



# MAIZE

## Annual Report

# 2012



RESEARCH  
PROGRAM ON  
Maize

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# MAIZE: Catalyzing the force of maize farmers

2012 was an exciting year for MAIZE. Over 860,000 farmers benefited from CIMMYT and IITA research outputs, and many more are benefiting through germplasm released by partners in countries such as Bangladesh, Ethiopia, El Salvador, Kenya, India, Malawi, and Mozambique.

The work of researchers and partners has been translating into results and impact in Africa, Asia and Latin America:

The rapid response of MAIZE and the Kenya Agricultural Research Institute (KARI) to the outbreak of the deadly Maize Lethal Necrotic Virus (MLN) in eastern Africa in 2012 resulted in quick identification of promising CIMMYT inbred lines and pre-commercial hybrids with resistance or moderate resistance to MLN, offering considerable hope to combating the disease through breeding efforts.

Two million smallholder farmers across sub-Saharan Africa are using varieties developed by the Drought Tolerant Maize for Africa (DTMA) project, involving CIMMYT and IITA in collaboration with national agricultural research systems. With better yields than leading commercial varieties under drought conditions – and outstanding harvests when rains are good – the DTMA varieties improve food security and income of farmers in 13 countries. To date, the total volume of drought tolerant maize varieties produced by seed companies has increased from 19,000 metric tons in 2007 to 30,000 metric tons of seed annually across the 13 target countries.

The release of the first publicly available inducer line for doubled haploids (DH) in collaboration with the University of Hohenheim was met with great enthusiasm and

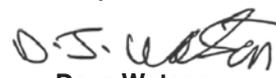
engagement among MAIZE partners. The DH technology, already in high demand among maize breeders from national agricultural research systems and small and medium enterprises, significantly reduces the cost and time needed for breeding.

2012 also saw MAIZE initiate a gender audit to find new avenues for increasing women's participation in maize value chains; the Research Program's gender strategy was approved by the Consortium.

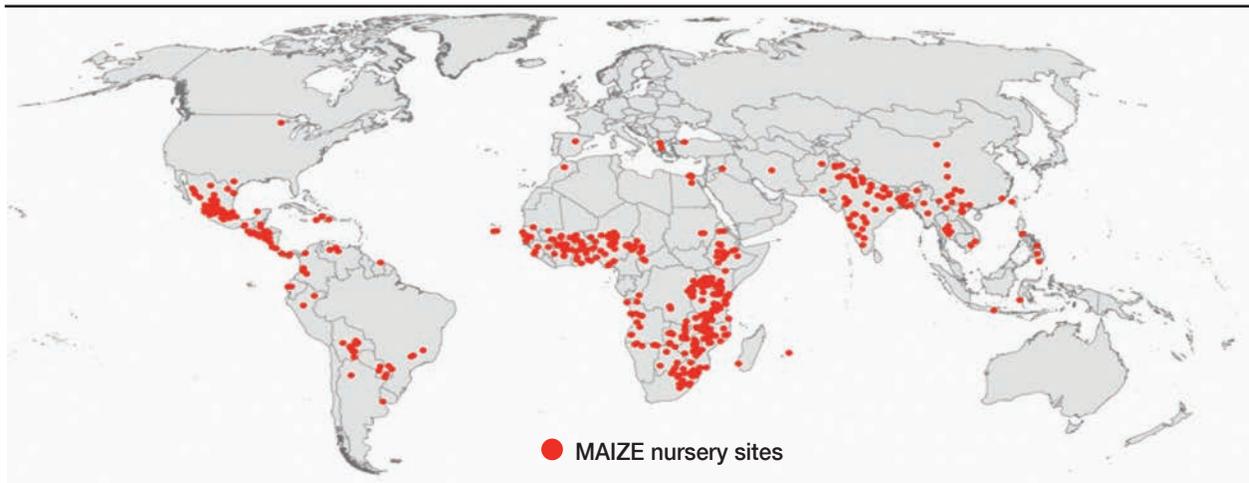
The success of Aflasafe™, a non-toxic and affordable solution to Aflatoxins, one of Africa's most serious food safety issues infecting maize both in the field and in storage, is one of IITA's innovative scientific solutions already improving nutrition and agricultural production in 2012.

Finally, MAIZE experts joined forces with the Royal Tropical Institute (KIT) in support of farming-systems focused innovation platforms helping researchers and local partners understand farmers' needs and realities from a 'systems' perspective. The goal? Better mechanisms for multi-stakeholder interaction to share beyond the MAIZE program.

Looking back, we feel that 2012 was a year to establish groundwork for success with new models of collaboration and more wide-spread and rapid seed distribution. More than ever, we are ready to make a difference in the lives of millions of resource-poor consumers for whom maize is the preferred staple.

  
Dave Watson

Our partners in germplasm exchange worldwide. The map shows collaborators in over 265 institutions and 55 countries, who demand new maize germplasm to test and adapt; benefiting both maize farmers and consumers.





# What we do

Launched in 2012, **MAIZE** is a CGIAR Research Program (CRP) led by **CIMMYT**. With **IITA** as its main CGIAR Consortium partner, **MAIZE** focuses on increasing maize production for the 900 million poor consumers for whom maize is a staple food in Africa, South Asia and Latin America. **MAIZE**'s overarching goal is to double maize productivity and increase incomes and livelihood opportunities from sustainable maize-based farming systems. It also builds up on the new cutting edge collaboration established internationally to unlock the black box of genetic diversity in maize through “**Seeds of Discovery**”, or on the continued success of further elevating the stress tolerance of maize in Africa, with similar efforts now becoming stronger in Asia and Latin America.

As part of the impact pathway on ‘Sustainable Intensification and income opportunities for the poor’, **MAIZE** is also establishing new models of collaboration for more wide-spread and rapid seed distribution and working closely with other CGIAR Research Programs such as **GRiSP** (The Global Rice Science Partnership), **WHEAT** and **CCAFS** (Climate Change, Agriculture and Food security), but also the Humid tropics, on the sustainable intensification of maize and cereal based systems in Africa, Mexico and South Asia. This area of work represents significant opportunities for empowering women farmers and collaborators too.

Most concerning for us is the emergence of a new highly virulent maize disease (**Maize lethal Necrotic Virus**) in eastern Africa that has wiped out maize production in parts of Kenya and is now emerging in Tanzania, Uganda and likely Rwanda. Contributing to impact pathway 2, ‘Maize varieties – stress tolerant, nutritious & safe’, work was initiated in alliance with the Kenya Agricultural Research Institute (**KARI**), other eastern African National Agricultural Research Systems (NARS) and seed companies to identify resistance sources in CIMMYT germplasm which rapidly need to get integrated into released varieties.

Finally **MAIZE** is also supporting research on **postharvest technologies**, aligned with impact

pathway 3, ‘Integrated post-harvest management’, which could have a significant impact on reducing poverty. It is already making postharvest technologies available for storage pests and aflatoxin, thereby helping to waste less and stabilize prices at farm level; not just producing more.

## Introducing 9 Strategic Initiatives

At the core of **MAIZE** strategy are nine inter-connected research agendas for the next 5-10 years, called **Strategic Initiatives**. They cover maize-based farming systems, drought-tolerant varieties, better targeting for new technologies, policies, postharvest management, precision agriculture and institutional innovations.

**Through MAIZE Strategic Initiatives**  
Nine 5-10 year Research Agenda

1. Socioeconomics and policies for maize futures
2. Sustainable intensification and income opportunities for the poor
3. Smallholder precision agriculture
4. Stress tolerant maize for the poorest
5. Towards doubling maize productivity
6. Integrated postharvest management
7. Nutritious maize (with CRP4)
8. Seeds of discovery – tackling the black box of genetic diversity
9. New tools and methods for NARS and SMEs

**Maize** - Global Alliance for Improving Food Security and the Livelihoods of the Resource poor in the Developing World

## Focus on partnerships

The program brings together over 300 researchers and development partners and distinguishes itself by allocating funds to non-CGIAR researchers, to fill **MAIZE** research gaps, and capture a wider range of innovative ideas, by launching a call for **competitive grants**. So far, the **MAIZE** Competitive Partner Grants initiative awarded thirty-seven grants to researchers in over 20 countries, with a first year budget of over US\$ 2.5 million. Grants were awarded for 1, 2 and 3-year research projects.

