and review the IPPM techniques to be implemented in the AP.

Participants in the Expert Consultation Meeting on Integrated Production and Protection Management, 16–18 October 2001, Dubai, UAE

Greenhouse environments are characteristically warm and humid, with low air velocities. These conditions are ideal for plants, as well as for pests and diseases. Since most greenhouse crops are of a high commercial value, any slight damage by pests and diseases can significantly reduce market value. The extensive use of chemicals in disease and pest control complicates problems of increased resistance, and health and environmental hazards. Natural enemies are often killed along with the pests by non-target-specific chemicals. A healthy plant can usually withstand pest attack better than a stressed one, which can be achieved by applying other control measures that reduces the use of hazardous chemicals.

IPPM is a modern approach for greenhouse management, equivalent to Integrated Pest Management (IPM) as applied in the open field,

and is a priority research topic for APRP. IPPM aims at improving greenhouse management and crop protection using less chemical pesticides for healthy, vigorous, and chemical-free crops.

11.3. Expert Consultation Meeting on Greenhouse Cooling and Ventilation in Arabian Peninsula, 20–21 January 2002, Kuwait

ICARDA-APRP implemented an expert consultation meeting in Kuwait to discuss and review the local activities and experiments in greenhouse ventilation and cooling management in the AP countries, and for international experts to review the state-of-the-art. In total, 38 scientists and researchers from international organizations and NARS of seven AP countries participated. There were eight presentations in the technical sessions, led by international scientists from the FAO; the Central Laboratory for Expert Systems and the Central Laboratory for Agricultural Climate, both of Egypt; the University of Hanover of Germany; Al Ain University of UAE; and the Silsoe Research Institute of the UK.

Expert Consultation Meeting on Greenhouse Cooling and Ventilation in Arabian Peninsula, 20–21 January 2002, Kuwait

11.4. Regional workshop on "Agricultural Research Systems and Strategies in the GCC Countries", 23–25 February 2004

This workshop at ICARDA HQ was collaboratively organized by ICARDA-APRP and the GCC, in response to GCC requests for analyses of agricultural research systems and strategies. Twenty-one participants from GCC countries, the GCC General Secretariat, and ICARDA staff attended. During the workshop, representatives from GCC countries (Bahrain, UAE, Oman, Qatar, and Saudi Arabia) presented their agricultural research status and structure. The presentations were followed by discussions on developing collaborative research within GCC countries.

11.5. Development of Sustainable Systems of Date palm in the Arabian Peninsula, 29–31 May 2004, Abu Dhabi, UAE

The workshop was organized by ICARDA and the Ministry of Agriculture and Fisheries of the UAE, in collaboration with the UAE University (UAEU) and the General Secretariat of the GCC. Over

70 researchers, date palm specialists, and experts were invited. These participants represented ICARDA, GCC countries (Bahrain, UAE, Kuwait, Oman, Qatar, and Saudi Arabia), Yemen, Egypt, Iran, Morocco, Sudan, Tunisia, and the USA, and also included representatives of FAO, UAEU, and the Arab Authority for Agricultural Development (AAAD). Fifteen scientific papers and seven AP country reports were presented.

There were group discussions involving the individual scientists, specialists, and GCC country representatives, who were organized into five major teams. The teams listed priorities for future research and development on date palm in the AP.

12. Future Collaboration and Transfer of Technology

The achievements of ICARDA in the AP are demonstrated by the useful technology packages developed by APRP in rangeland rehabilitation, irrigated forages, on-farm water management, and protected agriculture. ICARDA-APRP adopted and tested the developed technology packages at a number of pilot private farms although these have not yet been fully transferred to a wider range of poor farmers and end-users

The technology packages would have positive impacts on welfare of poor farmers in the region, and on management of natural resources, and the environment. To fulfill these goals and objectives AFESD, IFAD, and OFID are funding a new ICARDA-APRP program to transfer these technologies to end-users and for further development. The packages include:

1. Promoting an integrated production system for indigenous forage species with high water use efficiency for AP farmers.
2. Developing an integrated production system for spineless forage cactus.
3. Enhancing adoption of new forage and rangeland production systems by providing large quantities of seeds of suitable species.
4. Developing participatory technology for rangeland rehabilitation through water harvesting and re-seeding techniques.
5. Increasing adoption of IPPM for high quality cash crops, reducing pesticide residue and hazardous chemical use.
6. Increasing adoption of high intensity techniques for more water use efficient production of high quality cash crops.

During the new APRP program, ICARDA will continue to seek

new horizons for supporting agricultural development and natural resource management in the Arabian Peninsula, through scientifically sound research and development activities. As in our previous work, modern state-of-the-art technology will be used to achieve this important goal.

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