



 **CIMMYT**^{MR}
International Maize and Wheat Improvement Center

ANNUAL REPORT 2017





CIMMYT - the International Maize and Wheat Improvement Center - is the global leader in publicly-funded maize and wheat research and related farming systems. Headquartered near Mexico City, CIMMYT works with hundreds of partners throughout the developing world to sustainably increase the productivity of maize and wheat cropping systems, thus improving global food security and reducing poverty. CIMMYT is a member of the CGIAR System and leads the CGIAR Research Programs on Maize and Wheat and the Excellence in Breeding Platform. The Center receives support from national governments, foundations, development banks and other public and private agencies.

Photo: CIMMYT/Alfonso Cortés

SUSTAINABLE DEVELOPMENT GOALS

On September 24, 2013, the newly formed United Nations (UN) High-level Political Forum on Sustainable Development held its first meeting. At the Rio+20 Conference, Member States also agreed to launch a process to develop a set of Sustainable Development Goals (SDGs), which were to build upon the Millennium Development Goals (MGDs) that were established in 2000 and expired in 2015.

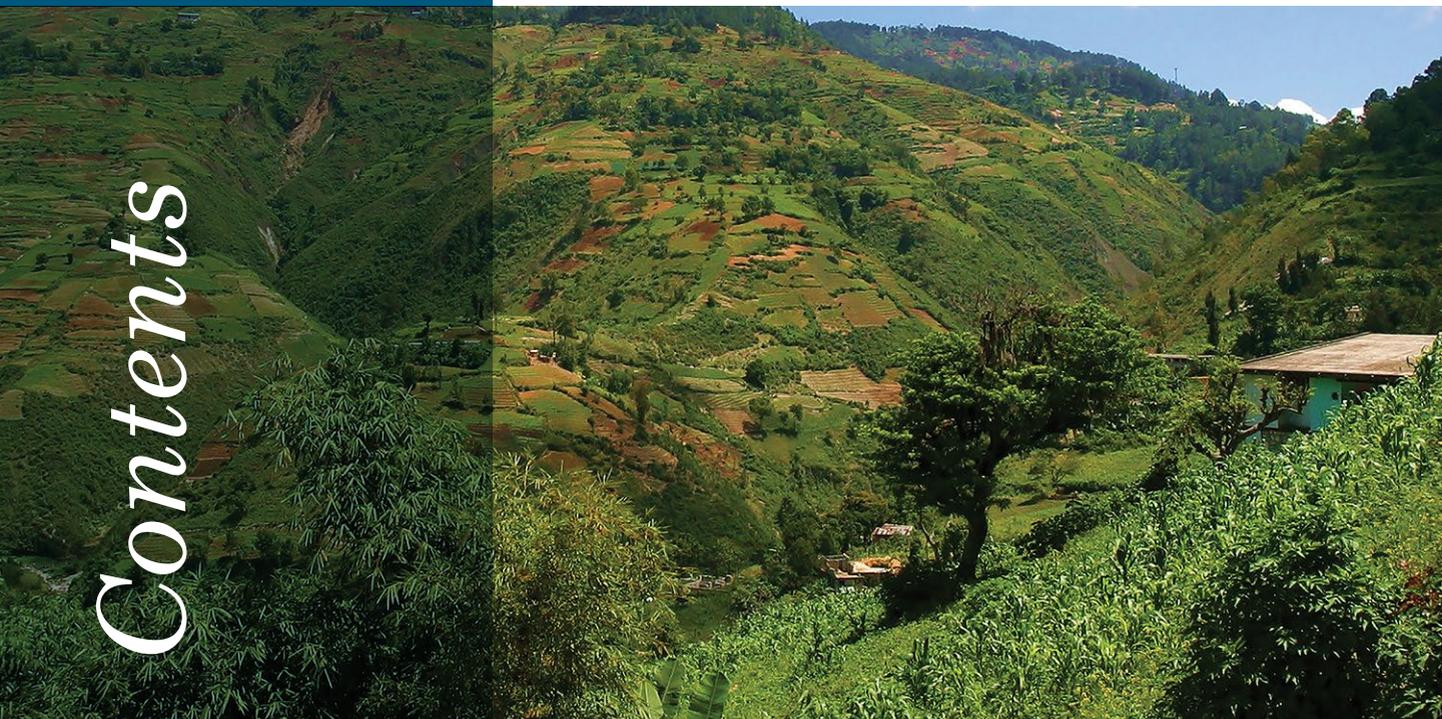
Of the 17 individual goals, 10 relate directly to CGIAR activities and to CIMMYT's mandate. The SDGs have set the pathway for the next 15 years of agricultural, social and economic development. Likewise, CGIAR has transformed its approach to ensure that its work aligns with the ambitious goals.

CIMMYT, through its research for development activities, is working toward a world free of poverty, hunger and environmental degradation. CIMMYT and CGIAR efforts help bring the world closer to reaching the goals, such as the empowerment of women, the reduction of greenhouse gas emissions and the improvement of health and nutrition for the world's poorest people.

In this issue, SDG icons attached to each story help signal how CIMMYT's work ties to the SDGs.



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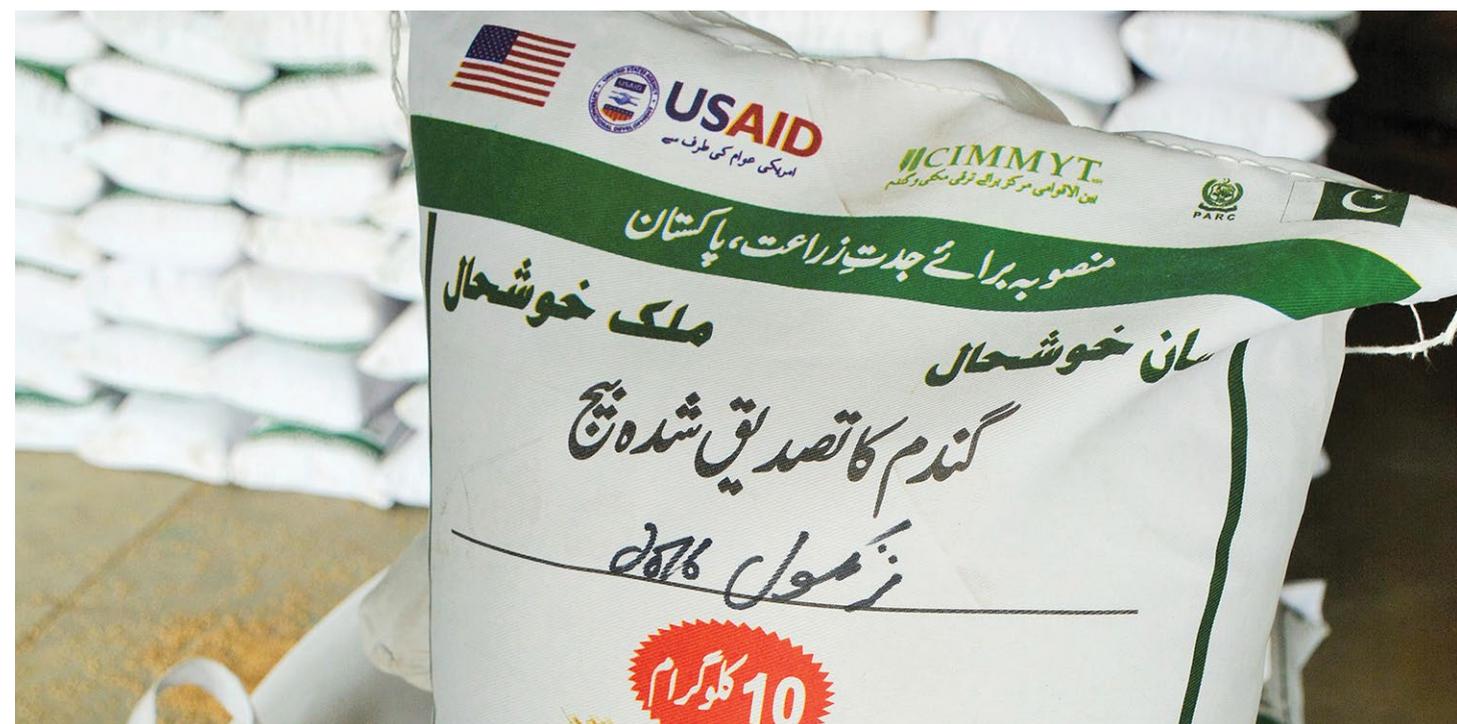


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Message from the Chair of the

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Supporting the Center's quality research and staff for impact

In 2017, CIMMYT maintained and strengthened its integrated application of excellent science for impact, carried out through multiple partnerships with a strong emphasis on capacity building, to fulfill its mission.

