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Collective Action for the Rehabilitation of Global Public Goods in the CGIAR Genetic Resources System: Phase 2 (GPG2)

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Executive Summary

Background of the Project

The 700,000-plus samples of plant genetic resources in the in-trust collections held in the genebanks of the CGIAR Centres and information on those collections represent important global public goods to be put to work for human well-being. Thus, the genebanks are a vital strategic tool for the Centres' and their partners to achieve a positive impact on the livelihoods of the poor. As well as having the important role of custodians of the collections, the Centres have unique expertise in conservation and use of genetic resources. This positions the CGIAR very strongly to play a significant part in creating a global system for the conservation and use of plant genetic resources to optimize their contribution to livelihoods now and in the future.

The GPG2 project (*“Collective Action for the Rehabilitation of Global Public Goods in the CGIAR Genetic Resources System: Phase 2”*) was a three-year, \$10.46 million project (2007-2009) funded by the World Bank through its contribution to the CGIAR, and coordinated by the System-wide Genetic Resources Programme (SGRP) on behalf of the CGIAR Centres.

It had a two-fold objective of achieving effective stewardship of the Centres' in-trust collections and providing leadership to partners in developing a global crop-based conservation and use system. The project builds upon the Centre-own upgrading carried out under Phase 1 of the project (GPG1), with \$13.6 million funding from the World Bank. The GPG2 project completed the work required to bring Centres' infrastructure and operations up to international standards, resulting in a significantly higher capacity in the genebanks.

The project was designed on a logical framework basis, expressed through a hierarchy of Objectives culminating in the Development Goal that: *Crop genetic resources and associated biodiversity are put to use in developing countries to fight poverty, enhance food security and health, and protect the environment*. Six Outputs, with respective Outcomes are listed below. They cover secure conservation, effective management and facilitated access to the in-trust collections, CGIAR Centre involvement with wider biodiversity, and development of a global conservation and use system.

Output 1 (*Uniform risk management procedures developed and implemented in all CGIAR genebanks*) was delivered through activities to upgrade genebank facilities, to process accessions into storage to agreed standards and to safety backup, to improve storage procedures for clonal crops, and to implement and promote systematic risk management. The expected outcome for this output is that the *“CGIAR Centres meet the commitments made in the in-trust agreements regarding security, and provide an example and guidance to partners on risk management”*.

Output 2 (*Best practices for genebank management developed and implemented in the CGIAR Centres and made available to partners*) was delivered through activities to refine and disseminate best practices for collection conservation and use, including germplasm health, to develop and implement inventory management systems, and to develop and disseminate decision-support tools to enhance the cost-effectiveness of collection management. The corresponding expected outcome is that *“the in-trust collections are more effectively and efficiently managed according to agreed and promoted best practices”*.

Output 3 (*Unified protocols for locating and delivering germplasm, and for sharing information on common crops in place at all CGIAR genebanks*) involved the development of a collaborative platform

to support best practices for the safe movement of germplasm, the design and implementation of a one-stop entry point for information on and ordering from the in-trust collections, and the design and implementation of harmonized registries for crops held in common by the Centres and other genebanks. The expected outcome is that *“Users have safer and more effective and efficient access to the in-trust collections”*.

Output 4 (*Strategies and tools for enhancing knowledge on the diversity held in the in-trust collections*) was delivered through activities to enhance the quality of information available on the collections, assessment of gaps in diversity and genetic integrity, and subsequent studies of crop diversity. The expected outcome for this Output is that *“Increased understanding of the diversity in the in-trust collections renders them more useful to Centre breeding programmes and to partners”*.

Output 5 (*Recommendations for the wider involvement of the CGIAR genebanks in addressing genetic and genomic stocks, associated biodiversity and underutilized species*) involved activities that looked beyond the current in-trust collections to develop an inventory of genetic and genomic collections and develop related management procedures, to survey available microbial, fungal, insect and nematode collections and analyze the CGIAR System’s comparative advantage for involvement therein, and to optimize the System’s contribution to global efforts on underutilized plant genetic resources. The expected outcome of this Output is that *“Coherent strategies and plans are in place for more effective conservation and use of genetic and genomic stocks, associated biodiversity and underutilized species in the achievement of CGIAR System and Centre objectives”*.

Output 6 (*Mechanisms for improved collective action among the CGIAR genebanks in the delivery of global public goods and promotion of international collaboration on conservation*) was delivered through activities to manage collective action effectively, both during the lifetime of the project and sustainably into the future, to promote awareness and use of the in-trust collections, to support and monitor the development of a global system and the CGIAR Centres’ performance therein, to enhance the research capacity of the CGIAR System, and to direct the enhancement of human capacity both within the CGIAR System and in the wider plant genetic resources community. The expected outcome for this Output is that *“The CGIAR contribution to the development of a global crop-based conservation and use system is enhanced”*.

The project was implemented over a period of three years (January 2007 – December 2009), with a no-cost extension for 17 of the 38 Activities until 30 June 2010. To achieve effective management of this large and complex project, a dedicated Project Coordinator was appointed to work with the SGRP Coordinator and under the guidance of the SGRP Executive Committee. Twenty-eight individual collaborative Activities, plus 10 Centre-own Activities, were led by Activity Coordinators from the staff participating Centres, in cooperation with Task Forces that involved Centres and external partners, totaling about 150 people from 30 countries participating in the project. Activity coordinators were responsible for the development and implementation of the workplan and budget, and financial and technical reporting. The project took advantage of opportunities for working with collaborative efforts within and outside the CGIAR, for example, the Consortium for Spatial Information (CSI), the Generation Challenge Program (GCP), the Central Advisory Service on Intellectual Property (CAS-IP), the Internal Auditing Unit (IAU), the International Centre for Underutilized Crops (ICUC), the ICT-KM Program, and the Global Facilitation Unit for Underutilized Species (GFU). The collaborative approach included capacity-building for the benefit of both NARS partners and the maintenance of core expertise within the Centres.

The primary beneficiaries of the project are the CGIAR Centre genebanks, which will benefit in their operations and their capacity to serve their stakeholder communities through more effective, cost-effective, secure and accessible stewardship of the in-trust collections, efficiencies in the management of crops in common, sharing of knowledge and tools, and more effective research planning for collective and individual action. The ultimate beneficiaries of the project, however, will be poor farmers and communities in the developing world. Greater access to a wider range of diversity will provide farmers, NARS, public and private plant breeding organizations, and seed producers with options to react to challenges ranging from climate change and new pests and diseases, to emerging consumer preferences, with collateral livelihood benefits through reduced pesticide use and reduced pressure on fragile environments.

The aim of the project is that, upon its completion, the CGIAR in-trust collections will have a financial and technical basis for long-term, sustainable and accessible stewardship of the valuable public goods that they represent, with the CGIAR exercising leadership in a collective effort with other international organizations and NARS to build an effective global system for the conservation and use of crop diversity.

Key Project Achievements

This project has been an excellent collective experience that will be an example for the coming changes within the new CGIAR. A range of 148 products were developed within the various activities, covering 20 crops as well as some non crop-specific and non-plant taxa. These achievements can be summarized in the following 3 main areas:

1. Improving Procedures for Managing Genetic Resources

Best management practices for seed and clonal crop collections in the CG and for optimum conservation and use were developed and compiled into a knowledge base, including training materials and exchange of technologies between Centres, producing products targeting the following areas of germplasm management- see website [\[hyperlink here\]](#)

Conservation: Storage procedures for 7 seed crops and protocols for 4 clonal crops with guidelines for medium- and long-term conservation – see webpage [\[hyperlink here\]](#)

Reducing loss of genetic integrity: Recommendations for reducing and managing the loss of genetic integrity of conserved germplasm for 4 crops – see webpage [\[hyperlink here\]](#)

Management of transgenes: Specific guidelines for 3 crops to maintain conventional germplasm accessions free from transgenic introgression and for conserving germplasm of transgenic crops – see webpage [\[hyperlink here\]](#)

Safety duplication of germplasm: Procedures and model agreements for a System-wide strategy - see webpage [\[hyperlink here\]](#)

Inventory management: Model genebank inventory systems and guidelines for bar-coding specifications to assist Centres in implementation - see webpage [\[hyperlink here\]](#)

Safe-movement of germplasm: Safe-movement guidelines of best practices for 20 crops, including methodologies for pathogen detection and a collaborative platform with recommendations on harmonization of regulatory and phytosanitary requirements of the CGIAR Centres and their host countries – see webpage [\[hyperlink here\]](#)

Risk-management: Guidelines for risk-management procedures including assessment of risk and a map of risk mitigations to ensure the security, quality and availability of in-trust collections with recommendation for linkages to Centre-wide risk management – see webpage [\[hyperlink here\]](#)

Cost-effectiveness: A methodology and a decision-support tool to enhance the cost-effectiveness of collection management for optimal resource allocation - see webpage [\[hyperlink here\]](#)

Reducing backlogs: Upgrading and improvements of the Centers' management of the in-trust collections, in terms of reduced backlogs in the processing of accessions into storage, including regeneration, characterization, health and viability testing, documentation, and safety-duplication in accordance with the System-wide principles and deposit strategy, building on the accomplishments of the first phase of the project (GPG1). By the end of 2009, of the 721,594 samples of accessions planned to be processed, **1,232,497 samples of accessions were actually processed** (an over-achievement of 159%). About 29% of the accessions processed for safety duplication were sent to Svalbard while 71% was sent to the various host institutions for conventional safety duplication.

Improvements in the physical infrastructure at various genebanks resulted in greater overall security of their germplasm collections. Seed health testing and the monitoring of plant health during germplasm regeneration maintained a high level of seed quality for both conservation and distribution purposes.

2. Increasing the Value and Use of the Collections

One-stop entry point: A germplasm ordering system prototype using SINGER data and a help-desk to support Centres' implementation - see website [\[hyperlink here\]](#)

Eco-geographic gaps: Geo-referenced data checked and an analysis protocol for identifying basic eco-geographic gaps in the diversity of wild species and cultivated materials applied to wild species from 10 genebanks- see webpage [\[hyperlink here\]](#)

Diversity research: Existing phenotypic characterization strategies on selected crops in the CG (chickpea, rice, maize, potato, *Musa*, pigeonpea, sorghum) and patterns of demand for trait-specific germplasm reviewed to determine potential value and usefulness across Centres – see webpage [\[hyperlink here\]](#)

Crop register templates: Jointly developed for crops in common. For barley example – see webpage [\[hyperlink here\]](#)

Improvement of location data quality: Many missing data and errors were corrected from databases – see webpage [\[hyperlink here\]](#)

Central repository of scanned passport data from collecting missions – see webpage [\[hyperlink here\]](#)

3. Planning for the Future

A **Sustainability Plan** to ensure a durable result from the investment in rehabilitation of the collections, and to support the fulfillment of the Centres' in-trust commitments in the future. The plan includes a costing of the custodianship operations as well as the strategic, user-oriented operations (impact-focused) - see Annex 4.

A draft **strategic plan** for enhancing CGIAR System capacity to identify and address research priorities for collective actions – see *electronic Annex 10*.

A **plan for engaging and retaining skilled human capacity** in the System, directly linked to the development of the sustainability plan, including staffing recommendations for Centres' management – *see electronic Annex 10*.

