WHEAT
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CGIAR
RESEARCH PROGRAM ON Wheat

Contents

CGIAR Research program on wheat (WHEAT) is supported by CGIAR, a global research partnership for a food secure future.

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Message from the WHEAT Program Manager

In 2012, around 1.6 million farmers made use of the results of 145 projects under WHEAT. Millions more have benefited from input-saving agronomy and precision agriculture tools and other research results generated through past CGIAR funding for wheat research. Indeed, CGIAR-derived improved varieties are grown on over 50 percent of the entire area sown to wheat in the developing world, where two thirds of global production comes from. In 2012, WHEAT funding ensured that improved germplasm demand from 620 collaborators in 120 countries was met by CIMMYT and ICARDA.

Six countries on two continents became 'Ug99 epidemic'-proof this year (secure from a devastating stem rust that is spreading across the world) and India saw an early commercialization success that builds on multi-year shuttle breeding between Mexico and Kenya. On the upstream front, 'Seeds of Discovery' started the largest genetic diversity analyses ever to find heat tolerant wheat.

Across the globe, wheat research is funded mostly by public sources. WHEAT made strides to better leverage and coordinate this investment nationally, regionally, and globally. Researchers from 36 institutions jointly developed the Wheat Yield Consortium Business Plan and took it to 21 donors and research councils from 17 countries. WHEAT is a founding member of the G-20 Wheat Initiative, which wants to better coordinate large national research programs. But better R&D coordination across organizations and institutions is not enough. Greater long-term investments in wheat R4D are needed to avoid 'pricing out' 1.2 billion poor from accessing a healthy and diverse diet due to rising staple food prices.

Wheat is grown in many male-dominated societies, so WHEAT initiated a gender audit to find new avenues for increasing womens' participation in wheat value chains.

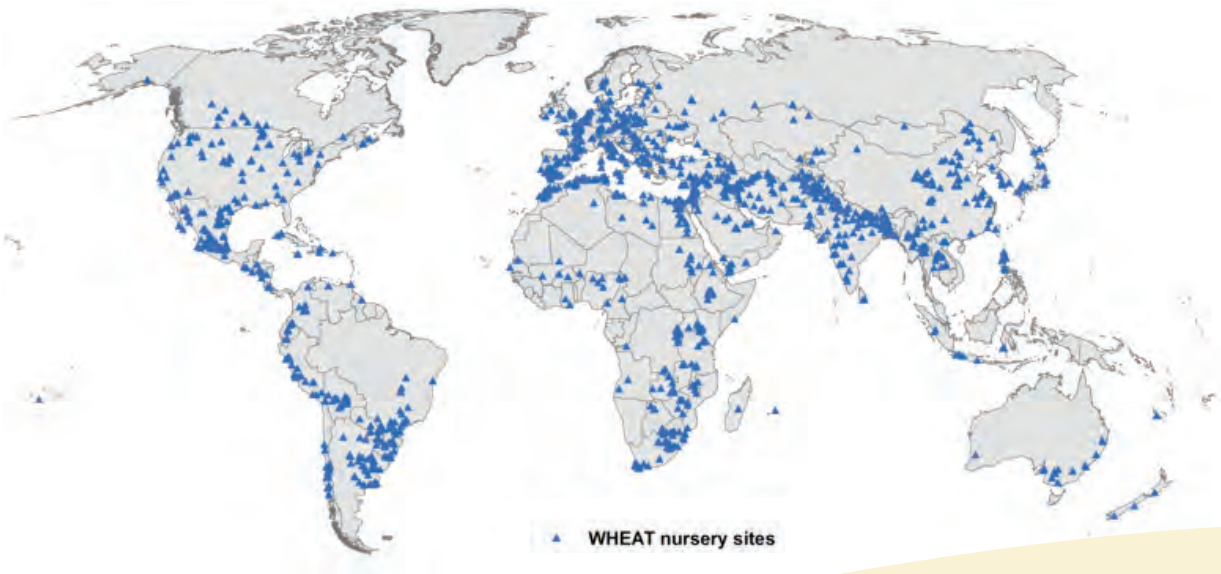
As populations, urbanization and women entering the workforce increase, CIMMYT and ICARDA are working to sustainably improve food security in Africa. As the estimated $US 6bn wheat import bill (2012) shows, wheat is a no longer a minor crop for consumers in sub-Saharan Africa. African Agriculture Ministers officially recognized this in November, whilst the African Development Bank (AfDB) started to invest in wheat R4D. Building on that, WHEAT is developing a Wheat for Africa (W4A) Strategy, to encourage national and international actors to join forces in filling the R4D gaps.

Today, people consume 2.8 times the wheat that was eaten in 1961. Twelve of the 15 farming systems on our planet, where most poor people live, are maize-, rice- or wheat-based, or a combination thereof. Wheat products are staple foods that cannot be easily substituted. The potential for improvement is enormous and so is the potential for wheat.

Victor Kommerell

Victor Kommerell

Our partners in germplasm exchange worldwide. The map shows 620 cooperators, who send back data to CIMMYT or ICARDA. Thanks to these data, we are able to develop improved varieties for the benefit of wheat farmers and consumers.



What's so big about WHEAT?

WHEAT is a CGIAR Research Program led by CIMMYT and launched in 2012. With ICARDA as its main CGIAR Consortium partner, WHEAT focuses on increasing wheat production for the 2.5 billion poor consumers for whom wheat is a staple food. The program brings together over 200 research and development partners: Top researchers with national agricultural research systems, non-governmental organizations, advanced research institutes, civil society organizations, farmer organizations, and the private sector.

Introducing 10 Strategic Initiatives

At the core of WHEAT strategy are 10 inter-connected research agendas for the next 5-10 years, called Strategic Initiatives. They cover comprehensive wheat improvement, agronomy, systems and precision agriculture and frontier research on breaking the genetic yield barrier. Over the mid- to long-term, WHEAT research aims to (1) stabilize wheat prices, (2) boost farm-level wheat productivity, (3) fortify wheat's resistance to important diseases and pests and (4) enhance its adaptation to warmer climates. Challenges are big: all of this must occur without using more land and as fertilizer, water, and labor costs rise.

Focus on partnerships

For WHEAT, partnership is paramount. From year one, the CGIAR Research Program distinguished itself by allocating funds to non-CGIAR researchers, to fill WHEAT research gaps, by launching a call for competitive grants. In 2012, fifty-five grants were awarded through the MAIZE and WHEAT Competitive Partner Grants. WHEAT alone granted nineteen projects, with a first year budget of US$2.4 million for mostly 2- and 3-year research projects, delivered by non-CGIAR partners from India, Uzbekistan, Turkey, China, UK and USA . The competitive partner grants aim to extend MAIZE and WHEAT partnerships to capture a wider range of innovative ideas, such as a scoping study in South Asia to investigate how gender and social equity issues around wheat-based agricultural research are currently being addressed. The grants can also complement ongoing research, be the latter CGIAR- or bilaterally funded.

Early examples of impact

On the final day of the 'Wheat for Food Security in Africa' Conference in October 2012, Addis Ababa, Ethiopia, participants, including four Ministers of Agriculture, signed a Conference Declaration recognizing that a ca. US$20 billion annual African wheat import bill is unsustainable and thus the importance of protecting wheat producers, for countries with the potential to increase production to receive technical support and get access to varieties resilient to climate change. As a direct result of the Declaration, the Joint Conference of African Union Ministers of Agriculture and Trade (JCMAT), held during 29-30 November 2012, formally decided to include wheat among the strategic commodities for achieving food and nutrition security in Africa.

Globally, at least 40 new wheat varieties descending from WHEAT research were released by national partners in 2012. In India, two new higher yielding Ug99 resistant varieties, derived by the private seed sector from CGIAR Ug99 resistant germplasm, provide spread and yield advantages over current popular varieties. The two varieties are promoted in northwestern India, with seeds sales and ha coverage expanding rapidly. This would not have been possible but for the Ug99 resistance-focused shuttle breeding efforts between CIMMYT and Kenya over the last few years. The two Indian lines' resistance was identified in Kenya 2006-7. Overall, shuttle breeding (2 breeding cycles per year) has led to a substantial increase in internationally distributed wheat germplasm with resistance to Ug99, without compromising on grain yield and other necessary traits.

