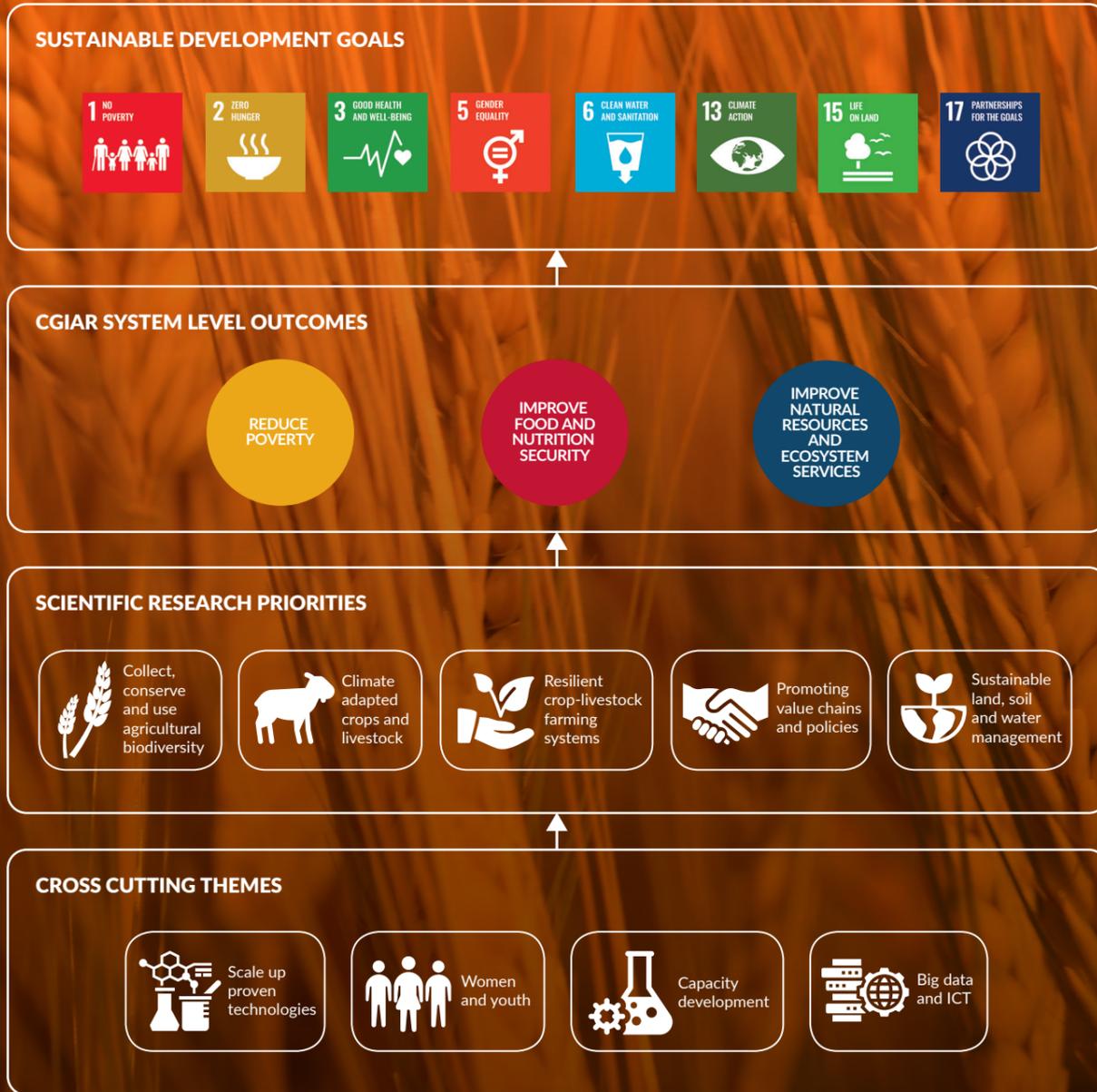


# SCIENCE FOR RESILIENT LIVELIHOODS IN DRY AREAS UNDER A CLIMATE CRISIS



ANNUAL  
REPORT **2019**





## Who we are

The International Center for Agricultural Research in the Dry Areas (ICARDA) is a non-profit international organization undertaking people-centered research-for-development to provide innovative, science-based solutions that improve the livelihoods of communities across the non-tropical dry areas. In partnership with research institutions, governments, NGOs and the private sector, our work advances scientific knowledge, shapes practices, and informs policy.

Since its establishment in 1975, ICARDA has implemented research-for-development programs in 50 countries across the world's dry areas. Working in multi-disciplinary teams with a range of specialized skills, our scientists draw from unrivaled dryland expertise and local knowledge, unique collections of the world's major food crops, extensive research funding networks, and forty years of trust from within the countries where we work. We develop peer-reviewed scientific solutions that are applied across the globe to build thriving and resilient communities with adequate incomes, secure access to food, markets and nutrition, and the capacity to sustainably manage natural resources.

## A people-centered vision

Our approach puts the knowledge, experience and challenges of the communities we serve at the center of our research. We believe this is the only way to ensure our vision of thriving and resilient livelihoods in the dry areas of the developing world becomes a reality. A future where small scale farmers can achieve adequate incomes, secure access to food, markets, and nutrition, and have the capacity to manage natural resources in equitable, sustainable, and innovative ways.

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Our vast and diverse basket of proven technologies can address many dryland challenges

## A rapidly changing context

Throughout my career I have encountered a multitude of serious challenges to the livelihoods of rural farming communities in the drylands, not least the impact of climate change and declining agricultural resources that ICARDA and CGIAR is committed to overcome. But the COVID-19 pandemic, ongoing at the time of publishing this report, is an unprecedented threat that has starkly exposed the fragility of global food systems. I am deeply humbled by ICARDA's dedicated staff, partners and donors who worked throughout to meet our objectives, and the crisis clearly demonstrates that demand-driven research-for-development for more resilient dryland livelihoods must accelerate.

In 2019 ICARDA continued to pursue that exact goal. Through new approaches that respect the environment, such as crop improvement and water management, conservation agriculture, rangeland protection and soil restoration, integrated livestock/fodder systems, and Farming with Alternative Pollinators, we increased farmer incomes while rehabilitating land for enhanced and long-term use. Our water management projects, critical under a changing climate, along with innovations like the raised-bed wheat systems and improved climate/disease resistant crops and livestock, helped farmers in water-scarce, hot surroundings, achieve 'more with less'. And seed multiplications from our International Nurseries and Genebanks were scaled up in time for well-prepared 2019 planting seasons, the products of which now help to provide safety nets for communities hit by COVID-19.

At organizational level we continued to remodel and modernize for meaningful contributions towards CGIAR System Level Outcomes, the UN SDGs, and the priorities of the countries we work in. We focused our own demand-driven research teams and are embracing mechanization, big data, remote sensing, and mobile applications. Above all, we are challenging the status quo by providing women and youth the opportunities they need to attain their rightful place as agricultural partners and leaders.

As the only CGIAR center headquartered in the non-tropical drylands there is an urgency to capitalize on over forty years of research collaboration, partnership, knowledge and trust. Alongside the communities and governments of the countries in which we work, we are maximizing the potential of the drylands to achieve solutions that support millions of vulnerable people from the mounting threats of poverty, malnutrition, unemployment, future shocks and subsequent regional instability. Together with our partners and donors, we are helping agricultural food systems innovate and evolve to ensure that every seed, drop of water, and square inch of land produces food at its maximum capacity.

Aly Abousabaa  
Director General, ICARDA

# SCIENCE FOR RESILIENT LIVELIHOODS IN THE DRIEST AREAS OF THE WORLD

## Our international mandate for research-for-development in non-tropical dry areas

Global dry areas cover some 47 percent of the world's land and are home to 30 percent of the global population. Non-tropical dry areas are characterised by hot, dry summers and cool or cold winters with precipitation primarily in the cool season (the opposite of tropical dry areas). Rainfall is marginal and its distribution and reliability is highly variable.

The charter of ICARDA was signed in 1975 by the International Bank for Reconstruction (IBRD), the Food and Agriculture Organization of the United Nations (FAO), and the United Nations Development Programme (UNDP) and, on behalf of the Consultative Group on International Agricultural Research (IDRC).

ICARDA was assigned international responsibility for the improvement of barley, lentils, and faba beans and regional responsibility, in cooperation with other CGIAR centers, for research in wheat, chickpea, and other crops of major importance to the region, such as grasspea, pasture, and forage legumes, as well as associated farming systems. ICARDA is also mandated to undertake research into small ruminant (sheep and goat) production systems.

"ICARDA is the only CGIAR Center headquartered in the non-tropical drylands"



2.7 BILLION people in the non-tropical drylands

## Dryland Communities

Forty-four percent of the world's food including half its livestock is cultivated in the global dry areas. Yet of the 3.8 billion people who live there, almost 20 percent live in chronic poverty. As climate change intensifies, farmers face serious water scarcity, climate variability, severe environmental degradation, and extreme temperatures and drought.