More on **MAIZE**



# Where we work

## West Africa

In West Africa, the Drought Tolerant Maize in Africa (DTMA) project studies the level and intensity of adoption of drought-tolerant maize varieties and constraints to further adoption



## South Asia

In Nepal, the Hill Maize Research Project (HMRP) supports community-based seed producers to produce/supply quality maize seeds at a competitive price



## Latin America

The International Maize Yield Consortium (IMIC) evaluates specific training needs of the maize seed sector



## Southern Africa

The Instituto de Investigaçao Agraria Mozambique (IIAM) is working on increasing sustainable agricultural production in Mozambique (maize/legume) through conservation agriculture



## East Africa

The University of Nairobi is breeding maize lines for resistance to aflatoxins and fumonisins in Eastern and Southern Africa



## Global

The Royal Tropical Institute (KIT) works closely with MAIZE to operationalize innovation system thinking for improved research impact

The six projects highlighted are representative of CIMMYT and IITA research directions and partnerships.

Click on each image to find out more about our work.



## Dealing with a deadly maize disease in eastern Africa

Reports of an unknown disease affecting maize crops in the South Rift region of Kenya appeared in September 2011. The disease was identified as maize lethal necrosis (MLN) after serological and molecular tests were carried out on infected maize plants from Bomet County and Nakuru District between February and March 2012 by a scientific team from the Kenya Agricultural Research Institute (KARI) and CIMMYT, in partnership with the US Department of Agriculture and Ohio State University. During 2012, the disease was also reported in the Central and Eastern Provinces as well as in some areas of Tanzania and Uganda. In August 2012, invited by the Government of Tanzania, CIMMYT surveyed the affected regions and identified the disease as MLN.

“Maize is Africa’s most important cereal crop, with more than 300 million of Africa’s most vulnerable people depending on it for their food security and livelihoods,” says B.M. Prasanna, Director of CIMMYT’s Global Maize Program. “The emergence of MLN in eastern Africa has dealt a big blow to farming communities and maize-based seed companies.” MLN infection rates and damage can be very high, seriously affecting yields and sometimes causing complete loss of the crop. Infected plants are frequently barren; ears may be small or deformed and set little or no seed. “There is no maize farmer in the whole of Nyakinywa area in Kaplamai division who has been spared by the disease, which

is a danger to food security,” said area chief Francis Morogo in April 2013 in an interview with the Daily Nation newspaper.

Control of MLN is complicated by the fact that it is caused by a combination of two viruses that are difficult to differentiate individually based on visual symptoms. Maize chlorotic mottle virus (MCMV) and sugarcane mosaic virus (SCMV) typically produce milder symptoms when they infect maize individually. In combination, however, these two viruses rapidly produce a synergistic reaction that seriously damages or kills infected plants. Maize plants are susceptible to MLN at all stages in their growth, from seedling to maturity. As with all viral diseases in plants, a vector is responsible for transmitting the viruses from plant to plant and field to field; MCMV is carried by thrips and beetles and SCMV by aphids.

A recent regional workshop on the MLN disease and its management was organized by CIMMYT and KARI in Nairobi. The workshop helped to establish strong collaboration between research and regulatory institutions in eastern Africa to effectively tackle the MLN challenge. “Robust multi-disciplinary and multi-institutional efforts are vital to effectively tackle the MLN challenge in eastern Africa,” Prasanna states. All stakeholders agreed that the foremost priority is to

identify and speed deployment of MLN-resistant maize varieties and emphasized the need to develop an action plan that could lead to accelerated development and deployment of MLN-resistant maize germplasm, with other relevant traits, in eastern Africa.

Studies undertaken jointly by CIMMYT and KARI over the past two years have confirmed the vulnerability of most pre-commercial and commercial maize germplasm to MLN under natural disease pressure as well as under artificial inoculation. More encouraging, however, was the identification of promising CIMMYT inbred lines and pre-commercial hybrids with resistance or moderate resistance to MLN, which offer considerable hope to combating the disease through breeding efforts.

Together, CIMMYT and KARI are now planning to establish a centralized MLN screening facility for eastern Africa at the KARI Livestock Research Farm in Naivasha to facilitate reliable screening of maize germplasm and deliver MLN-resistant varieties to replace existing susceptible cultivars as quickly as possible. “Besides accelerated development and delivery of elite MLN-resistant products to farmers, our aim is also to build the capacity of regional institutions for developing robust breeding pipelines to incorporate MLN-resistant germplasm, and ensure that farmers have access to such products at the earliest opportunity,” Prasanna adds.

Watch a video on [Maize Lethal Necrosis](#)

### Further reading:

Adams, I.P. et al (2012). Use of next-generation sequencing for the identification and characterization of Maize chlorotic mottle virus and Sugarcane mosaic virus causing maize lethal necrosis in Kenya. *Plant Pathology* 1365-3059.

Louie, R. (1980). Sugarcane mosaic virus in Kenya. *Plant Disease* 64:944-947

Niblett C.L. and C.E. Claflin (1978). Corn lethal necrosis – a new virus disease of corn in Kansas. *Plant Disease Reporter* 62: 15-19

Wangai, A. et al (2012). First report of maize chlorotic mottle virus and Maize lethal Necrosis in Kenya. *Plant Disease* 96: 1582.

### What are the typical symptoms?

- Mild to severe mottling on the leaves, usually starting from the base of young leaves in the whorl and extending upwards toward the leaf tips.
- Stunting and premature aging of the plants.
- Dying (known as “necrosis”) of the leaf margins that progresses to the mid-rib and eventually the entire leaf.
- Necrosis of young leaves in the whorl before expansion, leading to a symptom known as “dead heart” and eventually plant death.



“Robust multi-disciplinary and multi-institutional efforts are vital to tackle the MLN challenge in eastern Africa”

**B.M. Prasanna,**  
Director, CIMMYT Global Maize Program



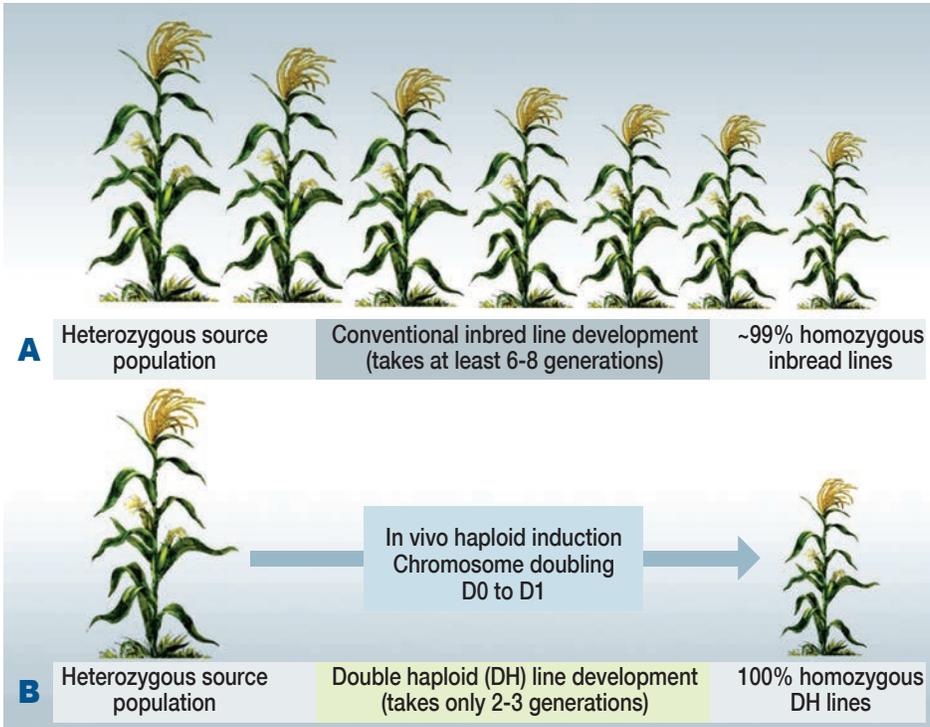
## Double-tech: New look for maize breeding

Use of doubled haploid (DH) technology, first developed over 50 years ago to produce homozygous (identical) maize plants has, in the last 10-15 years, gained momentum in the maize breeding programs of multinational seed companies. Such popularity is justified, with the technology reducing the time required to develop completely homozygous inbred lines (the building blocks of hybrids), simplifying the logistics and enhancing the genetic gain in breeding programs. But in Latin America, Africa and Asia, public programs and small and medium-scale seed companies have lagged behind, lacking knowledge of the technology and having limited access to 'inducer' plants (the starting point for the DH breeding process), adapted to tropical/sub-tropical conditions.

