

# WHEAT

The Vital Grain of  
Civilization and Food Security



RESEARCH  
PROGRAM ON  
Wheat



WHEAT CRP

annual report 2013

# Wheat Matters – Today and Tomorrow

# Wheat and Food Security Rise and Fall with Grain Markets

**215 million hectares** – the area on which wheat is grown each year, worldwide.

- Equivalent to Greenland.
- Sown from Scandinavia to the Southern Cone of South America – more regions than any other staple crop.



Nearly **US \$50 billion-worth** of wheat is traded globally each year.

**2.5** billion people in **89** = Wheat consumers worldwide



Wheat is first among the three major staple crops as a source of protein in developing countries.

## North Africa and West and Central Asia

Wheat is the dominant staple crop and provides as much as half of all calories consumed in these regions.



**60%** MORE

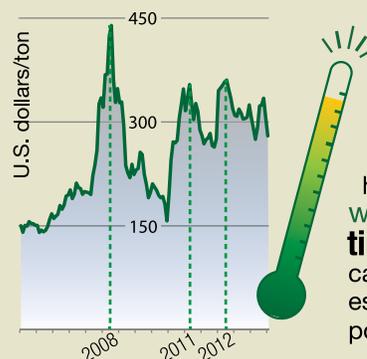
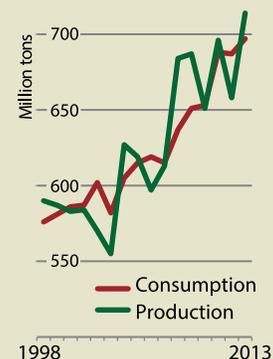
**WHEAT** THAN TODAY...



The amount the world will need to grow to meet consumer demand by 2050.

## Wheat Consumption:

In 8 of the last 15 years, world wheat **production** has fallen short of demand.



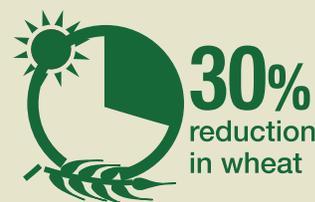
Extreme weather events and trade dynamics have destabilized wheat markets **three times since 2000**, causing price spikes that especially harm resource-poor consumers.

**80% HIGHER** THAN IN 2005 = \$ The Price of Wheat Today

This affects poor consumers – including smallholder farm households – who spend most of their income on food.

## As much as 30 percent

the reduction in South Asia's wheat yields forecast by climate change experts, if farmers continue to use current varieties and practices.



## WE CAN GROW MORE WHEAT RESPONSIBLY TO MEET RISING DEMAND

- Improved varieties and more effective agricultural practices generated remarkable **wheat production increases** that have fed expanding populations since the 1960s.
- The yield gains from those technologies have added US \$500 million-worth of grain to wheat harvests each year and **kept wheat grain prices at historically low levels** until 2005, benefiting farmers and poor consumers.
- New **technology and better policies** can power wheat-based farming to meet the crop's accelerating global demand, which is driven by emerging and developing countries.

# Contents



- 2** Message from the Program Manager



- 4** Wheat: Vital Grain of Civilization and Food Security –  
Message from the WHEAT Stakeholder Committee



- 6** Wheat Rises to Challenges and Demand in Ethiopia



- 10** Wheat Farming in South Asia: Early Sowing Beats Terminal Heat



- 13** Innovative Farm Machinery Transforms Agriculture in Bangladesh



- 14** Fueling Economic Growth and Food Production in Pakistan



- 16** MasAgro in Mexico: You Cannot Walk the Road to Food Security Alone



- 20** Gender Equality: A Rallying Point for WHEAT



- 23** A Global Strategy for ICARDA's Wheat Program

**Inside Back Cover:** Acronyms and Credits



*CGIAR is a global partnership that unites 15 research organizations dedicated to a food secure future. CGIAR research is reducing rural poverty, increasing food security, improving human health and nutrition and ensuring more sustainable management of natural resources. This effort is carried out in collaboration with hundreds of partner organizations, national and regional research institutes, civil society organizations, academia and the private sector.*



# WHEAT – A Global Alliance Unparalleled in the History of Research on Wheat

WHEAT is a [CGIAR Research Program \(CRP\)](#) launched in 2012 and led by the International Maize and Wheat Improvement Center ([CIMMYT](#)).

Joining advanced science with field-level research and extension in lower- and middle-income countries, WHEAT works to raise the productivity, production and affordable availability of wheat for 2.5 billion resource-poor consumers who depend on the crop as a staple food.

WHEAT partner organizations develop and test more productive, disease-resistant wheat varieties and efficient, sustainable wheat-based cropping systems, bringing them to farmers with support from:

- Socioeconomics analysis to prioritize research-for-development investments for greatest value and social inclusion.
- The study and comprehensive use of wheat native diversity and wild relatives.
- New genetics and crop physiology approaches to enhance wheat adaptation for climate change and significantly raise genetic yield potential.
- Better seed production and distribution systems.
- A new generation of trained and inspired wheat professionals.

Our partners include:

- In management: The Australian Centre for International Agricultural Research ([ACIAR](#)), the British Biotechnology and Biological Sciences Research Council ([BBSRC](#)), the International Center for Agricultural Research in the Dry Areas ([ICARDA](#)) and the Indian Council of Agricultural Research ([ICAR](#)).
- In implementation: A community of more than 200 public and private organizations worldwide, among them national governments, companies, international centers, regional and local agencies and farmers.

Funding for WHEAT comes from CGIAR and generous donors including national governments, foundations, development banks and other public and private agencies.



*Victor Kommerell*

**Victor Kommerell**

WHEAT Program Manager

Email: [v.kommerell@cgiar.org](mailto:v.kommerell@cgiar.org)

# WHEAT: The Vital Grain of Civilization and Food Security

## Message from the WHEAT Stakeholder Committee

### Wheat Matters – Today and Tomorrow

Wheat is grown each year on more than 215 million hectares (ha) – an area equivalent to all of Greenland and spread across more regions than any other staple crop. Wheat is in high demand as a food for 2.5 billion people in 89 countries. Nearly US \$50 billion-worth of wheat is traded globally each year. It is first among the three major staple crops as a source of protein in the diets of consumers in low- and middle-income countries, and second only to rice as a source of calories in those countries. In North Africa and West and Central Asia, wheat is the dominant staple crop and provides as much as half of all calories consumed. Over 60 percent of the world's wheat is produced in developing and emerging countries like China and India. Global demand for wheat is expected to increase 60 percent by 2050, driven by urbanization, rising incomes and working women in low- and middle-income countries.

### Wheat and Food Security Rise and Fall with Grain Markets

Wheat consumption is rising faster than its production, due partly to inadequate investment in wheat research and development. In eight of the last 15 years, world wheat production has fallen short of demand, reducing stocks dangerously. Extreme weather events have fueled volatility in commodity markets and destabilized wheat prices three times since 2000. Overall, the cost of wheat rose 115 percent during 2005–2011, particularly affecting poor consumers (including smallholder farm households), who spend much of their income on food. Models predict that if farmers continue to use current varieties and cropping practices, wheat yields in South Asia will fall as much as 30 percent by 2050 due to warmer, more erratic weather.



## We can Grow More Wheat Responsibly to Meet Rising Demand

Improved varieties and more effective cropping – rather than use of new land – led to remarkable wheat production increases that have fed expanding populations since the 1960s. The yield gains from those technologies have added at least US \$500 million-worth of grain to wheat harvests each year and kept wheat grain prices at historically low levels up to 2005, benefitting farmers and poor consumers. Appropriate technology and policies can once again power wheat-based farming to meet the crop's accelerating global demand. This is WHEAT's role.

## A Strategy for Sustainable Food Security

WHEAT delivers impact by fostering and strengthening partnerships. These encompass farmers and multiple institutions working across borders and at all levels, from policymakers' circles and advanced laboratories to agricultural input and machinery providers. WHEAT also marshals and channels funding for greatest effect. Partners in WHEAT are breeding more productive, resilient wheat varieties and getting them to farmers in the form of high-quality seed. WHEAT researchers are honing and promoting more precise, resource-conserving cropping practices that save farmers money and reduce environmental impact. The work fosters equity for women and disadvantaged groups and better incomes and livelihoods. The challenges are daunting and agricultural innovations can take 10-15 years to develop and deploy, so this effort cannot stop – new research needs to start now and current work must intensify.



Julia Cimes/CIMMYT

## Thanks to Partners and Supporters

On behalf of millions of wheat farmers in developing countries and the more than 1 billion wheat consumers outside of more prosperous nations, we sincerely thank the national agricultural research systems, regional and international organizations, private companies, non-governmental organizations and advanced research institutes whose committed, high-quality work is highlighted in the coming pages. We are most grateful for the funding and other support from donor organizations for research and development in breeding, seed and farming systems, socioeconomic and capacity building associated with wheat – a crop which Rachel Laudan, renowned author on the history of food, termed “the grain at the center of civilization.”