Unless the drylands are better utilized and livelihoods improve, widespread poverty, political instability, and unemployment will force ever-growing populations to leave their homes in search of better opportunities elsewhere, putting pressure on cities, governments, and other countries.

Our unique scientific expertise, our vast network of partners, and our decentralized model of operation put us in a unique position to deliver the innovative solutions needed to transform agriculture and achieve sustainable and resilient livelihoods in non-tropical dry areas.



## How we work

We provide innovative, science-based solutions for communities in the non-tropical dry areas of the developing world. We work together with a wide network of national agricultural research systems (NARS) and advanced research institutions to enhance their efforts and competencies so they can drive their own research and development agendas. We also work closely with other CGIAR research centers, NGOs, governments, and the private sector. We aim to provide communities with:



### Better biodiversity and crops

We conserve and use landraces and crop wild relatives in our Genebank and breeding programs to develop new germplasm and breeds.



### Climate-adapted livestock systems

We search for adaptive traits in indigenous sheep and goat populations and build our breeding programs on adapted livestock. We utilize innovative technologies and approaches to increase sheep and goat productivity and promote climate-smart feed and precision feeding systems.



### Sustainable land, soil and water management

We deliver practical technologies and solutions that protect environments and help smallholder farmers produce 'more with less' through integrated packages that enhance water, land, and workforce productivity in the face of water scarcity, limited resources, and severe land degradation.



### Improved farmer livelihoods

We develop sustainable value chains that prioritize smallholder farmers and households in dry areas. The value chains target our mandate crops – barley, lentil, faba bean, wheat, chickpea, and grasspea – and sheep and goats.

# HIGHLIGHTS 2019

## Program Highlights

ICARDA strengthened its role as a global leader and collaborator in research-for-development in non-tropical dry areas through its partnerships, open-access data, and proven successes.



50 projects in  
33 countries



889 total  
publications



14 new  
agricultural  
innovations



187 partners

More than 7,000 germplasm accessions and elite germplasm of our mandate crops were shared in 46 countries to support adaptation to climate change and sustainable intensification.

Experiments and modelling proved that conservation agriculture (CA) is a viable option in North Africa to adapt rain-fed cereal-livestock farming systems to climate change.

Due to the success of the Farming with Alternative Pollinators (FAP) approach, Morocco was the first Arab country to join the Coalition of The Willing on Pollinators and began development of a cross-sector pollinator-protection strategy.

Genome-wide scans of Bonga sheep in Ethiopia identified known and novel regions associated with prolificacy and reproduction traits that can eventually speed up genetic progress in breeding programs.

In the MENA region, integrated management systems with rainwater harvesting, land rehabilitation and restoration, and livestock grazing have been developed to improve productivity and resilience of low rainfall rangeland areas.

In collaboration with FAO, NARS partners, and the University of Cordoba, ICARDA established an international network to improve water management and increase productivity of a wide range of crops in farmers' fields across the MENA region.

In India, ICARDA developed innovative tools based on remote sensing and artificial intelligence to support the scaling of improved technologies (cactus and lentil varieties) with ex ante assessment and suitability mapping (assessing regions and methods for suitability of said technologies).

## Research for development 2019

- ICARDA significantly advanced the implementation of its 2017–2026 Strategic Plan, supported by key partners and donors in the countries where we work. ICARDA's partnerships with these stakeholders, as well as with other CGIAR Centers and Research or Development institutes, have created strong bonds and enhanced our integration with scientific communities that cover a wide diversity of disciplines.
- With the support of the CGIAR Excellence in Breeding Platform and after an independent review of ICARDA's breeding programs, ICARDA is fully engaged in the modernization and upgrading of its facilities.
- In collaboration with other CGIAR Centers, ICARDA made significant contributions to the development of the Two Degree Initiative in which ICARDA leads the MENA Grand Challenge, the Livestock Initiative, the CGIAR GENDER Platform, and the Excellence in Agronomy Initiative.
- ICARDA continues to coordinate development of the DryArc Initiative, in collaboration with seven other CGIAR Centers. The DryArc, with its systemic approach of innovation in dryland agri-food systems under water scarcity and climate change, will make significant contributions to the Sustainable Development Goals (SDGs):



DryArc is also being used as a framework to restructure ICARDA Research Programs into more strategic research teams.

## Country and Regional Offices

- ICARDA's 14 Country, Regional and Project Offices were restructured in 2019 under the leadership of the Deputy Director General – Research (DDG-R) and the Director of Corporate Services, to further maximize program delivery and resource mobilization, while outreach and research teams continued to be strengthened under ICARDA's Strategic Plan 2017–2026.

## Capacity Development

- During 2019, the Capacity Development Unit continued its expansion with special support provided by The Arab Fund for Social & Economic Development (AFESD) for the training of Master and PhD students from Arab countries. More than 1,250 trainees from national programs (42 percent of them women) were supported at 60 special courses.
- ICARDA's long-term partnership with the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) was further developed with four international courses on Food Loss and Waste, Livestock and Climate Change, Big Data in Agri-Food Systems, and Farming Systems Design.
- ICARDA's online training platform and the ICARDA alumni group were expanded.



One CGIAR

ICARDA Board members and Management are actively engaged in the reform process designed to create a more integrated CGIAR, known as One CGIAR.

ICARDA Director General Mr. Aly Abousabaa was appointed as Director General and Co-Convenor to the CGIAR General Assembly and coordinated the engagement of all 15 Centers/Alliances in the future One CGIAR system and research programs. ICARDA's Board and Management continue to engage in the One CGIAR process at different levels, through the System Management Board, Transitional Consultation Forum, Transition Advisory Groups, CGIAR Communities of Practice, and working groups. Through regular meetings of various groups, constructive feedback is provided by ICARDA on a continuous basis.

# OUR WORK

## BETTER AGRICULTURAL BIODIVERSITY AND CROPS

Increased and reliable agricultural production in dryland areas is vital to global food security and addresses growing dependence on costly food imports amid the challenges presented by climate change, diminishing natural resources, and rapidly growing populations. Conserving and utilizing dry area crops, landraces and wild relatives can improve agricultural production by securing genetic gains, allowing adaptation of crops to climate change, and addressing market-related challenges such as grain quality and costs of production.

In 2019, ICARDA continued to play a critical role in the conservation, development, improvement, and dissemination of climate-resilient, market-driven crop varieties that provide a critical defence against extreme temperatures, water scarcity, and the emergence of new pests and diseases.



### BREEDING

Our breeding program applies conventional and molecular breeding to develop crops highly-adapted and resistant to climate variations and disease. Crop breeding efforts involve: introducing desirable traits from landraces and wild relatives into elite germplasm, mainstreaming nutritional quality (including biofortification) into current breeding programs, and widening the genetic base as a major strategy to increase yield potential, stability, quality, and nutrition.



### GENEBANKS

ICARDA's collection of unique in-trust genetic materials ranks among the most important worldwide. These collections are rich in landraces and wild relative species. We manage a genebank containing 143,000 samples of major spring and winter cereals, food legumes, forage, and rangeland species.



### INTERNATIONAL NURSERIES

ICARDA and its national partners utilize the genetic resources conserved in our genebank to develop improved lines that we share worldwide through our International Nurseries for a wide range of agricultural systems.



CGIAR

### Working alongside the CGIAR Research Programs (CRPs)

ICARDA is grateful for the financial support and partnership from the CRPs. Together we combine our expertise, knowledge and field data, to support our mutual stakeholders and carry out our important work.

## ICARDA's First International Experts Workshop on Pre-breeding Utilizing Crop Wild Relatives – Rabat, Morocco

The Global Crop Diversity Trust, contributing to a global initiative funded by the Government of Norway, Adapting Agriculture to Climate Change: Collecting, Protecting, and Preparing Crop Wild Relatives, has supported projects to strengthen pre-breeding activities. Within this initiative, over the past four years, ICARDA has implemented the project, Trait Discovery and Deployment through Mainstreaming the Wild Gene Pool in Barley and Grasspea Breeding Programs to Adapt to Climate Change, a collaboration with Morocco's National Institute for Agricultural Research (INRA-Morocco), and the Leibniz Institute of Plant Genetics and Crop Plant Research, Germany.

Within this project, ICARDA helped organize the First International Experts Workshop on Pre-breeding Utilizing Crop Wild Relatives, bringing together representatives from 48 countries, including the representatives of CGIAR centers, universities, and national partners. Pre-breeding is the process of identifying favorable genetic traits from landraces and crop wild relatives, and introducing them into breeding programs to develop modern crop varieties.