More on WHEAT: http://wheat.org

Where we work

East Asia

In China, CIMMYT is a strategic partner of the Chinese Academy of Agricultural Science (CAAS) for international collaboration, on applied biotechnology in crop improvement, among others.

CWANA

In the Central and West Asia and North Africa region (CWANA), ICARDA is supported by USDA to enhance the sustainability of rainfed and irrigated wheat in wheat-based systems in Pakistan.

South Asia

WHEAT works in India, Bangladesh, Nepal and Pakistan to investigate how gender and social equity issues around wheat-based agricultural research are being addressed.

Latin America

CIMMYT's Intensification challenges and options are identified through system approaches at farm and landscape scales.

East Africa

In Ethiopia, ICARDA and USAID work on the rapid deployment of rust resistant wheat varieties for achieving food security.

Global

The Wheat yield Consortium (WYC), established in 2009, is a collaboration between 31 partner organizations, with 83 expert scientists and aims to increase wheat yield potential 50% by 2030.

The six projects highlighted are representative of CIMMYT and ICARDA research direction's and partnerships.

Bringing new seed varieties to farmers' fields

With rust a major threat to wheat production in developing countries, popularizing new resistant varieties enables farmers to replace rust-susceptible varieties growing in their fields. In 2012, with ICARDA's support, national agriculture research systems (NARS) in Egypt, Pakistan, and Ethiopia actively promoted new, improved seed varieties by spreading the word among farmers about the threat of rust and the availability of new, resistant varieties.

In Egypt, the National Wheat Research Program carried out over 1,200 demonstrations across 23 governorates to disseminate knowledge about the new varieties and associated agronomic practices. Some 450 fields were planted with the two newly-released Ug99 resistant wheat cultivars 'Misr1' and 'Misr2'. The demonstration plots showed that farmers using the new varieties could increase their grain yield by around 20 percent. A senior NARS manager commented, "The approach opened our eyes to where research and extension can be linked, and a record yield has been achieved on the farmers' fields."

Positive uptake

Participating farmers have shown a positive perception of Ug99 resistant varieties

Misr 1 (86%) and Misr 2 (70.3%) due to:

- high productivity (89.9%)
- resistance to stem rust Ug99 (86.1%)
- good baking quality (74.7%), etc.

Improving access

However, new varieties can be hard to obtain in marginal and less accessible, remote areas. For example, availability and access to wheat seed in rainfed areas of Punjab and Baluchistan are more problematic compared to irrigated areas of Punjab, due to the absence of a well-organized seed system. Bringing seed to farmers in such regions requires an innovative approach based on decentralized seed production and marketing, with the participation of farmers themselves. The approach involves engaging individuals, groups of farmers or farmer organizations/associations or supporting small-scale seed enterprises.

An innovative approach

The approach is: *participatory* – mobilizing and involving small farmers based on their identified needs; *decentralized* – multiplying adapted and farmer-preferred varieties in target environments; *cost effective* – minimizing transaction costs and thus reducing seed prices; *business oriented* – linking seed production to demand from communities; *relevant* – adopting seed quality appropriate to farmer requirements; *appropriate* – using low-cost cleaner/treater to improve seed quality; and *sustainable* – empowering farmers to take leadership roles in the seed business.

In Pakistan, ICARDA initiated farmer-based seed production in partnership with the Barani Agricultural Research Institute (Chakwal), the Cereal Crops Research Institute (Nowshera), and the National Institute of Food and Agriculture (Peshawar). Eleven entrepreneur farmers in Barani (8) and Swabi (3) and one small-scale seed producer in Nowshera received new seed varieties and fertilizers together with training on quality seed production. They were monitored regularly for quality seed production and given access to low-cost, mobile, seed cleaning and treatment machines designed by ICARDA and manufactured by a private company.

The farmers produced over 56 tons of seed from eight different bread wheat varieties, and many succeeded in selling their seed at prices that were 30-50 percent (US$76-127/ton) above the local grain price. Analysis of on-farm seed production and marketing showed on average a net profit of US$700 per hectare, indicating better profitability in the seed business than grain production. Both the farmers involved in local seed production and the farming communities are pleased with the new varieties and stated that the initiative brought the seed of new wheat varieties to their door steps, which was not the case in the past. They also emphasized the approach not only created awareness of new varieties, but also facilitated the availability of seed at local level, ensuring farmers' access to seed at lower cost. With access to seed, they are confident of raising production and productivity.

In Pakistan, to reach the farmers, improved crop varieties must first reach local seed vendors who form an essential link in the chain between researchers, seed producers, and farmers.

> *"Here is an interesting paradox at the centre of farming: it is that an activity which involves so much bulk and heavy lifting should be controlled to such an extent by a thing as tiny and delicate as the seed that is planted into the soil."*
>
> **Joe DeVries,**
> Director of the Program for Africa's Seed Systems, AGRA

In Ethiopia, ICARDA directly engaged with farmers in 36 target districts of four major wheat growing regions, under the government's Agricultural Growth Plan, to ensure the rapid deployment of rust-resistant and high-yielding wheat varieties. Each farmer was provided with at least 37.5 kg seed – sufficient to plant a quarter of a hectare clustered with another three neighboring farmers. A total of 4,239 farmers (6.2 percent women) planted 176 tons of seed from 13 different rust-resistant varieties, producing 3,720 tons of seed. This has reached over 21,000 household members, who were the direct beneficiaries. Farmers kept 10 percent of the produce for their own future use, returned the amount they had originally received from the project in kind, and exchanged the remaining seed through local channels or sold it to the formal sector for further distribution to farmers. Preliminary cost-benefit analysis of seed multiplication/dissemination estimated that their annual incomes increased by an average of between US$50 and US$200 per year, depending on farm size.

More about wheat varieties against rust diseases:
http://www.icarda.org/defending-against-wheat-rust-diseases

Beating drought with conservation agriculture in Kazakhstan

In Kazakhstan, conventionally grown wheat has been severely affected by 2012's drought and high temperatures. According to farmer Idris Kozhebayev, wheat crops in Akmola Region normally average 42 grains per spike, but this year are producing only 2-4 grains per spike.

Kazakhstan is the world's sixth largest wheat exporter, but more than 14 million of the country's 15 million hectares of wheat are rainfed, and are thus vulnerable to dry weather. The 2012 drought has reportedly shrunk the wheat crop by nearly 60 percent from 2011's record harvests; in Akmola, the harvests are expected to produce only enough grain to supply next year's seed.

In Kostanay, the country's main wheat growing region, crops went two months without rain after planting in April. However, many farmers had adopted conservation agriculture techniques – reduced or zero tillage, keeping crop residues on the soil and rotating crops – that protected them from the drought's worst effects. While these farmers reported yields of 2 tons per hectare, some using conventional practices lost their entire crop.

Farmers were initially attracted to zero tillage and conservation agriculture because the approaches dramatically cut costs: farming this way requires less labor, machinery use, fuel, water, or fertilizers. In rainfed cropping, conservation agriculture can also boost yields. Research has shown that conservation agriculture increases soil moisture by as much as 24 percent on most fields. In Kazakhstan, the practices capture snow on the surface and improve water retention under heavy snowfall and subzero temperatures. Zero tillage also augments soil organic matter and cuts erosion by 75-100 percent. All this has helped to nearly double average wheat yields, from 1.4 to 2.6 tons per hectare, according to Valentin Dvurechenskii, director general of the Kostanay Agricultural Research Institute.

"I've been a farmer for 35 years, and I've never seen anything like this," says Oleg Danilenko, farmer and director general of Dievskaya Agrofirma flour millers, echoing the view of many of his peers. Danilenko believes the harsh conditions have highlighted the advantages of conservation agriculture. "No other results have been nearly as successful," he says.

The findings of a 2012 FAO-Investment Centre mission to Kazakhstan suggest that adoption of zero tillage and conservation agriculture had raised domestic wheat production by almost 2 million tons. According to the mission report, this represents an increase in income of US$0.58 billion over 2010-12, providing enough grain to satisfy the annual cereal requirements of almost 5 million people, and sequestering about 1.8 million additional tons of carbon dioxide per year.

