Iraq Harvest

حصاد

AGRICULTURAL INNOVATION FOR **IRAQ'S SMALLHOLDER FARMERS**

Progress and achievements of the HSAD-Iraq program

PACKAGES AND POLICIES TO IMPROVE VALUE CHAINS FOR RURAL COMMUNITIES

- Seed systems
- Agricultural policies
- Integrated pest management
- Date palm tissue culture
- Conservation agriculture
- Water harvesting and supplemental irrigation
- Developing rangelands, forage and small ruminants

HSAD | Iraq

Harmonized Support for Agriculture Development

الدعم المنسق لتحقيق التنمية الزراعية

ICARDA
Science for Better Livelihoods in Dry Areas

USAID | IRAQ
FROM THE AMERICAN PEOPLE

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This magazine summarizes the key activities and achievements of the HSAD-Iraq program – 'Harmonized Support for Agriculture Development' – in Iraq in 2013–2014. The work of many researchers contributes to the substance and achievements of the HSAD partnership. Here are those who contributed to the project's work (listed in alphabetical order within each activity): **Seeds:** Azoz Ahmad Sulaiman (Deputy DG for Research and Extension of MoAWR), Farooq Othman (Head of Department for Seed Certification MoAWR), Francis Janno (National Focal Point), Sabah Dira Abid (HSAD National seed expert), Sushil Pandey (ICARDA seed expert), Zewdie Biasham (ICARDA Focal Point). **Date Palm IPM:** Abdul-Sattar Ali (HSAD IPM Expert), Hamid Hadwan (National Focal Point), Michael Baum (ICARDA Focal Point), Nizar Al-Anbaky (MoA IPM Expert). **Date Palm Tissue-culture:** Abdulminam Ali (HSAD Tissue-culture specialist), Michael Baum (ICARDA Focal Point), Saleh Bader (ICARDA Tissue-culture specialist). **Agricultural Policy:** Abdulhussein El-Hakim (HSAD Policy specialist), Aden Aw-Hassan (ICARDA Focal Point), Ahmed Mazid (ICARDA Policy specialist), Clemens Breisinger (IFPRI), Dario Debowicz (IFPRI), Jameel Al Dabagh (HSAD Policy specialist), Jena Ferguson (IFPRI), Mohammad Jabbar Abdulradh (National Focal Point), Roberto Telleria (ICARDA Policy specialist), Saad Hatim (MoA Policy specialist), Teunis van-Rheenen (IFPRI Focal Point), Watheq Abdulkahar (MoA Policy specialist). **Ag-Extension:** Andrea Bohn (UCON Focal Point), Faisal Kadhum Mutasher (National Focal Point), Guy Fipps (UCON), Maad Rawendoozi (UCON), Mohammad Douglah (ICARDA Focal Point). **Conservation Agriculture:** Atef Haddad (ICARDA), Stephen Loss (ICARDA Focal Point). **Water Harvesting:** Mohammad Boufaroua (ICARDA), Theib Oweis (ICARDA Focal Point). **Rangeland, Forage and Livestock:** Ates Serkan (ICARDA Focal Point), Firas Muzahem Hussein Hussein Alkhilani (National Focal Point), Monir Louhaichi (ICARDA Rangeland specialist), Muhi El-din Hilali (Dairy processing specialist). **Editorial:** Editorial research, reporting and writing, design and layout: Green Ink. Editorial coordination: Michael Devlin (ICARDA). **Production:** Mai Touma (ICARDA).

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Contents

Foreword

The Harmonized Support for Agriculture Development (HSAD) project was developed in 2012 to support the efforts of the Government of Iraq to improve the livelihoods of the rural communities in the country. Iraq's rural communities, for whom agriculture is a major source of livelihoods, face a range of challenges, including degraded land and water resources and salinity in irrigated areas; low-yielding crop varieties and lack of crop diversity; difficult access to markets; and the need for updated knowledge on improved technologies and the potential of crop diversity for high-value income-generating agricultural products.

The main aim of the nationwide HSAD project is to assist the Iraqi Ministry of Agriculture in identifying and addressing key constraints to greater competitiveness of selected agriculture and agribusiness value chains.

The HSAD strategy capitalizes on the experience of completed and on-going ICARDA projects in Iraq, with the full involvement of the Ministry and close interaction with Iraqi policy and decision makers in the ministries that have a role in developing value chains.

Research by ICARDA and partners over three decades has produced a broad understanding and solutions to the challenges faced by Iraq's rural communities. But much of this expertise has not been fully used as it was not presented in a way that is suitable for broader uptake by partner countries.

This situation provides both an opportunity and a challenge for the HSAD project: how to transfer technical expertise in a practical form, for use by Iraqi partners in policies, planning and rural extension practices. To achieve this goal, HSAD was designed as a partnership that builds capacity in these levels of actors in Iraq. It aims to transfer knowledge to project partners, encouraging them to further expand the activities after project completion, as part of an integrated national rural development plan.

In planning HSAD, we were challenged by the partners to bring together our years of experience and expertise in using integrated systems approaches to improve rural livelihoods. We developed a range of technical packages and fine-tuned them to meet the needs of various socio-economic situations in Iraq. Other international partners in the HSAD partnership also contributed important expertise. UCON – the Consortium of U.S. Universities – shared expertise and methods for organizing and delivering effective extension programs for technology transfer. Our sister CGIAR center, IFPRI, created the Social Accounting Matrix and the Iraq Spatial policy planning tool, which we hope will become Iraqi senior policy-makers' tool of choice for better understanding the current situation and forecasting various scenarios to facilitate rapid policy decisions for the country's benefit.

Above all, HSAD is about improved livelihoods in rural communities. This means more opportunities for income generation through: better crop productivity using improved higher-yielding varieties that resist disease and pests; new types of economic high-value crops; integrated crop-rangelands-livestock systems; and through practical approaches to cope with the threat of climate change and the lack of water – including water harvesting, conservation agriculture and mitigation of salinity threats.

From our work on the ground with some 40 countries that face similar problems to Iraq, we know that the key to widespread adoption of innovations at community level lies in an enabling policy environment and community approach. ICARDA and the partners have been active in building capacity and providing practical advice – both to senior policy-makers and extension services and to farm communities. Some 80 capacity-building activities were held, reaching 2000 stakeholders in less then two years.

Perhaps the biggest challenge we faced was to respond to the changed lifetime of the project when, in 2013, HSAD funding was reduced from five years to 20 months. As the project now closes after this shortened period, I am pleased to report that many effective activities have been completed, successful case studies identified and a wide range of Iraqi partners trained. Today, as HSAD concludes, ICARDA's partnership with Iraq continues through our ongoing partnership in other projects that generate and transfer technologies, expertise and advice to enhance sustainable agricultural development and improve livelihoods in rural areas.

The HSAD experience was one that positively influenced all those involved, and we hope that these new relationships continue. On behalf of all partners, I would like to express great appreciation to USAID for their initiative and financial support to the HSAD project and to the Ministry of Agriculture in Iraq, and to the Iraqi Government for their valuable contribution and support in making HSAD a real success.

Dr Mahmoud Solh
Director-General, ICARDA

Strategic support to Iraq's Agricultural Initiative

The Iraqi Ministry of Agriculture, through its national 'Agricultural Initiative' and the other programs it manages, is progressing the country's rural development plan to improve the livelihoods of people living in rural areas.

The Agricultural Initiative works at several levels to make agriculture more productive and to bring more income to families in its communities. It puts in place new policies, improves the effectiveness and skills of extension services and helps the agricultural research services develop and evaluate new technologies. The Initiative helps Iraqi farmers who face obstacles such as water scarcity, low mechanization, limited financial resources and high production costs and the need for effective agricultural services and marketing. In its 20-month existence, the HSAD project has helped demonstrate to farmers and government partners how performance can be improved – for example by working with agricultural extension services to show farmers how new technologies and practices can improve their lives.

The key to achieving better livelihoods for the rural population is to have robust value chains that link farmers with markets. This approach, however, will not work without targeted investments at the household and village level in rural areas. An important activity of the Initiative is to provide loans to farming families and agribusinesses in order to stimulate local enterprises such as the value-added processing of legumes, dates and date packaging, horticulture and dairy products.