## Better seeds for all who need them

ICARDA's mandate within CGIAR is to improve barley, lentil, faba bean, and grasspea at a global level, and kabuli chickpea, and durum and bread wheat regionally. We develop nurseries for a wide range of agricultural and global seed distribution systems and in 2019 delivered seeds for research or adoption all over the world, leading to the release of improved crop varieties with traits such as high grain yield and quality, abiotic (drought, heat) and biotic (rusts) stress tolerance, and early maturity.

In partnership with FAO we laid the groundwork for a future program to support the recovery of Syria's food system by vastly multiplying basic wheat, barley, chickpea, and lentil seed, and our seed health programs in Lebanon and Morocco help monitor and quarantine pests and phytosanitary clearances alongside national plant quarantine services.

In Ethiopia, Nigeria and Sudan, the ICARDA-coordinated Technologies for African Agricultural Transformation (TAAT) project, funded by the African Development Bank, uses innovation platforms to build networks and partnerships to bring together committed and new stakeholders. TAAT is instrumental in strengthening production capacity and seed systems in Sub-Saharan Africa, disseminating improved climate-resilient wheat varieties, and introducing innovative technologies and practices to increase staple crop productivity.



"The African Development Bank believes that the TAAT wheat compact is a real game-changer for Africa. Expanded production will relieve the continent of an ever-increasing import bill of nearly USD \$10 billion per annum."

– Dr. Martin Fregene, Director, Agriculture and Agro-Industry, African Development Bank



3,932 plant accessions distributed



143,000 total accessions conserved in genebanks end 2019

## Global food security through sustainable use of agricultural biodiversity

Established in 1985, ICARDA's genebank system offers a valuable collection of resources for drylands agrobiodiversity. The genebanks hold more than 143,000 accessions (seed 'lots'), gathered mainly from Central and West Asia, and North and East Africa. Ranked among the most important worldwide, ICARDA's unique in-trust collections are rich in landraces and wild relative species, many of which are fast disappearing species essential to global food security.

In 2019, new sources of resistance to major insects and diseases were discovered for barley, lentil, and wheat, and successful interspecific crosses were bred between grasspea and six wild Lathyrus species with resistance to Orobanche (a parasitic weed) and low ODAP (a toxin) content. As well as conserving and protecting biodiversity, ICARDA also carries out discovery missions in dryland areas to find new or threatened species, which are deposited into our genebanks for safekeeping.

# BETTER AGRICULTURAL BIODIVERSITY AND CROPS

In response to rapidly changing climatic conditions across non-tropical dry areas, ICARDA applies conventional and molecular breeding strategies to develop highly adapted crops and livestock with resistance or tolerance to major biotic constraints such as disease and pests, and abiotic constraints such as heat, salinity, drought, and cold spells.

## Speed-breeding protocol for cool-season food legumes

Speed breeding under controlled conditions – daily exposure to artificial light – shortens the growth-time of one generation of a plant. This reduces the generation advancement time from five years to one, significantly reduces field and labor costs, and shortens the overall time needed to release a new variety.

In 2016, ICARDA established a fully automated pilot facility in Rabat for speed breeding with a capacity for 3,000 entries. This facility successfully develops and optimizes speed breeding protocols, including screening for diseases. In 2020, within the framework of the Modernization of ICARDA Breeding Programs initiative, supported by the AFESD and the Templeton World Charity Foundation, among others, ICARDA will scale-up the facilities and increase capacity to more than 100,000 entries.



25°C AND 22 HOURS LIGHT/DAY

20 DAYS

25 DAYS

30 DAYS

35 DAYS

## Improving faba bean yields through integrated agricultural packages

ICARDA's integrated packages of knowledge and new innovative approaches to soil, land, and water management, backed-up by the buy-in and trust of the local communities where we work, offers dryland countries a route to self-sufficiency in the production of their strategic crops.

In Egypt, the outbreak of faba bean necrotic yellow virus (FBNYV) in 1991, as well as a threat from *Orobanche crenata* (a parasitic weed), contributed to major faba bean losses. ICARDA has now deployed cultivated lines of faba bean that are resistant to *Orobanche crenata*. These will help not only Egypt but Mediterranean countries where the weed originated and Ethiopia and Sudan where it has since spread. Heat-tolerant Faba seeds were also identified and dissected for components. These lines can survive at 35°C during the flowering stage. Breeding product profiles were also developed for faba bean with NARS partners following the guidelines of the CGIAR Excellence in Breeding Platform in order to prioritize future breeding efforts.



"ICARDA's supply of high-quality germplasm under development for testing and selection, is a major pillar in our collaboration for improving crops that will actually grow in this country generating many food legumes and cereals varieties contributing to food security. It is a highly valued partnership in which we see a strong continuation and expansion".

- Prof. Mohamed KHARRAT, Directeur du Laboratoire des Grandes Cultures, INRAT



## ICARDA's barley and wheat program

In 2019, ICARDA's wheat and barley breeding programs, supported by CRP Wheat and CRP livestock, continued their modernization process following recommendations from the CGIAR's Excellence in Breeding Platform. ICARDA's wheat breeding programs have been granted access under the One Global Wheat program of the new CIMMYT speed breeding facilities under development in Toluca (Mexico). The facilities will accelerate the breeding response to current threats, especially in the rainfed environments that ICARDA targets.

This technology will be used alongside the genomic selection approach, which has been used to efficiently identify high yielding germplasm in ICARDA's durum wheat program. The barley program has also used new molecular techniques, such as gene pyramiding, to increase the resistance of new germplasm to devastating diseases such as Barley Yellow Dwarf Virus. New dual-purpose genotypes with increased disease resistance are now in the pipeline to be distributed to NARS.

Eight new high yielding barley varieties developed from the Center's spring barley elite germplasm have been released in Iran, Turkey, Ethiopia, Jordan, and India. In Ethiopia, improved wheat adoption increased by 10 percent in one year, a response to smart packaging and input marketing, and new ICARDA studies in Iraq have



ICARDA faba bean breeding profiles were developed with NARS partners referencing the CGIAR Excellence in Breeding Platform. All our seeds are available for anyone through an online nursery request. Visit our international Nurseries pages for more details at [www.indms.icarda.org](http://www.indms.icarda.org)

demonstrated the threats that soil salinity pose to technical efficiency and environmental efficiency in wheat production systems. Recent wheat releases include the new drought-tolerant barley variety Kounouz, now adopted in Tunisia and in 2019 some 1,624 tons of certified Kounouz seeds were produced with the support of two large-scale seed multiplying cooperatives, Coopérative Centrale des Semences et des Plantes Sélectionnés and Cooperative Centrale des Semences, and one private seed enterprise, Tunifert.

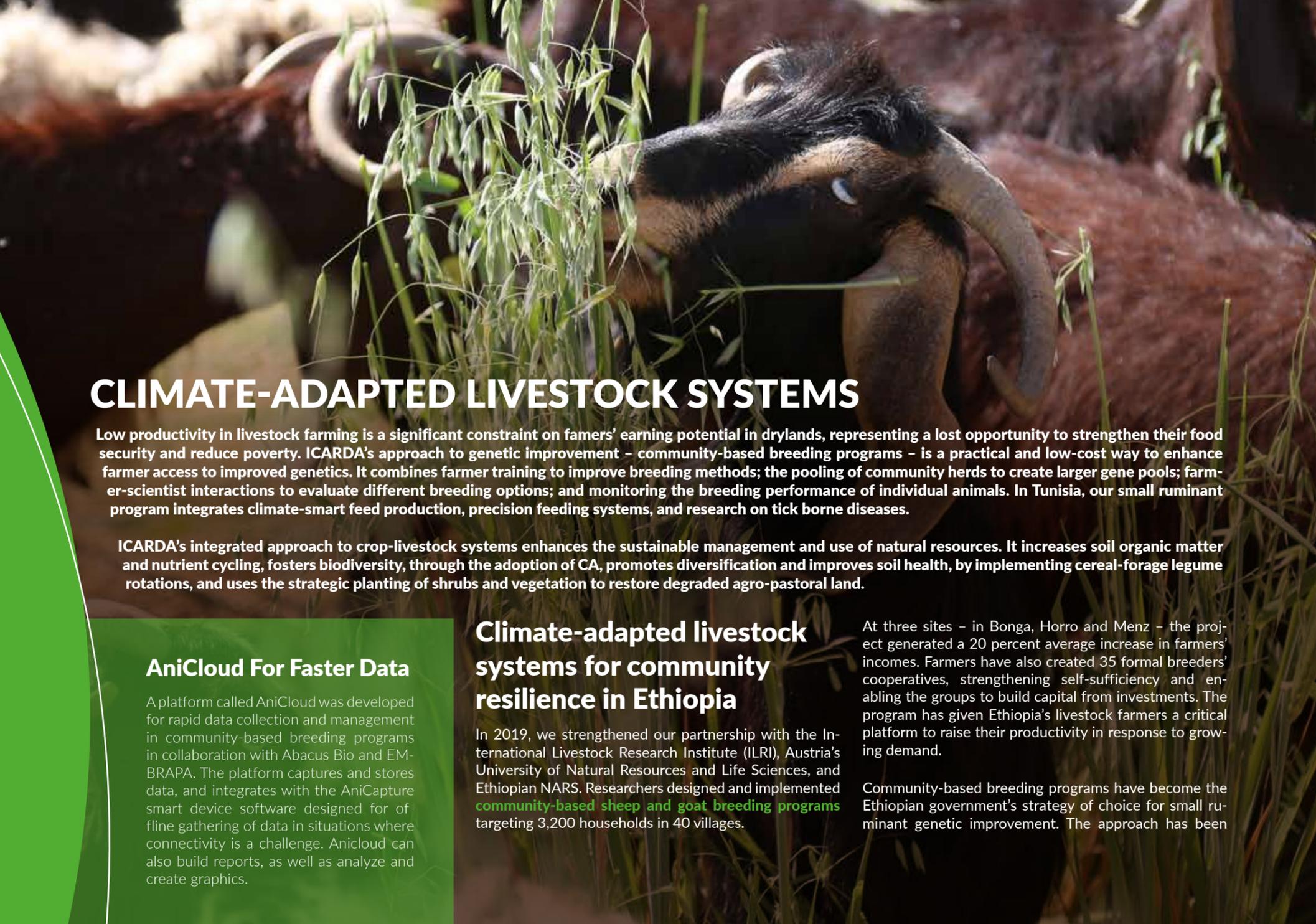
The value of ICARDA's wheat and barley germplasm continues to be acknowledged by countries such as Australia who renewed the CIMMYT-Australia-ICARDA Germplasm Exchange project to strengthen scientific partnerships for another three years.