Underpinning those efforts, the Center's new resource mobilization strategy seeks to nurture relationships with traditional donors as well as to develop exciting alternative funding pathways, and is closely linked with Center project management.

This year, CIMMYT played a pivotal role in facing major new threats such as wheat blast in Asia and fall armyworm in Africa.

With an emphasis on crops for future climates, through cross-institutional projects the Center is strategically testing and promoting maize and wheat agri-food systems that address changing climates in Africa and South Asia.

CIMMYT also afforded me a fantastic look at the field-level application of sustainable intensification practices and technologies through a visit with farmers and partners in Celaya, Mexico, a breadbasket region beset by natural resource challenges.

As part of addressing the 2015 United Nations Sustainable Development Goals (SDGs), CIMMYT is working to facilitate linkages within CGIAR and among public and private partners worldwide.

As always, the Board is impressed with the quality of CIMMYT science, staff, and impacts, and thanks the Center's steadfast funders for their support, as well as welcoming new contributors. We look forward to helping the Center build partnerships, further its institutional capacity, and strengthen resource-mobilization intelligence systems, as it executes its strategy.

Nicole L. Birrell
Chair, Board of Trustees

Message from the

Director General



CIMMYT science and partnerships: Changing lives for the better

In 2017, CIMMYT and partners were at the center of global responses to several grave challenges to maize and wheat agriculture. In South Asia, we supported the fast-track release by Bangladesh of a new variety that resists wheat blast, a deadly and mysterious disease that appeared for the first time in the region in 2016. In Africa, our staff coordinated with global, regional, and national partners on an integrated strategy to control fall armyworm, a pest from the Americas that since 2016 has devastated over 1.5 million hectares of Africa's maize. In the Americas, CIMMYT provided Haiti with 150 tons of improved maize seed to assist farmers and replenish emergency reserves as part of the nation's recovery from the impact of earthquakes, droughts, and hurricanes.

Successful resource mobilization this year included exciting new directions and partnerships, such as the agreement with Henan Agricultural University in China, to open a joint maize and wheat research center, or the launch with Nestlé in

Mexico of a responsible sourcing collaboration in which thousands of Mexican farmers will use sustainable practices to produce more than some 400,000 tons of maize and wheat.

In support of the dynamic new CGIAR research portfolio for 2017-22, CIMMYT is providing leadership and guidance and will oversee the new Excellence in Breeding Platform.

I offer sincere thanks to funders and other partners and stakeholders for your unwavering support of CIMMYT's mission, especially in today's uncertain and challenging circumstances. We are proud to work with you as a significant force for good.

Martin Kropff
Director General



CIMMYT Trustees in 2017. First row (l to r): Ramesh Chand, Rita Mumm, Martin Kropff (Director General), Nicole Birrell, William (Bill) Angus. Second row: Harry de Roo, Marianne Bänziger (Deputy Director General), Raúl Gerardo Obando Rodríguez, Bongiwwe Njobe, Feng Feng. Third row: José Cacho, Bob Semple, Neal Gutterson. Not pictured: José Eduardo Calzada Roviroso, Alfonso Cebrenros Murillo, Luis Fernando Flores Lui.

2017

Maize and wheat science for improved livelihoods



Hunger fighters

About **1,500 people** working together in **over 50 countries** to provide maize and wheat science for improved livelihoods.



Healthy crops

CIMMYT released **71 new maize and 49 wheat varieties** stacked with crucial traits including drought and heat tolerance to help farmers adapt to climate change. Some varieties offer enhanced levels of micronutrients, such as zinc and iron, through biofortification to fight hidden hunger.



Farming innovations

CIMMYT researchers work with farmers to tailor sustainable intensification practices, such as conservation agriculture, that **boost food production while limiting environmental impact**.



Improved livelihoods

Over **18 million farmers** are benefiting through improved maize and wheat system farming practices.

Research for impact



The outcomes of CIMMYT research generates **benefits of \$3.5-4 billion annually**.



Publications

CIMMYT researchers authored **306 publications** promoting agriculture science for development.

Sharing knowledge



Almost **75,000 farmers, scientists and technical workers** took part in **2,700 training and capacity development activities** in more than 18 countries.

Maize and wheat seeds for the world



CIMMYT annually distributes more than 1,500 maize and wheat shipments. These shipments contain more than **500,000 individual seed packets** sent to as many as **100 countries**.



Time-saving machinery

CIMMYT creates and promotes the use of agricultural mechanization to reduce farmers' workload and increase productivity. **Farmers in Malawi are saving 35-45 days of labor** with direct-seed machinery in conservation agriculture systems, compared to conventional methods.

CGIAR Research Programs and Platforms



New maize varieties and intensive efforts to tackle a deadly pest in Africa

MAIZE partners around the world released 79 new maize varieties in 2017, including 44 in sub-Saharan Africa, 26 in Latin America, and 9 in South Asia. In addition to high and stable yield potential, these varieties include traits such as tolerance to heat and drought, as well as resistance to devastating maize diseases, such as maize lethal necrosis (MLN), maize streak virus, tar spot complex, and the parasitic weed known as striga. Twenty-one of the varieties are biofortified through breeding for enhanced grain nutrients to combat malnutrition.

To stop the fall armyworm (FAW), a devastating pest from the Americas that continues its march across sub-Saharan

Africa, MAIZE has worked closely with international and national partners, organizing stakeholder consultations and training events and producing a comprehensive technical guide on the integrated management of FAW. The MAIZE team has developed MLN-resistant maize hybrids that are now available in eastern Africa. The release of second-generation tropicalized haploid inducers and the use of doubled haploid lines in breeding programs have great potential to reduce breeding times and costs.



Wheat seed offers farmers resilience and nutrition

Applying advanced science, field research, and innovation in extension, WHEAT partners worked to raise the productivity

and affordable availability of wheat for 2.5 billion resource-poor consumers in 89 countries. In 2017, national partners in 16 countries released 65 wheat varieties, derived all or in part from the research of CIMMYT or its principal WHEAT partner, the International Center for Agricultural Research in the Dry Areas (ICARDA).

In response to Ethiopia's worst drought in 50 years and a critical shortage of maize and wheat seed, Ethiopian organizations, seed producers, and CIMMYT partnered to deliver to farmers over 3,400 tons of high-quality seed that

was sown on more than 100,300 hectares, reaching 271,000 rural households and benefiting 1.6 million people.

Bangladesh released a high-yielding wheat variety that is resistant to wheat blast, a fungal disease from the Americas that appeared in Bangladesh in 2016 and threatens some 7 million hectares of wheat land in South Asia. Bred in record time from a CIMMYT wheat line and called BARI Gom 33, the new release also features enhanced levels of zinc, a key micronutrient lacking in the diets of millions in the region.



Evidence-based approaches for gender in agricultural research

MAIZE and WHEAT have contributed to and drawn lessons from GENNOVATE, a CIMMYT-led study involving more than 7,500 rural men and women in 26 countries, as well as 11 CRPs and nearly a dozen crops and other agricultural outputs. In 2017, the initiative delivered reports on study outcomes to

MAIZE, WHEAT, and other CRPs, and made available a suite of tools and resources for scientists applying gender-aware approaches.



