

France and ICARDA

Ties that Bind



International Center for Agricultural Research
in the Dry Areas

About ICARDA and the CGIAR



Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 15 centers supported by the CGIAR. ICARDA's mission is to contribute to the improvement of livelihoods of the resource-poor in dry areas by enhancing food security and alleviating poverty through research and partnerships to achieve sustainable increases in agricultural productivity and income, while ensuring the efficient and more equitable use and conservation of natural resources.

ICARDA has a global mandate for the improvement of barley, lentil and faba bean, and serves the non-tropical dry areas for the improvement of on-farm water use efficiency, rangeland and small-ruminant production. In the Central and West Asia and North Africa (CWANA) region, ICARDA contributes to the improvement of bread and durum wheats, kabuli chickpea, pasture and forage legumes, and associated farming systems. It also works on improved land management, diversification of production systems, and value-added crop and livestock products. Social, economic and policy research is an integral component of ICARDA's research to better target poverty and to enhance the uptake and maximize impact of research outputs.



The Consultative Group on International Agricultural Research (CGIAR) is a strategic alliance of countries, international and regional organizations, and private foundations supporting 15 international agricultural Centers that work with national agricultural research systems and civil society organizations including the private sector. The alliance mobilizes agricultural science to reduce poverty, foster human well being, promote agricultural growth and protect the environment. The CGIAR generates global public goods that are available to all.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD) are cosponsors of the CGIAR. The World Bank provides the CGIAR with a System Office in Washington, DC. A Science Council, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

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Cover photograph: Experiments on a farmer's field near Toulouse. ICARDA is part of an INRA project to develop improved wheat breeding populations from traditional landraces.

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The government of France and a number of French research organizations have supported ICARDA's work for more than 30 years. This support has helped to significantly improve farm productivity, incomes and livelihoods in dry and marginal areas, and strengthen national research and development capacity in a number of developing countries.

This document describes some of the successes achieved by France-ICARDA partnerships, and the opportunities for further collaboration.

Foreword

I am pleased to share the latest publication in our Ties that Bind series, summarizing the achievements made through partnerships between French institutions, developing-country research organizations, and ICARDA. France and ICARDA indeed have ties that bind them: a shared commitment, shared goals, and complementary areas of expertise.

ICARDA's research mandate covers non-tropical dry areas – and a large proportion of these areas lies in the Mediterranean basin, including North Africa and the Near East. France has a special interest in both regions, and this was the catalyst for a long and highly productive partnership between the government of France, French research institutions and universities, and ICARDA. In terms of synergies, French expertise in modern biotechnology and other 'new science' perfectly complements ICARDA's experience in both upstream and adaptive research, and its close ties with national research and development agencies in the Mediterranean basin.

Since the early 1970s, France has been a funder and supporter of the CGIAR system, of which ICARDA is a part. The major share of this support has come through staff secondments, where French expertise is made available to international research centers. Under this arrangement, scientists from CIRAD and INRA have been outposted to ICARDA headquarters, and to our regional offices in Tunisia and Egypt.

Partnerships with France have not only strengthened our science, but our governance as well. ICARDA has been fortunate to have four eminent French agricultural experts on our Board of Trustees: Alfred Conesa, Joseph Casas, Michel de Nuce de Lamothe, and our current Board Chair, Henri Carsalade. They have been part of our governance team, helping to set priorities and shape our research-for-development agenda.

This booklet describes some of the highlights of collaborative research in various areas: biotechnology and crop improvement, crop-livestock systems, socio-economics, and natural resource

management. French funding and expertise have enabled ICARDA, through its partnerships, to make significant contributions to food security, capacity development, and sustainable agricultural development of dry areas.

The ties between France and ICARDA were forged more than 30 years ago, and continue to grow stronger. I am confident that new programs such as the CIRAD-INRA French Initiative for International Agricultural Research will build on previous work, and lead to significant improvements in the productivity and sustainability of Mediterranean farming systems.