## WHEAT Stakeholder Committee

### Marianne Bänziger

Deputy Director General for Research and Partnerships, CIMMYT

### Shirish Barwale

Director, Maharashtra Hybrid Seeds Co. (MAHYCO), India

### Abderrazak Daaloul

Emeritus Professor, National Institute of Agronomy of Tunisia (INAT), Tunisia

### Catherine Feuillet

Senior Vice President, Traits Research, Research and Development, Bayer CropScience

### Tony Fischer

Honorary Research Fellow, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia

### Eleni Zaudi Gabre-Madhin

Founder, eleni LLC; former CEO, Ethiopia Commodity Exchange, Ethiopia

### Thomas A. Lumpkin

Director General, CIMMYT

### Mahmoud Solh

Director General, ICARDA

### Yiching Song

Senior Research Associate and Program Head, Centre for Chinese Agricultural Policy, Chinese Academy of Sciences (CAS), China

### Victor M. Villalobos

Director General, Inter-American Institute for Cooperation in Agriculture (IICA)



**Wheat**

**Rises to Meet Challenges and**



*Concerted action and high-yielding, disease-resistant varieties from WHEAT partners, along with supportive government policies and better cropping practices, have caused Ethiopia's wheat production to more than double in a decade, rising from 1.60 to 3.92 million tons from 2003-04 to 2013-14. Food security has measurably improved in households that have taken up the improved wheat technologies. Despite this, rising demand and evolving pathogens doggedly challenge Ethiopia's wheat farmers and those who support them.*

More wheat growers in Ethiopia are using high-yielding, disease-resistant varieties, as well as improved practices like row planting and fertilizer and herbicide applications, according to Bekele Abeyo, CIMMYT wheat breeder/pathologist for Sub-Saharan Africa who is based in Ethiopia. "About 4.7 million farm households – more than one-third of those that grow cereals – depend on wheat," said Abeyo. "Average wheat yields on Ethiopian farms have risen from about 1.47 to 2.45 tons per hectare (t/ha) since 2004, and the impacts on food security are significant."

"The study shows significant food security benefits even for farmers who grow just a small area of improved wheat," Abeyo said.

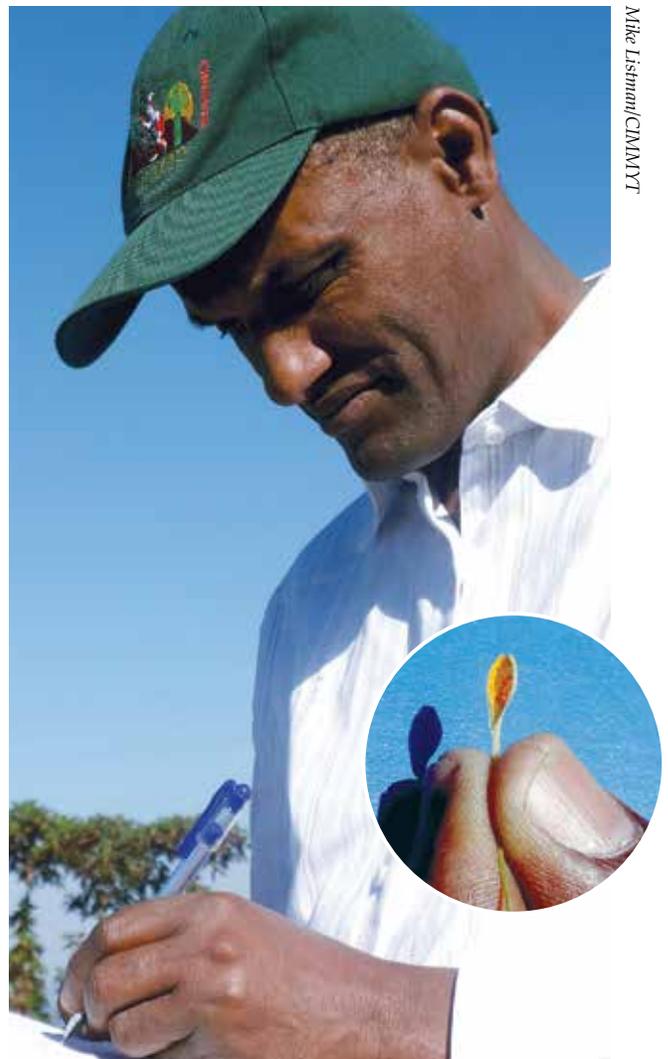
Sub-Saharan Africa's largest wheat producer, Ethiopia grows the crop on over 1.6 million ha, with the main production areas concentrated in the country's Central and Southeastern Highlands. Despite this, with Ethiopia's rising population and expanding cities, demand for wheat outstrips national supplies and annual imports have topped 1 million tons in recent years. *(continued on page 8)*

Bekele Abeyo, CIMMYT wheat breeder/pathologist for Sub-Saharan Africa, scores the resistance of experimental wheat plants to the fungal disease yellow rust at Bekoji Research Station, Oromia Region, Ethiopia. "Spores like these can sail on the wind to other plants, fields or regions," he explained, showing a wheat glume filled with the yellow powder of rust spores.

## Demand in Ethiopia

A 2014 [nationwide study](#) published in *Food Policy* and involving more than 2,000 farm households in Ethiopia's major wheat-producing areas revealed that those who adopt improved wheat varieties are able to spend more on food, are more likely to be food-secure and are less likely to suffer chronic or transitory food shortages.

◀ Farmers are also experimenters. Behailu Metaferia, a farmer from Shorima Village, Oromia Region, Ethiopia, sows a range of improved varieties of his chief crop, wheat, to test them and to produce food and seed. Seed sells for 40 percent more than grain. "Last year I harvested 15 quintals (1.5 tons) of wheat seed," Metaferia said. "I saved four quintals to sow this year and sold the rest to neighboring farmers." He and his family grow teff, the native Ethiopian grain used in the popular fermented bread injera, as well as fava beans, peas and maize, and keep farm animals that include several dairy cows.



Mike Lishman/CIMMYT



## Eastern Africa: Growing Wheat in Cradle of its Crippling Pathogens

Since 1970, farmers have had access to more than 100 high-yielding bread wheat and durum wheat (for pasta and semolina) varieties. These were developed and spread through collaboration among WHEAT partners, including the Ethiopian Institute of Agricultural Research (EIAR), Ethiopia's regional agricultural research institutes

One result was the Borlaug Global Rust Initiative (BGRI), initiated by CIMMYT, the Indian Council of Agricultural Research (ICAR), ICARDA, the Food and Agriculture Organization (FAO) of the United Nations and Cornell University in 2008. Fostered by the Durable Rust Resistance in Wheat (DRRW) project and led by Cornell, the Initiative marshals scores of scientists in work to develop and spread improved varieties that resist stem, yellow and leaf rust.

**The value of RustTracker was demonstrated in early 2013, when serious outbreaks of yellow rust were observed from North Africa to South Asia.**

– Dave Hodson

Coordinator of the Global Cereal Rust Monitoring System

(RARIs), ICARDA and CIMMYT, a center whose work has contributed to 80 percent of Ethiopia's wheat varieties. Despite the availability of improved varieties, wheat productivity gains were modest for many years, held in check by sub-optimal agronomic practices, limited use of inputs such as inorganic fertilizer, lack of effective seed systems or farm credit, unstable prices for wheat grain and – most damaging of all – periodic droughts and wheat disease outbreaks.

Fungal diseases of wheat, especially stem rust and yellow rust, have historically plagued Ethiopian wheat crops, particularly when weather was conducive and new rust races managed to overcome the resistance of widely grown varieties. In 1998, a new, highly virulent strain of wheat stem rust known as Ug99 emerged in eastern Africa and began to spread, evolve and vanquish long-held resistance in varieties of the region and beyond. The wheat world took notice. Led by the late Dr. Norman E. Borlaug, globally acclaimed wheat scientist and Nobel Peace Prize laureate, WHEAT partners undertook a series of initiatives to find and cross resistance genes into high-yielding wheat varieties.

With leadership from EIAR, RARIs and the Ministry of Agriculture, and strong support from CIMMYT and ICARDA, Ethiopian farmers have gained access to a new generation of high-yielding, rust-resistant wheat varieties from BGRI, through ICARDA-led efforts to tackle yellow rust and from other sources. Key to this were seed multiplication and distribution efforts funded by the U.S. Agency for International Development (USAID), as well as seed production by ACDI/VOCA, the Alliance for a Green Revolution in Africa (AGRA), the Eastern African Agricultural Productivity Project (EAAPP), FAO and the Ethiopian Agricultural Transformation Agency (ATA).

