ANNUAL REPORT 2011

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International Center for Agricultural Research
in the Dry Areas

ICARDA

Annual Report 2011

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Citation:
ICARDA. 2012. ICARDA Annual Report 2011. International Center for Agricultural Research in the Dry Areas, Aleppo, Syria. iv + 52 pp.

ISSN: 0254-8313

AGROVOC descriptors: Cicer arietinum; Lens culinaris; Vicia faba; Hordeum vulgare; Triticum aestivum; Triticum durum; Lathyrus sativus; Aegilops; Medicago sativa; Pisum sativum; Trifolium; Trigonella; Vicia narbonensis; feed legumes; shrubs; fruit trees; goats; ruminants; sheep; livestock; agricultural development; dryland farming; farming systems; animal production; crop production; agronomic characters; biodiversity; biological control; disease control; pest control; pest resistance; drought resistance; genetic maps; genetic markers; genetic resistance; genetic resources; genetic variation; land races; germplasm conservation; plant collections; microsatellites; land use; pastures; grassland management; steppes; rangelands; reclamation; environmental degradation; irrigation; water arvesting; water management; harvesting; rural communities; rural development; training; human resources; development; malnutrition; nutritive quality; poverty; mechanical methods; remote sensing; research networks; research; resource conservation; resource management; seed production; stubble cleaning; Sunn pest; sustainability; temperature resistance; cold; vegetation; geographical information system; diffusion of information; agroclimatic zones; arid zones; semi-arid zones; international cooperation; Middle East; North Africa; West Asia; Central Asia and the Caucasus, South Asia and China; Arabian Peninsula.

AGRIS category codes: A50, A01, E10, F01, F30, H10, H20, H60, L01, U30

Contents

Foreword

Poverty, food insecurity, natural resource degradation and climate change are global challenges; but they impact most severely on rural communities in dry areas. Addressing these challenges requires a combination of good science, integrated research-for-development approaches, and effective partnerships. As this report illustrates, all three elements are in place, resulting in new technologies and tangible benefits in more than 40 countries.

This year saw the inception of the CGIAR Research Program, "Dryland Systems" (CRP1.1) – a global initiative led by ICARDA and implemented in partnership with more than 80 institutions worldwide. The program uses a multi-disciplinary, agro-ecosystems based approach to improve food security and livelihoods in dry areas worldwide. Program partners are working together to better define research targets, action sites, implementation mechanisms, and monitoring measures in five target regions: West Africa Sahel and the Dry Savannas; East and Southern Africa; West Asia and North Africa; Central Asia and the Caucasus; and South Asia.

This report describes new technologies, tools and approaches that ICARDA and its partners have developed. These include innovations in drought mitigation, climate change adaption, water management, control of wheat rust diseases, pest management methods, new lentil varieties to improve income and nutrition, and wheat varieties that combine hardiness with high yield potential. Two large-scale, multi-country research projects – Enhancement of food security in the Arab region and the Water and Livelihoods Initiative – reported a second season of excellent results. Technologies introduced through these projects are helping to increase crop yields, water-use efficiency and research-for-development capacity in each target country.

Plant breeders have developed new high-yielding, stress-resistant varieties of a range of crops, using germplasm or breeding material supplied by ICARDA. In 2011, at least 26 new varieties were released for cultivation in 11 countries. Low-cost technologies are being scaled out to increase water productivity in both rainfed and irrigated areas. Integrated crop-livestock-rangeland approaches are helping to increase sustainability and productivity in marginal areas, and create new income streams for small-scale sheep and goat producers. National research programs are being strengthened through a Young Scientist Program, initiated in 2011.

Several new initiatives were launched in 2011, aiming to scale out results from earlier projects. New research projects were initiated in South Asia, Sub-Saharan Africa, North Africa and West Asia. An agricultural information network was launched, linking seven countries in North Africa and West Asia. ICARDA joined the Regional Partnership Framework on Food Security in Asia and the Pacific. In South Asia, collaborative research programs were established with Bangladesh and Nepal; and the partnership with India culminated in ICARDA's Board of Trustees meeting and a joint India-ICARDA Day, both hosted by the Indian Council for Agricultural Research.

Development investors have been critical to these successes. ICARDA is highly appreciative of the many donors who have supported the Center's activities – not only in 2011, but for over 30 years.

In most developing countries, dryland agro-ecosystems hold the key to food security. ICARDA's goal is to work with partners to unlock the agricultural potential of dryland areas worldwide. We are happy to report that, together, we are making rapid progress.

Henri Carsalade
Chair, Board of Trustees

Mahmoud Solh
Director General

HIGHLIGHTS OF THE YEAR

Highlights from 2011: new research findings, expanded partnerships, and greater impacts on food security and livelihoods.

Lentil variety BARIMasur-7, released in Bangladesh: high yielding, early maturing, resistant to multiple diseases.

HIGHER YIELDS, BETTER NUTRITION

Legumes are the main source of protein for more than one billion people in South Asia. ICARDA and its partners have developed new legume varieties with high yields, enhanced nutritional value, as well as other traits such as drought tolerance and disease resistance.

In India, two improved lentil varieties yielded more 1.5 tons per hectare – twice the national average – in large-scale field trials. The new varieties are NDL-1, developed by Indian scientists from ICARDA parent material, and HUL-57. They are being promoted together with a 'package' of crop management methods to maximize yields. In Bangladesh, lentil variety BARIMasur-7, developed by the Bangladesh Agricultural Research Institute and ICARDA, was released for cultivation in 2011. It is early maturing, resistant to Stemphylium blight and other diseases, and yields 1.8 to 2.3 t/ha, 40% higher than the best varieties currently available, and more than double the yield of traditional local varieties.

Grasspea is another important legume crop in South Asia, especially in marginal areas – but some varieties contain unacceptable levels of a neurotoxin known as ß-ODAP. Grasspea variety BARIKhesari-3 – developed from an ICARDA breeding line – is being trialed in Bangladesh. The new variety has very low ß-ODAP content, 0.04% compared to 0.4-1.6% in local varieties. It yields 1.8-2.0 t/ha, double the yield of local varieties, produces much higher biomass (more fodder for livestock), and combines tolerance to waterlogging as well as drought.

Similar successes are being reported in Central Asia. In Tajikistan, chickpea variety Sino – developed by the Institute of Crop Husbandry (ICH), the Tajik Academy of Agricultural Sciences, and ICARDA – was released for cultivation in 2011. Sino does well in rainfed conditions, without irrigation. In three seasons of trials, it yielded an average of 1.7 t/ha, significantly higher than most current varieties. It can be sown in winter as well as in spring; is resistant to Ascochyta blight, the most important chickpea disease in the region; and can be used for food as well as livestock and poultry feed.

Training programs promote grasspea technologies – varieties, crop management, processing – in India and Bangladesh.

Seed multiplication field of chickpea variety Sino, released in Tajikistan: high yielding, large seeded, highly profitable.

Responding to a global threat: the Stripe Rust Symposium brought together scientists, policy makers and donors from 31 countries.

RUST-RESISTANT WHEAT

The world's wheat supplies are threatened by a virulent new strain of stripe (yellow) rust. Rust epidemics caused massive losses in at least nine countries in 2009/2010, destroying 40% of the harvest in many areas. ICARDA is part of global efforts to prevent future epidemics.

In 2011, ICARDA organized the International Wheat Stripe Rust Symposium with support from FAO, IDRC, AARINENA, the Borlaug Global Rust Initiative, IFAD, and CIMMYT. The meeting brought together scientists, policy makers and donor organizations from 31 countries, and led to the Aleppo Declaration – a global commitment to work together to overcome this threat. ICARDA is working with partners in several countries on a range of measures: developing new rust-resistant varieties, establishing surveillance and monitoring systems to predict outbreaks, pathogen studies to understand the development of new strains of the pathogen, and training programs for researchers, farmers and extension staff to diagnose and manage rust diseases.

In Iraq, where stripe rust was first reported in the 2011/12 cropping season, we worked with government agencies to develop an emergency response, as well as medium and long-term strategies for rust management. In Algeria, ten wheat genotypes resistant to stripe rust were tested in low, moderate and high-rainfall environments. Sonoot 10 performed extremely well, and will be trialed in farmers' fields next season. In Ethiopia (which lost nearly 80% of its wheat harvest last year), two new rust-resistant varieties of spring bread wheat were released last year. Flag 5 and ETBW 5483 are resistant to stripe rust, stem rust (including the highly virulent Ug99 race and its derivatives), and Septoria leaf blotch. They yield 5.1 to 5.4 t/ha, 20% more than most current varieties. In 2011, ICARDA and national agencies ramped up seed multiplication of both varieties, as part of a USAID-funded program.

RESEARCH INNOVATIONS

An important breakthrough in 2011 was the development of a new hydroponic screening method to identify chickpea varieties resistant to Fusarium wilt, a widespread soil-borne disease that severely reduces yields. The new technique is more cost effective and accurate than traditional field-based methods, and enables plant breeders to simultaneously screen for resistance to a number of fungal races. Breeders will also be able to use the new method to help identify genes resistant to different races of the wilt pathogen, and to combine multiple genes into a single variety through DNA marker-assisted selection.

Other strategic research is helping to develop drought-tolerant varieties of durum wheat and barley that use nitrogen more efficiently. The amount of nitrogen cereals accumulate in grain is a key factor in determining yield and nutritional value. Preliminary findings show high genotypic variation in land and water productivity, nitrogen uptake, and nitrogen-harvest index – the ratio of N content in the grain to the total N content in the plant. The results will help develop varieties that use water and nitrogen more efficiently, producing higher yields and potentially more nutritious grain in water-stressed environments.

WATER PRODUCTIVITY: MORE CROP PER DROP

With water scarcity approaching critical levels in many countries, it is vital to increase water productivity, producing more output per unit of water consumed. ICARDA researchers used an innovative approach. Socioeconomic and biophysical data from six countries were analyzed using a simulation model, to increase water productivity by better matching crop and land use to agro-ecosystem conditions. This was part of the USAID-funded Water and Livelihoods Initiative (WLI) led by ICARDA. Partners include national research centers in Iraq, Jordan, Lebanon, Palestine, Syria and Yemen; and several universities – the University of California-Davis, University of Florida, University of Jordan, and the American University of Beirut.

New hydroponic method to screen chickpea genotypes for fusarium wilt resistance: more accurate, less expensive.

Benchmark research site in Egypt: new crop and land management methods to increase water productivity in irrigated areas.

The analytical tool used was the Soil and Water Assessment Tool (SWAT), a simulation model that helps understand soil and water dynamics at the watershed scale. Preliminary results have been shared with national research and extension agencies as well as farm communities. The base data were collected from benchmark research sites in the six countries during the Water Benchmarks Project.

Other research projects are helping to increase water productivity by promoting technology 'packages' that combine improved varieties, crop management techniques, and irrigation methods to maintain or increase yields using less water and fertilizer. One example is the Water Benchmarks Project (the current phase is supported by the Arab Fund for Economic and Social Development, AFESD). Field days in Egypt, organized in partnership with the Agricultural Research Center and other national organizations, are helping to promote such packages. The project is also testing further improvements in raised-bed planting and other techniques to improve water productivity. Another collaborative program in Egypt, involving government agencies, ICARDA, and Australian partners, focuses on three different types of irrigated environments – the fertile 'old lands' in the Nile Delta, reclaimed and salt-affected areas in the Delta, and 'new lands' in low-rainfall areas, where large-scale irrigation schemes are being developed. The aim is to develop and promote efficient irrigation methods as alternatives to the common practice of flood irrigation.

CONSERVATION AGRICULTURE

Conservation agriculture – a combination of reduced tillage, crop rotations, and other management practices – allows farmers to increase yields while reducing production costs and improving soil health. ICARDA is working with research centers, extension services, farmer groups, NGOs and the private sector from different countries to test and promote conservation agriculture technologies. These efforts are driven by an Australian-funded project, implemented jointly with national authorities in Iraq and Syria, and research organizations and universities in Australia.

Adoption in West Asia of has grown from near-zero to 28,000 hectares in less than five years. Zero-till fields now cover more than 8000 hectares in Iraq, and more than 20,000 hectares in Syria. In Algeria, adoption has more than tripled in the past two years. In 2010, conservation agriculture was used on 1500 hectares across eight provinces. In 2011 this rose to over 5500 hectares across 12 provinces. Key to this increase (as in West Asia) was partnership with equipment manufacturers to develop low-cost, locally manufactured direct-drilling machines. This allows farmers to plant seeds in unplowed soils covered with residues from the previous season, saving time and fuel, reducing costs, and improving yields and soil health.

PROTECTING BIODIVERSITY

Agro-biodiversity – particularly traditional crop varieties, wild crop relatives and progenitors, and rangeland plants – is declining rapidly in many dry areas. ICARDA works with scientists, farming and pastoral communities, and national policy makers to help preserve these vital resources for future generations.

In rangeland areas in West and Central Asia and North Africa, researchers are helping to quantify biodiversity loss, identify threatened species, and promote practical, community-led measures for biodiversity conservation. These measures include seed nurseries, new grazing regimes, and rangeland monitoring techniques. In 2011, ICARDA sent 7760 seed samples of cereal and food legume crops to the Svalbard Global Seed Vault in Norway. The seed vault now contains more than 102,000 accessions provided by ICARDA. The samples are stored in an underground vault on the remote Arctic island of Spitzbergen, as an insurance against loss of vital germplasm.

INTEGRATED RESEARCH FOR DEVELOPMENT

Many dry-area developing countries face severe food security challenges. An ICARDA study in 2011 showed that these challenges could be partly or largely overcome even in dry environments, *using currently available technologies*. The study examined yield gaps – the difference

Low-cost zero-tillage seeders, fabricated, in Syria with technical support from an Australia-ICARDA project.

From Tel Hadya to the Arctic. ICARDA has provided the Svalbard Seed Vault with more than 100,000 accessions.

between potential and actual yields – for wheat in the Mediterranean region. The results showed that adoption of improved varieties and crop management techniques could increase wheat yields by 1.7-2.0 times in Syria, 1.6-2.5 times in Morocco, and 1.5-3.0 times in Turkey. The study identified specific technologies (e.g. supplemental irrigation) for rainfed agriculture in dry areas, that could be combined with new varieties and improved management practices. This could substantially reduce the wide gap between the yields on research stations and by 'advanced' farmers, and those achieved by the majority of smallholder farmers.

In Afghanistan an IFAD-funded project on dairy goat production specifically targeted poor women. The project has led to significant improvements in animal numbers, genetic quality, health and productivity. Training programs have led to changes in husbandry and processing methods, resulting in better quality dairy products. Women involved in the project have increased their annual income by $ 150 on average.

In Iraq, the Australian Agency for International Development (AusAID) and the Australian Centre for International Agricultural Research (ACIAR) support several projects – on conservation agriculture, salinity management, capacity building and other areas – that are helping to rebuild the agriculture sector. Partners include Iraqi universities and research and extension agencies, Adelaide University and the University of Western Australia.

In Palestine, the Netherlands government is funding a similar integrated approach – combining crops, livestock and biodiversity conservation to help revive agricultural development. Over 100 farmers in the West Bank are experimenting with new high-yielding varieties on half hectare plots, using seed provide by ICARDA. A national genebank has been established, to spearhead genetic resource conservation.

In Morocco, joint projects with the Institut National de Recherche Agronomique are helping small-scale farmers produce value-added products for market. The project introduced simple home-based methods for making high-quality, high-value dairy products. In the Ouarzazate region, research and extension agencies are helping to upgrade manufacturing practices at three local cheese units, and cheese producers are adopting new processing technologies.

Private sector involvement is crucial in the development of varieties for industry. ICARDA's barley program in Mexico works with the country's private sector and Indian scientists to develop high-yielding, disease-resistant barley varieties for malting, baby food and other uses. These varieties are targeted at irrigated environments and high rainfall areas. Results from 2011 were highly promising, with high-yielding lines advanced to large-scale field trials.

Sound seed policies generate multiple benefits: faster dissemination of new varieties, better returns for farmers, free exchange of germplasm between researchers in different countries, and growth in regional seed markets. ICARDA brought together policy makers and research leaders from ten countries at a seed policy workshop for the Economic Cooperation Organization (ECO) region. The workshop laid the foundation for sustainable seed sector development in the region, by identifying sectoral constraints, policy issues, complementarity between current and proposed (new) regulations, and possible management structures for the seed sector.

NEW RESEARCH PROJECTS

Dryland agricultural systems are diverse and complex, with multiple interacting components and high levels of variability within and across seasons. A new global research program, led by ICARDA, takes an integrated, multi-disciplinary, systems approach to overcome these challenges. It is the CGIAR Research Program on Integrated and Sustainable Agricultural Production Systems for Improved Food Security and Livelihoods in Dry Areas, also known as Dryland Systems or CRP 1.1.

