

Crop Improvement and Management Research Program Strategy

Global context/trends

Cereal crops are the main food staples for much of the world, with maize, rice and wheat the most widely cultivated. Demand for cereal crops will rise because of global population growth, increased demand for cereal-based animal feed and diversion of crops from foods to biofuels.

At the same time cereal production faces several constraints to production: the impacts of climate change, pressure on crop lands, and reduced availability of water. Increases in productivity have also seemed to plateau in the last decade. The conflation of these factors in 2007 saw rises in global food prices caused by supply shortages. This crisis impacted most heavily on the poor, who have the least amount of flexibility to cater for price rises of staple foods.

For broad acre crops other than the three main staples, for example legumes and sorghum, underinvestment in research has resulted in declining productivity trends. Legumes are important in human diets, particularly as a protein source. Legumes also play an important role in the sustainability of some cropping systems. Research into productivity, quality and disease resistance is needed to deliver improved varieties.

The past decade has created novel, powerful tools for understanding the genetic basis of useful traits in crops. Applying these tools to crop improvement for crops in developing nations has the potential to accelerate genetic progress.

International 'fit'

Increasing the productivity of cereal and legume cropping at the smallholder scale is vital to achieving food security. This relies on a mix of genetic improvement through breeding and the implementation of innovative agronomic practices. For breeding improved varieties, international exchange of germplasm is essential, allowing access to new genetic materials. Recent disease outbreaks, such as the wheat disease Ug99, exemplify the need for genetically-broad germplasm as the raw material of breeding. At the same time the new DNA based research tools are increasing the usefulness of diverse germplasm and the speed with which genetic diversity can be harnessed in new improved varieties.

Research themes

The program aims to increase productivity, sustainability and utilisation of major crops and cropping systems through research on agronomic practices and improved breeding methods, including breeding data management. In Timor-Leste (East Timor), building on the recently completed program "Seeds of Life", a joint project with the Land and Water Resources program will explore options for farming system innovations and intensification to improve farmers' livelihood. In South Asia, the program operates in partnership with India to deliver improved wheat and sorghum varieties, through the deployment of DNA markers for assisted breeding. A project jointly funded with the Bill and Melinda Gates Foundation is supporting the modernisation of the Ethiopian sorghum breeding program. The International Mungbean Improvement Network (Bangladesh-India-Myanmar-Australia) is increasing the genetic diversity used to breed improved mungbean varieties. Another network (Ethiopia-India-Nepal-Pakistan-Australia) aims at the identification and deployment of wheat genes for resistance to stripe rust. In Bangladesh, the program will research wheat and pulses variety deployment together with agronomic improvements focused on tolerance to salt in the Southern regions. In Pakistan the program is launching a project aimed at increasing pulses (chickpea, lentil and groundnut) production, while in Afghanistan the emphasis is on the

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evaluation and release of suitable improved wheat and maize varieties, together with appropriate agronomic packages, including conservation farming.

Countries

Country	% of budget: active projects (operational plan 16-17)
Afghanistan	30
India	20
Bangladesh	13
Timor-Leste	10
Pakistan	8
Ethiopia	5
Myanmar	3
Nepal	3
Other (Pacific)	8

Key impact pathways	Contributions of Projects in the CIM program (examples)
Increased availability of, and access to, grains, fruits and vegetables	<ul style="list-style-type: none"> • Agricultural Innovations in Timor-Leste • Sustainable wheat and maize production in Afghanistan • Pulses in Pakistan • Salt tolerance in Bangladesh • Improving post-rainy sorghum varieties in India.
Greater product utilisation and reduce postharvest losses	<ul style="list-style-type: none"> • Pulses in Pakistan • International Mungbean Improvement Network
Improved nutritional quality and diversity of diets	<ul style="list-style-type: none"> • Pulses in Pakistan • International Mungbean Improvement Network.
New and diversified enterprise options	<ul style="list-style-type: none"> • Agricultural Innovations in Timor Leste • Salt tolerance in Bangladesh
Enhanced market chains for smallholder agriculture	<ul style="list-style-type: none"> • Agricultural Innovations in Timor-Leste
Increased productivity, quality and market access for agriculture products	<ul style="list-style-type: none"> • Molecular-marker technologies for faster wheat breeding in India. • Sorghum breeding in Ethiopia
Greater resilience and diversity of production systems	<ul style="list-style-type: none"> • Agricultural Innovations in Timor-Leste • Pulses in Pakistan
Strengthened plant biosecurity	<ul style="list-style-type: none"> • Wheat resistance to stripe rust (India, Nepal, Pakistan and Ethiopia)

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Future focus

The program will continue to focus on the interactions of breeding and agronomic practice, with linkages to other relevant projects to increase. The focus on sustainable intensification will guide future work in Timor-Leste. The cooperative research with India on marker-assisted wheat breeding will continue to focus on root and water-use efficiency traits, together with ongoing attention to rust disease and building the capacity of Indian scientists to use the most current marker technologies (including information management systems) in breeding. The development of pulses options for the diverse wheat and rice-based systems of South Asia will continue through projects on mungbean, chickpea and lentils, and salt tolerance germplasm and cultural practices. For all plant breeding projects, the program will endeavour to increase the performance of the partner breeding program, and link with global initiatives aimed at increasing genetic gains. In the longer term, new plant breeding tools and methods (relying on the widespread availability of DNA sequences, and genome editing methods) could be deployed in a range of crop improvement projects, for example for legumes, targeting disease resistance and quality. The program may explore the deployment of transgenic methodologies for appropriate traits and geographic locations.

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