## Seed, Policies and Surveillance

Wheat is a strategic food security crop and ever-more expensive to import, so the Ethiopian government has invested heavily in boosting wheat production. Measures include making seed of improved wheat widely available, spreading better practices like row planting and fostering farmers' access to fertilizer and fungicides.

As part of DRRW, CIMMYT has led the development of a sophisticated, multi-partner wheat disease monitoring and response system known as RustTracker that has directly benefited Ethiopia. "The value of RustTracker was demonstrated in early 2013, when serious outbreaks of yellow rust were observed from North Africa to South Asia," said Dave Hodson, coordinator of the Global Cereal Rust Monitoring System at CIMMYT who created and manages RustTracker. "This prompted an alert for the East African region and resulted in mitigation efforts in Ethiopia, including comprehensive major and minor season surveys, timely control in infected areas and frequent information exchange amongst stakeholders." The widespread adoption of resistant varieties and this effective surveillance and control program helped Ethiopia



to head off a potentially massive yellow rust outbreak in 2013-14 and attain a record wheat harvest.

## Matching the Rise of Lethal Fungi

Adoption of rust-resistant wheat varieties is expanding but pathogens are also evolving, so large areas of wheat can quickly become disease-susceptible, according to Hodson. “There’s no freezing winter in Ethiopia to break fungal growth,” he explained. “Wheat production is continual and new, highly virulent strains can develop quickly. As a result, resistance has broken down in many older Ethiopian wheats and several more recent releases.” Despite this, certain old varieties are still widely grown, Hodson said, citing the case of the popular 1995 release, *Kubsa*. “Its original resistances to yellow and stem rust are no longer effective, but farmers still sow *Kubsa* on more than a quarter of a million hectares.”

A severe, localized epidemic in late 2013 showed the wildfire nature of rust attacks. “A deadly new stem rust strain hit 10,000 hectares or more in the Bale/Arsi wheat production zone,” said Hodson. “The current most popular variety in Ethiopia, *Digalu*, is resistant to yellow rust and the Ug99 stem rust races, but was totally susceptible to the new strain, and there was near-complete grain damage in fields that hadn’t been sprayed with a good fungicide.”

Farmer awareness has grown, but selecting and releasing truly resistant varieties is a big challenge, according to Solomon Galalcha, former Director of EIAR’s Kulumsa Agricultural Research Center. “In most nurseries here, we discard as much as 60 percent of the lines because

they prove susceptible,” he said. Located in the Ethiopian highlands some 170 kilometers (km) southeast of the capital, Addis Ababa, Kulumsa is one of the three key sites in eastern Africa (the others are Debre Zeit Agricultural Research Center, Ethiopia, and Njoro, Kenya) where researchers test thousands of wheat lines each year under intense attack from naturally occurring rust.

Rather than seeking varieties with major genes, each alone able to withstand a specific rust race or group of races but whose effects can be overcome by a mutating pathogen, breeders now select for combinations of several minor genes that individually might only slow disease development but whose pooled effects can confer high levels of immunity, according to Ravi Singh, CIMMYT wheat breeder and distinguished scientist. “As with a combination lock, if you put more numbers in the combination, the lock is harder to pick,” he said. “Similarly, a pathogen is unlikely through natural mutation to overcome the effects of multiple, minor resistance genes, which often act synergistically and whose effects are not targeted to a single race or race group. This type of resistance can last longer.”

In addition to crop diseases, the challenges for Ethiopian wheat farmers are diminishing land holdings, soil degradation, erosion and scarce water, according to Abeyo. “To be sustainable,” he explained, “the high wheat yields we see now must be accompanied by more sustainable management of resources like farmland and water.”

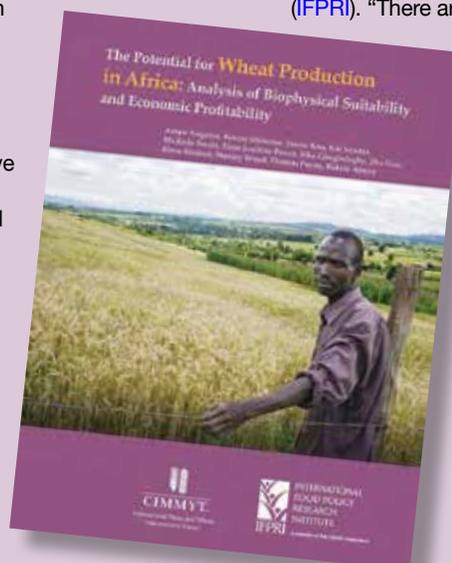
For more information, contact **Bekele Abeyo**, CIMMYT wheat breeder/pathologist for Sub-Saharan Africa ([b.abeyo@cgiar.org](mailto:b.abeyo@cgiar.org)).

## Getting Wheat Back on the Map in Africa

Efforts to put wheat on the food and trade agenda in Africa came together at the Forum for Agricultural Research in Africa (FARA) meeting in Accra, Ghana, in July 2013, when 30 senior research, development and policy experts met with WHEAT representatives to develop a strategy for promoting African wheat production and markets.

Food preferences in Sub-Saharan Africa have been shifting for decades from traditional staples such as coarse cereals to wheat and rice. Now, urbanization, a growing middle class and changing lifestyles, including women who work, are driving a rapid rise in demand for wheat, but production in the region falls short and consuming countries draw on foreign reserves to import at least US \$12 billion-worth of grain each year. “Most countries produce less than a quarter of what they could,” said Bekele Shiferaw, former director of CIMMYT’s socioeconomics program and key author

on a major 2013 [study on the suitability and profitability of wheat for Africa](#) by CIMMYT and the International Food Policy Research Institute (IFPRI). “There are many opportunities to raise wheat area and yields.”



A groundbreaking 2012 conference, *Wheat for Food Security in Africa in Addis Ababa*, organized by EIAR, CIMMYT, ICARDA, IFPRI, the African Union (AU) and WHEAT, led to the endorsement of wheat as a strategic crop for Africa by African Union agriculture ministers, an endorsement officially noted by AU heads of state in early 2013.

“The idea now is to put together all the actors – on the production side, in legislation and in markets,” said Victor Kommerell, WHEAT manager. “The focus is to gather more evidence on production and market potential, on how to bring wheat into existing farming systems and particularly smallholder farmers’ chances to grow it as a cash crop. Then we look at future consumption and regional trade.”



Wheat Farming in South Asia:  
**EARLY SOWING**  
Beats Terminal Heat



*Farmers in South Asia, a wheat breadbasket challenged by land degradation, water scarcities, and rising temperatures and labor costs, are reaping benefits from the work of WHEAT partners to develop and spread resource-conserving cropping practices and better policies.*

It is not unusual for siblings to differ, and such was the case for two brothers in Naropatti Village, Muzaffarpur District, Bihar State, India, when they decided how to manage their wheat crops. Adhering to advice from experts of the Cereal Systems Initiative for South Asia (CSISA), Pankaj Kumar Singh sowed his crop in early November 2013 using zero tillage (seed is placed directly into unplowed soils and surface residues from the preceding rice crop) and he followed up with timely applications of irrigation, fertilizer and herbicides. "I believed this would fetch me a much higher yield than I would get from traditional practices," Pankaj said.

His brother, Srikant Kumar Singh, did not share Pankaj's enthusiasm for new technologies. Instead, he followed the old practices of casting the seed over the field, with few inputs and in late November. In the end, Srikant's reluctance to innovate left him with a poor crop right next to his brother Pankaj's vigorous wheat field. But Naropatti farmers have generally had a successful 2013-14 wheat season, with many adopting early sowing, according to R.K. Malik, who leads work under CSISA Objective 1 to spread technologies that increase cereal productivity, resource use efficiency and incomes.

"Earlier sowing of wheat is an important adaptation to climate change in the eastern Indo-Gangetic Plains and it doesn't cost anything, so smallholder farmers can easily



**Earlier sowing of wheat is an important adaptation to climate change...it doesn't cost anything, so smallholder farmers can easily benefit from the practice...**



– R.K. Malik  
Leader of CSISA Objective 1

benefit from the practice," Malik said. According to Malik, sowing wheat in late November or early December – the normal practice in eastern India – makes the crop vulnerable to late-season heat that can exceed 35 degrees Celsius and reduce wheat yields by 50 percent. "We've confirmed this through several seasons of on-farm experiments in Bihar and Eastern Uttar Pradesh," Malik explained.

### Moving Wheat's Calendar Forward

Established in 2009 and supported by the [Bill & Melinda Gates Foundation](#) and USAID, CSISA promotes durable improvements in the cereal-based cropping systems of South Asia and particularly in the Indo-Gangetic Plains, an area of 700,000 square kilometers and 1.3 billion inhabitants that is South Asia's breadbasket. CSISA involves more than 300 public, civil society and private sector partners, according to Andrew McDonald, CSISA project leader. "Together we develop and spread resource-conserving crop management technology and new cereal varieties, strategies and systems for livestock and aquaculture, and improved policies and markets in Bangladesh, India and Nepal," he said. *(continued on page 12)*

◀ Over 300 million people in South Asia depend on rice-wheat cropping rotations for food and livelihoods. Higher temperatures, degraded soils and dwindling water supplies threaten the region's productivity.



