DRAFT FOR DISCUSSION

GCP transition overview paper

November 2012

This paper has been authored by the GCP Management Team with input from the Transition Strategy Taskforce[1]
It has been endorsed by the GCP governance bodies: Executive board and Consortium Committee

Contents

[1] Taskforce members: *Vivienne Anthony (Syngenta Foundation), Andrew Bennett (GCP Executive Board [EB] Chair), Stefania Grando (CGIAR Consortium Office), Dave Hoisington (GCP Consortium Committee Chair/ICRISAT), Jurandir Magalhães (EMBRAPA), John O'Toole (Consultant) Markus Palenberg (EB member) and Jean-Marcel Ribaut (GCP Director)*

Tables and figures

Tables

Figures

Acronyms and abbreviations

AfricaRice	Africa Rice Center
Alt$_{SB}$	major Al tolerance gene in sorghum cross BR007 × SC283
BAC	bacterial artificial chromosome
BCNAM	backcross nested association mapping
BMGF	Bill & Melinda Gates Foundation, USA
CB	capacity building
CC	Consortium Committee
CGIAR Consortium	CGIAR Consortium of International Agricultural Research Centers (*also* Consortium; one of two bodies of CGIAR)
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (*International Maize and Wheat Improvement Center*)
CoPs	communities of practice
CRPs	CGIAR Research Programmes
CSSLs	chromosome segment substitution lines
CWANA	Central and West Asia and North Africa
DPKit	Delivery Plant Kit (of GCP)
EB	Executive Board
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária, Brazil (*Brazilian Agricultural Research Corporation*)
EPMR	External Programme and Management Review
FAO	Food and Agriculture Organization of the United Nations
GCP	Generation Challenge Programme (of CGIAR)
GIPB	Global Partnership Initiative for Plant Breeding Capacity Building (of FAO)
IBP	Integrated Breeding Platform (of GCP)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IP	intellectual property
IRRI	International Rice Research Institute
ISPC	Independent Science and Partnership Council (of CGIAR)
KASPar assay	KBioscience Competitive Allele-Specific PCR SNP genotyping system
LAC	Latin America and the Caribbean
m	Million
MABC	marker-assisted backcrossing
MAGIC	multiparent advanced generation intercross
MARS	marker-assisted recurrent selection
MATE	family of multidrug and toxin extrusion transporters
NAM	nested association mapping
NILs	near isogenic lines
PSC	Programme Steering Committee
Pup1	phosphorus uptake 1 (gene)
RI	Research Initiative (of GCP), *formerly* Challenge Initiative (CI)
RIL(s)	recombinant inbred line(s)
SPIA	Standing Panel on Impact Assessment (of ISPC)
SSA	sub-Saharan Africa
SSEA	South and Southeast Asia

TLII	Tropical Legumes II Project
USD	United States dollar
USDA	United States Department of Agriculture
ZmMATE1	MATE gene of maize (*Zea mays*) [see MATE]

1 Summary

In preparation for the Generation Challenge Programme's closure, a number of steps are being taken, including the drafting of a series of nine topic-specific white papers covering the Programme's crop research and service components. Crop research products include genomic resources, cloned genes, informative markers, genetic resources and improved germplasm. The Programme will have achieved most of its research objectives *vis-à-vis* these products by the end of 2014. Nearly all ongoing research activities will be completed before December 2014. A few activities related to the development of improved varieties and genetic stocks will require additional work, and should be conducted with appropriate CGIAR Research Programmes (CRPs), lead Centres and other institutes.

The service component includes the Integrated Breeding Platform (IBP) which is a mix of crop breeding informatics tools and services accessible through a web portal. These products are being developed to promote access to crop information and marker technology to empower breeders in developing countries to adopt and apply integrated breeding approaches. IBP is envisioned to continue past the Programme. How, and in what shape and format, remains to be determined once the potential impact of the IBP is better defined. The future of the IBP will need to be discussed with stakeholder during a meeting scheduled for mid-2013.

The future placement of the Programme's capacity building, communications and networking components would take two proposed pathways. While crop-specific research elements are to be embedded in respective CRPs, more generic and cross-cutting issues are proposed for positioning within CGIAR's global strategy, and would be ideally positioned as a complement to the IBP.

2 Introduction

GCP is an innovative global partnership in modern crop breeding for food security that currently comprises a portfolio of more than 100 collaborative inter-institutional research projects. Initially proposed and approved in 2003, GCP started operations in 2004 and is scheduled to close in December 2014, as envisioned at its founding, and in conformity with the recent CGIAR reform.