'Dryland Systems' brings together a large multi-disciplinary team drawn from partner organizations across five

The CGIAR Research Program on Dryland Systems: focusing on the entire farming system rather than the individual components.

New research projects in Iraq will help combat salinity in soil and irrigation water – which affects a quarter of the country's farmland.

global target regions. It is this huge pool of skills and experience that makes a holistic approach possible; the aim is to better understand component interactions and their effects on the overall system. The findings will help identify system synergies and develop new farming technologies, research tools, and policy options to improve rural livelihoods in dry areas.

New research in Iraq, funded by the Australian and Italian governments, aims to combat salinity – which affects at least one-quarter of the country's farmland. Partners include five Iraqi government ministries led by the Ministry of Agriculture; University of Basra; international centers (ICARDA, IWMI, ICBA); Australian organizations (CSIRO, University of Western Australia) and others. Researchers will collect baseline data on salinity, set up salinity monitoring systems, and test and promote remedial measures. Another project, funded by the Japan International Cooperation Agency, will test improved wheat varieties, water and land management practices, and seed production technologies.

A large-scale regional project funded by three key donors (see page 8) aims to boost food security in five countries – Egypt, Morocco, Sudan, Syria and Tunisia – in the first phase, with likely expansion to other countries in the future. Project technologies are already leading to substantial improvements in yield, water productivity and farm profits in both irrigated and rainfed systems. In Egypt, for example, farmers reported excellent results in the 2010/11 season from improved land and water management methods, and new wheat varieties that combine high yield, disease resistance, and grain quality. Wheat yields increased by 25% in El Sharkia Governorate, and 17% in Assiut Governorate, and farmers in El Sharkia used 20% less irrigation water.

In India, ICARDA is contributing to a major national effort to boost lentil production in four agro-ecological regions. The collaborative project, focusing on dryland areas, is funded by the National Food Security Mission. It builds on synergies between ICARDA and national research and extension agencies – and is expected to deliver technologies that could be scaled out to many other developing countries.

ICARDA is leading a new IFAD-funded project to improve food security and help small-scale livestock producers in rainfed barley systems in Iraq and Jordan adapt to climate change. The three-year project will look at food security and climate change from a regional perspective, focusing on the low-rainfall agro-ecosystems that cover large parts of West Asia.

The new IFAD-funded Regional Agricultural Information Network for West Asia and North Africa (RAIN-WANA) builds on a highly successful ICARDA project that dramatically improved knowledge sharing in Egypt and Sudan. The new regional network will involve seven countries: Egypt, Lebanon, Libya, Qatar, Sudan, Syria, and the United Arab Emirates.

Other new projects launched in 2011 include: conservation of wheat and barley landraces, treated wastewater and grey water irrigation, and protected agriculture (Palestine); and improving water-use efficiency (Egypt, funded by ACIAR).

RESEARCH FOR DEVELOPMENT

ICARDA's research aims to improve smallholder crop and livestock production systems in dry areas. We use a multi-disciplinary, integrated agro-ecosystems approach, working closely with partner organizations and local communities.

BIODIVERSITY AND INTEGRATED GENE MANAGEMENT (BIGM)

The BIGM Program works to conserve agricultural biodiversity in dry areas and use these resources to improve food security, nutrition and livelihoods. Research covers durum and bread wheat, barley, chickpea, lentil, faba bean, and forage and pasture crops. BIGM scientists work on biodiversity conservation as well as crop improvement. Activities include both conventional and biotechnology approaches, integrated disease and pest management, and seed production and delivery systems to enhance adoption of new varieties.

INTEGRATED WATER AND LAND MANAGEMENT (IWLM)

The IWLM Program aims to improve the management of scarce water resources and combat desertification and land degradation. IWLM scientists develop technical, institutional and policy options for improving water productivity in both rainfed and irrigated production systems; for sustainable, equitable, and economic use of all water sources; and for improved land management and drought mitigation. Research focuses on appropriate, effective technologies such as supplemental irrigation and rainwater harvesting.

DIVERSIFICATION AND SUSTAINABLE INTENSIFICATION OF PRODUCTION SYSTEMS (DSIPS)

The DSIPS Program focuses on improving livelihoods and reducing risk by intensifying and diversifying traditional production systems. Research covers agronomy, integrated crop-livestock-rangeland systems, market linkages, supporting diversification into higher value crops, and creating new income opportunities through value addition to crop and livestock products. Activities also include improved forages and other feed technologies, conservation agriculture, community-based livestock breeding programs, and protected (greenhouse) agriculture.

SOCIAL, ECONOMIC AND POLICY RESEARCH (SEPR)

The SEPR Program aims to better understand rural poverty, livelihood strategies and gender issues to improve the targeting of research and development investments and accelerate technology adoption. Activities include poverty mapping, value chain and market analysis, and policy and institutional options in agriculture. Adoption and impact studies help identify barriers to the adoption of new technologies, provide lessons for the design of research and development programs, and provide quantitative evidence of the returns to research investments.

THE REGIONAL APPROACH

Regional partnership are key to ensuring that research generates strong development impacts. ICARDA's regional programs, networks, and country offices promote these partnerships, introduce and promote new technologies, and build national research capacity. ICARDA has seven regional programs and networks:

- Arabian Peninsula Regional Program
- Central Asia and Caucasus Regional program
- Highlands Regional Network
- Nile Valley and Sub-Saharan Africa Regional Program
- North Africa Regional Program
- South Asia and China Regional Program
- West Asia Regional Program

New technologies for food security in Arab countries

Transferring new technologies and strengthening the capacity of farmers, extension staff, and agricultural scientists can greatly boost food security. During 2011 a large regional project led by ICARDA, and supported by the Arab Fund for Economic and Social Development, the Islamic Development Bank, and the Kuwait Fund for Arab Economic Development, started doing just this in five Arab countries.

TARGETING WHEAT PRODUCTION SYSTEMS

The project first looked at improving wheat based farming systems in five countries – Egypt, Morocco, Sudan, Syria, and Tunisia. This involved adapting new technologies to the different environments in the different countries, disseminating technologies, and training young scientists.

Despite unfavorable growing conditions and social unrest in some countries in the 2010/11 season, field trials and demonstrations of improved wheat technologies at eight sites representing the major agro-ecologies in each country were encouraging. Even in Syria, where there was a severe drought, yields from trials using improved technologies showed improvements compared to yields from existing practices.

Feedback from five countries: technology packages promoted by the project have helped substantially increase wheat yields.

In Egypt's El-Sharkia governorate, techniques tested – improved varieties, planting on raised beds to improve water-use efficiency, and reducing application of nitrogenous fertilizer – showed yield increases of 30% over farmer practices. Results in Sudan showed the value of high-yielding varieties, bed planting, and lower rates of nitrogenous fertilizer for improving yields of irrigated wheat. In Morocco, improved technologies produced an increase in yield of up to 60% over farmer practices in irrigated wheat, but a smaller increase in yield in rainfed wheat. No-tillage practices that were tested delivered the same yield at less cost. Similarly, using deficit irrigation, and drip irrigation rather than basin or raised-bed irrigation, produced the same yield but used less water. Improved technologies tested in Tunisia gave improved yields over farmer practices of up to 28% under irrigation in the Chebika region, and 17% under rainfed conditions in the Fernana region.

Multi-disciplinary project teams have raised awareness of improved technologies, not only among farmers but also among agricultural scientists, technicians, and officials. Training courses, workshops, seminars, visits, and other activities to share knowledge reached 3225 farmers and more than 4900 people in all. Some farmers are already adopting technologies introduced by the project, and are asking for seed of new varieties and to join the project.

The project also includes a Young Scientists Training Program. Young scientists from each of the five countries were hosted at ICARDA's main research station in Aleppo and received training in wheat-based agricultural systems, and, in particular, conducted research on topics related to wheat production in their own countries.

CLOSING THE YIELD GAP

Results indicate that there is real scope for closing the yield gap in wheat production and improving food security in Arab countries by introducing and adopting improved technology across very large and diverse areas.

Looking forward, the OPEC Fund for International Development is expected to join the effort in 2012, enabling the project to expand to four more countries.

FOR FURTHER INFORMATION CONTACT
Habib Halila Email: H.Halila@cgiar.org

Bio-pesticides bring hope to date growers in Iraq

Iraq's date orchards are under attack by the Dubas bug (*Ommatissus lybicus*) – one of the most serious pests of date palm – significantly reducing yields and quality. The Ministry of Agriculture and ICARDA have been investigating the role of alternative control agents for the pest, as part of the collaborative IFAD-funded project on integrated pest management and organic fertilization.

Iraq is a leading producer and exporter of dates. The date palm provides food, feed, and firewood, and is also used in the construction of houses. Dates and their products are an important source of household income, especially in rural areas, and a valuable source of nutrition.

ALTERNATIVE PEST CONTROL IN THE FIELD

The effect of various non-chemical treatments on Dubas bug was evaluated in several studies around the country. In 2010, neem oil (azadirachtin), summer oil, and a local strain of the insect-killing fungus *Beauveria bassiana*, used in different concentrations and combinations, were tried in a 5 hectare date orchard in Al Fahhama, north of Baghdad. This study targeted both eggs and nymphs of the bug.

Nymphs and adults of the Dubas bug. Environment-friendly biopesticides are helping to fight the most serious pest of date palm.

All three compounds showed promise as bio-pesticides. After 30 days, they were all found to be very effective on Dubas eggs, especially neem oil and *Beauveria bassiana*. These two compounds reduced egg numbers by over 99%, compared with the control. However, neem oil combined with summer oil was more effective on nymphs than *B. bassiana*. These results were also confirmed in the 2011 growing season.

SUPPORTING A NATIONAL PEST MANAGEMENT STRATEGY

As part of ICARDA's strategy to develop a national integrated system against the Dubas bug, several bio-pesticides were tested against Dubas bug eggs and nymphs in a 2 hectare date palm plantation. Treatments were *B. bassiana* (both local and commercial formulations), *Lecanicillium lecanii (Verticillium lecanii), Metarhizium* sp., *Trichoderma* sp., neem, and neem plus summer oil. Bio-pesticides were sprayed at a rate of 5 g/l, and neem at 2.5 ml/l. While all had some effect on the pest, the best and most consistent results were obtained with both *Beauveria* products followed by *Lecanicillium*, neem, and neem plus summer oil.

Since neem had performed consistently well in these trials, a field experiment was set up using different concentrations of neem. At a concentration of 3 ml/l, neem resulted in 95% mortality of Dubas eggs. *Beauveria* sp. and *Trichoderma* sp. were less effective. ICARDA is planning to continue studies on the role of neem and other bio-pesticides in the Dubas control program.

POLICY CHANGED

Based on these findings, the Ministry of Agriculture has decided to change its control strategy for the dubas bug and launched a 'Clean Control Campaign' using neem. Alternative control measures, based on bio-pesticides, would reduce insecticide use and environmental pollution and also contribute to the conservation and enhancement of natural enemies.

FOR FURTHER INFORMATION CONTACT
Nasri Haddad Email: N.Haddad@cgiar.org

Defending against wheat rust diseases

The world's wheat supplies have few defenses against new races of rust diseases. The Ug99 strain of stem rust has spread from East Africa to West Asia, and threatens South Asia, Central Asia, China, and the Mediterranean region. Stripe rust remains an ongoing and chronic threat to all wheat systems and is endemic in these countries. In 2009 and 2010 wheat crops in many countries were ravaged by epidemics of stripe rust. Leaf rust is becoming more common. ICARDA is part of a global thrust to develop new rust-resistant varieties and shore up farmers' defenses against rust diseases, and offers countries its long expertise in managing stripe rust and breeding and supplying resistant varieties.

FIRST LINE OF DEFENSE

The first line of defense against rust diseases – and one that is low cost and environmentally friendly – is to provide farmers with resistant varieties that are adapted to conditions in their particular environment. ICARDA tested 250 durum wheat genotypes and found around 80 that contained the Sr2 gene, which minimizes – although it does not prevent – stem rust. Out of 300 bread wheat genotypes, around 210 contained Sr2, and around 130 contained genes that are effective against stripe and leaf rusts. ICARDA scientists identified high-yielding lines that combine resistance to both Ug99 and stripe rust. The aim was to find replacements for susceptible varieties that farmers are currently using which also give better yields.

Seed plot at ICARDA's Tel Hadya station: high-yielding, rust-resistant wheat varieties being multiplied for distribution to Ethiopia.

NARS partners tested the elite lines provided by ICARDA in disease hot spots across Africa and West Asia. Varieties were tested for resistance to Ug99 in Ethiopia, Kenya, Sudan, and Yemen, to stripe rust in Ethiopia, and Syria, to Septoria in Ethiopia, and to stem and leaf rust in Lebanon.

FAST TRACKING RESISTANT VARIETIES TO FARMERS

In Ethiopia – where stripe rust epidemics destroyed 80% of the wheat crop in some areas in 2009-2010 – three new high-yielding varieties with combined resistance to multiple rusts were fast-tracked to release in 2011. 'Hoganna', 'Shorima', and 'Huluka' combine resistance to stripe rust and Ug99, and yield on average 21% more than the currently used susceptible variety 'Kubsa'. In Egypt, two heat tolerant high-yielding varieties for the south of the country, 'Sid 13' and 'EGSeed-7', were released.

Coupled with fast release of the new varieties, NARS partners worked with farmers to demonstrate that the new releases perform better than the varieties they currently use. Setting up production systems to multiply seed on a large scale was also important. Seed producers were supplied with enough suitable seed to grow sufficient certified seed to plant around 185,000 hectares in the 2011/12 cropping season. Over 3500 farmers, men and women, also grew the new varieties for seed, helping speed take-up across four regions.

Ultimately, the goal is to develop new resistant varieties to replace current susceptible ones – more than 80% of today's commercial wheat varieties are susceptible to stem and/or stripe rust – and to put these in the hands of small-scale farmers in wheat-producing areas everywhere.

FOR FURTHER INFORMATION CONTACT
Michael Baum Email: m.baum@cgiar.org

Magical lentil – a quiet revolution

In food security terms, while the attention of much of the world is focused on headline grabbing crops such as wheat, rice and corn (maize), a quiet revolution has been taking place with a "humble" legume – lentil. Across much of North Africa, through Arab lands to South Asia, the lentil is a crucial food staple.

South Asia (chiefly India, Bangladesh and Nepal) is by far the largest producer, consumer and importer of lentil and accounts for 45% of global lentil production. The "quiet revolution" here has seen total production double from 0.62 million tons in 1980, to 1.21 million tons in 2010.

BANGLADESH REDUCES FOOD IMPORT NEEDS

In Bangladesh, the economic and nutritional benefits that improved lentils have brought to the population are well documented. Bangladesh grows some 150,000 ha of lentil, but has traditionally needed to import more than half of its consumption. Joint research between ICARDA and the Bangladesh Agricultural Research Institute (BARI) has helped reduce this gap with the development of a number of new lentil varieties.

Experimental lentil field at ICARDA. After the harvest, seeds of each variety are packed for weighing, measurement and laboratory analysis.

These new varieties are generally short duration, high yielding with resistance or tolerance to crop diseases such as rust and blight. Lentils are grown in the post-rainy season, about half as a sole crop and half intercropped with wheat, oilseeds or other crops. In 2009 an ICARDA impact study showed improved varieties on over 110,000 ha in Bangladesh, delivering an annual extra production gain of some 55,000 tons, and valued at US$38 million annually. That's a significant figure in an economy as fragile as Bangladesh.

It's reckoned that 1.1 million farmers (average land-holding 0.1 ha) are now benefiting from increased farm incomes and extra household lentil consumption. About 5.5 million people are assessed to be receiving direct benefit from improved BARI/ICARDA lentil technologies. Farmers use the extra income to purchase clothes and medicine, for funding the education of their children, building brick houses, buying rice and bullocks, and for repaying loans.

BOOSTING INCOME AND NUTRITION IN ETHIOPIA

Similar lentil magic has been at work in Ethiopia in collaborative efforts between the Ethiopian Institute for Agricultural Research and ICARDA. Their joint legumes program has delivered chickpea varieties that can be successfully grown in waterlogged and fungal disease-prone areas as well as lentils that yield six times the harvest of traditional landraces.

An IFPRI impact study in 2010 showed that the release and uptake of high yielding, rust and wilt resistant lentil varieties in Ethiopia has increased the growing area and harvest at an annual rate of 15% from 1994 to 2009. This resulted in 105,956 ha cropped with lentils, and 123,777 tons of production in the 2009/2010 cropping season.