تقديم معالي الوزير لمجلة الحصاد

قامت وزارة الزراعة بدعم وإسناد من المبادرة الزراعية والبرامج الأخرى الخاصة بها بتقديم الخدمات للزراعة في العراق من اجل تطويرها وتطوير واقع المزارعين وتحسين مستوى معيشتهم.

تعمل وزارة الزراعة على عدة مستويات لزيادة الإنتاج الزراعي وزيادة موارد العائلات الفلاحية بتطبيق عدد من السياسات الزراعية ودعمت الإرشاد الزراعي والبحث العلمي الزراعي واختبار تقانات زراعية حديثة لتطوير الإنتاج.

ان مفتاح تحسين مستوى المعيشة في المجتمعات الريفية هو تطوير سلسلة القيمة الغذائية للمنتجات الزراعية وربط استخدام التقانات بالسوق، ان هذا لايمكن تحقيقه بدون استثمارات على مستوى الأسرة الريفية والقرية في المجتمعات الريفية.

تقوم وزارة الزراعة بتقديم القروض لصغار المزارعين والمستثمرين ، وهذا قد حفز تطوير سلاسل القيمة الغذائية في الحبوب والبقوليات والتمور والمحاصيل البستانية ومنتجات الألبان وصناعة الدواجن . ان برامجنا لدعم صغار المستثمرين قد ساعد في تطوير عمليات تجارية جديدة مثل تعبئة التمور وصناعة الألبان.

لقد جاء عمل مشروع حصاد خلال العشرين شهر الماضية ليقع ضمن توجيهات الوزارة واستراتيجيتها في تطوير المجتمعات الريفية.لقد قام المشروع بإدخال تقانات جديدة في الإرشاد والبحث العلمي واستقدم عدداً من الباحثين العالميين والمختصين الزراعيين لهذا الغرض.

وعرض زملاؤنا من خبراء ايكاردا خبراتهم المتحصل عليها من خلال عملهم في المناطق الجافة بدول أخرى ومن خلال تطبيق عدة تقانات جديدة . كما كان لخبراء وزارتنا دور مهما في دعم مشروع حصاد وذلك من خلال تعاونهم المستمر مع خبراء ايكاردا في تطبيق خطة عمل المشروع ، الأمر الذي ادى للوصول إلى تحقيق الأهداف المشتركة.

وكان لتشكيلات ودوائر الزراعة دور في تذليل المشاكل والمعوقات التي يواجهها المزارع العراقي والتي من ضمنها شحة المياه ونقص المكننة وزيادة كلف الإنتاج وبضمنها الطاقة الكهربائية والوقود والحاجة إلى خدمات زراعية أكثر وفتح الأسواق وخلال العشرين شهرا الماضية عرض مشروع حصاد نماذج لتطوير الزراعة منها العمل في مجال الإرشاد الزراعي باستخدام التقانات الحديثة.

ان التقانات الحديثة لا تحدث التغير بدون وجود إطار عمل وعمل فعلي ونحن كصانعي قرار ضمن مسؤولياتنا تطوير السياسات الزراعية واستحداث القوانين والضوابط التي تسهل عمل القطاع العام وساهم خبراء مشروع حصاد في دراسة سلاسل القيمة الغذائية للحنطة والتمور من اجل زيادة دخل المزارع والمشاريع الزراعية- الصناعية الصغيرة

ان تبادل الخبرات والمعرفة بين وزارة الزراعة ومشروع حصاد وكذلك تطوير خدمات الإرشاد الزراعي والبحث العلمي وبدعم وإسناد من المبادرة الزراعية ستؤدي إلى تطوير خطة التنمية الزراعية الوطنية وبما يحقق أهداف وزارة الزراعة وصولاً للأمن الغذائي.

د.عز الدين عبدالله الدولة
وزير الزراعة

HSAD has exposed national research and extension services to the latest thinking on agricultural development from the team's international group of scientists and agricultural specialists. ICARDA scientists also shared their expertise in drylands production systems, gained in their work in many countries. The involvement of scientists and specialists in the Ministry and their close cooperation with ICARDA experts was critical to HSAD's progress.

Experience has shown that technologies have little value without a framework for action. HSAD experts have also supported Iraq's reform agenda, advising in the development of laws and regulations to facilitate effective public-sector engagement, to support the competitiveness of agricultural value chains and raise the incomes of farmers and agribusinesses.

As HSAD completes its work, it leaves behind a wealth of tools, agricultural technologies, policy options and expertise for use by Iraq's institutions, extension and research services, to help strengthen and deliver the national plan and achieve the goals of the Ministry.

H.E. Izzeddin Abdullah H. Aldola
Minister of Agriculture

The HSAD-Iraq partnership

Bringing a competitive edge to farmers and agribusiness

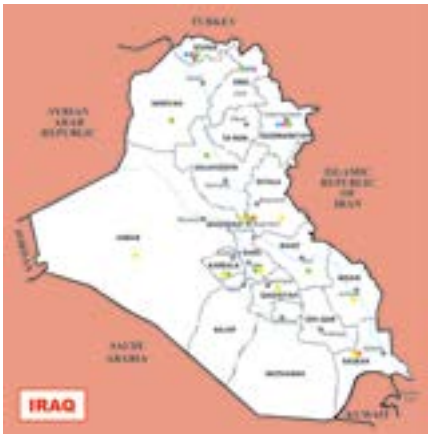
HSAD – the program for Harmonized Support for Agricultural Development – is a partnership between the Government of Iraq and ICARDA, involving a range of international partners and funded by USAID. It has worked for the past 20 months to support the government's efforts to strengthen the country's agricultural value chains and access to markets for smallholder farmers. HSAD mobilized an international team of scientists and development experts and worked with provincial, regional and district authorities. More than 150 officials across six government ministries were involved in the project.

Started in late 2012 and completed in mid-2014, HSAD builds on ICARDA's expertise in supporting countries to improve the productivity of their drylands agricultural production and livelihood systems. The program has tested a range of 'technology and policy packages' that have a high potential for scaling-up to improve incomes and boost productivity for many of the country's rural communities. Project action areas included water and land management, higher performing crop technologies and practices, and socio-economic and policy experience.

Strengthening strategic commodities and value chains

The priorities for work on strategic commodities and value chains, critical to Iraq's food security, were developed in consultations led by the Iraqi Ministry of Agriculture with ICARDA and the international partners. These include wheat and barley, forage and food legumes, small ruminant production and dairy products, and date palm. In May 2013 the workplan was revised to concentrate on seeds, integrated pest management, date palm tissue culture, policy, water harvesting, conservation agriculture and strengthening agricultural extension.

The program was managed from a national coordination unit in Baghdad with three regional centers in central (Baghdad), northern (Erbil), and southern (Basra) Iraq. To provide the evidence base for future scaling-up of the technologies and approaches tested, the HSAD work was done in action sites selected to represent the country's agro-ecologies and production systems.



- *Seed activities*
- *Integrated Pest Management for date palm*
- *Date palm tissue-culture*
- *Water harvesting*
- *Conservation agriculture*

Cross cutting activities, all provinces: policy and agricultural extension

Engaging and building capacity with communities

HSAD was also active in transferring knowledge between partners and strengthening the capacity of farmers and agency specialists.

In the policy arena, the program supported the Ministry of Agriculture in its efforts to develop new policies and regulations and expand the capacity of extension services. It delivered a focused capacity-strengthening effort, engaging with more than 2000 farmers, extension services and agricultural officials in technical training sessions and farmer field days, professional mentoring and certificate courses.

HSAD resources

http://hsad.icarda.org/resources

Development manuals and guides

- Guide to producing effective video programs for extension (English, Arabic, Kurdish)
- Manual: Integrated Pest Management for date palm (English, Arabic)
- 40 Fact sheets for agricultural extension agents (Arabic)
- Seed Processing Manual (Arabic, Summary in English)
- Conservation Agriculture Manual (Kurdish, English)

Working papers

- Working Paper: Summary of HSAD Training Courses (English)
- HSAD Success Story briefings (English)
- Working Paper: Review of the progress and achievements – HSAD–Iraq program Harmonized Support for Agriculture Development 2013–2014
- IFPRI-ICARDA discussion paper on Agriculture for Development in Iraq.