The purpose of this paper is to provide an overview of the current status of GCP's activities, outcomes and possible impact, service platforms delivery, and to outline proposed post-closure transfers of assets and requisite actions to secure a decade of significant research investments totalling about USD 180 million. This overview paper builds on individual position papers developed for each of the nine GCP components (Table 1).

Table 1. GCP components (each with a detailed white paper)

No	Component/Paper title	Contents
1	Genetic resources	Genetic stocks of seeds and germplasm (NILS, RILs, synthetics, MAGIC populations, CSSLs, BAC libraries) crop diversity reference sets
2	Genomic resources	Gene sequence data, molecular markers, genetic and physical maps, transcriptome data and arrays

No	Component/Paper title	Contents
3	Cloned genes	Gene sequence data, clones
4	Informative molecular markers	New traits, molecular markers, genetic maps
5	Molecular breeding	Crop breeding lines and improved varieties
6	Integrated Breeding Platform	Breeding information and communities of practice, data management tools, analysis and decision support tools, data management service, breeding and support services
7	Capacity-building activities	Training courses and knowledge building, learning resources, in-country infrastructure support
8	Scientific and social network	Research partnerships, crop communities, social media presence
9	Institutional memory	Websites, project reports, publications, lessons learnt, project management systems

3 GCP evolution from 2004–2014

3.1 Concept and mission

GCP was established as a highly novel concept in 2004 to focus on, and take advantage of, the rapid technological developments emerging in international molecular plant science, particularly the potential of comparative genomics, bioinformatics, efficient genotyping and molecular markers to track and improve single and polygenic traits. Its mission, 'Using genetic diversity and advanced plant science to improve crops for greater food security in the developing world', continues to be relevant today. New tools and approaches were being created that enabled potential utilisation of plant genetic diversity that had hitherto been largely inaccessible to plant scientists in developing countries, due to technical difficulties, limited capacities and costs. CGIAR research leaders recognised that this was a new dawn and ground-breaking molecular science was needed to optimise CGIAR's research efforts. Partnerships would be vital for success and capacity building in developing countries was an imperative to enable full use of biodiversity and the application of modern breeding technologies for crop improvement to enhance food security. Hence, GCP was conceived as a broker that would contract partner institutions to conduct research through competitive and commissioned projects, ensuring that the overall Programme objectives were met. One of the major objectives that is also one of the major achievements, was to bring scientists from different horizons and with different skills to work together, bridging the gap between upstream and applied research, so that biotechnology could have greater impact on plant breeding efficiency in developing countries.

3.2 Project portfolio

Phase 1 (2004–2008) mainly consisted of exploration and discovery projects, pursuing the most promising molecular research interventions and high-potential partnerships to deliver significant products to improve genetic research and crop breeding (see banana and rice examples). During this time, GCP worked on 18 crops (Table 2).

A strategic decision was taken by management in 2008, supported by an External Programme and Management Review (EPMR), to consolidate GCP's research in order to optimise efficiency and outputs during GCP's term, while also enhancing potential for longer-term impact. The outcome of this consolidation was to focus on seven Research Initiatives covering nine target crops (Table 3).

Table 2. Research budget allocation by crop

Crops		Budget			
		Phase I	Phase II	Total	%
1.	Bananas & plantains	1,040,999	-	**1,040,999**	0.9
2.	Barley	3,101,780	-	**3,101,780**	2.5
3.	Beans	1,933,738	6,434,232	**8,367,970**	6.8
4.	Cassava	4,600,979	4,460,023	**9,061,002**	7.4
5.	Chickpeas	1,603,123	5,819,309	**7,422,432**	6.1
6.	Coconuts	173,931	-	**173,931**	0.1
7.	Cowpeas	5,223,538	7,142,320	**12,365,857**	10.1
8.	Groundnuts	4,099,698	5,530,280	**9,629,979**	7.9
9.	Lentils	92,335	-	**92,335**	0.1
10.	Maize	6,801,412	5,474,224	**12,275,636**	10.0
11.	Millet (3 types)				
	Finger millet	139,694	-	**139,694**	0.1
	Foxtail millet	39,889	-	**39,889**	0.03
	Pearl millet	467,091	-	**467,091**	0.4
12.	Pigeonpeas	507,690	-	**507,690**	0.4
13.	Potatoes	1,146,952	-	**1,146,952**	0.9
14.	Rice	15,831,418	13,666,101	**29,497,519**	24.1
15.	Sorghum	3,418,045	9,397,182	**12,815,227**	10.5
16.	Sweet potatoes	632,018	-	**632,018**	0.5
17.	Wheat	5,676,107	7,694,557	**13,370,664**	10.9
18.	Yam	244,932	-	**244,932**	0.2
	TOTAL	**56,775,368**	**65,618,228**	**122,393,596**	**100**