FOR FURTHER INFORMATION CONTACT
Shiv Kumar Agrawal. Email: S.Agrawal@cgiar.org

Bread wheat: combining yield potential and drought tolerance

Wheat is grown under rainfed conditions in large parts of the CWANA region, leaving crops vulnerable to frequent and often severe drought. The challenge for researchers is to develop new varieties that can give adequate yields in dry years and high yields in good ones. ICARDA has identified varieties that have the potential to resist the effects of drought, while also producing a high yield.

CLIMATE COMPLICATIONS

Drought tolerance research is complicated by the high temporal and spatial variability of rainfall. And in dry areas across the region, this variability is likely to increase as a result of climate change. In the limited areas of the region where wheat farmers rely on supplemental irrigation, water is becoming increasingly scarce. This makes improvements in crop adaptation and water use efficiency a necessity. As dry areas become warmer, with more frequent extremes in weather conditions, it becomes ever more urgent to develop new, more drought-tolerant varieties in order to sustain food production.

ICARDA's germplasm development will help maximize yield during good seasons and minimize losses during dry periods. With this aim, each year ICARDA produces more than 500 experimental crosses between many wheat genotypes with complementary traits. It then evaluates the segregating populations (F2-F6) under irrigated (optimum) conditions using the modified pedigree/bulk selection method. The next step is to test the same set of germplasm under irrigated and rainfed (drought) conditions – two sets of experiments simultaneously, under different conditions – to identify genotypes that give good yields in both environments.

Wheat trials at Tel Hadya: new genotypes that combine drought tolerance with high yield potential and input responsiveness.

RESULTS FROM THE GROUND

During the 2010/11 season, 42 facultative/winter wheat genotypes developed using this approach were evaluated under both irrigated (450 mm) and rainfed (232 mm) conditions at ICARDA's Tel Hadya research station.

The experiment successfully identified genotypes such as '6', '27' and '31' which showed high yield potential combined with drought-tolerance properties. These genotypes yielded as high as 6.5 ton/ha under irrigation, and up to 2.5 ton/ha under rainfed conditions. In addition, they were resistant to stripe rust disease, with high grain quality.

The ability of some genotypes to produce good yields under both irrigated and rainfed conditions represents good phenotypic plasticity – the plant's ability to adapt to changes in environment. An analysis of these 42 genotypes comparing grain yield with physiological traits under drought conditions indicated that high yield is correlated with a cooler canopy temperature, large seed size, earliness, and somewhat taller plants.

ICARDA has distributed this elite germplasm to national research programs in multiple countries, for further evaluation under local conditions. Further understanding of individual traits, trait combinations, and dissection of their genetic basis is recommended to further increase wheat breeding efficiency and combine desired traits into new varieties.

FOR FURTHER INFORMATION CONTACT
Tadesse Wuletaw Email: W.Tadesse@cgiar.org

Modeling the impacts of climate change on crops

Projections by the Intergovernmental Panel on Climate Change (IPCC) give an indication of likely changes in climate on a global scale, but little information on how this might affect crops in particular regions. ICARDA and partners in Central Asia are using crop modeling to fill this gap. The study, funded by the Asian Development Bank, showed that, overall, future wheat yields in the region are likely to increase moderately.

A team of scientists from Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan and ICARDA modeled the growth of 14 wheat cultivars in 18 agro-ecological zones in the four countries for IPCC scenarios A1B and A2. The two scenarios predict the consequences of a focus on economic growth rather than the environment, with A1B being neither optimistic nor pessimistic and A2 being rather more pessimistic.

MODERATE POSITIVE IMPACT

The team of scientists used crop models to assess how crop growth, water and nitrogen uptake, above ground biomass, and yield of the wheat cultivars might change in the major agro-ecological zones in Central Asia in response to changes in climate under the two IPCC scenarios. To take account of differences in farming practices in each zone, researchers modeled suboptimal, average and optimal management practices, using data derived from household socio-economic surveys on the amount of nitrogen fertilizer applied, and the amount and timing of irrigation.

Wheat trials in Uzbekistan test new varieties that can take full advantage of warmer conditions expected as a result of climate change.

The results show a moderate positive impact on wheat yields across all four countries in the immediate future (2011-2040), mid-term (2041-2070), and long-term (2071-2100). The model predicted a slight decrease in wheat yields at only one site in Tajikistan, and no impact at three other sites.

Most of the predicted increases in yields are fairly small, ranging between 0.1 and 0.5 ton/ha/year. For Central Asia as a whole, yield increases averaged 12% ranging between 4 and 27%.

With optimal crop management – sufficient fertilizer and appropriate irrigation – wheat production could benefit from a changing climate in 12 out of the 18 sites studied. Under average management, production could increase in 9 out of the 18 sites. With sub-optimal crop management or under rainfed conditions, yields would increase to a lesser extent.

The main reason for the increase in future yields predicted by the crop models is a rise in temperature in winter and early spring. Higher temperatures shorten wheat life cycles, but overall better growth conditions in spring compensate for this. A slight increase in annual precipitation does not make much difference as it is offset by higher evapotranspiration because of higher temperatures. In the long term, higher temperatures at the flowering stage could become a problem in some years in the more southerly areas, and the spring wheat areas of northern Kazakhstan.

ADAPTING TO HIGHER TEMPERATURES

Given the lack of hard data, there is a great deal of uncertainty about the impact of changes in climate on crop productivity in Central Asia. Using crop models, scientists can reduce this uncertainty and suggest ways to take advantage of changes in climate. This study shows that heat-tolerant varieties and early planting could help farmers in Central Asia maintain and increase yields in the future in the face of climate change.

FOR FURTHER INFORMATION CONTACT
Rolf Sommer Email: R.Sommer@cgiar.org

Arresting land degradation in hillside olive orchards

Olives have been grown in northwest Syria since ancient times. Even now, olives are a major source of income for small-scale farmers. The area planted with olives has increased substantially in recent decades. However, traditional land-husbandry practices have not kept pace with the intensification and expansion of olive production into steeper areas. A project in Khaltan, Afrin, funded by the Coca Cola Foundation and the Global Environment Facility Small Grants Programme, and led by ICARDA, is working with communities to tackle land degradation in steep olive orchards.

PREVENTING DEGRADATION

In real life, managing water and land is complex. In hillside olive orchards, location-specific land conservation measures that protect the soil and, at the same time, enhance the productivity of olive trees are important. The first step was to work with the village community to map land ownership, topography, and erosion. Geographic information systems (GIS) were used to layer the sets of information, producing a map showing levels of land degradation across the community watershed. The map indicated the areas where most urgent action needed to be taken.

Science plus self-help: the community in Afrin builds simple stone structures to reduce water runoff and soil erosion.

MICRO-CREDIT AND TECHNICAL SUPPORT

The community then managed the distribution of 222 small interest-free loans provided by the project to enable farmers in degradation hotspots to apply cheap and easy soil and water conservation techniques. All the work was organized and carried out by the community. Farmers and their families, with technical backstopping from local extension services of the Ministry of Agriculture and Agrarian Reform and the General Commission for Scientific Agricultural Research, constructed water-harvesting and soil-retention structures – stone walls, bunds, and mini-terraces – to hinder surface runoff, conserve moisture and soil, allow organic matter and plant nutrients to accumulate, and maintain soil fertility.

A few heavy rainfall events accounted for most of the sediment loss from fields – two events accounted for almost two-thirds of the soil lost. The soil and water conservation practices reduced rill erosion by 60%, and captured 3.2 tons of soil per hectare that would otherwise have been lost.

PARTICIPATORY APPROACH

Helping communities draw up plans to prevent land degradation and to apply sustainable practices and technologies will improve land and water use. The participatory approach builds on the main interest of the farmers, which is to secure and increase olive production. The results of the project will be beneficial for the whole Afrin mountain area, and other similar Mediterranean areas, leading to more productive and sustainable use of the land.

Measures to prevent soil erosion and to harvest rainfall could become important for adapting to changing patterns of rainfall due to climate change. The project will expand work to Bitya, Idleb, and surrounding villages where no-tillage and weed control technologies will be tested to improve olive yields.

FOR FURTHER INFORMATION CONTACT
Feras Ziadat Email: F.Ziadat@cgiar.org

High returns on agricultural investments in Oman

Despite the growing importance of oil, the agricultural sector in Oman is still important to the country's economy. The Oman Government supports farmers by providing infrastructure, credit, technical advice, and financial assistance. A study by the Directorate General of Planning and Investment Development in Oman's Ministry of Agriculture and Fisheries and ICARDA assessed investment returns on government subsidies for irrigation systems and greenhouses. Subsidies for irrigation equipment and building greenhouses are part of a pioneering experiment to encourage farmers to adopt new resource-efficient technologies. The results indicate attractive returns on investment, both financially and socially.

IRRIGATION SYSTEMS AND GREENHOUSES

Subsidies were an important part of a government initiative to encourage farmers to adopt protected agriculture. The study surveyed a random sample of 900 farmers and showed that the subsidies did have this result, hastening the adoption of irrigation technology by nine years and the adoption of protected agriculture by five years.

Government investments are encouraging growers to adopt low-cost hydroponic systems – resulting in huge water savings.

Over the last ten years more than 2000 farms have received financial support to install modern irrigation systems, that now water more than 10,000 faddan (1 faddan = 0.42 hectare). When they saw the benefits, many farmers adopted the technology at their own expense. The new systems saved an estimated 38.5 million cubic meters of water in 2010. The saved water was used to irrigate new farmland: between 2005 and 2009, cultivated area grew from 151,000 to 175,000 faddan. Each Omani riyal (1 riyal = US$2.61)] invested – in subsidies for irrigation systems, and extension and other services – yielded net agricultural returns of 1.51 riyals.

Likewise, seeing how greenhouses built with subsidies improved productivity, many farmers who did not receive subsidies were inspired to pay for building greenhouses out of their own pockets. The number of greenhouses grew from 782 in 2001 to 4740 in 2010. Farmers used around 90% of the greenhouses to grow cucumbers and 5–9% to grow tomatoes.

Protected agriculture doubled water productivity, and significantly increased yields, compared with open-field cropping. Production of cucumbers increased dramatically, from 2354 tons in 2007 to 34,336 tons in 2009. Nearly all cucumbers grown in Oman, 96%, are now produced in greenhouses. Each Omani riyal paid as a subsidy for establishing greenhouses yielded a net agricultural return of 1.69 riyals.

The subsidies also had longer-term impacts, improving farmers' perception of (and increasing demand for) new agricultural technologies.

CONTINUING SUPPORT FOR PROGRESS

These results suggest that continuing with agricultural subsidies could encourage all farmers to adopt modern irrigation technologies for crops and trees, increasing their [profits while ensuring more efficient use of scarce water. Monitoring will identify the reasons why some farmers do not install irrigation systems or build greenhouses, helping to target future initiatives. As the new technologies lead to increases in production, the next step will be to link farmers with profitable markets, with the hope that eventually government subsidies can be reduced or removed.

FOR FURTHER INFORMATION CONTACT
Ahmed Mazid Email: A.Mazid@cgiar.org

Involving farmers in sheep breeding in Ethiopia

Sheep play an important role in the rural economy of Ethiopia, but productivity is among the lowest in sub-Saharan Africa. Simultaneously, demand for sheep products is increasing rapidly. Improving productivity can significantly increase the incomes of smallholder farmers and pastoralists, while enhancing national food security.

A NEW APPROACH

Centralized breeding systems that attempted to replicate developed-country approaches to genetic improvement or to import improved commercial breeds for crossbreeding with indigenous breeds have met with little success.

An alternative approach – community-based livestock breeding programs – is attracting global interest. This strategy centers on full farmer participation, taking into account farmers' views and priorities, their breeding objectives, and local capacity and infrastructure. Designing a community-based breeding program is much more than genetics and productivity. It is a matter of community development, where the livelihoods of livestock owners are improved through productive and adapted animals and markets for their products.

Owners select breeding animals, which are then used as a common resource to improve the genetic quality of village flocks.

BRINGING THE BENEFITS TO ETHIOPIA

Following this approach, ICARDA, the International Livestock Research Institute, and the University of Natural Resources and Life Sciences, Vienna, Austria, working with the Ethiopian Institute of Agricultural Research, have designed and implemented community based sheep breeding programs in Ethiopia. The project, supported by the Austrian Development Agency, has been running for four years. It operates in four regions representing different agro-ecologies, and focuses on four indigenous sheep breeds.

Functional programs have been implemented in eight communities involving 500 households and over 8000 sheep. A methodological framework (guidelines) for the development of community based breeding programs for smallholder producers is available and a database for capture and management of sheep data is being developed. Capacity building to improve the ability of communities and researchers to manage the breeding programs has been embedded in the project.

The project has positively influenced policy makers. The federal and regional research systems are revising their breeding plans to institutionalize this new approach. Results of the project were disseminated through 50 scientific publications including journal articles, presentations at national and international conferences, theses, working papers, and posters in various languages.

Overall, the program has already led to some tangible outcomes, although it will take more time until genetic gains can be fully evaluated. Negative selection has been reversed as fast growing lambs are now being retained for breeding instead of ending up in markets, while the acute shortage of breeding rams observed previously has also been rectified as farmers are now fully aware of the importance of breeding males. Preliminary data show that market sales have increased through more births of lambs, bigger lambs at birth and weaning and reduced mortality due to a combination of breeding with improved health care and feeding.

FOR FURTHER INFORMATION CONTACT
Aynalem Haile Email: A.Haile@cgiar.org

Rehabilitating degraded steppe lowlands

Increasing population pressure on the steppes of West Asia has led to overgrazing, unsustainable cropping, and soil and water erosion. In particular, lowland and wadi beds, traditionally cropped with barley as part of the pastoral systems, face desertification. Lowlands are only a small part of steppe areas but are especially important to pastoralists in drought years. Many, though, have become unproductive and have been abandoned.

A project supported by the OPEC Fund for International Development in Syria and Azerbaijan tested ways to rehabilitate, intensify, and diversify production in these lowland areas to provide forage for livestock while conserving the environment and biodiversity.

RENOVATING RANGELANDS

Salsola vermiculata is a rangeland shrub that provides good fodder for livestock. Direct seeding saves time and cost compared with transplanting seedlings. The study evaluated three techniques for preparing soil for direct seeding of *Salsola vermiculata* – scarifying the soil surface, pitting, and furrowing. Direct seeding into scarified soil produced ten times as many seedlings as the other two techniques.

Researchers in Azerbaijan measure the impact of continuous grazing on species composition and the spread of invasive species.

Biodiversity on steppes is rich but only a few species, *Atriplex, Halaxyon*, and *Salsola vermiculata*, are typically used to rehabilitate degraded areas. A study in Syria investigated the potential for establishing 12 other steppe fodder species that have not been tried before. Survival rates were between 60% and 96%.

In Azerbaijan, three species tested for alley cropping – *A. fragrans, S. erassa* and *Kochia prostrata* – showed acceptable survival rates. A. fragrans had a survival rate of 80% and could be used to diversify the range of forage shrubs used to rehabilitate lowlands.

Several grasses were tested for suitability for planting in lowlands. *S. dendroides* and *Kochia prostata,* in particular, did well without irrigation, suggesting they could be useful as fodder crops.

The studies also showed the damage cause by continuous grazing, notably a large increase in invasive species. In Syria, the most invasive species, *Peganum harmala,* covered 34% of the land in open areas but only 4% in protected areas. In Azerbaijan, annual species covered 87% of a protected site compared to 57% on an open site. Clearly, continuous grazing threatens biodiversity, and reduces the ability of plant communities to recover and provide good forage.

The next step is to assess the economic feasibility of alternative agricultural practices compared to continuous grazing and barley cropping. The assessment so far indicates that adoption rates of new technologies by pastoralists could reach 40% for planting shrubs, 90% for periodically resting grazing areas, and 100% for directly seeding fodder shrubs.

MAKING STEPPE LOWLANDS MORE PRODUCTIVE

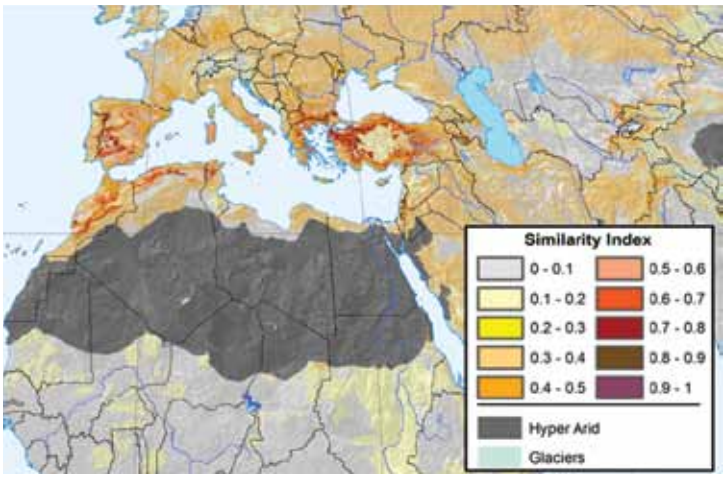
Carefully managed steppe lowlands could serve as feed reserves for livestock, especially in years when rainfall is low. As well as their value for conserving native biodiversity, these areas have a lot of potential for improving livelihoods. Direct-seeded fodder shrubs coupled with periodic resting of grazing areas could help intensify and diversify agriculture, create employment opportunities, and sustain pastoral ecosystems into the future.