With the support of CIMMYT, FAO, ICARDA, the World Bank, the Ministry of Agriculture of Kazakhstan, and other international

organizations and donors, Kazakhstan increased the land under conservation agriculture from practically nothing in 2000 to 0.5 million hectares in 2007. In 2012, as a result of ongoing farmer engagement through demonstration plots, field days, and close work with farmer unions, conservation agriculture was practiced on 2 million hectares – 13 percent of the country's wheat-growing area. "This amazing adoption is thanks to a few scientists who saw the potential, but more importantly to the pioneer farmers who perfected the techniques and put them into practice. Farmers believe farmers!" says conservation agriculture expert Pat Wall, who, together with CIMMYT colleagues Alexei Morgounov and Muratbek Karabayev, initiated field trials with Kazakhstani scientists in the country's northern steppes in 2000.

Based on the positive results of research trials and tests in farmers' fields, Kazakhstan's current state policy calls for every province to pursue zero tillage.

> *"Zero tillage in the rice-wheat farming systems of the Indo-Gangetic plains represent the most profoundly influential natural resource management activity to date within the CGIAR in terms of the geographic scope of diffusion and the number of farmers affected."*

M.Renkow,
Professor of Agricultural & Resource Economics at NCSU

Two million hectares are currently under zero tillage, making Kazakhstan one of the top-ten countries for conservation agriculture.

Further reading:

- Chauhan, B. S., G. Mahajan, V. Sardana, J. Timsina, and M.L.Jat (2012). Productivity and sustainability of the rice-wheat cropping system in the Indo-Gangetic Plains of the Indian subcontinent: problems, opportunities, and strategies. Adv. Agron, 117: 315-369.
- Erenstein, O., K. Sayre, P. Wall, J. Hellin, and J. Dixon, J. (2012). Conservation Agriculture in Maize- and Wheat-Based Systems in the (Sub) tropics: Lessons from Adaptation Initiatives in South Asia, Mexico, and Southern Africa. *Journal of Sustainable Agriculture, 36*(2): 180–206.
- Govaerts, B., N. Verhulst, A. Castellanos-Navarrete, K.D. Sayre, J. Dixon, and L. Dendooven (2009). Conservation agriculture and soil carbon sequestration: between myth and farmer reality. Crit. Rev. Plant Sci., 28: 97–122
- Valbuena, D., O. Erenstein, S. Homann-Kee Tui, T. Abdoulaye, L. Claessens, A.J. Duncan, B. Gérard, M. Rufino, N. Teufel, A. van Rooyen, and M.T. van Wijkh (2012). Conservation Agriculture in mixed crop–livestock systems: Scoping crop residue trade-offs in Sub-Saharan Africa and South Asia. Field crops research, 132: 175-184.

More on Conservation Agriculture:
http://www.cimmyt.org/en/what-we-do/conservation-agriculture

Seeking a new approach to optimize fertilizer use

Application of nitrogen fertilizer is one of the most significant costs in wheat production and efficient application of fertilizers is a major problem in many parts of the world. In Mexico, for example, it is estimated that farmers in the irrigated wheat systems who apply nitrogen fertilizer to their fields do so with only 30-35 percent efficiency. The remaining 65-70 percent is unused by the crop and not only represents a wasted expense for producers, but also leads to environmental damage, including emissions of nitrous oxide (a powerful greenhouse gas) to the atmosphere, and nitrate pollution, both of groundwater resources and the precious marine habitat of the Sea of Cortes.

The WHEAT Research Program is working with Mexico's Sustainable Modernization of Traditional Agriculture (MasAgro) initiative to develop new ways for farmers to be more precise in their application of fertilizers. In particular, the partners are developing and promoting the use of field sensors, including ground sensors and satellite-mounted sensors, combined with complementary data handling software, to support fertilizer recommendations at farm, system and regional levels.

GreenSeeker™ is a sensor that is used in precision agriculture to measure crop biomass and color, in order to calculate whether crops are being adequately supplied with essential nutrients. As a handheld device or mounted on a vehicle, it produces a beam of red and near infra-red light, which is bounced off the crop, with the results converted into a 'normalized difference vegetation index' (NDVI) value. By taking readings in different parts of a field, farmers can learn which areas need more or less fertilizer, enabling precise and cost-effective application.

Farmers involved in the validation and adoption of GreenSeeker™ for use in Mexico have been required to grow a strip in their field where nitrogen fertilizer is applied at non-limiting rates. This is the reference point for the diagnosis. On the rest of the plot, all other factors such as planting density, crop variety and application of other nutrients are carried out as in the diagnostic strip; the only difference is that less nitrogen fertilizer is applied. Crop biomass and color information from the sensors is then used to calculate detailed fertilizer recommendations for that specific field, including meeting the varying fertilizer needs of different parts of the field.

Using sensors, Mexican farmers are able to get accurate dosage rates for nitrogen application in order to achieve both optimum yields (wheat and maize) and quality (wheat). Now used in Mexico for more than four years on over 7,000 hectares, the technology has enabled farmers to reduce nitrogen applications by 25-30 percent, on average, without affecting crop yields. This represents an average reduction in input costs of US$100, rising to US$230 per hectare in some cases. "With the money that I saved on fertilizer using the

sensor last crop cycle, I was able to buy a new pickup truck," says farmer Martin Arreola, from the southern Sonora region.

Under the MasAgro initiative, calibration for GreenSeeker™ sensors in different Mexican agro-ecological zones was finalized in time for promotion and adoption of the technology in the autumn-winter of 2012 while calibration in other areas is going on at full speed. The GreenSeeker™ technology has now been tested in wheat (in Baja California, Guanajuato, Michoacán, Sinaloa and Sonora regions of Mexico), maize (Sinaloa and Sonora) and barley (Bajio). To speed up adoption of the technology, a pocket sensor costing around US$500 – around one-tenth the cost of the standard GreenSeeker™ model – has been developed, which is now available on the commercial market.

"I am very excited at the current adoption of field sensors by farmers because it represents a win-win situation, where both farmers and the environment benefit," says Ivan Ortiz-Monasterio, principal scientist at CIMMYT. The results generated in Mexico will be of considerable significance to other regions where WHEAT works, including countries such as Ethiopia and Zimbabwe, which lack soil mapping and have poor fertilizer availability, and others like China and India, where over-fertilization with nitrogen is resulting in high costs and serious environmental impacts.

"It's been proven that of all the interventions to reduce poverty, improving agricultural productivity is the best. All the other different economic activity – yes it trickles down. But nothing as efficiently as in agriculture. (…) Places like CIMMYT do really unbelievable work. And given the impact of their work, and the importance of the work, we've all got to be disappointed that funding is not even at peak levels."

Bill Gates,
Speaking at an International Agriculture and Food Security Briefing sponsored by Farmers Feeding the World, a Farm Journal Foundation Initiative, and the Senate Hunger Caucus, Washington D.C.

More on MasAgro: http://masagro.mx/index.php/en/

The **Sustainable Modernization of Traditional Agriculture (MasAgro)** Project promotes the work of Mexican growers through the support of organizations dedicated to improve agriculture in Mexico. The Mexican Government and the international scientific community collaborate to enable small and medium scale rainfed growers to harvest high and stable yields, and to raise their income sustainably.

Seeds of Discovery

Studies the genetic composition of maize and wheat to identify the natural qualities that make certain seeds or varieties of both grains more tolerant to disease and to the effects of climate change on agriculture.

International Maize Improvement Consortium for Latin America (IMIC-LA)

Builds capacities of local maize seed producers to develop and to distribute different types of low-cost maize varieties and hybrids for growers with limited resources. Makes state-of-the-art technologies available to seed breeders so that they may, in turn, meet the growers' demand for improved seed at affordable prices.

Wheat Yield Consortium

Adopts a coordinated approach to research at the international level with an aim to raise wheat's yield potential by 50% over the next 20 years.

Take it to the Farmer

Accelerates the integration of all stakeholders in the national agrifood chain through innovation networks, and promotes conservation and precision agriculture to raise the productivity, profitability and sustainability of Mexico's rural sector.