To address this situation, CIMMYT is introducing tropical inducer lines to share with interested institutions in developing countries. So far seven organizations have acquired CIMMYT inducer lines, including three companies in Latin America that are adapting the technology. CIMMYT has also been assisting the Vietnamese National Maize Research Institute (NMRI) in expanding its technical capacity to use the DH technology. Three NMRI scientists were trained at CIMMYT-HQ from January to May 2012, followed by a four-day training course for 60 NMRI breeders/scientists during 10-12 September 2012, led by CIMMYT scientists Vijay Chaikam and Dan Jeffers.

"To assist more organizations to take up the technology, CIMMYT has also produced a manual covering the technical details of DH line production," says Chaikam, a CIMMYT scientist working with the DH technology. "The Center is also establishing centralized DH line production facilities and offering services to interested partners. One such production facility in Mexico, for example, is now available to Latin American maize breeders. IITA scientists have also sent some of their materials to CIMMYT for the generation of inbred lines using the double haploid method. "I can see the DH method as having a big potential in our program for the development of early and extra-early inbred lines," explains IITA's maize breeder Baffour Badu-Apraku.

With financial support from the Bill & Melinda Gates Foundation, CIMMYT will soon be establishing a centralized maize DH facility for sub-Saharan Africa, in collaboration with the University of Hohenheim, Germany. The DH facility will also serve as a training hub for scientists and technical personnel from national programs and small and medium-sized seed companies that may not have advanced breeding facilities. It will enhance CIMMYT's capacity to generate DH lines for effective use in Africa based breeding programs such as the Drought Tolerant Maize for Africa (DTMA), Water Efficient Maize for Africa (WEMA), Improved Maize for African Soils (IMAS), and the Maize HarvestPlus Program in Africa. A similar facility is also planned for India, to address the demand for DH lines in Asia.



Double haploid: the number 1 technology demanded by National Agricultural Research Systems (NARS) and Small and medium Enterprises (SMES).

More on [Tropicalized maize haploid inducer lines](#)

Watch a video on **Doubled Haploids: A simple method to improve efficiency of maize breeding**

A scientific explanation of the Doubled Haploid (DH) technique, including a step by step guide for the creation of a DH line. The video also describes the necessary attributes for a successful DH program in public or private institutions. A joint production of the International Maize and Wheat Improvement Center (CIMMYT) and the University of Hohenheim.

“In sub-Saharan Africa, increasing droughts and excessive heat are likely to mean that within about 20 years the staple crop maize will no longer thrive in about 40% of current farmland.”

Turn Down The Heat: Climate Extremes, Regional Impacts and the Case for Resilience  
 Report prepared for the World Bank by the Potsdam Institute for Climate Impact Research and Climate Analytics



## Appraising innovation systems

“Innovation emerges from interaction,” says Mariana Wongtschowski of the Royal Tropical Institute (KIT), “and while researchers may play a role, their role isn’t necessarily the most important one.” Between August and November 2012, Wongtschowski led a joint MAIZE/KIT research project on making use of innovation platforms to strengthen collaboration within MAIZE, by jointly coaching and supporting researchers and local partners to understand farmers’ needs and realities from a ‘systems’ perspective. As a result, a number of candidate projects were selected which will support the use of innovation platforms to shape and implement research agendas in 2013 and beyond.

‘Innovation platform in MAIZE projects’ is a forum for stakeholders along the value chain, from farmers and extension agents to private sector, seed companies and government officers. Innovation platforms are a means to achieve multiple stakeholder engagement over complex issues. They are particularly useful in agricultural development. Agricultural issues tend to be complex, involving many different biophysical, socioeconomic and political factors and concerning various formal and informal institutions. By bringing together stakeholders from different sectors and levels, innovation platforms can be highly effective at both identifying and addressing these issues.

### Systems analysis

The four-month research exercise focussed on how stakeholder collaboration takes place within a number of MAIZE projects, and where it could be improved.

“We aim to look beyond the role of the researchers to understand how markets, policy, community dynamics and other local actors influence farmers’ livelihoods,” Wongtschowski explained at the project outset. “From there, mechanisms for multi-stakeholder interaction will be designed and implemented or strengthened; then the whole process will be documented and shared within and beyond the MAIZE Program.”

KIT reviewed 11 projects that fit under the umbrella of MAIZE. This included a desk review of project documentation, an interview of project managers from nine of these projects, and two intensive field visits. KIT particularly observed how scientists and other stakeholders interact within each of these projects. To what extent are farmers, traders, NGOs and other stakeholders part and parcel of decision-making about what the project focuses on? How do they use the information generated by the project on the ground, and then provide feedback to researchers?

### Enabling innovation?

For many projects, innovation platforms are intended to support collaborative decision-making. However, MAIZE was concerned that these were not always being put to optimal use to adequately influence the research agenda. Jens Andersson, an innovation systems scientist based in Zimbabwe, is aware of the issues. “At CIMMYT, we look at innovation platforms as a means to reach impact at scale, or as a vehicle for technology transfer,” he says.

Simply creating an innovation platform is not enough to achieve effective collaboration and stakeholder input. “We have to be very wary of those who talk very little,” warns Andersson, alluding to the often silent majority of women at farmer meetings.

## Challenging but essential

Bruno Gerard, director of the Global Conservation Agriculture Program (GCAP), points out other challenges facing innovation platforms and systems, which he says are often resource intensive and difficult to scale out and up due to their context-specificity. But, he adds, “They are critical for better understanding of social processes within farming systems and for putting technical innovations in context, as they can provide important missing knowledge for researchers, farmers and other actors, including the private sector, in a co-learning fashion.”

One question that often arises during discussions on agricultural innovation platforms is whether it should be the researcher’s role to facilitate an innovation platform, or whether this should be carried out by another actor, such as a farmers’ organization. “As researchers we have to be careful to intervene more as a catalyst and honest broker and not to be too central, in order to achieve positive, long-term changes,” says Gerard. “We have to think of a good exit strategy from the beginning.”