FOR FURTHER INFORMATION CONTACT
Mounir Louhaichi Email: M.Louhaichi@cgiar.org

Mapping adaptability zones for small ruminant breeds

An improved understanding of the adaptation of livestock breeds to their production environment is important for many decisions in animal genetic resources management. But adaptation is complex and difficult to measure. One approach is to describe the production environments in which a breed has been kept for some time, and to which it has probably become adapted. The most effective way of doing this is to map the breed's biophysical production environment and link this to existing GIS-based datasets, together with the collection of management environment descriptors using standardized questionnaires.

Map 1: Distribution area of the Dagliç sheep breed in Turkey.



Map 2: Parts of Europe, Africa and Asia are environmentally similar to the 'natural' Dagliç habitat in Turkey.

ICARDA and national partners were commissioned by the FAO to contribute to its global Domestic Animal Diversity Information System by providing characterizations of the environmental conditions in the distribution areas of 85 sheep and goat breeds in four pilot countries – Egypt, Iran, Morocco, and Turkey. The study also developed GIS-based methods for rapid biophysical characterization of breed distribution areas and for identifying new areas where these breeds could potentially be introduced.

BREED DISTRIBUTION AND ECOLOGICAL SIMILARITY

The official breed distribution maps (e.g. Map 1 for the Turkish Dagliç sheep breed) and biophysical characteristics of these areas were analyzed to identify other areas – outside its normal distribution -- where a breed might be adapted. The key was to compare the similarity of the physical environments to their current breed distribution areas.

In similarity analysis, the value of a parameter or index at one location (the 'match' location) is compared with other ('target') locations to quantify the degree of similarity. In our study the match locations were the breed distribution areas. The target area was the entire global land area, except for extreme environments such as glaciers or hyper-arid deserts. The similarity assessment looked at the more permanent biophysical characteristics – climate, topography, soils – rather than land use or land cover. Map 2 shows that many parts of Europe, Africa and Asia are environmentally similar to the distribution area of the Turkish Dagliç sheep breed.

IS SIMILARITY ENOUGH?

Of course, similarity in the biophysical environment is not a sufficient predictor for the success of introduction outside the current breed area, hence the need for descriptors of the management environment, as advocated by FAO's Domestic Animal Diversity Information System approach. However, for most small ruminant breeds in the region, the natural environment is of paramount importance, particularly if the breed is not sheltered and has to thrive on what the environment provides for a major part of the year.

FOR FURTHER INFORMATION CONTACT
M. Fawaz Tulaymat Email: M.F.Tulaymat@cgiar.org

Supplemental irrigation benefits farmers and the environment

Efficient irrigation can boost farmers' profits as well as save a great deal of water and prevent the build-up of salinity in the soil. A study by ICARDA in three Syrian wheat-producing areas measured the economic and environmental impacts of improved supplemental irrigation.

IMPROVED SUPPLEMENTAL IRRIGATION

Using market and non-market valuation methods, researchers determined what difference shifting from traditional supplemental irrigation to improved supplemental irrigation would make. Farmers in Syria use supplemental irrigation to boost yields of wheat in areas where rainfall ranges between 250 mm and 350 mm a year. Traditional, gravity-flow irrigation loses between 10% and 60% of the water from evaporation and seepage. Where land has not been adequately leveled, traditional supplemental irrigation also often leads to over-irrigation and salinization. In Aleppo governate, for example, farmers applied 47% more supplemental irrigation to wheat than the recommended application rate. Improved supplemental irrigation, adopted on more than 22% of wheat-producing areas in Aleppo, Al-Hassakeh, and Daraa provinces, saves at least 120 million m^3 of water a year.

Mobile sprinklers for supplemental irrigation: labor-intensive but low cost, moveable by hand, suitable for small and medium-scale farms.

The study showed that the economic and environmental impacts realized due to the savings in water, depending on how the water saved will be used in future, could amount to US$13.84 million a year. Applying supplemental irrigation by sprinklers would make an even greater economic impact.

The study also indicated that improved supplemental irrigation does not affect soil salinity at the moment and is unlikely to be a problem in the near future. The water table in the wheat-growing areas is deep, at least 40 m below the surface. This means that, even in years when rainfall only amounts to 200 mm, applying 648 mm/ha irrigation would be sufficient to leach 6 deciSiemens per meter (dS/m) surface salt to 1dS/m in one season.

CONSERVING WATER, BOOSTING PROFITS

At the moment farmers do not pay for irrigation water. Charging them for the water they use over the recommended rate of 1800 m^3 could result in most, if not all, farmers adopting improved supplemental irrigation. This would save a further 234 million m^3 of water a year on top of current savings.

Water productivity would also improve, leading to more profit for farmers and giving them another reason to adopt improved supplemental irrigation. Charging for excess water use could increase adoption of sprinklers – currently used over only 41% of the area – boosting farmers' profit further. However, a water-user charge could reduce national wheat production by 4%, mainly because farmers irrigating by surface canal would cut down on the amount of water they apply. If policies succeed in increasing adoption of sprinklers to 78%, then there would be no loss of production.

Water resources in Syria are limited and groundwater levels are falling. The results of the study could help devise policies that encourage farmers to use water wisely and penalize those who do not.

FOR FURTHER INFORMATION CONTACT
Yigezu Yigezu Email: Y.Yigezu@cgiar.org

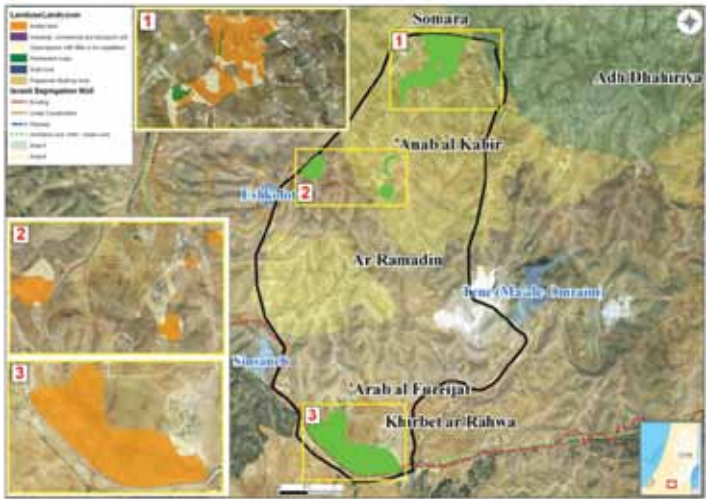
GIS tools help match crops to environments

Matching crops to suitable environments, both biophysical and social, can greatly improve food production. A USAID-funded collaborative program used geographic information systems (GIS) to match land to various land uses – such as permanent tree crops, field crops or rangeland – in Iraq, Jordan, Palestine, and Yemen.

Partners in similar agro-ecosystems across the four countries worked together. As well as land characteristics, researchers took into account local know-how on crop choices and farming practices. In Palestine they mapped areas suitable for permanent tree crops, field crops, and rangeland. In Iraq, Jordan, and Yemen they mapped soils and areas suitable for water harvesting and irrigation.

GIS-ENABLED LAND ASSESSMENT

In Palestine, the study showed that areas suitable for trees have an average precipitation of 320-340 mm, average slopes of less than 4%, and reasonably deep soil. Areas suitable for field crops have an average precipitation of 300-340 mm, slopes of between 4% and 12%, and soils more than 70 cm deep. Areas suitable for rangeland have similar average precipitation to areas suitable for tree crops, but shallower soils and steeper slopes. Using GIS tools researchers integrated this information on maps and identified which areas were suitable for the different kinds of land use.



Benchmark site at Hebron, Palestine: GIS mapping helps identify land that is best suited for field crops.

In Jordan, researchers compared maps showing soils, water harvesting, and suitability for irrigation with maps of current land use. This took into account how farmers actually use the land. Farmers know from long experience which areas are best for particular crops and how to adapt their management practices to deal with any deficiencies. They choose what to grow based on markets, prices, the cost of inputs, the availability of capital, their know-how, and farming traditions, as well as the characteristics of the land. Farmers have found ways of overcoming limitations posed by less than ideal conditions. They grow vegetables in plastic tunnels to deal with low winter temperatures, and plant dwarf varieties, add organic matter, remove stones, and use special training systems to grow tree crops on stony, shallow soils.

In Jordan the study indicated that combining conventional land suitability mapping with information about how farmers actually use land increases the area that is highly suitable for growing vegetables under drip irrigation by 18%, and the area suitable for drip-irrigated trees by 25%.

MAKING LAND SUITABILITY MAPS WORK FOR FARMERS

Determining sustainable uses for land is very important for matching land and land use to improve agricultural productivity in fragile environments. This new approach to mapping land suitability could help plan better use and management of limited resources in these environments. Combining biophysical data – on rainfall, temperature, soil depth, water-holding capacity, slope, stoniness, erosion, and surface cover – with the knowledge of farmers – gained from their generations of practical experience – indicates helps identify ways to adapt production systems in fragile environments to improve system sustainability as well as farmer's livelihoods.

FOR FURTHER INFORMATION CONTACT
Feras Ziadat Email: F.Ziadat@cgiar.org

Lebanon targets seed self sufficiency by 2013

Self-sufficiency in cereals and legumes seeds. That's the aim of a thriving partnership effort in Lebanon to develop, multiply and supply improved varieties of wheat, barley, lentil and chickpea to commercial farmers.

ICARDA is working with the Ministry of Agriculture and the Lebanese Agricultural Research Institute (LARI), alongside leading large-scale local farmers, to build this crucial capacity in-country.

Agriculture Minister Dr Hussein El-Hajj Hassan kicked off the initiative in 2010 with a fund of US$ 1 million and the ambition to reduce imports to a minimum by 2013. Besides improving food security there will be a big saving in foreign expenditure. Recently, Italian imported durum wheat seed has been selling in Lebanon for US$ 1200/ton whilst the new improved varieties from LARI are marketed to farmers at a subsidized rate of US$ 335/ton.

This is the biggest agricultural success story for Lebanon since 1975, says Dr Michel Afram, President-Director General of LARI. For too long domestic food production has been a low priority. Now he's optimistic that a corner has been turned. And he points with optimism to other projects in the pipeline such as the home production of fruit tree stock and the advance of the Government's food safety program.

Tel Amara seed facility, Lebanon. ICARDA is supporting national efforts to scale up seed production of new, high yielding varieties.

NEW VARIETIES, HIGH QUALITY SEED

In agronomic terms the seed self sufficiency effort is focused on proving and multiplying new varieties for Lebanon's conditions, including frost resistance, drought and disease tolerance, while pushing the yield and quality envelope.

Compared to landraces and other older low yielding varieties the project has the capacity to double yield and significantly raise farm incomes. Some 50% of the source germplasm being used is from ICARDA, 40% is of local origin and 10% is from ACSAD – the Arab Centre for the Study of Arid Zones and Dry Lands.

At the Bekaa Valley LARI research headquarters at Tel Amara, Rabih Kabalan – head of the cereals and legume department – says he's optimistic to deliver 4000 tons of commercial wheat seed annually to meet the Minister's 2013 target and 2400 tons of barley seed. For chickpea the target is 167 tons, and lentil 100 tons. New stores are being fitted out, with three seed cleaning and dressing machines due for delivery later in 2012.

After the breeder's (G0) stage, all multiplication (for basic, foundation and certified seed) takes place on commercial farms signed up to the program. They are aided by monitoring and supervision from LARI staff on issues such as irrigation, fertilizers, crop protection and variety rogueing.

To illustrate the growing success of the initiative, some 1696 tons of durum wheat is available for commercial sowing this year (2012). That figure comprises the ICARDA varieties Lahn 2 (1000 tons), Cham 3 (560 tons), Icarasha 2 (100 tons), and the ICARDA/ACSAD variety Douma 1 (36 tons).

New varieties to be released through the program this year include the ICARDA bread wheat MR1009; the ICARDA durum wheats Miki 3, Azeghar, the ICARDA lentil Idleb 2 (ILL 5883) and the ICARDA chickpea Ghab 5 (Flip88-85).

FOR FURTHER INFORMATION CONTACT
Hassan Machlab Email: H.Machlab@cgiar.org

Barley – a strategic crop for resource-poor farmers

Barley is a strategic crop in the dry areas, vital for food, livestock feed, and the livelihood for millions of resource-poor farmers. But barley yields – and R&D investments – are much lower than those of other cereals.

A NEW STRATEGY FOR BARLEY RESEARCH

ICARDA has a global mandate for barley research in the dry areas, with successful (and expanding) work in many parts of the developing world, including North Africa, Central Asia, East and Southern Africa, and West Asia. These regions account for nearly three-quarters of barley area (12.8 million hectares) and two-thirds of barley production (18.2 million tons) in dry areas worldwide. Table 1 summarizes yield and production statistics for these regions. ICARDA's barley research team is using these and other statistics to refine its plant breeding strategies and priorities.

The research challenges are numerous: boosting productivity, helping farmers adapt to climate change, mitigating the effects of globalization on local markets and value chains, and encouraging policy makers to narrow the large gaps in allocated resources (human and financial) to barley compared to other crops.

REDEFINING PRIORITIES

Barley scientists are using a strategic framework to identify research targets and design and implement new initiatives. The components of the framework:

- Focal agro-regions: the program will target countries or regions with high barley area (A) and low yields (Y).
- Focal countries: based on barley area and productivity as well as other criteria such as the potential to provide germplasm to other countries in the same agro-region.
- Spillover/impact countries: based on population, rural poverty, barley use, demand and supply, yield gap (difference between actual and potential yield), as well as area and productivity.

Barley is an important component of the global CGIAR Research Programs (CRPs), which pool skills and resources from multiple CGIAR centers. CRP 3.6 (the program on Dryland Cereals, led by ICRISAT and ICARDA) is key to implementing the new strategy. While activities may begin concurrently, the primary focus will be on North Africa and East and Southern Africa, where barley is a vital food crop in countries with large populations and widespread poverty, such as Morocco and Ethiopia.

Table 1. Priorities fotr barley research: focal agro-regions and spillover/impact countries.