Excitement around excellence in breeding

In 2017, the CIMMYT-led Excellence in Breeding Platform (EiB) completed an online portal that will host breeding knowledge, tools, services, and learning modules. Platform leaders Michael Quinn and Marianne Bänziger visited breeders throughout CGIAR to promote the EiB to centers and partners, and obtain feedback on the EiB approach. Members commit to a suite of seven recommended breeding improvements.

Broad CGIAR research engagements

CIMMYT is a leading implementation partner in the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), as well as participating in the CGIAR Research Program on Policies, Institutions and Markets, the Big Data for Agriculture Platform, and the CGIAR Genebanks Platform.

Highlights

from around the world



To reduce air pollution around New Delhi, federal and state governments in India are pushing for sustainable alternatives to rice paddy residue burning, a widespread practice farmers use to clear their fields before sowing wheat. CIMMYT is working with partners to promote locally-manufactured farm implements that sow wheat seed directly into unplowed land, with residues of harvested rice paddies on the soil surface. This eliminates the need for burning crop residues and tilling the soil, and can reduce greenhouse gas emissions by 500 kilograms per hectare and increase farmer income by \$150 per hectare.

Funded by ACIAR, BMGF, CGIAR, ICAR, USAID, CCAFS, WHEAT



The Chinese State Council presented CIMMYT with the prestigious International Science and Technology Cooperation Award for joint breeding research, which resulted in the development of high-yielding, disease-resistant wheat varieties with improved grain quality. CIMMYT's breeding contributions are present in more than 26 percent of all major wheat varieties released in China this century.



In an article in *Science*, CIMMYT scientists and diverse agricultural research organizations and companies proposed the creation of an integrated, global network to improve the yield and climate resilience of key staple food crops. Modeled on the International Wheat Improvement Network created in 1968, which has provided returns on investment as high as 100 to 1, the global crop network would harmonize data sharing across crops and regions and speed up technology adoption.

Funded by BMGF, USAID

CIMMYT's new MLN Information Portal provides researchers with up-to-date information and surveillance tools to help curb the spread of maize lethal necrosis (MLN), a deadly disease that has ravaged maize in eastern Africa. Quickly diagnosing and monitoring MLN at the local, national, and regional levels is crucial to safeguard food security and livelihoods. For more information, visit www.mln.cimmyt.org.

Funded by USAID, BMGF, MAIZE



In an unprecedented study of the maize genome, CIMMYT, advanced research institutions and national system researchers used novel and powerful approaches to analyze landrace diversity and identify more than 1,000 genes that influence the maize life cycle and adaption to different environments. The resulting blueprint will help breeders better identify genetic variation of value from landraces and deploy this in the development of improved, climate-resilient maize varieties.

Funded by SAGARPA



Seeds of Discovery, a platform for utilizing maize and wheat genetic resources, launched an online product catalogue describing freely available germplasm, software, services, publications, and self-learning modules on accessing and using maize and wheat genetic diversity. They also released four short videos describing this unique initiative. Learn more: seedsofdiscovery.org.

Funded by SAGARPA, BBSRC, MAIZE, WHEAT

A study in Zimbabwe found that households that grew drought-tolerant (DT) maize were able to harvest over 600 kilograms more maize per hectare. This translates into \$240 per hectare extra income, equivalent to 9 months' worth of additional food security at no additional cost. DT maize offers an invaluable safety net for the 30 percent of adopting households in areas surveyed, which include many smallholder farmers with limited off-farm incomes or market access.

Over the years, generous funding for this work was provided by BMGF, DFID, GIZ, HGBF, IFAD, MAIZE, SIDA, CDC, UNDP and USAID





Photo: CIMMYT/J. Siamachira

on the offensive:

joining forces

against fall armyworm in Africa

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The fall armyworm could cause maize yield losses projected at \$2.5 to \$6.2 billion a year. Experts estimate that Africa will need an investment of at least \$150 to \$200 million annually for research and pest management to mitigate related damage.

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Photo: CIMMYT/J. Siamachira

The voracious fall armyworm (*Spodoptera frugiperda*) has marched across Africa in the last two years, causing millions of dollars in damage to maize and other crops and threatening the food security and livelihoods of smallholders and their families in nearly 40 African countries.

A highly aggressive and invasive insect pest, fall armyworm has ravaged crops in the Americas for decades and is now a major threat throughout Africa. The pest prefers maize, a staple food for more than 200 million people in the continent.

The CGIAR Research Program on Maize (MAIZE) has been at the forefront of the fight against the pest, through a multi-institutional initiative led by B.M. Prasanna, director of CIMMYT's global maize program and MAIZE.

Costly implications

Fall armyworm could cause maize yield losses in Africa worth as much as \$6.2 billion a year, according to the Centre for Agriculture and Biosciences International (CABI). Control measures may cost as much as \$200 million annually, including developing and deploying integrated pest management (IPM) technologies and practices.

The full impact of the pest on seed security, food security, and smallholder farmers' incomes in Africa is yet unknown, but targets to alleviate poverty and hunger detailed in the U.N. Sustainable

Development Goals (SDGs) may be difficult to achieve without coordinated IPM efforts.

Beyond the economic damage to crops, indiscriminate and unguided application of highly toxic pesticides could harm the health of women and children on farms and damage the safety and sustainability of the region's ecology and environment. At a conference in April on fall armyworm in Africa organized jointly by CIMMYT, the Alliance for a Green Revolution in Africa (AGRA), and the Food and Agriculture Organization of the United Nations (FAO) in Nairobi, experts raised concerns about the possible spread of fall armyworm into Asia and Europe.

A highly aggressive and invasive insect pest, fall armyworm has ravaged crops in the Americas for decades and is now a major threat throughout Africa.

Integrated management of fall armyworm

CIMMYT and USAID brought out a comprehensive technical manual "Fall Armyworm in Africa: A Guide for Integrated Pest Management," based on material written collectively by national and international research and development partners and outcomes of an expert workshop in Entebbe, Uganda.

USAID and CIMMYT held three regional training and awareness-raising workshops in Harare during 2017-18.

A study tour by an African delegation to Brazil is planned for March 2018 to understand how experts in that country have managed the pest for decades.

CIMMYT scientists are seeking sources of resistance to fall armyworm in maize seed collections, to test them and – through conventional breeding – incorporate the resistance into improved varieties. Initial experiments have uncovered promising breeding materials.



Photo: CIMMYT/J. Siamachira

Partners

Global partners on FAW management efforts include Alliance for a Green Revolution in Africa (AGRA), Centre for Agriculture and Biosciences International (CABI), the Brazilian Agricultural Research Corporation (Embrapa), Food and Agriculture Organization of the United Nations (FAO), the Kenya Agriculture and Livestock Research Organization (KALRO), the International Institute of Tropical Agriculture (IITA), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the International Centre of Insect Physiology and Ecology (ICIPE), the United States Department of Agriculture (USDA), and the U.S. Agency for International Development (USAID).

Better varieties, systems, and incomes for African farmers

Eight years of work by the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (SIMLESA) project has facilitated the release of 40 improved maize and 64 legume varieties to smallholder farmers in Ethiopia, Kenya, Malawi, Mozambique, Tanzania and spill-over countries (Botswana, Rwanda, and Uganda).



Led by CIMMYT and funded by the Australian Centre for International Agricultural Research (ACIAR), SIMLESA has also helped over 235,000 farming households to adopt more sustainable crop management practices and cope with the effects of climate change and declining soil fertility.

"With the project closing in June 2018, we're consolidating cropping trials, training farmers, and laying the foundation for follow-up research on sustainable intensification, diversification, smallholder mechanization, and crop-livestock integration across Africa," said Mulugetta Mekuria, CIMMYT senior scientist and SIMLESA project leader.



seeds of hope:
**reducing
malnutrition
in Haiti**

More about Haiti



In the early 17th Century, the French established a presence on Hispaniola (present day Haiti and Dominican Republic) in the Caribbean Sea. In 1697, Spain ceded to France the western third of the island, which later became Haiti.