## Joint learning

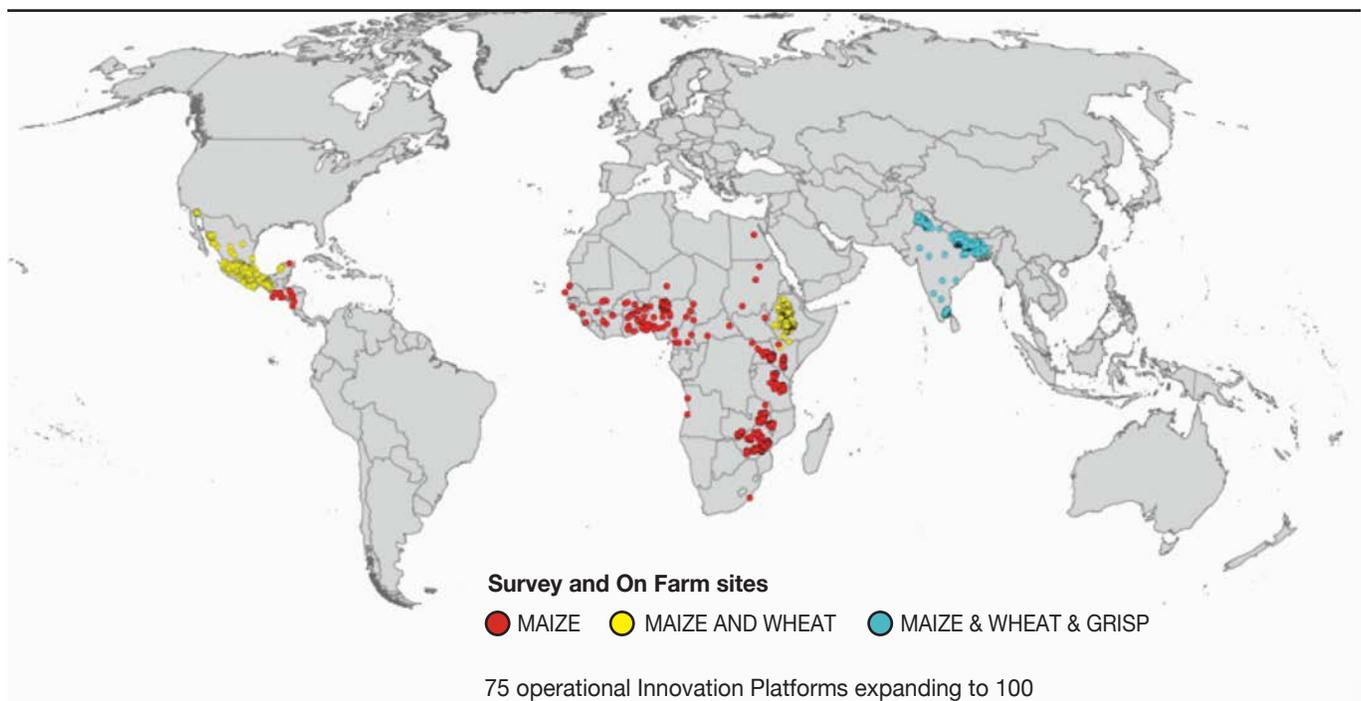
The results from the KIT review have now been used to select a number of candidate projects as pilots. By June 2013 these pilots will be in full swing and will support the use of innovation platforms to collectively shape the research agenda and to implement such an agenda together with other stakeholders. Less teaching and more joint learning will be key. “Ultimately, it is how this interactive learning is applied to meaningfully craft and apply solutions to the identified challenges that include equitable access to knowledge, inputs, markets, capital, and equipment,” adds Michael Misiko, CIMMYT innovation specialist. Currently the team is working with three projects, to document lessons for the scientific community and practitioners. The two innovation specialists (Andersson and Misiko) joined the MAIZE team in November 2012 to further support these efforts.

### More on agricultural innovation:

Gildemacher, P. and R. Mur. 2013. [Bringing new ideas into practice; experiments with agricultural innovation. Learning from research Into Use in Africa. Overview.](#) Overview. KIT Publishers, Amsterdam

Watch a video on [agricultural innovations systems](#)

### Innovation platforms: worldwide





## Conservation agriculture: Coping with water scarcity

Maize farmers in Malawi's Balaka District lost at least one third of their harvests in the 2011/2012 cropping season to late, erratic or severely reduced rainfall which led to a devastating drought. Among those who escaped hunger were 400 farmers and their families who had adopted conservation agriculture. "I'm harvesting between 30 and 40 bags of maize now per acre, where I used to get only 15 or 20 bags," says farmer Daimoniz Miondo. "Before conservation agriculture, there was a lot of erosion and the rain would wash away the fertilizer and affect the yields."

### Saving harvests

Conservation agriculture is a set of basic principles that includes eliminating the traditional ridge-and-furrow tillage systems, keeping crop residues on the soil, and rotating or intercropping maize with other, mainly leguminous, crops. The approach is designed to improve soil structure and fertility, increase infiltration and water retention, and reduce labor, erosion and greenhouse gas emissions. CIMMYT cropping systems agronomist in southern Africa, Christian Thierfelder, explains that for small scale farmers who rely on rainfed agriculture, the benefits of conservation agriculture are dramatic during dry spells: "residues retained as surface mulch, root holes and earthworms catch and channel falling rain and impede evaporation." In 2012, maize in conventionally-managed plots wilted in

the drought but in fields managed using conservation agriculture, there was no problem.

In the 2006/2007 cropping season, CIMMYT began work with six farmers at Lemu near the Balaka Township in southern Malawi, to study, test, and promote conservation agriculture. "A key strategy has been to establish demonstration and validation plots run by farmers in their fields, with backstopping from extension, research and NGO partners," says Thierfelder. "We provide the farmers with seed, fertilizer, and herbicide, which they pay back to a community project or fund at harvest time. For farmers, the test plots are successful examples of conservation agriculture and serve as learning centers. We group them strategically for use as on-farm trials to evaluate the performance of conservation agriculture across years. This is particularly important as conservation agriculture is a longer term investment for farmers - the real benefits become significant only after 3-5 years." By the 2011/2012 crop season, nearly one fifth of the area's 2,200 farmers had adopted conservation agriculture practices.

Although there is a lot of documented evidence on the benefits of conservation agriculture, there are still challenges to overcome, including limited access to fertilizers and herbicides or the tradition and mindset of using the plow, but extension efforts, research, messaging for conservation agriculture, and

demonstration and validation plots have been paying off. Uptake in areas where the regional NGO Total LandCare (TLC) partnered with CIMMYT has been greater. TLC not only extended the principles and practices of conservation agriculture to farmers in target communities but also established a soft loan scheme for farmers to access critical inputs such as improved seed and herbicides. TLC's Zonal Manager John Chisui explains that the negative effects of climate change are also playing a role in farmers' acceptance of the new cropping system: "People can see that under conservation agriculture, the crop will do much better and can withstand seasonal dry-spells, compared to conventional approaches."

### **Saving labor**

In Malawi, draft animals are scarce and traditional cultivation for maize involves as many as 160,000 hoe strokes per hectare. Farmers who use the traditional ridge and furrow systems for land preparation, which involves hard manual labor of approximately 20-25 days to create the ridges per hectare, can now plant the crops directly into the soil by just using a pointed stick to make a hole for fertilizer and seed under conservation agriculture. If herbicides are used for weed control it saves the farmers another 10-15 labor days. This extra labor can effectively be used to add value to farm products, move to more labor intensive higher value crops, expand the cultivated land area, sell farm produce in the market, take up off-farm labor or go fishing, which is common along the lake shore. "I cannot stop practicing conservation agriculture, because I'm getting lots of benefits," farmer Belita Maleko from Mwansambo in Nkhonkhotakota District says. "I have enough time to grow other crops. I've built another house with the proceeds. I'm a happy woman."

CIMMYT started this work with TLC in 2005 with 12 farmers around Nkhonkhotakota District and has now expanded to other districts reaching out to more than 30,000 farmers. These successful results, in line with CIMMYT's aim to sustainably intensify current farming systems, are a result of effective synergies between organizations with a common interest. The involvement and facilitation of input and output markets and finally the commitment by farmers and extension officers

to change from degrading labor intensive systems to more sustainable conservation agriculture systems also made a great difference to smallholder farmers in Malawi. "We realize this is a complex technology with many challenges to overcome," Thierfelder explains. "Achieving widespread adoption may take considerable time and effort, but 'difficult' is not a good excuse for not getting started."

*“Conservation agriculture should create a win-win-win situation: provide more food for farmers, reverse environmental degradation, and arrest climate change for future generations.”*

**S. Mkomwa,**

Executive Secretary, African Conservation Tillage network (ACT)

#### **Further reading:**

Erenstein, O., K. Sayre, P. Wall, J. Hellin, and J. Dixon (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(92): 180-206

Ngwira, A.R., C. Thierfelder, and D.M. Lambert (2012). Conservation agriculture systems for Malawian smallholder farmers: long term effects on crop productivity, profitability and soil quality. *Renewable Agriculture and Food Systems*, 1-14.