Strategies for neglected and underutilized plant species in the CGIAR and in national genebanks. Groups of species prioritized, main areas of relevance for model development in consultation with key stakeholders, guidelines for assessing benefits delivered to communities and comparative advantages of Centres for carrying out activities and research suitable for collective actions – *see webpage [\[hyperlink here\]](#)*

Strategies for non plant taxa in the CGIAR system and national genebanks, including bacteria, fungi, oomycetes, viruses, insects and nematodes – *see webpage [\[hyperlink here\]](#)*

Strategies for genetic stocks, with survey results documenting, list existing and future genetic stock collections for all major crops - *see webpage [\[hyperlink here\]](#)*

A proposed set of **indicators to measure the performance** of the CGIAR Centres in managing the in-trust germplasm collections – *see webpage [\[hyperlink here\]](#)*

A **policy analysis** of the elements of an integrated system, with country report analysis from Peru, Morocco, Kenya and Philippines, as well as a cross cutting analysis of common features – *see webpage [\[hyperlink here\]](#)*

Guidelines on quality management for genebanks with a feasibility study on the use of ISO for genebanks - *see webpage [\[hyperlink here\]](#)*

The particular strength of the project was the way that it build on a foundation of individual Centre competence to develop new modalities of collaboration for the integration and sharing of standards and methodologies across genebanks to increase System-wide efficiency and effectiveness in the management and accessibility of crops, particularly those held in common among Centres. This was accomplished through the development of common information systems, the identification of replicates between Centre collections, and the sharing of tasks in conserving and distributing material. Effective collaboration among the Centres provided a springboard for the CGIAR to take leadership in the development of a more effective and efficient global crop-based conservation and use system.

Internal Assessment and Learning

The project partners assessed the planning, implementation and reporting during the project to identify what worked well and what could be improved for future collective action projects. Several sources and methods were used to gather this information, and the following were relevant:

- Project implementation and management done through many contracts and LoAs resulted in many reporting requirements per activity. It would have been more efficient to aggregate similar activities and regional activities to fewer, larger contracts for reporting.
- Time at the beginning of the project for start-up activities and team building would have reduced the initial delays and should be taken into consideration in future project planning.
- Interdependency of activities should be taken into account when estimating time schedules, workplans and budget allocation. Regular monitoring of progress of activities against milestones is important to decide when alternative solutions need to be considered to meet commitments.

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- More uniform participation and full engagement from all partners would have facilitated activities to progress in parallel and avoid some of the delays.
 - Communication among partners was essential to deliver outputs in such a complex project but care must be taken to avoid information overload. When dealing with dispersed project partners across continents and time zones, a diversity of media should be used to communicate and whenever possible, more direct communication and personal interactions should be used.
 - It would be very helpful for future collaborative initiatives to identify at least one champion per Centre early in the project to support communication and information sharing.
 - Most GPG2 products were only completed towards the end of the project. Greater efforts to promote and disseminate these products and outputs over a longer period of time would increase their usefulness.
 - Many of the products of the project are dynamic and will require regular updates to remain relevant. Products with high potential for further development to improve them should continue to be supported by Centres after the end of the project.

External Review of the Project

The two external project evaluation teams made useful and relevant recommendations to improve project implementation (mid-term review report) and enhance the impact of project results (final review report). These are detailed in the annexes of this report. Important changes were made in response to the mid-term external review:

- The Internal Audit Unit audits were completed to assure the adequate management of funds. Consultants were employed to support the project coordination.
- The quality control system for products was formalized and improved.
- The SGRP website was improved to create more awareness and facilitate dissemination of information during, as well as after, the project.
- Development of the sustainability plan allowed the time and space for strategic thinking and planning about the role of Centre genebanks in the wider global genetic resources system. The future visioning process is ongoing in parallel with the change management process within the CGIAR and future activities may need to be adjusted accordingly.

Relevant changes were also made in response to the final external review:

- The quality of specific products was further improved with friendly formats of easy access.
- There were extra efforts made to finalize all unfinished products.
- More awareness was raised about the GPG2 results and products to maximize their use.

General Lessons Learned

A lot was learned about the ground rules of working together amongst the CGIAR genebank community. New links were created between the scientists using knowledge sharing mechanisms that supported and eased dissemination of the GPG2 products. Attribution was identified as a key issue for collaborative work and for the products of collective action which are made available as

Global Public Goods. Important steps were taken to address this need and provide guidelines for attribution in this and future collaboration. Guidelines on attribution were initiated in GPG2 for information sharing using social media.

Interdependencies where some activities could only proceed after results were available from others resulted in inevitable delays during the first two years of the project and led to a heavy workload to complete activities at the end. The transaction costs of working together required more effort than initially expected.

SGRP proved to be a highly effective platform from which to coordinate, promote, and report on such a large system-wide project based on collective action. The collective action approach was instrumental in instilling a “system mindset” amongst the project partners, enabling them to focus on larger problems, larger goals, and greater impacts than may be addressed by individual Centres.

Conclusions and Recommendations

The main conclusions can be summarized into 3 main areas:

1. Integrating the GPG2 Outputs into On-Going Genebank Activities

GPG2 was an important project with many valuable products generated by both Centre-own and collective activities. It was not possible to test or validate all products during the life of the project, and some products are still being internalized into genebank operations. GPG2 also provided a learning experience that will guide partners in the CGIAR system in future collaboration and established useful networks. Given the important benefits of working together in areas of common interest, this community of practice should be nurtured and supported, irrespective of the current re-structuring of the CGIAR system.

The significant successes and cumulative benefits of the GPG1 and GPG2 projects were achieved to a very large extent through a collaborative, system-wide approach to genetic resources. The CGIAR can continue to take advantage of the intellectual capital of this group of specialists to identify and address new areas of work that would benefit from a collective approach to research and strategic thinking. The ongoing efforts by the Consortium Board to assess the needs and determine the means of support to the genebanks are appreciated, and the CGIAR genetic resources community is keen to contribute to these efforts and, ultimately, to the development objectives of the CGIAR as a whole.

Recommendation 1: Efforts should be made by each Centre to identify the relevant outputs and incorporate them into their routine planning and implementation of genebank operations, aiming at achieving greater efficiency, cost effectiveness and rationalization in management, conservation and use of genetic resources system-wide.

Recommendation 2: The Centres’ commitment to system-wide collective action in the area of genetic resources should be continued. Drawing upon the conclusions of the scoping study on genetic resources being commissioned by the Consortium Board, a mechanism should be put in place to ensure the continuity, adoption and use of many of the products and practices initiated in GPG2.

2. Guiding Activities to Completion

Some of the GPG2 tasks could not be finished as planned due to either lack of time (requiring more time than planned) or due to the interdependency with closely linked activities that were only ready towards the end of the project. Unfinished tasks considered as relevant such as the assessment of gaps due to loss of collected samples (4.1.3) could be completed in due course.

Recommendation 3: Centres should commit to use the collection data made more easily available during GPG2 to verify and expand their databases and perform gap analysis to have a more precise idea of lost material, gaps in current collection and the need to complement crop collections to achieve a good coverage of diversity.

Significant progress was made in reaching a common understanding among the Centres' genetic resources staff on a future vision as part of the development of the Sustainability Plan for CGIAR genebanks. Substantive inputs and recommendations were recently received from the Global Crop Diversity Trust and the Alliance Executive on the Plan. This iterative, consultative process need to be continued so that a practical Plan is developed that will serve as a reference point, justifying the basis for mobilizing the sustained support that is required for the adequate maintenance of the invaluable germplasm collections that are held in-trust as international public goods for the global community.

Recommendation 4: Genebank managers from each Centre should commit to actively participate in the further development of the Sustainability Plan, addressing stakeholders' concerns and incorporating their ideas so that the Plan can be endorsed by Centre management within the Strategy and Results Framework and by other key stakeholders. This Sustainability Plan should form an integral part of the funding strategy for the CGIAR-supported genebanks.

3. Building a Global System

Achieving a strengthened global system will require more effective partnerships among those working in conservation and use efforts worldwide to enhance the visibility and understanding of the role that plant genetic resources play in development. Currently there are different views of the global system among the diverse players and a lack of clarity on the concept and vision of a global system. Current visions, while not mutually exclusive, are not yet well articulated or coordinated.

Recommendation 5: A consultation process should be implemented among key stakeholders to more clearly describe a shared vision of the nature and function of the global system of genetic resources conservation and use.

Recommendation 6: The CGIAR, as one of the larger groups managing crop diversity as Global Public Goods, needs to articulate more clearly its role in the global system in order to take a more active part in it.

Preface

This report provides a general overview and summarizes the overall achievements of the GPG2 project, incorporating cumulative progress from Years 1, 2, and 3 and the final achievements through the end of the 6-month no-cost extension (NCE) (30 June 2010). Annexes 7 and 8 provide a list of partners involved in the project and the GPG2 Task Force members. Annex 9 provides a full list of acronyms and Annex 10 lists all referenced GPG2 documents in electronic format.

Section 1 gives a general overview of the project, its origins, objectives, structure and implementation.

Section 2 summarizes the key achievements of the project's Collective activities, per project Output, with an overview of the implementation, main highlights, next steps and future plans.

Section 3 presents the key achievements in the project's Centre-own Activities, with summary tables of accessions processed and the genebank upgrades at each Centre. The details of the tasks and milestone accomplishments for each of the Collective and Centre-own Activities are listed in Annexes 1 and 2, respectively. For each Activity, the overall level (%) of completion is indicated, compiled from the progress on each of the corresponding tasks and milestones agreed to in the project proposal (2006), and detailed in the yearly workplans. A full list of the 148 (public and internal) products derived from the GPG2 project, with the respective URL links, where applicable, is provided in Annex 3. An electronic annex to this report is provided on DVD (Annex 10), which contains additional documents with relevant details regarding the Centre-own and Collective Activities, as well as electronic versions of all other public documents produced by the project or otherwise mentioned in this report.

Section 4 presents a summary of the evaluation and monitoring exercises, listing important meetings held between collaborators and main findings from the two external reviews and self-assessments carried out. The Final Review Report can be found in Annex 5 and the SGRP responses to the recommendations are contained in Annex 6. The Mid-term Review Report is available electronically in Annex 10. The self-assessment reports are available on the SGRP website, with password protection.

Section 5 gives an overview of the impact of project outputs, as well as their adoption and uptake by the various beneficiaries. It provides a schematic comparison of the main products created under each output, how are they being used, and the results for each expected outcome.

Section 6 provides a general picture of the development of the Sustainability Plan and the current situation and adoption. This is a vital product of GPG2, to be used towards the sustainable planning of future activities in genebanks. The Sustainability Plan can be found in Annex 4.

Section 7 provides a brief overview of the funding patterns, reporting and internal audits carried out during the GPG2 project. The full financial report is presented in Annex 5.

Section 8 gives a brief description of the lessons learned, some reasons for success and explanations of any failures identified during the project implementation, in addition to those mentioned by the external reviewers.

Section 9 summarizes the main conclusions and provides recommendations for further actions to ensure the continuity and long-term impact of the important outputs generated by the project.

1. Introduction and Background

Opportunity

The collections held by CGIAR Centres represent the foremost international effort to conserve and manage crop, forage and agroforestry genetic resources. The CGIAR genebanks currently hold over 700,000 accessions, representing more than one-tenth of the world's total genebank accessions, with a particular richness in the concentration of traditional farmer's varieties.

The establishment of the CGIAR collections took place in response to an extremely urgent need to secure threatened resources for the future. The crisis circumstances prompting this international response meant that immediate needs were taken care of, but there was neither an overarching framework for the conservation actions, nor sufficient provisions for continued financial support. Therefore, recognizing the importance of the collections and their potential vulnerability, the CGIAR Centres took measures to secure the genetic resources that they hold by placing them under the legal framework of in-trust agreements, signed first with FAO in 1994, and more recently with the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in 2006. The Centres also embarked upon a programme of upgrading their conservation facilities and improving the conservation status of the accessions in terms of storage conditions, health, regeneration, safety back-up and information management.

The financial resources available to the Centres for implementing these measures were, however, limited. This meant that the Centres were unable to fully meet the standards of operation expected under the terms of the in-trust agreements signed with FAO in 1994. In fact, Centres have seen their unrestricted core funding drop by 50% since that year, and donors are rarely willing to provide restricted funding to support routine genebank operations. Fortunately, through the initiative of the System-wide Genetic Resources Programme (SGRP), a \$13.6M grant was provided by the World Bank in 2003, entitled "Rehabilitation of Global Public Goods in the CGIAR Genetic Resources System: Phase 1" – commonly referred to as "GPG1"). Over a 3-year period, the GPG1 initiative enabled significant progress to be made in upgrading the CGIAR genebank facilities, in reducing the backlog of accessions waiting to be processed and placed in secure conservation conditions, and in documenting the basic information about the accessions to enhance the usefulness of the collections.