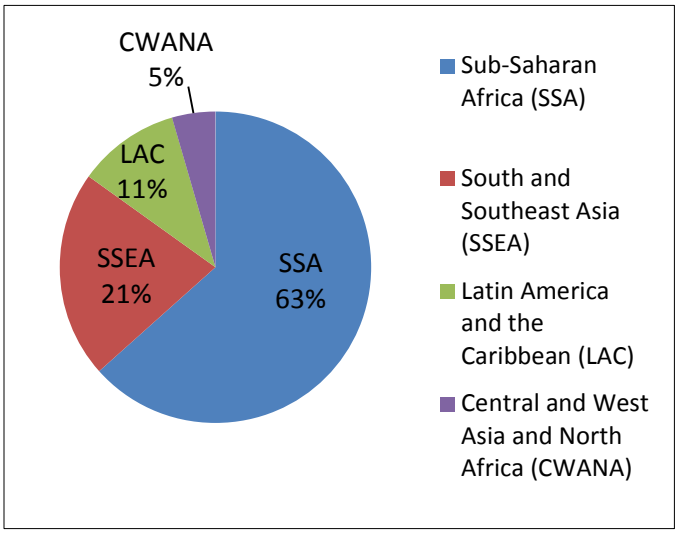
Table 3. GCP Research Initiatives, target countries and traits for Phase II (2009–2014)

Research Initiative		Target countries	Target traits
1.	Cassava	Ghana, Nigeria, Tanzania, Uganda	• Resistance to cassava mosaic disease, cassava green mite, cassava bacterial blight and cassava brown streak disease • Drought tolerance
2.	Legumes		
	Beans	• *Africa:* Ethiopia, Kenya, Malawi, Zimbabwe • *Latin America:* Mexico, Nicaragua	• Resistance to bruchids, bean common mosaic virus and common bacterial blight • Drought tolerance
	Chickpeas	• *Africa:* Ethiopia, Kenya • *Asia:* India	• Resistance to *Helicoverpa* pod borer • Drought tolerance
	Cowpeas	• Burkina Faso, Mozambique, Senegal	• Flower thrips, root-knot nematode, bacterial blight and Fusarium • Drought tolerance

Research Initiative		Target countries	Target traits
	Groundnuts	• Malawi, Senegal, Tanzania	• Early leaf spot, rust and rosette disease resistance • Drought tolerance
3.	Maize	• *Africa:* Kenya • *Asia:* China, India, Indonesia, Philippines, Thailand, Vietnam	• Grey leaf spot • Drought tolerance
4.	Rice	• *Africa:* Burkina Faso, Mali, Nigeria • *Asia*: India, Sri Lanka, Philippines	• Blast resistance, bacterial leaf blight, salt tolerance • Drought tolerance
5.	Sorghum	• *Africa:* Ghana, Kenya, Mali, Senegal • *Asia:* India	• Tillering, stay-green trait • Drought tolerance
6.	Wheat	• *Africa:* Ethiopia, Morocco • *Asia:* China, India	• Heat tolerance, water-use efficiency • Drought tolerance
7	Comparative Genomics	• *Africa:* Kenya, Mali, Niger • *Asia:* Indonesia, The Philippines • *Latin America:* Brazil	Tolerance to aluminium toxicity and low phosphorus (for maize, rice and sorghum)

Phase II (2009–2014) focuses on applying genomic tools and molecular breeding approaches to increase and accelerate genetic gains. Particular emphasis is laid on improving germplasm adapted to challenging environmental conditions in developing countries, with a primary focus on sub-Saharan Africa, and South and Southeast Asia (Figure 2). As is evident in Table 3, drought tolerance remains a high priority, but other aspects such as soil conditions and disease resistance are also addressed. To better support its Research Initiatives (by providing better access to genomic resources, advanced laboratory services, and robust analytical and data management tools, all major bottlenecks that still impede adoption of modern breeding in developing countries), GCP has since June 2009 been coordinating the development and implementation of the Integrated Breeding Platform (IBP). The Platform is designed as a 'one-stop shop' for crop information, informatics tools, data management infrastructure and services to address the needs, and enhance the efficiency, of integrated breeding projects, particularly in developing countries.

