ICARDA Caravan
Issue No. 20/21 June/December 2004

ICARDA

Review of agriculture in the dry areas

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Caravan

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About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 15 centers supported by the 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 the Central and West Asia and North Africa region for the improvement of bread and durum wheats, chickpea, pasture and forage legumes, 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 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 cosponsors 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.

***Cover Photo*:** The ultimate objective of ICARDA's work is to improve food production to alleviate hunger and poverty in the poorer sections of the communities in the dry areas. Here, a woman makes *tannour* bread in a traditional way in Syria from a new wheat variety, developed by ICARDA in collaboration with the Syrian national program, and now widely grown by farmers.

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From the Director General

The next decade is critical for all stakeholders in development if the Millennium Development Goals (MDGs), especially halving poverty and hunger by 2015, are to be met. The challenges are even greater for the world's dry areas where the harsh environmental conditions make agriculture difficult and threaten the livelihoods of millions.

To support the developing countries achieve the MDGs, ICARDA, in 2004, redesigned its research strategy to focus more on poverty alleviation. The 19 research projects, on which the Center's research portfolio was built, were consolidated into six mega-projects for better coherence of research activities. The six mega-projects are: (i) management of scarce water resources and mitigation of drought; (ii) integrated gene management: conservation, improvement and sustainable use of agrobiodiversity; (iii) improved land management to combat desertification; (iv) diversification and sustainable improvement of rural livelihoods; (v) poverty and livelihoods analysis; and (vi) knowledge management and dissemination for sustainable development. In addition, ICARDA is the convening Center for a CGIAR System-wide Eco-regional Program: "Collaborative Research Program for Sustainable Agricultural Development in Central Asia and the Caucasus."

Water scarcity is a key characteristic feature of dry areas. Most of the countries with massive dry areas are located in ICARDA's eco-regional geographic mandate area—the Central and West Asia and North Africa (CWANA) region. At least 15 countries in CWANA are already below the "water poverty line." Renewable water resources are limited and rainfall is highly variable and unpredictable. To improve the management of the scarce water resources and to mitigate drought, ICARDA is assessing the available water resources, including precipitation, surface water, ground and marginal water, and developing technologies to increase water-use efficiency on the farm.

Several food, feed, and horticultural crops originated in the CWANA region and their wild relatives and landraces are still found in the area. Having survived for thousands of years in dry, harsh conditions of the region, these genetic resources represent a treasure of useful genes. But, rising populations and degradation of agricultural land is causing their erosion. The global climate change is predicted to make the dry areas of CWANA even drier and hotter, and add to the threat of genetic erosion. ICARDA is working to identify useful genetic resources for use in crop breeding for stable and increased yields and improved nutritional quality, as well as to conserve them for use by future generations.

The CWANA region encompasses a range of agro-ecosystems that have evolved in an environment of climatic extremes. Much of the land is prone to degradation. Some degradation occurs naturally, but in many areas the degradation is accelerated by human activities. They include overgrazing of rangeland, inappropriate land management that encourages soil erosion by wind and water, inappropriate irrigation management leading to salinization, and degradation of the natural vegetation biodiversity. ICARDA aims to identify options for rehabilitating degraded land resources and, at the same time, improve and strengthen systems of land management to control degradation and sustain future production.

However, the challenge of sustainable livelihoods of the people in marginal dry areas cannot be addressed only through improved productivity of crops. Other factors, such as marketing and investment opportunities, diversity of income sources and possibilities for value addition to crop and livestock products need increased attention. Within its redesigned research portfolio, ICARDA will address these aspects as well, and expand its work to cover high-value tree and horticultural crops.

Poverty has many faces. It may be driven by economic, nutritional, social and other aspects. There is an urgent need to better understand the causes and determinants of poverty so that our actions could be targeted to reduce it. ICARDA's new poverty-focused research portfolio places higher emphasis on socioeconomic studies to address these issues.

ICARDA's research efforts would be in vain if the knowledge generated did not reach extension personnel and farmers. The Center, in its redesigned research portfolio, will substantially strengthen its efforts to develop solutions to practical problems confronting development. It will harness the benefits of modern communication and information technologies to disseminate the technological, institutional and policy options developed through research activities to contribute to development programs. It is through the application of these options that we can expect to see increased agricultural production and improved livelihoods.

ICARDA is aware that the ambitious objectives of its research portfolio cannot be met without partnerships. A global research and development partnership - another MDG - is crucial to mobilize the necessary resources and share experiences on pathways to poverty alleviation. The external review panels of ICARDA have always acknowledged the strong partnerships of the Center within CWANA and beyond. The Center will continue to further strengthen its partnerships with national, regional and international institutions and governments to promote agricultural productivity in the dry areas.

This issue of *Caravan* provides examples of the impact of ICARDA's collaborative research activities and expanding partnerships on improving livelihoods in the dry areas.

Prof. Dr Adel El-Beltagy
Director General

ICARDA Celebrates Presentation Day 2004

ICARDA's mandate is not so easy to understand. Some of the work is relevant for the whole world, some of the work is relevant for certain crops only and specific to the region, and some of the work is focused on the immediate issues and livelihoods of poor-farmers, and communities within the region," said Dr Margaret Catley-Carlson, ICARDA Board Chair, in her welcome address to the distinguished guests at the Center's Presentation Day on 24 April.

The annual Presentation Day, organized by ICARDA, brings ministers, ambassadors and other senior officials from the embassies in Damascus, leaders of national programs in CWANA, and media representatives to the Center.

Dr Catley-Carlson said that attending Presentation Days helps in understanding the multifaceted work of the Center and its achievements. She pointed out that ICARDA's work is carried out in collaboration with national agricultural research organizations, international agricultural research agencies, and other organizations mandated to operationalize such major conventions as those on Climate Change and Biodiversity. ICARDA is, therefore, "A Center Beyond Walls."

Citing examples of ICARDA's successful work with partners in several countries, Dr Catley-Carlson said the Center's work is evident in the improved agricultural production in the region. "We are proud of the good work which the Center has done in this region despite considerable challenges of the weather, rainwater availability and extreme variability," she added.

Dr Margaret Catley-Carlson, Chair, ICARDA Board of Trustees, welcomed guests at the Presentation Day.

Dr Catley-Carlson explained that water availability is the lens through which all entities of ICARDA view their work. She noted that water is crucial to the Center's eco-region which faces the threat of desertification. "We must hold back the process of desertification; we must hold on to the water and the soil resources which are even more precious in this region because there is always a challenge to maintain them in the best possible state," she observed.

To the donors, who make the work of ICARDA possible, Dr Catley-Carlson said "thank you for believing in ICARDA enough to continue to give financial support and please give more."

Prof. Dr Adel El-Beltagy, ICARDA Director General, then welcomed the guests and presented an overview of the challenges facing the poor in the Center's mandate region and the work ICARDA is doing with its partners to improve their livelihoods through agricultural research. He said that the West Asia and North Africa region faces the most serious threat of water shortage, which is likely to lead to decreased agricultural production. "War, civil conflicts and natural disasters are further compounding human misery and destroying natural resources," he added.

To address the challenges, international and regional organizations alone cannot make a difference; it is the responsibility of the developing coun-

At the opening of Presentation Day, Dr Margaret Catley-Carlson, ICARDA Board Chair, and Prof. Dr Adel El-Beltagy, ICARDA Director General, welcomed the guests on behalf of the Board, Management and Staff of the Center. Among the dignitaries who were present at the celebrations were: H.E. Mr Sayed Hussain Anwari, Minister of Agriculture and Livestock, Afghanistan; H.E. Dr Adel Safar, Minister of Agriculture and Agrarian Reform, Syria; H.E. Mr Gholamreza Sahraian, First Deputy Minister, H.E. Dr Abdol Mehdi Bakhshandeh, Deputy Minister for Planning and Economy and Prof. Dr Ali Ahoonmanesh, Deputy Minister and Head of AREO, Ministry of Jihad-e-Agriculture, Iran; H.E. Mr Abdul Kareem Mohammad Al Amri, President, AAAID, UAE; Dr Abdul Illah Hamid Mohammed (former Minister of Agriculture, Iraq), AAAID, UAE; Dr Mumtaz Ahmad, Additional Secretary, Ministry of Food, Agriculture and Livestock, Pakistan; Dr Azzam Tubailey, Secretary General, Ministry of Agriculture, Palestine; Ambassadors of Algeria (H.E. Mr Kamel Bouchema), Egypt (H.E. Mr Hazem Khairat), Indonesia (H.E. Dr Sukarni Sikar), Morocco (H.E. Mr Abdelouahab Bellouki), Sweden (H.E. Ms Viola Furubjelke), Switzerland (H.E. Mr Jacques de Walteville), and Tunisia (H.E. Mr Ezzedine Kerkanir); Chargé d'Affaires of Netherlands (Mr Jilles Beschoor Plug); Second Secretary of Japanese Embassy (Mr Takeshi Okuda); Consul General of Armenia (Mr Armen Melkonian) and Turkey (Mr Hulusi Kilic); Attaché of French Embassy (Mr Wael Kaadan); Resident Representative, UNDP-PAPP, Palestine (Mr Timothy Rothermel); Dr Scott Christiansen, USAID/ANE/TS/ENV, USA; Dr Wadia Abdulsattar, USAID, Yemen; Resident Representative, JICA, Syria (Mr Kazuhide Nagasawa); JICA, Jordan (Dr Tikkosato); Prof. Dr Iwao Kobori, former Vice-Chair of ICARDA Board, UNU, Japan; Heads of National Research Programs: Dr Dir Dad Punjsheri, Afghanistan; Dr Kamal Feliachi, Algeria; Dr Hamid Narjisse, Morocco; Dr Belgacem Henchi, CITET, Tunisia; Dr Fethi Labdi, INAT, Tunisia; Dr Diallo Boubacar Cisse, Mauritania; Prof. Dr M. Abbas Mabrouk, DRC, Egypt; Dr Hassaneen El Gabbas and Dr El Azhari Hamada, ARC, Sudan; Dr Abera Deressa, EARO, Ethiopia; Dr Kidane Asmeron, NARI, Eritrea; Dr M.S. Islam, BARI, Bangladesh; Dr Masood Ali, IIPR, India; Dr Majed Jamal, GCSAR, Syria; Dr Mesut Keser, GAP, Turkey; Dr Kadir Melan, GDAR, Turkey; and Dr Adel Judah, ACSAD, Syria.

Swiss Grant for Desertification Project

Agreement Signed on Presentation Day

The Government of Switzerland, through the Swiss Agency for Development Cooperation (SDC), approved a grant to ICARDA for the research project entitled "Communal Management and Optimization of Mechanized Micro-Catchment Water Harvesting for Combating Desertification in the East Mediterranean Region." The project is aimed at improving livelihoods and reducing desertification in the marginal steppe areas of Syria and Jordan. The grant agreement was signed at ICARDA on 24 April 2004 by H.E. Jacques de Watteville, Ambassador of Switzerland to Syria, and Prof. Dr Adel El-Beltagy, ICARDA Director General.

Using a participatory approach, the project aims to develop an institutional framework for community-based implementation and management of micro-catchment water harvesting systems; improve the capacity of communities to manage common natural resources; enhance efficiency and effectiveness of rainwater use; optimize the design parameters of micro-catchment water harvesting systems; and identify the biophysical and socioeconomic parameters for the optimal application of micro-catchment water harvesting.

The agreement further strengthens the ties between ICARDA and Switzerland, which have included collaboration on such projects as renovation of traditional water supply systems and sustainable management of the agropastoral resource base in the Maghreb.

tries to create conditions conducive to development, said Dr El-Beltagy. Citing a recent study of WANA NARS, he noted that "the average investment on agricultural research for 18 WANA countries was found to be 0.41% of the Gross Domestic Product. This is much below the 1.5% level recommended by the World Bank, the European Union, IFPRI and other organizations. There is an urgent need to increase national investments in agricultural research."

The Director General also said that the Center is developing a new strategic plan based on a 5 to 10-year future vision, which will take into consideration ICARDA's internal and external environments. "The new plan is built upon the recommendations from the regional priority setting for agricultural research, and takes into account the ongoing changes in agriculture and the environment globally," he said.