Sims B.G., C. Thierfelder, J. Kienzle, T. Friedrich, and A. Kassam (2012). Development of the conservation agriculture equipment industry in sub-Saharan Africa. *Applied Engineering in Agriculture* 28 (6): 1-11.



# Integrating gender into WHEAT and MAIZE CRPs: A leap forward

The 16 CGIAR Research Programs (CRPs) are developing strategies to integrate gender into research. Among the first CRPs to undertake a gender audit of their activities, WHEAT and MAIZE organized a workshop on implementing the gender audits on 10-11 December 2012, facilitated by gender specialists Chris Hunter and Katrine Danielsen, both from the Royal Tropical Institute (KIT), a MAIZE and WHEAT CRP research partner based in Amsterdam, the Netherlands.

“A gender audit is an assessment by which organizations can identify how they are addressing gender within their research programs and organization. It implies that the organization will assess their performance against some standards,” explains Chris Hunter, Senior Advisor on Social Development and Gender Equity. “Many organizations, including CIMMYT, don’t currently have a gender policy. The gender audit assesses performance against best practice, meaning that what we are doing should be positive towards both men and women.”

Challenges of gender mainstreaming were first discussed at the Fourth World Conference on Women in Beijing in 1995. During this conference it was recognised that just having a few add ons for women did not work. “In a subsequent conference (Beijing +5), it became clear that it still wasn’t always working, so gender audits were, in part, a response to that,” says Hunter. “It is about what have we been doing and identifying where we are getting stuck.”

## How is a gender audit conducted?

A gender audit usually comprises surveys and focus group discussions involving organizations, partners, and those who are ‘watching what the organization does’. For MAIZE and WHEAT, it should provide a baseline for assessing progress on integrating gender into the CRPs and help prioritize activities.

“We really want to collaborate closely with CIMMYT, ICARDA, and IITA to institutionalize gender awareness within the CRPs and to support the empowerment of women farmers and those working along maize and wheat value-chains,” emphasizes Dave Watson, MAIZE CRP manager. “Interventions can reinforce or alter gender relations. At the moment, by ignoring gender realities, we could do harm and get poor results,” he adds. “The ultimate goal is to make our research programs more gender transformative and address both the causes and consequences of gender inequalities, following KIT’s findings.”

Addressing gender inequality can be arduous and require great resourcefulness. “One of the areas that Chris and Katrine emphasized in our inception meeting for the gender audit is that getting to gender equality in development outcomes means that we must consider things like participatory decision-making and transparency in project design, in addition to what it might take to see gender-equal uptake of our research

products,” remarks Jenny Nelson, workshop participant and program manager of the Global Wheat Program. “This is an important, maybe even revolutionary change in the way agriculture-for-development has worked.”

Hunter and Danielsen will now assess how gender is currently addressed in projects across the CRPs and how it can be strengthened. The gender audit will take place between January and May 2013 and will include assessments of gender knowledge, attitudes and awareness of research staff and managers of the lead centers and key partners. This will lead to a detailed gender action plan.

#### Further reading:

The Gender in Agriculture Sourcebook, (World Bank, FAO, IFAD), 2009

The state of food and agriculture 2010-2011 (FAO), Women in agriculture: closing the gender gap for development

CGIAR Gender and Agriculture Research Network, Addressing the gender gap in agriculture: opportunities for collaboration in gender-responsive research, 2012

“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%. According to FAO, this alone would raise total agricultural output in developing countries by 2.5-4%, which, in turn, could reduce the number of hungry people in the world by 12-17% or 100-150 million people.”

#### Amare Tegbaru: Transforming the power relations between men and women

In my work, I push for the transformation of gender relations, as efficiency and managerial approaches cannot transform the power relations between women and men. A gender transformative approach is a complex social phenomenon based on people’s interests, motivations, relationships, and innovative actions that are embedded in their historical and cultural situations.

My work has always been at the community level. I try to work bottom up and produce evidence of how agriculture research for development and commitment to gender concerns can successfully reduce poverty in the sector. I am also hopeful that evidence produced at grass root level following respectful approaches involving women and men on their own terms, will influence policy makers at all levels to support gender equality.

*Amare Tegbaru is IITA gender specialist*



A farmer at work weeding in a maize field in the Indian state of Bihar.



## Innovative agricultural technologies for sustainable intensification

The need for sustainable intensification in sub-Saharan Africa (SSA) is widely recognized, but farm power is a forgotten resource: tractor hire schemes have collapsed and the number of draft animals is declining. The consequence is high labor drudgery, which disproportionately affects women. “Sustainable intensification in SSA will require improved access to mechanization and/or energy saving technologies such as conservation agriculture (CA),” explains Frédéric Baudron, CIMMYT Cropping System Agronomist.

With the support of the Australian International Food Security Centre (ACIAR), the Farm Mechanization & Conservation Agriculture for Sustainable Intensification (FACASI) project will begin in 2013 in Kenya and Tanzania, implemented by CIMMYT and its national partners. The aim is to identify appropriate technologies based on 2-wheel tractors (2WT) and test innovative partnerships with agribusinesses to deliver these technologies to smallholders. The project is expected to reduce labor drudgery - which is mainly placed on women, increase maize and wheat productivity, and create rural employment.

MAIZE will contribute to and benefit from this project, and lessons learned will be shared with IITA and ICARDA. In addition to generating a large body of knowledge and establishing strong linkages amongst stakeholders, it is anticipated that over 360 rural service providers will

emerge, 9,900 farms will benefit from 2WT-based CA, while over 25,000 farms will benefit from 2WT-based transport, threshing and shelling. “The adoption of 2WT-based technologies will alter rural-urban migration trends thanks to the creation of new livelihood opportunities in rural areas and the transformation of farming into a profitable, drudgery-free and attractive sector for the youth,” adds Baudron.



Identifying appropriate technologies based on 2-wheel tractors (2WT)

Airborne remote sensing is another innovative technology that is supporting precision agriculture, providing an efficient method for the rapid collection of data over a specified area. Consisting of a multispectral and a thermal camera, software and methods allowing for semi-automated image processing, the potential of this technology is enormous: using the multispectral camera in an airplane as a ‘flying GreenSeeker’ could enable researchers to diagnose nitrogen needs to optimize yields for 1,000 hectares in an hour.

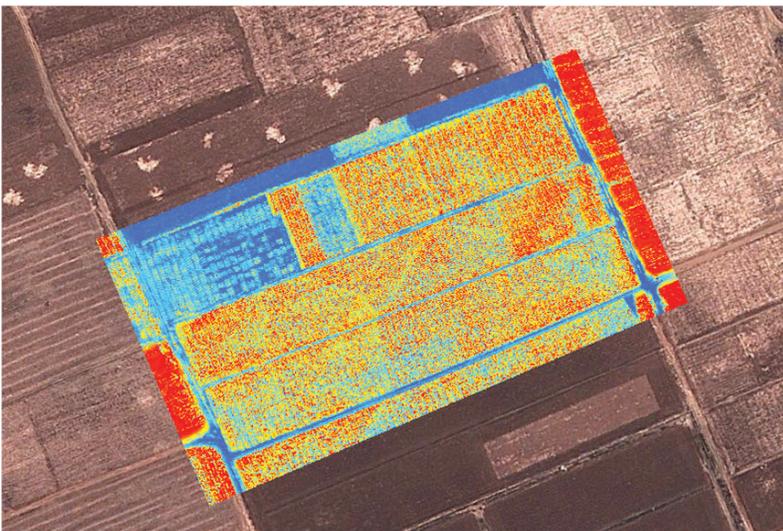
In Mexico, the equipment is being used by MasAgro to measure the impact of tillage on crop water use efficiency and enable CIMMYT to develop a diagnostic tool to help farmers determine the right time to irrigate wheat in Yaqui Valley. Weekly measurements of CIMMYT’s Obregón research station, in Mexico, will further research conducted on crop stress indicators and the identification of successful remote sensing indices. In the future, the measurements could be used for phenotyping, plant disease assessment and agronomic research. And when combined with a viable business model and ICTs, the measurements could potentially provide an efficient decision support tool for farmers.