Video presentations

- Overview of Program Activities
- Conservation Agriculture
- Water Harvesting
- Integrated Pest Management for Date Palm
- Strengthening Seed Systems
- Use of Trays for Seedling Production in Greenhouses

Partners

HSAD was led by the Iraq Ministry of Agriculture with support from international partners. The program drew on knowledge gained from completed and on-going projects in Iraq and similar agro-ecologies in other countries. ICARDA is the lead agency.

National partners

- Ministry of Irrigation and Water Resources
- Ministry of Higher Education and Scientific Research
- Ministry of Science and Technology
- Ministry of Trade
- Ministry of Planning
- Ministry of Environment
- Ministry of Agriculture and Water Resources – KRG-Iraq
- Provincial universities/ agricultural colleges

International research-for-development consortium

- International Food Policy Research Institute (IFPRI)
- University of Illinois – Urbana-Champaign
- Texas A&M University
- University of Florida
- University of California, Davis
- CGIAR centers

HSAD key results

Seed systems

- 554 tons of breeder wheat seeds provided
- 5286 kg of promising wheat lines provided
- Seed processing plan assessment and upgrade recommendations
- 265 wheat genotypes provided; 40 tons of Adana 99 wheat (drought + rust resistant).

Capacity building

- 2000 farmers & extension staff trained
- 13 workshops – 490 participants
- 100 technical staff engaged across ministries and line agencies
- 6 Ministries working together
- 31 publications – English, Kurdish, Arabic.

Integrated Pest Management – date palm

- Activities in 8 provinces
- Practices applied on 500 ha; 321 farmers use new approaches.

Date palm tissue culture

- 2 protocols for tissue culture were introduced
- 10,000 offshoots for date palm new variety multiplication
- Rehabilitation of Basra laboratory to world standards.

Conservation agriculture

- Working and expansion in 4 provinces
- Financial study shows conservation agriculture saves farmers $350/hectare.

Water harvesting

- Assist ministry to identify 2 high potential pilot sites
- Support plan to develop 80 hill lakes for supplemental irrigation
- Implementation package prepared: site selection method, topography, soil characterization, hill lake design, standard tendering documents.

Extension

- Refreshing approach and content of extension to farmers – South + Central Iraq
- Introduction of a new policy to strengthen the collaboration between the research and extension departments of the Ministry of Agriculture.

Policy – tools for government planning

- Drafted implementing regulations of National Seed Law
- Study of wheat seed policy
- Iraq Spatial national policy planning tool
- Analysis & baseline survey of wheat and date palm value chains
- Policy Modeling – Iraqi social accounting matrix.

Nature needs no plow – but farmers need seeders

Think of growing cereals, and you probably think first of plowing the land. In the dry areas of Iraq, however, plowing often creates more problems than it solves. One solution being adopted in various guises around the world is conservation agriculture. The HSAD project, drawing on global experience, is helping to spread the benefits of conservation agriculture, for farmers and the wider environment.

Above: Conventional seeders have to be specially modified in order to enable zero-till conservation agriculture, with a raised seed hopper and stronger tines

Field trials and demonstrations are important to show the benefits and optimal practices for conservation agriculture. This work builds on a five-year Iraq–ICARDA conservation agriculture partnership funded by the Australian Centre for International Agricultural Research (ACIAR)

An essential machine for any farmer who wants to stop plowing is the zero-till seeder. Instead of cutting deep into the soil and turning it over, like a plow does, the zero-till seeder makes a narrow slot into which it drops a seed at precise intervals. Spring tines close the slot over the seed, leaving the field almost untouched. Unfortunately, farmers in Iraq have so far had little access to such machines.

Zero-till farming brings many benefits that can enhance the sustainability of agriculture in arid areas. The soil is not disturbed, and so is much less prone to erosion by wind and water. The residues of previous crops, left on the surface, also help to protect the soil. Residues slow evaporation from the soil, and when it does rain they help the water to infiltrate the ground rather than running off. As the residues decay, they contribute nutrients and structure to the soil. Animals, allowed to graze the residues, add their waste to the soil too.

Long term, conservation agriculture mitigates climate change. It reduces greenhouse gas emissions because it consumes less fuel per hectare, and as the crop residues break down and enter the soil they sequester carbon. Better water efficiency and improved nutrient cycling mean less opportunity for polluting run-off. The net result is an overall improvement in the broad environment.

To realize these wider gains, however, farmers need to be practicing conservation agriculture over a large area and for a long time. And they will do that only if it rewards them directly.

Greater profits

Fortunately, conservation agriculture pays. It saves time, labor and fuel. Because zero-till seeders optimize the seed rate, they save on the cost of seed. Earlier planting, along with better nutrient levels in the soil, translates into lower fertilizer costs and higher yields. More efficient water use means less risk of a crop failure in rainfed lands and reduces pumping costs for irrigation.

Sarmad Karim Khalil Kakay is one of more than 100 farmers who took part in HSAD training sessions. While convinced of all the benefits of conservation agriculture, his main motivation is clear: "Zero tillage has provided more profit and in the last two or three years we have not had to use fertilizer. It also provides more water storage so you don't have to use more water – you just have to plant and wait for the mercy of God."

All in all, ICARDA scientists calculate that farmers who adopt conservation agriculture can benefit to the tune of US$355 per hectare each year.

But they need zero-till seeders!

Converting conventional seeders

Conventional seeders cannot cope with the harder soil of untilled land and are easily blocked by the crop residues left on the soil surface. Having undertaken previous research on conservation agriculture, ICARDA technicians working

with HSAD knew exactly how to convert a conventional seeder into one suitable for zero-till work. The Ainkawa Research Centre in Iraq bought a conventional Rama seeder and worked with farmers and technicians in Mosul to convert it. The changes included:

- narrow 'knife' points, which cut a narrow slot in the undisturbed soil, to replace the typical 'duck-foot' points
- tines with stronger springs to enable seeding into hard, undisturbed stony and shallow soils without risking damage to the seeder
- row spacing increased to 20–25 cm to allow residues to flow away from the knives and tines
- a raised seeder frame and longer tine shanks to avoid residue clumping
- a raised seed box height to provide a good flow of seed down the pipes into the soil.

Khaled Rashgary, second from left, owned a conventional seeder that ICARDA and HSAD staff helped him to convert for zero-till

Helping farmers to help themselves

Project staff not only converted seeders themselves, they also trained farmers to do the job. Khaled Rashgary is one of those. A friend in Mosul had told him about the lower input costs, which gave the idea a certain appeal, and he already owned a conventional seeder. He called on ICARDA and HSAD staff, who gave him instructions, and he and a group of neighbors converted the machine.

"We hope that zero tillage can succeed," he said, "and ensure our costs decrease by at least a quarter. If this is successful, we can gain a lot of benefits from it. This is only the first year but we hope we can get a lot of success from it."

Other farmers are watching his results closely, and if they are good, they will be sure to adopt zero-till themselves.

The benefits of conservation tillage: Mohammed Kher Semalka, a farmer, shows off his flourishing crop sown with a zero-till seeder in late 2012

Some history and a bright future

ICARDA's research on conservation agriculture in Iraq started in 2005, with a project funded by the Australian Centre for International Agricultural Research (ACIAR). One of the crucial challenges has been to overcome local prejudices, which hold that intensive cultivation is essential for success in arid lands. In fact, at the start of the project young farmers said that their fathers had forbidden them to try conservation agriculture because, they were told, no good could come from such madness. It was only demonstrations of higher yields and lower costs that brought farmers around.

In 2006, a dozen farmers were using zero-till methods. By 2010 this figure was about 50, and the area had expanded from 52 hectares to about 6000 hectares. By 2017, if all goes well, about 70,000 hectares in Erbil, Duhok and Sulaymaniyah (Iraqi Kurdistan Region) will have converted to conservation agriculture, about 10% of the total area under cultivation in those provinces. Assuming a 15% increase in yield and reduced fuel and labor costs of around US$50 per ha, this would result in an increase in total farm income of about US$8.8 million each year.

Additional benefits to the economy will come from the local manufacture and repair of zero-till seeders, also promoted by HSAD.

A date with integrated pest management

The date palm was originally domesticated in the area of the Fertile Crescent that is now Iraq. The crop is widely grown throughout the country, predominantly in central and southern regions. There, it is a key element in irrigated farming systems and an important cash crop. But while Iraq once led the world in date production and exports, over recent years production has slipped, largely due to an upsurge in pest damage.