On ICARDA's work in germplasm conservation, the DG said that the Center has continued to increase its collections. "Most valuable were 529 unique accessions of bread and primitive wheat, originating from the germplasm collections of Vavilov and his colleagues before 1941 and donated to ICARDA by the Vavilov Institute (VIR), St Petersburg, Russia. To date, ICARDA has embarked on 10 such collection missions in all eight countries in the Central Asia and the Caucasus region. These missions have collected over 2300 unique genotypes that are now held in ICARDA's genebank." He cited several examples of ICARDA's achievements in germplasm enhancement, natural resource management and human resource development.

Reporting on ICARDA's work in conflict situations, the DG expressed satisfaction with the work of the ICARDA-led Future Harvest Consortium in Afghanistan. "In a short period of about two years, we see the work of the Consortium leading to increased availability of food; an increase in household incomes; a restoration in social stability; crop diversification to wean farmers away from poppy production, and above all, confidence of the people of Afghanistan in the work of ICARDA-led Consortium."

The DG informed the guests that ICARDA is working with other CG Centers on a consortium approach for rebuilding agriculture in Iraq. He said the objectives will be to immediately multiply and deliver quality seed of adapted varieties, provide technical assistance in the development of sustainable agriculture, and develop a strategy that will ensure a close integration of relief, rehabilitation and development activities.

In spite of the serious security problems and constraints, Dr El-Beltagy said that ICARDA has continued to work in Palestine. The Center is working with local and international partners under a GEF/UNDP-funded project on *in situ* conservation of dryland agrobiodiversity in Palestine. In addition, ICARDA has to date trained more than 62 researchers from Palestine. "We hope peace will soon return to Palestine, so we can, using a consortium approach, speedily contribute to improving the livelihood of the people in the country," he added.

The DG thanked the investors whose continued support enables the Center to achieve its mission, and paid tribute to the national agricultural research systems in the region with whom ICARDA carries out its activities. He expressed special thanks to the people of Aleppo for their hospitality and to the Government of the Syrian Arab Republic for its generous and continued support to ICARDA.

The guests visited ICARDA's farm and toured the Biotechnology Laboratory, Milk Products Processing Laboratory, Virology Laboratory, Animal Nutrition Laboratory, and the Water Harvesting Demonstration Trials to get a flavor of ICARDA's research.■

CGIAR Science Council Meets at ICARDA

The inaugural meeting of the newly established Science Council (SC) of the CGIAR was held at ICARDA headquarters on 12-15 May 2004. Issues discussed at the meeting included: the state of global agricultural research; CGIAR system priorities and strategies; monitoring and evaluating the change process in the CGIAR; progress of the Challenge Programs; external reviews of CGIAR Centers; and a report of the study on biosafety.

Dr Per Pinstrup-Andersen, SC Chair, said the Council enjoys a lot of goodwill from all stakeholders and the expectations are high. He called upon Council members to discuss all issues openly and in depth. Prof. Dr Adel El-Beltagy, Director General of ICARDA, said that as the CG System is undergoing a transition, thousands of scientists are looking to the SC for wisdom and guidance. The SC should help the CG System go through the change process without diverting from its central goal—that of bridging the gap between the haves and have-nots in the world.

As the successor to the Interim Science Council (ISC) and the Technical Advisory Committee TAC), the mission of the nine-member Science Council is to enhance and promote the quality, relevance and impact of science in the CGIAR, to advise the Group on strategic scientific issues of importance to its goals, and to mobilize and harness the best of science to address the goals of the international agricultural research.

Dr Per Pinstrup-Andersen (center) addressing the participants at the inaugural session of the Science Council meeting.

The SC generously allowed a 4-hour slot in its program in the forenoon of 14 May to familiarize itself with ICARDA's work. The program included presentations and visit to ICARDA facilities.

The Science Council members are: Dr Virender Lal Chopra, President, National Academy of Agricultural Science, India; Dr Alain de Janvry, Professor, University of California at Berkeley, USA; Dr Kenneth Fischer, Adjunct Professor, School of Land and Food Science, University of Queensland, Australia; Dr Michael Gale, Emeritus Fellow, John Innes Centre, Norwich Research Park, UK; Dr Hans Gregersen, ret. Professor, University of Minnesota; Dr Richard Harwood, Professor, Michigan State University, USA; Dr Keiji Kainuma, Executive Research Advisor, National Food Research Institute, Japan; Dr Onesmo K. ole-MoiYoi, Director, Research and Partnerships, International Centre of Insect Physiology and Ecology (ICIPE), Kenya; and, Dr Lisa Sennerby-Forsse, Secretary General, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), Sweden.

The meeting was attended by representatives from several CG Centers, as well as from Belgium, CIDA-Canada, France, Germany, Italy, DFID-UK and USAID. ■

Members of the Science Council and its Secretariat.

And briefly...

Australians Visit

The Western Australian Minister of Agriculture, H.E. Honorable Kim Chance, visited ICARDA in January to promote collaboration between Australian research organizations and universities, and the Center. He toured ICARDA's laboratories including the genebank which has supplied many samples of genetic material that has benefited agriculture in Australia.

ADB Project Launched in Central Asia

The work plan and budget for an Asian Development Bank (ADB) project on "Improving Rural Livelihoods through Efficient On-Farm Water and Soil Fertility Management in Central Asia" were finalized at an inception workshop held in Tashkent in February. Scientists from Central Asia and representatives from NARS, SDC, USAID, GTZ, ICARDA, and IWMI were present.

Traveling through Sudan

A national traveling workshop in Sudan in January attracted more than 100 farmers, 60 scientists, and professors, students and extensionists. The group visited research stations and farmers' fields around the country to observe advances in food legumes and wheat research.

Tune In

ICARDA-Afghanistan is producing a weekly radio program on agriculture which is aired on 28 local radio stations all over the country. The program features interviews with farmers, researchers, and extensionists, and provides information on technologies for improved agricultural production. Farmers, who now identify closely with the program, usually meet in groups to listen to the broadcasts.

Conference on Herbaria Science

The First International Conference on Herbaria Science on 'Strategy of the Egyptian Herbaria,' was held in March in Egypt. Participants from Kuwait, Lebanon, Jordan, Saudi Arabia, and FAO attended the conference to discuss and develop strategies to enhance the herbaria sciences and technologies in the overall framework of social and economic development.

ICARDA Hosts CBC and CDC Meetings

ICARDA hosted the CGIAR Center Board Chairs Committee (CBC) and the Center Directors Committee (CDC) meetings on 5-7 May 2004. Dr Ian Johnson, CGIAR Chairman and World Bank Vice-President for Sustainable Development; Dr Francisco Reifschneider, CGIAR Director; and Dr Per Pinstrup-Andersen, Chairman of the CGIAR Science Council (SC), also participated in the deliberations.

The CBC agenda included discussions on Center reports, evaluation of the CGIAR Board Orientation Program, CGIAR Structure and Membership, donor performance assessment, and CGIAR reference guides.

The CDC agenda included discussions on the updates from the subcommittees and task forces of the CDC, various strategic and management issues of the Future Harvest Alliance Office, update on Future Harvest, programmatic and global organizational alignments for the CGIAR, lessons learned from the Challenge Programs, Center Deputy Directors Committee (CDDC) update on the System-wide and Ecoregional Programs and Performance Measurement, and Center-linkages and alliances.

During his visit to ICARDA to participate in the CBC/CDC meetings, CGIAR Chair Dr Ian Johnson (second from left) took the opportunity to address the senior staff of the Center on the challenges facing the CGIAR and international agricultural research. Seated with him are (from left to right) Dr Francisco Reifschneider, CGIAR Director; Dr Margaret Catley-Carlson, ICARDA Board Chair; and Prof. Dr Adel El-Beltagy, ICARDA Director General.

A joint meeting of the CBC and the CDC included discussions of the Center staff compensation study; reports of the Working Groups on Performance Measurement and Challenge Programs; progress with the CGIAR Open University Initiative, System Office and the Future Harvest Alliance; Board Orientation; and the CGIAR Charter. Dr Teresa Fogelberg, Panel Chair, also presented a report of the Review of the Gender and Diversity Program at the joint meeting.■

Members of the CBC and CDC and other participants who attended the meetings.

Belgian Parliamentary Delegation

Members of the Belgian Parliament, including the Honorable Senator Anne-Marie Lizin, President, Senate Commission for Foreign Affairs and Defense, met with the Director General and scientists at ICARDA in February to discuss the Center's efforts in rehabilitating agriculture in the conflict-affected countries in the region.

Kyrgyz Parliamentary Delegation

A delegation, led by H.E. Mr Aleksander Kostyuk, Minister of Agriculture, visited ICARDA in June to further collaboration with the Center. The delegation discussed rainfed winter cereal production and identified several promising lines of winter and facultative bread wheat for evaluation in Kyrgyzstan.

Wheat Website Online

A new wheat landrace website, featuring information on more than 15,000 bread wheat landrace accessions and the climatic parameters associated with their collection, was launched in June. The development of the website was funded by the Grains Research and Development Corporation (GRDC), Australia. The URL is www.icarda.org/bwl_db.

New Wheat and Vetch Varieties for Central Asia and the Caucasus

Two varieties of bread wheat, 'Azametly-95' and 'Nurlu-99' from CIMMYT-ICARDA-Turkey nurseries were released in March in Azerbaijan. The varieties have resistance to a number of diseases, including yellow rust, and are suitable for growing in irrigated low-lands and foothills. In Kyrgyzstan, 'Jamin,' was released as a spring crop for the mountainous areas; this is the first facultative wheat variety released in the country since 1978. Three new varieties of vetch, 'Abigi,' 'Abika,' and 'Abiza,' belonging to winter forage legumes were released in Georgia.

Conference on Yellow Rust

ICARDA scientists with their partners organized the Second Yellow Rust Conference held in March in Pakistan. More than a 100 participants from 26 Pakistani research institutions and 18 countries attended the conference to discuss approaches to managing yellow rust, epidemiology, biotechnology, breeding and disease monitoring.

World Bank ARD Meeting at ICARDA

It was a time for comparing notes and sharing experiences when a group of World Bank senior staff and officials from national agricultural research systems (NARS) met with ICARDA scientists on 12-16 June 2004. The World Bank Study Tour was organized by ICARDA and the Bank's Agriculture and Rural Development (ARD) Sector, and co-hosted by the Government of Syria. It was part of the continuing dialog and knowledge sharing between the Bank's ARD Sector and CGIAR scientists. Participants included senior officials from NARS of Jordan, Morocco, Mozambique, Palestine, Sudan, Syria, and Yemen; officials from the ARD Sector, based in Washington DC, and their regional counterparts based in Egypt, Ghana, Palestine, and South Africa; and ICARDA senior scientists.

Opening session of the World Bank ARD Study Tour. Left to right: Prof. Dr Adel El-Beltagy, ICARDA DG; Dr Sushma Ganguly, Sector Manager, Agriculture and Rural Development, and Leader of the World Bank team; and H.E. Dr Abdallah Dardari, President, State Planning Commission of Syria.

The agenda included two days of workshops and another two days of field visits in Syria to ICARDA's benchmark site for integrated natural resource management in Khanasser Valley, and research sites for *in situ* biodiversity conservation near the coast of Lattakia. During the workshop there were presentations and discussions on trade, food safety/standards and EU accession; agriculture and natural resource management in dry areas. Presenters included World Bank officials, ICARDA scientists, and NARS representatives.

Biotechnology Laboratory

The participants expressed great admiration for ICARDA's research work. They noted the strong and unique relationship between ICARDA and the NARS in the region.

Noting that the CGIAR centers have a wealth of knowledge, Dr Sushma Ganguly, Manager of the ARD Sector at the World Bank, called for a systematic knowledge sharing approach through joint analytical work and publications, CGIAR participation in the newly formed Global Platform for Rural Development, staff exchanges, and increased advocacy work. She identified possible areas of collaboration with ICARDA, specifically in water-use efficiency and sustainable cropping systems, as well as agrobiodiversity conservation.

This was the first time that a World Bank ARD meeting/tour was held at ICARDA. The World Bank is the cosponsor of, and one of the leading donors to the CGIAR.

And briefly...

International Sunn Pest Conference

Scientists from 23 countries met at ICARDA headquarters on 19-22 July for the Second International Conference on Sunn Pest. The conference, which attracted more than 130 participants, featured 50 oral presentations and 30 poster sessions on a variety of topics including the socioeconomics of Sunn pest; integrated managment, including chemical, biological and host resistance options; and biology and ecology of Sunn pest.