Elsewhere, work to improve phenotyping tools for maize product development has brought together researchers from the University of Barcelona, Zimbabwe’s Crop Breeding Institute, the Instituto Nacional de Innovación Agraria in Peru and AirElectronics in Spain, to develop a novel affordable field based phenotyping

platform under a MAIZE grant. “MAIZE is facilitating the development of cutting edge technologies within vulnerable regions to facilitate national capacity for adapting maize systems to climate change,” explains Jill Cairns, CIMMYT Maize Physiologist. “Yield gaps within Southern Africa are high and are likely to increase under climate change. There is an urgent need to develop long term, national capacity to adapt maize systems to climate change.”

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’ 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.

More on [Airborne remote sensing](#)



“Sky Walker” advances phenotyping in Southern Africa



## SeeD: Unlocking genetic potential

Latin American maize landraces are globally the most important maize genetic resources. Mesoamerica (southern Mexico and Guatemala) is where maize ancestors evolved and were domesticated approximately 10,000 years ago, before spreading to North and South America along ancient trade networks. So it is no surprise that the most important collections of maize landraces and wild relatives are held by the genebanks of Mexico, including over 27,000 accessions of landraces and 388 wild-relative accessions in CIMMYT's international genebank. Together they represent the broadest reserve of genetic variability of maize worldwide. And yet while genebanks have made valuable steps towards collecting and preserving maize accessions, to date only a minute portion of the vast diversity in these collections has been put to practical use in modern crop breeding.

Recent advancements in DNA-sequencing and phenotyping technologies have created a timely opportunity to cost-effectively unlock the value of these collections for the benefit of farmers by assisting breeders to develop better cultivars more quickly. The Seeds of Discovery (SeeD) project aims to genetically profile entire genebanks and make the resulting information (molecular and phenotypic descriptors) freely available to breeders, agronomists, and agricultural researchers worldwide. By combining the power of next-generation sequencing platforms, field trials and GIS based tools, maize (as well as wheat) germplasm collections will be mined for novel

alleles controlling adaptive traits and yield potential. Information about phenotypic and allelic diversity in ancestral varieties can be leveraged in marker assisted pre-breeding to mobilize those useful alleles into breeding programs.

"SeeD is about 'letting the genie out of the genebank bottle'," explains Peter Wenzl, SeeD Project Lead. "We are mobilizing novel, useful genetic variation into breeding programs to accelerate progress towards higher-yielding, climate-ready cultivars. MAIZE provides the knowledge framework enabling better targeting of our research considering end user needs and adoption processes." In 2011 SeeD reported on the creation, phenotyping and genotyping of one of the world's largest population for genome-wide association studies, a process to help identify genes and gene combinations of importance (such as heat tolerance) which can be then tracked to help combine the best genes together through breeding to create climate ready varieties. In 2012, the phenotyping of these materials with many Mexican collaborators continued, and the first exciting analysis results started to emerge. SeeD also initiated computer simulations to identify the best approaches to select and recombine these materials, and developed and validated a new approach to characterize maize populations using cutting edge DNA sequencing approaches.

Visit the [SeeD of Discovery website](#)



## Tackling the toxins with aflasafe™

“All the maize for my home consumption comes from my aflasafe™-treated field,” says farmer Alhaji Al-Hassan from Nigeria’s Kaduna State. “When I take my maize to the market, buyers rush for it because the quality looks better. The grains look clean.”

First developed by the United States Department of Agriculture and adapted for use in Nigeria by the International Institute for Tropical Agriculture (IITA) and the African Agriculture Technology Foundation (AATF), aflasafe™ is fast gaining ground across Africa as a non-toxic and affordable solution to one of the continent’s most serious food safety issues.

Aflatoxins are invisible, tasteless poisons produced by *Aspergillus flavus*, a mould commonly found infecting crops such as maize and groundnut, both in the field and in storage. While acute exposure to aflatoxins can kill, prolonged exposure leads to impeded growth, liver disease, immune suppression and cancer, with women, children and the poor most vulnerable. Aflatoxins also impact on international trade, with African economies losing US\$450 million every year from barred exports.

### Competitive exclusion

Aflasafe™ works by ‘pushing out’ harmful, toxin-producing strains of *A. flavus* from the field through the deliberate introduction of indigenous but non-toxic, harmless strains - a process known as ‘competitive exclusion’. Heat-killed sorghum grains are coated with the non-toxic fungal strains and scattered by hand in

the field prior to crop flowering. Field tests in Nigeria between 2009 and 2012 showed that use of aflasafe™ consistently reduced aflatoxin contamination in maize and groundnut crops by 80-90%.

In 2012, these findings led to the adoption of the biocontrol product by several extension agencies in Nigeria. IITA is currently constructing a low-cost manufacturing facility at its Ibadan campus in order to optimize the production process for aflasafe™ so that it can be taken up by other developing countries. The facility, which will be able to produce up to 5 tons of aflasafe™ per hour, will also test commercialization models. Market linkages between aflasafe™ users and quality conscious food processors are also being developed, in collaboration with the private sector. With aflatoxin-contaminated maize in poultry feed a major risk to animal health, links are also being developed with poultry producers.

### Spreading the science

The success of aflasafe™ has led to an expansion in biocontrol research in Burkina Faso, Ghana, Kenya, Mali, Senegal, Tanzania and Zambia. In Kenya, IITA has identified four non-toxic strains of *A. flavus* in locally grown maize, which are now being used to make a Kenya-specific product called aflasafe™-KE01. Researchers from the Institute are currently gathering efficacy data to determine where the product will be deployed. “We are happy with the innovative scientific solution which has done well in Nigeria,” says Dr Wilson



Songa, Kenya's agriculture secretary. "The ball is now in our court, and we shall move fast...We needed the technology yesterday!"

Senegal is also developing its own version - aflasafe™-SE01, and IITA is optimistic that both Kenya and Senegal will have their own fully registered versions of aflasafe™ in two years, with Burkina Faso reaching the same point in three years and Zambia in four. Meanwhile, at the 2012 G20 meeting in Mexico, G20 leaders announced that aflasafe™ will be one of three initial pilot projects to be supported under the 'AgResults' initiative, which aims to incentivize the adoption of agricultural technologies by the poor.

### Affordable technology

IITA's experience in Nigeria suggests that the cost of aflasafe™ - at US\$1.5 per kg, with a recommended usage of 10 kg per hectare - is affordable for most farmers in the country. The Institute calculates that adoption of biocontrol with other management practices will reduce aflatoxin contamination by more than 70% in maize and groundnut and increase crop value by at least 25%, as well as improving the health of women and children.

With mass production and commercialization of the technology now imminent in Nigeria, the country's Minister of Agriculture and Rural Development, Hon. Akinwumi Adesina, has been enthusiastic in his support. "For too many years we have neglected to regulate aflatoxin in the production of food," Adesina says. "IITA has worked tirelessly to control aflatoxin and educate farmers on the harmful effects of this toxin. When we consider the potential benefits of aflasafe™, it is ultimately smallholders who stand to gain the most," he concludes.

Watch videos on aflatoxins and bio control product Aflasafe™

[Making African Food Crops Safer](#)

[Making Biocontrol Options More Accessible to African Farmers](#)

*“The challenge of food security in sub-Saharan Africa is formidable, the timeframe for action is tight and the investment required is substantial. But the potential gains for human development are immense.”*

Africa Human Development Report 2012: Towards a Food Secure Future,  
United Nations Development Programme



## Seed chain – From lab to field

**In Mexico, like most developing countries, only a small proportion of fields are planted with high quality seed. More than three-quarters of maize grown in the country, for example, is traditional varieties which, despite having the advantages of being tough and suitable to local conditions, only produce relatively small harvests. And with climate change, many once perfectly-adapted traditional varieties are now struggling.**

How, then, to reach small farmers with improved, locally adapted seed that can withstand the rigours of poor soils, rainfed cultivation and adverse weather? Sophisticated maize hybrids produced by transnational seed companies give unbeatable performance on irrigated land with appropriate inputs, but struggle in more typical Mexican farming conditions. But small and medium-sized seed companies offer a solution, a way to connect the latest in advanced crop breeding with the realities of smallholder maize production.