Natural disasters

Haiti has been hit by 5 hurricanes in the past 10 years, and suffered a magnitude 7.0 earthquake in 2010 that impacted much of the country.



Above: Impact of Hurricane Matthew in 2016. Below: The capital Port-au-Prince, located near the epicenter of the 2010 earthquake, suffered severe human and material losses.



Hugo Córdoba
(1942-2009)

Using resilient, high-yielding hybrids, Dr. Hugo Córdoba ensured that advanced technologies reached farmers' hands throughout Central America and the rest of the developing world, generating improved seeds sown on at least 4 million hectares.

In 2017, CIMMYT sent 150 tons of new and improved maize seed to Haiti to jumpstart the development of the country's maize seed sector, improve local food security, and decrease malnutrition. This was the largest seed shipment to any country in CIMMYT's history.

The lack of a strong seed system is one of the main factors that holds back farm productivity. Haiti has the lowest maize yields in Latin America and the Caribbean, and around half of the population is undernourished. A crippling earthquake in 2010, a longstanding drought, and Hurricane Matthew in 2016 have exacerbated the nation's difficulties, affecting 2 million people.

In addition to the new seed shipment, Haitian farmers and community leaders are receiving training to help their country develop a thriving maize seed sector. Recent Haitian alumni of CIMMYT trainings have now become trainers and are passing along their new knowledge.

"It is a great satisfaction for me to participate in this training, as I learned how to better produce maize for seeds and I will get better crops when I apply the information from this training," said Josette Léveill e, a farmer participating in the trainings. "I will not keep this information to myself. I will meet with my organization and share the information with them."

The seed from CIMMYT comes from a maize variety

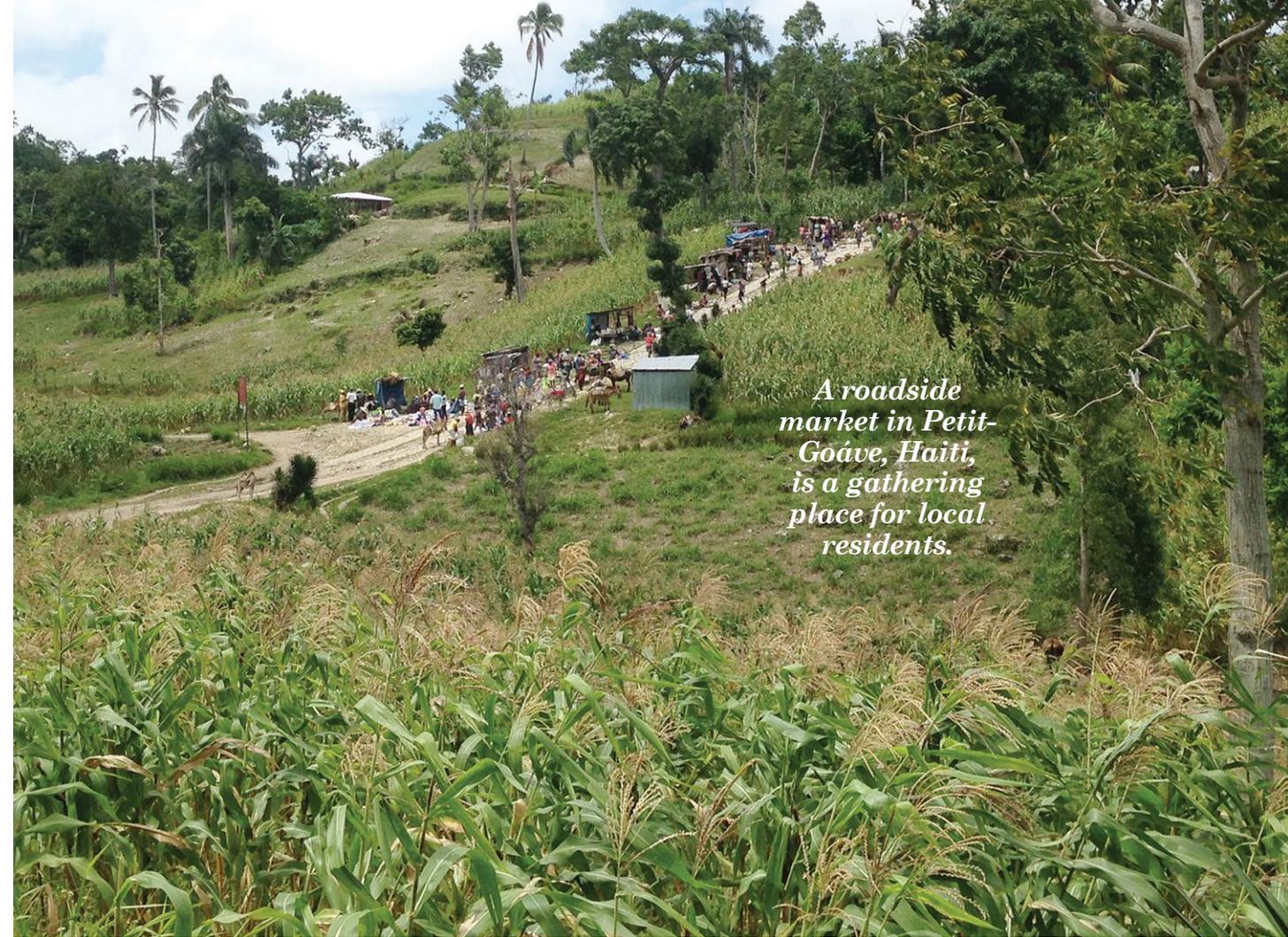
developed specifically for Haiti in the 1990s using conventional breeding methods. Named "Hugo" in honor of the late CIMMYT maize breeder Hugo C ordova, the variety is well adapted to the country's conditions and is a quality protein maize, meaning that it contains enhanced levels of lysine and tryptophan, which can decrease malnutrition and stunting among children who consume it.

The product of decades of maize research in Haiti and Latin America, Hugo quickly became a favorite among farmers. However, due to the country's lack of a certified seed production process, yields began to decline over time and protein quality decreased.

"Farmers often sell their entire crop at harvest, leaving nothing for the next season, forcing them to plant simple maize grain that they buy from local markets rather than certified seed, which drastically reduces yield," said Alberto Chassaigne, a maize seed system specialist at CIMMYT.

For the Haiti shipment, CIMMYT and partners developed Hugo Plus, a renewed version of Hugo that can produce up to seven tons of maize per hectare under good management, a full ton greater than the old Hugo variety.

Of the 2017 Hugo Plus shipment, 20 tons were sold to farmers at affordable prices in agricultural input boutiques established by Feed the Future (FTF) and partners, who have since been selling their harvest as seed to neighbors. The remaining 130 tons were used by CIMMYT



A roadside market in Petit-Go ve, Haiti, is a gathering place for local residents.



"It is a great satisfaction for me to participate in this training, as I learned how to better produce maize for seeds and I will get better crops when I apply the information..."

Josette L veill e,
a farmer participating in the trainings

and FTF to establish a strategic seed reserve in Haiti, offering an immediate source of seed in the event of a natural disaster.

This reserve, along with CIMMYT's training of Haitian farmers on the importance of using seed rather than grain and how to produce seed, helps ensure that Hugo Plus and other improved varieties will continue

to perform well, maintain quality, and increase food security. In the future, the project hopes to help consolidate the country's emerging maize seed industry, with support from the newly trained seed producers and processors to ensure that the renewed Hugo remains high quality and that the strategic maize seed reserve is periodically rotated and refreshed.

Funders

This work is supported by the Feed the Future program of the U.S. Agency for International Development (USAID).



Ethiopia's wheat energizing seed sector

A sunny November day brings hundreds of seed producers to Doyogena, a scenic highland village in Ethiopia's Southern Nations, Nationalities, and Peoples' Region (SNNP). The visitors form a bustling line to collect more than \$90 each, on average, in profits from representatives of the Zereta Kembata Seed Multiplication and Marketing Union.