A handwritten signature in black ink, appearing to read 'Mahmoud Solh', written in a cursive style.

Mahmoud Solh
Director General, ICARDA

Message from the ICARDA Board Chair

I am delighted to be able to contribute some thoughts on the cooperation between France and ICARDA, having been a strong promoter of that cooperation on both sides, and having worked to strengthen that cooperation over time. ICARDA always remembers that France was among the 14 countries and institutions that together established the Center and was among its earliest donors. ICARDA also recognizes, given the geography and history of France, the special interest of the French in the Mediterranean and dry areas, and particularly in North Africa and the Middle East.



Since the 1970s, France and ICARDA have been partners in strategic research issues and scientific programs and activities. Together, they support agriculture in the dry areas, where many poor farmers strive to make a living, and where fragile resources are under increasing pressure. Agricultural production remains the foundation for development in many countries in the dry areas – making economic and social development more important than ever. I will not list the many initiatives and the various fora where France and ICARDA have worked together to defend the principles of sustainable and equitable development to improve rural welfare and protect the environment.

ICARDA and French institutions have a long history of successful agricultural research in dry areas. They have maintained continuous and significant cooperation in a variety of research areas, based on exchange of scientists, joint programs, scientist interactions and information sharing. Scientists from France have worked and are working at ICARDA's headquarters and its outreach stations. Research has focused on thematic areas identified by both parties. There is a lively and dynamic context of working together, which should lead in the near future to promising new developments.

We see evolution both in the CGIAR and in French policies: our world is moving. In this time of change I shall continue to work hard to increase and strengthen this collaboration for the benefit of the CGIAR, ICARDA and the French research establishment, and to achieve our shared goals of alleviating poverty, enhancing food security, and securing the sustainable development of dry areas.

Henri Carsalade

Chair, ICARDA Board of Trustees and
Chair, Governing Board, Agropolis Foundation



On-farm research site in Syria. Barley producers from ten countries – including members of the Réseau Semences Paysannes in France – share experiences on variety selection and crop management.

Long term commitment

French funding support to ICARDA totals nearly US\$ 7 million. About one third of this has been unrestricted funding for ICARDA's research and training activities. The remaining has helped to support specific collaborative projects, mainly in the southern Mediterranean region of North Africa and West Asia.

Twenty French scientists have been full time ICARDA staff since the Center was established in 1977. Many others have served as consultants and technical advisers. Four French professionals have served on ICARDA's Board of Trustees; the current Board Chair is Dr Henri Carsalade, former Director General of CIRAD and currently Chair of the Governing Board of the Agropolis Foundation.

Our research partners in France

- Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD)
- Centre National de la Recherche Scientifique (CNRS)
- Ecole Nationale Supérieure d'Arts et Métiers (ENSAM)
- Institut National de la Recherche Agronomique (INRA)
- Institut de Recherche pour le Développement (IRD)
- Institut Technique de l'Agriculture Biologique (ITAB)
- Several universities including Université de Paris-Sud, Paris X, Montpellier SupAgro, Montpellier and Rennes

Biotechnology

ICARDA is widely acknowledged as a leading biotechnology research and training center for dry areas. Much of the credit goes to France, which helped establish the biotech laboratory, develop the research portfolio and oversee its management in the initial stages.

The laboratory was established in 1988 with a grant from the government of France and additional support from the United Nations Development Program. A researcher from IRD helped standardize laboratory protocols; experts from ENSAM/INRA and the Université de Paris-Sud served on the Biotechnology Steering Committee for several years in the 1990s.



ICARDA's biotech lab, set up with French funding, is internationally recognized as a research and training center.

Doubled haploids. The doubled-haploid system is a powerful tool for plant breeders. It not only shortens – by several years – the time needed to develop a new crop variety, but also makes it easier to target specific traits. A team from INRA, Université de Paris-Sud and ICARDA have developed and standardized doubled-haploid techniques for barley and wheat, and trained researchers in the use of these techniques. Algeria, Iran, Iraq, Morocco, Sudan and Tunisia are now using doubled-haploid systems in their breeding programs. In 2005, two new heat-tolerant bread wheat varieties, developed (by researchers trained at ICARDA) using doubled-haploid lines, were released in Sudan.