14 projects in 17 countries



18 ICARDA improved crop varieties adopted by countries in 2019



# CLIMATE-ADAPTED LIVESTOCK SYSTEMS

Low productivity in livestock farming is a significant constraint on farmers' earning potential in drylands, representing a lost opportunity to strengthen their food security and reduce poverty. ICARDA's approach to genetic improvement – community-based breeding programs – is a practical and low-cost way to enhance farmer access to improved genetics. It combines farmer training to improve breeding methods; the pooling of community herds to create larger gene pools; farmer-scientist interactions to evaluate different breeding options; and monitoring the breeding performance of individual animals. In Tunisia, our small ruminant program integrates climate-smart feed production, precision feeding systems, and research on tick borne diseases.

ICARDA's integrated approach to crop-livestock systems enhances the sustainable management and use of natural resources. It increases soil organic matter and nutrient cycling, fosters biodiversity, through the adoption of CA, promotes diversification and improves soil health, by implementing cereal-forage legume rotations, and uses the strategic planting of shrubs and vegetation to restore degraded agro-pastoral land.

## AniCloud For Faster Data

A platform called AniCloud was developed for rapid data collection and management in community-based breeding programs in collaboration with Abacus Bio and EM-BRAPA. The platform captures and stores data, and integrates with the AniCapture smart device software designed for offline gathering of data in situations where connectivity is a challenge. AniCloud can also build reports, as well as analyze and create graphics.

## Climate-adapted livestock systems for community resilience in Ethiopia

In 2019, we strengthened our partnership with the International Livestock Research Institute (ILRI), Austria's University of Natural Resources and Life Sciences, and Ethiopian NARS. Researchers designed and implemented **community-based sheep and goat breeding programs** targeting 3,200 households in 40 villages.

At three sites – in Bonga, Horro and Menz – the project generated a 20 percent average increase in farmers' incomes. Farmers have also created 35 formal breeders' cooperatives, strengthening self-sufficiency and enabling the groups to build capital from investments. The program has given Ethiopia's livestock farmers a critical platform to raise their productivity in response to growing demand.

Community-based breeding programs have become the Ethiopian government's strategy of choice for small ruminant genetic improvement. The approach has been

incorporated into the country's Livestock Master Plan, which has received a US\$560,000 investment to upscale across the country. Uganda, Malawi, Liberia, South Africa, and Burkina Faso have also adopted similar programs, influenced by the genetic gains and socio-economic successes experienced in Ethiopia.

Our sheep fattening programs are also being implemented in four locations in Ethiopia. The programs target knowledge sharing and the promotion of best practices and adopt a market orientation to foster employment and the entrepreneurial skills of youth living in Ethiopia's highlands. In 2019, 44 youth groups with a total of 485 members (41 percent female) located across 29 villages **were trained** in sheep husbandry, ration balancing and formulation, entrepreneurship skills development, finance, and marketing.

## Integrated crop-livestock conservation agriculture farming systems

Through an initiative funded by the International Fund for Agricultural Development (IFAD), use of crop-livestock conservation agriculture (CLCA) in the Drylands, ICARDA offers smallholder farmers in Algeria and Tunisia flexible technology packages to implement CLCA and address needs of their livestock and the environment. The packages include grazing management tools, improved crop varieties, water-saving techniques, weed control, and crop rotation.

In Algeria, the impact of CLCA resulted in a 30–40 percent reduction in irrigation water-use and a two- to three-fold increase in barley and wheat production. In Tunisia, fungal diseases in durum wheat fields was significantly reduced and studies show a strong productivity and environmental impact when CLCA is scaled up across North Africa. ICARDA also assesses the impact of CLCA on natural resources, especially soil health and

water efficiency. **Preliminary results** in Tunisia showed that soil loss due to erosion reduced by 14 percent, some 62 kilograms per hectare (kg/ha) under CLCA technology, compared to conventional practices.

ICARDA is developing guidelines so that CLCA can be adopted and scaled up in similar conditions globally through a 'Livestock for Profit' strategy under CLCA systems. This encompasses stubble grazing, forage and alternative feed resources, and animal health interventions. The integrated Organization for Scaling approach brought together professional farmer groups and private seed companies to conclude multiplication contracts for the promising forage seeds and avoid availability bottlenecks.



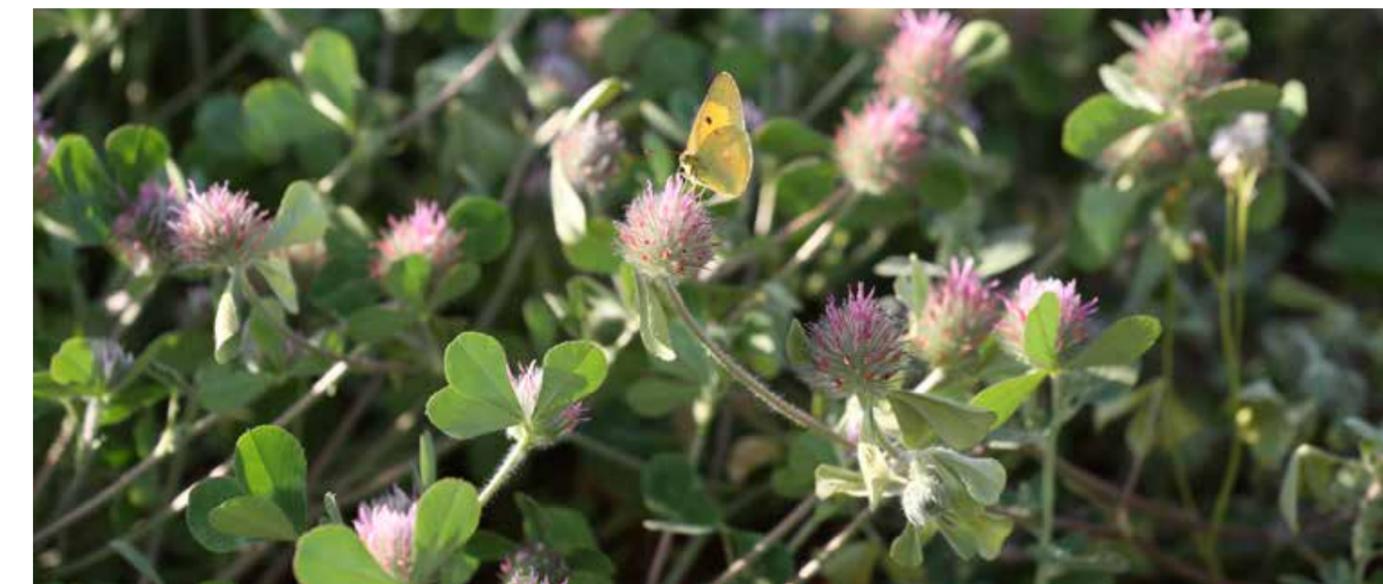
20 projects in 24 countries



11 new livestock nutrition and management innovations

## Conservation Agriculture (CA)

CA is the process of enhancing soil fertility and conserving moisture through the avoidance of plowing (zero-tillage), diversifying crop rotations, and the conservation of crop residue, making crop production more resilient to climate change compared to conventional tillage.