Above: A farmer carefully places capsules containing parasitoids that will attack the eggs of pests in the crown of a date palm

Solar powered light traps attract adult pests, which farmers can then monitor to time their use of anti-pest strategies. This work builds on the results of the ICARDA date palm integrated pest management project, funded by IFAD

In the first light of dawn, one of the palms in farmer Abdulkarim's date grove shines out like a street lamp. Carefully Abdulkarim climbs the jagged trunk. He fishes under the lamp and withdraws a small container, tucking it into his jacket and bringing it back to ground level. Inside the container are adult date palm borer beetles, attracted by the light after emerging. Abdulkarim tips the dead beetles on the ground, satisfied, and climbs back up to replace the trap.

Solar-powered light traps have proved very effective at reducing the number of adult date palm borers flying around the date palms, directly contributing to higher yields of more valuable fruit for Abdulkarim and hundreds of other farmers. They are just one element in a package of integrated pest management measures developed by HSAD and partners to improve the productivity and earning potential of the date palm in Iraq.

Integrated pest management

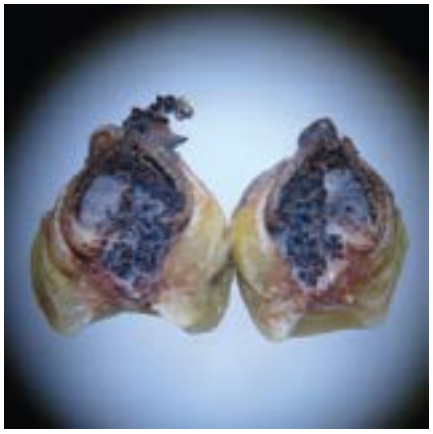
Integrated pest management (IPM) is a broad-based approach that aims to keep pest populations below levels that would result in economic damage. It requires careful consideration of all available techniques to control pests, which are then integrated into a package that discourages the development of pest populations while keeping pesticides and other interventions to levels that minimize risks to human health and the environment. In addition to date palm, HSAD has also developed IPM for diseases and insect pests of cereals and chickpea (see box 'Cereals and chickpea').

Many different insect pests attack date palms, including various borers, Dubas bug and lesser date moth. Each requires slightly different forms of management.

Dubas bug (*Ommatissus lybicus*), also known as old world date bug, is perhaps the worst threat. Periodic massive infestations severely weaken date palms and can kill them. Spraying with conventional insecticides can be effective, but is expensive and potentially damaging to human health and the environment. HSAD worked in three places – Karbala, Babil and Baghdad – to test neem and oxymatrine, insecticides derived from plant extracts.

The botanical insecticides worked well, reducing infestation levels by up to 95% and increasing the yield of marketable fruit (see box 'Cost-effective'). Oxymatrine also killed the eggs of Dubas bug, which was not expected. This raises the possibility that spraying against the eggs could increase the effectiveness of the IPM package. In response to research by HSAD and its partners, the Government of Iraq now approves the use of plant extracts such as neem by farmers, and the Ministry of Agriculture is using neem to spray thousands of hectares of date palms as part of its annual pest control campaign.

Lesser date moth (*Batrachedra amydraula*) is also a serious pest; the larvae bore into young fruit and severely reduce yield. To control lesser date moth, researchers looked at two



Larvae of the lesser date moth on a young fruit (left). Unchecked, lesser date moth leads to considerable damage to fruits (right)

options, *Bacillus thuringiensis* (Bt), a bacterium that secretes a toxin that kills insects that eat it, and a parasitoid wasp, *Trichogramma evanescens*, whose larvae kill the lesser date moth larvae. With both approaches, timing is everything, because the treatments are most effective against larvae newly emerged from eggs.

Adult lesser date moths tend to fly, and the females to lay eggs, around the time of pollination. This, though, varies with environmental conditions such as dust storms and rain. For this reason, light traps were used to monitor the emergence of adults, and only after clear evidence that the adults were flying were Bt spray and parasitoids applied to the palms. Overall, the IPM package reduced the pest load by around 65%, a figure than can surely be improved with further research.

Difficult but worthwhile

In some respects, IPM is more difficult than conventional pest control. Rather than just spraying to a schedule, more learning is required by farmers. They have to identify the pests and monitor their behavior, taking appropriate action only when necessary. Likewise, extension agents have to be well-versed in IPM principles and how to tackle specific pests. So, training and capacity building are crucial to the success of IPM, and HSAD is complementing the research with workshops and on-farm training.

The date palm orchard in Diwaniyeh, Iraq where HSAD and partners developed integrated pest management to control date palm pests

Abdulkarim is one of several farmers who received training from the HSAD team. He is now seeing benefits on his own farm. "Applying IPM tools with proper timing has helped control the insect pests efficiently," he says. "It has also helped to increase the [date] yield."

Cost-effective

Because neem and oxymatrine are cheaper than conventional synthetic pesticides, farmers who currently use pesticides to control Dubas bug will save an estimated $403 per 2500 m^2 by switching to IPM. For farmers who do not use pesticides at the moment, the benefits are even greater: US$844 per 2500 m^2, a cost-benefit ratio of 1:37.

Overall, economists with HSAD estimate that if all farmers currently using pesticides adopted IPM, their combined income would increase by just over US$36 million a year. For farmers who currently use no control, the benefits would be even higher, about US$75 million a year. These higher household incomes do not include benefits to health and to the environment.

Cereals and chickpea

Cereals, notably wheat and barley, and chickpea also succumb to pests and diseases. Sunn pest on cereals and Ascochyta blight and Fusarium wilt on chickpea and other legumes reduce production and cost money to control. To address these threats to food security and incomes, HSAD looked at the use of biological compost, soil improvement and mycorrhizal fungi, as well as resistant varieties of chickpea. Overall, the results showed great promise. Inoculation with Rhizobium fungi appeared to increase the number of pods on the plant and the weight of the seeds. The biopesticides, alone and in combination, all apparently reduced the incidence of wilt on the plants. Thus a package of Rhizobium and biopesticides would represent a useful addition to the technologies available to farmers to improve the productivity of chickpea.

Videos link farmers to solutions

Extension services have so far failed to boost the growth of Iraq's agricultural sector, in part because the extension agents themselves have been out of touch with what farmers really need. In a ground-breaking effort, staff from the Ministry of Agriculture learned to use video to enable farmers to communicate with other farmers.

Above: Josephine Rodgers of Access Agriculture (centre) discusses details of the day's shoot with some of the students on the video training course

Herish Omar, of the Media Sector at the Ministry of Agriculture and Water Resources in Erbil, said the course boosted his confidence

During a two-week training course in Basra, 11 Ministry of Agriculture staff found themselves working 12-hour days, from dawn to dusk. It was a far cry from the normally sedate life of a civil servant, but they reveled in it. A second course trained 8 extension agents from the Iraqi Kurdistan Region Ministry of Agriculture, on integrated pest management for date palm, water resources and seed trays. These courses on producing farmer-to-farmer videos focused specifically on integrated pest management for date palm, promoting the benefits of conservation agriculture and supplemental irrigation in wheat cropping.

"This experience has been very rewarding," said Ahmad Ibrahim, Director of the Media Sector at the Ministry of Agriculture and Water Resources in Erbil. "We have worked very hard, had limited time, but are pleased with the final films we have produced."

Although many of the trainees had extensive experience in making videos, they were generally either following the minister or filming subjects planned for them, according to Josephine Rodgers of Access Agriculture, the NGO engaged by HSAD to provide the training.

"They are film-makers," Rodgers said. "They know the technology – but they were not storytellers."

The courses set out to turn the film-makers into storytellers.

Many extension agents were already familiar with video as a communication tool. The point of the training was to help them produce videos that farmers would find relevant, easy to understand and useful. "Crucially," said Rogers, "they learned that in order to simplify a subject, they first need to understand it well themselves."

The course covered techniques such as story-boarding, to ensure that their message has maximum impact. Participants learned how to research and script the story, film it, and then modify the script in light of what they had filmed. But most of all, they learned to work with the farmers, to give them a conduit to teach and learn from one another.

Listening to the audience

Farmers in Iraq, as elsewhere, often do not trust the advice offered by extension agents, especially when it involves doing something new or different. They view it as propaganda. Using the new approaches they had learned, the film-makers talked to farmers to discover the problems they faced. They interviewed farmers who had overcome those same problems, and technical experts who had good advice to offer. They used the internet to research the problem further. Only then did they start to film.