Information delivered on a bicycle

Riding around the countryside on bicycles, 'InfoLadies' are women entrepreneurs that use various information and communication tools (including laptops, mobile phones and blood sugar meters) to provide low-fee services to rural women in Bangladesh, many of whom lack basic information on health, agriculture and education. First developed in 2008 by D.Net, a Bangladeshi NGO, InfoLadies now provide information relating to legal advice, job searches, market linkages and government services, amongst others. Benefiting from three months' training on use of computers, printers, cameras and the internet, InfoLadies have become a key channel for providing information, through the use of ICTs, to women facing social, economic and cultural challenges, including mobility constraints, and who lack the means to improve their lives.

Taking advantage of this established network, the Cereal Systems Initiative for South Asia in Bangladesh (CSISA-BD)[1], organized a three-day training workshop (26-28 February) to introduce some of the project's most promising agricultural practices and technologies to 17 InfoLadies. Funded by USAID's 'Feed the Future' program and the Bill and Melinda Gates Foundation (BMGF), and jointly implemented by CIMMYT, IRRI and WorldFish, CSISA-BD is providing various types of training for women, who generally have lower levels of education than men in Bangladesh.

At an InfoLadies training workshop, held at the Spandan Training Center in Mymensingh, Dr. Dinabandhu Pandit, CIMMYT-CSISA Cropping Systems Agronomist, discussed the increasing importance of maize and wheat-based cropping systems for income generation and food security in Bangladesh. For wheat, he particularly focused on the production of Ug99-tolerant wheat seed varieties using a two-wheel tractor with a mechanical seeder attachment. The trainees also attended a field visit to Char Jelkhana, where on-going demonstrations and applications of wheat cropping practices and technologies were observed in the fields of local farmers.

Since Bangladeshi women are mostly involved in post-harvest activities, including seed preservation, the training also included capacity building on seed production, preservation methods and the marketing of Ug99-tolerant wheat varieties. The trainees learnt that the minimum price paid for wheat seed in Bangladesh during 2012 was US$500/ton; in contrast, the price of wheat grain in the same year was half that amount (US$250/ton). By employing improved post-harvest techniques, women can very easily earn additional income by producing and storing wheat seed for a period of seven months (from April to October) before sale.

1 CSISA-BD is a contributing project to WHEAT

Both during and after the training, the InfoLadies have shown great enthusiasm to learn new agricultural practices and technologies and explore their income-generation potential. This enthusiasm was reinforced during the field visit and through their interaction with women farmers from a charland (river island) village. Adequate information is crucial for farmers in deciding whether or not to adopt a technology. Therefore, training InfoLadies on a few key agricultural practices and supplying them with supporting brochures and posters, allows them to add 'agricultural information' to the list of services they provide to rural villagers.

The training program also covered: improved and intercrop-based farming systems, fertilizer management, management and application of maize varieties, post-harvest technologies for rice, basic aquaculture and pond management, cage aquaculture, horticulture and nutrition. The program ended with a day-long session on entrepreneurship development, including book-keeping, business planning and customer satisfaction. By tapping into this resource of lively women, CSISA-BD aims to help transfer technologies and methods to a wider audience for improved production and food security, as well as generate income from marketing of the technologies.

Related material:
Footage from the video 'save more, grow more, earn more' (bit.ly/11kfElw) from CSISA's work in Bangladesh was selected for the video 'Turning the tide on global hunger' (bit.ly/QHEWei), which was shown at the 'Feed the Future: Partnering with Civil Society' event, in New York on September 27, 2012.

More about CSISA: https://sites.google.com/site/csisaportal/

CIMMYT is collaborating with national partners in Bangladesh to provide training sessions to farmers, facilitating access to and adoption of improved seed, technologies and practices.

"A typical INFOLADY is a trained young woman, who uses a bicycle to travel about five to ten kilometers a day and offers variety of Information and Communications Technology (ICT)-based services and other services at the door-steps of the community she lives in. The INFOLADY carries a range of ICTs with her. She acts as a human interface to the community with the World Wide Web and other information portals. She carries a netbook computer with webcam, digital camera, and mobile phone with internet connectivity and a headphone whereby she can record problems, download information, connect to experts and find solutions to agricultural, health and development questions that community members might have."

http://infolady.com.bd/

Keeping track of rust

'The disease that never sleeps' is how Nobel Prize winner Norman Borlaug once described wheat rust, a group of deadly, constantly changing fungal pathogens that pose a serious threat to food security worldwide. Globally, the three wheat rusts – stem, leaf and stripe rust – are the most economically damaging diseases of wheat. All inflict devastating losses when epidemics occur, but stem and stripe rust are the most feared, inflicting losses of 60 percent or more under favorable conditions. Successful control of stem rust – mainly through resistance breeding – is estimated to have saved farmers worldwide over US$1 billion annually for more than four decades. However, past wheat breeding successes cannot protect the world's wheat crop indefinitely against this constantly changing enemy. With new rust threats emerging, scientists have implemented a global rust tracking system, to try to stay ahead of their evolving enemy.

The Global Cereal Rust Monitoring System was initiated in 2008 as part of the Durable Rust Resistance in Wheat (DRRW) project, generously funded by the Bill and Melinda Gates Foundation and the UK Department for International Development. The rust tracking system now covers 38 countries, and includes most of the wheat grown in developing countries. Information from field surveys, pathotype analysis and predictive models are stored in a state-of-the-art data management system (the Wheat Rust Toolbox) and made available via the RustTracker information system developed by CIMMYT in collaboration with partners from the Global Rust Reference Centre, Denmark's Aarhus University, ICARDA, and others.

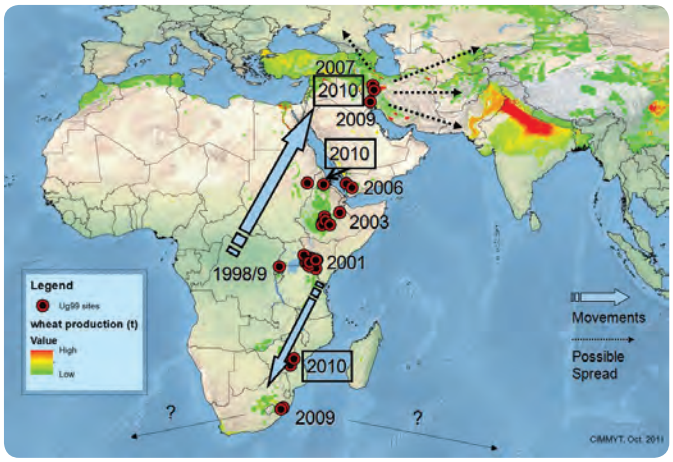
"The aim of RustTracker is to provide a single source of information relating to global rust monitoring activities," says CIMMYT's Dave Hodson, who coordinates the rust monitoring work. "Regularly updated information can provide rapid notifications of important pathogen changes or movements, new outbreaks, or risks of outbreaks. No other comparable monitoring system for a major crop disease currently exists at such a wide geographical scale."

Ug99, an especially virulent strain of stem rust first identified in Uganda in 1999, was the catalyst for developing the rust tracking system. Eight closely related variants of Ug99 now exist and have spread to 11 countries between South Africa and Sudan and across the Red Sea to Yemen and Iran. With a large proportion of the world's wheat estimated to be susceptible to the Ug99 races, the threat to South Asia is a major concern. The region, home to 1.4 billion people, produces around 20 percent of the world's wheat; small-scale farmers without access to fungicides are particularly vulnerable.

In recent years, new, highly aggressive strains of stripe rust (also known as yellow rust) affecting many of the most widely grown wheat varieties have emerged and caused devastating

epidemics in Azerbaijan, Ethiopia, Iraq, Morocco, Syria, Tajikistan and Uzbekistan, with national yield losses as high as 40 percent. Using information in RustTracker – for example 'risk maps' based on country survey data – the aim is to help researchers in countries in the path of virulent rust strains to assess the severity of the threat and prepare. Pakistan is a typical example: here national rust surveillance efforts are coordinated by Atiq ur Rehman Rattu (NARC, Islamabad), extensive surveys are undertaken annually throughout the major wheat growing areas and all the information is uploaded into the RustTracker system.