# WHERE WE WORK

EGYPT ETHIOPIA  
MOROCCO  
PAKISTAN  
LEBANON  
SUDAN UAE  
UZBEKISTAN  
SYRIA INDIA  
AFGHANISTAN  
JORDAN TURKEY  
TUNISIA



**LEBANON**  
ICARDA TEMPORARY HQ  
(2013 - PRESENT)  
**Established: 1977**  
International Nurseries Hub  
Research Platform  
• Irrigated farming  
• Rainfed farming

**AFGHANISTAN**  
**Established: 2002**  
• Rainfed farming  
• Irrigated farming  
• Agro-sylvo-pastoral

**EGYPT**  
**Established: 1978**  
• Irrigated farming  
• Desert Farming

**ETHIOPIA**  
**Established: 1993**  
Sub-Saharan Africa Hub  
• Rainfed farming  
• Irrigated farming  
• Agro-sylvo-pastoral

**INDIA**  
**Established: 1986**  
South Asia Hub  
Research Platform  
• Rainfed farming  
• Agro-sylvo-pastoral

**JORDAN**  
**Established: 1977**  
• Agro-sylvo-pastoral  
• Irrigated farming

**MOROCCO**  
**Established: 1985**  
Genebank Hub  
Research Platform  
• Irrigated farming  
• Rainfed farming

**PAKISTAN**  
**Established: 1980**  
• Irrigated farming

**SUDAN**  
**Established: 1978**  
• Irrigated farming

**SYRIA**  
ICARDA HQ (1977-)  
**Established: 1977**  
• Rainfed farming  
• Irrigated farming  
• Agro-sylvo-pastoral

**TUNISIA**  
**Established: 1980**  
• Agro-sylvo-pastoral  
• Desert Farming

**TURKEY**  
**Established: 1985**  
• Rainfed farming  
• Rust Center

**U.A.E**  
**Established: 1992**  
Arabian Peninsula Hub  
• Desert Farming

**UZBEKISTAN**  
**Established: 1998**  
Central Asia Hub  
• Agro-sylvo-pastoral  
• Rainfed farming

## 1. Irrigated farming

A wide diversity of crops less dependent on seasons. ICARDA irrigated approaches protect the environment through crop rotations and intercropping. Also integrates high yielding crop varieties, land preparation and irrigation systems for efficient water use, solar-powered irrigation, fertilizer efficiency, salinity management.



## 2. Rainfed

Producing more food in an uncertain climate. ICARDA reduces rain dependency through 'more-for-less' innovations - drought-resistant crops and livestock, mechanization, better land, soil and water management and conservation agriculture.



## 3. Agro-sylvo-pastoral farming

Resilient livelihoods without adequate rain. Environment and bio-diversity protective agriculture by integrating crops, agroforestry and livestock, improving soil fertility and reducing land degradation. Market-oriented livestock production, rainwater harvesting, rangeland management, small-scale dairy production.



## 4. Desert farming

Resilient livelihoods without rain - 'More-for-less' innovations such as date palm and multi-layer systems, protected agriculture, soil-less agriculture, solar-powered irrigation, salinity management, camels and heat-tolerant goats and sheep, improved water-efficient forages and shrubs.



Limited irrigation may be used for some crops and at some periods in rainfed and agro-sylvo-pastoral systems

ICARDA can support implementation of all four farming systems in any drylands country.



# BETTER LAND, SOIL, AND WATER MANAGEMENT FOR FOOD PRODUCTION AND DIVERSIFIED DIETS

Nowhere in the world is water scarcity a more direct threat to the lives of millions of people than in dryland countries. In response to this challenge, ICARDA's Water, Land, and Ecosystems Research Program carries out research-for-development on three diversified and sustainable practices for family and large-scale farming.

Our research includes maximizing in-situ storage of water in rainfed agriculture and rangelands through conservation interventions; improving on-farm water use and management for higher water and land productivity; and the safe use of treated wastewater for the production of feed and forage.

We explore the use of wastewater for irrigation, soil fertility and health, while developing indicators to assess changes in soil quality, and we work on ways to restore degraded agro-pastoral land. ICARDA solutions allow farmers to plant and manage crops at the optimal time, without being at the mercy of unpredictable rainfall.



16 projects in 17 countries



3 new innovations to improve land, soil, and water management



## Innovative Agriculture for Small Holder Resilience (iNASHR)

This project aims to out-scale a combination of technologies and agronomic practices in Egypt, including laser-leveling, mechanized raised bed, crop rotation, and water and land management strategies to sustainably increase wheat and faba bean production.

Adoption of the proposed package will contribute to improved soil fertility and water use efficiency at the farm level, improved water quality for downstream users, and improved nutrition at the household level.

## Enhancing water and land productivity in Egypt

In 2019, in collaboration with Agricultural Research Center, Zagazig University, and Tanta Motors of Egypt, ICARDA developed an improved version of the Raised Bed Machine (RBM), to expand the adoption of a mechanized raised bed system (MRB) among smallholder farmers in Egypt for multiple crops. The RBM can prepare an acre of agricultural land in 30 minutes, a task that would otherwise take 10 farmers a full working day to complete manually. The RBM, initially used for wheat, has also been tested on berseem clover, maize, cotton, and faba bean.

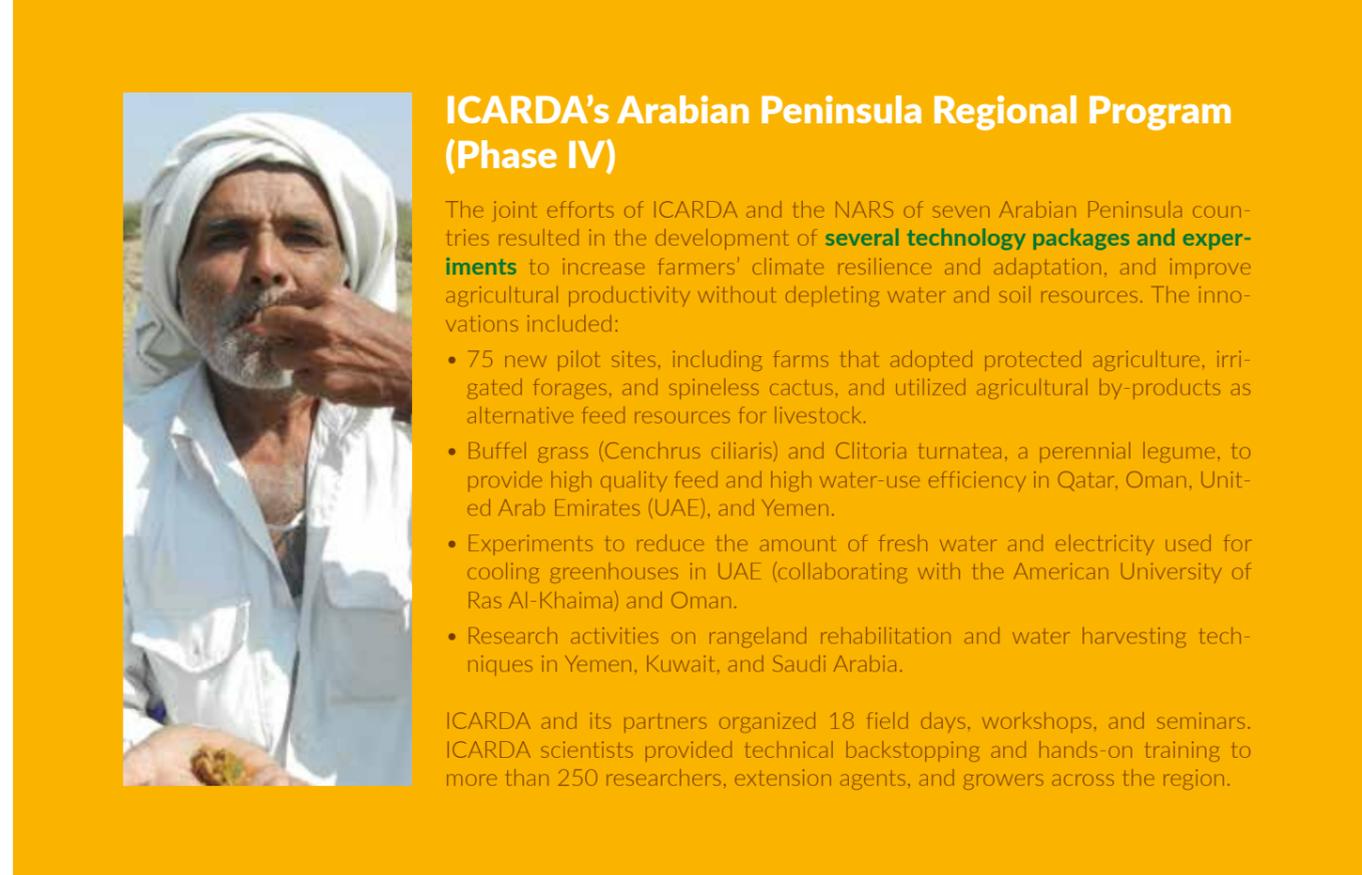
The RBM can sow different crops simultaneously, improving water productivity and increasing yields in diversified wheat-based farming systems. Since 2010, farmers using the RBM in Egypt have experienced a 25 percent saving in applied water, a 25 percent reduction in farming costs, a 30 percent increase in the efficiency of fertilizer use, and a 25 percent increase in crop yields.