Maria Esther Rivas is director general of a small seed company, Bidasem, based in the central Mexican plains region known as the Bajío. Each year her company produces around 10,000 bags of maize seed, each holding 22.5 kg. The company's four maize hybrids have all been developed from freely-available CIMMYT parent lines.

"Our materials may not be very pretty, they're not as uniform as others, but they're really tough. They

withstand drought well, and when excessive rains are a problem they stay on their feet and can give a good yield," says Rivas, a striking, elegant woman who as a child spent hours with her agronomist father talking to farmers and understanding their seed needs. "Producing our own hybrids wouldn't be possible if we didn't have the germplasm from CIMMYT," she says. "Without CIMMYT, we wouldn't exist."

The relationship between Bidasem and CIMMYT is now deepening through their participation in Mexico's Sustainable Modernization of Traditional Agriculture (MasAgro) initiative, launched in 2011 to help smallholders raise and stabilise their crop yields and cope with climate change. The initiative is a partnership between the Mexican government, CIMMYT and numerous public, private and farmer organisations. Seed companies and research organisations have been invited to enter hybrids in regional field trials under rainfed conditions and in different locations.

"Bidasem and other seed companies are incredibly important partners for me," says Marc Rojas, one of MasAgro's coordinators. "One of our aims is to make that bridge [between crop breeders and farmers] much more efficient and get products out into farmers' fields as quickly as possible. Our vision is for seed companies and research organisations to work together as one team."



Rivas and her production manager have attended three MasAgro training courses between them – two on seed production and one on seed company administration. “Having MasAgro and CIMMYT gives me a lot of strength, a lot of confidence in moving forward. I think we’ll advance much more rapidly,” she says. Her main concerns in doing so are the challenges of water stress and high temperatures. But working in partnership she feels confident that she will be able to meet the challenge and provide a link in the chain that brings the best possible seed from laboratory and trial plot to the fields of central Mexico.

More on [MasAgro](#)



Quality control produces clean maize seed

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.



## Defying drought for more productive maize

Across sub-Saharan Africa, an estimated 2 million smallholder farmers are using Drought Tolerant Maize for Africa (DTMA) varieties to improve their yields, food security and income. “This maize is like an insurance against hunger and total crop failure, even under hot, dry conditions like those of recent years,” says 79-year-old Rashid Said Mpinga, a farmer in Morogoro, Tanzania, who has been growing maize for almost half a century. “Without good quality maize seed, you cannot earn enough; you cannot have life.”

Jointly implemented by CIMMYT and IITA in collaboration with National Agricultural Research Systems, the DTMA initiative has been responsible for the development and dissemination of more than 100 new drought-tolerant maize varieties to farmers in 13 project countries - Angola, Benin, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Nigeria, Tanzania, Uganda, Zambia, and Zimbabwe - between 2007 and 2012. The project uses conventional breeding, where plants with good drought tolerance characteristics are cross-bred to produce varieties which are productive, nutritious and grow well in African conditions. In particular, the DTMA varieties provide farmers with better yields than leading commercial varieties under moderate drought conditions, while giving outstanding harvests when rains are good.

In 2012, a total of 4,387 early generation and 1,000 advanced maize inbred lines with varying maturity, derived from diverse sources, were planted for evaluation'

at two locations. Inbred lines with desirable agronomic and stress tolerance traits will be selected from the 4,387 early generation lines for further inbreeding in 2013.

Several inbred lines among these were also screened under controlled drought stress in 2012 and promising lines were selected for testing in hybrid combinations. Drought tolerant inbred lines with adaptive traits have been used to develop 700 new hybrids, which were split into 14 separate trials and evaluated under controlled drought stress, along with commercial hybrid checks, at Ikenne, Nigeria, in 2012. These trials sustained yield reductions of 65-81% due to drought stress.

Among the 700 hybrids, 114 produced grain yields varying from 2-3.5 metric tons (MT) per ha, whereas the commercial hybrid checks produced grain yields varying from 0.9-1.9 MT per ha. The selected best hybrids will be tested in advanced hybrid trials (Stage 2) in multiple locations and under drought stress in 2013.

“We have now accumulated substantial amounts of knowledge; we have outstanding maize varieties and significant quantities of seed,” says Tsedek Abate, CIMMYT scientist and leader of the DTMA project. “We see great opportunities for scaling up the available technologies.”

More on [DTMA](#)  
Watch also a [video on DTMA](#)



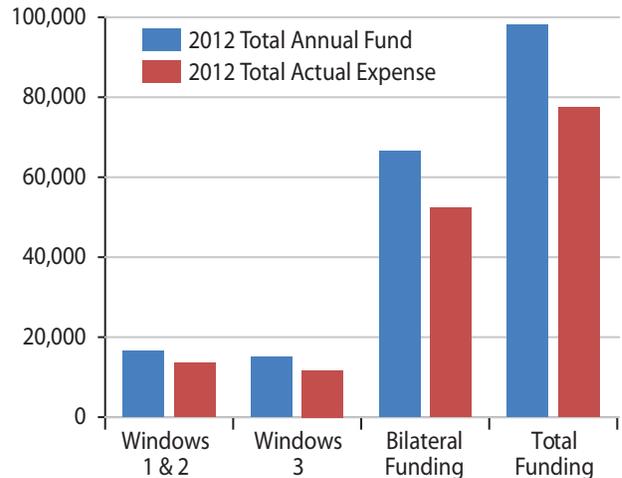
# MAIZE 2012 Financial highlights

## MAIZE budget (2012-2014)

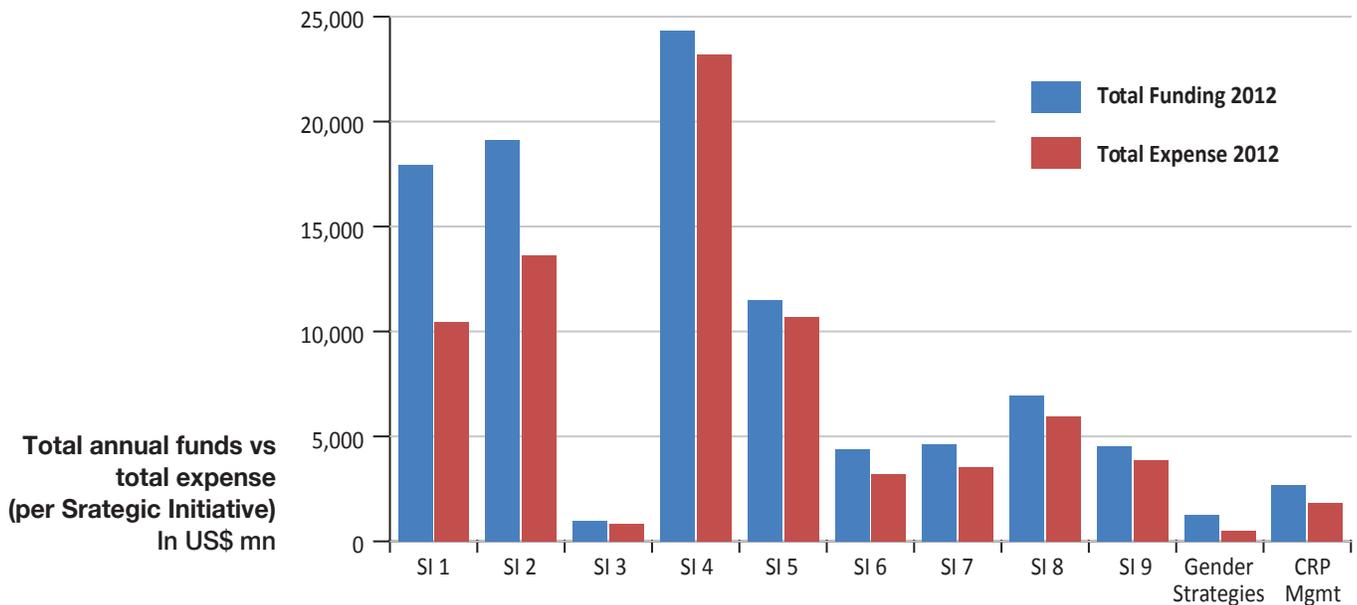
The whole-of life total budget or cumulative budget per financial plans for MAIZE (all sources of funding) is US\$235,829mn and the total cumulative expenditure at the end of 2012 is US\$102,910mn leaving an available balance of US\$ 132,919mn for the next remaining years (budget figure as per Program Implementation Agreement – PIA).