The spread of wheat stem rust UG99 lineage



Within five years, the rust tracking system has developed into one of the most extensive and fully functional global crop disease monitoring platforms. Through a global network of partners it has successfully tracked the spread and evolution of important new races, such as the Ug99 race group. The system is continually updated by in-country partners uploading field survey data and providing samples for analysis. Mobile technologies, such as smartphones and tablets, are now being used to collect survey data and transfer it from the field into the core databases. New molecular diagnostic tools developed by the USDA-ARS Cereals Disease Laboratory, Minnesota, are providing rapid detection of Ug99 races in samples collected from farmers' fields. However, all of the rust surveillance activities only have relevance if they inform the wheat variety improvement efforts. Hence strong linkages to core wheat cultivar databases such as the CIMMYT Wheat Atlas and Genetic Resources Information System for Wheat and Triticale (GRIS) are being developed to ensure that both host and pathogen information are connected.

Field workers at Njoro Agricultural Research Station in Kenya sowing wheat seed samples in international trials for screening for resistance to Ug99.

The next steps for rust surveillance include a geographical expansion of coverage (targeting 40 countries contributing annually), increased capacity for collaborating partners through enhanced training, and improved coverage of a wider range of rust diseases, especially stripe rust. Through a new collaboration with Cambridge University, UK, Hodson is hopeful that the initiative can make further progress on disease early warning and mitigation advice. The other major challenge is to ensure the long-term sustainability of the global rust monitoring system. This is critical given the continual emergence of new, virulent rust races. A failure of the global monitoring system, and the allied control and mitigation efforts, would undoubtedly result in re-emerging threats to wheat production and food security.

Online tools:
http://rusttracker.cimmyt.org/
http://www.wheatpedigree.net for GRIS
http://www.wheatrust.cornell.edu/

Visit the Durable Rust Resistance in Wheat (DRRW) website:
http://www.wheatrust.cornell.edu/index.html

A growing need for African wheat

In 2012, African countries spent around US$18 billion to import some 40 million tons of wheat, of which sub-Saharan African (SSA) countries accounted for around 15 million tons. "Demand for wheat in SSA countries is growing faster than for any other staple, in particular in urban areas. Interestingly, a major factor is that working women are demanding more wheat, since wheat products are very convenient to prepare," says Hans Braun, director of CIMMYT's global wheat program. Yet across the continent, farmers produce only around 40 percent of the wheat consumed locally, leaving Africa's growing demand for the crop largely in the hands of global traders. With declining self-sufficiency rates, these trends threaten the nutritional and national security of countries in the region and, in coming years, Africa could face further hunger, instability and even political violence, as seen in North Africa's bread riots during the 2007/8 food price crisis.

To discuss the constraints and potential for wheat production in Africa, and the policy changes needed to achieve profitable domestic wheat systems, the first ever conference to be held on the subject was organised by the Ethiopian Institute of Agricultural Research (EIAR), CIMMYT, ICARDA, the International Food Policy Research Institute (IFPRI), the African Union and the WHEAT Research Program. Attended by over 250 participants, the 'Wheat for Food Security in Africa' conference was held during 8-12 October 2012, in Addis Ababa, Ethiopia.

A key paper presented at the conference provided a 12 country analysis of SSA's economic and biological potential to produce rainfed wheat. Prepared by CIMMYT and IFPRI researchers, the report states that African farmers are only achieving a small part of their potential production. Using advanced computer modeling techniques, the analysis reveals that, even in rainfed areas, with appropriate use of fertilizers and other inputs, 20-100 percent of land area across the 12 nations appears to be ecologically suitable for profitable wheat farming. Lead author, Bekele Shiferaw, stated that at least eight of the countries, particularly in highland production systems in Eastern and Central Africa, could become less dependent on wheat imports. However, to fulfill wheat's potential, governments and development agencies will need to analyse the wheat value chain in great detail and then be ready to invest significantly in infrastructure and technical support.

> *"We can't make people eat research papers."*
>
> **Norman Borlaug**

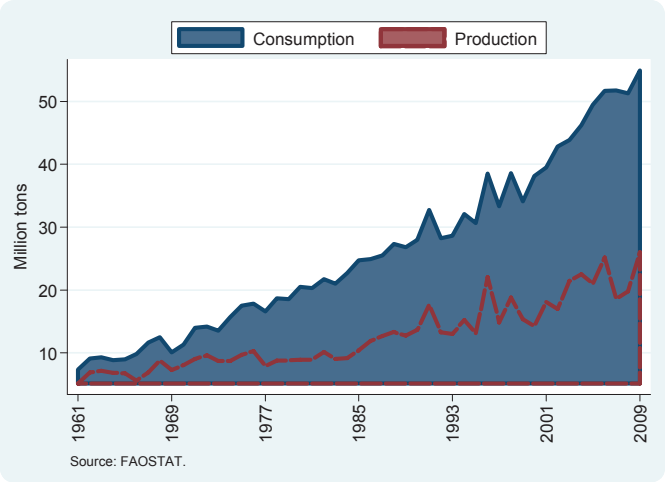
From across the continent, 100 African researchers were sponsored to attend the conference and present posters on different aspects of wheat research. Ministers of Agriculture from Burundi, Ethiopia, Sudan, and Zimbabwe were also active participants. And, on the final day, participants and ministers signed a conference declaration recognizing the importance of protecting wheat producers, and calling for countries with the potential to increase production to receive technical support and access to varieties resilient to climate change. As a direct result of this declaration, participants in the joint Conference of African Union Ministers of Agriculture and Trade, held during 29-30 November 2012, formally decided to include wheat among the strategic commodities for achieving food and nutrition security in Africa.

In 2007, Assistant Professor Nicole Mason of Michigan State University carried out an urban consumption survey in four cities in Zambia, and was struck by how popular bread and other wheat products were among respondents in all income groups. "I expected urbanization to be a key factor driving rising wheat consumption in Africa but surprisingly, our results suggest that changes in the percentage of the urban population didn't have a significant effect on country-level wheat consumption." Instead, the survey suggested that demographic and socio-economic changes, such as rising incomes and increased participation of women in the labor force, were driving wheat consumption.

"We suspect that this is because wheat products (bread, pasta, chapati, etc.) take less time to prepare than many other popular staple carbohydrates like maize meal porridge," says Mason. "When women work more outside of the home, they have less time to devote to food preparation and may prefer quicker options like these wheat products."

Wheat is Ethiopia's third most important cereal in terms of cultivated land and number of smallholders engaged in production.

Trends in the domestic wheat production gap in Africa, 1961-2009



What is Africa's wheat potential? Is it worth the investment?

- Sub-Saharan Africa now grows less than 10% of the wheat that it could.
- Wheat straw and other residues can contribute significant economic value as fodder.
- Rising temperatures are likely to reduce wheat production in developing countries by 20-30%; drought and heat tolerant varieties under development will allow farmers to meet the challenges of climate change.
- Investing in wheat will spur inter-African trade.
- Wheat can be intercropped, adding income for African farmers.

More on wheat for Africa: http://wheat.org/wheat-in-africa/wheat-a-strategic-crop-for-africa

A new season for winter wheat?

As climate change makes tropical wheat environments less favorable, new varieties will help wheat to beat the heat. High temperatures damage wheat yields on more than 9 million hectares globally. This is likely to increase, however, with the Intergovernmental Panel on Climate Change predicting that global temperatures will rise by 1.8-4.0°C by the end of the century. Current heat-stressed areas, which include some of the world's poorest regions, are likely to suffer from reduced yields.

Winter wheat is primarily grown in rainfed areas and is a natural reserve of drought-adaptive traits and genes. Winter wheat also has a grain yield advantage, producing approximately 25 percent more than hard red spring wheat. The richest and oldest reservoir of adaptive genes is thought to come from winter wheat in Turkey, from where wheat originated. As heat and drought are predicted to strongly reduce wheat production in the coming years, and given the likelihood of further fuel and food price rises, wheat research is focusing on landraces, to capture useful traits and genes, in particular adaptation to drought in rainfed systems from West and Central Asia.

"Landraces are local varieties of domesticated plant species which have been developed largely by natural processes and survived over time, withstanding severe droughts and heat."