Furthermore, under the project, Enhancing Water Productivity by Improving On-farm Irrigation Management in Minya and Fayoum, funded by the European Commission, MRB cultivation was applied in 2000 demonstration fields and three consolidated platforms. Several capacity building activities on MRB, including farmer



"Smart water, soil and land management is vital for the MENA region, one of the most climate-vulnerable places on earth. In its 40-year history, ICARDA's innovations and approaches have helped make the livelihoods of millions of small-holder more resilient in the face of intensifying climate change"

- Dr. Pasquale Steduto, Independent Senior Water Advisor



## ICARDA's Arabian Peninsula Regional Program (Phase IV)

The joint efforts of ICARDA and the NARS of seven Arabian Peninsula countries resulted in the development of **several technology packages and experiments** to increase farmers' climate resilience and adaptation, and improve agricultural productivity without depleting water and soil resources. The innovations included:

- 75 new pilot sites, including farms that adopted protected agriculture, irrigated forages, and spineless cactus, and utilized agricultural by-products as alternative feed resources for livestock.
- Buffel grass (*Cenchrus ciliaris*) and *Clitoria turnatea*, a perennial legume, to provide high quality feed and high water-use efficiency in Qatar, Oman, United Arab Emirates (UAE), and Yemen.
- Experiments to reduce the amount of fresh water and electricity used for cooling greenhouses in UAE (collaborating with the American University of Ras Al-Khaima) and Oman.
- Research activities on rangeland rehabilitation and water harvesting techniques in Yemen, Kuwait, and Saudi Arabia.

ICARDA and its partners organized 18 field days, workshops, and seminars. ICARDA scientists provided technical backstopping and hands-on training to more than 250 researchers, extension agents, and growers across the region.

field schools, field days, harvest days and other special training sessions, were conducted. These were provided for 40 water user associations, and their 200 members, 100 individual farmers, 10 extension officers and five researchers.

MRB technology was extensively disseminated for sustainable agricultural intensification on a large scale across 22 governorates, part of a nationwide campaign. The government established the National Wheat Campaign to enhance self-sufficiency in wheat. MRB, along with other agronomic packages, has exponentially transformed wheat production in Egypt. By 2019, it had been adopted by more than 700,000 farmers in Egypt.

In a country where approximately 50 percent of wheat demand is met by imports, and 95 percent of water originates beyond its borders, the Government of Egypt is targeting two million acres of wheat to be cultivated using MRB by 2022. Widespread adoption of the RBM technology package is expected to increase Egypt's wheat production - from 8 million tons in 2017 to about 14 million tons in 2025. In addition to strengthening national food security, the technology could also save irrigation water - by more than 1.5 billion cubic meters per year by 2025.



# BETTER LAND, SOIL, AND WATER MANAGEMENT TO PROTECT RANGELANDS

ICARDA's research team on soil, water, and vegetation management works with agro-pastoral communities to protect rangeland health through unique and integrated soil and water conservation technologies, landscape afforestation with indigenous multi-purpose species (herbaceous, shrubs and trees), and better livestock management programs (grazing management). Together, these are essential to ensure the stability and resilience of communities' agro-pastoral production systems and halt land degradation. They are designed for potential scale-up to all global arid and semi-arid rangelands.

## Threatened rangelands = threatened communities

Rangelands in non-tropical dry areas are under increasing strain as a result of rapid population growth, overgrazing, mechanization, unsustainable resource management, and unpredictable climate patterns. In addition, invasions of unpalatable and partially toxic plants reduce the ability of indigenous plants to thrive, progressively altering livestock feed systems. As a result, native vegetation (both in terms of biomass and biodiversity) and soils are being severely degraded.

## Integrated watershed management in Jordan

Three years into ICARDA's rangeland and Marab rehabilitation activities in Jordan, efforts to enhance upland micro water harvesting while fostering groundwater recharge has helped reduce surface runoff by 50 percent, improving vegetation and biodiversity. Though average rainfall in the region is below 200 millimeters (mm), Marab rainwater harvest capture helps secure up to 500 mm, allowing crop and fruit tree production.

ICARDA's rehabilitation of rangelands approach using mechanized micro water harvesting techniques, coupled

with planting of native shrubs, has since been adopted by relevant ministries. Research also helped to understand long-term impact of restored areas on water runoff and soil erosion rates during the past (baseline), present (degraded), and future (rehabilitated). In the long-term this approach could decrease surface runoff by around 10–30 percent and as rangeland hydrology and erosion processes are related to plant growth and ground cover, a balanced interaction between rangeland hydrology and vegetation status is key to achieving sustainability.

ICARDA's enhanced Marab agriculture can double local barley production compared with traditional upland practices while reducing local inputs, particularly im-

portant for nutrition and reseeding purposes. Farmers can simultaneously rehabilitate fragile uplands, enhance overall biomass production and biodiversity, protect ecosystem services, and conserve Bedouin heritage landscapes.

## Promoting silvopastoral practices to protect rangeland in Tunisia

ICARDA and FAO, in partnership with the Tunisian Ministry of Agriculture, have been working together to develop an integrated package aimed at sustainable restoration of silvopastoral systems in semi-arid ecosystems. Silvopastoral systems are a mutually beneficial practice of integrating trees, forage, and the grazing of domesticated animals to reduce overall degradation, increase productivity, and enhance ecosystem services.

A pilot silvopasture site established in 2017 in central Tunisia quickly became a center of national attention and a model for outscaling best silvopastoral practices. The focus of the project is on revegetating degraded areas using indigenous herbaceous and woody species. It is now being monitored and managed with support from CRP Livestock. The reseeding, using native forage legume (sulla), has completely changed the landscape and attracted the attention of farmers, extension agents, and local authorities. The afforestation survival rate is above 80 percent. Soil erosion has also been cut substantially and there has been a tenfold increase in biomass, resulting in a 66 percent reduction in feeding costs.

The improved site is owned by the state (forestry commission) for use by surrounding communities with grazing access. However, these farmers have also requested access to seeds (for the sulla forage legumes) and seedlings (for the shrubs and trees) for their own private land, demonstrating the adoption and scalability potential of the technology.



## Marabs and ICARDA technology

The Marab concept is ancient and simple: by creating relatively flat land, excess water runoff from upland watershed areas during rainstorms slows and spreads out over downstream floodplains, infiltrating soil and retaining water for targeted field crop support. ICARDA optimizes this concept through advanced site location and implementation, based on biophysical assessment tools, including hydrological modeling. This optimizes water collection while embedding the Marab agro-pastoral technology into basin water management, securing water for downstream requirements. Marabs helps dryland farmers extend growing windows, raise productivity, and reduce pressure on fragile resources.

## The Rangeland Restoration Toolbox

ICARDA, ILRI and the International Union for Conservation of Nature, have been working together to develop a rangeland restoration toolbox that encompasses the current state-of-knowledge on sustainable rangeland management in non-tropical dry areas. This information resource is designed to enhance the sustainable management of rangeland ecosystems and help countries achieve land degradation neutrality.



## IMPROVING FARMER LIVELIHOODS

The ultimate goal of our research in global drylands is to break the cycle of poverty, improve food and nutritional security, halt or reverse the alarming process of resource degradation, and help communities living in non-tropical dry areas adapt to the impacts of climate variability and change. We envision thriving and sustainable agricultural sectors that generate adequate incomes, provide secure access to food, markets, and nutrition, and support communities so they can manage their natural resources and sustain their own livelihoods.

Although agriculture has the potential to generate income and provide financial stability for rural households, this potential is often not reached as food production systems are not fully developed, and targeted investments—in new technologies, infrastructure, and markets—are low.

Enhancing farmer access to markets requires efforts to improve the business management and marketing skills of smallholder farmers, ensuring they have the knowledge and expertise to meet quality standards. ICARDA researchers assess and evaluate value chains for major dryland crops and commodities, such as durum wheat, barley, legumes, and small ruminants, and we work closely with key stakeholders along each chain to allow agriculture to generate income for poor households and stimulate wider economic activity.

### Demand-driven selection of durum wheat varieties for Africa

In 2019, ICARDA revised how it delivers durum wheat germplasm to partners via a demand-driven model using product profiles.

This strategy follows the guidelines set by the CGIAR Excellence in Breeding initiative, part of CRP WHEAT's modernization scheme. The strategy's goal is to gather, in a more objective way, the specific needs for various wheat traits through detailed agreements with in-country NARS.

