

The CGIAR Generation Challenge Programme



Reflecting on Phase I and looking ahead to Phase II

Created by the Consultative Group on International Agricultural Research (CGIAR) in 2003, the Generation Challenge Programme (GCP) is a time-bound 10-year initiative in two phases: 2004–2008 and 2009–2013.

GCP's mission is to use plant genetic diversity, advanced genomic science and comparative biology to develop tools and technologies that will support plant breeders in the developing world in their efforts to produce better crop varieties for resource-poor farmers in drought-prone environments. GCP links basic science with applied research through a broad network of plant scientists from diverse backgrounds, working in international and national agricultural research at CG Centres, in academia and regional and country research programmes. The network generates knowledge, explores new allelic diversity and develops practical tools such as molecular markers for desirable traits to increase the efficiency of plant breeding in developing countries.

The road behind us...

Our contribution to science

- ***Unpackaging and repackaging genetic diversity:*** During its first phase, GCP has contributed considerable scientific knowledge on genetic diversity and genetic underpinnings of several important traits, particularly drought tolerance. More specifically, we have completed analysing the diversity in germplasm collections for 21 crops, and assembled reference sets for the same. These reference sets are a subset of a large germplasm bank, representing as far as possible the genetic diversity of the entire gene-bank collection. The sets are a significant outcome that will for the foreseeable future help focus—and therefore increase—the efficiency for gene discovery and trait improvement research.
- ***Platforms and partnerships:*** Since its inception, GCP—in collaboration with partners—has established genotyping, informatics and genomics platforms for breeders to access modern marker technologies. Through, different approaches, including genome sequencing, new marker resources have been developed for less-studied crops like, cassava, chickpeas, cowpea, *Musa*, pigeonpeas and potatoes. With these new tools, efficient genetic studies are now possible. But the relatively more studied crops also got our attention: we supported the



development of large-scale marker platform for beans, rice and sorghum, so as to apply modern marker-assisted breeding approaches.

- **Taming and naming—Enriching the genetic base and selecting for major genes:** Phase I also saw the incorporation of genes from wild relatives in groundnuts and wheat to broaden the genetic basis of cultivars and increase productivity by improving target traits. Several major genes have been identified for virus resistance in cassava, aluminium tolerance in sorghum and phosphorus uptake in rice. For all these genes, applied breeding projects have already been initiated in collaboration with developing country programmes to incorporate these genes in germplasm adapted to target environments.
- **Investigating drought-tolerance genes:** We used a mix of complementary approaches in an intensive and extensive effort towards a better understanding of the genetic basis for drought tolerance in most [GCP crops](#).¹ These approaches included association genetics, comparative genomics, functional genomics and quantitative genetic studies. As a result, a large number of candidate genes and genomic regions contributing to drought tolerance has been identified. In Phase II, GCP will now use marker-assisted breeding to test and transfer favourable alleles at those genes and genomic regions into germplasm adapted to drought-prone environments.
- **Tools for product delivery and information sharing:** Naturally, all the results from this expansive set of research activities is of limited value in the absence of information and data exchange. With this foresight, in Phase I we invested in developing the basic infrastructure for the GCP information platform and database, which is now fully functional. In addition, significant resources have been allocated to develop suitable informatics tools for GCP scientists to store, analyse and compare their data. As most research activities supported by GCP aim to deliver products for breeders in the short or long term, it was important to develop an integrated delivery strategy. At conception stage, every project must clearly identify expected products and corresponding primary users. [Delivery Plans](#) maximise impact since bottlenecks in the delivery pipeline can be identified in advance, and solutions found.
- **Enhancing and building on capacity:** A clear recurrent issue was the capacity and resources of developing country breeding programmes to conduct modern breeding. Consequently, a major effort in Phase I was identifying needs and designing capacity development projects to leverage existing capacity. This was with a view to facilitating primary users of GCP products in target developing countries to integrate these products into their breeding activities. We anticipate that this effort will continue—and most probably be expanded—in the second phase of the Programme.

¹ GCP's mandate crops are barley, cassava, chickpeas, coconuts, cowpeas, groundnuts, lentils, maize, millets, *Musa*, *Phaseolus*, pigeonpeas, potatoes, rice, sorghum, sweet potatoes, wheat and yams

Building the GCP community

During our first phase, we have developed an extensive consortium partnership and leveraged resources to establish a broad network of [R&D partners](#) with diverse and extensive capability and capacity to support [GCP objectives](#). In the words of one of our Phase I review reports, perhaps the most important value of GCP thus far is the opportunities we have provided for people of diverse backgrounds to collectively reflect on, and formulate, solutions to complex problems in plant improvement and—in the process—to learn from one another.

As Phase I comes to a close, GCP is supported by a vibrant community of researchers and stakeholders all along the pipeline of our activities. These partners are from more than 80 diverse institutes such as universities, CG Centres, country research programmes and civil society organisations. Recently, we have cultivated strategic partnerships with the private sector, identifying practical ways—on a case-by-case basis—for private sector engagement in our activities, particularly in marker-assisted breeding. Another sub-sector of interest in terms of product delivery is the small- and medium-scale enterprises (SMEs). SMEs are an effective conduit for promoting GCP tools and technologies, thus providing a vital link with farmers in target countries.