New Lentil Varieties in Africa

'Tershale' and 'Alem Tina,' two new varieties of red lentil with resistance to rust and wilt root-rot complex were released in Ethiopia. So far, Ethiopia has released seven varieties of lentil, all of which originated from ICARDA-supplied germplasm.

Two varieties of yellow lentil, 'Chaouia' and 'Abda' were released in Morocco; these varieties mature early which allows them to escape *Orobanche* (a parasitic weed) attacks.

Natural Pastures Discussed on TV

The causes of degradation of natural pastures, and their rehabilitation, were the subject of a one-hour TV program that was aired on 9 May on 'Al-Manar,' a Lebanese station that transmits globally via satellite. Mr Adel Nassar of ICARDA's Terbol office participated in the program and discussed the productivity and biodiversity of natural pastures, and the role of communities and NGOs in their protection.

Al-Saeed Prize to Yemen

Yemen's Agricultural Research and Extension Authority (AREA) won the Al-Saeed Prize for Science and Literature in 2003. AREA Chairman, Dr Ismail Muharram, won the award for his study on 'Alternatives to *Qat* Growing.' *Qat* is a mild stimulant that is in high demand in Yemen. Around 30 studies competed for the prize.

Improving Dairy Production

Fifteen Bedouin women in Syria attended a traveling workshop in June to discuss strategies to facilitate milk collection and improve dairy quality. Some of the technologies that were demonstrated included a newly-designed milking ramp and commercial starters for yoghurt and cheese.

Iraq Develops Plans with ICARDA to Rebuild Agriculture

A delegation of officials from northern Iraq visited ICARDA on 6-8 April 2004 to further the collaboration between Iraq and the Center that started in 1979. During a series of meetings, the delegation, led by Mr Anwar Ahmed, Program Officer, Office of Project Coordination (OPC), and ICARDA senior management and scientists developed a proposal for the implementation of collaborative research and training activities in northern Iraq.

ICARDA and Iraq will be working together on (i) human resource development and capacity building, (ii) conducting study tours, (iii) participating in regional and international scientific conferences and workshops, (iv) exchanging adapted germplasm and improved varieties for testing in Iraq, (v) establishing demonstration trials and organizing farmer field days and schools, (vi) exchanging publications and other information.

This visit followed the ninth Iraq/ICARDA Biennial Coordination Meeting which was held in Amman, Jordan, 16-17 November 2003, to discuss ICARDA's role in rebuilding Iraq's agricultural system that has been severely impacted by the recent conflict. Seven scientists from ICARDA, led by Prof. Dr Adel El-Beltagy, ICARDA Director General; 12 Iraqi scientists, led by Dr Basil Dalali, First Undersecretary in the Ministry of Agriculture; and representatives from USAID, JICA, FAO, and the national program of Jordan attended the opening session.

Prof. Dr Adel El-Beltagy (left), Director General of ICARDA, received the delegation from northern Iraq and discussed the ICARDA strategy and plan of work for rebuilding agriculture in the country. Seated next to the DG from left to right: Mr Anwar Ahmed, Program Officer, Office of Project Coordination (OPC); Mr Bahjat Mohamed, Director, Dohuk Region Research Station; Mr Ali Mohamed Ameen, Director General, Agricultural Research, Extension and Training in Erbil; and Dr Nariman Haweiz, Director General, Veterinary and Animal Production in Sulaimanyah.

The agenda of the meeting included the review of past successes of the Iraq/ICARDA collaboration such as the release of more than 18 varieties of cereals and legumes, safe custody of Iraqi germplasm at the ICARDA genebank, studies on supplemental irrigation, and technical backstopping and training on which future programs could be built. The delegation also discussed the short-, medium- and long-term actions for agricultural development based on market-driven approaches, the involvement of the private sector and strengthening the seed sector and research and extension infrastructure. Following the meeting, on request from Iraqi participants, ICARDA supplied 20 tons of high quality seed of barley, bread and durum wheat, lentil, and chickpea for on-farm demonstrations to farmers in Iraq.

A few projects in Iraq are already underway. ICARDA is working on an IFAD-funded project to provide policy, and institutional options that empower local communities, promote sustainable livelihoods and production systems, and conserve agropastoral resources in 8 countries including Iraq. ICARDA is also collaborating with the Australian Centre for International Agricultural Research (ACIAR) to increase cereal and legume productivity by introducing improved germplasm, promoting better crop management techniques, and developing the capacity of Iraqi scientists.■

Focus on Medicinal Plants

A team of 13 members of the Medicinal Plant Committee of Aleppo, Syria, visited ICARDA on 30 June 2004 to discuss the importance of preserving the diversity of medicinal plants in Syria and their role in providing additional incomes to farmers. Mr Mohamed Omar, Head of the Aleppo Chamber of Agriculture, led the team.

ICARDA; Institut des Régions Arides, (IRA) Tunisia; and USDA-ARS, organized a conference on 1-3 June 2004 in Djerba, Tunisia to promote the sustainable use of medicinal, herbal and aromatic plants in the region and create a network of medicinal plant experts. More than 150 participants from 7 countries attended the conference.

Living with the Desert

The ICARDA DG, Prof. Dr Adel El-Beltagy, made a keynote presentation at an international conference on "Living with the Desert" held at the United Nations University, Tokyo, Japan on 19-20 May 2004. The conference was held to review global research on managing dryland natural resources and anthropogenic adaptation to the desert.

DG and CAC Head Honored

The Azerbaijan Agricultural Academy conferred honorary doctorate degrees on Prof. Dr Adel El-Beltagy, ICARDA DG, and Dr Raj Paroda, Head, CGIAR Program for CAC. The degrees were awarded to honor their valuable contributions to strengthening agricultural research in Azerbaijan.

IPM Training Course

A regional course on Integrated Pest Management (IPM) techniques to mitigate the impact of diseases and insect pests in cereals was conducted in Tashkent, Uzbekistan, on 18-23 May 2004 by ICARDA, CIMMYT, and GTZ. Twenty-two participants attended the course which included both laboratory and field work.

ICARDA/Oman Sign MoU

The Ambassador of the Sultanate of Oman in Syria, H.E. Mr Hilal Ben Salem Al-Sayabi, visited ICARDA on 22 August 2004 to sign an agreement to establish a Seed Technology Unit in Oman. This work will be done in cooperation with the Arabian Peninsula Regional Program of ICARDA.

Palestine/ICARDA Coordination Meeting

H.E. Dr Ibrahim Abu El-Naja (second from left), Minister of Agriculture, Palestine, speaking during the opening session of the Palestine/ICARDA Biennial Coordination Meeting. Prof. Dr Adel El-Beltagy, ICARDA Director General (second from right); H.E. Dr Azzam Tubeileh (right), Deputy Minister of Agriculture, Palestine; and Dr Mohan Saxena (left), ICARDA ADG (At-large), joined the Minister at the opening session.

The Palestine/ICARDA Biennial Coordination Meeting was held at ICARDA headquarters on 7-8 October 2004. The Palestinian delegation was led by H.E. Dr Ibrahim Abu El-Naja, Minister of Agriculture, and included H.E. Dr Azzam Tubeileh, Deputy Minister of Agriculture; Dr Walid Abd Rabboh, Consultant to the Minister; Mr Shaker Joudeh, Deputy to the Deputy Minister; Dr Ali Fataftah, Director of the Palestine National Agricultural Research Council; Mr Abdallah Al-Laham, UNDP Representative in Palestine; and Mr Younis Sbeih, Project Coordinator for the GEF/UNDP funded Project.

Prof. Dr Adel El-Beltagy, the Director General, led the team of ICARDA scientists.

The meeting reviewed the ongoing collaboration and identified areas for future programs. At the opening session, H.E. Dr Abu El-Naja said that, with the rising population, the demand for food has increased dramatically; however, given the production constraints, local production is not enough to meet the growing demand. ICARDA's research can contribute to the achievement of food security and improvement of the livelihoods of rural communities in Palastine, he said.

Prof. Dr Adel El-Beltagy reiterated ICARDA's commitment to support agricultural production in Palestine, working with the national agricultural research system and international organizations. ICARDA is one of the first international agricultural research Centers to work on agricultural development in Palestine, he said. He noted that during the past decade of collaboration between Palestine and ICARDA, more than 82 Palestinians have been trained by ICARDA, and germplasm for cereals and legumes has been provided through two projects implemented jointly in the Palestinian territories. He thanked UNDP and other donors that are supporting agricultural research projects in the Palestinian Territories.

Palestine/ICARDA collaborative research activities have included: repatriation of genetic resources and nurseries—600 accessions of cereals and legumes; seeds of feed legumes for rangeland rehabilitation; nurseries of cereals and food legumes provided until 2000; and provision of seeds of wild fruit trees for reforestation efforts—capacity building, technical backstopping, access to information and documentation, and development of joint projects (Dryland Agrobiodiversity and Dryland Initiative).

Priority areas for future collaboration include: genetic resources and biodiversity conservation; integrated natural resources management mainly on management of scarce water; use of GIS/RS tools, integrated pest management, rangeland rehabilitation, property rights and policy development; and rehabilitation of agricultural research. ■

And briefly...

Farmers' Field Day

More than 250 Syrian farmers attended a winter chickpea field day in Idlib Province, Syria on 2 June 2004. ICARDA has been recommending that farmers shift from the traditional spring planting of chickpea to early or late winter. Three chickpea varieties with tolerance to *Ascochtya* blight and cold have been released in Syria. The field day was held to obtain farmers' feedback on the performance of the varieties.

Collaboration with Japan

The Japanese International Cooperation Agency (JICA), the Syrian State Board of Planning, and ICARDA signed an agreement to strengthen agricultural research and human resource development in Afghanistan and Syria by organizing courses and workshops on a variety of topics ranging from station management to participatory plant breeding. The project is designed to run for five years.

Pakistan Minister Visits ICARDA

The Federal Minister of Food, Agriculture and Livestock, Pakistan, H.E. Mr Sardar Yar Muhammad Rind, visited ICARDA on 24-25 July 2004. H.E. Mr Rind met with the DG, Prof. Dr El-Beltagy, and discussed ICARDA's work in Pakistan including crop improvement, water harvesting and management, the introduction of saltbush for improving livestock feed, and the socioeconomics of dry-area agriculture in Balochistan. H.E. Mr Rind signed a Memorandum of Understanding with Prof. Dr El-Beltagy to strengthen the collaboration between ICARDA and Pakistan.

Protected Agriculture in Afghanistan

A team of ICARDA staff and technicians constructed a new Protected Agriculture Center and six green houses to grow high-value crops at the Badam Bagh Research Station in Kabul, Afghanistan, in August 2004. Two courses were also conducted to train both growers and trainers on protected agriculture in marginal land and water deficit areas, the installation and site selection of green houses, and nursery establishment and transplants production. These activities were part of the USAID-RAMP project.

Celebration as Bangladesh Produces More Lentil

Prof. Dr Adel El-Beltagy, ICARDA DG, presented a plaque to H.E. Mr M.K. Anwar, Minister of Agriculture, Bangladesh, to acknowledge his strong support to agricultural research and to the farmers of Bangladesh. His support led to the wide adoption of ICARDA/BARI-developed improved lentil varieties and production technologies in Bangladesh.

Pulses, especially lentil, are the main source of protein and other essential nutrients for the majority of people in Bangladesh. Lentil, usually served as *dhal* with rice, is considered "poor man's meat" because of its high protein content. It is also rich in Fe, Zn and β-carotene, micronutrients that are essential for health. Its straw is a valued animal feed, and lentil planted in rotation with rice adds nitrogen to the soil and helps break pest and disease cycles.

Lentil is the number one preferred pulse in Bangladesh; however, domestic production satisfies less than half the country's needs. Therefore, the Pulses Research Center of the Bangladesh Agricultural Research Institute (BARI) and ICARDA are working together to develop improved technologies to help resource-poor farmers of Bangladesh.

The major constraint to lentil improvement in Bangladesh was the lack of variability, especially in the key traits that contribute to higher yield and disease resistance. The obvious solution was to introduce the desired traits through breeding, using exotic germplasm. But Bangladesh's lentil is a short-duration type which matures within 100-110 days, causing an asynchrony in the flowering of the local cultivars and those of exotic origin. It was decided that hybridization was the best way forward. ICARDA was requested to produce crosses specifically for Bangladesh, making use of the country's improved landraces and ICARDA germplasm with resistance to *Stemphylium* blight and rust – the most damaging lentil diseases in Bangladesh. In consultation with national breeders, crosses were made at ICARDA under an extended photoperiod (18 hours plus) to improve synchrony in flowering and facilitate crossing with Bangladesh landraces. Wide crosses were made and many desirable genes were introgressed – including those for disease resistance. The breaking of this ancient 'bottleneck' of narrow genetic base of lentil in South Asia represents a major scientific achievement.