Figure 1. Budget allocation by region (Phases I and II)



3.3 Governance and intellectual property

Legally, GCP is a 'partnership consortium' (not an independent legal entity), established under the Amended Consortium Agreement. The International Maize and Wheat Improvement Center (CIMMYT) is GCP's host agent and therefore has a fiduciary role, ultimately assuming the Programme's financial and legal liabilities. The Executive Board (EB) has been GCP's policy, management and financial oversight body since 2008. Prior to that, this role was played by the Programme Steering Committee (PSC),

comprising management representatives of the 18 member institutes of the GCP Consortium (of whom four are from emerging economies, five are from developed countries and nine are CGIAR Centres). Having ceded management and monitoring of the Programme to the EB in December 2007, the PSC dissolved itself in 2009, and was replaced by the Consortium Committee (CC). The CC remains the apex governance body of the Programme, with the power to amend the Consortium Agreement and to dissolve the EB, but with the obligation to nominate another EB within a few months. CC members, nominated by each of the institutions of the GCP Consortium, are mainly highly accomplished scientists, and the CC has thus far primarily played a scientific advisory role, interacting with the GCP Management Team and the EB. In the run-up to GCP's closure, the CC has once more come to the forefront in the search for options to safeguard and secure GCP's legacy and ensure that the investments, gains and progress made are not lost.

GCP's intellectual property (IP) policy is premised on the fact that GCP aims to produce globally accessible international public goods. It strikes a balance between providing developing countries unencumbered rights of access to research outputs, while also recognising the individual researchers' IP rights.

4 Collaborative partnerships and research networks

A continuous and unifying characteristic of GCP operations has been the formation and nurturing of collaborative research projects and networks. This approach, whose value GCP's funders acknowledge, blends the inventiveness, skills, experience, outlook and resources of public-sector researchers in national and regional research programmes, with expertise from the CGIAR, academia and the private sector. GCP has thus built an extensive and productive research community, best summed up by this observation in the EPMR report: "*Perhaps the most important value of GCP thus far, is the opportunities it has provided for people of diverse backgrounds to think collectively about solutions to complex problems and in the process to learn from one another*." As GCP's focus has increasingly shifted from exploration and discovery to application and impact, so too has project leadership, with more and more projects led by developing-country partners, and a corresponding shift in budget allocation. In the early years of the Programme, only about 25 percent of the research budget was allocated to developing countries, compared to a projected allocation of more than 50 percent in 2012 (see p11, *Transition strategy*).

5 Finance

GCP's annual budget averages USD 16m. The cumulative 2003–2012 research investment by various funders is USD 148m, projected to rise to a cumulative total of USD 162m by the end of 2013. Table 2 shows research budget allocation by crop, while Figure 2 shows allocation by region. Under both cases resources allocated to cross-cutting activities (e.g. IBP development) as well as operational costs are not included.

6 Overview of the Programme – research outputs and products

GCP project proposals identify activity outputs from the outset and their path to delivery and use. GCP outputs and products fall into three broad categories: 1) research, 2) services, and, 3) capacity building and social/professional networks (Annex 1 provides a detailed assessment of the post-GCP status of each). Tangible research outputs are also defined in supplementary Product Delivery Plans which

describes specific products, uses, constraints, capacity building needs, distribution channels, IP issues and delivery timelines.

6.1 GCP crop research component outputs

GCP crop research outputs include genomic resources, cloned genes, informative markers, genetic resources and improved germplasm. The Programme will have achieved most of its research objectives *vis-à-vis* these products by the end of 2014. More than 400 research papers, acknowledging GCP's support have been published in peer-reviewed journals from 2004 to September 2012.

Genomic resources, cloned genes and informative markers: Through GCP-supported work, genotyping resources for all target crops are now readily accessible, including high-throughput marker technologies and sufficient genomic resources to conduct meaningful genetic studies and molecular breeding. Many informative marker products for drought and abiotic traits are already in use in breeding programmes and a large number have been converted to the preferred KASPar system for high-throughput genotyping. As a result of gene cloning projects, informative/predictive gene-based markers have been developed for aluminium tolerance in sorghum (*Alt_{SB}*) and maize (*ZmMATE1*), and for tolerance to low phosphorous in rice (*Pup1*). Molecular markers for *Salt1* gene in rice were also successfully used for molecular breeding in several Asian countries. Although the comparative genomics approach has turned out less promising than had been expected at the beginning of the programme, GCP objectives for these research components will have been achieved by 2014, and any additional work on these product lines should be carried out by the commodity CGIAR Research Programmes (CRPs) based on mutual agreement currently under discussion (see Annex 2).