A tale of two technologies: Pankaj Kumar Singh, a farmer in Naropatti Village, Muzaffarpur District, Bihar State, India, stands with his own lush, early-sown, zero-tilled wheat crop at his back, while looking over the poor plot of his brother, who followed the traditional practices of sowing in late November and simply tossing wheat seed onto the soil.

**An ongoing survey shows that zero tillage is now used to sow wheat in 38 percent of the villages...starting from nearly zero adoption in 2009.**

– R.K. Malik  
Leader of CSISA Objective 1

CSISA partners have worked in recent years with Bihar's Department of Agriculture, its Agriculture Management Education & Training Institute and diverse extension agencies to promote zero tillage and early sowing of wheat. During the Department of Agriculture's planning meeting in November 2013, CSISA specialists urged extension agents and farmers to adopt early sowing of wheat to offset rice crop losses from a severe drought that year. Word spread to adjacent villages and many farmers advanced their wheat planting dates. With encouragement from CSISA, farmers also applied fertilizer and herbicide at the right times. In Kishanwada Village, early sowing of the 2012-13 wheat crop resulted in an unprecedented grain harvest of 7.3 t/ha, nearly 2.5 times the average yield in India. Based on such evidence and CSISA advocacy, the Bihar Department of Agriculture changed its official recommendations in 2014, encouraging farmers to sow wheat before 15 November.

"An ongoing survey shows that zero tillage is now used to sow wheat in 38 percent of the villages participating in CSISA's Bihar innovation hub, starting from nearly zero adoption in 2009," says Malik.

### Long-Term Spread of Innovation

CSISA builds on and extends the success of the Rice-Wheat Consortium (RWC) for the Indo-Gangetic Plains, which tested and promoted resource-conserving cropping practices in South Asia during 1997-2004, as documented in a [2011 case study](#) by the UK's Department for International Development (DFID), one of the funders of that work.

"WHEAT invests one-third of its research budget on cropping systems, with a focus on sustainable intensification," explained Victor Kommerell, WHEAT manager. "Conservation and precision agriculture-based practices save water, nutrients and energy and raise incomes, and can be adapted to serve the needs of both large- and small-scale farmers."

For more information, contact **R.K. Malik**, CSISA Objective 1 Leader, Bihar and eastern UP Hub Manager ([RK.Malik@cgiar.org](mailto:RK.Malik@cgiar.org)).

# Innovative Farm Machinery Transforms Agriculture in Bangladesh

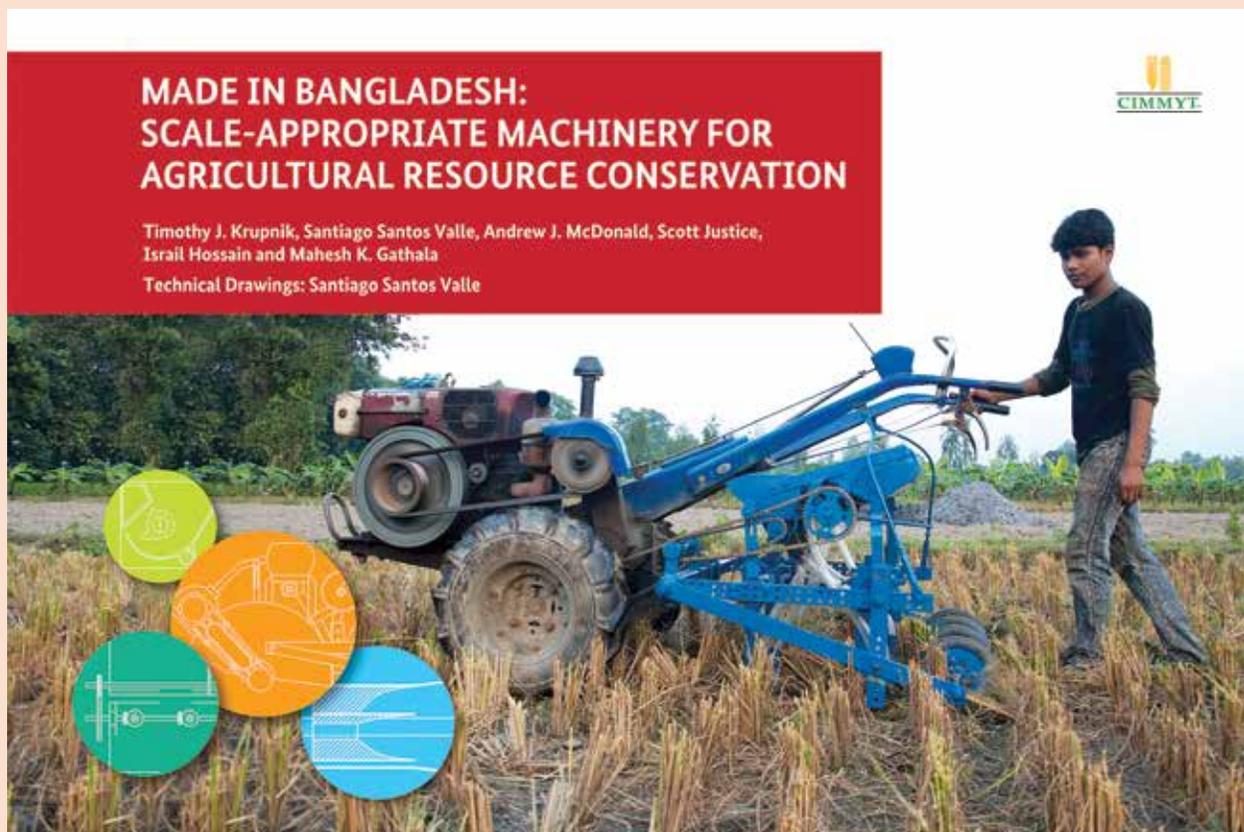
Improved resource-conserving practices like zero tillage require farm machinery appropriate for the diverse soils and multi-crop systems of South Asia. Published in 2013, the open-source book “[Made in Bangladesh: Scale-appropriate machinery for agricultural resource conservation](#)” describes and provides scaled technical drawings for agricultural implements designed for use with the two-wheel tractors now common throughout Bangladesh and parts of Nepal.

“In Bangladesh, the average farmers’ field size is just 0.2 hectares or less,” said Timothy Krupnik, a CIMMYT systems agronomist and one of the book’s authors.

“Farmers make optimal use of nearly every square

centimeter of arable land, often several times a year, putting intense pressure on natural resources. In South Asia, the use of appropriate agricultural machinery helps to conserve natural resources, decrease costs and increase farmers’ profits. But more small-scale farmers need to benefit, which is why the open-source supply of the designs for these machineries is important to help scale-up their use.”

Funding for the book came from the USAID Mission in Bangladesh through CSISA, as well as the European Union (EU) and the Australian Centre for International Agricultural Research (ACIAR).





Fueling

# ECONOMIC GROWTH and Food Production in Pakistan

*Pakistan ushered in a new era of integrated agricultural research in March 2013 when the Ministry of National Food Security and Research (MNFSR), CIMMYT, three other international agricultural research centers, the [University of California at Davis](#) (UC Davis), USAID, the Pakistan Agricultural Research Council (PARC) and key agricultural leaders from throughout Pakistan gathered in Islamabad to announce the [Agricultural Innovation Program \(AIP\)](#).*

Under this US \$30 million initiative funded through USAID, Pakistani and international scientists are working with farmers in cereal, vegetable and livestock systems to revitalize science-supported innovation, building on the country's long history of international collaboration in agricultural development.

"The program will develop a science-driven model to improve the livelihoods of Pakistan's agricultural producers and enable economic growth," Dr. Shahid Masood, PARC plant scientist, told the Pakistani newspaper [The Nation](#). "The international and Pakistani partners involved are dedicated to research, collaboration and investments that will ensure success."

## **An Integrator for Development**

Agriculture accounts for more than one-fifth of Pakistan's economy and two-fifths of the country's employment. Low economic growth and higher prices for foods like wheat have increased the number of the food-insecure poor. Expanding urban areas require more food, while farmers are squeezed by rising production costs, fluctuating market prices, water and soil degradation and climate change. Wheat is sown on 40 percent of Pakistan's arable land, often in rotation with rice or cotton, and provides some 37 percent of food energy and protein in Pakistani

diets, according to a [2013 FAO study](#). But farmers also grow maize, sugarcane, fruits, lentils, chickpeas, tobacco, rapeseed, barley and mustard, as well as raising farm animals for milk, beef, mutton and eggs.