The introgression of rust and *Stemphylium* blight resistant genes of exotic origin led to the development of 'Barimasur-4' lentil variety. This is the most widely adopted variety in the country and it produces an average mean seed yield of 2300 kg/ha compared with 1800 kg/ha of 'Barimasur-2.' It has a 53% advantage over the standard check, 'Uthfala.'

More than 39,000 tons of seed of the improved varieties has been distributed to farmers and around 60,000 ha have been planted to improved varieties, mostly 'Barimasur-4.' Lentil farmers

Continued on page 12

Child Nutrition Seminar

ICARDA's Natural Resource Management Program inaugurated a Development Seminar Series in October. Dr Shibani Ghosh presented a seminar on the nutritional well-being of children in Syria. The seminar was attended by policy makers from national institutions.

Sudanese Minister Meets Scientists

Four ICARDA scientists had the privilege of meeting Sudan's Minister of Science and Technology, H.E. Prof. Al-Zubair Bashir Taha, on 23 August 2004. They discussed ICARDA's work in Sudan and H.E. Prof. Taha requested the Center's assistance in solving the problem of *Orobanche* infestation, which has grown serious enough to be discussed at the federal level.

Japanese Fellows at ICARDA

ICARDA is hosting three of the 11 Japanese Fellows who were selected for the Japan-CGIAR Fellowship Program that was launched this year. The fellowship was started by the Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF) to strengthen international partnership by supporting young or mid-career Japanese scientists interested in international research for development.

New Chickpea in Australia

A new large-seeded kabuli chickpea variety selected from ICARDA-supplied germplasm was released in Australia in August. The 'Kimberely Large' has a 6% yield advantage over the currently grown variety and represents the latest product of the collaboration between Australia and ICARDA.

Conference on Grain Legumes

ICARDA scientists made 10 presentations at the Fifth European Conference on Grain Legumes held on 7-11 June 2004 in Dijon, France. The posters were on breeding, pathology, virology, biotechnology and IPM techniques of lentil, chickpea, and faba bean.

New Potato Pest

ICARDA and CIP staff spotted the Colorado Potato Beetle for the first time in Afghanistan. The beetle significantly reduces yields by eating potato leaves. Researchers are working on developing pest management options to control this insect.

have also adopted related production practices, including relay cropping and mixed and intercropping, which have helped to further increase productivity. Bangladesh's farmers are now producing an additional 28,000 tons of lentil annually, worth US$ 450/ton at the farm gate, or US$ 12.6 million in total.

Increased lentil productivity has made a major contribution to alleviating poverty and malnutrition, and improving the country's economy. An impact analysis found that the extra income earned from lentil cultivation was used by farmers to buy clothes (15.6%), personal items (19.5%), rice and other foods (9.9%), seed for the next crop (16.6%), children's education (14.8%), medical treatment (13.7%), to pay off loans (5.8%), and other purposes, such as purchasing cattle, threshers, making brick houses, and repairing farm implements (4.1%).

Mr Mohammad Abdul Sattar (center), a lentil farmer in Pabna, Bangladesh, was honored for his contributions to technology adoption and dissemination. Left to right: Dr William Erskine, ADG (Research), ICARDA; Prof. Dr Adel El-Beltagy, ICARDA DG; Mr Omar Ali, Pulse Agronomist, BARI; Dr M.S. Islam, BARI DG; and Dr M.M. Rahman, Director of Research, BARI.

To celebrate the successes achieved through the BARI-ICARDA partnership, BARI organized the "BARI-ICARDA Friendship Day" on 14 February 2004 in Dhaka. ICARDA was represented by the Director General, Prof. Dr Adel El-Beltagy; the Assistant Director General (Research), Dr William Erskine; and Lentil Breeder, Dr Ashutosh Sarker. H.E. Mr M.K. Anwar, Minister of Agriculture, Bangladesh, was the Chief Guest. Other senior officials included: Dr Mohammad N. Alam, Executive Chairman, Bangladesh Agricultural Research Council; Mr Tarique Hassain, Director General, Department of Agricultural Extension; Dr Shariful Islam, Chairman, Bangladesh Agricultural Development Corporation; Prof. Abdul Halim, Vice-Chancellor, Bangabandhu Sheikh Mujibur Rahman Agricultural University; Mr A.S.M. Abdul Halim, Secretary, Ministry of Agriculture; Dr Abdul Hamid, Director General Bangladesh Institute of Nuclear Agriculture; Dr M.M. Rahman, Director of Research, BARI; and Mr Abul Hussain, Director, Pulses Research Center. Farmers, scientists and representatives of national and international development organizations also participated in the event.

Prof. Dr Adel El-Beltagy, who gave a presentation on "ICARDA's contribution to food and nutritional security in the developing world," thanked the donor agencies, including CIDA, IDRC and ACIAR, whose support for pulse research in the last two decades, has helped Bangladesh develop improved lentil varieties and production technologies, which have been adopted by farmers. He emphasized the need for collaboration between BARI and ICARDA in other areas, such as genetic enhancement of barley, grass pea, and kabuli chickpea.

H.E. Mr M.K. Anwar praised the BARI-ICARDA partnership in lentil improvement, which has enabled the country to dramatically increase production. He called for crop diversification and increased pulse production to ensure food security and to usher in "a second agricultural revolution" for the people of Bangladesh.

As part of the Friendship Day celebration, Prof. El-Beltagy presented a commemorative plaque to the Minister of Agriculture, the Director General, BARI, the Chairman of BARC, and the Secretary, Ministry of Agriculture to acknowledge their support to the ICARDA/Bangladesh collaborative program. The Minister presented awards to two farmers, Mohammad Abdul Sattar and Mohammad Shajahan, who produced up to 2.7 t/ha of lentil using 'Barimasur-4.' Seven scientists, including Drs Willie Erskine and Ashutosh Sarker from ICARDA, also received recognition from the Minister for their contribution to improving the welfare of marginal farmers in Bangladesh through lentil improvement.■

The ICARDA delegation with colleagues from Bangladesh's research and extension departments visited the lentil field of Mr Altaf Hussain (center), a farmer in Ghanna village, Bangladesh. Mr Hussain grew 'Barimasur 4' and expects a yield of 2.4 t/ha this year. Traditional lentil varieties produce less than 1.0 t/ha.

IFAD President Visits ICARDA

IFAD President, Mr Lennart Båge (center) along with H.E. Dr Adel Safar (right), Minister of Agriculture and Agrarian Reform, Syria, and Prof. Dr Adel El-Beltagy, ICARDA DG, visited the plaque at the entrance of ICARDA's Administration Building which is inscribed with an acknowledgement of IFAD's support for the construction of the building.

Mr Lennart Båge, President of the International Fund for Agricultural Development (IFAD), visited ICARDA on 10 May 2004. He was accompanied by Dr Abdulmajid Slama, Director of Near East and North Africa (NENA) Division of IFAD, Dr Abdelhamid Abdouli, Country Portfolio Manager for NENA Division, and Ms Farhana Haque Rahman, Coordinator, Communications Special Program of IFAD. The delegation had the opportunity to get a first-hand view of the physical facilities and research that resulted from their partnership with the Center.

ICARDA Director General, Prof. Dr Adel El-Beltagy, welcomed Mr Båge and expressed ICARDA's gratitude for IFAD's generous support for the construction of the Administration and Training Building of the Center. He also acknowledged IFAD's continuous support for research on improving the livelihoods of rural communities in the dry areas.

Mr Båge visited ICARDA's laboratories and held discussions with senior management and scientists on ways to meet the challenges of poverty reduction and mitigate the degradation of natural resources in the region. He expressed great appreciation for ICARDA's work. "I had heard of the good work the Center was doing," Mr Båge said. "But now I have seen it myself."

Through its proactive role in the CGIAR governance and financial support for specific non-core programs, IFAD has directed the CGIAR research agenda towards the needs of the rural poor, sustainable management and capacity building of NARS.

The partnership between ICARDA and IFAD dates back to the inception of both organizations in 1977. IFAD is a major donor and key supporter of ICARDA's research targeting the poor. ICARDA's research funded by IFAD has helped resource-poor farmers by increasing crop yields in their fields, providing improved measures for crop protection, and preventing environmental degradation in the dry areas. ICARDA has also been able to undertake highly successful research projects, such as the Nile Valley Faba Bean Project in Egypt and Sudan and the Livestock Integration Project in Central Asia, that have demonstrated significant impact on development in rural areas. The output of ICARDA's research has provided technologies for use in investment projects supported by IFAD in the CWANA region. ICARDA scientists have also backstopped IFAD field projects by providing training.

An example of this fruitful partnership is the Mashreq/Maghreb Project that IFAD, along with the Arab Fund for Economic and Social Development (AFESD), funded from 1995 to 2002 with the main aim of developing more productive and sustainable small ruminant-based systems through the integration of crop and livestock production within and across barley and rangeland-based systems.

ICARDA scientists developed new "best-bet" packages that include practices to enhance fertility and lambing rates, and rehabilitate rangelands using fodder shrubs like *Atriplex* and cactus. Farmers in various communities throughout the region have started to adopt these practices and benefit from improvements. For example, in the Zoghmar community in Tunisia, the adoption rate of planting cactus in the rangelands has risen to 46%. Using cactus is resulting in a 50% reduction of fallow and degraded land.

The next step is to repeat this community-based approach over a large geographical area and to overcome policy and institutional constraints. To achieve this, in April 2004, IFAD committed US$1.3 million to "Developing Sustainable Livelihoods of Agropastoral Communities of WANA," a project that will continue until 2007.

IFAD's mandate is to fund rural development projects that will improve the nutritional level and living conditions of the poorest populations in developing countries. IFAD joined the CGIAR in 1979 and became a cosponsor in 2001. In the past 25 years, IFAD has committed approximately US$ 120 million for 127 CGIAR-led research programs.■

IFAD

Ties that Bind

ICARDA and the Millennium Development Goals

Halving poverty in the dry areas by 2015

At the United Nations Millennium Summit, held in September 2000, world leaders and their development partners committed themselves to a set of targets to be achieved by 2015, aimed at providing better lives for the millions of people still mired in poverty around the world. The Millennium Development Goals provide a concrete framework to guide all actors in development.

ICARDA's research and training activities are impacting poverty and improving livelihoods in the dry areas in line with the attainment of the Millennium Development Goals, particularly those related to agriculture. The Center is making a contribution to the attainment of five of the eight Millennium Development Goals.

Goal One: Eradicate Extreme Poverty and Hunger

In the dry areas the environment is harsh, stressful and variable, and agriculture is more complex than in areas with adequate rainfall. ICARDA is working with national agricultural research systems to develop crop varieties suited to these environments, and improved crop production technologies and better water management systems that enable increased food production and better incomes for the poor.

Goal Three: Promote Gender Equality and Empower Women

As more men migrate to urban areas in search of better paid work, women are left with increasing responsibilities on the farm. In many instances, women are responsible for providing food and other basic needs for the home.

Therefore, ICARDA scientists are working more on mainstreaming gender in research activities. Results show that where women are empowered, through knowledge of better agricultural technologies, food production and livelihoods have improved.

Goal Four: Reduce Child Mortality

A major cause of child deaths in poor countries is lack of adequate nutrition. ICARDA scientists are developing improved varieties of protein-rich legume crops, such as faba bean, lentil and chickpea, for the countries where populations depend on these crops for their nutrition. The Center is working on systems for improved small ruminant production in CWANA to increase availability of milk and dairy products. Social studies on child nutrition and its impact are also being carried out.

The Millennium Development Goals

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

Goal Seven: Ensure Environmental Sustainability

Managing natural resources in a sustainable way is at the core of ICARDA's research agenda. The Center is working with national programs to rehabilitate rangelands—through practices that discourage range and soil degradation—and to promote better water-use practices by developing water-harvesting systems, enhancing water-use efficiency and encouraging the use of indigenous water-harvesting systems.