Split into five production groups (three in Basra and two in Erbil), the trainees created six-minute videos from start to finish. The Basra team produced two films, on managing pests and diseases in date palms and on the use of polystyrene seed trays to grow higher-quality vegetables. The Erbil team's films covered conservation agriculture and supplemental irrigation. Each team learned new filming and editing techniques, which they put to good use

with the material they had gathered. They recorded commentary, mixed in music and created title sequences. Then came the acid test: a screening for 10 farmers who were invited to give their feedback.

Everyone's a critic

Discussions were forthright, often veering into more general criticisms of extension in general. And some of the feedback was negative. Farmers complained that the videos were not specific enough, and that they would need more detailed information if they were going to change their farming practices. But there was praise too. Farmers' comments included: "a very good explanation"; "we like this kind of program"; "we know that this is good information from good farmers"; and "we would like more programs in the future, especially on vegetables".

The farmers also made positive suggestions for improvements. They wanted the films to show recommendations and advice in sequence so that they could clearly understand the steps of implementation. And they wished the videos had covered a longer time frame, so that they could follow progress through an entire cropping season. Clearly this last recommendation was not possible in a two-week training course, and the film-makers explained that their time had been extremely limited. But they also said that they would definitely take the farmer's points into consideration in future films.

Ahmad Ibrahim (right), Director of the Media Sector at the Ministry of Agriculture and Water Resources in Erbil, was pleased with the results of the course

Extending the importance of videos

And there will be future films. Phil Malone of Access Agriculture says "the trainees have really learned about the importance of involving the farmers and producing this new kind of video for Iraq. They are determined to produce more in future."

Farmer-to-farmer videos can be crucial in gaining the trust of farmers. They are more likely to be well-disposed to another farmer whose problems they can identify with and whose solutions the video and extension agents can help them to adopt.

Ahmad Ibrahim, Director of the Media Sector at the Ministry of Agriculture and Water Resources in Erbil, explained that "our Directorate has not previously had a good vision of how to produce farmer-to-farmer videos. I for sure plan to transfer my experience gained here to my colleagues through practical work training."

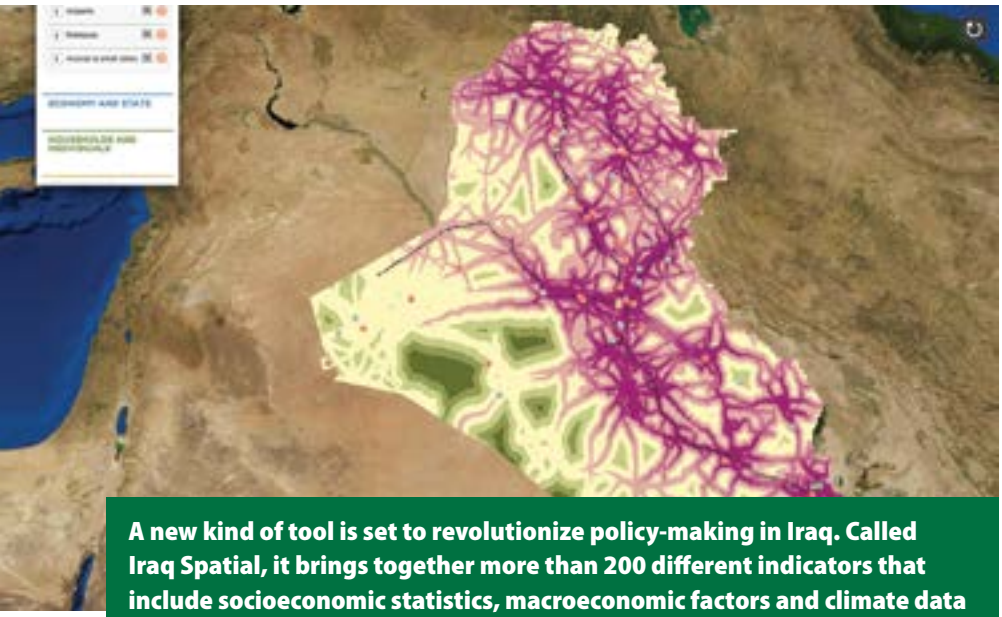
Rodgers supports that. "The younger staff have the potential, and their boss realizes it and is pushing upwards."

One of those younger people is Herish Omar, a member of the Media Sector at the Ministry of Agriculture and Water Resources in Erbil, who has about 15 years of experience working on agricultural films. He spoke for all the trainees.

"This training has given me the confidence to use new techniques and to make these films on my own initiative," he said at the end of the course. "I will go and see my Director and suggest that this is the right way to make films and communicate with farmers. I plan to initiate new networks with other directorates and suggest a new way of producing videos for extension which directly respond to farmers' requests for information. We need to go directly to farmers and collect information from them."

After documenting helpful stories for farmers, the team paused to document their participation in the training course (Basra)

Iraq Spatial: an online tool to improve policy



A new kind of tool is set to revolutionize policy-making in Iraq. Called Iraq Spatial, it brings together more than 200 different indicators that include socioeconomic statistics, macroeconomic factors and climate data and forecasts. These are mapped geographically with unprecedented accuracy. Iraq Spatial offers a 'one-stop shop' of comprehensive, reliable data that can help policy-makers to target efforts where they can do the most good.

Above: Ready-made maps provide a starting point, for example showing access to small cities, railroads and airports, information to guide improved links between rural food production areas and markets

JAMES (JIM) GORDON/WIKIMEDIA

Even the smallest market opportunities matter

Iraq's agriculture and rural development policy-makers face a daunting task. The country covers almost 440,000 km^2 and encompasses an array of ecosystems – remnant permanent marshes, snow-capped peaks and flat, arid plains. The population is located in both rural areas and crowded urban areas. Many rural areas are at risk of food insecurity, and transport and access to markets for farmers can be difficult. The economy is growing, but with many urgent calls on the government and international donors, how do you decide what to do and where?

Without access to accurate and comprehensive data, developing appropriate policies is a complex task for policy-makers and researchers. Iraq Spatial provides both the data that policy-makers need to decide on new policies and the tools for predicting the impacts of those decisions. It offers, for example, the opportunity to see

TAMARA CHALABI/RUYA FOUNDATION

Connecting farmers to markets is crucial to improving incomes

which governorates have the greatest proportion of families living below the poverty line of US$2.2 (purchasing power parity) a day. It shows the kinds of employment available in those areas. And it allows policy-makers to see whether investing in roads to enable access to markets is a better bet than irrigation to improve productivity.

Indicators related to climate, such as precipitation and temperature and their effects on crop productivity, are built into the model, which can also forecast future changes in these factors. This gives Iraq Spatial additional power, in that it allows policy-makers to look further ahead and see how their decisions might play out under different climate-change scenarios.

Despite the complexity of the underlying data and models, Iraq Spatial also offers decision-makers easy entry to the data. Decision-makers can choose from a series of ready-made maps, selecting the one that relates to their area of interest. They can then customize the map to suit their needs by asking specific questions of the data.

Model policies

Iraq Spatial is part of the larger Arab Spatial, which covers the whole region. It builds on the model developed for Arab Spatial by providing data at a more detailed resolution, so that policy can be targeted more precisely at district and even smaller levels. The tool was developed through the HSAD project, bringing together research from the

CHRISTIAN PEACEMAKER TEAMS/WIKIMEDIA

Processing to add value

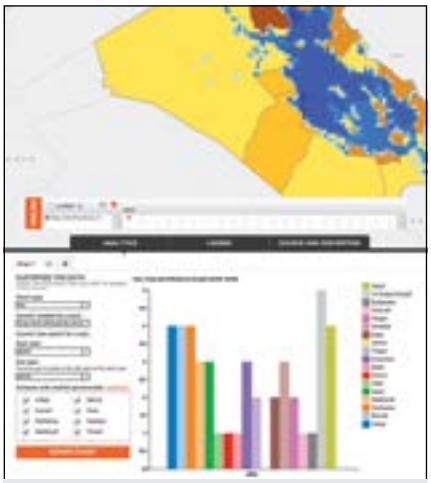
International Food Policy Research Institute (IFPRI), which developed the concept, and ICARDA, which compiled and applied the data for Iraq.