The significant progress achieved under GPG1 served as an impetus for taking the work of the Centres forward to complete the rehabilitation of the collections and the genebanks where they are conserved, and to provide a foundation for their steady-state maintenance into the future. In 2006, the World Bank approved a grant of \$10.4M for a second phase of the project, known as GPG2, which included a large number of activities aimed at strengthening the collective action within the CGIAR and facilitating access to the in-trust collections. The timing was opportune for such an investment, as the international context of recent global policy developments was conducive to the Centres' stepping forward to play their role in the development of a global system based on a comparative advantage of effective collective action and a unique amalgamation of technical expertise. The CGIAR's recognition of its role in global crop conservation echoes the calls by the International Treaty (ITPGRFA) and the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources (GPA) for an effective and efficient global system. Other elements of the CGIAR's priorities recognized the research required to support a global system and the importance of underutilized species in the fight against poverty and malnutrition. Jointly founded by the CGIAR and FAO, with roots in the SGRP, The Global Crop Diversity Trust (GCDT), was established to support such a system, and is well on the way to meeting its objectives. The collections held in common by the CGIAR Centres are obvious candidates in their own right for rational management with economies and efficiencies enabled through inter-Centre cooperation. Through collective action, the Centres can

provide a model within the global system for achieving secure conservation and access whilst managing costs.

The GPG2 project united two important elements of the CGIAR's genetic resources agenda, namely, upgrading the CGIAR genebanks and providing leadership towards the development of the global system. The human and financial resources for achieving these respective objectives were significant, but built upon a solid foundation that was already in place. The CGIAR genebanks are recognized worldwide as centres of excellence and leaders in the development of storage procedures, genetic diversity analysis and information management that underpin the conservation and use of genetic resources. In the highly specialized field of genetic resources management, the Centres' genebanks have a well-established track record of applying available technologies, developing new technologies and transferring technologies to partners in the global system. This global leadership role is facilitated and strengthened by the experience of collective action under the aegis of the SGRP, to define and work towards common goals and enable efficiencies of scale. As such, the Centres are in a strong position to contribute to the development of a global crop-based conservation system, working in complementary partnership with other international and national collections to achieve common objectives and standards.

The work presented in this final GPG2 report benefited from the experience of conducting GPG1, as well as feedback received during the mid-term and final review processes of GPG2. The GPG2 project made it possible to complete the measures for securing the in-trust collections, and was an excellent springboard for positioning the CGIAR to undertake a fuller, more proactive role in integrating, promoting and underpinning a global system, as proposed in the project document.

Objectives

Through this project, the CGIAR Centres--as the legal stewards of such valuable, global public goods--aimed to raise the standards of conservation of the in-trust collections to better ensure the long-term accessibility necessary to make an optimal contribution to fighting poverty, increasing food security, and diversifying sustainable and more resilient production systems. Although the GPG2 project built upon the successes of GPG1, by completing the upgrading of the genebank facilities and eliminating backlogs, it went beyond the Centre-own activities to take advantage of the opportunities for collective action that the Centres could reap by working together as a system. The collective activities had two key objectives, namely:

- enhancing and streamlining the System's management of global public goods through the development and sharing of knowledge and standards, and the achievement of efficiencies of scale, especially with regard to crops held in common across the System;
- generating scientific, technical and managerial know-how in order to optimize the operation of the genebanks, which will lead to the additional benefit of positioning the CGIAR in contributing to the development of a global system involving a wider community of partners.

These key objectives are embodied in the hierarchy of Objectives covering the Development Goal, Intermediate Goal, Purpose, and the six project Outputs summarized below.

Project Goals, Purpose, Outputs and Outcomes:

- Development Goal:** Crop genetic resources and associated biodiversity are put to use in developing countries to fight poverty, enhance food security and health, and protect the environment.
- Intermediate Goal:** Creation of a comprehensive, effective and sustainable global conservation and use system.
- Purpose:** The CGIAR Centres achieve effective stewardship of their in-trust collections and provide leadership for partners in developing a global crop-based conservation and use system.
- Output 1:** **Uniform risk-management procedures developed and implemented in all CGIAR genebanks.**
- Outcome 1:* *The CGIAR Centres meet the commitments made in the in-trust agreements regarding security, and provide an example and guidance to partners on risk management.*
- Output 2:** **Best practices for genebank management developed and implemented in the CGIAR Centres and made available to partners.**
- Outcome 2:* *The in-trust collections are more effectively and efficiently managed according to agreed and promoted best practices.*
- Output 3:** **Unified protocols for locating and delivering germplasm and for sharing information on common crops in place at all CGIAR genebanks.**
- Outcome 3:* *Users have safer and more effective and efficient access to the in-trust collections.*
- Output 4:** **Strategies and tools for enhancing knowledge on the diversity held in the in-trust collections.**
- Outcome 4:* *Increased understanding of the diversity in the in-trust collections renders them more useful to Centre breeding programmes and to partners.*
- Output 5:** **Recommendations for the wider involvement of CGIAR genebanks in addressing genetic and genomic stocks, associated biodiversity and underutilized species.**
- Outcome 5:* *Coherent strategies and plans are in place for more effective conservation and use of genetic and genomic stocks, associated biodiversity and underutilized species in achieving CGIAR System and Centre objectives.*
- Output 6:** **Mechanisms for improved collective action among CGIAR genebanks in the delivery of global public goods and promotion of international collaboration on conservation.**
- Outcome 6:* *The CGIAR contribution to the development of a global crop-based conservation and use system is enhanced.*

Technical Approach

This section summarizes the technical approach taken in the project. Annexes 1 and 2 provide details on the Activities implemented to deliver each Output. Many of the gaps that remained after GPG1 are addressed by GPG2, and facilities and operations were upgraded accordingly. Genebank operations were further enhanced by the application of new tools and approaches that were developed through the project.

New modalities of collaboration were developed for the **integration and sharing of standards and methodologies** across genebanks to increase System-wide efficiency and effectiveness. The work addressed System-wide issues of improved coordination regarding crops in common, i.e. rice, wheat, barley, cassava, maize, chickpea, forages, and banana, promoting integration in the management of such crops. This will increase efficiency and effectiveness across the CGIAR genebanks holding these crops, and provide more user-friendly access for users inside and outside the System.

The project developed **new models and tools that can be applied widely on the basis of crop or germplasm type** (seed, vegetative collection, *in vitro* collection), and generated an increased understanding of the diversity available in the global public goods managed by the CGIAR, and the potential for further development of CGIAR collections. Case studies were used to validate new tools and approaches involving a range of crops and Centres.

The integrated and complex set of activities involved in the project required coordination at the System-wide level and careful monitoring and evaluation to ensure effective project management to meet milestones and deliver outputs. The **assessment and active management of risks** were taken on board as central issues in the stewardship of the germplasm collections and related information. The project design sought to maximize the safety and sustainability of the collections, by directing scarce resources to where they would have the most impact. Moreover, the project design explicitly included **performance management**, involving the development of criteria for assessing improvements over time in the security, quality and availability of the in-trust collections, and for assessing the effectiveness of the System's contribution to the development of cooperation at the global level.

Modus Operandi

The basis of the project was collective action, bringing together the existing expertise, experience and knowledge of the Centres, and taking advantage of synergy and complementarity. This approach was applied in order to streamline the System's efforts in managing and delivering global public goods to stakeholders to achieve System goals. The collective action is most evident in the work on crops in common; the one-stop ordering facility; common resources and platforms for best practices in genebank management and plant health; and common principles for risk management, performance assessment and safety backup. Beyond these activities, a spirit of collective action underpins all of the project's work, typifying the way in which the SGRP has developed over the years to reconcile Centre autonomy with inter-Centre collaboration. Thus, the project includes work on strategy development, scoping, and research priority-setting which all draw upon the collective know-how of the System, in addition to outside expertise. The goal is to guide future work both within the System and in the wider plant genetic resources community, laying the basis for stronger cooperation at the global scale.

The collaborative approach in working with the wider community depends upon the partners' willingness to accept the CGIAR in a leadership role. Building on a history of collaboration, FAO, the International Treaty, the Global Crop Diversity Trust and key National Agricultural Research Systems (NARS) were important partners that brought knowledge and expertise to the project. The CGIAR's

prominent position in recent international policy developments bodes well for the recognition of its leadership, as do the many collaborative relationships that the SGRP and individual Centres have with partners. The CGIAR already has a reputation for the successful delivery of technologies, information and germplasm. The project served to reinforce this through its inclusive approach to agenda-setting on, for example, underutilized species and associated biodiversity.

The project engaged groups beyond the genebanks, such as plant health experts and the networks of underutilized crop experts built up by the Global Facilitation Unit for Underutilized Species (GFU) and the International Centre for Underutilised Crops (ICUC). It also took full advantage of working with other CGIAR System collaborative efforts, including the Consortium for Spatial Information (CSI), the Generation Challenge Program (GCP), the Internal Auditing Unit, the Central Advisory Service on Intellectual Property (CAS-IP), SINGER and other CGIAR programs. Collaboration tools such as the CGIAR's intranet/extranet, the SGRP website, and the DotProject project management software provided virtual platforms for project teams to work more productively and virtually.

Project Structure and Management

The Secretariat of the System-wide Genetic Resources Programme (SGRP) was responsible for coordinating the project and reported to the donor on behalf of the 11 CGIAR Centres implementing the project: AfricaRice, Bioversity International, CIAT, CIMMYT, CIP, ICARDA, ICRISAT, IFPRI, IITA, ILRI and IRRI. Information for this report was collected and summarized from annual activity reports, review reports and self-assessment surveys. The project was monitored and regularly discussed by the Inter-Centre Working Group on Genetic Resources (ICWG-GR), which is the Steering Committee of the SGRP. The project was implemented by the participating Centres in close collaboration with a number of international, regional and national partners. The list of partner organizations and collaborators is presented in Annex 7.

The total budget was US\$10,458,490, mostly used between 1 January 2007 and 31 December 2009. In December 2009, some of the project activities that had been delayed, received a no-cost extension (NCE) until 30 June 2010.

The project was administrated through 35 contracts (Letters of Agreement) signed between the SGRP Secretariat and the participating CGIAR Centres, specifying the Activity Coordinator, Task Force members involved in the work undertaken, conditions for the disbursement of funds, and requirements for technical and financial reporting to the SGRP.

The Project Management Structure was Organized into:

- **21 Activities.**
- **48 Sub-activities.**
- **28 Activity/Sub-activity Coordinators.**
- **13 Lead institutes.**
- **24 Task forces of between 5-10 members (a group of about 150 participants).**
- **725 Milestones constituting the contractual commitments vis-à-vis the World Bank.**
- **35 Contracts (Letters of Agreement) - with 3-year duration.**
- **38 Annual workplans - for each of the 3 years (28 for collective activities, plus 10 for the Centre-own upgrading plans).**
- **35 Annual financial reports - for each of the 3 years.**
- **35 Annual technical reports - for each of the 3 years.**
- **1 Annual technical and financial report to the World Bank - for each of the 3 years.**

The management of the project was demanding due to its complex, multi-partner nature, with collaborative elements and autonomous actions coordinated within an established agenda. To achieve effective management, a dedicated Project Coordinator was appointed to work under the supervision of the SGRP Coordinator and under the guidance of the SGRP Executive Committee. The Project Coordinator was responsible for day-to-day monitoring of Project implementation, and also had a leading role in a number of overarching collaborative activities. Individual collaborative activities were coordinated by a focal person in a Centre or System group such as CSI or SINGER, with the support and involvement of Task Groups, other Centres or external partners, as needed. Responsibility for development and implementation of the workplans, budgets and financial and technical reporting was devolved to the Activity Coordinators. Responsibility for providing annual technical and financial reports also resided with the corresponding Activity Coordinators and their Centres. The Project Coordinator collated individual technical and financial reports and was responsible, along with the SGRP Coordinator, for compiling each annual project progress report for review by the SGRP Executive Committee and submission to the CGIAR Secretariat. The project was subject to regularly scheduled financial audits, and to Mid-term and Final External Reviews. The outcomes of these external reviews, financial audits, and their recommendations are presented in Sections 4 and 7 and Annexes 5 and 6.