Goal Eight: Develop a Global Partnership for Development

Addressing the challenges faced by people in the dry areas requires full participation of a wide range of actors at national, regional and global levels. ICARDA's research strategy hinges on

partnerships with national agricultural research systems, regional agricultural research networks, international agricultural research institutions, and other partners. The Center is also at the forefront in deliberations aimed at improving the plight of the poor in the dry and conflict-prone areas through emergency interventions as well as the implementation of medium- and long-term projects for sustainable rehabilitation of the agricultural sector.

Sharpening the poverty focus: ICARDA's New Research Portfolio

ICARDA is taking steps to sharpen the focus of its research activities for the achievement of the Millenium Development Goals. Starting in January 2005, the Center will implement a realigned research portfolio to increase impact on poverty, and address the priorities identified for agricultural research by all stakeholders in Central and West Asia and North Africa. ICARDA has redesigned its research as a single coherent poverty-focused program, sub-divided into six mega-projects. The new structure ensures continuity of the current research activities and additionally accommodates a number of new approaches and avenues in research. These newer avenues include: improved income generation from high value crops and adding value to staple crop and livestock products; rehabilitating agriculture in conflict/post-conflict situations; and closer alignment of agricultural research with mainstream development programs through research-for-development applications.

The six mega-projects address specific thematic problems.

Mega-Project 1.
Management of scarce water resources and mitigation of drought

By definition the dry areas are regions of water scarcity. Renewable water resources are limited and rainfall is highly variable and unpredictable. This short-term climatic variability is likely to be exacerbated by longer term climate change. Countries with predominantly rural economies and high dependence on dryland agriculture will be at most risk as they are highly vulnerable to shifts in seasonal climatic patterns. This project focuses on developing strategies for the more efficient and effective use of limited water resources in agricultural production and drought mitigation.

Mega-Project 2.
Integrated gene management: conservation, improvement and sustainable use of agrobiodiversity

The CWANA region contains three major centers of plant diversity, where numerous species of temperate-zone agriculture originated and where their wild relatives and landraces are still found. The region also is the Center of considerable small-ruminant biodiversity. These are a valuable source of genetic material for future germplasm enhancement. The *ex situ* collections developed and maintained by this project provide continuous and reliable access to genetic resources required to develop germplasm with higher and more stable yields, better resistance to evolving biotic and abiotic stresses (particularly drought and heat) including those emanating from climate change, and better end-use and nutritional quality.

Mega-Project 3.
Improved land management to combat desertification

An estimated 45% of the total area of irrigated and rainfed arable land together with the vast areas of rangelands in CWANA is subjected to some degree of land degradation with consequent reductions in biological productivity. The project aims to identify options for rehabilitating degraded land resources, and improve and strengthen systems of land management to control degradation and sustain future production.

Mega-Project 4.
Diversification and sustainable improvement of rural livelihoods

Within dry areas the majority of the rural population is involved in the agricultural sector and the development of agriculture is recognized as the engine for national economic growth and development. Given the natural resource constraints in the ecoregion, especially in more marginal areas, productivity increases alone will not be sufficient to combat poverty and improve rural livelihoods. Innovative options are needed to diversify income generating opportunities. Such options include diversifying cropping systems and the utilization of high-value plant species, and increasing the quality and end-use value of agricultural commodities. This project contributes to the overall aim of developing productive and sustainable systems that conserve the resource base while supporting rural livelihoods in the dry areas.

Mega-Project 5.
Poverty and livelihoods analysis

In the dry areas, poverty in all its dimensions (economic, nutritional and natural resources) is widespread. In the CWANA region an estimated 70% of the poverty is in rural areas even though only some 43% of the total population lives there. The rural population is largely dependent on agriculture, which is facing a number of converging environmental trends that reduce options, drive migration and threaten the future sustainability of livelihoods, particularly in marginalized areas (e.g., mountains and desert margins). The project provides a deeper understanding of the determinants of poverty, and the livelihood strategies adopted by rural communities. The analysis is needed to continually refine the targeting of ICARDA's research and identify pathways out of poverty.

Mega-Project 6.
Knowledge management and dissemination for sustainable development

Given the importance of agriculture in national growth and development, the sound management of the knowledge generated from science and technology and its alignment/linkage into use by end-users for sustainable development is crucial. This project includes research activities that link with development and knowledge management and dissemination that were not previously explicit in ICARDA's research portfolio.

All the above projects will be implemented in close collaboration with national programs within the region, the international research centers, and other partners. The implementaion will take cognizance of the changing trends in international agricultural research, the new tools of science, as well as the various national priorities.

Taking Research to Farmers Fields in Iran

Mustafa Pala, A. Ghaffari, and Habib Ketata

It is sometimes difficult for researchers and farmers to agree on the causes of low productivity in crops. But when they both grasp the problems and seek solutions together, there can be wide impact in a short time. ICARDA's collaborative research with the Dryland Agricultural Research Institute in Iran is a good example of the importance of researchers working closely with farmers.

DARI and ICARDA researchers in a field sown to an improved chickpea variety in Maragheh Province.

Wheat and barley are the most important cereal crops in the Islamic Republic of Iran, with a total area of 5.2 and 1.8 million hectares, respectively. Both crops are grown under irrigated and rainfed conditions, although barley is predominantly rainfed. Irrigated wheat covers one-third of the total wheat area in the country, but accounts for more than two-thirds of the total wheat production. Despite irrigation, average yield remains low because of diseases and insect pests, persistent droughts, excessive cold in the mountainous areas, high temperatures during the late spring in other areas, and poor agronomic practices.

ICARDA has been working with researchers and farmers in Iran to identify solutions to the production constraints. The Center signed an agreement in 1990 with the Agricultural Research and Education Organization (AERO) of Iran which paved the way for the establishment of the Dryland Agricultural Research Institute (DARI) in 1993. Since then, ICARDA/DARI collaboration has focused on: enhancing the skills of DARI researchers to conduct practical diagnostic farm surveys; providing a preliminary description and problem identification of major rainfed farming systems in agricultural areas surrounding Maragheh region; and using the survey findings to guide the planning and design of on-station and on-farm trials to validate the improved technologies for suitable crop sequences, proper tillage, use of improved varieties, stand establishment (sowing date, sowing geometry), fertilizer use, and weed control.

A farmer's field sown to 'Azer-2,' an improved wheat variety, yielded 4.2 t/ha when managed by researchers/extensionists (shown on the left) and 1 t/ha when managed by farmers (shown on the right).

Identifying the problem

A farm survey conducted in 1995 in Maragheh and Hashtrood provinces revealed several factors that hinder crop productivity. Farmers were mainly growing local cereal varieties which gave low yields because of the lack of tolerance to biotic and abiotic stresses. 'Sardari,' a local wheat variety, was planted by 90% of wheat farmers. 'Akarpa,' a local barley variety, was grown by 56% of barley growers. There was, therefore, great scope for testing and subsequently disseminating improved cereal varieties, along with improved technologies through on-farm verification and demonstration trials.

Most farmers plant wheat at what is probably the optimum time, between mid-September and mid-October. However, 85% of barley is planted in spring because of lack of cold-tolerant varieties. Thus, introduction of more cold-tolerant barley varieties would appreciably increase production without any additional cost.

The most common sowing method for wheat is hand broadcasting (84%), followed by covering with a moldboard plow (48%); and this practice is even more widely used for barley (92% and 68%, respectively). There was need to demonstrate the advantages of seed drills over broadcasting to encourage farmers to buy their own machines or establish a custom-operated machine planting system. Research results indicate that using drills and placing fertilizer at a depth of 9 cm from the soil surface, combined with dry planting between mid-September and mid-October using cold tolerant cereal varieties is superior to broadcasting.

The survey also showed that while most farmers cultivate once before plant-

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As *Caravan* was going to press we received the good news that Iran had attained self-sufficiency in wheat production. A ceremony to mark the achievement was held on 16 November. "Self-sufficiency in wheat production means a great deal in terms of economic considerations," President Mohammed Khatami said. Officials believe that wheat self-sufficiency is largely due to sound farm management, research activities, increased production and distribution of quality seed and implementation of training programs.

ing their wheat, some cultivate twice, and a few, three times. The first cultivation is late, generally towards the end of May or early June, and the second tillage is delayed by 62% of farmers until planting time. Delayed tillage reduces rainwater penetration into the soil and increases moisture loss through evaporation and weed transpiration. For the first and second tillage, 98% and 47% of farmers, respectively, use a moldboard plow; and for the third, a ducks-foot and harrow.

The use of the moldboard plow for the second tillage is not the most appropriate because it results in further losses of stored moisture by evaporation. Research results showed the following best practices:

1) use of a moldboard or chisel plow in fall or early spring as soon as the weather permits to improve rainwater penetration into the soil;
2) secondary tillage with a ducks-foot cultivator to a depth of 10-12 cm after the rainfall ceases (early to mid-June) to create an isolation layer of soil mulch that reduces evaporation; and
3) good seedbed preparation at planting with ducks-foot to 8-10 cm depth for a suitable stand establishment.

Farmers had a different view

Instead of focusing on best practices and the need for improved varieties, farmers rated restricted fertilizer use (88%) and lack of machinery (69%) as the most important factors limiting crop production, followed by time of tillage (30%). Other factors were credit, tillage implements, sowing method, labor shortage, harvesting method, weeds and seed rate. Although time of tillage was identified by researchers as the third most important factor limiting production, 70% of farmers rated it unimportant. This showed a difference in perception between the farmers and researchers. It was, therefore, crucial to have very close involvement of the farmers, researchers and extension staff in the research process. This was done through on-farm demonstrations, field visits, and discussions. Training courses were also conducted for extension staff.

Working on solutions together

Following the farm survey, research experiments were designed to provide solutions to problems identified. Specific activities have included:

- Introduction of improved wheat varieties and testing them on farmers' fields.
- On-farm fertilizer trials to identify crop response in different locations and create awareness among policy makers.
- Sowing methods to compare recommended practices with traditional farmer practice.
- Studies on chemical weed control in wheat.
- Effects of sowing dates, seed rate and weeding on yields.
- Monitoring the perception of farmers regarding the new technologies.

Initial results are impressive. After seeing the crop productivity in the demonstration farms, farmers have widely adopted the technologies on their own farms. In the 2002/03 season, the recommended technologies were adopted in more than 85,000 ha in four provinces as opposed to 4000 ha in the previous season. Despite the severe drought that prevailed in most rainfed areas, about 12.5 million tons of wheat was harvested, enough to meet nearly 90% of the country's needs. Much of this production came from irrigated areas, but improved productivity on dryland also contributed.

Conclusion

The participation of farmers, researchers, and extension workers in the testing, demonstration and dissemination of improved technologies is leading to increased technology adoption and improved crop yields. When the timely application and cost-effective management practices such as earlier tillage, better seed bed, earlier planting with drill use, banding of fertilizers and better weed control are combined with improved varieties by farmers, there will be a breakthrough in sustainable rainfed crop productivity in dryland areas of Iran and other similar environments in Central and West Asia and North Africa. ■

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Achievements of the Iran/ICARDA collaboration

The Iran-ICARDA partnership benefits both partners. ICARDA offers expertise and provides improved germplasm of its mandate crops, while Iran brings the NARS commitment of a country with a wealth of genetic resources and a multitude of test environments, both of which are useful for ICARDA research. This synergetic association has led to several achievements in Iran, particularly in the past 10 years. Among the major achievements are:

- Establishment of DARI in 1993, following an agreement between Iran and ICARDA which was signed in 1990. DARI's mission focuses on the improvement of major field crops grown in rainfed areas, including wheat, barley, chickpea and lentil. DARI has evolved from a small institute of 29 technical staff members in 1994 to 76 in 2004, 10 of whom are PhD holders. Similarly, the number of DARI research stations has gone up from 6 in 1994 to 12 in 2004.
- Release of 12 varieties of crops in 10 years. DARI researchers, using technical expertise and backstopping of ICARDA, also developed improved production technologies and methods for the proper management of natural resources.
- Training of more than 750 researchers from DARI and other institutes in Iran at ICARDA and elsewhere in diverse research subjects from 1990 to 2004. More than 40 students earned PhD degrees from foreign universities and returned to work at their original institutes.
- Implementation both within and outside the country of several training programs to upgrade the competence level of technical staff involved in seed production. Laboratory facilities have been acquired by SPII and put to use with the help of ICARDA scientists. Presently, Iran is producing the needed amounts of improved seed for its major field crops, including wheat and barley. More recently, a new AREO institute (PVR-SCRI) has been established to take responsibility for plant variety rights, and seed certification and control. ICARDA's Seed Unit staff provided technical advice as needed.
- Initiation of a regional project to control Sunn Pest, a major insect pest of cereal crops (primarily wheat) with outside funding and joint efforts of researchers from three adjacent countries (Iran, Syria, and Turkey). The project has developed an environment-friendly control method based on the use of entomopathogenic fungi.