Genetic stocks and improved germplasm: Although the inclusive and participatory approach initially adopted by GCP to characterise crop diversity created some problems in terms of data sharing and quality control since results were coming from different groups, GCP's objectives to develop genetic stocks (reference sets, CSSLs, NILs, etc) and characterisation for novel allele discovery, have largely been achieved. However, some final work will be required on the development, characterisation and selection of breeding lines from recombinant populations of genetic stocks. Additional work is also required to convert improved lines resulting from the latest molecular breeding selection projects into varieties ready for distribution to farmers (details in Annex 2). The continuance of these residual activities for genetic stocks and improved germplasm is already embedded in several of the CRP workplans, covering various MAGIC, BCNAM and improved populations. Underlying this is the continuing and evolving need to identify new alleles and haplotypes in all strategic crops to improve cultivated germplasm. Where possible, GCP will work with these CRPs and associated Centres to mobilise resources and refine plans for the logical completion of the activities.

6.2 GCP service component outputs

GCP's service component outputs include the modules of the Integrated Breeding Platform which are a mix of crop breeding informatics tools and services – a web portal, data management software, data analysis and decision support software, various breeding and support services, and community-building and interaction facilities. These products are being developed to promote access to modern methods and technology to empower breeders in developing countries to adopt and apply molecular breeding approaches.

For broad adoption, one of the challenges that IBP foresees, is the difficulty in changing mindsets and attracting users to adopt new ways of working. However, the IBP is still in its infancy and will continue to

grow and mature over time. This notwithstanding, it is one of the major assets of GCP envisioned to continue past the Programme. How, and in what shape and format, remains to be defined.

6.3 GCP Capacity-building and scientific/social networking

Capacity building: GCP has developed a number of innovative capacity-building resources and approaches. These include the modular Integrated Breeding Multi-Year Course, various digital learning resources, the practice of embedding CB activities in actual research projects, formal post-training support in applying newly acquired knowledge and skills, and infrastructure support at selected sites. Project activities in this area will be completed by the end of 2014, but the demand for CB interventions will continue – hence a need to expand and mainstream these products, possibly through the continuing elements of the Integrated Breeding Platform.

Scientific/social networking: GCP promoted and facilitated the growth and development of a broad scientific and social network, by establishing novel collaborations between partners from CGIAR Centres and institutes in the developed and developing countries. These enhanced human assets are among the most valuable and tangible products of the Programme and creates valuable opportunities to generate new projects, methods and technologies and share and disseminate knowledge and best practice. These need to be promoted and replicated in the post-GCP era.

6.4 Sustainability

Though projected to be largely complete by 2014, most of GCP's products will however still be in demand by the target groups, and will therefore require further refinement based on feedback by users.

Sustainable management of genetic stocks is a key CGIAR priority today. Recent dialogue with CGIAR gene-bank managers suggests a chargeback system on a two-tier scale, with non-profit researchers receiving stocks at lower charges than researchers with commercial goals, could be considered to recover costs for managing genetic resources. Genomic resources and informative markers are in a more privileged position compared to other GCP products, as most of them are publicly available and easily accessible through various websites, and once published and well-documented will remain accessible in a sustainable way as long as needed. Cloned genes will be available through the institutions that cloned them, subject to GCP's IP requirements.

Sustainable distribution of improved germplasm after December 2014 is more challenging. However, since the molecular breeding activities supported by GCP are already embedded in the respective crop CRP workplans, products generated would likely be sustained by the appropriate CRP partners. To meet farmers' future needs in a constantly changing environment, foresight and planning will be essential for relevant further germplasm research and development post-GCP.

6.5 Impact

The nature of GCP's work is such that impact is realisable and measurable at different times. The adoption rate of IBP tools and services, evolution of the composition and dynamics of crop communities, and demand for finished products such as genetic and genomic resources, cloned genes and informative markers are very good impact indicators in the short to medium term. Adoption and impact of improved germplasm in farmers' fields as well as increased efficiency in breeding programmes due to tools and services provided by the IBP are, of course, long-term impact indicators.

There will be an external evaluation of the Programme before its sunset, during which time the more quantitative elements of its work will be evaluated. However, impact will also need to be determined

well after 2014. GCP plans to allocate resources and work in close collaboration with the Standing Panel on Impact Assessment (SPIA of the CGIAR Independent Science and Partnership Council [ISPC]) to define a post-GCP impact assessment for a series of key products.

7 GCP's niche and achievements

Throughout its lifetime, GCP has endeavoured to be responsive to the expectations and needs of the stakeholder community – primarily food crop breeders in developing countries. By identifying their needs, and finding innovative means to address them, the Programme developed several exceptional characteristics.