The inherent complexity of the GPG2 project (shown in Figures 1 and 2) made project management a labor-intensive effort. A computerized project management application (DotProject) was adopted and adapted by the project in May-September 2008, and greatly facilitated the tasks of project management, monitoring and reporting. All activity leaders had remote access to this online tool to review and upload their progress reports. This tool managed all the technical reporting aspects but did not include the tracking of financial reports and related information, which was done separately by the SGRP Budget and Financial Assistant (PBFA) and the Bioversity Finance Department. The online tool is available as a password-protected archive at: <http://www.sgrp.cgiar.org/gpg2pc/index.php>.

The Leading Activity Coordinators and Centres for each of the Sub-Activities are listed in Figures 1 and 2 respectively.

In addition to the complex project structure, implementation became more challenging due to the replacement of various activity leaders, as well as a change in the project coordination during the, no-cost extension period.

Figure 1. GPG2 Project Chart with Activity Coordinators' names

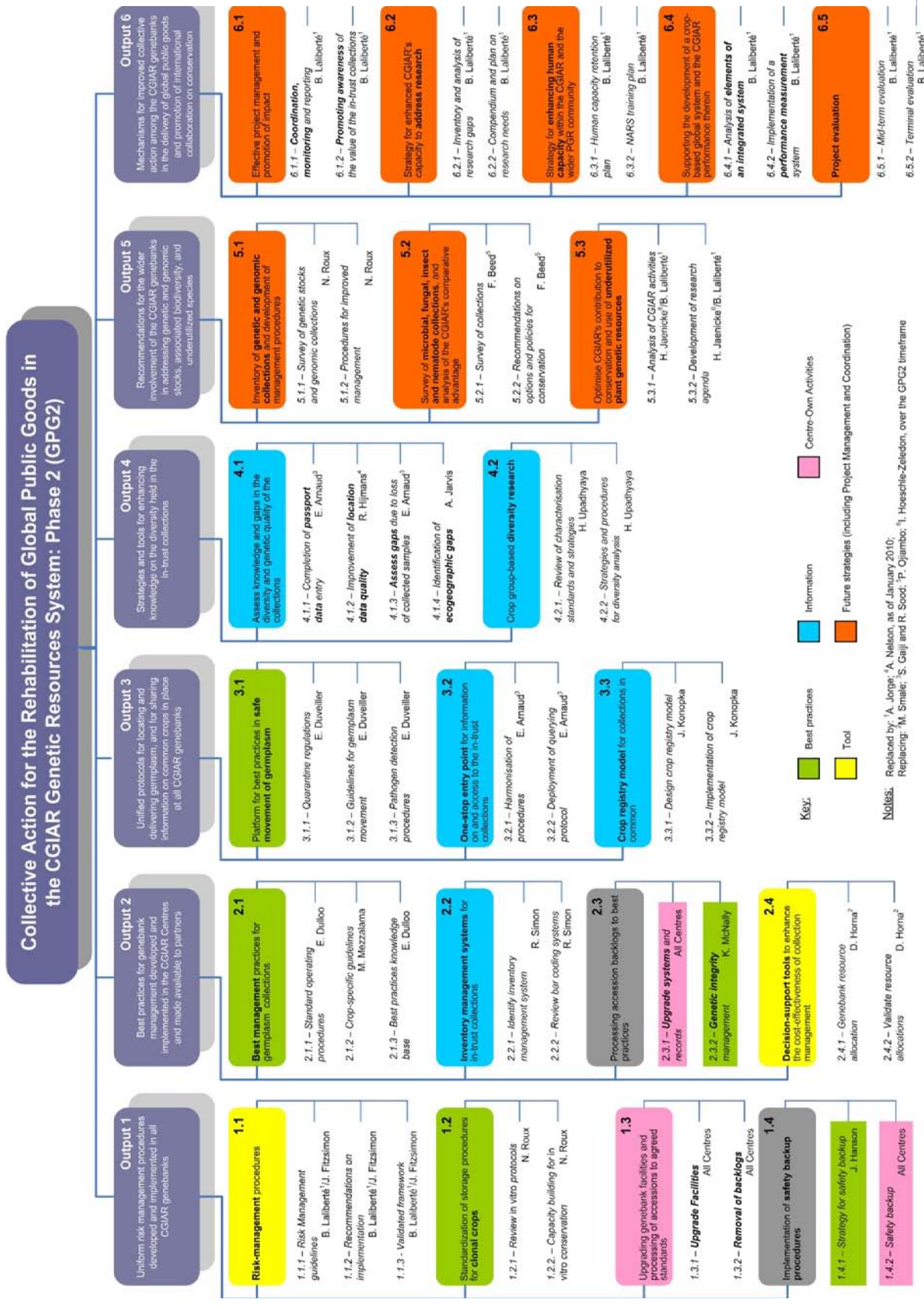
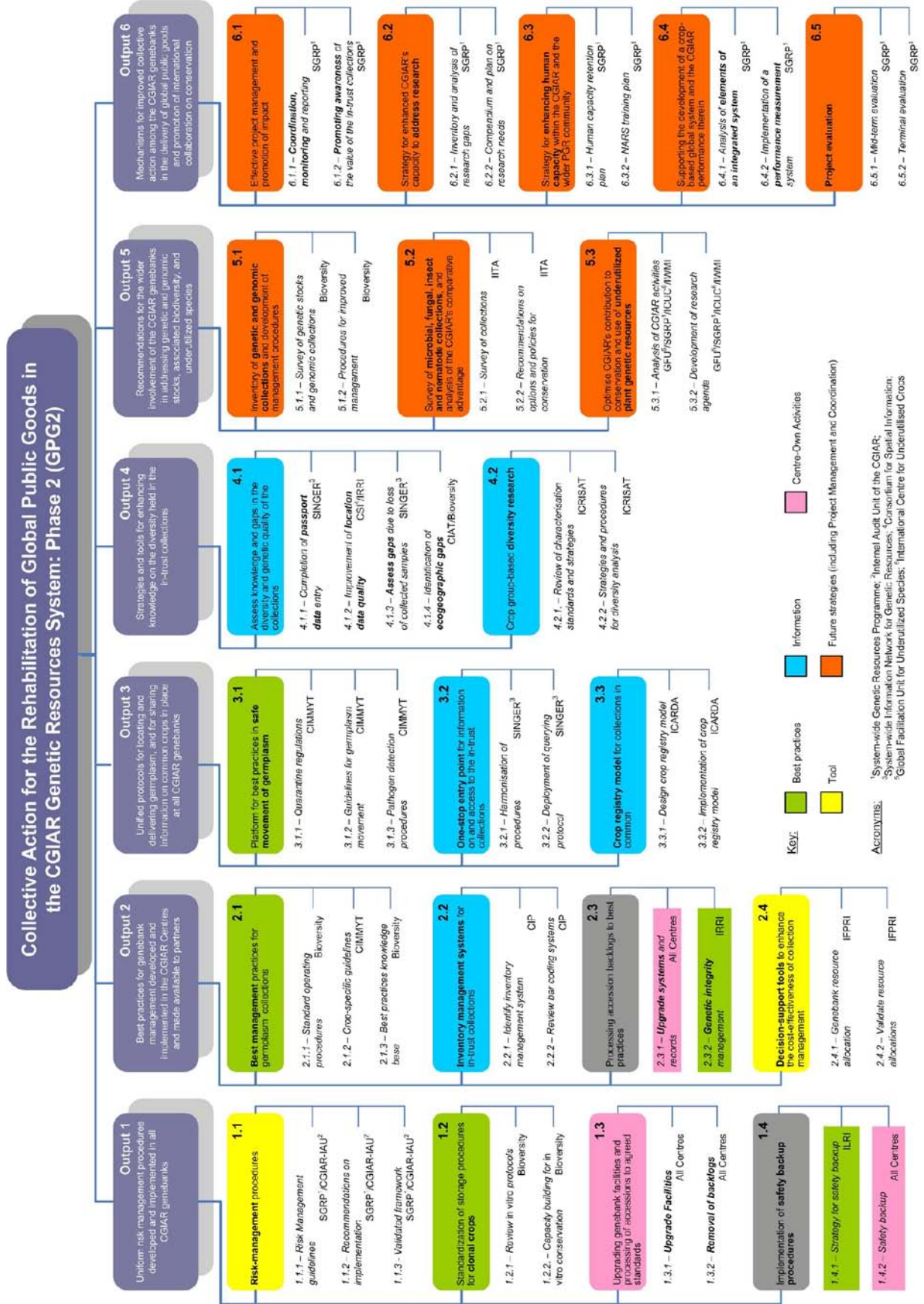


Figure 2. GPG2 Project Chart with Leading Centres



2. Collective Activities – Summary of Cumulative Achievements

General Overview

Tasks were initially defined (and regularly adjusted each year) to achieve the 725 milestones of the project across the 6 outputs over the 3 years. Full lists of tasks and milestones are shown in Annex 1 and Annex 2, for collective and Centre-own activities respectively, and the full details per Centre in electronic format, in Annex 10. The tasks defined for the Centre-own activities were mostly quantifiable, as most relate to the number of accessions to be processed. However, a large proportion of these milestones were under the collective activities, and specific networks and partnerships were established to be able to achieve them all. Throughout the project, the need arose to quantify achievements and establish how much was accomplished by whom and exactly what this entailed. There was also a constant need to display and make publically available the different informative materials (documents, reports, websites, webpage links, multimedia and other products) resulting from this initiative. A list of specific products and respective web links or files was compiled for each activity and the summary of links is displayed in Annex 3. A complete, detailed list of products is provided electronically in Annex 10. An estimated total of 148 distinct products were generated, each corresponding to a specific milestone and expected output. This total is not definitive, as the results of some outputs are underestimated in terms of the number of distinct products; however it is a convenient means of quantifying the diverse range of tangible outputs generated. A good example is the Crop Genebank Knowledge Base (CGKB), which was counted as two website products: one general and another crop-specific, although it consists of more than 200 separate webpages. Furthermore, each product was classified by the following categories: type of product (e.g. webpage(s), technical guidelines, document, database, case study, survey, position paper, scientific paper, tool, multimedia/PA, poster, report), status of completion (e.g. in preparation, working draft, final draft, final), status of peer review (e.g. reviewed, under review, not reviewed), type of activity (e.g. tool, best practices, information/documentation, future strategies), CGIAR contributors, leading Centre, and crops covered. The full list of contributors (Task Force members and organizations) to the GPG2 products is too large to be compiled in the tables, so this information is clearly acknowledged in each product and summarized in Annexes 7 and 8.

A general view of the coverage of the results of the collective activities is given in Tables 2.1, 2.2 and 2.3. CIMMYT participated in the delivery of the most products (ca. 90%), followed closely by Bioversity, ICRISAT, IRRI, ILRI, IITA, ICARDA, CIP and CIAT each with more than 70% participation in the total number of collective products generated (Table 2.1). Equally important were other CGIAR initiatives (Capacity Strengthening, Education and Training Groups, CAS-IP, CSI, IAU, ICUC, SGRP and SINGER), which contributed to about 40% of the products. Many non-CGIAR organizations also provided major contributions to the project outputs and are listed in Annex 7. These figures show that the GPG2 was a true collaborative effort and that various partners contributed to many of the products.