Breeding Barley for Resistance to *Fusarium* Head Blight

The Fusarium Head Blight fungus ruins both the quality and yield of barley crops, which has caused multi-million dollar losses to the food, feed, and malting industries around the world. ICARDA and CIMMYT scientists are trying to breed varieties of barley with resistance to the onslaught of this destructive disease.

Researchers inoculate barley spikes to test their susceptibility to *Fusarium* Head Blight.

The *Fusarium* fungus responds to the coming of spring and the increased warmth and humidity by releasing hundreds of miniscule, crescent-shaped spores. Rain and wind carry the spores across fields until they settle on exposed parts of small grain crops, such as barley. As the fungal infection progresses, only some of the damage – such as shriveled, lightweight, discolored grain, or black or salmon-colored fungal growth on the hull – becomes evident. The most serious effect of *Fusarium* Head Blight, or FHB, remains invisible to the eye. The fungus produces a mycotoxin called deoxynivalenol, which is toxic to humans, and causes excessive vomiting, hormonal disorders, and even cancer in animals. High levels of the mycotoxin can ruin a potentially profitable barley crop and render it useless for food, feed, and brewing.

FHB causes serious difficulties in the commercialization, export, and processing of commercial grade barley. Epidemic outbreaks of FHB have caused serious losses worldwide. In the US, the economic losses caused by the fungus from 1998 to 2000 represent as much as 25.7% of the commercial value; in 2000, the losses represented almost 36% of the total sale of the crop. In 2001, the fungus caused Uruguay's barley yield to drop from the 2500 kg/ha estimated before harvest to 800 kg/ha. Most of the harvested grain was contaminated with the mycotoxin. The obvious, though not necessarily the simplest, solution is to breed disease-resistant barley.

By Flavio Capettini

Fusarium Head Blight testing nursery in Toluca, Mexico.

Breeding Strategy

Complete immunity to FHB has not been identified in barley, which is why mitigating the impact of this disease is an extremely challenging and critical research objective. When the ICARDA/CIMMYT barley breeding program started looking for sources of FHB resistance in 1986, only 23 barley accessions out of a total of 5000 screened were found to be partially resistant. These were used extensively in crosses to introduce resistance genes into the main breeding program. Sources of FHB resistance were also shared with other breeding programs worldwide after epidemics.

After identifying the sources of FHB resistance, researchers carried out various crosses in an attempt to enhance the resistance in successive generations. The ICARDA/CIMMYT program discovered two forms of resistance (Type I and Type II) to FHB in barley, which were previously described only in wheat. Type I is

Resistant (right) and susceptible barley at the Toluca Experimental Station, Mexico.

resistance to the penetration of the fungus in the spike and Type II is resistance to the spread of the fungus within the spike. Researchers crossed Type I and Type II resistant plants to combine the resistance. The resulting lines were evaluated at the Toluca Experiment Station in Mexico where environmental conditions are ideal for the spread of the *Fusarium* fungus. Researchers also collaborated with barley breeding programs in Brazil, Canada, China, Ecuador, Uruguay and the United States.

The breeding strategy proved to be effective. Researchers achieved enhanced levels of protection from FHB when they combined 1-3 sources of resistance. They also observed that the improved lines were resistant in a variety of geographical areas. "Since FHB infection is highly influenced by environmental conditions, it is very important that the resistance is expressed in several different environments and crop growing conditions worldwide," says Dr William Erskine, ICARDA's Assistant Director General (Research). The barley bred for resistance in Mexico showed resistance and low levels of the mycotoxin when grown in Canada, China, Latin America and the United States.

In 1998, the ICARDA/CIMMYT breeding program released 'Gobernadora,' a 2-row barley variety with enhanced levels of resistance. "Gobernadora represents one of the most important results of the program, mainly because it reached a sizeable commercial planted area in China," says Erskine. 'Gobernadora' was released in Shanghai, China, with the new name of 'Zhenmai-1,' and was grown on more than 100,000 hectares in three provinces in the lower basin of the Yangtze River where FHB is endemic. Today 'Gobernadora' is commonly used as a source of resistance for germplasm enhancement and in research studies.

Collaborative Projects

For the past four years, ICARDA/CIMMYT's barley breeding program has been working with Busch Agricultural Resources Inc. to produce FHB-resistant germplasm for brewing using commercial US sources. The project is also producing F_7 advanced lines with high levels of FHB resistance and enhanced resistance to Stripe, Stem and Leaf Rust, Barley Yellow Dwarf Virus, and Net and Spot Blotch. Researchers plan to test for malting quality lines in the future.

Barley breeders have also been working with the US Wheat and Barley Scab Initiative (USWBSI) for four years to introgress FHB-resistant elite lines and cultivars from the US into the ICARDA/CIMMYT program and vice-versa. This special breeding program is expected to increase the chance of finding FHB-resistant lines that are adapted to a specific target area. The program also aims to enhance malting quality in barley and has incorporated genetic material from Australia, Europe, South America, as well as the United States into the main breeding pool. Augmenting malting quality of barley will further enhance the contribution the program is making to help the poor farmers in the region by capturing opportunities for worldwide collaboration.

Tailor-made Solutions

The problem of breeding for FHB resistance is further complicated by the number of species of *Fusarium* fungus in a given location. Graduate thesis work carried out in Mexico found 14 species of *Fusarium* in the main barley commercial area of the Mexican Highlands. When researchers artificially inoculated the most commonly grown barley cultivar with fungal samples collected in the field, several produced mycotoxins, though they did not reduce yield. The results revealed that the most frequently occurring species of *Fusarium* in the Mexican Highlands was *F. avenaceum*, rather than *F. graminearum*, which is usually the case. When researchers evaluated genotypes from different programs in Latin America, Mexico and the United States for Type I and Type II resistance, they found that resistance varied with the species. This means that barley varieties released in Mexico should be resistant to *F. avenaceum*, not just *F. graminearum*, and that breeding efforts need to be specifically tailored to species and location.

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In Morocco, IPM Options Increase Wheat and Chickpea Yields

Saadia Lhaloui

Cereals and food legumes are important crops in Morocco cultivated by small- and medium-scale farmers in rainfed areas. While demand for these crops has grown rapidly in the past two decades due to the increased population, the decline in yields is alarming. In addition to the harsh environment, the crops are attacked by a number of diseases, insects, and weeds causing major yield losses. ICARDA and INRA scientists are working with farmers in Morocco to identify solutions.

Agricultural production constitutes about 20% of Morocco's gross domestic product and employs 50% of the population. There are about 8.5 million hectares of good agricultural land, of which 90% is rainfed. An estimated 80% of this arable land is used for growing cereals and food legumes, and is mainly arid or semi-arid. The crops suffer low-rainfall and high-temperature stresses, in addition to biotic stresses caused by insects, diseases, and weeds. As a result, the country has recorded an average of 30% yield loss in cereals and food legumes caused by insects and diseases, with cereal grain losses caused by the Hessian fly alone costing an estimated US$ 200 million annually.

The IPM Project

ICARDA has been working with the *Institut National de la Recherche Agronomique* (INRA), Morocco, and other partners to control the weeds, insects and diseases in cereal and legume crops. This has included research on resistant varieties, seed treatment, use of pesticides, and other agronomic practices. Crop production packages that comprise improved cultivars, optimal levels of fertilizers, irrigation, weed control and a selective use of pesticides were developed and recommended to farmers. Initially, results were mixed, with the pests continuing to damage crops, causing major yield losses.

Realizing the need for a holistic approach to pest management in the cropping systems, ICARDA and INRA embarked on an Integrated Pest Management (IPM) project within the context of the CGIAR System-wide Program on IPM. The objective is to enhance cereal and food legume production in the rainfed areas of Morocco by developing a sustainable and ecologically sound IPM program to reduce crop losses caused by major pests and weeds, raise awareness of IPM principles, and increase the incomes of farmers. Using a variety of methods to keep crop damage below the economic threshold without causing adverse effects on the environment, IPM is a sustainable approach to combat pests.

Project Implementation

The project strategy hinged on farmer participatory research, training and learning approaches emphasizing the involvement of farmers, extension specialists and researchers at all stages, especially in the selection of best-bet options. IPM pilot sites were established in farmers' fields. The sites were located in Abda and Chaouia in central Morocco, where rainfed wheat and chickpea are the major crops in the rotation. In this area, wheat production faces a major pest problem, the Hessian fly, (which in some years causes complete crop failure), and chickpea is attacked by the fungal disease, *Ascochyta* blight.

In each community, three lead farmers were selected to test five IPM options for wheat and four for chickpea. After consultations with farmers prior to planting, it was agreed that the IPM options for wheat would include: (i) Hessian fly control, (ii) weed control, (iii) appropriate fertilization, (iv) right planting date, (v) and use of a drill for planting. For chickpea, the IPM options were: (i) improved varieties, (ii) weed control, (iii) use of drill for planting, and (iv) appropriate planting date. These options were tested by farmers, working with researchers and extension specialists, during three planting seasons. The farmers' sites were used as training areas for neighboring farmers throughout the growing season. These sites were visited by more than 500 farmers. At each occasion, pests were shown to farmers and options of control were discussed in the field using plots and pest damage on the plant as actual visuals. Meetings with farmers and extension agents were organized each year after harvest to discuss the results for the different IPM options, and compare with the yield of the neighboring farmers who followed traditional practices. The year's exercise as a whole was also discussed and a plan of action for the following season developed.

A lead farmer (extreme left) explaining IPM principles to neighboring farmers in Morocco.

Wheat IPM Options

Farmers learned that the time of sowing is an important factor affecting grain yield. Reductions in yield with delayed sowing were attributed to hastened crop development with low dry matter production, and, to a greater degree, to moisture stress. The other major yield limiting factor was the higher incidence of Hessian fly attacks on late-sown susceptible cultivars as compared to early-sown ones.

The use of resistant cultivars gave a two-fold yield increase over the susceptible ones at the early planting date, while it was up three-fold for the late planting date. The best IPM option produced 2248 kg/ha wheat in one of the pilot sites, and averaged 1631 kg/ha over all sites and 800 kg/ha in the region. This 100% increase was mainly due to the wheat varieties resistant to Hessian fly, and early planting.

The early-planting date and seed of the Hessian fly-resistant varieties caused no extra cost to the farmer; therefore, adoption of the IPM practices increased wheat yields at no added cost to the farmer.

A simulation study on the adoption of Hessian fly-resistant varieties, where overall benefits and costs were calculated using a reasonable, least-favorable case, gave an internal rate of return of 39%. Considering that the adoption rate of newly released varieties is about 90%, it is predicted that Hessian fly-resistant varieties will significantly increase wheat production, and the country should recover the estimated US $200 million lost annually due to the Hessian fly. Similarly, expected adoption of the proposed IPM practices will positively impact national cereal and food legume crop production over the long term. The benefits are likely to be even more because the project promotes more IPM options than those for Hessian fly control.

Chickpea IPM Options

Using best-bet IPM options improved chickpea yields significantly. Major gains were registered when a combination of winter planting, *Ascochyta* blight tolerant variety and early weed control was utilized, compared to traditional spring planting. Grain yields varied from 730 to 1295 kg/ha (average of 945 kg/ha). For conventional spring planting, they varied from 130 to 670 kg/ha (averaging 350 kg). Therefore, an earlier sowing date (from spring to winter) using an adapted chickpea variety increased yields from two- to four-fold or more.

Scientists discussing the benefits of IPM with farmers in Morocco during a field day.

Significant yield improvement of chickpea in the region can, therefore, be obtained from adoption of winter chickpea technology particularly in drier years compared to traditional spring planting. Spring planting exposes the crop to drought at all stages of growth and development, whereas with winter planting, the drought comes only in the later stage, when the crop has already produced yield.

However, winter planting of chickpea predisposes the plants to higher infestation by weeds and unless there is adequate weed management, yields can be drastically reduced. The project considers weed and nutrient management in chickpea as strategic within a cereal-based system. Weed control using pre-emergence herbicides appears to be one of the main components of winter-chickpea technology. Yield increases ranged from 20 to over 100%, depending on the site, within winter chickpea planting treatments. Controlling weeds early reduces competition for the limited water and nutrients that contributes to increased chickpea yields.