Pakistan's complex farming systems are finding support in the diverse portfolio and institutional mix of AIP. With overall management from CIMMYT, the Program also draws on one of the most extensive collaborations of international research organizations, including the International Livestock Research Institute (ILRI), the International Rice Research Institute (IRRI), UC Davis, ICARDA and the World Vegetable Center (AVRDC). UC Davis is helping to link with U.S. science and innovation via AIP's human resource development component, which is also engaging Pakistani women scientists. PARC is the hosting partner and will oversee the competitive grants portfolio and ensure that AIP is led and executed by national partners.

"The AIP is already fostering a demand-driven, results-oriented science research community and enhancing linkages among Pakistan's agricultural research and innovation communities, the wider global community of agricultural scientists and the private and civil society sectors," said Dr. Muhammad Imtiaz, CIMMYT's Pakistan country liaison officer and AIP project leader.

## A Rich History of Collaboration

The work builds on a Pakistan-CIMMYT relationship that spans five decades. In 1961, Pakistani FAO trainee Manzoor Bajwa, who was working with Norman Borlaug, selected Mexipak, a high-yielding wheat that went on to become Pakistan's most popular variety. After importing Mexipak seed from Mexico, Pakistan harvested 7 million tons of wheat in 1968, making it one of the first countries in Asia to become self-sufficient in the crop.

A farmer applies fertilizer using a multicrop bed planter.



Thomas A. Lumpkin (left), CIMMYT director general, celebrates the re-opening of the CIMMYT office and launch of the Agricultural Innovation Program with Dr. Iftikhar Ahmad, Chairman of the Pakistan Agricultural Research Council (PARC), and PARC plant scientist Dr. Shahid Masood (center and right, respectively).

Most of Pakistan's wheat crop (24 million tons in 2012) is produced with varieties derived through joint Pakistan-CIMMYT breeding research. The Pak-81 line, also selected by a Pakistani wheat breeder training at CIMMYT, has since been released in more countries than any other wheat variety. Finally, during the 1990s-early 2000s, CIMMYT supported Pakistani research efforts to launch conservation agriculture in South Asia.

The rest of the world profits from these successes, as evidenced by Pakistan's contributions to the selection and impact of both Mexipak and Pak-81. According to PARC Chairman Dr. Iftikhar Ahmad, "It must be a two-way process in that Pakistan must also contribute to international science."

The AIP also complements the work of the Wheat Production Enhancement Program for Pakistan (WPEP), a program involving PARC, the government of Pakistan, ICARDA, 11 other national partner institutes in Pakistan and three U.S. Department of Agriculture/Agricultural Research Service (USDA-ARS) units, with support from [USDA](#) and implementation by CIMMYT.

For more information, contact **Muhammad Imtiaz**, CIMMYT-Pakistan country liaison officer ([m.imtiaz@cgiar.org](mailto:m.imtiaz@cgiar.org)).



**MASAGRO** in Mexico:

**You Cannot Walk the Road to Food**



*Wheat research under the Mexico-based Sustainable Modernization of Traditional Agriculture (MasAgro) program excelled in both internal and external reviews in 2013. MasAgro has greatly improved the livelihoods of participating farmers.*

Increasing the profitability of wheat in Mexico by an estimated US \$35 million in 2013, reaching some 50,000 farmers and benefitting about 200,000 people are a few of the achievements reported by MasAgro for 2013. In the leading Mexican wheat-producing state of Sonora, Jesús Rafael Valenzuela Borbón said MasAgro has helped him promote conservation agriculture, which provides higher yields in dry conditions. Valenzuela is in charge of a conservation agriculture experiment site near Navojoa, where he is growing maize and wheat in rotation. “The results are very favorable,” he said.

A joint effort funded by Mexico and launched in 2010 by Mexico’s Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA) with CIMMYT, MasAgro works with 180 partners – Mexican research organizations, policymakers, farmers and private companies – to strengthen national food security through research, capacity building and technology transfer. For wheat, partners test and promote the adoption of conservation agriculture and precision



▲ Bram Govaerts, CIMMYT cropping systems specialist and MasAgro leader, works to integrate technological innovation and raise incomes in Mexico’s farming systems while minimizing detrimental environmental impacts.

## More Precise Farming: Sky is the Limit

Second only to maize as a major food crop in Mexico, wheat is grown on some 600,000 hectares and provides 8 percent of Mexicans’ daily calories by way of pasta and diverse baked or processed foods. The country produces about 3.3 million tons of wheat per year, but recently has imported as much as 4 million tons yearly to satisfy national demand (FAOSTAT 2014). At the same time, soils in many wheat farming areas are **degrading** and water resources are overexploited and growing **scarcer**. Finally, Mexico is among the countries where climate trends since 1980 have slowed wheat yield gains.<sup>1</sup> “In addition to making better use of available water and crop nutrients, conservation agriculture cuts wheat farmers’ production costs by greatly reducing tractor use,” said Bram Govaerts, associate director of CIMMYT’s Global Conservation Agriculture Program and MasAgro coordinator.

New technologies tested and promoted with farmers by MasAgro help ensure that just the right amount of fertilizer is applied precisely when plants need it. “Adoption of **GreenSeeker**<sup>®</sup>, an inexpensive handheld sensor of reflected light that measures biomass, has brought Mexican farmers savings in 2013 estimated at US \$1.7 million,” said Govaerts. “Decreasing fertilizer use also lowers greenhouse gas emissions and nitrate runoff into water systems.” (continued on page 18)

# Security Alone

agriculture practices to increase yields, improve farm household incomes, reduce environmental impacts and mitigate climate change. Already practiced widely in Europe, North America and the Southern Cone of South America, conservation agriculture means reducing or eliminating plowing, keeping residues from previous crops on the soil surface and using strategic rotations.

Research and extension hubs for Mexico’s main farming systems or ecologies are MasAgro’s platform of choice to perfect and pass on innovations. Experiments in each hub test selected technologies locally, as well as mobilizing research and information exchanges among scientists, extension specialists, farmers and others connected to agriculture. The experiments are in turn attached to on-farm modules – there are now more than 1,400 throughout Mexico – where farmers try out new practices and report impressions to peers and researchers.



<sup>1</sup> Lobell et al. 2011. Climate trends and global crop production since 1980. Science DOI: [10.1126/science.1204531](https://doi.org/10.1126/science.1204531).



In the latest development, satellites serve as remote sensors to assess crop health and fertilizer needs. “As part of WHEAT, MasAgro worked with Mexico’s Servicio de Información Agroalimentaria y Pesquera (SIAP) to develop and launch ‘GreenSat’ during 2013,” Govaerts said. “This web-based system allows farmers to use SPOT-6 satellite images of wheat-growing areas to calculate optimal nitrogen fertilizer dosages.” Over 2014, the system will be operational in four major wheat-growing areas of Mexico.

### Smart Mechanization and Machinery for Mexican Wheat Farmers

Back on the ground, conservation agriculture relies on specialized implements such as attachments that can reliably sow seed through crop residues into untilled soil. MasAgro’s mechanization unit develops appropriate

“Adoption of GreenSeeker®, an inexpensive handheld sensor that measures biomass, has brought Mexican farmers savings in 2013 estimated at US \$1.7 million.”

– Bram Govaerts  
Associate director of CIMMYT’s Global Conservation Agriculture Program and MasAgro coordinator



implements for large- and small-scale farmers in settings from irrigated flats to rain-fed hillsides. The team exploits 3-D design programs and computer simulations to test machinery and extensive trials in farmers' fields. Some 500 Mexican farmers and 100 manufacturers and machinery service providers attended agricultural engineering workshops organized by MasAgro in 2013, learning about and commenting on new designs. Through MasAgro, direct seeding implements developed by WHEAT in South Asia were imported and adapted for use in Mexico. In turn, a successful implement designed for two-wheel tractors in Mexico is being tested in Africa and Asia. Future innovations will include on-the-go, sensor-based fertilizer application systems and more sophisticated machinery featuring mechanical, electrical, telecommunications, control and computer engineering components.

## Linking Farmers with Technical Support and the Full Value Chain

Using mobile phones and the Internet, MasAgro has assembled standardized e-log books containing detailed information on the farms and practices of some 20,000 maize and wheat farmers in Mexico (the number grows as you read this). The log books are connected to a [GoogleEarth™](#)-based visualization tool; clicking on a point brings up information on the location, the farmers, the crops and cropping systems and specific practices used.

MasAgro is taking full advantage of farmers' growing use of cellular telephone technology and social media to access market, crop management and other useful information. A pilot SMS service for farmers – MasAgro Móvil – was launched in July 2012 and now reaches 3,700 farmers and the number is growing. The service was recently recognized by the Inter-American Development Bank (IDB) as an innovation for food security in Latin America.

Over three years, a rigorous MasAgro course to formally certify conservation agriculture technicians has trained more than 180 graduates who work with more than 2,000 Mexican rural extension agents to reach farmers.