Table 2.1 Number of collective products per Centre or Programme*

CGIAR Centre or Programme	Number of products to which the CGIAR Centre or Programme contributed
AfricaRice	58
Bioversity	101
CIAT	72
CIMMYT	94
CIP	70
ICARDA	80
ICRAF	27
ICRISAT	83
IFPRI	15
IITA	74
ILRI	81
IRRI	83
IWMI	3
CGIAR Programmes**	77

Notes:

*A large number of non-CGIAR organizations also provided contributions to the above-listed products. The full list is available in Annex 7.

**CGIAR Programmes and Initiatives include: Capacity Strengthening, Education and Training Groups, CAS-IP,CSI, IAU, ICUC, SGRP and SINGER.

These 148 collective products were well-balanced between the crop-specific (ca. 60% of the products, covering 20 crops, with 1-10 products per crop), and non-crop-specific (ca. 65%), as well as ca. 5% related to non-plant taxa (Table 2.2). This demonstrates the broad coverage of the GPG2 products, which were developed not only for important crops, but also in such a way as to be generally applicable and easily adapted/customized to address specific crops. It also shows some innovative work towards new areas of priorities that are not related to crop

Table 2.2 Number of collective products per crop

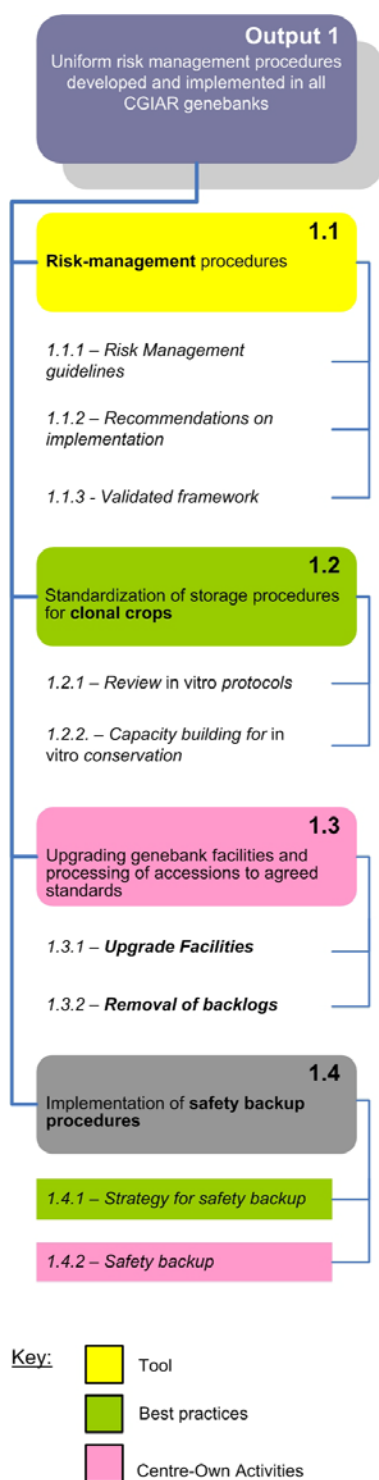
Crop	Number of products
Barley	5
Cassava	9
Chickpea	6
Common bean	1
Cowpea	1
Faba bean	1
Forage grasses	5
Forage legumes	5
Groundnut	1
Lentil	1
Maize	6
Millets	1
<i>Musa</i>	9
Pigeonpea	2
Potato	8
Rice	8
Sorghum	4
Sweetpotato	5
Wheat	5
Yam	4
Multicrop	92
Non-plant taxa	6

One third of the collective products were technical guidelines and another third are available online on websites (Table 2.3). About a quarter of the products are documents, position papers or reports that have recommendations on strategies and ways forward in the respective areas. This shows a wide range of disseminated products that will be of use for various types of users -- some for technical training, some for teaching, others providing new sources of updated information and references, others that will play an important role in making decisions and defining strategies at the planning level.

Table 2.3 Number of collective products by type

Type of product	Number of products
Case study	7
Database	6
Document	10
Multimedia/PA	17
Position paper	11
Poster	5
Report	13
Scientific paper	7
Survey	5
Technical guidelines	54
Tool	6
Webpage(s)	51

OUTPUT 1: Uniform Risk-Management Procedures Developed and Implemented in all CGIAR Genebanks



Overview

Secure conservation is at the heart of the Centres' stewardship of their collections, and depends on accurate assessment and the appropriate management of risks. The adequacy of conservation technologies is key, requiring particular attention for clonal crops. Safety duplication to back up collections provides necessary insurance against a range of threats.

Implementation

The development of risk-management guidelines to ensure the security, quality and availability of the in-trust collections was led by the CGIAR Internal Audit Unit (IAU), IRRI, CIAT and ILRI. A researcher from the national institute in the Philippines, PhilRice was seconded to work on the risk-management guidelines between October 2007 and October 2009. A consultant was hired to enter the results into user-friendly formats to be uploaded online. Good links have been insured between Activity 1.1 (risk-management procedures) with the closely related GPG2 Activities: procedures for clonal crops (1.2); safety backup procedures (1.4); best practices for germplasm conservation (2.1.1 and 2.1.3); decision-support tool for effective genebank management (2.4); and performance measurement system (6.4.2). Bioversity led the activities in clonal crops (1.2), in close collaboration with CIP, CIAT and IITA. Several face-to-face visits were carried out to fine tune the risk management (1.1) and a few workshops brought together the clonal crops experts (1.2) to discuss pending issues and move forward. One external consultant was hired for two years to compile all relevant information and updates on the conservation of clonal crops (1.2). Activity 1.3 was developed independently by each of the 10 CGIAR genebanks. Activity 1.4.1 was taken over by ILRI and finished in close collaboration with CGIAR partners.

Detailed summaries per activity, tasks and milestones are provided in Annex 1.

Key Products Output 1:

- Risk Management methodology paper and online tool (1.1).
- Detailed risk analysis matrices developed for seed and clonal crops (1.1).
- A document on *in vitro* conservation methods and principles composed of three parts (1.2).
 - Part I: “Global Public Goods Phase 2: Project Landscape & General Status of Clonal Crop *In Vitro* Conservation Technologies” - available at <http://croppgenebank.sgrp.cgiar.org/>.
 - Part II: “Status of *In vitro* Conservation Technologies for: Andean Root & Tuber Crops, Cassava, Banana, Potato, Sweetpotato & Yam” - available at: <http://croppgenebank.sgrp.cgiar.org/>.
 - Part III: “Multi-Crop Guidelines for Developing *In Vitro* Conservation Best Practices for Clonal Crops” - SGRP publication.
- Draft training manual – under review (1.2).
- Safety duplication principles and strategies developed (1.4.1).
- Current status of adoption of the safety duplication principles and lessons learned from their application developed with heads of Genetic Resources in CGIAR Centres (1.4.1).
- Wiki space page established to compile and share all information (1.4.1).
- All information posted on management strategies section of the Crop Genebank Knowledge Base (1.4.1).
- Capacity strengthening of one intern (1.4.1).

The full list of products, CGIAR contributors and links is provided in Annex 3 and also at www.sgrp.cgiar.org

For the summary information on the progress on Centre-own upgrading Sub-activities (1.3.1, 1.3.2 and 1.4.2), see Section 3 of this report.

Highlights

- Common framework for analyzing risks and a database of common risks, risk mitigations and contingency actions were identified, compiled and made available for public users. A user-friendly tool was developed in order to consolidate this information in one place, and is available for immediate use with the possibility of being expanded and custom-adjusted. The product has been circulated among all CGIAR genebanks and genebanks in the Philippines and the United States for peer review (1.1).
- The process for storing 5 clonal crops over the medium and long term is now sufficiently documented for the purpose of establishing a baseline for future auditing and quality checking across CGIAR Centres, and supporting technical decisions regarding conservation strategies. Cross-testing protocols are being examined for response uniformity in more than one location and will become available at a later date. The work resulted in a considerable transfer of technology, capacity building and networking amongst genebank staff in all Centres. A hardcopy training manual to promote the conservation of clonal crops by CGIAR partners including NARS is scheduled to be published in the future (1.2).
- Through the collective work on Activity 1.2, a strong network was established among the clonal crops genebank scientists, who formed a Clonal Crops Task Force which will remain active after the end of the project.
- Current safety backup procedures were reviewed and analyzed, and recommendations were made available to the genebank community. Background documents were made available and alternative options were given for various economic, technical and legal aspects and their corresponding risks. Recommendations were applied within other GPG2 Centre-own activities and feedback was provided from the Centres and incorporated into the recommendations (1.4.1).

Next Steps

The work undertaken in this project was considerably more than initially expected, with several interactions between various partners and simultaneous activities with interdependencies.

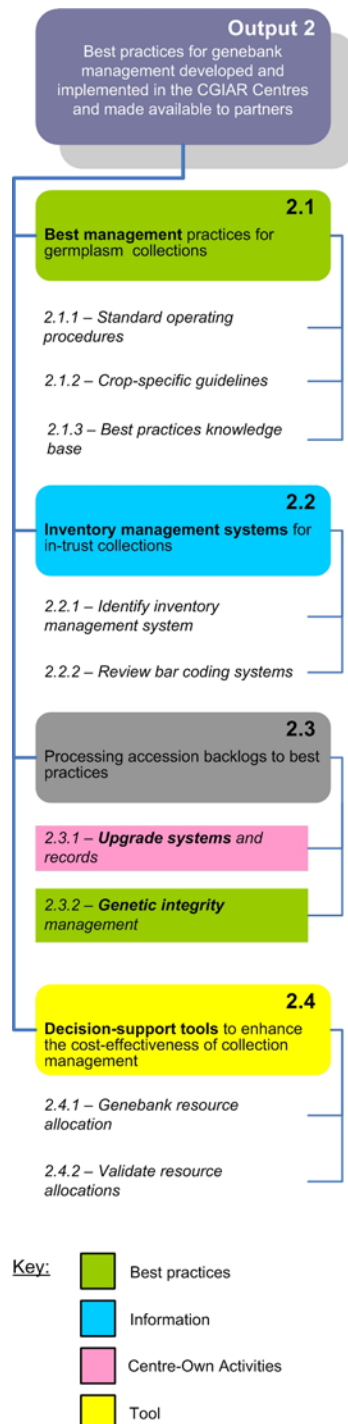
The last step of the risk-management procedures activity (1.1), regarding complete response and adoption by all CGIAR genebanks of the tools developed, was not able to be fully achieved within the short timeframe of the project. However, PhilRice has already adopted the tool, using the rice-specific risk/mitigation database, and has provided several comments, which were incorporated into the last few weeks of the project. Some CGIAR genebanks have begun using the tool in their risk-management activities, and IAU will promote its implementation, on an ongoing basis after GPG2 has formally ended, as part of their collaboration with the CGIAR Centres on developing enterprise risk-management systems. The relevant Crop Genebank Knowledge Base focal point will regularly update the corresponding pages and respond to any queries from users. It would be useful to monitor the uptake of the risk-management guidelines and monitor how the tool is used and/or customized in the future, to better evaluate the impact of this product in genebank management.

The Activity relating to storage procedures (1.2) was fully finished, having also finalized the training manual with recommendations from the work carried out. The trilogy publications are being edited to be published soon. Draft versions are available online and final versions will replace them when ready. The clonal network established will continue after GPG2, since several benefits and synergies were obtained from working together. The recommendation has been made to monitor the production and dissemination of the training manual on the conservation of clonal crops. It would be helpful if disseminating partners could be identified in advance in order to provide NARS with training using the soon-to-be-released manual.

Safety backup backlogs were widely reduced in all Centres thanks to the Centre-own component of GPG2. Strategies and recommendations developed in Activity 1.4.1 are now available online and can be taken up by the Centres. The relevant CGKB focal point will regularly update the corresponding pages and respond to any queries from users.