"The union collects certified seed of wheat varieties grown by more than 1,100 farmers, several hundred of whom are women, belonging to 8 farmer cooperatives," said Yosef Balewold, the general manager of Zereta Kembata.

Pitted against a yearly onslaught of fast-evolving fungal diseases that can infect as much as

\$200 million worth of the crop they are growing, over 75,000 small-scale wheat farmers in Ethiopia's 4 major wheat-growing regions gained access by late 2017 to a vital asset: over 400 tons of new, disease resistant wheat seed, much of it produced by other farmers.

Marketed in tandem with science-based recommendations for growing wheat, Ethiopia's annual seed supply has steadily increased since 2014 through the Wheat Seed Scaling Initiative, led by CIMMYT.

"We're energizing and diversifying Ethiopia's wheat seed sector, partly by involving and benefitting both formal and farmer seed producers, including women and men," said Bekele Abeyo, a CIMMYT scientist who leads the project.



Ethiopian farmer seed producers collect payment at the Zereta Kembata Seed Multiplication and Marketing Union facility in Doyogena.

Photo: CIMMYT/A. Habtamu

Owing to the rapid rise of new and deadly strains of stem and yellow rust, farmers must swiftly begin to sow a range of varieties bearing new resistant genes, but limited access to the seed has been a bottleneck, according to Abeyo.

In addition to assisting government-managed seed enterprises and 4 private seed producers, CIMMYT supports 10 farmer cooperative unions that purchase, pack, and sell the seed grown by numerous primary

cooperatives, as well as 12 farmer seed producer associations, including 4 women's groups, who profit from growing and selling quality seed of the new varieties.

Women seize chance to advance

The Tembo Awtena Women's Seed Producers Association in Angacha District, SNNP, began producing wheat seed for sale in 2015, with support from the Wheat Seed Scaling Initiative.

"In 2016, with support from CIMMYT, we sold more than \$7,400 worth of seed," said Amarech Desta, Tembo Awtena chairwoman, adding that news of the association's success had attracted 30 additional women farmers in 2017, bringing the total membership to 133.

Desalech Ashamo, an association member who is a single head of a household, received nearly \$300 for the seed she grew in 2017 and used the earnings to paint her house. "A big advantage is that all

our seed is sold in one lot, rather than piecemeal, so we receive a lump sum that can be used for a significant household project."

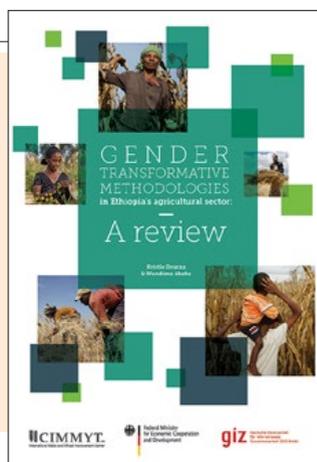
Tembo Awtena members are especially pleased at being one of the three women's seed production groups in the Oromia and SNNP regions to receive seed threshers through the Initiative. Association members had been threshing the wheat seed manually, a long and laborious process, according to Desta. "With the new machine, we will be able to thresh in one hour what would take us three days by hand," she said.

Partners

The success of the Wheat Seed Scaling Initiative depends on the commitment and contributions of diverse national and global partners, including key partner Ethiopian Institute of Agricultural Research. The work is funded by the U.S. Agency for International Development (USAID). Other important partners include state and district level officials in the Amhara, Oromia, SNNP, and Tigray regions. Most of the varieties come from breeding lines from CIMMYT and the International Center for Agricultural Research in the Dry Areas (ICARDA); a number of varieties were developed through the Delivering Genetic Gain in Wheat project, led by Cornell University and funded by the Bill & Melinda Gates Foundation and the UK's Department for International Development (DFID).



Photo: CIMMYT/A. Habtamu



CIMMYT promotes gender awareness in Ethiopia

A report on gender research methodologies offers a collection of research tools and activities designed to make participants think, learn, analyze, and plan for action.

Based on in-depth interviews with over 45 agricultural sector stakeholders in Ethiopia, the report identifies 7 people-centered methodologies that can be applied

in many settings to help improve gender equity and more quickly achieve program goals.

Diverse professionals and practitioners in agricultural research, extension and policy in Ethiopia are applying these and other gender-sensitive approaches.

Funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)



Photo: CIMMYT/Xochiquetzal Fonseca

connecting the dots in

maize seed systems

of Africa and Latin America



As part of work to foster competitive maize seed markets and offer farmers quality seed at affordable prices, CIMMYT is helping more than 100 small and medium-scale seed companies in Africa and Latin America to assess potential markets and to seize new opportunities.

“Just as carmakers retool assembly lines and marketing to roll out a new model, maize seed companies must revamp operations for new varieties,” said Kate Fehlenberg, manager of the CIMMYT-led Drought Tolerant Maize for Africa Seed Scaling (DTMASS) project. “It takes at least 3-5 years before the new product hits the market, so seed producers want assurance of demand before replacing older varieties or targeting new markets.”

CIMMYT supports public-private partnerships

- The Center’s maize and socioeconomics programs are applying geographic information systems technology to help identify and assess potential markets, allowing companies to home in on suitable improved varieties, forecast the volume of seed demand, and plan and resource marketing campaigns.
- Data on hybrids and their parent lines from CIMMYT breeding programs allow companies to estimate production costs and expected performance – crucial for decisions to invest in new varieties.
- Annual training events organized by CIMMYT for

country partners cover hybrid seed production and offer tools to identify and analyze market opportunities.

- With international and local organizations, CIMMYT helps to scale out best agronomic practices and improved seed in farming communities, leveraging local distribution networks and offering technical expertise.
- The Center is partnering with digital service providers in target communities to make seed available to farmers and suppliers and to measure demand and adoption.

As a result, seed companies can invest in new high-yielding, resilient maize varieties in a much more secure environment, retire obsolete products, and boost smallholder farmers’ food security while improving their profits.

CIMMYT in Mexico Progress in 2017

New maize and wheat sustainable sourcing partnerships in Mexico

In 2017, CIMMYT partnered with several world class agriculture and food processing companies to implement responsible local sourcing projects in Mexico. More than 3,300 local farmers growing maize and wheat on more than 35,000 hectares in 5 states of Mexico will benefit from these initiatives. Together, these farmers will supply 400,000 tons of grain to participating companies in the next 3-5 years.

Responsible local sourcing is a farmer capacity-building and market integration strategy that develops sustainable farming systems and promotes closer and more equitable business interactions between farmers, food processing companies and consumers. The effort will produce more nutritious food by shaping flexible and balanced grain supply chains that apply high quality standards to meet consumer expectations and demand. This will benefit local maize and wheat farmers who adopt sustainable intensification practices and improve natural resource management, through increased yields and incomes.

20 percent average yield increase achieved in maize production on MasAgro* plots compared with conventional plots.

Maize participant farmers harvest **twice the average yield** of their regions.

19 percent average increase in profits from wheat produced under sustainable intensification practices.

More than 30 seed companies sold **46 MasAgro maize hybrids and 5 varieties under 147 commercial brands**.

Maize hybrids and varieties were sold in 24 states, 118 regions and 398 municipalities in central and southeastern Mexico.