Through this array of different partnerships, GCP is achieving one of its major objectives—bridging the gap between fundamental and applied research.

At the crossroads...

In GCP's midlife and in the transition from Phase I to Phase II, we have had—and we anticipate to have—several changes to better support our science, and to rise to the challenge of cultivating plant genetic diversity for the benefit of the resource-poor.

- **Evolution of our governance:** A non-scientific but nonetheless very significant development in Phase I is the fundamental reform in our governance structure, undertaken by GCP's Programme Steering Committee (PSC). This ushered in a new seven-member Executive Board (EB) effective 1 June 2008. The reform resulted in the transfer of several major responsibilities from the PSC to the EB. Chief among these responsibilities is oversight of the scientific strategy of the Programme. This change in governance was mainly to promote both efficiency and objectivity since, unlike the PSC, EB members are not at all involved in GCP research activities.
- **Dynamic management:** As would be expected, concepts and ideas at GCP's founding are now evolving into products, tools, methodologies and firmer new directions as our projects mature and our project portfolio expands. Consequently, we are realigning our management structure to keep in step with the various stages in the implementation of our strategy. As the end-product component of our strategy increasingly takes centre stage, it is now very clear that we need to add a second dimension in our management matrix to span the Subprogramme dimension. This new dimension will ensure that once end-products and their corresponding impact indicators are identified at Programme level, there is a management function to guarantee that actives and resources across Subprogrammes will deliver those end-products.



- **Our challenges:** In keeping with our middle name, we have faced—and will continue to face—several challenges in implementing our mission. The main ones include the following:
 - We have been criticised for being too dispersed in our research, and this constructive criticism is very well taken. In response, we will endeavour to strike a healthy balance between weaving and nurturing the vibrant R&D community that constitutes GCP, while also ensuring greater focus in our work.
 - Secondly, by nature and by definition, GCP is a diverse and geographically dispersed community. A downside to our broad spread and diversity is the communication and data release and exchange challenges these two aspects entail.
 - Thirdly, one other main challenge will be designing and implementing a viable and effective exit strategy to assure the sustainability of GCP products, once the Programme terminates in 2013.
 - Finally, we recognise the private sector as crucial partners. We have already identified several areas of fruitful collaboration on a case-by-case basis. On the one hand, the private sector already plays an advisory role in GCP. But also beyond this role, and in terms of more ‘hands-on’ engagement, our private sector partners actively collaborate in developing new tools, and facilitate access to necessary resources under clearly defined conditions. By addressing the challenge of the reality of our different objectives on the use and distribution of research outputs, this customised approach should result in a win-win outcome for both parties in this public–private sector partnership.

The road ahead . . .

- **Building on success:** In Phase I, the good support of our funders (see box below) translated into a total of USD 82 million. This investment helped to keep GCP on track in meeting its objectives, as demonstrated by the overall very positive feedback from the different reviews, including the External Programme and Management Review (EPMR) towards the end of Phase I (October 2007).
- **More focus:** But we are not resting on our laurels. The GCP Management Team and the reports of most recent reviews also recognise the need for GCP to more sharply focus its research agenda, with better defined impact indicators, if the Programme is to clearly demonstrate achievements by 2013. To attain this objective, we have identified a set of seven [Challenge Initiatives](#) (CIs) that are crop-, trait- and country-specific. In Phase II, a significant portion of GCP research funds will be dedicated to these CIs, with special attention to marker-assisted breeding.
- **Proof and partners:** While we expect that the impact of the Challenge Initiatives will probably spill over beyond the target countries, having impact on breeding in the focus countries is what will constitute our proof of concept. GCP will continue to demonstrate that a research approach tapping into crop diversity and using modern biotechnology-based breeding can have impact on crop breeding in drought-prone environments. By so doing, we hope that R&D initiatives and national governments will be willing to further build on GCP achievements, and extend the achievements based on the same—or similar—approaches.

Our reflections...

To sum up, and taking into account the challenges we have faced and anticipate to face, the net balance from Phase I is overall very positive: GCP has built a strong community, identified the

most promising research trends and well-positioned partners, and is already delivering a significant set of products to improve genetic research and crop breeding. We therefore approach Phase II on a positive and optimistic note.

In Phase II, in addition to research, we will also focus on platform development to guarantee the distribution of GCP products in a user-friendly and sustainable manner. And because we are a time-bound Programme, it is imperative that GCP ensure continued and sustainable use of its products after its lifetime. This objective will therefore be at the core of our exit strategy, to be developed in Phase II.

GCP's funders in Phase I

We gratefully acknowledge the support of the following funders in Phase I, listed below in alphabetical order:

- Austrian Research Centers GmbH (ARC)
- Bill & Melinda Gates Foundation
- Department for International Development (DFID), UK
- European Commission (EC)
- Kirkhouse Trust
- Pioneer Hi-Bred International, Inc
- Swedish International Development and Cooperation Agency (SIDA)
- Swiss Agency for Development and Cooperation (SDC)
- Syngenta
- Syngenta Foundation for Sustainable Agriculture
- The Rockefeller Foundation
- The World Bank