The framework developed by IFPRI and put to work in Iraq Spatial brings out the complex relationships among food security, macroeconomic stability, good governance, and strong performance across key sectors such as agriculture, water, energy, trade and transportation.

Dr Chandrashekhar Biradar, Head of ICARDA's Geoinformatics Unit, believes that Iraq Spatial has the potential to make a lasting impact in Iraq: "Iraq Spatial gives Iraq's decision-makers and research community the information they need to develop appropriate policy reforms and strategies that are capable of raising agricultural productivity and strengthening food security."

Iraq Spatial was launched in Baghdad in May 2014. This attracted considerable interest from the press and, more importantly, from the government experts who will be using it. Muthana El-Muadhidi, Director-general of Iraq's State Board for Agriculture Research, welcomed the opportunities the tool offers and is keen to make use of it: "We have many researchers from different specializations whose work will benefit greatly from the mapping and remote sensing capabilities of Iraq Spatial."

Support for irrigation may be a good policy option



Free and open

Iraq Spatial is built on two founding principles: it is free, and it is open source. The first means that anyone, not just government policy-makers or other privileged users, is free to look at the full range of underlying databases and to build maps that assemble multiple layers of information. Built-in analytical tools are available to explore and compare different options, and the results can be downloaded for further use and investigation.

Open source implies that all the data behind Iraq Spatial are freely available, and that the tool will be updated as the information on which it is built is updated. New sources of information will be added as they become available, and partners and other stakeholders are encouraged to share additional new data that they have. In this way, they will help to improve Iraq Spatial and make it even more useful.

This last is a key element of Iraq Spatial, according to Dr Chandrashekhar Biradar, Head of ICARDA's Geoinformatics Unit: "With an option for end users to add relevant data, the tool will become even more comprehensive over time, helping to further assist the targeting of interventions."

Restoring rangelands for the long haul

Rangelands are the unseen heart of drylands – unseen precisely because they are the largest type of ecosystem in most arid areas. Often neglected by research and government policy, Iraq's rangelands are home to some of the country's poorest people, providing vital support for their livestock and, hence, for the people themselves. But rangelands are also under threat and degraded. A HSAD project aims to turn that around.

Above: Salsola vermiculata, *one of the palatable species that livestock prefer, is being grown to restore degraded rangelands. Photo: René Baud*

Stand at a random location in an area characterized as dryland and cast your eye about: odds are, you're looking at rangeland. Agricultural land covers only about 20% of Iraq, divided roughly equally between cultivated crops and permanent pastures and meadows. Almost all the rest can be considered rangeland.

For poor rural people, rangelands are a vital resource. In addition to providing sheep, goats, camels and other livestock with grazing, they also provide a range of additional important resources, such as medicinal herbs, and ecosystem services such as nutrient cycling and pollution filtration. Unfortunately, a constellation of factors, both natural and human, has resulted in widespread degradation of rangelands. An estimated 70% of Iraq's rangelands are degraded to some extent. Improve them, and you can improve peoples' lives.

Atriplex halimus, *which is highly salt-tolerant, is another palatable species being used to improve grazing for livestock*

JEAN-PAUL PELTIER

Overgrazing hurts

Overstocking and overgrazing are perhaps the most important factors in rangeland degradation. Animals naturally eat those species they find most palatable, creating space for less preferred species to spread and become dominant. This results in a plant community that is less nutritious and that can sustain fewer livestock.

One strand in a skein of approaches to improving rangelands is to boost the presence of more palatable species at the same time as working with herders to ensure that they do not overgraze in future. For the HSAD project, ICARDA drew on its experience of rangeland restoration in Iraq's neighboring countries. This work centered on three very palatable species native to the area: *Artemisia herba-alba*, *Salsola vermiculata* and *Atriplex halimus*. These species, capable of improving the nutritional value of rangeland, are also vulnerable as a result of rangeland degradation. They were thus the focus of efforts to collect and multiply species.

HSAD worked with 21 nurseries or pastoral stations around the country. At each, managers were helped to establish seed banks and nurseries for the prevailing native species, recording detailed information on each species in a database.

At two sites – Ali Algharbe (Maysan) and Al-Shahabe (Wasit) – local pastoral communities agreed to establish nurseries of 75,000 m^2, which were dedicated to seed production and the multiplication of the key species. Seed and seedlings from these nurseries will be used to begin rehabilitation in

Overgrazing and salinity combine to reduce the value of rangelands throughout Iraq. Restored, and with better management by farmers, they will help support improved livelihoods for rural communities

autumn 2014. Participants have also begun to collect and conserve samples of threatened and vulnerable species as genetic resources, to preserve them in case of extinction.

Reseeding the range

Seed gathered from the nurseries cannot simply be scattered over the land; the area is too vast for anything other than a mechanized approach. Plowing, however, would simply promote further erosion and in any case is too costly. HSAD is adopting a technology developed by ICARDA researchers, known as the pitter seeder. Drawn by an ordinary car, preferably shortly after rain has softened the soil, the pitter seeder makes a series of long depressions in the ground. Into these shallow pits it drops seed of selected palatable species. The pits help to catch the rain that falls, and provide a little protection for the emerging seedlings. It is important, though, to enlist the cooperation of nearby herders, who need to keep their flocks away until the plants are well established, and then need to ensure that they do not overgraze again.

Rangeland restoration is a complex and long-term process that depends on close cooperation among the various interested parties and a willingness to forego quick wins in favor of long-term, sustainable development. Given that rangeland covers almost three-quarters of Iraq, and that much of it is in very poor shape, restoring it must be a priority. HSAD has shown the way.

Agroforestry and alley cropping

Ideally, reversing degradation requires reduced pressure on existing rangelands – giving them a chance to recover – at the same time as increased agricultural production. One of the key problems to be overcome is salinity. Agroforestry could be part of the solution.

Alley cropping introduces crops, and frequently livestock too, between alleys of shrubs or trees, all on the same piece of land, either simultaneously or sequentially. Production per unit area is higher than for any of the components on its own. If the alleys are planted along contours, they can improve the infiltration of rain and reduce erosion and further degradation. It provides green fodder for livestock at a time when natural supplies are low. And it offers additional employment opportunities.

A crucial requirement is for fodder species that can thrive despite salinity and drought, and that livestock will find palatable. HSAD and the farmers chose four candidate species to evaluate: *Cynodon dactylon* (Bermuda grass, indigenous to Iraq), *Paspalum vaginatum*, *Sporobolus arabicus* and *Panicum turgidum*. A trial site was prepared and fenced with the help of local farmers at Al-Nassariyah, and the performance of the four species is now being monitored.

Improved rams and more lambs

More productive animals, when well cared for, can kick off a virtuous circle that reduces pressure on rangelands. They bring the farmer bigger profits, so flocks can be smaller, and they are worth more, so get better care. HSAD has conducted research into rams and ewes in an effort to improve sheep flocks.

Rams with good genes and in good condition make an important contribution to the value of a farmer's flock, improving fertility, lambing rates and overall productivity. The Iraqi Ministry of Agriculture is breeding high-quality rams at its research stations and HSAD helped to distribute six such rams to farmers with the capacity to make good use of them, two in Baghdad, two in Anbar and two in Nineveh.

Lambing rates are low under farm conditions, and ewes that do not bear a lamb are essentially unproductive. One factor that improves lambing is for all the females in a flock to be in oestrus more or less synchronously. ICARDA has researched proven technologies to synchronize oestrus, and the project implemented these with nine demonstration farmers in four governorates. Ewes received progesterone-impregnated sponges, which were removed after 14 days. The ewes were then given injections of pregnant-mare serum gonadotrophin and rams were introduced to the flock. Three days later, 90–95% of the treated ewes had been mounted, indicating that oestrus had in fact been synchronized. Researchers and farmers confidently expect more lambs as a result.

Improving the production of date palms

Tissue culture is a valuable technique for multiplying date palms to produce hordes of healthy young plants. It could help to revive Iraq's ailing date palm industry, but it requires well-equipped laboratories and skilled people. That's where HSAD stepped in, improving equipment and training staff.

Above: Tissue culture allows the production of large numbers of healthy young plants of desirable date varieties. Photo: HPTCL

Dates have been a mainstay of food security in Iraq since biblical times. Even today, despite the challenges faced by the country, Iraq grows just under 9% of the world's dates. Not surprisingly, the production of dates fell from the mid-1990s. Since 2005, however, both the area of date orchards and the total harvest have been increasing. Not so the yield per hectare, which has remained almost flat over that period.