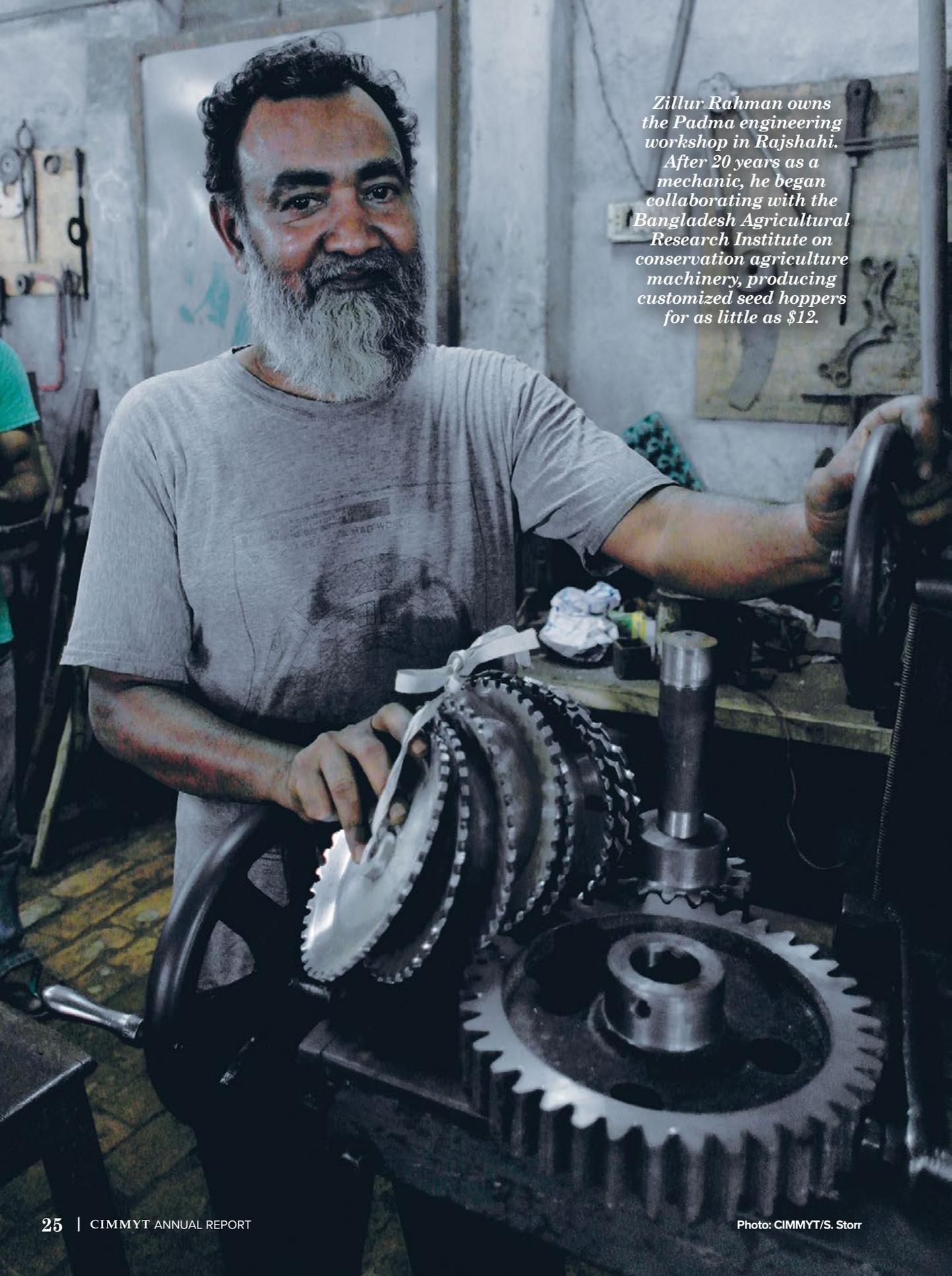
Participating companies sold **1.1 million bags of maize seed in 2017**. Half of the bags sold have CIMMYT germplasm.

Combined market share of companies that participate in MasAgro: **21%**.

CIMMYT and partners have **developed and released 49 maize hybrids since 2011**: 16 yellow hybrids and 33 white hybrids.



* MasAgro is a CIMMYT-led bilateral project between CIMMYT and Mexico's Department of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) that promotes agricultural development at different levels of Mexico's maize and wheat value chains.



Zillur Rahman owns the Padma engineering workshop in Rajshahi. After 20 years as a mechanic, he began collaborating with the Bangladesh Agricultural Research Institute on conservation agriculture machinery, producing customized seed hoppers for as little as \$12.



mechanization rural opportunities fuels

Appropriate mechanization can support the sustainable intensification of agri-food systems, helping to improve resource (soil, labor, water) use and providing social benefits like increased income, employment, food security, and less drudgery.

CIMMYT and partners design and test machinery and implements, train and support local manufacturers, work with extension agents and farmers in machinery use, and promote financial and rental services and farmer cooperatives. In Mexico, this has included the creation of machinery points: central locations from which

farmers and entrepreneurs can borrow implements in return for providing mechanization services to other farmers. The aims of CIMMYT support include increasing the performance and efficiency of farm activities, creating jobs and entrepreneurial opportunities to make rural livelihoods more sustainable, fostering agriculture-led industrialization and markets for rural economic growth, and improving the quality of primary and processed goods.

Here CIMMYT researchers reflect on the opportunities associated with the adoption of agricultural mechanization in Africa, Asia, and Latin America.



Frédéric Baudron

Cropping systems agronomist, sustainable intensification program, CIMMYT-Zimbabwe

shelled 100 tons in 2 months using a sheller designed by CIMMYT and its partners powered by a two-wheel tractor, earning \$5,000. Evidence is accumulating regarding the benefits that agricultural mechanization for hire is having on rural livelihoods in all four counties.



Timothy Krupnik

Cropping systems agronomist, CSISA, CIMMYT-Bangladesh

fragmented plots of land and face critical production risks. CIMMYT is increasingly a one-stop-shop for expertise in smallholder-appropriate farm mechanization.

The machinery options we work with in South Asia respond to increasingly severe rural labor bottlenecks that prevent smallholders from intensifying their cropping systems. In addition to being agronomically beneficial, the machines we focus on are designed to be affordable and ergonomic and can be scaled-out to farmers through commercial and rural service pathways. Many of these machines also reduce fuel use and allow farmers to conserve agricultural resources like soil, thereby mitigating greenhouse gas emissions.



Scott Justice

Rural mechanization specialist, CIMMYT-Nepal

Bangladesh, Sri Lanka and increasingly Nepal provide good illustrations of how small, fragmented, and even mountain farms can be mechanized and achieve productivity gains, if policies support fair access to scale-appropriate agricultural machinery services. Besides increased productivity, mechanization is often accompanied by increased cropping intensity. While drudgery reduction always seems to come

last in the literature on the benefits of agri-mechanization, it is an equally important outcome, particularly to reduce outmigration in Nepal.

We are beginning to see instances of younger and even educated members of households who are less inclined to migrate for work, while conversely mechanization is allowing greater time for off-farm income generation.



Carolina Camacho

Post-doctoral fellow - social science, socioeconomics program, CIMMYT-Mexico

In the state of Chiapas in southern Mexico, a region where smallholders predominate, mechanization has played a key role in the development of a group of crop and livestock producers. With support and training from CIMMYT, they have organized more productively and now offer custom services using machinery, purchasing and marketing harvests, and providing technical advice. CIMMYT's efforts have complemented local initiatives to develop farmer organizations and provide access to affordable financing, helping to give farmers a stronger voice in regional affairs and creating a cascade of innovation.



Jelle Van Loon

Mechanization specialist, Latin America, sustainable intensification program, CIMMYT-Mexico

The diverse landscape of farmer conditions in Latin America demands a broad strategy and an integrated approach to facilitate improved farming practices. Besides research and development on functional machinery innovations, we conduct user-specific trainings and foster direct access to appropriate tools.

Through MasAgro, a long-term sustainable intensification project involving CIMMYT and Mexico's agricultural secretariat, SAGARPA, we have advised and trained 17 metal workshops as providers of innovative, tailor-made farm equipment, and implements from 12 machinery hire points have serviced some 2,000 hectares of farmland in a single cropping season. We have also led the design or re-engineering of 40 prototypes to increase the return investments to make precision agriculture technology a more viable option for smallholder farmers.