To capture useful traits to use in winter wheat breeding, wheat landraces collections have been gathered by CIMMYT Turkey since 2011, originating from various countries of Central and West Asia (Afghanistan, China, Iran, Iraq, Tajikistan, Pakistan, Turkey, among others), totalling 10,000 accessions. These collections were mainly provided by genebanks around the world (including the Aegean Agricultural Research Institute Genebank in Turkey, Yokohama University in Japan, the Australian Winter Cereal Collection (AWCC), the CIMMYT and ICARDA genebanks, and Ankara genebank in Turkey), stored in some instances since the 1920s.

Finding hidden treasures

In 2009, an inventory of Turkey's wheat landraces was begun, as part of the International Winter Wheat Improvement Program (IWWIP) work, a joint enterprise between the Government of Turkey, CIMMYT and ICARDA. As a result, around 160 landraces have been found growing in 41 provinces. Although the total area where these varieties are grown is small, these landraces are very important to small farmers in remote mountainous regions because of their unique adaptation and suitability for homemade products.

Further analysis of these landraces has revealed a broad genetic diversity. Many landraces are later maturing than the modern wheat cultivars (Bezostaya and Gerek) and have larger grain size, with some even providing higher grain yields. This analysis will potentially lead to the identification of new genetic sources of adaptation to heat and drought stress. The best performing landraces are continuously being tested in more detail to identify new traits and genes that might have been lost through breeding and introgress these into modern cultivars. The best landraces can now be used in strategic spring-winter, winter-spring and winter-winter wheat crossing to introduce drought and heat adaptive traits from landraces into elite cultivars and hence enrich their genetic backgrounds.

> *"For every one degree in rise in temperature, a 10% decrease in yield is expected for wheat in tropical and semi-tropical regions. Production in wheat in these regions is expected to reduce by 30% due to climate change."*
>
> **D. Lobell,**
> Assistant Professor Environmental Earth System Science, Stanford University

At the same time, CIMMYT Turkey-Physiology component is identifying winter wheat traits that are consistently present in high yielding wheat grown under various drought and heat conditions. For example, traditional traits, like early maturing and intermediate plant height have explained up to 68 percent of yield variation in recent winter wheat cultivars grown under rainfed systems. "This shows the importance of introducing these two traits into newer germplasm," says Marta Lopes, a CIMMYT winter wheat physiologist. "We feel that by introducing these two traits into germplasm, grain yield under rainfed systems will be considerably increased and so will farmer's incomes."

Did you know?

- Wheat was one of the first domesticated food crops and for 8000 years has been the basic staple food of major civilizations in Europe, West Asia, and North Africa.
- Wheat is being harvested somewhere in the world in any given month.
- World trade for wheat is greater than for all other crops combined.
- Wheat provides more nourishment for humans than any other food source.

More on the International Winter Wheat Improvement Program (IWWIP): http://www.iwwip.org

More on Wheat Atlas: http://wheatatlas.org

Women and wheat in South Asia

In South Asia, poverty and gender inequalities, while showing some variation across different regions and social groups, have a significant impact on the status of agriculture, food security and nutrition. Targeted action focused on local realities is therefore key in addressing such issues. The WHEAT Research Program, for example, explicitly emphasizes the need to understand and address gender-related issues in all its proposed outputs.

Dr Tahseen Jafry, lead investigator of the research project on integration of gender in wheat-based systems in South Asia, and senior lecturer at Glasgow Caledonian University (UK) is conducting a scoping study funded by WHEAT in Bangladesh, India, Nepal and Pakistan on the integration of gender and social equity in wheat-based research for development. The project is investigating how gender and social equity issues in wheat research are currently being addressed, in order to determine viable options and approaches for future research programming.

"Though women participate in all activities related to agriculture they are usually the first to be marginalized and we need to look at mechanisms for changing that," says Jafry. "Through our research, we hope to determine who is doing what in addressing gender and social equity issues in wheat-based research in the region."

Key findings of the study have revealed that there are differences in the way women are engaged in wheat farming – across and within countries – and that inequalities exist with regards to access to knowledge and services in different regions. Women in hilly areas of Nepal and the western region of Bangladesh, for example, are better positioned with regards to gender equality than their counterparts in the plains of Nepal and eastern Bangladesh. Women in poorer families and lower castes have greater gender equality than those in richer families and higher castes, across the three countries.

Within research and extension, while there is considerable expertise and human resources for wheat research, such expertise does not exist for gender mainstreaming activities. While the need for research on gender and social equity in wheat is not articulated in key strategies and policy documents in the region, there is increasing recognition of the need to address gender, particularly by including women in training, demonstrations and trials.

In Bangladesh and Nepal, for example, the Participatory Varietal Selection (PVS) initiative is the key activity through which women are involved in wheat research. Bangladeshi researchers are employing the 'whole family approach' to farmer training, whereby a male and a female member from each family are invited to participate. This is expected to increase women's

access to training, in the context of local culture that prevents women from going out of their home without a male family member accompanying.

For WHEAT, there is the potential to engage with regional social science research experts in support of further gender analysis and capacity building, in order to build understanding and strengthen the role of women in wheat systems in the region.

Related material:
Reaching rural women case study: gender focused extension systems: bit.ly/16ulJkm

"Though women participate in all activities related to agriculture they are usually the first to be marginalized and we need to look at mechanisms for changing that."

Building global wheat researcher community's competence

"Anybody working in wheat research will come to CIMMYT at least once in their lifetime."

Tony Fischer,
WHEAT-Stakeholder Committee

WHEAT training events bring national wheat researchers together, across disciplines and departments. Participants attest that it is a unique opportunity to meet colleagues from other countries – and in several cases, colleagues from other institutions in their own country. The cumulative networking effect of recurring capacity development programs can be observed in ex-trainees joining CIMMYT or ICARDA Offices or university departments, which are WHEAT research partners.

The international wheat improvement training courses have been a major part of CIMMYT's commitment to long-term in-depth capacity development. As many national programs are refocusing their activities to include wheat bioinformatics, molecular breeding, physiology, conservation agriculture, pathology, and seed health issues, the Wheat Improvement Course offers a broad curriculum to the highly motivated wheat scientists from developing countries. Among other activities, participants are trained in pollination techniques, disease identification, and how to select plants and seed. From March to May 2012, participants benefited from Obregon's 170 hectares of wheat experimental fields, visits to farmers' fields, the Mexican national research programs and from interactions with established wheat scientists at CIMMYT.

The 2012 course was attended by 23 participants from 16 countries, who returned to their respective countries with skills and knowledge needed to design and run a modern wheat improvement, valuing teamwork and interdisciplinary research. Lutanga Makweti, a Zambian wheat breeder, for example, has initiated a crossing program to expand his companies' breeding activities in Zambia, passing on the skills and techniques he gained during the course to other young researchers in his country.

In two years, women participation in the Wheat Improvement Courses increased from 4 percent (2005-2010) to 24 percent (2011-12). In cooperation with Borlaug Global Rust Initiative (BGRI, led by Cornell University) and its Jeannie Borlaug Women In Triticum Fellowships, the number of women participating should rise to more than 30 percent over the next 2 years. Over the past 2 years more than 50 percent of the participants were young scientists, mostly MSc holders.

Towards gender equality in wheat-based systems

An interview with Lone Badstue, CIMMYT gender specialist

The CGIAR Research Program on wheat (WHEAT) is among the first CRP to have its own gender strategy, which you designed. Tell us about gender equality in wheat-based systems.

Relations between men and women are a key factor to consider in agricultural innovation and research for development. Indeed, addressing the gender disparities between women and men farmers in the developing world represents a significant development potential in itself. The FAO 2011 State of Food and Agriculture report estimates that if women had the same access to production resources as men, they could increase yields on their fields by 20-30 percent. According to FAO, this alone would raise total agricultural output in developing countries by 2.5-4 percent, potentially reducing the number of hungry people in the world by 12-17 percent or 100-150 million people.