Scaling Up IPM

The project IPM approach has been adopted in other regions of the country including Sais, Zaer, and Gharb. In the Sais region, the approach has been applied to control *Orobanche*, a devastating, parasitic weed on faba bean.

One of the pilot-site farmers established a crop protection company, offering pest management services to the whole Chaouia region. In addition, other projects have adopted the farmer participatory approach, benefiting from the lessons learned in the IPM project.

The success of the pilot sites has attracted many visitors including the World Bank President, ambassadors, senior Morocco Government officials and the media.

Lessons Learned

Farmers' fields became learning and training places. They were laboratories where concepts of pests, natural enemies, weeds, plant resistance, seed-borne diseases, cultural practices, and many other IPM-related concepts were examined and demonstrated. This process enhanced farmers' crop management skills and consolidated their role in sustainable and environmentally-sound farming.

Farmers' involvement in this project empowered them; they were active participants and not merely contacts for helping scientists in their research work. It also enabled the researchers to establish a process that integrated both technical and socioeconomic aspects, and ensured its implementation, because farmers were involved in the process from the beginning.■

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Sustainable Use of Groundwater in Syria

Policy decisions can have short- and long-term impacts on agriculture and the management of natural resources. Given that farmers respond to policy options in different ways and in accordance with their personal needs, it is crucial to determine the aggregate effects of their actions in order to evaluate the levels of success of the policies. ICARDA has conducted studies to determine how farmers respond to policy changes and recommended options that may contribute to the sustainability of groundwater use in Syria.

By Fadil Rida, Aden Aw-Hassan, Adriana Bruggeman

In Syria, agricultural production plans are drawn every year for the main products, and guaranteed prices of strategic crops such as wheat and cotton are set. Farmers participating in the production plans receive direct input subsidies in the form of seeds, fertilizers, and farm equipment. They also have greater access to low-interest loans for input purchases.

These policy actions have had a significant impact on agriculture and natural resources in Syria. Since the initiation of the policies, the area for high water consuming crops such as cotton, maize, sugar beet, and wheat has expanded. Whereas the use of irrigation has been on the rise since the 1960s as part of the development process, the twofold increase in the past two decades—from 0.6 in the early 1980s to over 1.2 million ha in late 1990s—was drastic. Thus, a significant agricultural area has shifted from rainfed to irrigated agriculture. The use of groundwater for irrigation has also significantly increased, with more than 60 percent of all irrigated areas using groundwater sources.

As a result, successes have been recorded: at least in the short-term. Increased irrigation has enabled more intensive use of fertilizers and the adoption of high yielding varieties which have contributed to an increase in agricultural production. For instance, during the period 1987-1996, the production of cotton rose from 160 to 230 thousand tons, an average growth of 6 percent annually. Wheat production increased from 1.6 to over 4 million tons in the same period.

However, the long-term impact of these policies is yet to be determined. ICARDA scientists have been studying the effect of subsidized fuel on the use of water on farms, the sustainability of using groundwater sources, the relationship between cropping patterns and groundwater depletion and how the increased use of groundwater would impact the water-scarcity situation.

A dried groundwater well. Though more than 140,000 groundwater wells have been constructed in Syria in the past two decades, many have now dried up.

A study conducted during 1999-2000 on the sustainability of groundwater for irrigation in rainfall stability zones 1 to 4 in Aleppo province found that cotton has contributed considerably to groundwater depletion in most of the villages where it is grown. In these water-scarce villages, the traditional rainfed barley and livestock system was replaced by a groundwater-based farming system.

Although groundwater irrigation has created employment opportunities in the short-term, it has led to out-migration to cities and neighboring countries in the medium-term. The impact of dried wells or sharp drops in well yields on the incomes and livelihoods of farm families relying on well-irrigation is significant, and those who can no longer sustain themselves on rainfed crops migrate to urban centers.

Researchers also found that due to the absence of alternative investment options in water-scarce villages, farmers enter into a chain of investments and reinvestments in well drilling, well deepening and horizontal drilling. Such investment is risky, as drilling failures can lead to severe losses. Evidence in the villages studied indicated that many farmers failed to repay loans used for drilling. Accordingly, they had to abandon their land and migrate to cities or neighboring countries to search for employment opportunities.

Nearly all groundwater irrigation pumps use diesel, but many farmers do not consider diesel as a production constraint since prices are highly subsidized. Consequently, they over-irrigate particularly during the early stages of crop growth when well-water yield is relatively higher than at later stages. Researchers estimated that farmers in all stability zones allocated between 14,000 and 16,000 cubic meters per hectare for cotton which is higher than the average crop water requirement estimated at 12,000 cubic meters per hectare.

Surface irrigation for summer crops.

Though surface irrigation has been the principal method in all stability zones, modern irrigation technologies, such as drip and sprinkler systems, have been recently introduced. However, farmers in the villages in the study area were not aware of these modern irrigation technologies—and many consider that such technologies fail to provide sufficient amounts of water for their crops. When the researchers simulated a situation where diesel fuel costs were increased by 50%, cotton farming was not profitable in all stability zones. Vegetables, deficit irrigation of wheat and livestock production could be viable options in these areas.

The study concluded that market-based fuel prices could have a positive impact on the efficiency of groundwater use, fuel consumption and cropping patterns in Syria. In addition, eliminating subsidies could provide farmers with the incentive to adopt activities with higher profit for achieving higher both per unit energy and water productivity. Absence of interventions in price determination for both inputs and outputs in the agricultural sector is likely to contribute to the sustainability of agricultural resources and increase farmers' incomes. Also, modern technologies for irrigation water conservation are necessary to raise the productivity of water used in agriculture. The government is promoting new irrigation technologies by providing subsidies and through the extension system.

Groundwater irrigation on a farm in one of the study sites.

The research team recommended that for farmers to adopt the new technologies for irrigation-water conservation, extensionists need to do more to educate farmers on the benefits of the technologies and dispel misconceptions.

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Water Project Benchmark Sites Launched in Egypt, Morocco, and Jordan

ICARDA has launched a new comprehensive water project, involving ten countries in the WANA region. The project, entitled "Community-based optimization of the management of scarce water resources in agriculture in West Asia and North Africa," is cosponsored by the Arab Fund for Economic and Social Development (AFESD), the International Fund for Agricultural Development (IFAD), and the NARS of the cooperating countries.

The project aims at increasing the impact of technologies that contribute to improved agricultural productivity, resource conservation, and livelihoods in those areas where water is most scarce. All three major agricultural production environments of WANA are addressed: the rainfed cropping systems, the drier areas (*badia*), and the fully irrigated areas. Research will be conducted with farming communities at benchmark and satellite sites in these three environments. The rainfed benchmark site, with research focus on supplemental irrigation, is located in Morocco, while complementary research activities are conducted at satellite sites in Algeria, Syria, and Tunisia. Jordan will host the *badia* water-harvesting benchmark site with satellite sites in Libya and Saudi Arabia. For the irrigated areas, the benchmark site is located in Egypt and satellite sites will be established in Iraq and Sudan.

Workshops were organized in Egypt, Morocco, and Jordan by the Natural Resources Management Program and ICARDA's regional offices for the Nile Valley and Red Sea, North Africa and West Asia, and the respective NARS to plan and initiate project activities of the project.

A workshop was held in Cairo on 6-8 January 2004 to develop the workplans for the benchmark site in Egypt. More than 40 participants from Egypt, Sudan, Iraq and Jordan attended the workshop. The Badia Benchmark Workshop, held on 19-23 October 2003 in Amman, Jordan attracted more than 50 participants. The Rainfed Benchmark Planning Workshop, to discuss site selection and plan research activities for Morocco, was held on 11-14 November 2003 in Rabat.

Developing Technologies with Farmers: ICARDA s Experience in Pakistan

It is tough being a farmer in the northern Punjab region of Pakistan. Poor soils, erosion and lack of irrigation characterize the farms in the area. Farmers grow sorghum, millet and groundnuts in the kharif (summer); and wheat, mustard, gram and lentil in the rabi (winter). Most of the cultivated land is barani (rainfed), so farmers depend on low and erratic rainfall. Working with the farmers and the national agricultural research system, ICARDA scientists are developing technologies that will enhance water-use efficiency for increased crop production.

Return flows from streams are pumped during the dry season to establish fruit and fodder trees in the wasteland (gullied area).

Akhtar Ali, Mohammad Rashid, Akhter Ali, Mohammed Mushtaq, Abdul Majid, Abdul Bari Salkini

In 1999, the Punjab provincial government, with support from the Government of Pakistan and the International Fund for Agricultural Development (IFAD), began the Barani Village Development Project (BVDP) to identify and solve production problems by working directly with farmers in the region. Operating in four districts of Punjab, BVDP covers an area of about one million hectares, with a population of over two million people. An estimated 80% of this population lives in rural areas and mainly depends on agriculture for its livelihood. The area is characterized by hot summers; rainfall averages 450 to 800 mm annually. Monsoon rains generally fall as heavy showers that cause high runoff and erosion of earthen field ridges. The severe degradation reduces the land value and productivity of crops.

Working closely with six provincial and national research institutions, ICARDA coordinated the project's applied research component to identify new technologies to integrate crops, rangelands and livestock production and establish pilot on-farm activities for demonstrations. The emphasis was on forging links between researchers, extensionists and farmers through extensive on-farm research.

Applied Research in Integrated Research Sites

Scientists selected three villages to represent the various ecologies and production challenges found in the Barani tract with a view to extrapolate the results of the experiments to other sites in the region with reasonable accuracy. The applied research focused on:

- Characterizing project target areas, production systems and communities
- Improving crop, fodder, and forage plants and related production practices – improved germplasm and production technologies were collected from national and international sources and then evaluated for their usefulness under local conditions
- Increasing livestock productivity through improving fodder and forages, and better management of rangelands
- Managing and conserving natural resources such as soil and water
- Assessing the adoption and impact of technologies

Farmers participated in planning and implementing the project and their experiences were incorporated into the research process. To further the dialog between the research interest groups, scientists organized participatory rural appraisals that involved all stakeholders to diagnose problems and set priorities. During these meetings, farmers and researchers finalized the terms of their partnership and details of the experiments. The researchers also planned field days to spread proven technologies to neighboring farms.

Cost-Effective Flow-Regulating Structures

Farmers expressed the need for low-cost structures that could help in regulating the flow of rainwater across the fields. Scientists worked with farmers to develop designs and construct structures that would successfully address the issues of erosion and rainwater management (see box).

Improved Fodder Crops

Without any additional management skills, special equipment or inputs, farmers at some sites reported a 25% increase in barley green biomass yield by using the new varieties introduced by the project. The Egyptian clover yield increased by more than 50% and oats by 20%. Many farmers have begun to produce seed of the new varieties for sale and neighboring farmers have expressed interest in being included in research trials in the future.

Improved summer varieties of maize, sorghum, millet and Sudan grass were introduced at all the research sites of the project. Maize and sorghum yielded much higher biomass than the local varieties at all sites and maize grain yield increased by 10-50%. Selected farmers are being trained to produce quality seed for sale to their neighbors.

Feed Concentrates Popularized

Researchers tested the use of Urea Mineral Molasses Blocks (UMMBs) in an attempt to improve the nutrition of milk producing livestock, especially during the periods of feed shortage. The blocks improved animal health, and the milk quality and yield. Farmers reported an average increase of two kilograms of milk per day and many have begun to use the blocks regularly. The process of producing the blocks at the village level has been initiated and this could generate income for local agri-business entrepreneurs.

Gypsum for Better Yield

The project area has alkaline soils. Therefore, the viability of applying gypsum to an improved groundnut variety 'Chakori,' and gypsum and green manuring to a wheat variety 'Inqulab 91' were tested. The yields of groundnut and wheat were increased by 13 and 34%, respectively. The project farmers were pleased with the results and adopted this practice. Researchers are linking farmers to gypsum dealers to ensure a sustainable supply of this input.

Lessons Learned

ICARDA's successful experience working in Barani areas confirms the value of following a participatory approach to technology development and dissemination, involving the farmers, extensionists, relevant government departments and scientists. Appropriate technologies were developed on pilot sites and have now been replicated by the farmers and extensionists. The soil conservation department has taken up low-cost structures as a development activity and farmers are constructing them on a cost-sharing basis. Similarly, entrepreneurs in the villages are in the process of producing the UMMBs. These efforts are not only improving their livelihood but also reducing natural resources degradation in the Barani area.