During the early focus on the 'proof-of-concept' of molecular breeding applications in developing countries, GCP management encountered many obstacles and found solutions for most. This continuous learning, coupled with a lean and flexible management structure, facilitated the development of a comprehensive package of practices and services (crop information management; breeding and genomics services, capacity-building support services and knowledge-sharing and communications services) that would stand out in the public international agricultural-research-for-development arena. As a result GCP is now well-positioned to serve the needs of 'cross-cutting issues' identified across the crop-based CRPs now being initiated under the reformed CGIAR system.

One of the hallmarks of GCP's innovativeness today is the crop-focused network model that harnesses, and capitalises on, the outputs of a large and diverse global community of researchers. The net result of this innovation has in certain instances seen GCP act as a 'change agent', facilitating both the application of science and physical and human resource capacity-building that has produced new crop varieties for farmers in targeted stress environments. A major contributor to this success has been the fostering of research partnerships and 'true collaborations' among those working to solve some of the most intractable problems in the world, such as drought tolerance. Learning how to foster this 'cultural change' among disparate and dispersed research scientists and organisations, and nurturing them into research teams, has been one of GCP's salient accomplishments. In addition, scientists from developing countries have increasingly assumed leadership in collaborative research projects. This is a very significant and relatively rare outcome in international agricultural research partnerships and ventures.

A key element of GCP's success in building and supporting a network of practitioners is that the concurrent capacity-building efforts are integral to hands-on research and hence represent a real and practical imperative to all partners. Embedding practical and applied research in human-resource capacity building has proved to be a formidable change catalyst. This melding of applied research and capacity building has paved the way for developing-country scientists and institutions to access significant new funding from GCP, as well as from national and international sources. For many developing-country scientists, this is their first experience in international research leadership and acquiring significant research funds. These outcomes and experiences greatly increase their enthusiasm and determination for future participation in future international partnerships, supported by a palpable 'GCP Spirit'!

8 Where we are, and where we go

The fact that GCP is time-bound and scheduled to close at the end of 2014 lends a level of urgency and import to this exercise. However, it is a measure of GCP management's adherence to the necessary due

diligence that this effort began two-and-a-half years in advance of programme termination. This allows sufficient time to deliberate, evaluate and pursue necessary negotiations to ensure that the Programme's most significant outputs will remain available to scientists and other users of GCP's products in the future.

The associated nine position papers and the discussion above illustrate:

- the evolution of GCP's mission;
- accomplishment of very significant genetic and genomic outputs;
- demonstration of the 'proof of concept' for molecular breeding in developing countries;
- development of a programme management style and content responsive to stakeholder needs; and, most importantly,
- continuous learning and application of those lessons to innovative modifications that provided applied research successes while also contributing to, and advancing, international agricultural research.

GCP will undergo a formal external evaluation by the end of 2013, but given the dynamism of GCP's scientific network, this impressive research history, supported by more than 400 peer-reviewed research papers and the long inventory list of assets, one may already be fairly satisfied that GCP has accomplished its overall goals and is ready to 'sunset'. However, this may miss the total synergy of all the learning and innovation that has now produced the truly dynamic 'consolidated package' of elements and services that have naturally evolved into and around the new Integrated Breeding Platform. The IBP embodies most major aspects of the continuous learning and programme modification that has happened over the last nine years.

The IBP has been in a pilot phase and will be formally opened to the wider public in December 2012. During the next 12 months, the GCP team plans to assess several areas including: the magnitude of potential demand for the IBP in both the public and the private sectors in the developing world; the potential for the IBP to earn revenue, perhaps through a public–private partnership to both expand the reach of the Platform as well as provide self-financing; and through active monitoring and surveillance to measure and learn from its apparent adoption rate.

Considering the output of this exercise, the expectations of GCP stakeholders expressed through a survey conducted at the beginning of the year, and taking into account the evolution of the CGIAR Research Programmes and other cross cutting initiatives at the Consortium level, the future of the IBP will need to be defined by mid-2013.

Dismantling the IBP will clearly and dramatically reduce its overall value and potential impact. What makes the Platform unique, adding considerable value to each of its individual components, is having them together, accessible in an integrated and configurable way through a single web portal. The IBP's core activities are, without doubt, geared to provide a data management and analysis system, and tools and services that will support breeders in their routine activities. However, those core functions can be extended to convert the IBP into a livelier and more comprehensive platform that would better serve a broad and diverse community of users, focusing on scientists in developing countries. Currently, two general scenarios are being considered:

1) The IBP operates in a relatively austere format, focusing on its core competence supporting data management, analysis and decision-support functions. The IBP would be a demand-driven

support platform that provides best practice and access to proper breeding tools and services. Under such a scenario, the level of CB will be limited to support in the use of the Platform's tools and services.