Progress towards achieving Outcome 1: The expected Outcome (1) of ensuring security and providing an example and guidance to partners in risk management was fully achieved and has started to be implemented, with material now publically available.

OUTPUT 2: Best Practices for Genebank Management Developed and Implemented in the CGIAR Centres and Made Available to Partners



Overview

The CGIAR System will ensure the security, viability, health, genetic integrity and accessibility of its in-trust collections, including crops in common. It will set and apply best practices for high-quality collection management and contribute the knowledge base to guide partners in the development of a global crop-based conservation system.

Implementation

Most of the Activities on developing and promoting best management practices (2.1.1 and 2.1.3) were coordinated by Bioversity and led by a scientist based at ILRI, in Ethiopia. The Sub-activity on crop-specific guidelines to maintain germplasm free from transgenes (2.1.2) was led by CIMMYT. These Activities were closely linked to the Activities on risk management (1.1), the development of performance measurement indicators (6.4.2) and the promotion and awareness of use of in-trust collections (6.1.2) through the development of a web-base information resource on specific crop-management practices. The Activity on developing an inventory management system (2.2), led by CIP was linked to the best practices and particularly the ISO feasibility study undertaken. The Sub-activity (2.3.2) on managing the loss of genetic integrity in the in-trust collections was led by IRRI. This activity had some delays starting but all the work was completed. The Activity on developing a tool for decisions on cost-effectiveness in collection management was led by IFPRI, and a costing decision tool was created for genebank operations including the management based on best practices, which is available online. The IT component of these activities was carried out with the support of IT consultants in Montpellier (for the best practices knowledge base) and Rome (to make a user-friendly version of the decision support tool).

Detailed summaries per activity, tasks and milestones are in Annex 1.

Key Products Output 2:

- Crop genebank knowledge base website at <http://cropgenebank.sgrp.cgiar.org/> with four major components (2.1.1 and 2.1.3).
 - Crop-specific genebank guidelines for 7 seed and 2 clonal crops.
 - Management procedures (linking outputs from other GPG2 activities/products) in 7 areas.
 - General genebank procedures.
 - Repository of learning resources.
- Development of an ISO feasibility study, analyzing information on its applicability to genebank management.
- General and crop-specific (cross-pollinated maize, vegetatively propagated potatoes, self-pollinated rice) guidelines for maintaining germplasm free from transgenes, available online (2.1.2).
- Sharing of knowledge, experiences and use cases with CG colleagues through face-to-face meetings and telecommunication (2.2).
- Technical guidelines developed by CIP (leader), IRRI, CIMMYT, ILRI, AfricaRice, Bioversity, ICARDA, ICRISAT, IITA and ICRAF and posted online on a wiki (2.2).
- CIPSER: an ICIS-based Pocket PC application to manage germplasm inventories available at http://www.central-repository.cgiar.org/crop_collecting_missions.html The exchange of technologies was facilitated, among Centres clustered by crop or topic, through the knowledge base collaborative website and helpdesk (2.2).
- Banana, chickpea, rice and maize genotypic studies – under review (2.3.2).
- Set of strategies formulated to enhance the management of genetic integrity for genebanks, available in the CGKB (2.3.2).
- Decision support tool (2.4).
- Guide to users (2.4).
- Methodological Framework paper: “Evaluating the Cost-Effectiveness of Collection Management: A Methodological Framework” (2.4).
- “Evaluating Cost-Effectiveness of Collection Management: *Ex-situ* Conservation of Plant Genetic Resources in the CG System” (2.4).

For the summary on progress in the Centre-own upgrading Sub-activity (2.3.1), see Section 3 of this report.

The full list of products, CGIAR contributors and links can be found in Annex 3 and also at www.sgrp.cgiar.org.

Highlights

- The knowledge base on genebank management issues was established to share recommendations on best practices of 9 crops and several GPG2 activities. It was expanded shortly thereafter to include direct links to more than two thirds of the GPG2 products and indirect links to the remaining GPG2 products. It is currently registering about 2,000 users per month (2.1.1).
- The user interface and visibility of online tools produced in GPG2 (risk management – Activity 1.1 and decision costing tool – Activity 2.4) as well as all the other GPG2 products was greatly improved with the user-friendly layout of the CGKB. The exchange of technologies was facilitated, among Centres clustered by crop or topic, through the knowledge base collaborative website and helpdesk (2.1.3).
- Linkages were also made in relevant CGKB pages in order to display the outputs of the best practices for clonal crops (1.2), also developed during GPG2. These products include not only the two main clonal crops of the CGKB (banana and cassava), which are linked in the relevant pages, but also potato, sweet potato and yam, as well as some non-crop specific guidelines, with links on the general procedures pages of the CGKB (2.1.3).

- Training materials were compiled and also created during the project (technical videos, flip books, photo albums) in consultation with the CG Capacity Strengthening Community. These are available online and greatly improve the usability of the site, in terms of training and capacity building for genebanks within and outside the CGIAR (2.1.3).
- Information on regulatory and best practice methods for transgene detection and crop regeneration were extracted from AGBIOS GM DATABASE, reporting all events released experimentally or commercially in all crops worldwide, including information regarding crops such as maize, rice and potato. This information is also linked to the best practices for the safe movement of germplasm, compiled in Activity 3.1 (2.1.2).
- Best practices (including guidelines for Barcode KIT Specifications) were identified for genebank inventory management systems (coordinated with the best practices Activity 2.1). Barcoding systems were reviewed and the Centres were assisted in implementing barcoding (2.2).
- Analysis of the genetic similarity of duplicate samples within and among genebanks (2.3.2) highlighted the loss of genetic integrity, in particular, through the mislabeling and loss of diversity of alleles due to unintentional selection for flowering dates. This will necessitate a change in emphasis for best practices in regeneration and seed handling practices, which previously focused more on reducing drift.
- A computerized decision-making tool to enhance the cost effectiveness of managing genebank collections (i.e. optimal resource allocation among genebanks) was tested and revised with data from five Centres and made available online through the CGKB. Guidelines and a paper including available literature and relevant data complement this interactive tool (2.4).

Next Steps

A comprehensive, user-friendly website—the CGKB—was established based on the results from Activities 2.1.1 and 2.1.3, and it has been very well accepted by the genebank community. Additional menus were incorporated to include more genebank-related activities from GPG2. Further links are being discussed and new links will be added after the end of the project, to make information more easily available to users, linking many of the products from activities related to the information provided (marked in blue in the project structure). The work carried out in Activity 2.1.3 has gone beyond the expectations for the project, including additional links to most of the GPG2 activities as well as several multimedia materials (more than 20 technical short movies and several flip books with pictures for low-band width). Focal points listed in the CGKB will regularly update their pages and respond to any queries from users. The site is a starting point that can be further expanded into various crop-specific or general genebank areas. The site is already expanding, even before its formal launch, which is scheduled to take place in October 2010 in various countries. It is already being translated into Spanish, and best practices for an additional crop are being developed with CAAS and Bioversity. It was successfully used for the first international genebank training course in Korea (RDA) (August 2009) and again in their second course, in July 2010. ICARDA and ILRI have already started using the site for their training and are planning to use it again. ILRI and CIMMYT both use it to train new staff. It has also been suggested that formal training agreements (with disseminating partners) could be established to promote the systematic uptake of the GPG2 products/tools where appropriate. New opportunities are already arising, with regard to creating new menus (collecting guidelines for information and documentation) involving private contributors and other genebanks outside the CGIAR. The site has

activated various methods (blog, editors' corner, and genebank news) for increasing communication with the users and informing them of what is being done, as well as for gathering feedback and comments from the users (wiki, discussion forum, and comment boxes). A Google Analytics application was also implemented for the purpose of monitoring statistics on site usage, the number and type of users, search engines used, types of pages viewed and time spent on each.

Inventory systems (2.2) achieved most of its milestones, although work is still in progress for finalizing the editing of the Final Report and recommendations. All information is available online at the CIP site.

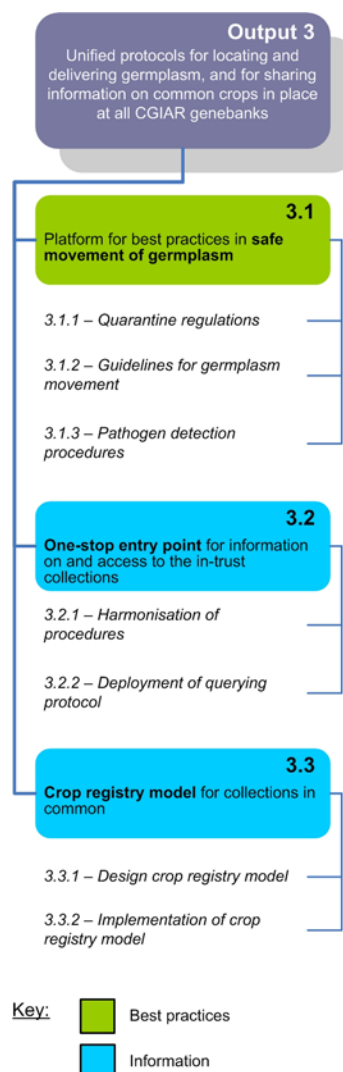
Strategies to enhance genetic integrity (2.3.2) have also been completed and have been recently circulated in order to obtain feedback from the genebanks. All current information is available online and the focal points listed in the CGKB will regularly update their pages and respond to any queries from users. Genebank procedures should be revised, taking these new findings (regarding risk factors) into consideration.

Activities in developing the cost-decision tool (2.4) were fully completed and the tool is now available online. The preliminary feedback received has already been incorporated. The corresponding focal points listed in the CGKB will regularly update their pages and respond to any queries from users. A survey monkey was incorporated into the webpage in order to gather comments and suggestions from users.

It has been recommended that periodic user surveys (addressed to genebanks and learning organizations) be carried out to determine how they are using the range of products (2.1.3) and interactive tools (1.1 and 2.4) accessed from the learning platform, in order to monitor the use of the CGKB in the future.

Progress towards achieving Outcome 2: The expected Outcome (2) of managing collections effectively and efficiently according to the best practices agreed upon and promoted has already been partially achieved. The tools and best practices have been developed, compiled, and made publicly available online, and are now in the process of being implemented by the Centres.

OUTPUT 3: Unified Protocols for Locating and Delivering Germplasm and for Sharing Information on Common Crops in Place at all CGIAR Genebanks



Overview

Common systems and procedures will enhance the System's ability to provide safe and ready access to the in-trust collections, by ensuring that accessions are free of pests and diseases, and that quality information is available to facilitate selection. A platform for collaborative efforts will include a one-stop entry point for information and ordering, and will make the contribution of providing leadership in working towards a global system.

Implementation

The development of a platform of best practices for safe movement of germplasm (3.1) was led by CIMMYT in collaboration with CIP and plant health specialists from other Centres. During the first year, a compendium of country regulations on pests and diseases was developed for guidelines concerning seed and clonal crops. A system-wide review of procedures for pathogen detection continued into the second year, due to the high number of pathogen cases encountered. This Activity was closely linked to the Activities on: risk management (1.1), procedures for clonal crops (1.2), best practices for germplasm management (2.1.1 and 2.1.3), and Centre-own Activities on health testing (2.3.1). The development of a one-stop-shop, single entry point for accessing material and information on the in-trust collections (3.2) through the System-wide Information Network for Genetic Resources (SINGER) was led by Bioversity in collaboration with all of the CGIAR Centres with genebanks and documentation specialists. The development of specific crop information systems (3.3) linked to SINGER, provided additional links to key national collections. This was led by ICARDA, capitalizing on the Barley Global Registry model. This activity was undertaken in close collaboration with the CGIAR genebanks holding collections of crops-in-common. The compilation of each crop-specific information system (registry) was led by one of the Centres (i.e. banana with Bioversity, cassava with CIAT, wheat with CIMMYT, potato with CIP, barley with ICARDA, chickpea with ICRISAT, forages with ILRI, and rice with IRRI). These registries are the starting point for integration and rationalization among collections within the CGIAR and possibly beyond. These activities were also closely linked to the activities focusing on completing the passport data entry for the CGIAR collecting missions (4.1.1) and the improvement of location data quality, including geo-referencing (4.1.2).