Drought-tolerant barley. A joint study by Montpellier SupAgro and ICARDA provided new insights into the genetics of drought tolerance in barley. The researchers identified quantitative trait loci (QTLs) in the barley genome that influence yields and plant



Collaborative research is helping to improve drought tolerance in popular barley varieties (such as Rihane, shown here).

characteristics in dryland environments, and analyzed gene-environment interactions at multiple locations. The study showed, for example, that the same allele could have different effects under different conditions (e.g. moderate versus severe drought). Ongoing studies are building on this work, examining a wider range of germplasm and analyzing differences in the expression and genetic variation in the identified genes. The results are helping to develop new barley varieties adapted to marginal, drought-prone environments.

Gene expression analysis. Drought tolerance is a complex trait, influenced by multiple factors – but can it be improved by manipulating only a few key genes? CIRAD, Montpellier SupAgro and ICARDA were partners in a study that helped identify potential key genes, understand allelic variation in these genes, and develop lab protocols to test the expression and effect of these genes in

different crops. For example, six candidate genes were identified that could play a central role in determining how well plants cope with dehydration. Dehydration response is crucial, because it determines the plant's ability to survive not only drought, but also low temperatures and soil salinity. The team studied these genes in five crops; ICARDA worked on barley, other centers on other components. Their results represent an important addition to the global knowledge base on drought tolerance.

Conserving and using biodiversity

The Mediterranean Basin and the Fertile Crescent region have an extraordinarily rich genepool, of many of the world's most important crops. ICARDA and French institutions are working together to protect this biodiversity, and use it to develop new crop varieties.

One example is a project by INRA-Rennes, ENSAM/INRA, Université de Paris-Sud and ICARDA, which studied the wild relatives and progenitors (genera *Triticum* and *Aegilops*) of wheat. The team identified sources of resistance to a number of important stresses: drought, a virus disease, two species of nematodes, three kinds of rust disease and the Hessian fly. Project outputs have also been 'leveraged' by other partners. Several resistance genes have been transferred from wild wheat to cultivated varieties – offering higher yields with reduced use of chemical pesticides.



Resistance genes are being transferred from wild wheat into cultivated varieties, to protect crops against the Hessian fly.

Another project, involving ICARDA, INRA and the Spanish Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, is analyzing genetic diversity and geographical origin in faba bean genotypes. Molecular markers have been developed, that are now being used to create a 'reference collection' that will enable geneticists and plant breeders to more effectively use genebank collections of faba bean landraces and their wild relatives.



Germplasm exchange between ICARDA and French research centers has helped conserve biodiversity, and identify sources of stress tolerance.

The ICARDA genebank contains 568 accessions received from France. This germplasm, of more than 20 species of crop plants and their wild relatives, is now being 'mined' for stress tolerance genes. More than 1300 ICARDA accessions have been shipped to INRA centers, universities and private institutes in France. They are being tested by French scientists, using field trials and DNA analysis, to find novel sources of resistance to drought, nematodes, diseases, viruses, insect pests and salinity.

Plant physiology

What physiological traits determine a plant's ability to tolerate drought and high temperatures? How best can these traits be used by plant breeders? Researchers from ICARDA, INRA-Rennes, ENSAM/INRA and Université de Paris-Sud have developed a set of 'integrative' physiological criteria for wheat. The five criteria – carbon isotope discrimination, ash content, spectral reflectance, canopy temperature depression and chlorophyll fluorescence – are a

major advance over currently used physiological criteria, for several reasons. They are reliable and accurate, can be measured quickly and fairly easily, and can be used to rapidly screen large numbers of genotypes for heat and drought tolerance. The new criteria are being used by durum wheat breeders to develop genetic stocks for high-stress, drought-prone environments in the Mediterranean region and elsewhere.