Focal Agro-Regions	Area million hectares	Rank	Production million tons	Rank	Yield t/ha	Rank	Focal countries	Spillover/impact countries and their rank for area (A) and yield (Y)
North Africa	3.5	2	3.7	3	1.05	7	Morocco	Morocco (A2-Y39), Algeria (A9-Y24), Tunisia (A12-Y35) Libya (A15-Y44), Egypt (A25-Y26)
Central Asia	1.9	4	2.4	6	1.23	6	Kazakhstan	Kazakhstan (A3-Y32), Uzbekistan (A23-Y32), Turkmenistan (A27-Y30), Tajikistan (A30-Y23)
East and Southern Africa	1.1	6	1.6	7	1.36	5	Ethiopia	Ethiopia (A7-Y30), Eritrea (A28-Y31), Yemen*(A31-Y28), South Africa (A24-Y4, Kenya (A37-Y12)
West Asia	6.1	1	10.4	1	1.69	4	Syria	Syria (A5-Y46), Iraq (A6-Y45), Jordan (A33-Y38), Armenia (A26-Y18), Georgia (A34-Y47), dry areas of Turkey**
Southern Asia	2.6	3	4.6	2	1.80	3	Iran, India	Iran (A4-Y16), India (A10-Y11), Afghanistan (A14-Y27), Pakistan (A21-Y41)
Latin America	1.2	5	2.9	5	2.43	2	Mexico	Mexico (A13-Y3), Peru (A17-Y9), Uruguay (A18-Y5), Bolivia (A22-Y42), Ecuador (A32-Y13)
Eastern Asia	0.8	7	3.0	4	3.68	1	China	China (A8-Y1), North Korea (A35-Y8), Thailand (A40-Y15), Mongolia (A42-Y33)

* Yemen is included in East Africa because barley is grown in agro-ecologies similar to the highlands of Ethiopia and Eritrea
** Target areas in Turkey (dry environments, low productivity) will be further assessed

FOR FURTHER INFORMATION CONTACT
Flavio Capettini Email: F.Capettini@cgiar.org

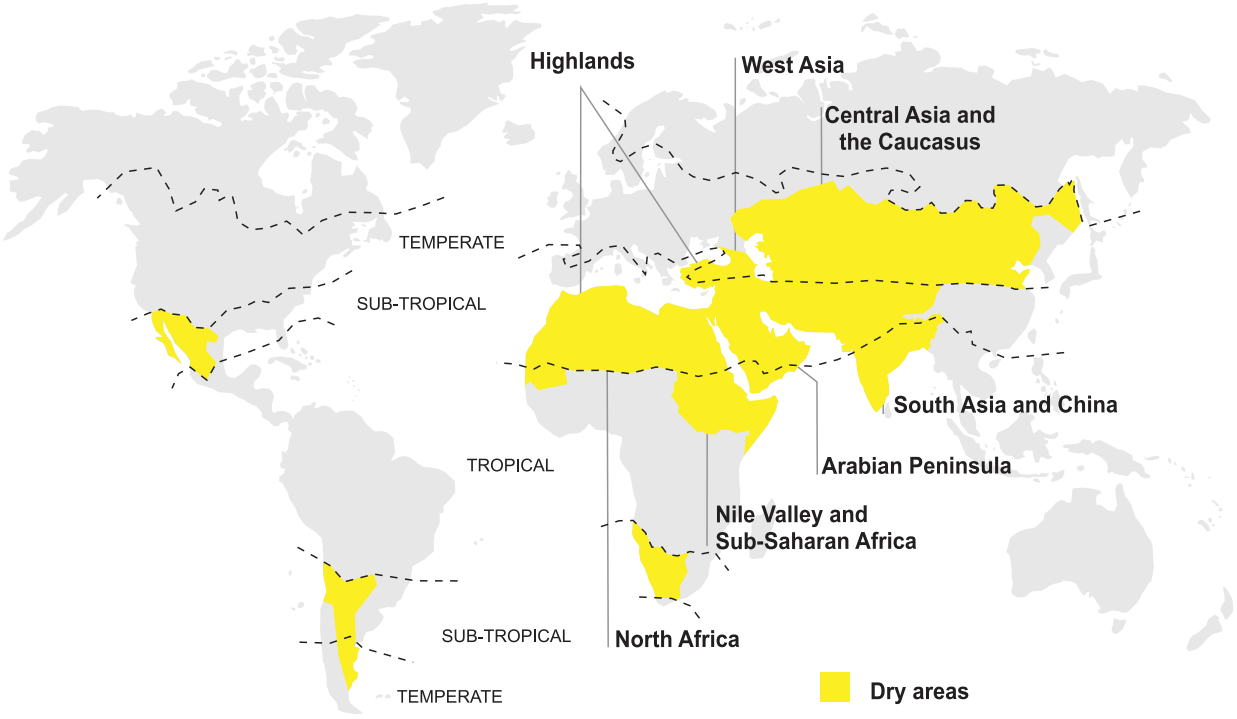
PARTNERSHIPS AND OUTREACH

All ICARDA's work, worldwide, is based on partnerships. We help bring together institutions from different countries, sharing knowledge, skills and resources. Partnerships continued to expand in 2011, with ongoing collaboration broadened, and new partnerships initiated.

H.E. Dr Adel Safar (right), Prime Minister of Syria, with Dr Mahmoud Solh, ICARDA Director General. The Prime Minister, who initiated many of the current Syria-ICARDA projects, promised that government support would continue.

ICARDA's chief partners are national research and extension systems. Frequent meetings, particularly with ministers and other policy makers, ensure that our research supports national and regional development priorities. On the ground, regular interactions with scientists, officials, and extension staff maintain and strengthen these partnerships.

ICARDA hosted visits by the Ministers of Agriculture of Afghanistan, Palestine, Syria and Turkey at its headquarters during 2011. ICARDA's Director General and senior management also met with the Ministers of Agriculture and high-level policy makers in Egypt, India, Jordan, Oman, Sudan and Turkey. These interactions ensure that ICARDA directs its research to priority areas and emerging needs.



ICARDA's regional programs

India-ICARDA partnerships are expanding rapidly. Left to right: H.E. Harish Rawat, Union Minister of State for Agriculture; Dr Mahmoud Solh, ICARDA Director General; Mr Henri Carsalade, Chair, ICARDA Board of Trustees

H.E. Dr Mehment Eker, Turkey's Minister of Agriculture, and Dr Masum Burak, Director General of Agricultural Research, tour research labs at ICARDA's headquarters in Tel Hadya.

EXPANDING IN AFRICA AND ASIA

ICARDA has worked for many years in Africa and partnerships, particularly in sub-Saharan Africa, are expanding. At a meeting in Addis Ababa, Ethiopia, scientists, development experts, and policy makers highlighted priorities for an African food security strategy. Collaborative research by ICARDA and its partners was identified as key to helping transform smallholder agriculture in dry areas across Africa.

In Sudan, ICARDA will work closely with the newly established Agricultural Research Corporation (ARC) Food Security Unit on agro-ecological characterization, irrigation systems, salinity management, and rainwater harvesting. Technologies developed by ARC and ICARDA will be crucial for ensuring food security.

Partnerships in South Asia are also expanding rapidly. The Indian Government is focusing on dryland (rainfed) areas in its agricultural development plans. Rainfed areas account for 60% of India's cropland and support half the total rural workforce. The focus on drylands gives added momentum to ICARDA's partnership with India – one of the strongest NARS globally.

ICARDA is contributing to a major effort launched by R&D institutions in India to boost lentil production in four agro-ecological regions. The collaborative project, funded by the National Food Security Mission, builds on synergies between ICARDA's expertise in dry areas and the strengths of the Indian Council of Agricultural Research (ICAR) institutions in delivering technologies to farmers. The partnership could lead to improvements in food security and rural livelihoods, not only in India, but in many developing countries.

Another key partner is the Bangladesh Institute of Nuclear Agriculture (BINA). ICARDA is working with BINA scientists to expand ongoing collaboration for regional benefit.

To broaden its reach to other Asian countries, ICARDA formally joined the Regional Partnership Framework on Food Security for Asia and the Pacific. Members include the Asian Development Bank, FAO, IFAD, the World Food Program, and the World Bank. The first phase of collaborative research will target six countries – Bangladesh, Cambodia, China, India, Laos, and Nepal.

Turkey is a key partner, providing skills and lessons for sharing with other countries. In 2011, ICARDA's partnership with Turkey on wheat and legumes expanded significantly. Prospects for projects on climate change adaptation and drought tolerance in partnership with the new Konya Drought Management Center are being explored. ICARDA renewed a long-standing Memorandum of Understanding for collaborative research with the Southeastern Anatolian Development Administration.

Syria and ICARDA have worked together closely for more than 30 years. The Syria-ICARDA partnership reached a new milestone with the signing of a Memorandum of Understanding between ICARDA and Syria's Regional Planning Commission. The agreement sets out a research agenda to inform the new National Framework for Regional Planning, and outlines how Syrian research organizations and ICARDA will work together. The aim is to provide analysis and input to inform rural development policy.

The Egypt-ICARDA partnership focuses on food security. Key priorities are improving the productivity of wheat-based systems, increasing on-farm water-use efficiency, and promoting conservation agriculture. A formal protocol is being developed for ICARDA representation on the national task force on wheat and maize, greater investment in capacity development, and collaboration with Egypt to scale out improved technologies to other countries in Africa.

Partners representing the Libyan Agricultural Research Council and Libyan Ministry of Agriculture called on ICARDA to help assess the state of the national agricultural research and extension system, and to help

H.E. Aziz Akhannouch, Morocco's Minister of Agriculture and Fisheries, with Director General Dr Mahmoud Solh. Morocco-ICARDA research partnerships expanded significantly in 2011.

Dr David Malone (center), IDRC President, visited ICARDA's headquarters in March, to discuss funding opportunities for research on poverty alleviation, food security and environmental sustainability.

rebuild the country's agricultural sector. As a first step, ICARDA sent seeds of wheat, barley, legume, and forage crops for the 2011/12 cropping season to Libya and gave Libyan scientists priority for training.

Jordan, Palestine, and ICARDA identified areas for expanding collaboration. These include rehabilitating research stations, training staff, protected agriculture, herbal plants, and conservation of genetic resources.

Uzbekistan is expanding its research partnerships with ICARDA. A new thrust, in addition to on-going work on bread wheat, is the development of heat- and drought-tolerant durum wheat.

SUPPORT FROM DEVELOPMENT INVESTORS

During the year, IFAD, AFESD, FAO, and other donors continued their support for ongoing projects. The Kuwait Fund scaled up support, contributing to the food security project funded by AFESD and IsDB.

FAO and ICARDA are working together to develop project proposals and workplans to expand ongoing collaboration on food security, water scarcity and climate change adaptation. IFAD and ICARDA explored new initiatives to build on their long-standing strategic partnership.

A REGIONAL APPROACH

ICARDA's network of regional programs and country offices coordinates partnerships with national research systems, helping to disseminate new technologies to farming communities, and channeling feedback on research needs to scientists. This network is crucial in harnessing synergies to address the complexity of dryland systems and the scale of the challenges. The regional programs provide technical support, training, and other resources to complement the skills, resources, and local knowledge of partner organizations.

This regional approach exploits opportunities of scale. Most agro-ecological zones span national borders. Different countries share similar constraints, meaning that technologies developed and tested at pilot sites can be adapted and scaled out to similar agro-ecological zones in other countries. Planning and implementing research from a regional (as opposed to national) perspective enables ICARDA and its partners to generate huge benefits from relatively small investments.

Nile Valley and Sub-Saharan Africa Regional Program

Activities in Egypt, Eritrea, Ethiopia and Sudan, with spill-over benefits to other countries in Africa

Countries in the Nile Valley and sub-Saharan Africa share a number of common problems, including low agricultural productivity, limited water resources, food insecurity, and vulnerability to climate change. ICARDA's partnerships in the region have helped develop innovative solutions, and scale out new technologies from pilot sites, to surrounding farming systems, and to other countries. The regional program aims to develop and promote high-yielding, disease-resistant crop varieties, improved resource management methods, and livestock technologies for small-scale households.

NEW FARMING TECHNOLOGIES

Eight new varieties of barley, durum wheat and faba bean, derived from ICARDA material, were released in Egypt and Ethiopia in 2011.

A USAID-funded initiative, 'Rapid deployment of high yielding, rust resistant wheat varieties' has reached over 4000 farmers in Ethiopia, Sudan, Eritrea, and Egypt. In collaboration with national institutions, over 150 tons of seed of improved wheat and legume varieties were distributed in Egypt, and over 200 tons in Ethiopia.

The program on 'Enhancing food security in the Arab region' has helped scale out improved wheat varieties and cultivation methods. Raised-bed planting technology developed by ICARDA and Egypt's Agricultural Research Center reduced water use by 30%. Adoption of this technology has increased from about 4000 acres last season to over 15,000 acres in the 2011/12 season, driven by clear economic benefits to farmers.

Field day in Egypt: promoting new technologies that allow farmers to obtain higher yields with less water and fertilizer.

In Ethiopia, a watershed development project in the Amhara region promotes simple, low-cost technologies for soil and water management. The project is funded by the Austrian Development Agency and implemented jointly by ICARDA, Amhara Regional Agricultural Research Institute and Boku university. Farmers in the project areas were able to increase yields by up to 100% and reduce soil erosion by 50%.

In Eritrea, a GIS study produced 'suitability maps' analyzing the potential for rainwater harvesting in the Zoba Debub area. Based on the findings – which showed that 70% of the Zoba area is suitable for micro-catchment harvesting – the government is constructing water harvesting systems at two sites, with more to follow.

An IFAD-funded project, 'Improving livelihoods of rural communities', focuses on integrated management of crops and livestock, targeting Egypt, Eritrea, Ethiopia, Sudan and Yemen. Project teams are identifying and testing new technologies and policy options to improve incomes, productivity, and climate-change resilience in agriculture.

BUILDING CAPACITY

Several training programs and field days were conducted in 2011. One example: training for livestock producers in Egypt, focusing on three areas: use of existing and new feed resources to combat feed shortages, adaptive measures against climate variability and change, and processing methods to produce value-added products for sale. The program was run in collaboration with CIRAD, INRA-France and ARC-Egypt.

UPCOMING PROJECTS

Ongoing pilot programs will be scaled out, including community-based livestock breeding, improving water productivity and irrigation efficiency, and management of salt-affected soils. Future plans include research on salinity management, cropping systems, climate change adaptation, rust-resistant varieties and seed systems.

In Ethiopia, ICARDA is part of a new consortium, with the Ministry of Agriculture and other partners, aiming to double the adoption of improved kabuli chickpea, from 20% currently to 40% in the next 5 years.

North Africa Regional Program

Activities in Algeria, Libya, Mauritania, Morocco and Tunisia

Scarce water severely limits agriculture in North African countries but is only one of many constraints. Many of the challenges farmers face are similar across large parts of the region. The Program works with partners to generate technologies and research findings that can be widely applied, not just in one area but across many countries.

One example is the introduction of a low-cost seed drill (developed in Syria) to Algeria, Morocco and Tunisia as part of a project to assess the potential for conservation agriculture to boost productivity in Africa. The findings of case studies in Morocco and Tunisia will be scaled out to other countries in the region.

RESEARCH HIGHLIGHTS

In 2011, unrest suspended work in Libya but work elsewhere forged ahead. Ongoing projects in Morocco and Tunisia evaluated water management technologies, and technologies for irrigating olives and mountain crops. Several studies identified ways to improve food security in the region. The findings of case studies on conservation agriculture in Morocco and Tunisia were shared at a regional meeting, and one involving all African countries. Research on natural resource management assessed the impact of afforestation on the climate and soil in Bou-Hedma National Park in Tunisia, and a project investigating how eco-tourism can contribute to sustainable management of drylands is being run in collaboration with NGOs.

Several IFAD-funded initiatives to empower rural women were continued. In the Middle Atlas, analyses of value chains for medicinal and aromatic plants were completed. Groups of women in Morocco and Algeria were helped to et up associations to produce and market herbs, saffron, wool, handicrafts, and goat cheese.

Sharing experiences: Moroccan women farmers demonstrate home-made value-added products from aromatic and medicinal plants.

Projects at the National Gene Bank in Tunisia, backstopped by ICARDA, focused on improving the productivity and quality of meat in Barbary sheep, and conserving indigenous seed. Products derived from indigenous seed have potential for niche markets.

COLLABORATION

A regional coordination meeting involving partners, and international donors and institutions, was held to set research priorities and plan work in five Maghreb countries. The Regional Program also took part in an international meeting on national drought policies. Two workshops provided opportunities to share findings of the Program's work on climate change and food security.

NEW PARTNERSHIPS

A new project funded by the African Development Bank on staple crops – rice, maize, cassava, and wheat – will involve three CGIAR centers, African research centers and international and regional institutions.

Morocco, India, ICARDA, ICRISAT, and the Swaminathan Foundation are finalizing a regional initiative on food legumes to improve nutrition.

PLANS FOR 2012

In 2012, the Program will work to re-establish collaboration with Libya, and to get projects in Mauritania and Algeria underway. Following up on a scoping mission, and visits to Morocco and Tunisia by representatives of Australian institutions, a regional project on conservation agriculture is being developed for funding by Australia.

West Asia Regional Program

Partnerships in Cyprus, Iraq, Jordan, Lebanon, Palestine, Syria and lowland Turkey

West Asia spans a range of agro-ecosystems, but common problems – scarce water, a highly variable climate, land degradation – occur throughout. The regional program brings together partners from across the region to share experiences and knowledge to address these problems. For example, new technologies for using recycled water, developed in Jordan, are being applied in Palestine. Proven technologies for conservation agriculture are being extended to new areas in Iraq under an AusAID-ACIAR funded project.

A new project in Iraq and Jordan to improve food security in rainfed barley systems could lead to findings that help livestock farmers in other countries adapt to climate change. The results of an IFAD-funded project in Lebanon and Morocco could lead to ways to manage scarce water more effectively in mountain agriculture.

COLLABORATIVE RESEARCH

In Palestine, farmers are testing ways of using treated wastewater and grey water safely in agriculture. The project is supported by the Arab Fund for Economic and Social Development and the Netherlands government. A travelling workshop took Palestinian farmers to Jordan, to see first-hand how these technologies are being used in home gardens, crop fields and research stations, to maintain production despite severe scarcity of regular irrigation water.

Palestinian farmers select varieties best suited to conditions on their own farms, under a project funded by the Netherlands.

BUILDING PARTNERSHIPS

In 2011, the Palestinian National Authority and ICARDA signed a landmark Memorandum of Understanding. Following the agreement, training for technical staff from the West Bank and Gaza and hands-on training for farmers helped projects get quickly underway.

Green Plan Lebanon has joined the IFAD-funded project to improve water management in mountain agriculture.