Detailed summaries per activity, tasks and milestones are included in Annex 1.

Key Products Output 3:

- Safe Transfer of Germplasm (STOG) Portal online, with detailed information for 15 seed crops and 5 clonal crops on (3.1):
 - Import and export requirements (seeds).
 - Technical guidelines (seeds).
 - Best practices for safe transfer of germplasm (seeds).
 - Disease lists (clonal).
 - Diagnostic protocols (clonal).
 - Protocol validation (clonal).
- A database was established at CIMMYT to keep information on country regulations updated and available to all partners and is available online (3.1).
- New SINGER website with ordering gateway: <http://singer.cgiar.org/> (3.2).
- Harmonization of germplasm selection and request procedures (3.2).
- Report from the Meeting of the Legal Focus Group, 27 October 2009 (3.2).
- SINGER survey sent to heads of Genetic Resource Units, breeders and IT managers (3.2).
- Report from the SINGER/GPG2 Consultation and Planning meeting, 24-28 August 2009, USDA-ARS, Beltsville, MD, USA (3.2).
- Poster entitled “Scanning and Data Extraction from Crop Collecting Mission Documents” (3.2).
- Poster entitled “The CGIAR System-wide Information Network for Genetic Resources” (3.2).
- Crop Register Templates (CRT) developed jointly by all Centres, available online (3.3).
- Offline cross-referencing tools (useful for continuation of work on current registers in future and for compilers of new registers, e.g. for other crops) (3.3).

The full list of products, CGIAR contributors and links is provided in Annex 3 and also at www.sgrp.cgiar.org.

Highlights

- A community of practice on seed health and safe movement of germplasm was developed during the project and facilitated through the two workshops for seed and clonal crops (at CIP, November 2007). This allowed for the compilation, updating of information shared on current procedures and regulations for each type of mandate crop, and development of draft methodologies for pathogen detection. The project also allowed CIMMYT to revise the guidelines for seed health in maize and wheat and also helped CIAT to produce new digital photos on pathogens, along with a new Genetic Resource Lab Manual (3.1).
- A new SINGER was developed with standard functionalities agreed upon for common protocols in ordering germplasm and requesting information on the in-trust collections. Features such as map-based selection of germplasm, climatic data, downloadable datasets and direct links from passport data to the crop databases have been incorporated. A prototype germplasm ordering system using SINGER data has been developed and is being facilitated/supported through a help desk (3.2).
- The new web-based crop registry model was developed at ICARDA with collaborating institutions (within and outside CGIAR), for CGIAR priority collections and collections in common. Essential data required for cross-referencing accessions in different collections was defined, and new data templates developed. ICARDA is using it for the Barley Register and, ILRI for the Forage Register. Other Centres are using their own systems to deploy the respective registers on the internet. An SGRP wiki website was deployed to facilitate communication between the developers of the crop registries (3.3).

Next Steps

The products created here are not static and are expected to evolve, be expanded and updated.

Some of the tasks initially planned were adjusted and replaced with different options to achieve the same milestone. The information in the STOG website pages will need to be kept current. The focal points should remain active and proactive in updating these pages, despite the end of GPG2 (3.1). There is a huge amount of information compiled and available online that will require considerable effort to remain updated and current.

There is a need for a SINGER automatic upload mechanism or data exchange process with Centres. There is also a need for linkages or merges with similar information systems that evolve rapidly and should be re-formulated, revisited or adjusted (3.2). Linkages are being discussed to be included in the CGKB (2.1.3).

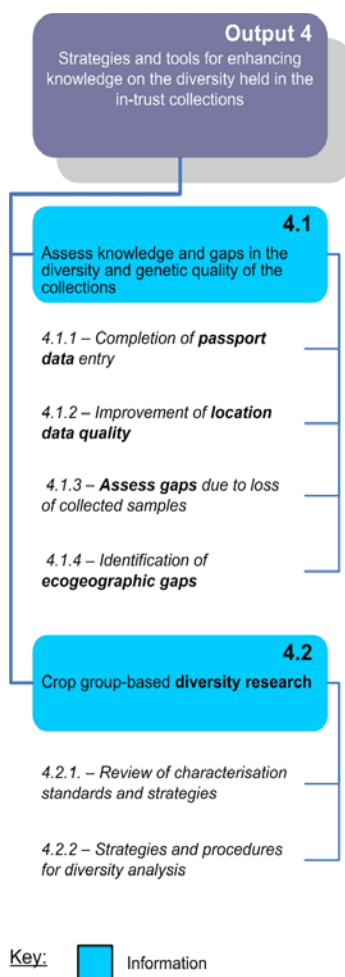
Centres have finished the first steps of the crop registries and are now improving the user-friendliness of their registries and seeking partnerships with NARS to include data from other relevant collections, for the purpose of enriching the crop registries (3.3).

Progress towards achieving Outcome 3: The expected Outcome (3) of ensuring that users have safer, more effective and efficient access to the in-trust collections is well underway, with a wide range of information and databases in place and available online in user-friendly formats.

Figure 3 Crops in common on the Crop Genebank Knowledge Base (CGKB)



OUTPUT 4: Strategies and Tools for Enhancing Knowledge on the Diversity Held in the In-Trust Collections



Overview

The capacity of the CGIAR to deliver global public goods and its comparative advantage within a global conservation system depend on the completeness of the collections and the quality of related information. Thus, there is a need for a detailed understanding of the genetic diversity included in and missing from the collections, as well as a need to fill critical gaps.

Implementation

The Activity on improving the completeness and quality of the passport data system-wide (4.1.1) was led by SINGER with the participation of all Centres. The Activity on improving location data quality (4.1.2) was led by CSI/IWMI with Bioversity/CIAT and IRRI. The Activities on reviewing existing characterization standards (4.2.1) and the development of strategies and procedures for diversity analysis (4.2.2) were led by ICRISAT with IRRI, CIMMYT, ICARDA, CIP, AfricaRice and Bioversity. These Activities were closely linked to the other Activities involving SINGER, including the development of a one-stop-shop entry point for accessing germplasm (3.1), crop registries (3.3) and the Centre-own Activities on documentation (1.3.2, 1.4.2, 2.3.1). The Activity of assessing gaps due to the loss of collected samples (4.1.3), could not start while the project was still in course, as it had to be done after all the passport data entry was completed (4.1.1). This was one of the few activities that was unanimously agreed upon (during 2009), but could not be implemented due to infeasibility.

Detailed summaries per activity, task and milestone are shown in Annex 1.

Key Products Output 4:

- Collecting missions' reports and field books available in pdf format for African yam beans, beans, Bambara groundnut, cassava, chickpea, cowpea, forages, groundnut, maize, pearl millet, pigeonpea, rice, sorghum, trees, wild *Vigna*, and yam. Some are already available from the Centre websites (e.g. CIAT) (4.1.1).
- Quality passport data partially including validated geo-references in Centres' database, updated data sets loaded on Bioversity repository and, later on, in SINGER (4.1.1).
- Renewed collection of missions' database in Bioversity with completed information: report title, authors/collectors, collector code (4.1.1).
- Improved display of information in SINGER, relating to collecting mission reports and accession (4.1.1).
- Central repository at the Bioversity IT department with all pdf files loaded and sorted, with metadata agreed formats to make the files retrievable through a search mask and a registry with an uploading system for web access (4.1.1).
- Genetic resources collection sites geo-referenced and corrected (production of data that enriches genebank databases and supports analysis of the data therein) (4.1.2).
- Website detailing the geo-referencing process (4.1.2).
- Short article on the geo-referencing activity "Mapping genebank collections" published in RiceToday (Apr-Jun 2010 issue) (4.1.2).
- Gap Analysis website, including forum for expert feedback (4.1.4).
- Comprehensive analysis of completeness of CGIAR genetic resources collections for wild and cultivated materials, and identification of priorities for future collecting (4.1.4).
- Five conference presentations and posters (4.1.4).
- Three papers currently being written and soon to be published (in preparation) (4.1.4).
- Help Desk (output from workshop) established for providing basic information related to analyzing diversity in common/priority crops (4.2).
- Descriptors developed for new traits (sweet sorghum) (4.2.1).
- Amendments made in the existing descriptors' list of common and priority crops (4.2.1).

The full list of products, CGIAR contributors and links is provided in Annex 3 and also at www.sgrp.cgiar.org.

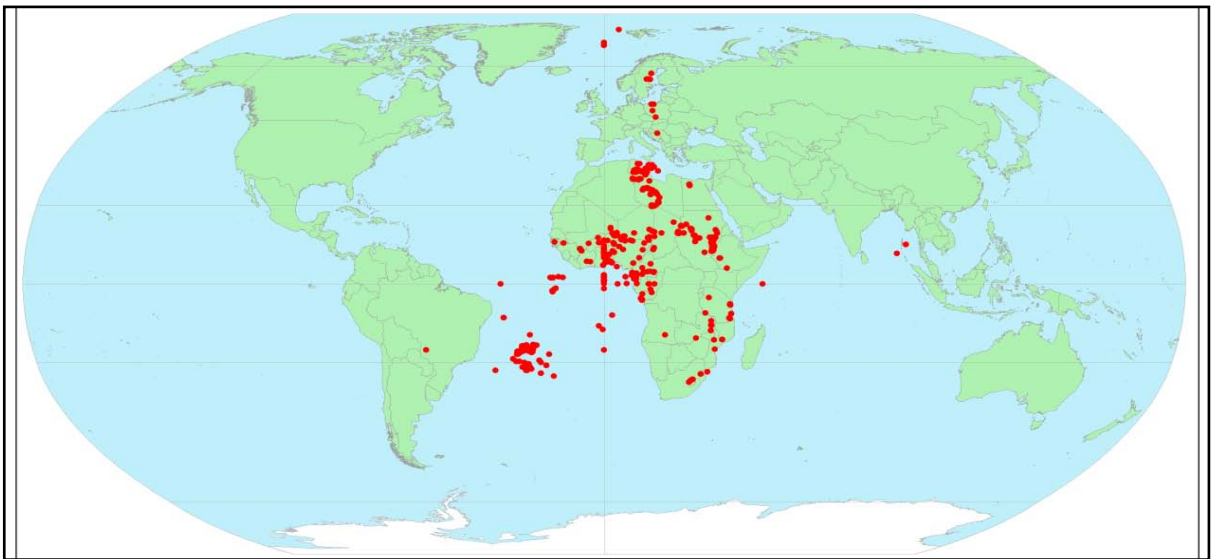
Highlights

- Collecting mission reports were assembled based on crops and Centres for the completion of passport data (4.1.1).
- Geo-referenced data was provided and checked for 50% of localities where accessions were collected without coordinates for crops, other than those in common (4.1.2).
- Major errors were found in latitude and longitude data from IITA due to mistakes in the original coordinates, and many gaps were detected in the geo-reference data for donated samples in the ILRI data as well (4.1.2). The maps below show data points before and after corrections (see maps 1a and 1b). Minor errors were also corrected in data sets from CIMMYT, ICARDA, ICRISAT and IRRI.
- Important findings were made while analyzing phenotypic traits and identifying areas that have few collections and are environmentally unique in terms of existing accessions. Map 2 (below) shows the example of Chad which, although it has few collections, it has a climate similar to other Sahel countries, thus suggesting that it is not a high priority area for further collection. In contrast, Southwest DRC has sorghum-growing environments that are underrepresented in the sorghum collection, which suggests that increased collection would be a priority for the future.
- An analysis protocol was developed for identifying basic eco-geographic gaps in the diversity of wild species and cultivated materials. The protocol was applied to wild species from 10 genebanks (4.1.4).