2) The core activities of the IBP are complemented with comprehensive capacity building and networking components. Here capacity building can include research components (small grants) to introduce scientists in developing countries to modern breeding approaches and enable them to adopt those approaches. Expanding on CB would provide favourable conditions for developing and expanding a proactive and diverse professional network of partners, including CoPs.

Governance and management will be defined once the scientific content and objectives of the IBP are clearly defined. When reaching that point the positioning of the IBP within or outside the CGIAR, the need to create a new entity or to find a host agent, and the value of creating a stakeholder consortium to manage the IBP will be discussed.

9 Conclusion and next steps

In conclusion, the cumulative analysis and evaluation of the GCP's nine position papers provide very distinct future options with regard to the placement and sustainability of GCP assets developed in the earlier research projects and more recent Research Initiatives. The Programme has produced a substantial and valuable array of outputs that are being utilised in crop breeding programmes.

All ongoing research activities aiming at producing genomic resources, cloned genes and linked markers will be completed before December 2014. Delivery of genetic stocks and improved germplasm from most molecular breeding projects will be completed by the end of 2014 but development of some, especially cultivars, will continue beyond this timeline under the management of the relevant CGIAR CRPs and lead Centres as well as advanced research institutes. GCP will closely engage with its partners until its very sunset to ensure – as far as will be possible – the integration, extension and expansion of activities as may be required. The Programme will help partners initiate related new activities that build on GCP's achievements, should there be clear added value and demand for such activities.

The most recent and complete innovation, stemming from the intensive learning of GCP's *modus operandi*, is the Integrated Breeding Platform. As noted above, it will be released publicly as a pilot platform in December 2012 to become fully functional in December 2013. Key decisions to define the governance as well as shape and content of the possible key components (services, research, capacity building and networking) of the IBP beyond December 2014 will have to be taken at the IBP annual meeting in June and during the GCP General Meeting in September 2013. A final proposal for a future IBP will need to be ready by December 2013.

Finally, the coming year will also entail wide-ranging discussions with a host of stakeholders, funders, CRP leads and Consortium partners, to further determine the future placement of GCP's capacity building, communications and networking components. The focus will be on determining the future role of these important GCP components in the IBP's future, and potential role within cross-cutting issues of CGIAR's global strategy.

Annexes

Annex 1: GCP outputs – Projection on 2014 status and post-GCP options

Output/ Product	Projected completion of programmes (2014)	Sustainability options and plans
Genomic resources	100% (completed 2012)	• Full use of existing genomic resources in breeding programmes in developing countries requires additional building of scientists skills, in-country field infrastructure and information management. • Continued access and support is proposed using the IBP.
Informative markers	100%	• Awareness building and integration into CRPs and country programmes.
Cloned genes	100%	• ICRISAT, INRAN, Moi University and IRRI are expected to maximise the utility of the cloned genes in their sorghum and rice programmes. CIMMYT has not been a member of the collaboration on maize (for this activity) and discussions are required. • USDA at Cornell University and EMBRAPA in Brazil are expected to continue with their gene cloning programmes on abiotic stress factors; grant programmes with them or other expert groups are an option.
Genetic resources	90% Reference sets completed end 2009, except for cassava – in progress	• Further work required on MAGIC populations of beans and rice, BCNAM for sorghum. These are now embedded in the respective crop CRPs so that completion is assured post-2014. • Genetic stocks will be stored, maintained and distributed from the CGIAR gene banks as the best repositories for these valuable research materials and for use within the CRPs. • Partner non-CGIAR institutes also needed to store and curate stocks produced within their country programmes. In-country resources are a concerning limiting factor.
Improved germplasm	70%	• Full integration into the CRPs is preferred as most objectives are harmonised with those of GCP: • *Maize and wheat* – MAIZE and WHEAT CRPs/CIMMYT • *Rice* – GRiSP, AfricaRice/IRRI • *Legumes* –Tropical Legumes Project/ CRP on Grain Legumes • *Sorghum* – CRP on Dryland Cereals • *Cassava*– funding considerations will influence priority setting and discussions are required. • MB activities that encourage extension from germplasm improvement to variety releases in the national country programmes, require consultation with CRP partners. • Working with regional private seed companies should