Gender equality is also a development objective in its own right. Just as reduction in poverty or ensuring greater access to justice is part of development, so too is the narrowing of gaps in well-being between men and women. Having said that, addressing gender inequality can be arduous and require great resourcefulness. Gender differences are particularly persistent when rooted in deeply entrenched gender roles and social norms, and WHEAT faces a special challenge in this regard in several of its main target regions. These regions, where many people live on less than US$2/day, form part of what has been referred to as the 'patriarchal belt'. Traditionally, these regions have been characterized by societies with strong cultural and social norms supporting particularly tenacious and unequal gender roles and relations, as documented in several studies.

What does this mean for wheat research for development?

For improved wheat technologies to have a positive impact on gender inequality, appropriate consideration of context-specific gender dynamics and very careful targeting are likely to be required. This may include special measures by program partners, to address unequal, gender-differentiated norms and rights that affect how labor, land, capital, knowledge or technologies are accessed and used for producing, marketing and consuming wheat. In fact, without appropriate incorporation of gender considerations, otherwise technically superior innovations may instead lead to further exacerbation of gender inequalities and fail to achieve anticipated impacts. In addition to this, improvements in gender equality tend

to enhance economic efficiency and strengthen other development outcomes, such as food and nutrition security and education.

The effect of female empowerment on children's schooling (both boys AND girls), for example, is increasingly documented. Greater female authority within households is being progressively recognized as an important policy goal for improving not just the well-being of women themselves but also of the children in those households. Research suggests that mothers are likely to allocate more household resources to children, compared to fathers. Therefore, an increase in a mother's decision-making ability within the family can have a positive impact on her children's welfare.

One may think that this has nothing to do with wheat research for development. However, gender equality is everybody's business and we have a responsibility in wheat research to support changes so that women farmers access, learn and benefit from research and innovations in the same way as their male peers.

Are there outputs from the gender strategy?

Yes, a key output of the wheat gender strategy, which is currently well under way, is a gender audit of the WHEAT Research Program, implemented by the Royal Tropical Institute (KIT). This is a stock-taking exercise, including a diversity of aspects related to gender integration, from research design and implementation to partnerships, gender analysis capacity, knowledge and attitudes. The purpose is to assess how gender is currently addressed in WHEAT and how this can be further strengthened. This will lead to a concrete gender action plan for the WHEAT Research Program.

"Gender equality is equal participation of women and men in decision-making, equal ability to exercise their human rights, equal access to and control of resources and the benefits of development, and equal opportunities in employment and in all other aspects of their livelihoods."

FAO, Men and women in agriculture: closing the gap

Further reading:

- Ferguson, A. (1996). Gendered Science – A critique of agricultural development, American Anthropologist, 540-552.
- Kandiyoti, D. (1988). Bargaining With Patriarchy, Gender and Society 2(3): 274–90.
- Mason, A. and E. King. (2001). Engendering development: through gender equality in rights, resources and voice. Washington D.C.: World Bank
- Offenhauer, P. (2005). Women in Islamic societies: A selected review of social scientific literature, The Federal Research Division, the Library of Congress, Washington, D.C.
- Quisumbing, A. and J. Maluccio. (2003).Resources at Marriage and Intrahousehold Allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa. Oxford Bulletin of Economics and Statistics 65 (3): 283-328.

"Greater female authority within households is being progressively recognized as an important policy goal for improving not just the well-being of women themselves but also of the children in those households."

More on WHEAT Gender audit: http://blog.cimmyt.org/?p=9899

Low investment in wheat funding

With around 130 million tons, annual global wheat trade is higher than that of maize and rice combined. More than 60 percent of wheat is produced in emerging and developing countries: China and India together produce nearly twice as much wheat as the USA and Russia combined. In North Africa and West and Central Asia, wheat is the dominant staple and provides 40-50 percent of all calories. Stable and reliable wheat production and the maintenance of prices at an affordable level are therefore paramount for global food security and political stability.

Wheat products are staple foods for humans, and cannot be easily substituted. Demand for wheat in the developing world is projected to increase 60 percent by 2050 to meet the needs of a growing population, while, at the same time, climate-change-induced temperatures are estimated to reduce wheat production in the same countries. The challenges for wheat growers and breeders to meet demand are growing and current global investments in wheat improvement are too meager to address those challenges properly. Moreover, given the time lag between research and development and widespread applications, action is required now, both at national and international levels.

Why is it critical to increase research funding for wheat?

Because wheat prices affect political stability:

The interplay between climate change, food prices (particularly wheat) and politics is a hidden stressor that helped to fuel the revolutions and will continue to make consolidating them into stable democracies much more difficult.

The numbers tell the story: *"Bread provides one-third of the caloric intake in Egypt, a country where 38 percent of income is spent on food,"* notes Troy Sternberg, Oxford University geographer, *"The doubling of global wheat prices – from $157/metric ton in June 2010 to $326/metric ton in February 2011 – thus significantly impacted the country's food supply and availability. Global food prices peaked at an all-time high in March 2011, shortly after President Hosni Mubarak was toppled in Egypt."*

Because demand for wheat is growing:

Between 2012 and 2050, world wheat trade (including flour) will expand by 20 million tons (15 percent), rising to nearly 157 million tons. Growth in wheat imports will be concentrated in those developing countries where income and population gains drive increases in demand. The largest growth markets will include Asian countries, the 15 countries of the Economic Community of West African States, other Sub-Saharan Africa countries, Egypt, Indonesia, Saudi Arabia, and other countries in the Africa and Middle East region. [USDA Long-term Projections, February 2012]

Because wheat prices are going up:

After the food price crisis, in 2007/2008, wheat price increased again above US$ 300/ton in mid-2010 and since then it is oscillating between US$ 300-350, which seems to be the new international wheat price 'standard.' [data from the Chicago International Grains Council]

How much research investment goes into wheat?

Wheat and wheat-based systems research is overwhelmingly funded by the public sector. There is less private sector investment due to fewer market opportunities (e.g. at this moment no marketable hybrids like in maize; no transgenic wheat released policies). Though recently, a few large agribusiness companies have started to raise their wheat-related R&D investments.

Heisey, Lantican, and Dubin (2002) estimated that, in 1990, the total annual investment in international wheat breeding research ranged from US$ 100 to US$ 150 million. Hans J. Braun, Director of the Global Wheat Program at CIMMYT, more recently compiled the following estimates illustrating that public and private investment in maize totals US$ 2 billion annually, while wheat investment, at US$ 480 million, totals less than 25% of that.

Investment in R&D for crops and traits

	Investments in million US $		
	All crops	Wheat	Maize
Private sector	3,200	200	1,900
Public sector		280	100
Total		480	2,000

- Biggest maize program ca 700 M$ / year;
- 95% of investments in maize in developed countries
- Several maize programs have more yield plots than all US wheat programs together

Compiled from various sources by H. J. Braun

Further reading:

- The Arab Spring and Climate Change, A Climate and Security Correlations Series, edited by Caitlin E. Werrell, Francesco Femia, and Anne-Marie Slaughter, February 2013.
- Rosegrant, M.W. and M. Agcaoili M. 2010. Global food demand, supply, and price prospects to 2010. Washington, DC: International Food Policy Research Institute.
- www.wheatinitiative.org

"The importance of wheat stems from its worldwide prominence as a foodstuff. In terms of production, it sits between maize and rice as the second most produced food grain in the world; aided by its ability to thrive in different climates and mature in a relatively short space of time. The market for wheat is never saturated, and demand is ever increasing. There is always a buyer somewhere, a fact that every trader in the wheat futures market is acutely aware of."