Working pro-actively through political channels, often at the behest of and with support from farmers, has greatly enhanced MasAgro's effectiveness. As one achievement of that approach, 10 major agricultural states of Mexico have signed agreements to align their agricultural development agendas with MasAgro. Gloria Meléndez Roca, director of rural development for the state of Tlaxcala's Secretary of Agricultural Development (SEFOA), recounts that for Tlaxcala this occurred in 2012, when the governor charged SEFOA to find solutions for a farm sector dominated by rain-fed, smallholder agriculture on Mexico's poorest soils. "One day a certified conservation

agriculture technician came to our offices and mentioned MasAgro to me," Meléndez recalled. "He said 'why don't we talk to CIMMYT.' Afterwards we all put our heads together and an agreement to partner with MasAgro was signed."

Govaerts said the lesson of MasAgro in Tlaxcala is that to achieve desired results, you need to consider farmers, the state and federal governments, agricultural organizations, companies and foundations as "part of the team, because you cannot walk the road to food security alone."

For more information, contact **Bram Govaerts**, MasAgro coordinator ([b.govaerts@cgiar.org](mailto:b.govaerts@cgiar.org)).



▲ Gloria Meléndez Roca, director of rural development for the Secretary of Agricultural Development in the Mexican state of Tlaxcala, was proud that, with 19 certified technicians, her state is among those with the greatest number of these highly-trained professionals. "We've learned a lot," Meléndez said, referring to Tlaxcala's participation in MasAgro. "This has been a new experience and we're adapting to farmers' needs."



# GENDER EQUALITY: A Rallying Point for Wheat

*According to the World Bank's 2012 World Development Report, women comprise 43 percent of the agricultural workforce worldwide. The WHEAT strategy on gender is designed to improve the effectiveness of research and development initiatives and foster equitable access to resources and rights for women and men.*

Gender affects wheat production in many low- and middle-income countries, where women in villages lack legal rights or face social or cultural exclusion from access to land, information, credit or new technologies.

"Research has shown that women spend more of their resources on children than do men," said Lone Badstue,

CIMMYT's strategic leader for gender research and mainstreaming. "Improving women's access to resources can directly benefit children's wellbeing and development. In fact, a [2011 report from FAO](#) states that providing women farmers with equitable access to agricultural resources could remove as many as 150 million people from the ranks of the undernourished."

In 2013, WHEAT obtained CGIAR approval for its gender strategy. "The aim is to strengthen WHEAT's ability to address issues of gender and social differentiation in wheat research-for-development and to ensure that our efforts promote equality and transform unequal norms, wherever possible," Badstue added.

WHEAT also commissioned a gender audit that was undertaken in 2013 by researchers from the Royal Tropical Institute (KIT). In the WHEAT gender strategy, the auditors found a clear commitment – as well as a rationale and policy direction – to address gender concerns. They also

**Women are not recognized as farmers or agricultural producers, so they are largely blocked from support services like subsidies or extension assistance...**

– Tahseen Jafry

Professor at Glasgow Caledonian University



saw evidence of steps to integrate a gender focus into WHEAT projects, but concluded in general that dominant gender-related attitudes and practices needed to be challenged in research projects, if gender strategy goals are to be achieved.

These and other audit findings provide solid input to enhance targeting and impact in WHEAT projects, and will foster strategic and practical follow-up, according to Badstue. The findings were discussed and validated at a 2013 workshop that involved CRP coordinators, senior management, gender experts and biological scientists.

## WHEAT Scopes out Equity Issues in South Asia

Gender and social equity are key development issues in South Asia, a region that is home to half the world's poor and where wheat is a major crop, but where there has been little research on the role of gender in wheat-based cropping systems. "We lack evidence about which groups are poor and excluded and about the nature of their production, consumption and marketing issues," said Tahseen Jafry, a professor at [Glasgow Caledonian University](#), UK, who specializes in gender and justice issues associated with climate change and agriculture. "But such groups clearly need better ways to access, adapt, adopt and apply new knowledge about

technologies, institutions, policies and markets, so they can fully benefit from new developments."

On behalf of WHEAT, Jafry led a scoping study on gender and equity in wheat farming in the Indo-Gangetic Plains, a 700,000-square-kilometer region that cuts across Pakistan, northern India, Nepal and Bangladesh. "The study examined the social architecture around wheat-based activities," Jafry said. "As part of this, it analyzed how cross-gender relationships and social positions vary and how this may influence access to and use of improved agricultural technologies, knowledge and practices." Results showed that women's roles in wheat farming vary greatly across social groups and locations and described the factors that determine who gets access to key goods and services.

"Land ownership, for example, is officially recorded in the name of a man," Jafry said. "Women are not recognized as farmers or agricultural producers, so they are largely blocked from support services like subsidies or extension assistance."

Despite these constraints, said Jafry, the study also revealed a vibrant social architecture – including partnerships, networks and alliances – that addresses gender and social exclusion issues in agriculture and which could play a positive and influential role. As examples, she cited Rangpur Dinajpur Rural Services (RDRS), a non-governmental organization working to empower the rural poor in Bangladesh, or Women Organizing for Change in Agriculture & Natural Resource Management (WOCAN), which strives to build leadership

*(continued on page 22)*



◀ On a 2013 visit to Sindhupalchowk village, Nepal, Lone Badstue, CIMMYT's strategic leader for gender research and mainstreaming, learned that organizing into farmer and seed producer groups enhances women farmers' access to resources like improved seed and fertilizer and improves their incomes and their families' nutrition.



and empower women in Nepal. “Connecting with these agencies could help bridge the gap between research and development,” she said. “Using gender-inclusive approaches as applied by these NGOs may be the only way right now to scale up technology adoption and achieve measurable household-level impacts in wheat research.”

Jafry recommended broadening collaboration, developing a regional strategy and setting impact targets for gender equality and social inclusiveness that are closely in line with the overall policy environment. “The aim,” she explained, “is for wheat research to better align with the broader development agenda, agricultural research-for-development, food security and nutrition, and the post-2015 Millennium Development Goals.”

### The Future of Gender in WHEAT

Together with qualitative methodology expert Patti Petesch and CGIAR colleagues Paula Kantor of [WorldFish](#) and Gordon Prain of the International Potato Center ([CIP](#)), Badstue is coordinating a global, comparative, qualitative study on gender norms across WHEAT and 11 other CGIAR Research Programs. To begin in 2014, work will build on methodologies applied by the World Bank in such global studies as “On Norms and Agency” and Voices of the Poor. “We’re aware of gender norms and patterns in agriculture and CGIAR work,” said Badstue, “but how and why agricultural innovations improve women’s lives in some settings but not others is not yet well understood.”

**“If women farmers receive information on climate change mitigation and adaptation strategies on mobile phones, they can discuss this in an informed way with their husbands and thus improve their participation in household decision-making.”**

– Surabhi Mittal  
CIMMYT socioeconomist

Participants will investigate numerous cases of evolving gender norms and “agency” – a person’s ability to define her or his goals and act upon them – in the context of agricultural innovation, providing core data for analysis across gender, generations, socioeconomic groups and community and country contexts. “This will help the CRPs advance along their established impact pathways and adjust activities as needed to achieve lasting and equitable improvements in agricultural outcomes,” said Badstue.

For more information, contact **Lone Badstue**, strategic leader for gender research and mainstreaming for CIMMYT ([l.badstue@cgiar.org](mailto:l.badstue@cgiar.org)).

## Gender Initiatives Empower Indian Farmers

A farmer in Haryana, India, said she did not understand the importance of working in agriculture until meeting CIMMYT socioeconomist Surabhi Mittal.

An agricultural economist, Mittal began studying technology and farmers for CIMMYT in India in 2010. Her team’s 2013 projects focused on understanding gender perspectives and behavior and arranging for female farmers to receive mobile phone voice messages with customized weather, seed and fertilizer advice, as part of a pilot project launched by the CGIAR Research Program on Climate Change, Agriculture and Food Security ([CCAFS](#)).

After three months of receiving these agro-advisories, the Haryana farmer mentioned above wrote to tell Mittal that she was inspired to work for food security. “I started the discussion with other women to increase their active



contributions in agricultural activities,” the woman farmer said. “After some initial obstacles, now many women are taking interest in modern agriculture.”

Cultural norms in the region make it hard to do effective gender research, said Mittal, who in the last two years has moved more formally to apply a gender lens to her research. “It’s problematic for female students and enumerators to travel to the field and difficult for extension agents to interact with female farmers or farmers’ wives,” Mittal said. But increasing access to information

empowers women working in wheat-based cropping systems, according to Mittal. In the case of the agro-advisories, study results show that listening rates are often higher among women than men, in villages where women have access to such messages.