## MAIZE expenditure (2012)

The majority of Windows 1 & 2 budget was spent in 2012. Please note that commitments to partners are not yet accounted in this report. The discrepancy is due to the fact that a wide range of projects based on other funding sources (bilateral/Window 3) do not follow a calendar year based cycle.

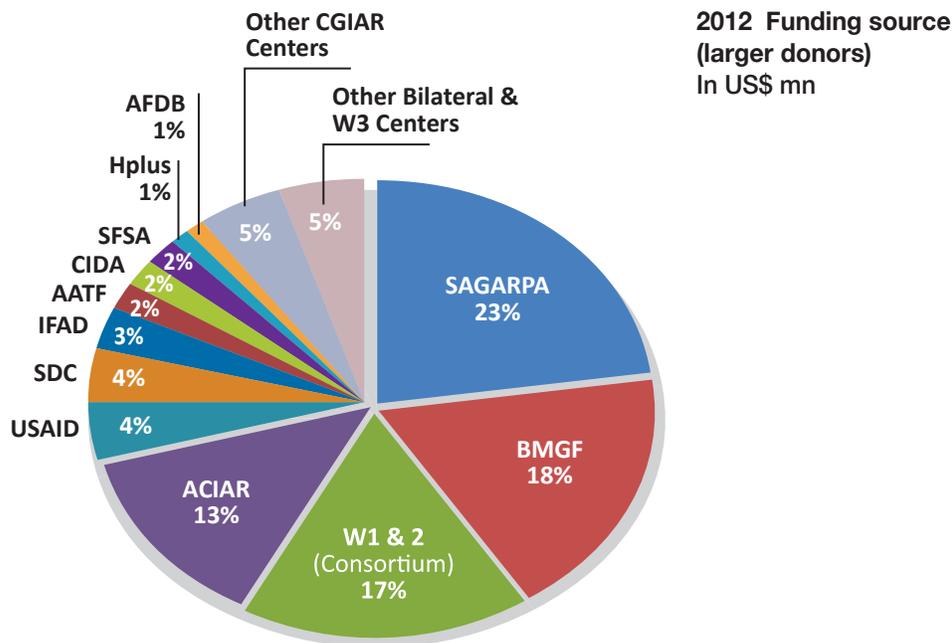
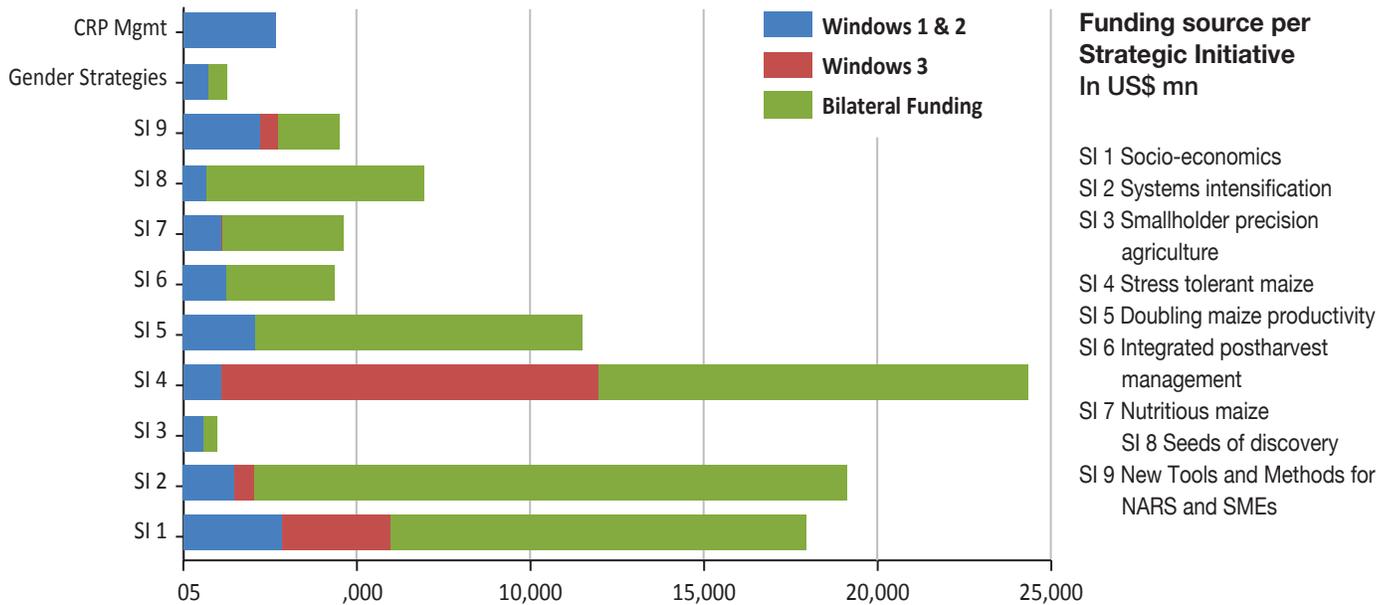


2012 financial plan vs. expenditure by funding source  
In US\$ mn



## Funding source per Strategic Initiative (2012)

This graph shows the budget distribution per Strategic Initiative (all sources of funding). Strategic Initiatives 1, 5 and 9 account for 43% of the total W1 and 2 budget.





## Acronyms

AATF	African Agricultural Technology Foundation
ACIAR	Australian Center for International Agricultural Research
AFDB	African Development Bank Group
BMGF	Bill & Melinda Gates Foundation
CGIAR	CGIAR is a global agriculture research partnership
CIDA	Canadian International development Agency
CIMMYT	International Maize and Wheat Improvement Center
DH	Doubled Haploid
DTMA	Drought Tolerant Maize for Africa
FAO	Food and Agriculture Organization of the United Nations
GRISP	Global Rice & Science Partnership
HPlus	Harvest Plus
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
MasAgro	The Sustainable Modernization of Traditional Agriculture
SAGARPA	Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food in Mexico
SDC	The Swiss Agency for Development and Cooperation
SFSA	Syngenta Foundation for Sustainable Agriculture
USAID	United States Agency for International Development

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



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



Together with rice and wheat, maize provides at least 30% of the food calories of more than 4.5 billion people in 94 developing countries.



They include 900 million poor consumers for whom maize is the preferred staple, 120 -140 million poor farm families and about one-third of all malnourished children.



Between now and 2050, the demand for maize in the developing world will double, and by 2025 maize will have become the crop with the greatest production globally and in the developing world.

But harvests at current levels of productivity growth will still fall short of demand and millions of farm families will remain in poverty. Unless vigorous measures are taken to accelerate yield growth, increase incomes from more productive, sustainable and resilient maize based systems, and give greater opportunities to women and young adults, the outcome will be less affordable food for millions of poor maize consumers, continuing poverty and childhood malnutrition, deforestation, soil degradation, reduced biodiversity, and accelerated depletion of water and fertilizer reserves.



RESEARCH  
PROGRAM ON  
Maize