Rangeland management

Research collaboration and joint staff appointments by CIRAD and ICARDA are helping to protect rangeland areas from degradation, and improve the profitability and sustainability of livestock production systems.

One study, led by a French scientist jointly appointed by CIRAD and ICARDA, examined livestock 'migration' patterns in the rangelands of Syria. Sheep and goat flocks follow a regular migration cycle,



*How to ensure the sustainability of crop-livestock systems in dry areas?
Studies on livestock migration are helping to provide answers.*

where access rights and range usage are governed by traditional custom. These practices were effective in the past but are less effective now, because of higher livestock populations, changing demographics, breakdown of social structures and other factors. The study produced new insights on how pastoralists cope with low and highly variable rainfall. Project findings on institutional options for rangeland management are now being applied in Syria, Morocco and Mauritania, and provided important inputs into the development of a 'pastoral code' in Mauritania.

Livestock production

A joint project by CIRAD, INRA, ICARDA and Egypt's Agricultural Research Center aims to improve the productivity and profitability of livestock systems, and help small-scale sheep and goat producers cope with climate change and benefit from rapidly evolving markets. It is led by a CIRAD scientist posted at ICARDA's regional office in Cairo. The research program focuses on three areas: livestock



A joint project is helping to identify new market opportunities for small-scale livestock producers.

nutrition, market opportunities and adaptation strategies. The nutrition component is helping to make better use of available feed sources as well as non-traditional feed products. Market studies have helped understand value chains, the roles of different actors, and the opportunities for value addition. Using a combination of diagnostic surveys and simulation models, the research team is also studying how livestock producers cope with drought and other external 'shocks', and identifying policy and institutional options to strengthen these coping strategies.

Bio-economic modeling

A bio-economic model developed jointly by CIRAD and ICARDA provides valuable lessons on how to promote new technologies in dry, resource-poor areas. The model, developed through case studies in Algeria, Morocco and Tunisia, aimed to simulate the process by which farm households make decisions to adopt (or not adopt) a new agricultural technology, under a range of scenarios. The research was led by a CIRAD scientist posted at ICARDA's regional office in Tunis. The model factored in a range of biophysical and socio-economic parameters for different types of households. It gave reliable results – the difference between (simulated) model results and actual survey data typically ranged from 6% to 13% for different parameters. This is still work in progress, but the approach and the methodology will be useful to researchers as well as rural development agencies.

Accelerating technology adoption

A number of new technologies, despite being effective and useful, have been adopted only on a limited scale. A research program involving CIRAD, CNRS, ICARDA and partners in several developing countries is helping to identify ways to accelerate technology adoption among small-scale farmers in arid and semi-arid areas. The program is supported by the FEMISE research network (Forum Euroméditerranéen des Instituts de Sciences Économiques).

The program focused on livestock technologies in Algeria, Morocco and Tunisia, examining a range of factors that could influence adoption: the relevance and effectiveness of the technology, supply/ demand conditions for inputs and outputs, policies and institutional arrangements, labor and credit availability at community level, and risk perception at farm level. The results showed that despite the challenges of small landholdings, uncertain rainfall and inadequate infrastructure, technology adoption could be considerably improved with more effective policy and institutional support. One viable option, for example, is to create an insurance system to encourage farmers to adopt new technologies in high-risk, drought-prone environments. Other options include: measures to reduce price uncertainty and price variability in existing markets (e.g. for live animals); and developing markets for 'by-products' from the new technology (e.g. cactus pads and fruit).

Research networks

Countries in the Mediterranean basin have similar soils and climates, and therefore similar challenges to agriculture – but very different capacities to meet these challenges. The solution is to share skills and resources more effectively, through research networks.

ICARDA is part of ARIMNet (Agricultural Research in the Mediterranean network), a new initiative supported by the European



Spineless cactus: a fodder source for North Africa. A CIRAD-ICARDA project provided the first detailed impact assessment of this technology.