# A Global Strategy for ICARDA's Wheat Program

*Having left its historical headquarters in Syria, ICARDA's wheat program continues to deliver benefits in partner countries and is using the Center's decentralization to strengthen collaborations and more effectively target national and regional priorities. This evolution presents a unique opportunity for the program to strengthen research and to develop and grow.*

Wheat is a crucial commodity across the world's dry areas. ICARDA is working there with national partners to raise productivity and develop new varieties that help farmers mitigate the effects of debilitating diseases, biophysical constraints and the multiple challenges posed by climate change, according to Michael Baum,

Director of ICARDA's Biodiversity and Integrated Gene Management Program. Baum said these continuing efforts are being pursued at existing and new locations – from Morocco to Sudan, and research sites in Turkey, Iran and Central Asia.

“Decentralization presents challenges, but it also offers ICARDA an opportunity to strengthen and grow,” said Baum. “The Center's wheat research is no exception, with outputs now targeting a much closer alignment with national and regional priorities. An evolving research infrastructure, including a strengthened capacity at existing locations and the development of new research platforms, also guarantees that ICARDA's research continues to help farmers sustain their wheat production against a backdrop of rising temperatures and more variable rainfall.”

This strategic move has relocated facilities and staff to integrated research platforms that address specific



priorities and facilitate collaboration and partnerships with national programs, advanced research institutions and other partners in the development and dissemination of new technologies. The new research agenda will be operated through three major research platforms, each located in a different region but serving dry areas globally:

**West Asia:** ICARDA has expanded facilities and activities in Lebanon, where a fully-functional wheat breeding station, international nurseries and a seed health laboratory have been established. Breeders are able to take advantage of optimal conditions, producing two crop generations in a single year.

**North Africa:** Building on an existing relationship with Morocco's National Institute of Agronomic Research (INRA) and focused on the intensification and diversification of rain-fed cereal-based production systems, ICARDA researchers have established a 100-ha research station where they are testing wheat resistance to heat, drought and Hessian fly. Scientists also have access to the facilities of a further six-to-eight INRA research stations.

**Sub-Saharan Africa:** Building on a partnership with the ILRI and the EIAR, scientists at the Sub-Saharan platform in Ethiopia are testing wheat varieties for a range of stresses, including stripe rust and stem rust variants such as Ug99.

In addition to these integrated research platforms, decentralization has strengthened capacity at existing research sites where activities target specific priorities.

**Egypt for High-Input Agriculture Research:** Egypt provides a platform with a focus on high-input irrigated agricultural systems. Activities contribute to collaborative research at the Sids research station on the management of irrigation systems and irrigated wheat improvement. This site represents irrigated agricultural production systems generally, an important element of dryland production systems.



**Turkey, Central Asia and Iran for Winter Wheat and Winter Barley Research:**

The extensive high-altitude and highland agro-ecologies with severe winters are particularly suitable for breeding winter and facultative wheat, as part of the International Winter Wheat Improvement Program (IWWIP) jointly implemented by Turkey, CIMMYT and ICARDA. Collaboration also builds on the CGIAR Program for Central Asia and the Caucasus in Tashkent, Uzbekistan. Wheat varieties developed in Ankara, Turkey, are also being tested in Central Asia.

**Turkey/ICARDA Cereal Rust Research Center:** Located in Izmir and a partnership with the Turkish Ministry of Food, Agriculture and Livestock, the Center provides countries with scientific expertise and services to identify and track wheat rust diseases. The work includes analyzing rust samples, identifying specific rust races and their virulence to specific varieties of wheat, screening wheat varieties from national breeding programs for resistance to different types of rust and offering advice on wheat varieties that best resist rust diseases in specific agro-climatic conditions.

**Sudan Heat Tolerance Research:** Building on ongoing collaborations with Sudan's Agricultural Research Corporation (ARC), this location at Wad Medani offers high temperatures and short seasons suited for breeding heat-tolerant, early-season wheat varieties for distribution to countries across the dry areas. High-yielding, heat-tolerant wheat varieties recently distributed to northern Nigeria are now yielding 5-6 t/ha in farmers' fields. This has helped convince Nigerian policymakers that domestic wheat production can reduce the country's growing dependence on wheat imports, protecting Nigerians from the vagaries of global commodity markets and strengthening national food security.

For more information, contact **Michael Baum**, Director of ICARDA's Biodiversity and Integrated Gene Management Program ([m.baum@cgiar.org](mailto:m.baum@cgiar.org)).



WHEAT (<http://wheat.org>) is a CGIAR Research Program launched in 2012 and led by the International Maize and Wheat Improvement Center (CIMMYT). Coupling advanced science with field-level research and extension in lower- and middle-income countries, WHEAT works to raise wheat productivity, production and affordable availability for 2.5 billion resource-poor consumers who depend on the crop as a staple food. Partners include the Australian Centre for International Agricultural Research (ACIAR), the British Biotechnology and Biological Sciences Research Council (BBSRC), the International Center for Agricultural Research in the Dry Areas (ICARDA), the Indian Council of Agricultural Research (ICAR), and a community of more than 200 public and private organizations worldwide, among them national governments, companies, international centers, regional and local agencies and farmers. Funding for WHEAT comes from CGIAR and generous donors including national governments, foundations, development banks and other public and private agencies.

© 2014, CGIAR Research Program on Wheat (WHEAT). All rights reserved. The designations employed in the presentation of materials in this publication do not imply the expression of any opinion whatsoever on the part of WHEAT or its contributory organizations concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries. The opinions expressed are those of the

author(s), and are not necessarily those of WHEAT or our partners. WHEAT encourages fair use of this material. Proper citation is requested.

**Correct citation:** WHEAT. 2014. Wheat: Vital Grain of Civilization and Food Security, 2013 Annual Report, CGIAR Research Program on Wheat. Mexico, D.F.: CGIAR Research Program on Wheat (WHEAT).

This publication is licensed under [Creative Commons: Attribution, Non-Commercial, ShareAlike, 4.0 International \(CC BY-NC-SA 4.0\)](https://creativecommons.org/licenses/by-nc-sa/4.0/).



**ISBN:** 978-607-8263-45-5

**AGROVOC Descriptors:** wheats; research; research institutions; research programmes; food security; food consumption; agricultural policies; grain; markets; North Africa; South Asia.

**Additional Keywords:** CIMMYT

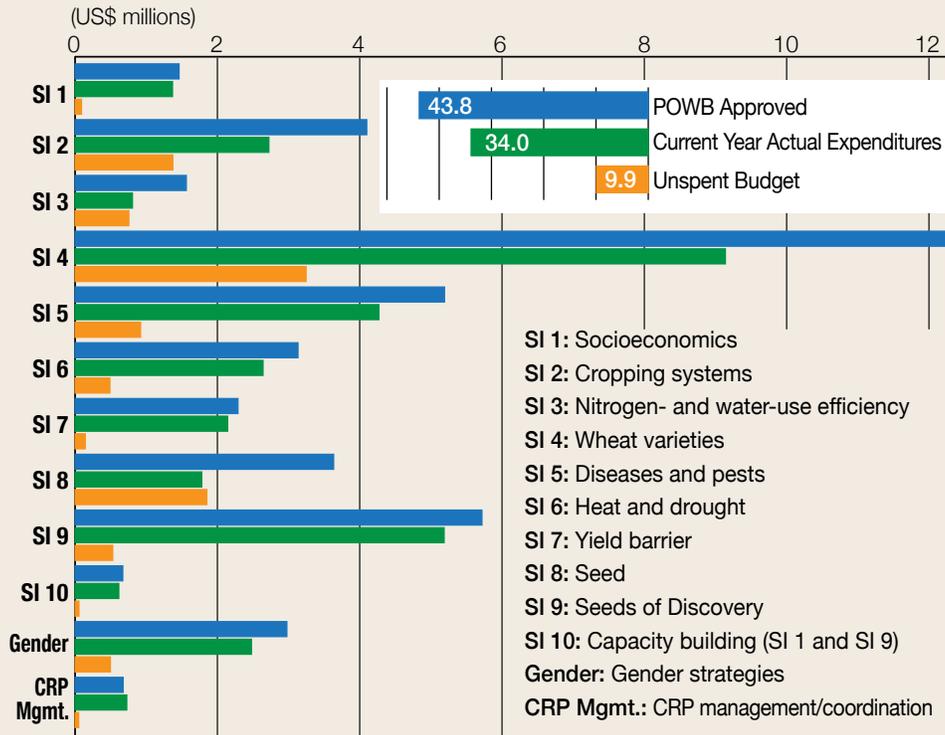
**AGRIS Category Codes:** A50 Agricultural Research; E10 Agricultural Economics and Policies

**Dewey Decimal Classification:** 633.11

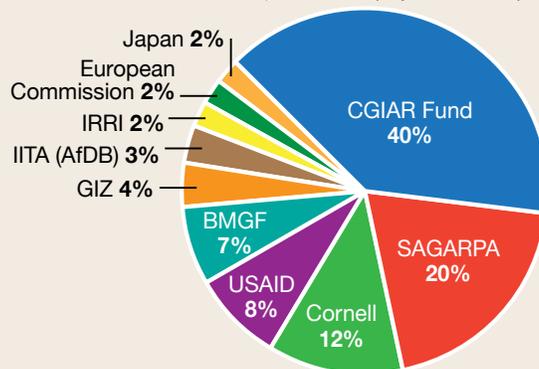
Printed in Mexico.