Output/ Product	Projected completion of programmes (2014)	Sustainability options and plans
		also be explored.
Integrated Breeding Platform	100%	• Whereas IBP components can in theory be disaggregated and variously placed both within and without the CGIAR Centres/CRPs and other institutions, this would lead to the loss of significant utility and advantages afforded by maintaining them as part of an integrated unit. Consultations and discussions will be held with various parties in the course of the coming weeks and months to determine the most viable option for the IBP.
Capacity building	80%	• Crop-based activities such as any unfinished postgraduate training expected to be handed over to the CRPs. • All CGIAR Centres undertake capacity building but so far, coordinated actions across Centres have been limited. Methodology training can be provided by other service providers, eg ,US universities, Wageningen, etc.
Communities of practice and knowledge transfer	100%	*Communities of practice* • Crop CoPs could be transferred to crop CRPs or CGIAR lead Centres if policies and resources are deployed to support these networks. Thematic or professional networks could be hosted by the CGIAR Consortium. • Another option for consideration is merger with other crop-based initiatives such as those supported by BMGF, USDA or FAO's GIPB • Continue as part of IBP if continued funding provides it with longevity. *Operations knowledge products* • Historical operations; reports, ie, project and annual reports, newsletters, Workflow Management System, DPKit and GCP policies. Archiving proposed at CGIAR Consortium. Discussions are in progress. *Crop-related knowledge products* • To be held at the CRPs or crop lead Centres thus ensuring use, maintenance and updates. Options also include non-CGIAR agencies, eg, FAO, Global Crop Diversity Trust, if funding available. *Core programme knowledge products* • Need to be placed in an easily accessible repository for continued use. Although individual components can be divided into different locations, ideally, should be kept part of IBP, if funding and support is provided post-2014. *Blogs and social media accounts (GCP and IBP)* • Subscribers to be directed to new accounts as appropriate within CRPs, Consortium, or elsewhere

Annex 2: Genetic stocks and improved germplasm activities post-GCP

Crop	Activities projected to continue post-2014'	Estimated cost (USD)
Beans	**Genetic stocks:** Finishing MAGIC population development, evaluation, line selection, progression and development	50,000 – 75,000
	Improved germplasm: Most products to be integrated into ongoing TLII. Progression of Andean germplasm lines improved for drought tolerance	50,000 – 100,000
Cassava	**Genetic stocks:-** Reference collection multiplication of stocks, virus indexing, tissue culture storage	100,000 – 150,000
	Improved germplasm: Evaluation and progression of MARS populations for development of drought-tolerant lines. Progression of derived biotic and drought trait improved lines	50, 000 – 100,000
Chickpeas	**Genetic stocks:** MAGIC population selected line evaluation, progression and development	10,000 – 30,000
	Improved germplasm: Most products to be integrated into ongoing TLII. Progression of drought-tolerant chickpea breeding lines developed through MABC/MARS	25,000 – 50,000
Cowpeas	**Genetic stocks:** MAGIC population selected line progression and development; multiplication of RILs	10,000 – 30,000
	Improved germplasm: Most products to be integrated into ongoing TLII. Progression of advanced breeding lines and local varieties improved for drought tolerance	25,000 – 50,000
Groundnuts	**Genetic stocks:** Evaluation of synthetics, cross evaluations, line progression	25,000 – 50,000
	Improved germplasm: Most products to be integrated into ongoing TLII. Progression of elite lines incorporating wild favourable alleles from groundnut synthetics for drought tolerance, rosette and rust resistance.	50,000 – 100,000
Maize	**Genetic stocks:** None foreseen	Nil
	Improved germplasm: Progression of highly drought-tolerant elite Asian inbreds and derived lines	25,000 – 50,000
Rice	**Genetic stocks:** Finishing MAGIC population development, evaluation, line selection, progression and development	25,000 – 50,000
	Improved germplasm: Completion of at least 4 bi-parental MARS populations and progression of derived lines improved for drought and biotic traits.	100,000 – 150,000
Sorghum	**Genetic stocks:** Completion of backcross NAM development. Progression of RILs incorporating the Alt_{SB} gene for aluminium tolerance.	50,000 – 100,000
	Improved germplasm: Completion of MARS programme and progression of derived lines improved for drought and biotic traits; progression of derived lines from backcross NAM for wide adaptation; progression of lines derived from RILs incorporating Alt_{SB} for aluminium tolerance.	50,000 – 100,000
Wheat	**Genetic stocks:** None foreseen	Nil
	Improved germplasm: Progression of progeny identified and selected for drought tolerance from MARS populations. Progression of elites lines with superior water-use efficiency from backcrossing programmes.	50,000 – 100,000