Coordination and planning meetings in each country helped align research to national and regional priorities. These included a key meeting to develop strategies to control wheat rust in Iraq.

CAPACITY DEVELOPMEN

During 2011, field schools on integrated pest management and the use of organic fertilizer were arranged for 126 wheat and date farmers, and 38 scientists and extension staff in Iraq. Changes in the amount of chemical pesticides and fertilizers farmers use will be tracked. The findings could benefit wheat and date producers far beyond the region.

In Palestine, 22 technical staff and 120 farmers were trained on best practice for field crops production technologies. 35 technical staff from Jordan, Iraq, Lebanon and Palestine attended ICARDA training courses on seed production, conservation agriculture, water productivity, genetic resource conservational and socioeconomic studies.

LOOKING AHEAD

ICARDA and the National Agricultural Research Center established a Genetic Resource Unit and trained Palestinian technicians to conserve, evaluate, and use germplasm. The unit will play a major role in conserving regional genetic resources.

Future plans include two major ACIAR-funded projects; on conservation agriculture in Iraq (funding has been approved for a new 3-year phase, which will focus on disseminating earlier findings to three northern governorates) and a new project on livestock, for which implementation will begin in 2012.

Central Asia and Caucasus Regional Program

Activities in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan in Central Asia; and Armenia, Azerbaijan and Georgia in the Caucasus

The eight countries in Central Asia and the Caucasus share a number of biophysical and socio-economic commonalities. The dry steppe and other agro-ecologies span multiple countries. ICARDA's regional approach is well suited to such circumstances.

Research on winter wheat is helping farmers across the region, and providing raw material for plant breeders globally. An IFAD-funded mohair processing program to create new income opportunities for women began in Tajikistan, and has been scaled out to Kazakhstan and Iran. Studies on climate change adaptation, initiated in four countries in 2010, will lead to results applicable to similar agro-ecologies in many different countries.

CROP IMPROVEMENT

Much of the region experienced severe drought spells during the 2010/2011 crop season, and crop yields were well below average. This heighted the importance of regional collaboration – sharing information, resources and facilities – to develop new stress-tolerant varieties.

ICARDA provided national research programs with improved germplasm of winter and spring wheat, barley, and legume crops (chickpea, lentil, faba bean, grasspea). The improved materials have high yield potential, superior grain quality, and are suited to cropping system and environmental conditions (salinity, drought, heat, cold, and pests) in the region.

ICARDA and its national partners have stepped up efforts to mitigate the impact of the virulent Ug99 strain of wheat stem rust should it enter the region, as is likely. The disease could affect 95% of all currently planted cereal grain varieties in CAC. In 2011, wheat rust surveillance was conducted in Azerbaijan, Georgia, Tajikistan, and Uzbekistan.

Field day in Central Asia. Extension brochures, plus farmer-extension-researcher interactions, are helping to disseminate new technologies.

CLIMATE CHANGE ADAPTATION

ICARDA and its partners have developed a participatory approach to discovering and spreading knowledge about adaptation across the region – a mix of mountains and desert/semi-desert areas. The self-help potential of local communities and their readiness to shift to more sustainable production options is remarkable in this region. In 2011 ICARDA-CAC introduced pastoral user groups, fenced seed isles, and seasonal grazing within a unique community-based climate adaptation approach which will likely prove useful in other parts of the world.

The crop-simulation model CropSyst is being used to assess the impact of climate change on wheat production through the ICARDA-IFPRI multi-disciplinary project for Central Asia and China, funded by the Asian Development Bank. Partners include Kazakhstan, Kyrgyz Republic, Tajikistan, and Uzbekistan. This has led to recommendations on improving management practices for better adaptation to climate change.

WIDENING PARTNERSHIPS, BUILDING SKILLS

ICARDA's Tashkent office hosts the facilitation unit for the largest agricultural research consortium in the region, comprising 11 national and international centers. The consortium links researchers from different countries, and helps tap global expertise for agricultural development in Central Asia and the Caucasus.

ICARDA's capacity development initiatives in 2011 included training courses on field experimental design and analysis as well as writing research manuscripts, organized in Uzbekistan for young researchers from Azerbaijan, Georgia, Kazakhstan and Uzbekistan. In partnership with Tajikistan's Livestock Institute, women involved in the mohair livelihood project were trained on design and marketing of high-value woolen products. Workshops on genebank management and germplasm documentation, evaluation and use attracted 50 researchers from across the region.

Arabian Peninsula Regional Program

Activities in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen

Most countries in the Arabian Peninsula share the same challenges: acute scarcity of water and arable land, and heavy dependence on food imports. ICARDA uses a regional approach to address these challenges simultaneously in multiple countries. The Arabian Peninsula Regional Program (APRP) aims to enhance rural livelihoods and agricultural productivity by transferring promising technology packages.

TECHNOLOGY ADOPTION

A regional project supported by the Arab Fund for Economic and Social Development and IFAD is helping to transfer new technologies to pilot growers, and encourage further dissemination through farmer-to-farmer communication. By December 2011, the project had reached more than 85% of the targeted pilot sites in the seven countries of the Arabian Peninsula.

Adoption of integrated production and protection management (IPPM) techniques by growers in Yemen increased incomes by 22% by increasing yields and drastically reducing the number of sprays needed. Similarly in Oman, where nine new growers adopted IPPM during 2011, applying such techniques combined with soilless production systems practically eliminated whitefly infestations.

ICARDA-APRP has simplified soilless production systems (hydroponics) enabling them to be used on medium- and small-scale farms, significantly improving yields and water productivity. In Oman, six new pilot growers adopted hydroponics for cucumber production, saving 13 m^3 of water per ton as compared to soil-based systems.

Protected agriculture offers huge improvements in water productivity, and allows farmers to grow high-value crops in very dry areas.

RESEARCH HIGHLIGHTS

In UAE and Qatar, research on hydroponics aims to enhance sustainability, reduce installation costs, increase water and land productivity, and reduce pesticide use.

In Oman, preliminary results of a water productivity study show that the optimum irrigation rate for buffel grass, which out-yielded Rhodes grass, is 15,000 m^3/ha. In Yemen, research on three varieties of buffel grass ('Gayandah', 'USA', and 'Biloela') showed that 'Gayandah' with 3.3 t/ha gives the highest yield.

A regional project, "Development of sustainable date palm production systems", funded by the Gulf Cooperation Council, has made major advances. The project includes three major components: problem solving research, transfer of proven technologies, and capacity building for national researchers. Research is helping to address several constraints: low yields, poor packaging and presentation, limited range of industrial date products, lack of technological knowhow, poor management of natural resources (land and water), and insect pests. Highly effective, time- and labor-saving liquid pollination techniques have been introduced in most GCC countries. New initiatives have been launched on quality assurance and postharvest handling to reduce wastage and improve the marketability of dates.

CAPACITY BUILDING, PARTNERSHIPS

During the year, ICARDA-APRP organized three training courses and six field days attended by 175 growers, researchers, and extension agents.

APRP's 4th Annual Regional Technical Coordination Meeting and Regional Steering Committee Meeting were held in Doha in December. The meetings were organized jointly with the Ministry of Environment, Qatar.

LOOKING AHEAD

Discussions with national policy makers have helped identify focus areas, for example protected agriculture, indigenous forages, and improvement of water-use efficiency. The regional program will continue to identify partnership and funding opportunities to support agricultural research and natural resource conservation throughout the Peninsula.

South Asia and China Regional Program

Activities in Bangladesh, Bhutan, China, India and Nepal

The countries targeted by this Regional Program are extremely diverse. The common thread is the critical importance of rainfed agriculture to national food security, and the need to accelerate technology dissemination to smallholder farmers in dry areas.

ICARDA aims to build on synergies with two of the world's largest agricultural research programs – in China and India – to generate benefits across the whole region and to share globally the lessons learnt from the remarkable growth in agriculture in these two countries. This effort is supported by the government of India, the Australian Centre for International Agricultural Research, and the CGIAR's HarvestPlus program.

RESEARCH AND TECHNOLOGY TRANSFER

Resilient, protein-rich legumes such as lentil, chickpea and grasspea are an invaluable part of the region's diet. In 2011, ICARDA and its partners throughout the region have continued to develop and distribute new, higher-performing varieties of these crops, as well as promoting effective new ways of cultivating them.

Improving nutritional quality of legumes has been a major focus in South Asia, home to 50% of the world's most under-nourished people. ICARDA's network has continued to push forward the cultivation of iron- and zinc-rich lentil varieties such as 'Barimasur-4', '-5' and '-6'. These are now being grown on over 110,000 hectares of land across Bangladesh, Nepal, and India.

Field day in Bangladesh. Research partnerships have produced new legume varieties, improved cropping systems, and other technologies.

The discovery and introduction of higher-yielding species has been another progress area. One example is the further propagation of a drought-resistant and higher-yielding strain of faba bean ('Yundou 147') in China. This improved crop now covers 50,000 hectares.

Lentil varieties 'Moitree' and 'NDL-1', released previously, are growing in popularity in India. The new lentils yield up to 54% (Moitree) and 91% more than local varieties.

New, fast-growing varieties of pulses – some taking just 90 days to mature – were introduced in north-west Bangladesh as a second crop for rice farmers. Instead of leaving their harvested paddies fallow all winter, ICARDA is encouraging many rice farmers to boost both household income and the fertility of their land by using conservation agriculture techniques to grow pulses as 'relay' crops.

WIDENING PARTNERSHIPS, BUILDING SKILLS

ICARDA was involved in a number of capacity-building meetings, seminars, and training programs during the year. One grassroots-based intervention trained 150 women across the region to add value to raw pulse products, namely chickpeas, lentils, and mung beans. The women learned how to store, split, process, and package the pulses.

Other courses helped build national research skills. For example, a six-day workshop organized in collaboration with the Indian Institute of Pulses Research, Kanpur, covered the use of GenStat statistical software and other tools for data analysis.

ICARDA delegations met with national research leaders and policy makers to identify common research interests; participated in scientific meetings; and co-hosted several major events, including an international workshop that helped boost cactus cultivation in the South Asia.

MOVING FORWARD

Several new initiatives are expected to come on-stream in 2012. These include the India-Morocco food legume initiative; research projects on rabi pulses (winter cultivation in the postrainy season); and multipurpose cacti for food, livestock feed and other uses.

Highlands Regional Network

Activities cover highland ecologies in Afghanistan, Iran, Pakistan and Turkey

AFGHANISTAN

In cooperation with local stakeholders and with funding from the Netherlands, ICARDA scientists identified two chickpea, two barley, and five wheat (three rainfed and two Ug99-resistant) varieties for potential release in Afghanistan.

ICARDA introduced sub-surface irrigation, and demonstrated the use of water harvesting and supplemental irrigation, increasing rainfed wheat yields by up to 80%.

Two village-based seed enterprises (VBSEs) and two herbal remedy producers' associations (HRPAs) were established in Uruzgan province. VBSEs received intensive training and support to produce certified seed. During the year, these VBSEs produced 8 tons of certified seeds of improved wheat varieties. Utilizing the training and resources provided, HRPAs have successfully begun production and marketing of value added products providing farmers with another source of off-farm income.

A project funded by IFAD and the Ministry of Agriculture, Irrigation and Livestock trained Afghan women in goat husbandry and hygienic milk production. After the second year, women reported that their annual income had increased by $150 on average. The pass-on-the-gift scheme – one of the project's most significant achievements – supplied goats to 450 women. After extensive testing under local conditions, a drought resistant species of saltbush (Atriplex) was introduced to overcome fodder shortages.

ICARDA provided major inputs into the development of national policies on dryland agriculture and the wheat sector, and helped organize the country's first National Workshop on Dryland Agriculture. New proposals for collaborative research were developed jointly with ICRISAT and UNEP.

The Program trained over 3300 Afghan researchers, extension workers, university students, and community members, including more than 2700 women, and funded 36 Afghan stakeholders (including four women) to attend training courses or meetings outside Afghanistan. Over 1000 farmers participated in 13 farmers' field days around the country. Ten technical bulletins were published and three radio programs on the promotion of food legumes were broadcast.

IRAN

The 1st Regional Winter Wheat Symposium was held in June in Tabriz. Over 100 participants reviewed winter wheat-based farming systems and collaboration between NARS and ICARDA and CIMMYT.

The 1st Regional Expert Meeting on Highland Agriculture was held in Karaj in November in collaboration with the Agricultural Extension, Education and Research Organization and the Seed and Plant Improvement Institute. The 175 participants reviewed the potential and constraints facing agricultural development in the cold highlands. The draft Review Report on the CWANA Highlands commissioned by ICARDA in 2009, including

An IFAD-funded project has supplied goats to 450 Afghan women, and significantly improved household incomes.

Maragheh, Iran: wheat scientists interact with farmers during a symposium that brought together over 100 scientists from nine countries.

proposed research priorities and elements of a research strategy for improving resilience of rural livelihoods and agricultural productivity was also discussed.

A joint project between the Animal Science Research Institute and ICARDA on the processing and export of cashmere, wool and mohair is being implemented in Baft (Kerman province). Collection of baseline information is underway.

Proposals for the second phase of the CGIAR's Karkheh River Basin Project were reviewed jointly with scientists from the Agricultural Extension, Education and Research Organization.

One barley and two bread wheat varieties selected from ICARDA germplasm were released by the Dryland Agricultural Research Institute.

Two training programs helped build skills among national researchers: a workshop on certification of food legume seed for staff of the Seed and Plant Certification and Registration Institute; and one on faba bean breeding for staff of the Seed and Plant Improvement Institute.

PAKISTAN

Research in Pakistan, conducted in partnership with federal and provincial research institutes, focused on water-saving technologies, wheat seed production and delivery systems, and cotton-wheat cropping systems (developing cotton varieties resistant to leaf curl virus). Field trials and demonstrations helped promote low-cost wheat technologies such as ridge-making and relay cropping. Ridges increased yields while reducing water consumption by 20-30%. Relay cropping (timely planting of wheat in a standing cotton crop) increased yield by up to 30%.

Two new projects were initiated, on watershed rehabilitation and irrigation improvement, and on cotton (germplasm enhancement, virus resistance, management practices).

Field days provided hundreds of farmers the opportunity to see ridge making and relay cropping technologies for water saving. Training courses on these technologies were also conducted for over 100 extension and technical staff. Annual and quarterly meetings provided a forum for many different national organizations to share results and strengthen collaborative research programs.

Looking ahead, ICARDA is working with national research centers and funding agencies to develop new initiatives to expand seed production in food legumes and forage/fodder crops. This will support national efforts to improve nutrition and increase milk and meat production.

TURKEY

The International Winter Wheat Improvement Program (IWWIP) is a joint breeding program between Turkey, CIMMYT, and ICARDA. Over 40 cultivars have so far been released in 11 countries and the adoption of new cultivars is increasing in the region. In 2011, three high-yielding, disease-resistant cultivars selected from IWWIP material, Rijaw, Konditerskaya, and Ayyildiz, were released in Iran, Kazakhstan, and Turkey, respectively.

A new Memorandum of Understanding between Turkey and ICARDA was signed during the visit of H.E. M. Mehdi Eker, Minister of Agriculture and Rural Affairs, to ICARDA. Another MoU was signed between Turkey's Southeastern Anatolia Regional Administration (GAP) and ICARDA in January.

Two collaborative project proposals have been prepared by Turkish NARS and ICARDA. The first is on developing drought-tolerant wheat germplasm and the second is on Awasi sheep. Two chickpea cultivars, 'Hasanbey' and 'Seckin', selected from ICARDA material were released by Turkish NARS.

An IWWIP Traveling Seminar toured Turkey, Bulgaria, and Romania visiting research institutes, evaluating material and holding half-day meetings. There were 66 participants from 15 countries.

The ICARDA-Tottori University, Japan, Drought Workshop was held in Konya, Turkey, with over 50 scientists from 10 countries. Presentations focused on drought tolerance and climate change mitigation.

Training programs were conducted for junior scientists from the region on wheat breeding, quality and statistics. IWWIP and NARS in Turkey held a 4-month course for 70 young researchers to improve their proficiency in English.

Partnerships in Turkey: new agreement on collaborative research, signed by Mr Sadrettin Karahocagil, GAP President, and Dr Mahmoud Solh.

CAPACITY DEVELOPMENT

Capacity development is at the heart of ICARDA's mandate. In 2011, more than 1000 researchers and nearly 4000 farmers benefited from training courses, workshops, field days and other opportunities. Other participants included graduate students, extension workers, members of women's cooperatives, and agri-business entrepreneurs.

Women make the difference: training workshop on integrating gender into research.

ICARDA's capacity development efforts are supported by a range of organizations, notably the Arab Fund for Economic and Social Development (AFESD), Japan International Cooperation Agency (JICA), ACIAR, IFAD and USAID. In addition, research projects, funded by various donors, almost always include a major capacity development component.