# WHEAT 2013 Financial Highlights

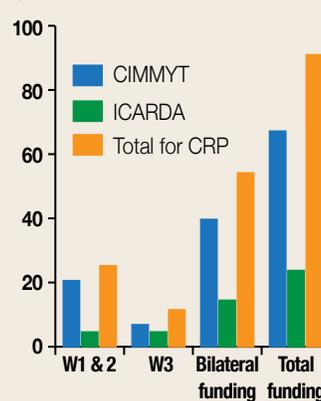
## Annual Financial Summary by Strategic Initiative (SI)



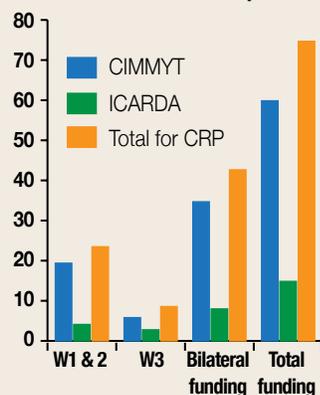
2013 Funding Sources (Top 10 Donors)



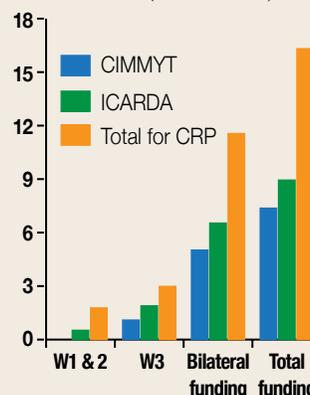
2013 Total POWB Budget Since Inception (US\$ millions)



2013 Actual Cumulative Expenses (US\$ millions)



Variance/Balance (US\$ millions)



# Acronyms

<b>ACIAR</b>	Australian Centre for International Agricultural Research
<b>AIP</b>	Agricultural Innovation Program, Pakistan
<b>AU</b>	African Union
<b>AGRA</b>	Alliance for a Green Revolution in Africa
<b>ARC</b>	Agricultural Research Corporation, Sudan
<b>ATA</b>	Ethiopian Agricultural Transformation Agency
<b>AVRDC</b>	World Vegetable Center
<b>BBSRC</b>	British Biotechnology and Biological Sciences Research Council
<b>BGRI</b>	Borlaug Global Rust Initiative
<b>CAS</b>	Centre for Chinese Agricultural Policy, Chinese Academy of Sciences
<b>CCAFS</b>	CGIAR Research Program on Climate Change, Agriculture and Food Security
<b>CIMMYT</b>	International Maize and Wheat Improvement Center
<b>CIP</b>	International Potato Center
<b>CSIRO</b>	Commonwealth Scientific and Industrial Research Organisation
<b>CSISA</b>	Cereal Systems Initiative for South Asia
<b>DFID</b>	Department for International Development, UK
<b>DRRW</b>	Durable Rust Resistance in Wheat project
<b>EIAR</b>	Ethiopian Institute of Agricultural Research
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FARA</b>	Forum for Agricultural Research in Africa
<b>IBD</b>	Inter-American Development Bank
<b>ICAR</b>	Indian Council of Agricultural Research
<b>ICARDA</b>	International Center for Agricultural Research in the Dry Areas
<b>IDB</b>	Inter-American Development Bank
<b>IFPRI</b>	International Food Policy Research Institute
<b>IICA</b>	Inter-American Institute for Cooperation in Agriculture
<b>ILRI</b>	International Livestock Research Institute
<b>INAT</b>	National Institute of Agronomy of Tunisia
<b>INRA</b>	Institut National de la Recherche Agronomique, France
<b>IRRI</b>	International Rice Research Institute
<b>IWWIP</b>	International Winter Wheat Improvement Program
<b>KIT</b>	Royal Tropical Institute, The Netherlands
<b>MAHYCO</b>	Maharashtra Hybrid Seeds Company
<b>MasAgro</b>	Sustainable Modernization of Traditional Agriculture project, Mexico
<b>MNFSR</b>	Ministry of National Food Security and Research, Pakistan
<b>PARC</b>	Pakistan Agricultural Research Council
<b>RARI</b>	Regional agricultural research institutes, Ethiopia
<b>RDRS</b>	Rangpur Dinajpur Rural Services, Bangladesh
<b>RWC</b>	Rice Wheat Consortium
<b>SAGARPA</b>	Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food, Mexico
<b>SEFOA</b>	Secretary of Agricultural Development, Tlaxcala, Mexico
<b>SIAP</b>	Servicio de Información Agroalimentaria y Pesquera, Mexico
<b>t/ha</b>	tons per hectare
<b>UC Davis</b>	University of California, Davis, U.S.A.
<b>USAID</b>	U.S. Agency for International Development
<b>USDA</b>	U.S. Department of Agriculture
<b>WOCAN</b>	Women Organizing for Change in Agriculture & Natural Resource Management, Nepal
<b>WPEP</b>	Wheat Production Enhancement Program for Pakistan

## WHEAT Management Committee

### Marianne Bänziger

Deputy Director General for Research and Partnerships, CIMMYT

### Michael Baum

Program Director BIGMP, ICARDA

### Hans Braun

Director, Global Wheat Program, CIMMYT

### Olaf Erenstein

Director, Socioeconomics Program, CIMMYT

### Bruno Gerard

Director, Global Conservation Agriculture Program, CIMMYT

### Eric Huttner

Research Program Manager for Crop Improvement and Management, ACIAR

### Graham Moore

[John Innes Centre](#), UK

### Kevin Pixley

Director, Genetic Resources Program, CIMMYT

### Indu Sharma

Project Director, Directorate of Wheat Research, Karnal, India

### Maarten van Ginkel

Deputy Director General for Research, ICARDA

---

### Writers/Editors:

Mike Listman, Scott Mall, Brenna Goth, Katie Lutz, Jack Durrell

### Contributors:

Bekele Abeyo, Iftikhar Ahmad, Lone Badstue, Michael Baum, Jesús Rafael Valenzuela Borbón, Bram Govaerts, Dave Hodson, Muhammad Imtiaz, Tahseen Jafry, Victor Kommerell, Timothy Krupnik, R.K. Malik, Gloria Meléndez Roca and Surabhi Mittal

### Creative Director:

Clyde R. Beaver III

### Graphic Design and Layout:

Marcelo Ortíz, Eliot Sánchez

### Photo Credits:

Front and inside back covers: Xochil Fonseca/CIMMYT; P. 16-19: MasAgro/CIMMYT; P. 24: ICARDA; all other photos: CIMMYT photo archives.



Recurrent food crises – combined with the global financial meltdown, volatile energy prices, natural resource depletion, and climate change – undercut and threaten the livelihoods of millions of poor people.

Accounting for a fifth of humanity's food, wheat is second only to rice as a source of calories in the diets of developing country consumers, and it is first as a source of protein.

Wheat is an especially critical “staff of life” for the approximately 1.2 billion “wheat dependent” to 2.5 billion “wheat consuming” poor – men, women and children who live on less than US \$2 per day – and approximately 30 million poor wheat producers and their families.

Demand for wheat in the developing world is projected to increase 60% by 2050.

At the same time, climate-change-induced temperature increases are likely to reduce wheat production in developing countries by 20-30%.

As a result, prices will more than double in real terms, eroding the purchasing power of poor consumers and creating conditions for widespread social unrest. This scenario is worsened by stagnating yields, soil degradation, increasing irrigation and fertilizer costs, and virulent new disease and pest strains.

**The CGIAR Research Program on Wheat (WHEAT)**  
Email: [wheatcrp@cgiar.org](mailto:wheatcrp@cgiar.org) • Web: <http://wheat.org>

International Maize and Wheat Improvement Center (CIMMYT)  
Apdo. Postal 6-641  
Mexico D.F., Mexico 06600  
Tel: +52 (55) 5804 2004  
Email: [cimmyt@cgiar.org](mailto:cimmyt@cgiar.org)  
[www.cimmyt.org](http://www.cimmyt.org)

International Center for Agricultural Research  
in the Dry Areas (ICARDA)  
P.O. Box 114/5055, Beirut, Lebanon  
Tel: + 961 1 843472 / 813303  
E-mail: [icarda@cgiar.org](mailto:icarda@cgiar.org)  
[www.icarda.cgiar.org](http://www.icarda.cgiar.org)



RESEARCH  
PROGRAM ON  
Wheat