Commission, coordinated by INRA Montpellier and involving 11 countries – Algeria, Cyprus, Egypt, France, Greece, Italy, Morocco, Portugal, Spain, Tunisia and Turkey. The network aims to develop research projects that will build on partners' synergies to address shared problems, eliminate duplication of effort and strengthen research capacity in the region's less developed countries. As a first step the network is developing a comprehensive database, covering every major research organization in every partner country: research portfolio, budget, staff resources, facilities, and ability to contribute to training programs. The database will serve as a permanent source of information for future development work throughout the region.



Scientists from ICARDA and French research organizations have co-authored more than 40 research publications in the past 10 years.

ICARDA has been a key player in the SEWANA (South Europe, West Asia, North Africa) Durum Wheat Research Network, which is partly funded by the government of France and receives technical support from several French institutions. More than 85% of the world's durum wheat is produced in SEWANA, but yields are often low as a result of drought, low temperatures, diseases, insect pests and other stresses. The network has helped document and conserve genetic diversity in durum wheat landraces and their wild relatives; use this genetic raw material to develop new breeding lines and populations; introduce new tools to assist plant breeders; and strengthen research capacity in developing countries across SEWANA. New varieties developed through the network are being grown

in 15 countries in North Africa, West Asia and the Mediterranean Basin, leading to significant improvements in yield and grain quality for the production of bread, pasta, couscous and other durum wheat products.



ICARDA and the Centre d'écologie fonctionnelle et évolutive in Montpellier are planning a joint study of how traditional cultivation methods have impacted fruit tree biodiversity in the Mediterranean.

New initiatives

France-ICARDA partnerships have achieved major successes in a relatively short period, with limited funds. But much more remains to be done to improve agricultural production and food security in the southern Mediterranean basin. Several new research projects are being planned that could contribute to meeting these goals. Each of these projects builds on previous work, and focuses on clear, achievable targets.

Less intensive, more sustainable agriculture. ICARDA is a partner in a new project led by INRA, which addresses a central issue in modern agriculture: the expansion of intensive, high-input production systems, and the widespread use – and associated risks – of genetically uniform varieties and hybrids bred for such systems. The EU-funded project, launched in March 2010, involves twelve countries: ten in Europe, two in Africa (Ethiopia, Mali). It aims to develop novel breeding and management strategies for organic and low-input farming systems, to improve the stability, productivity, diversification and sustainability of small-scale farming systems in Africa and Europe. Research components include: better use of crop genetic diversity, especially traditional landraces; farmer-participatory research methods (ICARDA will lead this component);

development of molecular tools for genotyping and selection; and socio-economics studies including impact assessment, livelihood stability, market factors, policies and legislation.

Drought-tolerant wheat varieties. A proposed project, developed by ICARDA and INRA-Montpellier, aims to use molecular genetics and genomic tools to develop drought-tolerant varieties of durum wheat. Previous research by the two institutions has identified QTLs on the durum wheat genome that could control drought tolerance and yield stability. The new project will conduct more detailed sequencing studies of this part of the genome. Potential partners include laboratories in France, Italy and UK, the US-based International Wheat Genome Sequencing Consortium, and national research programs in Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia and Turkey.

Mediterranean farming systems. A multi-disciplinary team from ICARDA is working with French partners to develop project components for the joint CIRAD-INRA French Initiative for International Agricultural Research (FI4IAR). The aim is to improve the sustainability of Mediterranean farming systems. Research components will include cereal and legume genomics, integrated pest management (IPM), soil and water management, diversification of farming systems, and integration of biophysical and socioeconomic research. ICARDA is well placed to contribute to this initiative, given its experience in each of these areas, and its strong partnerships with national research centers in many of the FI4IAR target countries.



Mediterranean farming systems are highly diverse – and can be highly productive, if the right technologies are used.

Ties that Bind

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