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Researchers and farmers discuss the construction of a dry stone water-harvesting structure at Damal.

Low-Cost Farm Runoff Management Structures: A Stunning Success in Barani Area

For a farmer in Barani areas in Pakistan, rains can be a nightmare. Heavy showers tend to carry with them the good soils, while the much-needed water for agricultural production runs off. The farmers, therefore, need to protect their fields from the destruction caused by the heavy monsoon rains, but at the same time collect some water for use in their fields. Initially, the Barani Village Development Project (BVDP) supported construction of some water and soil conservation structures. One such structure costs US$ 500 to 1000, with elaborate masonary craft. The project could not provide such structures to all the farmers in such a vast area (about 1 million ha), and farmers could not afford to construct the structures themselves. Not even the federal government had the resources to scale up the structures in the area.

ICARDA, working in collaboration with the Soil and Water Conservation Research Institute (SAWCRI), carried out research on possible alternative rainwater-harvesting structures that farmers could afford. Field visits and discussions with farmers in early 2002 led to the development of design criteria for selection and testing of low-cost structures. Topographic survey and design of the structures was carried out, followed by construction of about 25 structures in three selected sites. These structures, built with a combination of dry stone and vegetative cover, cost about US$ 50 each, about one-tenth of the cost of traditional masonary structures.

The structures were tested during the first monsoon rains in 2002. The research site at Khabal received 107 and 100 mm of rainfall on 13 and 14 August 2002 and Damal site received 85 and 75 mm of rainfall on 23 and 28 August 2002, respectively. In spite of the heavy rains, the structures performed very well. This built the confidence of the farmers and scientists in their work.

The structures harvested adequate runoff, so there was improved soil moisture and positive crop response to fertilizer. As a result, crop yields increased by 20-25% on some farms. Furthermore, the fields were saved from destructive effects of heavy rains. The farmers also reiterated that because of the simple and low-cost technology they could replicate these structures on their fields.

It was important, however, to prove to local leaders and BDVP officials that the new technology was effective and worth investing in. To achieve this, a number of activities were conducted:

- More than 50 water-harvesting structures were constructed at different locations to demonstrate their benefits to farming communities.
- Many senior policy decision makers were invited to the demonstration sites.
- Formal discussions with the project management staff were conducted on adoption of the technology.

In December 2003, all the stakeholders agreed that the technology should be adopted and that these structures be constructed in 70% of the BVDP locations. Such success was only possible because of the close collaboration between ICARDA and SAWCRI scientists and all farmers and other stakeholders.

Combating Desertification, Drought and Poverty

By Mark Winslow and Surendra Varma

Buried alive. Imagine deserts growing like cancers, swallowing up farmlands and towns as they expand. The idea is frightening enough to be made into a Hollywood horror movie.

The threat seemed very real in the early to mid-20th century, as some deserts expanded southwards across Africa's vast Sahel region, which lies just below the great Sahara Desert. To everyone's relief, though, longer-term research found that the Sahara was not really growing. Its apparent advance was due to extended periods of drought that came and went. But many now worry that global warming may bring back this unwelcome horror—like the frightening movie monster that refuses to die.

A new analysis by the global, non-profit Desertification, Drought, Poverty and Agriculture Consortium (DDPA), released in a workshop at the World Conservation Congress in Bangkok on 21 November 2004 concludes that the desertification and drought problems remain as troubling as ever. But it also points to evidence that some communities are finding ways to fight it, and win.

The DDPA provides research in support of the United Nations Convention to Combat Desertification (CCD). The DDPA is jointly convened by ICARDA and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) based in India.

Droughts are especially destructive for poor farmers and animal herders. Animals die, or must be sold off at low prices before they die. Crops wither. The few remaining trees are cut down for firewood. Soils are left without the protective cover of trees, crops and native plants. Without that protection they are easily blown away by wind or washed away by rains.

"When agriculture declines, poor people are hurt the most," says Dr Per Rydén, former Director of the Global Mechanism of the United Nations Convention to Combat Desertification. "They don't have savings or insurance to carry them through the dry years. They often have no choice but to leave their ancestral lands in search of work. They become environmental refugees, migrating into overcrowded cities or to the distant shores of developed countries that do not want them."

According to the Secretariat of the CCD, dryland degradation now threatens about 30% of the earth's terrestrial surface and already affects approximately 70% of these dry areas, which are home to about 250 million people in more than 110 countries. Another one billion people are at risk if these trends continue.

The CCD sees sustainable development as the way out of the desertification problem, and views research as important because it finds new ways to achieve this. "Since desertification and the environment are closely linked, we have to integrate both in our research strategy. This is why the DDPA uses 'Building Livelihoods, Saving Lands' as its motto," says Dr Richard Thomas of ICARDA.

"The doom and gloom captures headlines, but there are also many success stories that need to be told," says Dr Barry Shapiro of ICRISAT. "Farmers and herders are willing to take risks and change their practices if they see that their livelihoods will improve as a result. They are especially keen to respond to new market opportunities, for example, to sell new products to growing urban centers."

Through assistance from the International Fund for Agricultural Development (IFAD), the African Development Bank, the African Development Fund and the Government of Morocco, for example, thousands of goat herders in parched eastern Morocco agreed to rest a three-million hectare area of range land so that the vegetation could recover. Development aid provided them with barley to feed their animals in the meantime. Once the lands were covered with lush grasses again, the herders agreed to control the grazing at a level that the land could sustain.

Research in breeding new strains of crop plants has found types that do better despite the drought and heat. Drought-tolerant wheat varieties from ICARDA and CIMMYT (International Maize and Wheat Improvement Center) are spreading in West Asia and North Africa. In dryland India, ICRISAT research has found ways to increase the yield of an important legume crop called pigeonpea by causing it to mature early, before the droughts set in.

Recent studies by Dr Shenngen Fan and Dr Peter Hazell at the International Food Policy Research Institute (IFPRI) in Washington D.C. have shown that in India and China, a higher payoff from development aid was being delivered from the drylands compared to wetter areas.

"One of the most important roles the DDPA can play is to help exchange information and new research findings," says Prof. Dr Adel El-Beltagy, Director General of ICARDA. "By bringing so many partners together from all over the world, we can bring focus and scientific strength to help support the world's commitment to combating desertification, drought and poverty in some of the world's poorest countries." ■

For more information, visit www.ddpa.net

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Investors in ICARDA, 2004

(In descending order of the investment amount)

1. USA	**16. Denmark**	**29. IDRC**
2. World Bank	**17. Iran**	**30. UNCCD**
3. United Kingdom	**18. Water and Food Challenge Program**	**31. Austria**
4. European Union		**32. Belgium**
5. IFAD	**19. Syria**	**33. FAO**
6. Arab Fund	**20. Asian Development Bank**	**34. Ethiopia**
7. Germany	**21. Morocco**	**35. India**
8. The Netherlands	**22. Egypt**	**36. South Africa**
9. Canada	**23. Genetic Diversity Challenge Program**	**37. Biofortification Challenge Program**
10. Italy		
11. Norway	**24. Gulf Cooperation Council**	**38. China**
12. Switzerland	**25. France**	**39. Int. Nutrition Foundation**
13. Japan	**26. UNDP**	**40. Korea**
14. Sweden	**27. Pakistan**	**41. Turkey**
15. Australia	**28. OPEC Fund**	**42. ESCWA**

New publications

Indigenous Water Harvesting Systems in West Asia and North Africa. 2004. Oweis, T.; Hachum, A.; Bruggeman, A. 179 pp. ISBN: 92-9127-147X. This book is the outcome of a project on "On-farm Water Husbandry in West Asia and North Africa," implemented by ICARDA in Egypt, Iraq, Jordan, Libya, Morocco, Pakistan, Syria, Tunisia, and Yemen. Studies on indigenous water-harvesting systems reported in the book from these countries, with illustrations of indigenous water-harvesting systems, point to the fact that traditional techniques are the most sustainable and environmentally friendly, and should be the basis for planning modern water-harvesting systems. *Price: Soft cover US$ 40.00; hard cover US$ 45.00*

Meeting the Challenges of Barley Blights. 2004. Proceedings of the Second International Workshop on Barley Leaf Blights, 7-11 April 2002, ICARDA, Aleppo, Syria. Yahyaoui, A. H.; Brader, L.; Tekauz, A.; Wallwork, H.; and Steffenson, B. (eds.). 463 pp. Leaf blights cause considerable damage to one of the most important cereal crops, barley. This publication covers in depth a broad range of topics including disease epidemiology, breeding for disease resistance, exploitation of biotechnology tools, and disease management. The results presented show that the dynamics of the pathogens and their host plants require constant vigilance and high quality research. *Price: US$ 15.00. CD-ROM version only*

Agriculture, Environment and Human Welfare in West Asia and North Africa: The Search for Sustainability. 2004. Abstracts. Proceedings of a Workshop, 5-7 May 2002, ICARDA, Aleppo, Syria. ICARDA/IGBP/IDDC. vi + 78 pp. ISBN: 92-9127-151-2. This book of abstracts covers historical aspects of climate change and environmental degradation in West Asia and North Africa (WANA), presents the current state of the environment and its links to efforts to fight poverty, and provides a prediction on what is likely to happen in the region if the current degradation levels are not forestalled. It ends with recommendations on policy actions that can be employed to ensure sustainable development for the people in WANA. *Price: US$ 20.00*

Integrated Management of *Orobanche* in Food Legumes in the Near East and North Africa. 2004. Proceedings of the Expert Consultation on IPM for *Orobanche* in Food Legume Systems in the Near East and North Africa, 7-9 April 2003, Rabat, Morocco. Dahan, Rachid and Mohammed El-Mourid (eds.). 120pp. ISBN: 92-9127-158-X. *Orobanche* is one of the major production constraints to legume farmers in the Near East and North Africa. This publication covers a broad range of technologies for *Orobanche* control, identified by researchers in 10 countries of the region. These include identification and development of resistant varieties, use of pesticides, biological control, and agronomic practices. The book offers a broad range of recommendations on controlling *Orobanche* to improve food production. *Price: US$ 20.00*

Growing Olives and Other Tree Species in Marginal Dry Environments. 2004. Tubeileh, A.; Bruggeman, A.; and Turkelboom, F. 106 pp. ISBN: 92-9127-157-1. This book presents a review of the agroecological requirements and the limiting factors to olive production, identifies olive varieties best suited to the harsh environment in the dry areas, and provides recommendations for increased olive production under scarce-water conditions. Based on ICARDA's research activities in the Khanasser Valley, Syria, the book makes suggestions on possible alternative tree species that can provide additional livelihood options for the poor in marginal dry environments. *Price: US$ 15.00*

Micro-catchment Water Harvesting for Improved Vegetative Cover in the Syrian *Badia*. On-Farm Water Husbandry-Technical Report Series No. 3. 2004. Somme, G.; Oweis, T.; Abdulal, A.; Bruggeman, A.; and Ali, A. 38pp. ISBN: 92-9127-159-8. Soil degradation occurs in the dry areas when the top soil cannot retain moisture to enable vegetation to grow. This report presents findings of a study conducted in 1997-2001 in the Syria *Badia* to test different water-harvesting techniques for improving vegetative cover. The study identified technologies that could enhance soil-water retention to enable crops survive, even during periods of drought. *Price: US$ 15.00*

Agriculture in Central Asia: Research for Development. 2004. Ryan, J.; Vlek. P.; and Paroda, R. 361pp. ISBN: 92-9127-156-3. This publication is an outcome of a symposium on agricultural development in Central Asia organized jointly by ICARDA and the Center for Development Research (ZEF) Bonn, Germany, held at the American Society of Agronomy, Soil Science Society of Agronomy, Soil Science Society of America, and Crop Science Society of America Annual Meeting in Indianapolis, USA on 10-14 November 2002. Presentations at the symposium encompassed a range of issues from economic and structural to the biophysical aspects of agriculture, including soil resources, water management, cereal and legume crops, livestock and rangelands, biodiversity, conservation tillage and greenhouse gas flukes. *Price: US$ 35.00*

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Top: ICARDA's mandate crops (clock-wise): Barley, lentil, faba bean, wheat, chickpea, vetch, and grasspea. Bottom: Water is the key resource in dry areas, but it is getting scarcer at an alarming rate. ICARDA's research focuses on increasing on-farm water-use efficiency to produce more with less water.