In 2011, more than 1000 researchers from 47 countries benefited from training courses and internships. Another 55 scientists and 18 interns are working towards Masters or PhD degrees, co-supervised by ICARDA and their universities.

Training courses covered a range of topics: water management, genetic resources, biotechnology, seed production, crop management, conservation agriculture, experimental design and analysis, biometrics, biophysical characterization, modeling, gender perspectives and other areas. Field days to promote new technologies attracted thousands of farmers as well as government and NGO extension staff.

GLOBAL KNOWLEDGE, LOCAL RELEVANCE

In Afghanistan, 36 researchers and some 3600 farmers – including 2000 women – built skills in new crop and livestock technologies.

Training programs in Palestine covered new crop varieties, water management (recycling treated grey water and wastewater for irrigation) and genebank management.

In India, workshops and train-the-trainers programs helped promote new lentil technologies, to support national efforts. Another training program for scientists from Bangladesh, India and Nepal, focused on biometric techniques to design and analyze data from multi-environment trials.

A training program in Uzbekistan, attended by scientists from Azerbaijan, Georgia, Kazakhstan and Uzbekistan, focused on design and analysis of field experiments.

Conservation agriculture: an Australia-ICARDA team trains farmers, researchers, extension staff and entrepreneurs.

Field day at Terbol, Lebanon: seed producers learn about new varieties, crop management, and mechanical harvesting.

Graduate students from Egypt and the USA learn new project evaluation skills, as part of the Water and Livelihoods Initiative.

Following an intensive nine-week course, researchers from Azerbaijan, Egypt, Ethiopia, Iraq, Sudan and Syria are now familiar with the use of biotechnology tools for crop improvement.

Training on GIS and modeling techniques helped researchers from Ethiopia, Jordan, Lebanon, Morocco, and Syria characterize land-use types in different agro-ecosystems, to better match crop to environment.

A program funded by Australia continued to upgrade skills in conservation agriculture. Following a training course on tine and disc zero-till, equipment manufacturers from Iraq and Syria have the knowledge to design and build seeding machines.

A training course on gender perspectives provided staff from Egypt, Jordan, Lebanon, Palestine and Syria with the skills to design gender-aware research programs.

Several initiatives focused on seed production. In Egypt, researchers and field staff from 24 governorates sharpened their skills in wheat seed production. In Lebanon, seed producers learnt about new varieties, crop management and mechanization. A training course for regulatory staff from Afghanistan, Algeria, Nepal, Syria, and Sudan has helped improve seed quality control and ensure that only healthy seed is exchanged or shipped.

Horticulture and system diversification were other important areas. Extension staff from Syria and Morocco learnt about new methods for olive irrigation, in a training course jointly organized with Spain and Morocco. A workshop on date production helped accelerate technology transfer in six countries across the Arabian Peninsula.

HONORS AND AWARDS

Dr Mahmoud Solh, ICARDA Director General, received the Award of Distinction from the College of Agricultural and Environmental Sciences, University of California, Davis. He was honored for his research as well as his role in building international research and development partnerships.

Dr Alessandra Galié, sociologist, received the Storm-van der Chijs Award from Wageningen University. The award is given to selected women PhD students enrolled at the university.

Dr Atef Haddad, agronomist, was honored for a research paper written jointly by the conservation agriculture team, "Environmental impact of conservation agriculture in Syria". The award was presented by Syria's Minister of Environment.

Dr Mounir Louhaichi, rangeland ecologist, was elected member of the Continuing Committee for the International Rangeland Congress. He represented North Africa and Middle East in this global initiative.

Dr Rajinder Malhotra, chickpea breeder, received the International Service in Crop Science Award from the Crop Science Society of America. He was honored for his many contributions as a plant breeder and mentor to young researchers.

Dr Mohammed El Mourid, Coordinator of ICARDA's North Africa Regional Program, received the national agricultural award from the government of Morocco, for his contributions as a scientist and research manager, in promoting agricultural development in North Africa.

Dr Javed Rizvi (Country Manager) and his team at ICARDA-Afghanistan were honored by the Ministry of Agriculture, Irrigation and Livestock. The citation commended their role in introducing and promoting new agricultural technologies in Afghanistan.

Dr Mohammad Roozitalab, Coordinator, Iran-ICARDA Program, was elected by the Soil Science Society of Iran as a Distinguished Soil Scientist for his long-term contributions to the discipline.

Dr Ashutosh Sarker, Coordinator, South Asia and China Regional Program, was honored by the government of Nepal for his role in developing legume technologies to improve the livelihoods of Nepalese farmers.

APPENDICES

APPENDIX 1: VARIETIES RELEASED IN 2011, DEVELOPED FROM ICARDA MATERIAL

Crop	Country	Name	Characteristics
Bread wheat	Armenia	Kristina	High yield, good adaptation
	Armenia	Syunik	High yield, good adaptation
	Georgia	Lomtagora 109	Cold and drought tolerant winter wheat, disease resistant, high yield, good grain quality
	Iran	Rijaw	Suitable for cold and moderate areas
	Iran	Karim	Suitable for warm and semi warm areas
	Kazakhstan	Konditerskaya	High yield, adapted to Central Asian conditions
	Turkey	Ayyildiz	High yield, good grain quality
Durum wheat	Algeria	Beni Mestina	High yield potential, excellent grain quality
		Ammar 6	Drought tolerant, responsive to improved conditions, high yellow pigment
	Morocco	Faraj	Good resistance to Septoria tritici and to leaf rust
	Turkey	Gundus	Drought tolerant, responsive to improved conditions, high yellow pigment
	Iran	Saj 1	Drought tolerant, high yield stability
	Ethiopia	Werer	Good yield and yield stability, resistance to multiple rust diseases
Barley	India	UBP 1008	Two-row feed barley for northern hill areas
	Iran	Khorram	Suitable for warm and semi warm areas
	Egypt	Giza 133	High yield, suitable for irrigated environments
	Egypt	Giza 134	High yield, suitable for irrigated environments
	Egypt	Giza 135	High yield, adapted to rainfed and irrigated conditions
	Egypt	Giza 136	High yield, suitable for irrigated environments
Chickpea	Turkey	Hasanbey	Height suitable for mechanical harvesting, tolerant to Ascochyta blight, large seeds
	Turkey	Seckin	Height suitable for mechanical harvesting, tolerant to Ascochyta blight, large seeds
Lentil	Bangladesh	BARIMasur-7	Resistant to Stemphylium blight and other diseases
Faba bean	Egypt	Nubaria 2	Early maturing, drought tolerant, large pods and seeds
	Egypt	Misr 3	Orobanche resistant, high yield
	Egypt	Sakha 4	Suitable for early planting, resistant to chocolate spot
Grasspea	Bangladesh	BARIKhesari-3	Safe for consumption, with low beta-ODAP

APPENDIX 2: PUBLICATIONS

During the year 2011, ICARDA scientists produced nearly 200 scientific publications, including 147 papers in refereed journals, as well as information brochures, training manuals, and a range of other material for researchers and extension agents. Some of these publications are listed below.

PAPERS IN REFEREED JOURNALS

Abbeddou, S.,Rischkowsky, B.,Hilali, M.,Hess, H.D.,Kreuzer, M. 2011. Influence of feeding Mediterranean food industry by-products and forages to Awassi sheep on physicochemical properties of milk, yoghurt and cheese. Journal of Diary Research. 78(4): 426-435. (En).

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APPENDIX 3: DONORS AND INVESTORS

MAJOR DONORS, CUMULATIVE, 1977 TO 2011

USA (incl USAID, USDA)
World Bank
Germany
United Kingdom
IFAD
Netherlands
Arab Fund (AFESD)
European Commission
Italy
Australia
Canada
CGIAR (incl Consortium and Challenge Programs)
Sweden
Norway
Desertification Trust Fund
Iran
Libya ARC
Japan (incl JICA, JIRCAS)
IDRC
UNDP
Denmark
OPEC Fund
Egypt
France
Syria
Ford Foundation
Switzerland
Belgium
Austria
FAO
Asian Development Bank
Gulf Cooperation Council
Pakistan
India
Cornell University
Yemen
Saudi Arabia
Morocco
Spain
Turkey
Global Crop Diversity Trust
Tottori University
China
UNEP
UNCCD
Islamic Development Bank
Ethiopia
Finland
South Africa
Mexico
Peru

MAJOR DONORS IN 2011*

CGIAR Consortium
Australia
USA (incl USAID, USDA)
IFAD
Netherlands
Arab Fund (AFESD)
India
European Commission
Germany
Gulf Cooperation Council
Libya ARC
Belgium
Austria
Syria
Japan (incl JICA, JIRCAS)
Switzerland
FAO
IDRC
Morocco
Impulsora Agricola
Italy
Cornell University
Global Crop Diversity Trust
Asian Development Bank
Islamic Development Bank
Tottori University
Turkey
Iran
OPEC Fund
Common Fund for Commodities
Coca Cola Foundation
Portugal

* Donors contributing above $ 100,000 in year 2011

APPENDIX 4: AUDITED FINANCIAL STATEMENTS

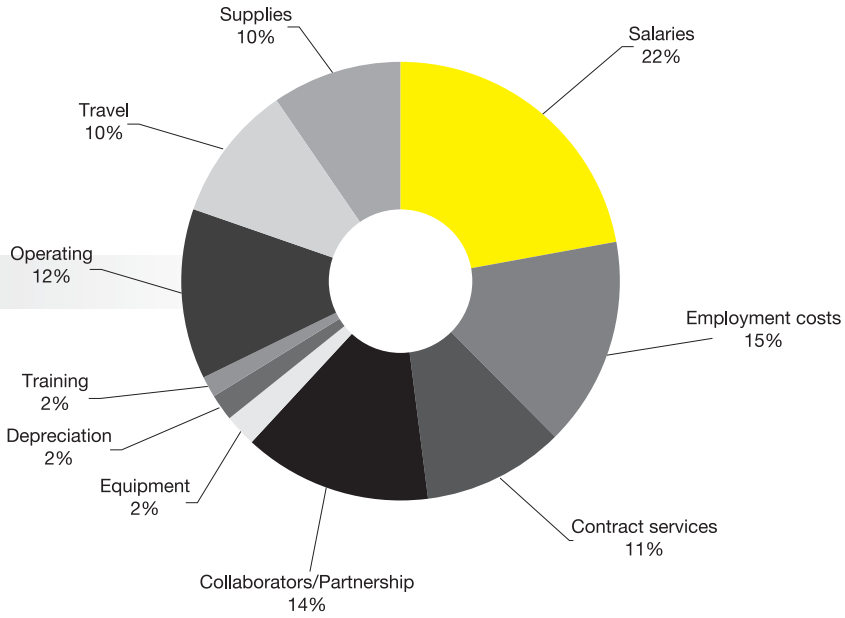
Statement of Activity (US$x000)	2011	2010
REVENUES		
Grants (Core and Restricted)	35,898	38,194
Other revenues and gains	1,478	676
Total revenues and gains	37,376	38,870
EXPENSES AND LOSSES		
Program related expenses	33,723	34,300
Management and general expenses	5,979	6,079
Other losses and expenses	-	97
Total expenses and losses	39,702	40,476
Indirect costs recovery	(2,665)	(2,639)
Net Expenses and losses	37,037	37,837
SURPLUS (DEFICIT)	339	1,033

Statement of Financial Position (US$x000)	2011	2010
ASSETS		
Current assets	40,435	43,795
Property & equipment	4,961	4,047
Other Assets	-	-
Total assets	45,396	47,842
LIABILITIES AND ASSETS		
Current liabilities	23,196	25,590
Long term liabilities	6,785	7,176
Total liabilties	29,981	32,766
Net Assets = Reserves	15,415	15,076
Total liabilities & net assets	45,396	47,842

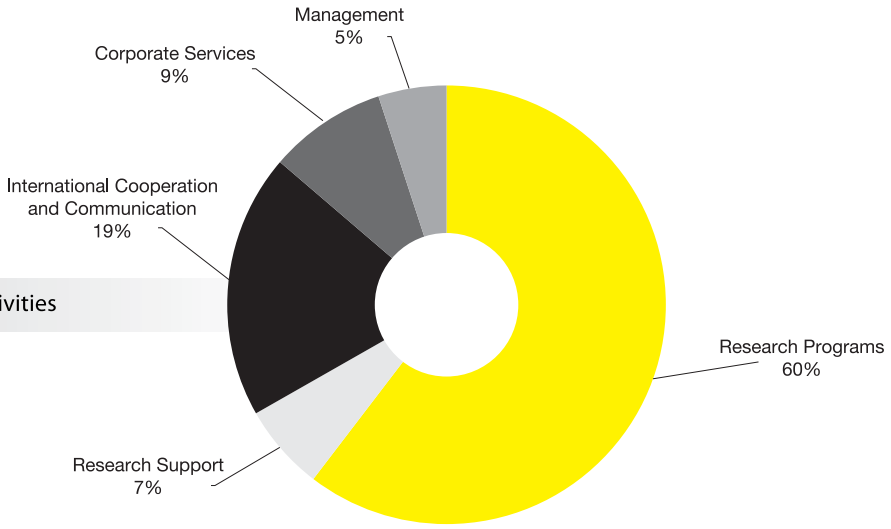
Statement of Grant Revenues, 2011 (US$x000)	
DONORS	Amount
Arab Fund for Economic and Social Development	2,229
Australia*	3,971
Austria*	542
Belgium*	693
Challenge Programs	406
CIAT - CRP	1,490
CGIAR	1,332
Cornell University, USA	263
Egypt -ARC	275
European Commission	1,127
Food and Agriculture Organization	407
Germany*	1,011
Gulf Cooperation Council	868
Impulsora Agricola, S.A. de C.V.	270
India	1,279
International Development Research Center	333
International Fund for Agricultural Development	2,704
Italy	266
Kuwait Fund	393
Japan	418
Libya	849
Morocco	280
Switzerland*	435
Syria*	500
Consortium of International Agricultural Research Centers*	5,248
The Netherlands*	2,474
United States of America	2,499
United States Department of Agriculture	569
Miscellaneous	2,767
TOTAL	35,898

* Donors that provided core funds

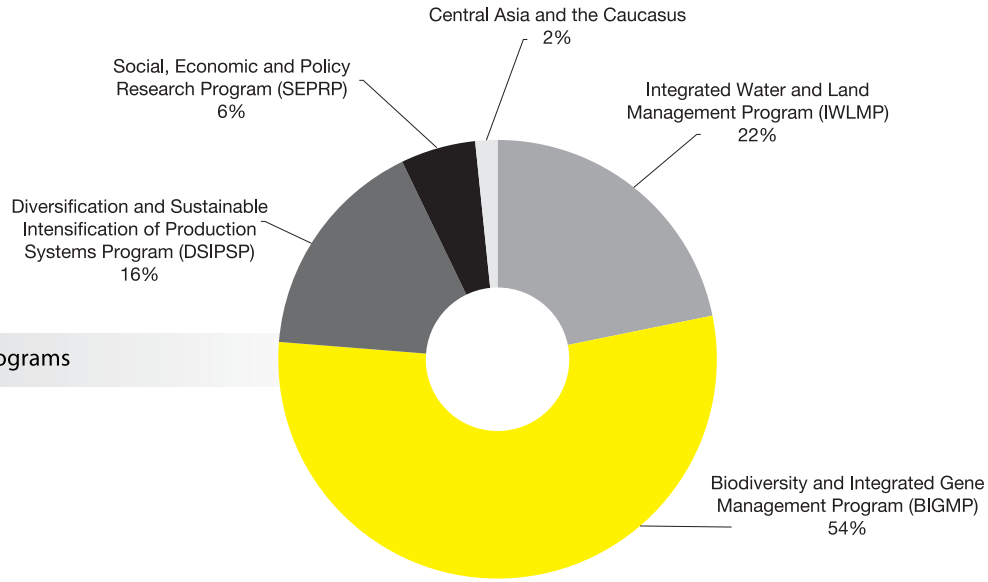
Expenditures by Category



Expenditures By Program and Activities



Expenditures by Research Programs



APPENDIX 5: BOARD OF TRUSTEES

Mr Henri Carsalade (France)
Board Chair
President, Agropolis Foundation, France
Expertise: agronomy

Dr Mona Bishay (Egypt)
Vice Chair
Consultant, International Fund for Agricultural Development
Expertise: economics, project and program evaluation

Dr Michel Afram (Lebanon)
President and Director General
Lebanese Agricultural Research Institute
Expertise: agricultural education and policy

Dr Eve Bosak (Australia)**
Director and CEO, Governance Asia Pty Ltd, Australia
Expertise: accounting, finance, corporate strategy