In the short term, this is probably the result of pests and diseases, which HSAD has also been tackling with a push towards integrated pest management. Longer term, Iraq needs to replace aging date orchards with more productive varieties. This is where tissue culture is important.

Healthy young plants of desirable varieties can be produced at low cost by tissue culture, improving livelihoods for date farmers

HPTCL

Rehabilitation and replanting

There are three ways to produce a new date palm. The simplest in many respects is to take advantage of the plant's own method of reproduction and plant a seed, but although this may be simple, it also has three major drawbacks.

First, almost half the plants will be a waste of effort. That is because the date palm is dioecious, meaning that male and female flowers are borne on separate plants. A few males are always needed to pollinate the females so that they produce dates. But until they flower, which can be a matter of several years, it is impossible to distinguish valuable female plants from disposable males, the vast majority of which are wasting resources while they are growing to maturity.

The time taken to reach maturity is the second drawback, as the plant needs care and attention during that time even though it is unproductive.

Third, the plants produced by seeds are a genetic mixture of their parents, because they are the result of sexual reproduction. That is, dates do not breed true. So although there is a slim chance that a seed will produce a better-quality plant, almost all seedlings are of poorer quality.

Cloning is better . . .

An alternative to sex is cloning. Date palms naturally produce clones in the form of offsets that grow around the base of a mature plant. The farmer can remove these, plant them and tend them, knowing that they will be female if taken



The traditional method for multiplying date palms is to remove offsets from a mother palm and replant those, but aside from being hard work it is also unreliable

from a female plant, that they will be the same variety as the parent, and that they will fruit a few years earlier than a seedling. All in all, offsets are better than seedlings. But they too have drawbacks, most notably that an adult date palm produces relatively few offsets and some favored varieties produce almost none. Moving offsets about the country can also spread pests and diseases.

. . . but tissue culture is best

Tissue culture offers all of the benefits of offsets with none of the drawbacks, and the very important additional benefit that it can produce almost limitless numbers of young plants.

Tissue culture is a laboratory technique that generally starts with the growing tip of a shoot. Inside this is an area called the meristem, which consists of rapidly growing cells. The meristem is dissected out and placed in a growing medium that contains all the necessary nutrients to keep it alive. The meristem continues to grow, and forms a clump known as a callus, which consists largely of undifferentiated plant cells. Treated with carefully calibrated doses of specific plant hormones, the cells of the callus differentiate into an embryo that eventually produces roots and shoots. The resulting plantlet can be cut away from the callus, grown on and eventually planted in a pot. It then has to be hardened to prepare it for life away from the cosseted conditions of the laboratory. Once that has been done, it can be planted out in an orchard.

Although tissue culture has been used to multiply date palms since the 1970s, it poses problems too. These include the challenges of contamination by fungi and bacteria. In even the best laboratories, contamination can cause losses of 3–15%, which represents a waste of time, effort and material and which can cause severe economic losses. Equally serious, some tissue-culture techniques seem to result in a high proportion of plantlets that are not genetically identical to their parent, which rather negates the point of the exercise.

In an effort to overcome both problems, the HSAD project ensured that staff received thorough training in disinfectant techniques in addition to everything else, and also that the specific protocol used to generate the plantlets was one believed to result in fewer off types. This approach, called organogenesis, results in the rapid conversion of meristems into differentiated shoots and roots. This avoids passing first through the callus and embryo phase, which is when the mutations happen that cause the plantlet to differ from its parent.

SARAVANAN

Barhee dates, a much-prized variety, will be multiplied by the program

An existing government tissue culture laboratory in Basra was the location for much of this training, delivered in summer 2013 by two international experts on date palm organogenesis. That laid the groundwork, during which Iraqi staff learned the protocol in detail and started to put it into practice. A second training workshop in December 2013 consolidated the lessons learned. This was a further step along the route to a complete transfer of the technology for efficient organogenesis tissue culture of date palms to Iraq. Similar efforts have taken place at the Zaafarania laboratory in Baghdad.

It will take time to ramp up production to meet the needs of Iraq's date growers, but the Basra laboratory is on target to produce 500 plants in 2014. One goal is to revitalize cultivation of the highly sought-after Barhee date, which originated around Basra and which is widely considered to be one of the most desirable date varieties.

It all starts with the seed

Iraq, at the eastern end of the Fertile Crescent, is generally considered to be where wheat was originally domesticated. Despite doubled average yields however, from less than 1000 kg per hectare in 1961 to more than 2000 kg in 2012, farmers in Iraq are still suffering from a yield gap. Much of this gap is the result of poor access to good quality seed. HSAD worked on many fronts to ensure that wheat farmers could get the best possible start for their crops.

Above: Good-quality seed is the foundation of productive agriculture. HSAD partners have been working to ensure adequate supplies of the most suitable varieties

Seed-cleaning machinery makes a vital contribution to the supply of high-quality seed, removing stones, weed seeds and debris

Scientific plant breeding, along with changes such as irrigation and the use of synthetic fertilizers, has seen wheat yields in the world's least developed countries increase from around 940 kg per hectare in 1961 to more than 2120 kg per hectare in 2012. Modern varieties with resistance to biotic and abiotic stresses can increase agricultural productivity and ensure food and nutritional security at the same time as improving farmers' livelihoods – but only if farmers have access to them.

In Iraq, as a result of two different bottlenecks, the seed system hitherto has not been able to deliver what today's wheat farmers need. The first bottleneck is to identify varieties that will perform well, while the second is to ensure an adequate supply of seed of good varieties. HSAD tackled both issues in order to develop the supply chain for high-quality wheat seed.

Seed production starts with the breeder's chosen variety. Once this is approved for release, it goes through successive multiplication stages as foundation seed, registered seed and eventually certified seed for sale to farmers. HSAD and the project partners stepped in at the beginning to identify promising elite lines from among breeders' selections. Working with Iraq's national agricultural research stations, they identified 11 high-potential lines of bread wheat and durum wheat. Some were suitable for rainfed cultivation and others for irrigation, while all were tolerant to abiotic stresses such as drought and salinity, or diseases such as rusts. These were grown on in Babil, Baghdad, Nineveh, Salahaddin, Wasit and Erbil, the idea being to produce enough seed for large-scale seed multiplication to begin as soon as the variety was approved by Iraq's Variety Registration, Release and Protection Committee.

Release of a new variety is not an end in itself. The variety has to be properly maintained in order to supply the high-quality foundation seed that is critical for large-scale seed multiplication. As with pre-release selection, the project identified 10 recently released and existing commercial bread and durum wheat varieties for multiplication. Seed companies including the public Mesopotamia Seed Company, the Seed Technology Centre and the public–private Iraqi Seed Company bulked those up with the help of 31 willing farmers. Together they produced around 5700 kg of seed to feed into the system.

Improving adoption

The adoption of improved technologies such as better wheat varieties has been very low in Iraq, for several reasons. Some extension agents do not engage with farmers and cannot persuade them to experiment. Others worry that if they recommended a newly released variety, farmers would be unable to get hold of it. Training workshops helped extension agents to develop the understanding and skills needed to encourage farmers to try new varieties, with the confidence that the strengthened supply chain will mean that the seed of newly released varieties will be available.

Working with the Ministry of Agriculture, ICARDA helped increase the supply of certified seed for wheat from 2500 kg in 2003 to 125,000 kg in 2013. The plan is for this to grow to 155,000 kg by 2015, greatly increasing food security and farmers' incomes.