AFRICA

CIMMYT efforts to promote mechanization have created rural job opportunities in eastern and southern Africa, where many struggle with high unemployment and poverty. Dozens of providers, both individuals and groups, have offered mechanization services such as tillage or shelling maize on contract in Ethiopia, Kenya, Tanzania, and Zimbabwe. In Tanzania, the average income from contract mechanization was \$6,100 in 2017. One service provider in Mbeya district

ASIA

Our work differs from farm mechanization research in developed countries, in that it focuses on offering solutions to the production problems of smaller-scale farmers with low investment capacities, who tend to grow crops on

Mechanization around the world



A hand tractor used in Africa and Asia



A seeder attachment used in China



A simple seeder pulled by cattle in Africa



A tractor with a large attachment in Mexico



Photo: CIMMYT/S. Storr



zinc-enriched wheat

fights malnutrition in Pakistan

.....

Years of biofortification research and breeding have resulted in Zincol, a wheat variety with 20 percent more zinc than conventional varieties.

.....



Cost of zinc deficiency

- Zinc deficiency **causes stunting, lowers immunity,** and increases risk of diarrheal disease and respiratory infections.
- **45% of children under 5** in Pakistan are estimated to be **zinc deficient** (WHO).
- Mineral and vitamin deficiencies cost Pakistan **nearly \$3 billion in GDP losses annually** (World Bank).



Years of biofortification research and breeding have resulted in Zincol, a high-yielding, zinc-enhanced variety that was released in 2016 and is gaining popularity in Pakistan.

Consuming just three chapattis – an unleavened flatbread common in South Asia – made with flour from Zincol can provide up to 40 percent of a child’s daily zinc requirement and 20 percent of an adult’s.

In 2017, farmers from 22 seed producer associations in Pakistan planted large portions

of their wheat fields with Zincol. Established to grow quality seed of new wheat varieties, these associations received assistance from the country’s National Rural Support Program, a key partner in the Pakistan Agricultural Innovation Program, led by CIMMYT.

“Over the 2016 and 2017 cropping seasons, 400 tons of seed of Zincol have been shared with farmers, seed companies and promotional partners,” said Imtiaz Muhammad, CIMMYT country representative in Pakistan and a wheat improvement specialist.

An additional 15 tons of Zincol was shared free of charge for testing with 600 farm families in Sukkar District, Sindh Province, through an initiative of World Vision-Canada and HarvestPlus, a CGIAR research program dedicated to the study and delivery of biofortified foods.

Zinc links to health

In Pakistan, 39 percent of children and 48 percent of pregnant women suffer from zinc deficiency, according to a 2011 National Nutrition Survey. These deficiencies lead to child stunting rates of over 40 percent and high infant mortality.

Zinc is essential for immune and nervous system development, making it especially vital for combatting malnutrition during pregnancy and in young children, according to the World Health Organization. South Asia has one of the highest rates of zinc-deficiency, resulting in a host of harmful effects.

Zincol resulted from CIMMYT’s biofortification breeding research, focused on enhancing nutrient levels in the grain of key food crops. The creators of Zincol drew upon diverse genetic resources, including wheat landraces and wild

relatives with the genetic potential to accumulate zinc in the grain. Genes for enhanced grain zinc content from those sources were crossed into adapted, high-yielding varieties over repeated cycles of selection involving many thousands of plants.

“Zincol also carries the genetic background of NARC 2011, a popular, high-yielding Pakistan wheat variety that resists wheat stem rust, a deadly disease that threatens wheat worldwide,” added Velu Govindan, a CIMMYT wheat breeder who specializes in biofortification and helped develop Zincol.

Zincol took nearly a decade to reach farmers after the initial breeding cross in 2007, several years faster than is the norm in Pakistan. Today enough Zincol seed has been distributed to cover over 20,000 hectares, and that could expand to more than half a million hectares by 2019.

Funders

U.S. Agency for International Development (USAID), HarvestPlus and World Vision-Canada.

CIMMYT financial overview

Top donors, 2017 (in thousands of U.S. dollars)

Donors	
United States Agency for International Development	32,413
CGIAR Research Programs/Platforms	25,220
Australia, UK (DFID), Belgium, Bill & Melinda Gates Foundation, Canada, France, India, Japan, Korea, Netherlands, New Zealand, Norway, Sweden, Switzerland and World Bank	
Secretaría de Agricultura, Ganadería, Desarrollo Rural y Pesca	22,173
Bill & Melinda Gates Foundation	17,783
Australian Centre for International Agricultural Research	6,559
Cornell University	3,710
Bill & Melinda Gates Foundation as back funder	
African Agricultural Technology Foundation	2,136
HarvestPlus	2,040
UK Government, Bill & Melinda Gates Foundation, US Government's Feed the Future initiative, European Commission, CGIAR Research Program Funders and supported by the John D. and Catherine T. MacArthur Foundation.	
Deutsche Gesellschaft für Internationale Zusammenarbeit	1,518
Secretaría de Desarrollo Agroalimentario y Rural	1,293

Table 1. Combined statement of financial position As of December 31, 2017 and 2016 (thousands of U.S. dollars)

	2017	2016
ASSETS		
Current assets:		
Cash and cash equivalents	99,223	90,990
Program - related cash and cash equivalents	1,735	4,898
Accounts receivable, net	11,028	13,916
Inventory and supplies, net	1,158	1,255
Total current assets	113,144	111,059
Non-current assets:		
Property and equipment, net	48,111	49,433
Intangible assets	31	33
Prepaid rent	342	500
Total non-current assets	48,484	49,966
TOTAL ASSETS	161,628	161,025
LIABILITIES AND NET ASSETS		
Current liabilities:		
Short-term employee benefits	\$ 644	723
Program - related accounts payable	2,042	5,609
Accounts payable, net	54,703	51,903
Deferred revenue	27,062	27,401
Total current liabilities	84,451	85,636
Non-current liabilities:		
Employee benefits	12,442	12,702
Provisions	707	120
Total non-current liabilities	13,149	12,822
TOTAL LIABILITIES	97,600	98,458
Net assets:		
Unrestricted		
Actuarial losses	(1,929)	(476)
Designated	20,785	22,190
Undesignated	45,172	40,853
Total unrestricted net assets	64,028	62,567
Total liabilities and net assets	161,628	161,025

2017 and 2016 financial statements

A summary of the combined statement of financial position and combined statement of activities and other comprehensive income for CIMMYT Int. and CIMMYT A.C., are set out in tables 1 and 2. Total revenues for 2017 amounted to US\$133.8 million and US\$134.4 million in 2016 (excluding financial income). The surplus for 2017 totaled US\$1.5 million and the deficit for 2016 US\$4.8 million (2016 results included an increase in extraordinary institutional provisions). Total net assets increased by US\$1.5 million in 2017 to US\$64.0 million.

As of this year, CIMMYT presents its Financial Statements under International Financial Reporting Standards (IFRS) only. The notes to the Financial Statements can be found here <https://www.cimmyt.org/financials/> and these notes further explain the IFRS transition process at CIMMYT, including a comparative overview.

Table 2. Combined statement of activities and other comprehensive income For the years ended December 31, 2017 and 2016 (thousands of U.S. dollars)

	2017	2016
Revenue		
Grant revenue:		
Windows 1 and 2	25,037	29,043
Window 3	55,138	61,754
Bilateral	53,365	43,256
Total grant revenue	133,540	134,053
Other revenue and gains	282	358
Total revenue	133,822	134,411
Expenses and losses		
Research expenses	83,679	78,592
CGIAR collaborator expenses	10,980	11,033
Non-CGIAR collaborator expenses	25,859	32,658
General and administration expenses	13,663	13,468
Other expenses and losses	(2,958)	3,041
Total expenses and losses	131,223	138,792
Operating surplus/(deficit)	2,599	(4,381)
Gain on sale of assets	34	47
Finance income	873	265
Finance expenses	(592)	(786)
Surplus/(deficit) for the year	2,914	(4,855)
Other comprehensive income		
Actuarial (loss) / gain - Defined benefit plan	(1,453)	20
Total other comprehensive (deficit) / income	(1,453)	20
Total comprehensive surplus/(deficit) for the year	1,461	(4,835)
Expenses by function		
Personnel costs	47,671	47,167
CGIAR Collaborator Expenses	10,980	11,033
Non CGIAR Collaborator Expenses	25,859	32,658
Supplies and services	34,788	37,072
Travel	4,252	4,786
Depreciation/Amortization	6,674	5,716
Cost sharing percentage	999	360
Total operating expenses	131,223	138,792

2017 and 2016 revenue overview

Total grant revenue for 2017 was US\$133.5 million and US\$134.1 million in 2016 (Table 3). Other revenues and gains (excluding financial income) amounted to US\$0.3 million in 2017 and US\$0.4 million in 2016.