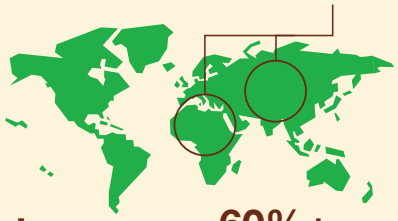
From http://howtotradecommodities.co.uk/wheat.html

Increasing research funding for wheat is critical

Wheat consumption

20%
of global calories for human consumption are provided by wheat

50%
of calories in North Africa and West and Central Asia are from wheat

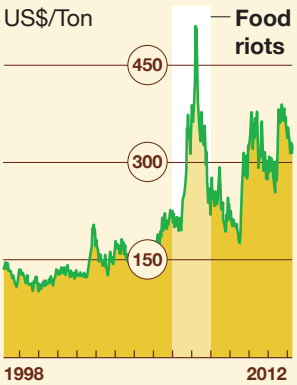


130m tons
annual global wheat trade is higher than maize and rice combined

60%+
of wheat is produced in emerging and developing countries

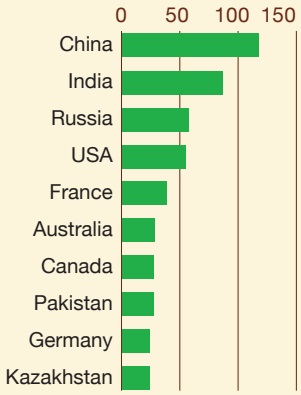
Price

Keeping wheat production stable and affordable is essential for global food security and political stability



Production

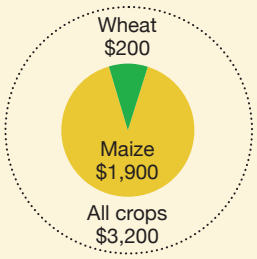
Top 10 countries
Tons million (2011)



Research & development

Even though it is a staple food crop, wheat research is underfunded, particularly in the private sector due to fewer market opportunities

Private Sector
Investments in US $ millions



Investment into research to control the wheat disease known as stem rust during 1961-2009 has added **6.2 million tons** annually to world wheat harvests, worth **US $1.12 billion** per year at 2010 prices

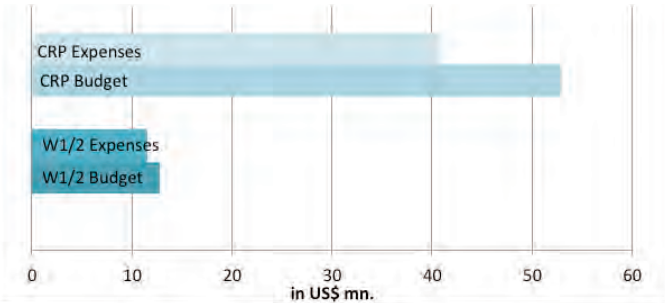
WHEAT 2012 Financial highlights

WHEAT budget (2012-2014)

The whole-of-life total budget for WHEAT (all sources of funding) is US$ 130,685mn (as per Program Implementation Agreement). In its first year (2012) WHEAT spent US$ 40,780mn, and US$ 89,905mn remain for the two consecutive years (as per PIA).

WHEAT expenditure (2012)

Budget versus actual expenditure 2012; by funding source (please note that commitments are not yet accounted for in the figures below):



The majority of Windows 1 and 2 budget was spent in 2012.

The discrepancy of total CRP expenses vs. total CRP budget is due to the fact that a wide range of projects based on other funding sources (bilateral/Windows 3) do not follow a calendar-year based cycle.

WHEAT Governance

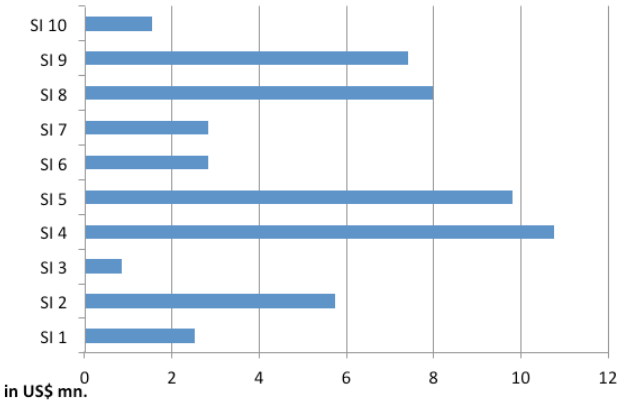
The research program is steered by the Stakeholder Committee (a majority of non-CGIAR members) and managed by the WHEAT management committee.

More on WHEAT governance:
http://wheat.org/who-we-are/governance

WHEAT budget (2012) per Strategic Initiative

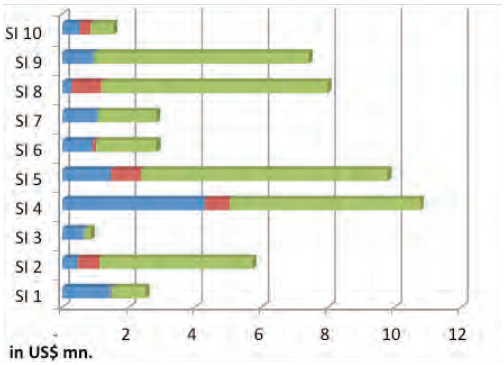
The WHEAT 'Systems' component (Strategic Initiatives 2, 3, 8) accounts for approximately 28% of CRP total budget.

Total budget per Strategic Initiative



The funding mix varies per Strategic Initiative.

WHEAT funding sources per Strategic Initiative



Green=bilateral, Red=windows 3, Blue=windows 1/2

SI 1: Socio-Economics
SI 2: Sustainable Wheat Systems
SI 3: Nutrient & Water Use Efficiency
SI 4: Productive varieties
SI 5: Resistance, disease and pest management
SI 6: Heat & drought tolerance
SI 7: Breaking yield barrier
SI 8: More & better seed
SI 9: Seeds of discovery
SI 10: Strengthen capacity

WHEAT bilateral funding sources (2012)

Bilateral Funding 2012 (larger donor and EU only)

Donor	To CIMMYT and/or ICARDA	Projects funded	Relate to Strategic Initiatives	Budget 2012 (US$000)	Plus Window 3 (2012)
ACIAR (AU)	CIMMYT	Afghanistan	Strategic Initiatives 8 & 10	633	
Bill &Melinda Gates Foundation (BMGF)	CIMMYT				822
BMZ (Germany) thru GIZ	Both	Heat tolerance	Strategic Initiative 6	996	
Cornell	Both	Durable Rust Resistance Initiative (donor: BMGF); Genomic Selection (for CIMMYT)	Strategic initiatives 5 & 7	5,291	
European Commission (thru EC-IFAD)	ICARDA	Legume-wheat systems	Strategic Initiative 2		1,031
GRDC (AU)	Both	Drought tolerance	Strategic Initiative 6	1,859	
Harvest Plus	Both	Harvest Plus (zinc & wheat)	Strategic Initiative 4	1,034	
IRRI	CIMMYT	Cereal Systems Initiative in South Asia (donors: BMFG, USAID)	Strategic Initiative 2	2,354	
Kuwaiti Fund & Islamic Dev Bank & Arab Fund	ICARDA	Food Security Enhancement	Strategic Initiatives 2 & 10	1,946	
SAGARPA	CIMMYT	MasAgro Take It To the Farmer, SeeD, Wheat Yield Consortium;	Strategic Initiatives 2 & 7 & 9	11,016	
USAID	Both	Feed The Future Projects, Ethiopia	Strategic Initiatives 2 & 4 & 8	1,244	841
USDA	Both	Pakistan, Karnal Bunt	Strategic Initiatives 2 & 5 & 8	5,296	

Turkey contributed $287k to the International Winter Wheat Program via W3/ICARDA. India's ICAR co-funded the Global Rust Initiative (DRRW) with $404k via W3/CIMMYT.

Acronyms

ACIAR: Australian Center for International Agricultural Research
BGRI: Borlaug Global Rust Initiative
CGIAR: CGIAR is a global agriculture research partnership
CIMMYT: International Wheat and Maize Improvement Center
CSISA: Cereal Systems Initiative for South Asia
DRRW: Durable Rust Resistance in Wheat
EIAR: Ethiopian Institute of Agricultural Research
GRDC: The Grains Research and Development Corporation
ICARDA: International Center for Agricultural Research in the Dry Areas
IFAD: International Fund for Agricultural development
IFPRI: International Food Policy Research Institute
IRRI: International Rice Research Institute
IWWIP: International Winter Wheat Improvement Program
KIT: Royal Tropical Institute
MasAgro: Sustainable Modernization of Traditional Agriculture in Mexico
SAGARPA: Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food in Mexico

What the world eats: Wheat – a sustainable strategy for food security

CRISIS

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.

1.2billion "wheat dependent" poor
2.5billion "wheat consuming" poor

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 USD 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.

30% reduction in wheat

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.

CGIAR
RESEARCH PROGRAM ON Wheat