Table 1: Promising wheat lines selected for pre-release multiplication

Name	Key traits	Type of wheat	Notes
643	Drought tolerant	Bread	Rainfed
649 C	Drought tolerant	Bread	Rainfed
708	Drought tolerant	Bread	Rainfed
Adnan	Drought tolerant	Durum	Rainfed
Alaa 172	Brown rust and Yellow rust resistant. Moderately resistant to Covered smut	Bread	Rainfed
Azmar 120	Yellow rust resistant. Moderately resistant to Covered smut	Bread	Rainfed
Babaga 3	Drought tolerant	Bread	Rainfed
Hamada 84	Yellow rust, Brown rust and Covered smut resistant	Bread	Rainfed
HSAD 122	Yellow rust and Covered smut resistant	Bread	Rainfed
Maaroof 63	Yellow rust and Brown rust resistant	Bread	Rainfed
Shaho 124	Yellow rust resistant. Moderately resistant to Covered smut	Bread	Rainfed

Table 2: Varieties selected for accelerated post-release multiplication

Variety	Type of wheat	Key traits
Al-Rasheed	Bread	High yielding
Bououth 22	Bread	High yielding
Digla	Bread	Salt tolerant
Faris	Bread	Rust resistant
Furat	Bread	Salt tolerant
Omrabie	Durum	High yielding
Sham 1	Bread	High yielding
Sham 6	Bread	High yielding
Tamooz 3	Bread	High yielding
Waha Iraq	Durum	High yielding

Developing knowledge and skills

Producing high-quality seed requires specific skills in addition to good farming techniques. The project offered several workshops to bring government staff up to speed in variety identification and maintenance, seed certification and seed processing.

Variety maintenance is the flip side of plant breeding, the goal being to preserve the characteristics of an existing variety rather than create a new one. A five-day workshop on plant breeding allowed 29 ministry staff to understand both how to design and implement a wheat-breeding program and how to maintain and multiply varieties. They also deepened their understanding of wheat pathogens.

Other workshops targeted seed producers and farmers from the private sector, and government officials responsible for implementing the National Seed Policy (adopted in 2008) and the Seed Law approved in 2013.

Clean seed is crucial

Good harvests depend on having clean seed to plant. The Ministry of Agriculture and Water Resources has placed seed-cleaning machines in villages, but often these were not maintained and fell into disuse. HSAD and ICARDA worked with partners to train farmers how to use and look after the seed-cleaning machines.

One such farmer is Anwar Faze, who has some 60 years of experience and is in charge of one of the restored machines, owned by the Ministry of Agriculture and Water Resources of Iraqi Kurdistan Region. He is very clear about the benefits of clean seed:

"Farmers in this region cannot obtain enough good seed. Every farmer needs a good profit and if the seeds are clean, and if they are treated and cleaned well, the yields will be very good. But if not, the yields will be very poor."

Anwar Faze shares his expertise in operating the seed cleaner with around 150 farmers in the surrounding area.

"We get very good results," he says, noting that with the training he received, he can maintain the machine. "The year before last the dynamo stopped and it had to be replaced. The government fixed it but sometimes you cannot wait and you have to do it yourself."

First, find your watershed: new rapid approaches to planning water harvesting

In northern Iraq, cereals depend on rain, which falls predominantly during winter. Even when water is adequate early in the season, resulting in lush fields of wheat and barley, scarcity later on in the cropping season can reduce yields almost to zero. Storing water early on, to deliver to crops when they need it most, can dramatically improve food security.

Above: Faisal A. Daham (center), head of Dams and Water Resources Engineering at the University of Salahaddin, with the project team assessing a high potential catchment area where a new hill lake will be located

The plan is simple enough. Build a structure to store water during the rainy season and then release it to the fields later when the crops can benefit most. This oversimplification, however, hides the mass of details that have to be in place for such a plan to work. The topography has to be just right, both to collect the rain and to store it. That means suitable soils to build the dam and to hold the water. There is no point, either, in building the perfect water-harvesting structure in the perfect place if there are no communities nearby who can benefit from the extra water. And even if there are nearby farmers, are they actually interested in cooperating with the project?

In an area as large as northern Iraq it would take large, dedicated, multi-disciplinary teams years just to identify the various places where water harvesting might work. Fortunately, they do not have to. Building on work by ICARDA's Integrated Water and Land Management research program – which began its work on the assessment and characterization of areas for potential water harvesting in neighboring Jordan in 2005 – the HSAD team was able to deploy a fast-track approach and show how this technique can help improve the situation for many rural communities in Iraq's wheat-producing areas.

Acquiring targets

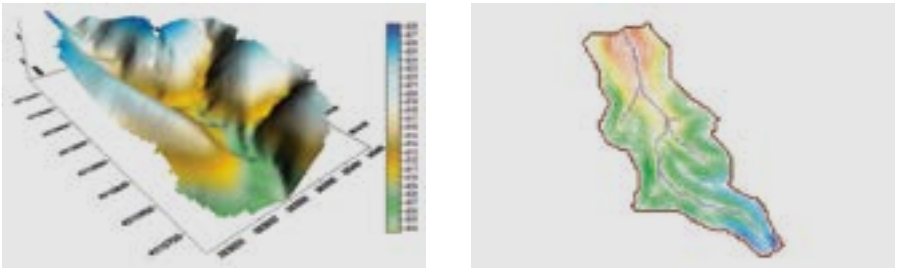
The search starts out in space, with satellites gathering data that can then be mashed up with maps in geographical information systems (GIS). These maps allow researchers to scan large areas quickly, using coarse data on the extent of the watersheds, rainfall, population distribution, topography, land use and many other factors.

Having identified candidate watersheds, teams visit to check factors that cannot easily be read from a map: accessibility; cropping systems, actual and potential; microclimates; water resources; soil type, depth and slope; and the nature of the human communities in the area. All those data go into detailed models that help the researchers to understand local hydrology and to analyze the suitability of the land for a water-harvesting project.

Site visits and subsequent modeling reduce the number of possible targets from hundreds to a manageable handful, at which point the team goes back to the field to gather biophysical and, perhaps even more important, socioeconomic data. Who owns the land? Are farmers willing to cooperate? Can water travel easily from storage to the fields where it will be needed? Is there good access to markets?

Finding the best sites

Using this three-step approach, the HSAD team identified two suitable watersheds to the southwest and northwest of Erbil. Even at this stage, there are factors that make one site more favorable than another. One, for example, was



Topographical and hydrological layers of the Chaluk water harvesting site, one of several identified in the HSAD pilot. The site identification method developed by ICARDA combines ground-level assessment of slope and soil, GIS imaging and socio-economic information about the proximity of the local population. A national plan targets the creation of some 80 hill lakes to provide stable irrigation for crops produced in the driest seasons – a positive impact for thousands of rural inhabitants.

scratched from the list because it could cause flooding in a nearby town, another because the local soils were no good for building the structures and it would have been too expensive to bring in the necessary materials.

In the end, the project identified two places where all the factors were propitious: Seibiran Agha 120 in the Zorga Zraw hills southwest of Erbil, and Shaluk, near the Zab river in the Damer Dagh hills to the northwest.

The potential for water harvesting and supplementary irrigation in the rainfed irrigation of Iraq is enormous. The two first structures being planned in the HSAD project are a proof of concept for how the country can use supplemental irrigation for wheat and other crops to ensure more stable food production in the face of climate change and increasingly unpredictable rainfall patterns. The watershed assessment method, developed and refined by ICARDA during a decade of research, is proving its worth by enabling HSAD project partners to select two very favorable water-harvesting sites in record time. A key element in the project has been to train Iraqi scientists and engineers to adopt the ICARDA integrated watershed management approach. This is a new capacity for the ministry and line agencies, which the country can expand over the coming years as part of its food security and rural development strategies.

The main value of water storage is that it enables farmers to give water when it will have the greatest impact on the ultimate yield

Luring farmers back to the land

One of the problems that successful water-harvesting schemes might solve is the flight of farmers to the cities. Twenty years ago, faced with low and unpredictable harvests, farmers in the Iraqi Kurdistan Region began to leave their land in search of work in nearby towns and cities.

Faisal A. Daham, head of Dams and Water Resources Engineering at the University of Salahaddin, was an advisor to the HSAD project. He is optimistic:

"This is a reason for [farmers] to return. If there are projects and these successfully raise productivity, they will return. When farmers see there are new techniques and technologies, they will take advantage, and when these interventions are cost-effective, they will use them more."

Daham points out that in the chosen target communities the soils are good and there are still enough farmers who want to work with the project. HSAD is also encouraging the communities to move into higher-value produce, building greenhouses and developing markets.

"Farmers are now growing wheat and barley," Daham says, "but with a more significant supply of water, they can also grow high-value crops such as fruit and vegetables."

He also points out that the two pilot sites are the beginning, not the end, of water harvesting in Iraq.

"We have several sites similar to the ones we have chosen which can be exploited during the dry season. The aim is to extend cultivated areas to make farmers return to their lands and proceed with production, and with supplemental irrigation their yields could potentially double."

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