Table 3. Sources of grants revenue For the years ended 31 December, 2017 and 2016 (thousands of U.S. dollars)

Donors Restricted	2017	2016
WINDOWS 1 & 2		
CRP on Wheat	76	12,404
CRP on Wheat	10,116	-
CRP on Policies, Institutions and Markets	-	451
CRP on Policies, Institutions and Markets	415	-
CRP on Maize	797	11,900
CRP on Maize	9,617	-
CRP on Climate Change, Agriculture and Food Security	-	2,540
CRP on Climate Change, Agriculture and Food Security	1,656	-
CGIAR Platform for Big Data in Agriculture	171	-
CGIAR Genebank Platform	-	1,311
CGIAR Genebank Platform	999	-
CGIAR Excellence in Breeding Platform	1,190	-
Total Windows 1 & 2	25,037	28,606
WINDOW 3		
Agricultural Research, Education and Extension Organization (AREEO)	213	182
Australian Centre for International Agricultural Research (ACIAR)	3,151	3,778
Bill & Melinda Gates Foundation	17,777	15,908
Chinese Academy of Agricultural Sciences (CAAS)	340	189
HarvestPlus	800	2,790
Indian Council of Agricultural Research (ICAR)	911	729
Instituto Nacional de Innovación Agraria, Spain (INIA)	2	(210)
International Fund for Agricultural Development (IFAD)	187	105
Ministry of Food, Agriculture & Livestock, Turkey	167	147
Ministry of Foreign Affairs of Japan (MOFA)	108	61
US Agency for International Development (USAID)	29,095	39,944
Total Window 3	52,752	63,623
BILATERAL		
African Agricultural Technology Foundation (AATF)	2,174	2,630
Agrovetel S.A.	32	57
Australian Centre for International Agricultural Research (ACIAR)	3,460	2,912
Arcadia Biosciences	115	183
Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)	-	94
Bangladesh Institute of ICT in Development	98	40
Barcel-Aspectos nutricionales y de salud asociados al trigo	-	87
Bayer CropScience NV	7	34
Bill & Melinda Gates Foundation	65	1,350
Biotechnological and Biological Sciences Research Council (BBSRC)	750	784
Borlaug Institute for South Asia (BISA)	332	139
Canadian International Development Agency (CIDA)	1,278	1,179
Catholic Relief Services (CRS)	301	41
Center for International Forestry Research (CIFOR)	-	43
Columbia University	-	71
Commonwealth Scientific and Industrial Research Organisation (CSIRO)	262	-
Consejo Nacional de Ciencia y Tecnología, México (CONACyT)	25	-
Cornell University	714	2,021
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	1,191	1,257

BILATERAL (cont'd)	2017	2016
Development Fund	196	128
Fomento Social Banamex, A.C.	63	-
Food and Agriculture Organization of the United Nations (FAO)	530	376
Global Crop Diversity Trust (GCdT)	992	443
Government of the Islamic Republic of Iran	102	-
Grains Research and Development Corporation (GRDC)	494	359
Harvard University	78	191
Henan Agricultural University, China (Henan AU, China)	162	-
Institute of Development Studies (IDS)	14	-
Instituto de Investigación y Capacitación Agropecuaria, Acuicola y Forestal del Estado de México (ICAMEX)	-	65
Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, México (INIFAP)	-	(17)
International Development Enterprises - UK (iDE UK)	222	112
International Food Policy Research Institute (IFPRI)	72	65
International Institute of Tropical Agriculture (IITA)	690	1,004
International Livestock Research Institute (ILRI)	126	126
International Plant Nutrition Institute (IPNI)	29	62
International Potato Center (CIP)	155	38
International Rescue Committee (IRC)	27	-
Japan International Research Center for Agricultural Sciences (JIRCAS)	43	53
Kansas State University	643	4
KazAgroInnovation	138	147
Kellogg Company, México	121	-
Ministry of Agriculture and Rural Development for Alberta	86	32
Ministry of Agriculture, Forestry and Fisheries	241	195
Montana State University	-	3
National Research Council, Canada	65	79
Norsk institutt for bioøkonomi (NIBIO)	57	-
Purdue University	89	182
Rezatec (UK Services) Limited	198	-
Rothamsted Research Limited	121	-
Rural Development Administration	-	69
Rwanda Agricultural Board	31	27
Secretaría de Desarrollo Agropecuario del Estado de Querétaro, México	274	15
Secretaría de Agricultura, Ganadería, Desarrollo Rural y Pesca (SAGARPA), México	21,824	16,963
Secretaría de Desarrollo Agropecuario y Rural, Guanajuato, México	1,293	971
Secretaría de Desarrollo Rural del Estado de Chihuahua, México	54	-
Secretaría de Relaciones Exteriores-Agencia Mexicana de Cooperación Internacional para el Desarrollo	-	9
Syngenta Foundation for Sustainable Agriculture	1,144	1,006
Total Land Care (TLC), Malawi	130	178
US Agency for International Development (USAID)	2,379	627
US Department of Agriculture (USDA)	717	520
United Way Worldwide/ Kellogg	137	30
University of California-Davis	475	138
University of Florida	7	-
University of Hohenheim	-	39
University of Nebraska	48	-
University of Texas, Austin	167	22
University of Twente	-	698
Various, public and private sector	630	212
Wageningen University	30	-
World Agroforestry Center (ICRAF)	123	79
World Agroforestry Center (ICRISAT)	1,033	115
Integrated Breeding Platform (IBP)	99	-
Total bilateral	47,154	38,286
Miscellaneous research grants	8,597	3,538
Total grants - Donors restricted	133,540	134,053

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Acronyms

ACIAR	Australian Centre for International Agricultural Research	ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
AGRA	Alliance for a Green Revolution in Africa	IFAD	International Fund for Agricultural Development
BBSRC	Biotechnological and Biological Sciences Research Council	IITA	International Institute of Tropical Agriculture
BMGF	Bill & Melinda Gates Foundation	IPM	Integrated Pest Management
CABI	Centre for Agriculture and Biosciences International	KALRO	Kenya Agricultural & Livestock Research Organization
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security	MAIZE	CGIAR Research Program on Maize
CIFOR	Center for International Forestry Research	MasAgro	Sustainable Modernization of Agriculture project
CRP	CGIAR Research Program	MDG	Millennium Development Goal
CSISA	Cereal Systems Initiative for South Asia	MLN	maize lethal necrosis
DFID	Department for International Development	SAGARPA	Mexico's Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food
DG	Director General	SDC	Swiss Agency for Development and Cooperation
DT	Drought tolerant	SDG	Sustainable Development Goal
DTMASS	Drought Tolerant Maize for Africa Seed Scaling	SIDA	Swedish International Development Cooperation Agency
EiB	Excellence in Breeding	SIMLESA	Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa
FAO	Food and Agriculture Organization of the United Nations	SNNP	Southern Nations, Nationalities, and People's Region
FAW	fall armyworm	UN	United Nations
FTF	Feed the Future	UNDP	United Nations Development Programme
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit	USAID	United States Agency for International Development
HGBF	Howard B. Buffett Foundation	USDA	United States Department of Agriculture
ICAR	Indian Council of Agricultural Research	WHEAT	CGIAR Research Program on Wheat
ICARDA	International Center for Agricultural Research in the Dry Areas		
ICIPE	International Centre of Insect Physiology and Ecology		

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