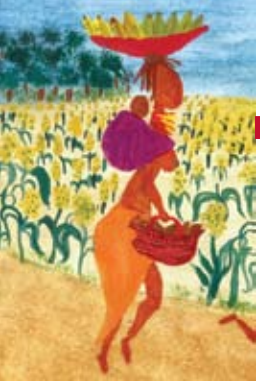

A call for collective action in agricultural research

A multi-faceted approach to solve a multi-faceted problem

Despite the marvels of modern agricultural technology, many farmers in drought-prone lands still struggle day-to-day to feed their families. And while the mandate of the GCIAR Generation Challenge Programme (GCP) prioritises research on crop drought tolerance, drought is not the only problem plaguing farmers today. To assess the severity of these other constraints and their importance relative to drought, GCP commissioned a study on crop production constraints, as well as opportunities for improving food crops in priority farming systems with high levels of poverty.

To address the multiple constraints limiting smallholder yields in Asia and Africa, new germplasm must be integrated with other agricultural research and development initiatives.

"The insights gleaned are of great value to breeders in selecting appropriate crop traits to complement drought tolerance," says John Dixon, who led the study.

The priority farming systems were identified in another GCP-commissioned study led by Hyman (see *Further reading*). These systems have large numbers of stunted children, frequent droughts and large areas of food crops.

Reaching those in greatest need, and maximising impact

The production study focused on cassava, chickpeas, cowpeas, rice, sorghum and wheat, which are important crops in most of the 15 high-priority farming systems across Asia and sub-Saharan Africa. In identifying abiotic, biotic, management and socio-economic constraints – along with suggested solutions – the study relied on farmers, local researchers, extension agents, agribusiness and non-governmental organisation staff with knowledge of, and experience with, each farming system, and other experienced development professionals.

What's crippling farm yields?

The severity of the constraints was measured by yield gaps (ie, the difference between smallholders' actual and potential yields). On average, the yield gaps for rice tended to be much smaller than those for wheat and cassava, while sorghum, chickpeas and cowpeas had the widest yield gaps.

Dixon observes, "For many crops, the vast majority of farmers are only getting half the potential yields. In drier drought-prone farming systems, the gaps are even wider, in the collective wisdom of more than 600 people that we spoke to from different backgrounds and areas of expertise."

Across most of the farming systems, abiotic and management constraints accounted for most of the yield loss for wheat; for rice and cassava, socio-economic and management constraints dominated; for sorghum, abiotic constraints were most severe; and for chickpeas and cowpeas, biotic constraints dictated yield loss. Though there were differences between crops and farming systems, on the whole, each of the four constraint types contributed roughly equally to total yield losses. The table summarises the most severe constraints for each crop and region.

What can we do now?

For crops such as sorghum, cowpeas, cassava and chickpeas, the study proposed a broad range of system-specific solutions to major constraints. Many of the solutions proposed for wheat and rice revolved around creating germplasm tolerant or resistant to various pests, diseases and water-related stresses.

Key constraints in crop production

* Bold represents dominant problems of the region: N = Nitrogen

	Abiotic	Biotic	Socio-economic	Management
East Asia & Pacific				
Cassava	**Soil physical degradation, soil fertility depletion**	–	**Fertilizer expensive or in short supply**	**Inadequate soil fertility management**
Rice	**Fertilizer use, nitrogen deficiency,** water availability, drought, irrigation problems	Leaf, stem, head pests; head diseases	Using low-yielding or outdated germplasm	–
Wheat	**Fertilizer use,** drought, water management	–	High cost of nitrogen fertlizer	Nitrogen fertilizer management, irrigation water management
South Asia				
Chickpeas	Soil fertility depletion, drought, excessively high temperatures	***Helicoverpa* pod borers,** botrytis grey mould, root or soil disease	High costs of pest and disease control, high costs or shortage of quality seed, using poor or unsuitable varieties	Inadequate fertilizer use and management, chickpeas planted inadequate for ehancing soil fertility or crop system sustainability
Rice	**Soil fertility depletion,** N deficiency, water shortage, drought	Weed competition; leaf, stem panicle diseases; pests	**N fertilizer expensive or in short supply,** lack of quality seed	**Inappropriate or poor nutrient and fertilizer use and management**
Sorghum	**Drought**	**Leaf, stem panicle pests and diseases,** weed competition	Poor access to agricultural information, inadequate farmer production and poor utilisation of knowledge or training	–
Wheat	**Soil fertility depletion, nitrogen deficiency**	Weed competition; leaf and stem fungal diseases, rodents	Lack of quality seed, poor irrigation, frequent drought	Late planting of crops
Sub–Saharan Africa				
Cassava	Soil fertility depletion, N deficiency, soil physical degradation	**Weed competition, African cassava mosaic virus**	**Inadequate access to finance, lack of policy support for crop, unstable markets,** use of poor or unsuitable germplasm	Inadequate fertilizer management, continous cropping, reduced bush fallow period
Chickpeas	–	**Root or soil disease**	High risk of production, using poor or unsuitable varieties	–
Cowpeas	Soil fertility depletion	**Pod insect pests; leaf, stem, flower pests;** weed competition	**High costs of pest and disease control,** expensive fertilizer, lack of quality seed, limited access to agricultural information	–
Rice	Soil infertility	**Weed competition**	N fertilizer expensive or in short supply, high costs of irrigation, using low-yielding or outdated germplasm, insufficient access to agricultural information, finance problems	**Inappropriate or poor nutrient and fertilizer use and management,** inappropriate water management
Sorghum	**N deficiency, soil physical degradation,** drought	***Striga* and weed competition**	Fertilizer expensive and in short supply	**Inadequate fertilizer use and management,** erratic and risky planting times
Wheat	Soil fertility, fertilizer	**Rust, weed competition**	**Lack of quality seed**	–

Overall, a multifaceted intervention approach is required, combining – among others – improved germplasm with input availability, credit accessibility, and training and extension programmes.

Next steps, a collaborative approach

Most of all, this study emphasises the need for collaborative interdisciplinary and cross-institutional efforts. No single intervention will suffice in curing the ills facing developing world farmers today.

Thus, GCP and other institutes in a position to guide crop improvement research should use these findings to focus future efforts on areas where the greatest impact can be made for those in greatest need.

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Further reading

Hyman G, Fujisaka S, Jones P, Wood S, de Vicente MC and Dixon J (2008). Strategic approaches to targeting technology generation: Assessing the coincidence of poverty and drought-prone crop production. *Agricultural Systems* 98 (1):50–61 Also published as a CIAT Working Paper (Hyman et al, 2007).

Generation Challenge Programme (2009).Where in the world do we start? Pinpointing global 'hunger hotspots' by merging worldwide data on poverty, drought and crop production. *Pathways to Impact Brief No 1*.

Pathways to impact briefs

1. ***Where in the world do we start?*** Pinpointing global 'hunger hotspots' by merging worldwide data on poverty, drought and crop production
2. ***A call for collective action in agricultural research:*** A multi-faceted approach to solve a multi-faceted problem
3. ***Molecular and conventional breeding through an economic lens:*** Facts and figures to shed light in a heated debate

Briefs and datasets on GCP's socioeconomic studies are publicly accessible at:
http://www.generationcp.org/sp5_impact