In Ethiopia, elite varieties of durum wheat (Mangudo and Utuba) introduced in 2014/15 have been scaled by the initiative, Africa Research in Sustainable Intensifica-

tion for the Next Generation (AfricaRISING), supported by the United States Agency for International Development, as part of the US Government's Feed the Future initiative. The project has conducted demonstrations on over 12,000 ha in the past three seasons and recent surveys revealed that the varieties had been cultivated on over 34 percent of the durum wheat area in Oromia, Amhara, and Tigray, with an average 3–5 percent gain in surface area per year. The Italian Agency for Develop-

ment Cooperation also promoted these varieties as part of their value chain approach for pasta production, and the Ethiopian Millers Association is working with farmers to reduce production costs and increase competitiveness against foreign pasta imports.

The recent shift toward product profiling has resulted in two new agreements between ICARDA and the Ethiopian Institute of Agricultural Research to develop, within three years, the next round of varieties that will replace Utuba and Mangudo.

### Increasing farmer income through food legumes

In 2019, ICARDA showed that food legume-cereal rotations have clear economic advantages over cereal monocropping in a study covering 21 major wheat growing provinces in Morocco.

The study demonstrated that adoption of rotations, as well as integrating ICARDA-improved faba bean varieties, led to a two-year average gross margin 48 percent higher than wheat monocropping, making rotations an economically beneficial option. Faba bean rotations can also improve the economic value of cereal crops by enhancing yields and protein content, key for industry buyers.

Past economic analyses on crop rotation used data from experimental stations or small-sized farmer surveys over one season. Uniquely, the ICARDA study examined two-year data from a large sample of 1,230 farm households.



“ICARDA's projects and innovations improve the incomes of farmers wherever they are adopted”

### Increasing farmers income by Farming with Alternative Pollinators (FAP)

Much of ICARDA's crop research focuses on cereal and mandate crops such as wheat, barley, chickpea and lentil, all of which are self-pollinating. However, since 2013, the FAP approach has been tested with other crops such as faba bean, cucumber, zucchini, melon, pumpkin, tomato, eggplant and apple. FAP highly increases productivity and income per surface by attracting wild pollinators and natural enemies.

The common pollinator protection approach in high-income countries is to subsidize strips of wildflowers in fields. FAP however uses marketable habitat enhancement plants only (oil seeds, spices, food crops, etc). Farmers realize the economic value of pollinators and natural enemies by comparing their net income from the use of FAP fields, with that of monocultural control fields. FAP has consistently demonstrated significant increases of income per surface motivating farmers to enhance habitats in their fields.

After a successful FAP pilot in 2013-2014 in Uzbekistan the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), currently funds a **FAP project** in the MENA region, with global components. The “Conservation of pollinator diversity for enhanced climate change resilience” project includes six countries bordering the SE Mediterranean. In 2019 Morocco strengthened its commitment to pollinators by joining the Coalition of the willing on pollinators, the first Arab country to do so.

“Animal pollinators are vital for global food security,” says Dr. Stefanie Christmann, ICARDA Senior Scientist FAP, who developed this new agro-ecologic approach 10 years ago to enable low- and middle-income countries to protect pollinators. “seventy-five percent of global food crops require pollinators. Cross-pollination enhances

### Food from fallow Land

In Southern Asia, several scaling initiatives on improved pulse production technologies are carried out by ICARDA. Under an IFAD-funded project, 23,845 farmers have directly benefitted across India, Bangladesh, and Nepal. Farmers harvested an average of 993 kg/ha of lentil grain from fallow lands worth US\$544 kg/ha. Additionally, lentil residues supported animal feed and soil was enriched to provide a sustainable rice-based cropping system.



genetic diversity and improves the chances of plants to adapt to changing climate. As 87% of all flowering plants depend on pollinators, all ecosystem services provided by these plants depend on pollinators. Their loss will probably result in serious poverty spirals, food insecurity, mass migration and conflicts.”



## A PEOPLE-CENTERED APPROACH

As the only CGIAR center Headquartered in the non-tropical dry areas and having been present across the region for over four decades, ICARDA is uniquely attuned to the challenges and needs of the people we support. Our research and the knowledge we generate is centered on the experiences and challenges of the men, women, and youth who live in the areas where we work, and their valuable knowledge contribution makes sure that our solutions are properly targeted, field tested, and scalable. The cutting-edge innovation we create together, with a special focus on women and youth, will spur agricultural transformation for millions of people in the driest areas of the world.

### Supporting Syria's recovery

Although the crisis in Syria continues, investing in the recovery of the country's agriculture sector in many areas will help reduce humanitarian assistance, stem migration, and encourage the return of displaced communities. If productive farming areas are neglected the recovery will be harder, longer, and more costly.

In 2019, in collaboration with FAO, ICARDA continued to rehabilitate Syria's seed sector, producing 43.6 tons of basic seed of wheat,

barley, chickpea, and lentil with farmers in Aleppo province to help multiply an estimated 1,550 tons of certified seed in 2020. ICARDA also implemented two FAO-funded training programs, Efficient Irrigation Techniques and Rainwater Harvesting, and a CA project was launched with UNDP Syria, for which an Arabic-language publication was produced.

### The potential of rural women and youth

Our research efforts in 2019 explored the transformative strategies needed to enhance women's food production and strengthen their food security, increase their incomes, and improve their working conditions.

Recognizing the need to integrate gender effectively into its programs, ICARDA successfully executed the Community-based Agriculture and Livestock Project in Afghanistan, which trained over 12,500 women for projects such as a village-based seed systems, kitchen gardens, and other income generating activities. It included male community leaders who helped ICARDA overcome pervading cultural norms to appoint female workshop and training facilitators. The outstanding success of the approach has led to its adoption by leading NGOs such as CARE and the Aga Khan Foundation.

Meanwhile, the TAAT Wheat Initiative enhanced women's productivity and income in Sudan, Nigeria, and Ethiopia, and provided support for youth through improved access to market and financial inputs. Capacity strength-

ening and access to new innovations and technologies have increased the income of women who now make more products from wheat flour, and youth, who have organized themselves into wheat production teams. For both groups it means reduced workloads, stronger decision-making power, and more control over their incomes. Some of this research has been used in **high level policy workshops**.

We also recognize that young scientists are critical to research-for-development. Many are women and ICARDA is supporting their contributions through the ALWA Women in Science Mentorship program, supported by CRP Wheat. Their impact will produce benefits for decades to come – ensuring that countries and insti-

tutions have the right combination of skills and knowledge to meet future challenges. A crop science capacity strengthening partnership with INRA-Morocco is also providing supervision, research, and training opportunities for MSc and PhD researchers.

A study (Agri-Gender 2018) that ICARDA participated in examined youth involvement in agriculture. It revealed that young men, contrary to popular belief, are interested in agriculture if it involves profitable production. The study concluded that targeted investments in high-value commercial agriculture, or efforts to strengthen the entrepreneurial skills of young people, could be options for kick-starting a youth-led agricultural transformation across the non-tropical dry areas.



### Supporting Farmers and Refugees in Lebanon

Qab Elias, on the Lebanese-Syria border, has experienced an influx of 45,000 Syrian refugees. The village's farmers also face challenges due to climate change. ICARDA, alongside UNDP, improves farmer livelihoods and creates job opportunities for refugees, while managing increasing pressures on land and water.

In 2018 and 2019, more than 600 farmers, local community members, and municipality staff were trained by water, land, and crop scientists and sociologists from ICARDA and the Lebanese Agricultural Research Institute. The workshops, part of a project funded by the Japanese government – 'Social Stabilization through Comprehensive Agricultural Support for Refugee Host Communities' – targets better water productivity, rainfed crop management, and improved irrigation systems.



"My mom grows ICARDA crops and sells them at market. She says they grow much better even though it is so much hotter now"

– Ellie, Egypt



## PARTNERSHIPS IN RESEARCH-FOR-DEVELOPMENT

Central to the success of ICARDA's Strategic Plan 2017–2026 is our collaboration with a diverse set of partners with common goals. We engage with NARS, academic institutions, development partners, governments, the private sector, and a range of other stakeholders. Most important is the value we place on the knowledge contribution from on-the-ground NARS partners, and dryland communities themselves.

We link with a wide network of stakeholders to ensure that the knowledge we generate is field-tested, available to all who need it, and versatile for global scaling.

### E-Learning at ICARDA

ICARDA has also responded to the growing demand for online learning. In partnership with the UN Food and Agriculture Organization (FAO), and the Arab Fund for Economic & Social Development (AFESD) ICARDA provides **free online courses** on a range of agricultural subjects to a global audience on its E-Learning Website. Courses address global agricultural topics that reflect ICARDA's agenda and the broader SDGs. Most of the content is currently offered in English, French, and Arabic, with more languages to follow.