Dr Masum Burak (Turkey)
Director General of Agricultural Research
Ministry of Agriculture and Rural Affairs, Turkey
Expertise: horticulture

Mr John Coleman (Canada)
Coleman, Duffett & Associates, Canada
Expertise: international trade, finance and development

Dr. Naif Al Salti (Syria)**
Director General, General Commission for Scientific Agricultural Research (GCSAR)
Ministry of Agriculture and Agrarian Reform, Syria
Expertise: agriculture, policy and planning

Dr Susan Schram (USA)
Vice President, Outreach and Cooperative Programs
Agricultural Coop. Development International/Volunteers in Overseas Cooperative Assistance (ACDI/VOCA), USA
Expertise: international agriculture, rural development

Mr Nader Sheikh Ali (Syria)
Director General, International Cooperation Division
State Planning Commission, Syria
Expertise: economics and planning

Dr Mahmoud Solh (ex officio)
Director General, ICARDA
Expertise: plant genetics

Ms Petal Somarsingh (USA)*
Principal, Financial Management Consultant
Olympus Management, USA
Expertise: management and administration

Dr Paul Steffen (Switzerland)
Director, Agroscope Reckenholz-Tanikon Research Station
Zurich, Switzerland
Expertise: agronomy, research management and policy

Mr Fawzi Al-Sultan (Kuwait)
Senior Partner, F & N Consultancy, Kuwait
Expertise: finance and development

Dr Mohammed Walid Tawil (Syria)*
Director General, General Commission for Scientific Agricultural Research (GCSAR)
Ministry of Agriculture and Agrarian Reform, Syria
Expertise: agriculture, plant breeding

Dr Carl-Gustaf Thornström (Sweden)
Associate Professor, Dept. of Plant Biology and Forest Genetics
Swedish University of Agricultural Sciences
Expertise: genetic resources, intellectual property rights

Dr Camilla Toulmin (United Kingdom)
Director, International Institute for Environment and Development, UK
Expertise: development economics, climate change

* completed term in 2011
** joined the Board in 2011

APPENDIX 6: SENIOR STAFF (AS OF 31 DECEMBER 2011)

OFFICE OF THE DIRECTOR GENERAL

Dr Mahmoud Solh, Director General
Dr Elizabeth Bailey, Executive Assistant to the Director General and Board Secretary
Dr Hiroaki Nishikawa, Consultant – Direction
Mr Ali Abu Hanish, Internal Auditor
Mr Bashir Al-Khouri, Consultant - Legal
Ms Houda Nourallah, Administrative Officer - DG/BOT
Ms Nora Hinnawi, Secretary – Executive

OFFICE OF THE DEPUTY DIRECTOR GENERAL - RESEARCH

Dr Maarten van Ginkel, Deputy Director General - Research
Dr Murari Singh, Senior Biometrician
Mr Khaled Al-Sham'aa, Specialist - Experimental Research Informatics
Mrs Ourouba Zein el-Deen, Secretary - Executive

GOVERNMENT LIAISON

Dr Majd Jamal, Assistant Director General - Government Liaison
Mr Mohamad Nabil Traboulsi, Assistant National Research Coordinator

CORPORATE SERVICES

Mr Koen Geerts, Assistant Director General - Corporate Services
Ms Lama Aswad, Physical Plant Officer
Ms Dalida Nalbandian, Purchase & Stores Manager
Mr Waheed S. Quader, Head - Physical Plant Unit
Ms Nuha Sadek, Secretary - Executive
Ms Hanaa Sharif Swar, Head of Damascus Office
Mrs Mary Street, Secretary – Executive
Dr Ammar Talas, Consultant - Medical

Finance

Mr Erwin Navarro Lopez, Director of Finance
Miss Anne Wambui Kabuthu, Finance Officer
Miss Ralda Gareg, Finance - Budget Officer
Mr Ghiath Nahas, Accounting Supervisor
Mr Govindaswamy Saravanan, Consultant
Mr Mohamed Samman, Treasury Supervisor
Mrs Imelda Silang, Accounting Manager
Ms Nahla Assal, Accountants Associate

Human Resources

Mr Nellooli P. Rajasekharan, Director of Human Resources
Miss Lobna Al-Fahili, Administrator - Resourcing
Ms Lina Yazbek, Administrator - HR Services
Ms Mary Malki, Administrator - Reward Management
International School of Aleppo
Mrs Shirley Ann Davis-Phillips, School Head
Miss Raghad Rahwan, Secretary - Executive
Mr Munzer Kastaly, Accountant - IISA

Station Operations

Mr Antoine Shomar, Assistant Farm Manager
Mr Bahij El-Kawas, Senior Supervisor – Horticulture
Mr Abdul Wahab Kabbani, Foreman Fabrication Workshop
Dr Hassan Machlab, Lebanon Country Manager

Visitors Services

Ms Hiba Eimesh, Coordinator - Visitors Services

RESEARCH PROGRAMS

Biodiversity and Integrated Gene Management (BIGM)

Dr Michael Baum, Program Director, BIGM
Dr Ahmed Amri, Head of GRS/Deputy Director of BIGMP
Dr Abdullah Bari, Genetic Resources Scientist
Dr Adnan Al-Yassin, Barley Breeder
Dr Aladdin Hamwieh, Associate Scientist - Chickpea Breeding
Dr Ali Shehadeh, Research Associate
Dr Amor Yahyaoui, Coordinator, ICARDA-CIMMYT
Dr Flavio Capettini, Barley Breeder
Dr Fouad Maalouf, Faba Bean Breeder
Dr Francis C. Ogbonnaya, Senior Biotechnologist
Dr Izzat Sidahmed Ali Tahir, Wheat Breeder
Dr Kenneth Street, Legume Germplasm Curator
Dr Kumarse Nazari, Cereal Pathologist
Dr Masanori Inagaki, JIRCAS Scientific Representative
Dr Miloudi Nachit, Durum Wheat Breeder
Dr Muhammad Imtiaz, Chickpea Breeder
Dr Mustapha El-Bouhssini, Entomologist
Dr Osman Abdalla El Nour, Bread Wheat Breeder
Dr Safaa Kumari, Plant Virologist
Dr Seid-Ahmed Kemal, Pulse Pathologist
Dr Shiv Kumar Agrawal, Lentil Breeder
Dr Siham Asaad, Head of ICARDA Seed Health Laboratory
Dr Sripada M. Udupa, Senior Scientist, Biotechnology
Dr Stefania Grando, Barley Breeder
Dr Wuletaw Tadesse Degu, Senior Scientist - Wheat Breeding
Dr Zewdie Bishaw, Head - Seed Unit
Dr. Manickavelu Alagu, Associate Scientist, Biotechnology
Mr Abdoul Aziz Niane, Scientist
Mr Adonis Kourieh, Research Associate
Mr Ala'a Yaljarouka, Research Associate
Mr Ali Abdullah Ismail, Research Associate
Mr Bilal Humeid, Research Associate I
Mr Fouad Jabi El-haramein, Research Associate
Mr Gaby Khalaf, Research Associate
Mr Haitham Kayyali, Research Associate
Mr Hani Nakkoul, Research Associate
Mr Hasan Al-Hasan, Research Associate
Mr Henry Pachayani, Research Associate
Mr Jan Konopka, Germplasm Documentation Officer
Mr Michael Michael, Research Associate
Mr Mohamed Fawzy Nawar, Documentation Specialist
Mr Munzer Alnaimi, Research Associate
Mr Samer Lababidi, Geneticist
Mr Samer Murad, Research Associate
Mr Samir Hajjar, Training Coordinator
Mr Tawffiq Istanbuli, Research Associate
Ms Fida Alo, Research Associate
Ms Rita Nalbandian, Secretary - Executive
Ms Sawsan Tawkaz, Research Associate
Ms Suhaila Arslan, Assistant Manager, International Nurseries

Integrated Water and Land Management (IWLM)

Dr Theib Oweis, Program Director, IWLM
Dr Ahmed Mohammed Al-Wadaey, Post Doctoral Fellow
Dr Fadi Karam, Irrigation and Water Mgmt Specialist
Dr Feras Ziadat, Soil Conservation/Land Mgmt Specialis
Dr Manzoor Qadir, Manager - ACIAR-Iraq Salinity Projects
Dr Mohammed Karrou, Water and Drought Mgmt Specialist
Dr Rolf Sommer, Soil Fertility Specialist
Dr Vinay Nangia, Agricultural Hydrologist
Mr Anas Al-Qari, NRS - Soil Conservation & Land Management
Mr Osama Douba, NRS - Irrigation and Water Management
Mr Pierre Hayek, Research Associate

Diversification and Sustainable Intensification of Production Systems (DSIPS)
Dr Rachid Serraj, Program Director, DSIPS
Dr Asamoah Larbi, Pasture and Forage Production Specialist
Dr Aynalem Haile, Small Ruminant Scientist - Breeding & Genetics
Dr Barbara Ann Rischkowsky, Senior Livestock Scientist (Small Ruminants Management)
Dr Colin Piggin, Project Leader, ACIAR/AusAID Iraq Project
Dr David Earle Feindel, Cropping Systems Agronomist
Dr Hafid Achtak, Post Doctoral Visiting Scientist – CIRAD
Dr Jane Wamatu, Associate Scientist - Animal Nutritionist
Dr Mounir Louhaichi, Range Ecology & Mgmt Scientist
Dr Muhi El-Dine Hilali, Research Associate
Dr Ravi Gopal Singh, Cropping Systems Agronomist
Dr Veronique Alary, Agro-Economist - CIRAD
Dr Serkan Ates, Forage Scientist
Miss Sawsan Hassan, Research Associate - Forage Systems
Mr Atef Haddad, Research Associate - Agronomy
Mr Fahim Ghassali, Research Associate
Mr Mohamad Amin Khatib Salkini, Research Associate
Mr Yaseen Khalil, Research Associate
Ms Monika Zaklouta, Research Associate I

Social, Economic and Policy Research (SEPR)
Dr Aden Aw-Hassan, Program Director, SEPRP
Dr Ahmed Mazid, Agricultural Economist
Dr Farouk Shomo, Socio Economist Researcher
Dr Malika Martini Abdelali, Socio-economist, Community & Gender Analysis Specialist
Dr Yigezu Atnafe Yigezu, Agricultural Economist
Dr Boubaker Dhehibi, Agricultural Resource Economist
Dr Roberto Telleria Juarez, Agricultural Policy Specialist
Mr Hisham Salahieh, Research Associate
Mr Tamer El-Shater, Research Associate

SUPPORT SERVICES

Capacity Development
Dr Iman El-Kaffass, Head - Capacity Development Unit
Mr Afif Dakermanji, Training Officer
Ms Laurice Abdul Majid, Officer - Administrative Material & Audiovisual Services

Communication, Documentation and Information Services
Mr Michael Devlin, Head - CODIS
Mr Ajay Varadachary, Communication Specialist
Mr Bernhard Hack, Visiting Scientist
Mr Majdi Kebbe, Translator/Translation Coordinator
Mr Manaf Hamam, Electronic Publishing Associate
Mrs Siba Darouzi, Library & Information Services Manager

Geographic Information Systems
Dr Eddy De-Pauw, Head, GIS Unit
Dr Wolfgang Goebel, Acting Head, GIS Unit
Dr Weicheng Wu, Remote Sensing Specialist
Mr Ahmed Hamoud, Research Associate - Meteorological
Mr Mohamed Fawaz Tulaymat, GIS Analyst
Mr Wolfgang Goebel, Acting Head Head, GIS Unit
Mr. Jalal Eddin Omari, Scientific Software Developert

Information Technology
Mr Colin Webster, Manager - ITU
Dr Fadil Rida, MIS Applications Specialist
Mr Ahmad Al-Mously, Web Developer
Mr Avadis Toubal Garajian, Network Administrator
Mr Hashem Abed, Senior Coordinator - Software Development
Mr Michael Sarkisian, Senior Systems Engineer
Mr Mohy-el-din Ammouneh, MIS Database Administrator
Ms Malake Ballouz, MIS Applications Analyst
Ms Samira Maksoud, Secretary - Executive

INTERNATIONAL PARTNERSHIPS

Dr Kamel Shideed, Assistant Director General - International Cooperation and Communication
Ms Amira Diab, Secretary - Executive

Arabian Peninsula Regional Program
Dr Ahmed Tawfik Moustafa, Regional Coordinator - APRP
Dr Azaiez Ouled Belgacem, Consultant - Range Ecology & Management
Dr Mohammad Al-Abid, Date Palm Specialist

Central Asia and Caucasus Regional Program
Dr Jozef Turok, Head of the Program Facilitation Unit, CGIAR Program for CAC and the Regional Coordinator
Dr Barno Tashpulatova, Research Fellow
Dr Nilufar Fazilbekova, Coordinator Bioversity-CWANA
Dr Nurali Saidov, Research Fellow
Dr Ram C. Sharma, Breeder
Dr Stefanie Christmann, Researcher, Env. Governance
Dr Zakir Khalikulov, Deputy Regional Coordinator
Mr Murat Aitmatov, Research Fellow
Mr Nariman Nishanov, Project Field Research Coordinator

Nile Valley and Sub-Saharan Africa Regional Program
Dr Fawzi Karajeh, Regional Coordinator - NVSSAP
Dr Geletu Bejiga, Consultant - Country Manager - Ethiopia
Dr Atef Swelam, On Farm Water Management Specialist

North Africa Regional Program
Dr Mohammed El-Mourid, Regional Coordinator - NARP
Mr Hakim Boulal, National Project Coordinator - Morocco

South Asia and China Regional Program
Dr Ashutosh Sarker, Regional Coordinator – SACRP and Food Legume Breeder

West Asia Regional Program
Dr Nasri Haddad, Regional Coordinator - WARP
Dr Mohamed Boufaroua, Water Resources Engineer
Mr Abdallah Alimari, National Project Coordinator - Palestine

Afghanistan
Dr Syed Javed Hasan Rizvi, Country Manager
Mr Abdul Rahman Manan, Senior Agriculture Advisor
Mr Syed Tehseen Gilani, Administrative and Finance Officer

Iran
Dr Zieaoddin Shoaei, Iran/ICARDA Technical Coordinator

Pakistan
Dr Abdul Majid, Senior Professional Officer, Pakistan

Turkey
Dr Mesut Keser, Consultant - Country Manager

Project Development and Grants Management
Mr Tareq Bremer, Grants Management Officer
Mrs Martha Bonilla, Proposal Writing Officer

APPENDIX 7: ACRONYMS

AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa
ACIAR	Australian Centre for Interna tional Agricultural Research
AfDB	African Development Bank
AFESD	Arab Fund for Economic and Social Development
APRP	Arabian Peninsula Regional Program
ARC	Agricultural Research Center
AusAID	Australian Agency for International Development
AVRDC	Asian Vegetable Research and Development Center
BARI	Bangladesh Agricultural Research Institute
BINA	Bangladesh Institute of Nuclear Agriculture
CAC	Central Asia and Caucasus
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (France)
CRP	CGIAR Research Program
CWANA	Central and West Asia and North Africa
FAO	Food and Agriculture Organization of the United Nations
FONTAGRO	Fondo Regional de Tecnología Agropecuaria (Regional Fund for Agricultural Technology)
GIS	geographic information systems
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
ICBA	International Center for Biosaline Agriculture
ICH	Institute of Crop Husbandry (Tajikistan)
ICRISAT	International Crops Research Institute for the Semi-Arid-Tropics
IDRC	International Development Research Centre (Canada)
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IIPR	Indian Institute of Pulse Research
INRA	Institut National de la Recherche Agronomique (France, Morocco)
INRGREF	Institut National des Recherches en Genie Rural, Eaux et Forets, Tunisia
IPCC	Intergovernmental Panel on Climate Change
IPPM	integrated production and protection management
IsDB	Islamic Development Bank
IWWIP	International Winter Wheat Improvement Program
JICA	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences
MoU	memorandum of understanding
NARS	national agricultural research systems
NCARE	National Center for Agricultural Research and Extension (Jordan)
ODAP	oxalyl diaminopropionic acid
OFID	OPEC Fund for International Development
PGRA	Plant Genetic Resources for Agriculture
RAIN-WANA	Regional Agricultural Information Network for West Asia and North Africa
SWAT	Soil and Water Assessment Tool
UAE	United Arab Emirates
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNU-INWEH	United Nations University - Institute for Water, Environment & Health
USAID	United States Agency for International Development
VBSE	village-based seed enterprise
WANA	West Asia and North Africa
WIP	Wheat Improvement Program (ICARDA and Egypt Agricultural Research Center)
WLI	Water and Livelihoods Initiative

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

P.O. Box 5466, Aleppo, Syria.
Tel: +963 21 2213433, 2225112, 2225012
E-mail: ICARDA@cgiar.org
Website: www.icarda.org