### Capacity development

ICARDA's capacity development ensures innovations are deployed by the communities we work with and helps national and international organizations and farmers to build the capacity to manage their goals.

In 2019, training activities were implemented and over 1,425 trainees benefitted, including 22 new students and 31 interns. Around 1,372 people attended ICARDA group courses, 42 percent women. Activities were funded by bilateral projects as well as fully or partially from AFESD funding supporting Arab human capacities in agriculture. ICARDA's partnership with CIHEAM helped implement a series of training courses for PhD and young

scientists working in dryland agriculture (videos available on ICARDA's E-Learning Platform).

Alongside the Partnership for Research and Innovation in the Mediterranean Area (PRIMA), ICARDA organized training courses to help Southern Mediterranean national partners respond to PRIMA development opportunities and funding. ICARDA will also be partnering with CIHEAM Zaragoza on the establishment of a master's degree on sustainable water management and governance in natural and agricultural environments, and with CIHEAM Montpellier on a master's degree program related to designing innovative agricultural systems for sustainable food production. The CIHEAM partnership helps ICARDA expand its partnerships with European experts, organizations, and universities.



"Our long and rewarding partnership is very important because not only do we share resources, innovation and unique experience towards a common goal, but it brings young, bright minds, with fresh new ideas and approaches, to dryland science."

– Dr. Hiromitsu NAKAJIMA,  
President of Tottori University, Japan

### ICARDA's longstanding relationships with Tottori and Utrecht universities

In 2019, Dr. Stefan Strohmeier, ICARDA Associate Scientist for Soil and Water Conservation, replaced recently retired ICARDA scientist, Dr. Theib Oweis, as Tottori University's cross-appointee. Meanwhile, Dr. Vinay Nangia, ICARDA Research Team Leader for Soil, Water, and Agronomy, continued in his role at Tottori as Professor for the International Platform for Dryland Research and Education. Both are trusted to advise on the curriculum and research studies valuable to both ICARDA and Tottori. Dr. Nangia also facilitated sessions at international conferences and UN meetings to present and promote joint solutions developed by researchers at ICARDA and Tottori. Both institutions have played an active role in



### Monitoring, Evaluation and Learning (MEL)

MEL is an open access online platform funded by CGIAR donors via CRPs, co-developed by several CGIAR Centers and hosted by ICARDA.

MEL facilitates faster and more informed decision-making for organizations. Designed for input, archiving, extraction, and sharing of a broad range of data, knowledge, and ideas MEL helps stakeholders to plan, manage, monitor, evaluate, report and share activities and results. By allowing all of these actions to be completed in one organized environment, MEL saves time and resources, while also reducing the risk of error.

the United Nations University Master's degree program in integrated drylands management.

Dr. Strohmeier continued in his role at Utrecht University, co-supervising students with external Senior Expert to ICARDA, Geert Sterk. By working on land degradation with Utrecht University ICARDA benefits from large-scale modeling and remote-sensing expertise and access

to supercomputers. Tottori, on the other hand, focuses on tests for fertility, physical, and chemical analysis, and offers ICARDA access to their outstanding advanced laboratories, water application optimization models and wheat varieties that have been tested for water saving abilities with farmers in Jordan and Morocco.

ICARDA, with its undisputed understanding of dryland environments and knowledge obtained from the communities who live there, can, in return, offer invaluable input to academic agricultural research by providing the data and experience for realistic modelling and risk analysis.

### DryArc – partnerships to strengthen the resilience of dryland agriculture

In September, 2019, ICARDA had the privilege of hosting the DryArc Co-Design Workshop at its Rabat offices, attended by seven CGIAR centers, international partners, donors and NARS, including ICRISAT, IITA, IFPRI, IWMI, WorldFish, CIMMYT, and ICBA. Through an integrated, interactive, and in-depth consultation, greater commitment was secured by all implementing parties, setting the DryArc Group on-track towards its next steps.

DryArc aims to improve and streamline dryland agricultural innovations, integrating them into agri-food systems and maximizing the potential to strengthen resilience, enhance food and nutrition security, and increase employment. The Initiative addresses the 2030 Agenda for Sustainable Development in a comprehensive way, accounting for trade-offs and maximizing synergies across SDGs, sectors, and scales.

The full commitment of research centers and NARS, alongside secure financial commitment from donors, will secure the next steps for this work.

## FINANCIAL INFORMATION

### STATEMENT OF ACTIVITY (IN THOUSANDS OF US DOLLARS)

REVENUE	2019	2018
Grants	27,794	31,680
Other revenues and gains	479	324
<b>Total Revenue</b>	<b>28,273</b>	<b>32,004</b>

### EXPENSES AND LOSSES

Program-related expenses	28,341	31,466
Management and general expenses	3,947	4,406
Non-Operating Expenses	(196)	968
Adjustment due to IFRS Conversion	371	1,057
Total expenses and losses	32,463	37,897
Indirect costs recovery	(3,122)	(3,279)
<b>Total Expenses</b>	<b>29,341</b>	<b>34,618</b>
Net Surplus/(Deficit)	(1,068)	(2,614)

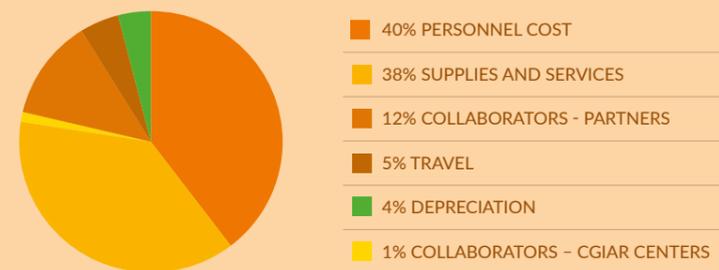
### STATEMENT OF FINANCIAL POSITION (IN THOUSANDS OF US DOLLARS)

ASSETS	2019	2018
Current assets	20,854	19,841
Property & equipment	1,918	2,203
<b>Total Assets</b>	<b>22,772</b>	<b>22,044</b>

### LIABILITIES AND ASSETS

Current liabilities	13,966	12,413
Long-term liabilities	3,107	2,864
Total Liabilities	17,073	15,277
Net Assets	5,699	6,767
<b>Total Liabilities and Net Assets</b>	<b>22,772</b>	<b>22,044</b>

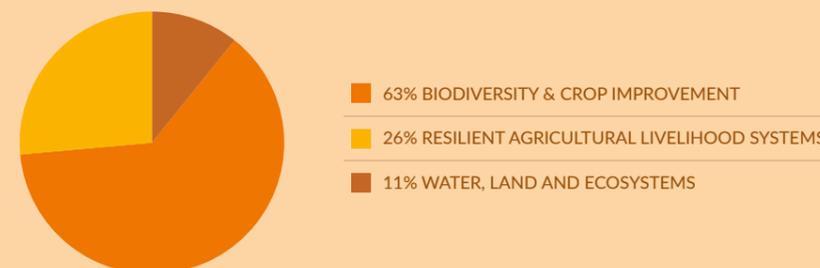
### EXPENDITURES BY NATURAL CLASSIFICATION



### EXPENDITURES BY PROGRAM AND ACTIVITIES



### EXPENDITURES BY RESEARCH PROGRAMS



## DONORS

Afghanistan Ministry of Agriculture, Irrigation, and Livestock
African Development Bank
Arab Fund for Economic and Social Development
Austrian Development Agency
Caritas Jordan
Caritas Switzerland
Ceva Sante Animale S.A.
Charles Sturt University
Cooperative for Assistance and Relief Everywhere
Cornell University
Deutsche Gesellschaft fur Internationale Zusammenarbeit GmbH
Directorate of Agriculture and Food Production, State Government of Odisha, India
Directorate of Soil Conservation and Watershed Development, State Government of Odisha, India
Empresa Brasileira de Pesquisa Agropecuária (Brazilian Enterprise for Agricultural Research)
Ethiopia Federal Ministry of Agriculture
European Commission
Federal Ministry of Agriculture and Rural Development, Nigeria
Food and Agriculture Organization of the United Nations
German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety
Global Crop Diversity Trust
Government of China
Government of Egypt
Government of Japan
Government of Morocco
Government of Norway
Government of Sudan
Government of Syria
Government of Turkey
Grains Research and Development Corporation
Gulf Cooperation Council
IHE Delft Institute for Water Education
Indian Council for Agricultural Research
Institut National de la Recherche Agronomique

International Center for Tropical Agriculture
International Crops Research Institute for the Semi-Arid Tropics
International Food Policy Research Institute
International Fund for Agricultural Development
International Institute of Tropical Agriculture
International Labour Organization
International Livestock Research Institute
International Maize and Wheat Improvement Center
International Water Management Institute
Japan International Cooperation Agency
John Innes Centre
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Templeton Charity Foundation
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United Nations Environment Program
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