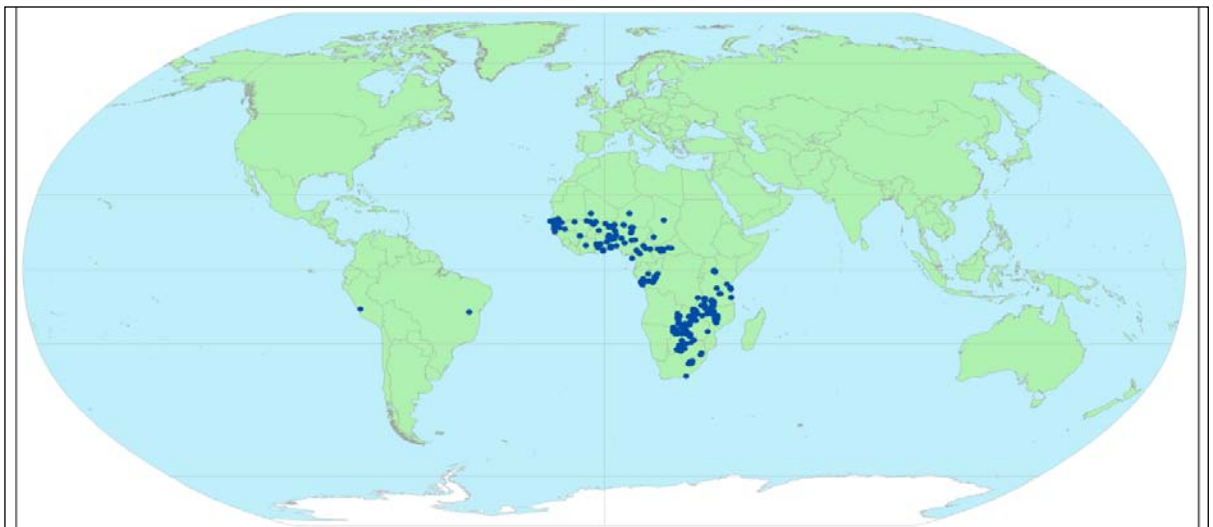
- The information from Centres on existing phenotypic characterization strategies and standards on selected crops (chickpea, rice, maize, potato, banana, pigeonpea, sorghum) was compiled and reviewed. This analysis was carried out in order to determine the potential usefulness of the germplasm (4.2).
- Patterns of demand for trait-specific germplasm in common/priority crops (chickpea, rice, maize, potato, banana, pigeonpea, sorghum) were surveyed across CGIAR Centres (4.2).
- Needs were assessed at the Centres for diversity and gap analyses using morphological and agronomic traits and molecular markers, involving the following crops: chickpea, rice, maize, potato, and pigeonpea (4.2).

Map 1a Latitude and longitude data points of passport data from the IITA/SINGER database, before and after the geo-reference corrections

IITA data before

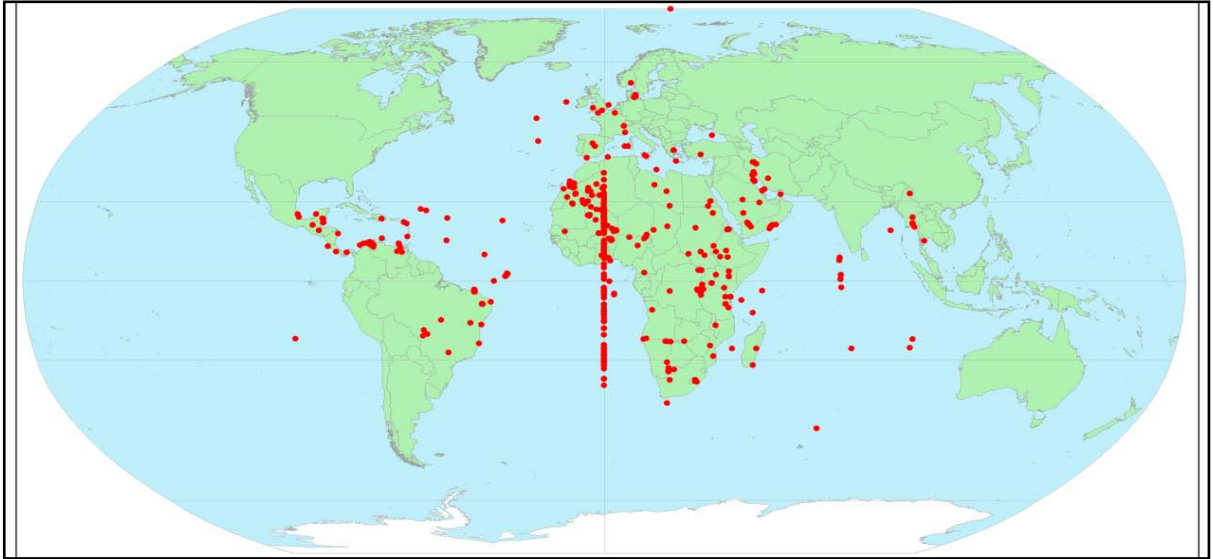


IITA data after

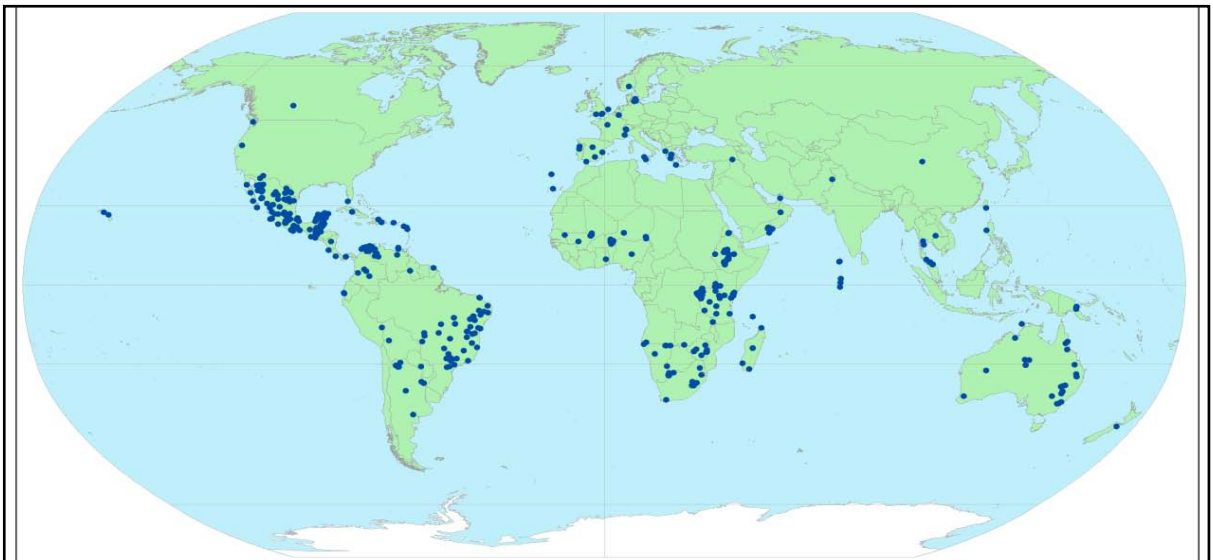


Map 1b Latitude and longitude data points of passport data from the ILRI/SINGER database, before and after the geo-reference corrections

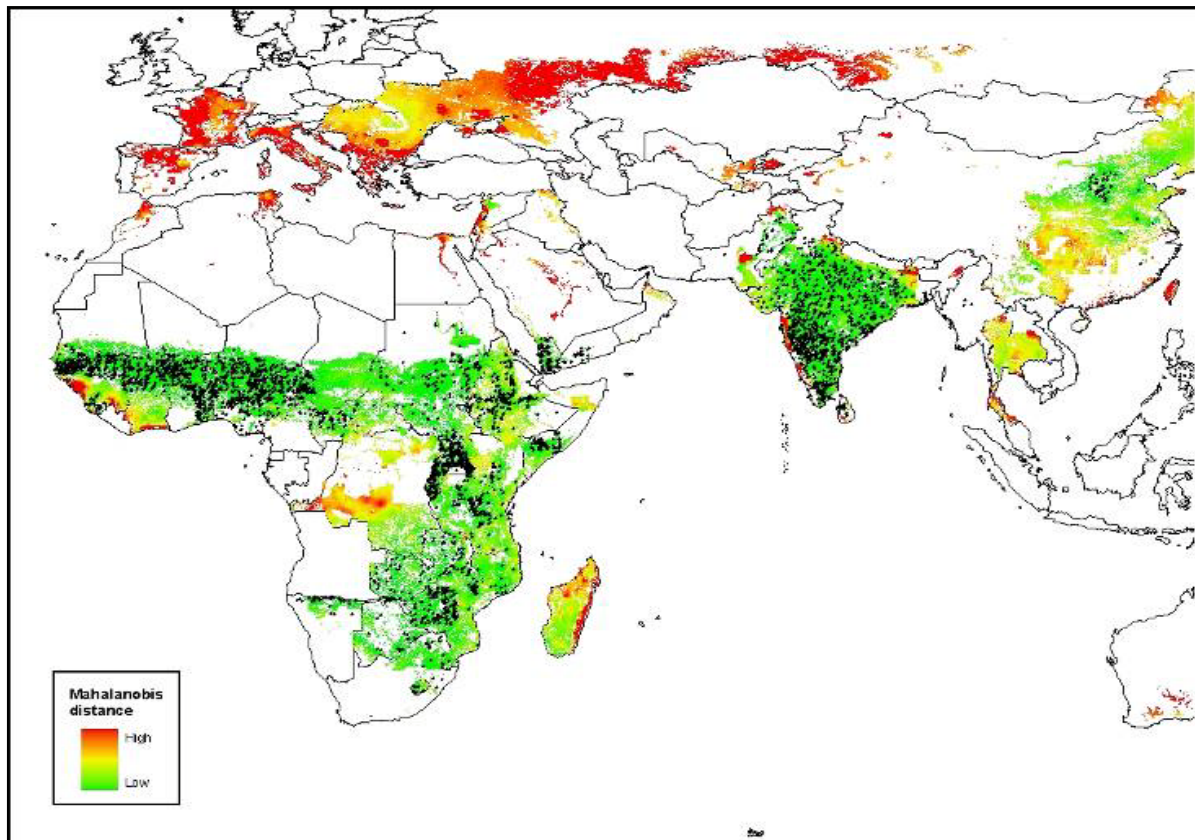
ILRI data before



ILRI data after



Map 2 Phenotypic traits



Next Steps

Although Activity 4.1.1 suffered some initial delays, several consultants were hired and rapid progress over the last few months of the project, resulting in 27,000 pdf files currently scanned. Work will continue after GPG2 ends and a final report will be produced with Centre-own funds by December 2010. A repository was established online at the end of the project and linkages will be made in SINGER and CGKB to increase awareness and access. This will also be promoted in future training courses (such as the one recently conducted in Korea) to raise awareness amongst NARS about this database and the need to include passport data from many more genebanks. The assessment of gaps in the collections (Activity 4.1.3) could only be done after 4.1.1 was finished, therefore, the gap assessment could not be completed. Centres will be able to use the scanned documents to correct and complete passport data to match accessions with available data, and then assess the gaps caused by the loss of collected samples, using their own resources.

Work on the geo-referencing of the localities (4.1.2) could not be fully finished due to the workload involved in checking samples one by one. Work will continue at IRRI even after GPG2 is finished, with Centre-own resources. Another major obstacle for geo-referencing concerned the information on the administrative subdivisions (such as State, Department or Province) because this data is not uniform in SINGER. It was suggested that in the future, Centres record this type of data in separate fields.

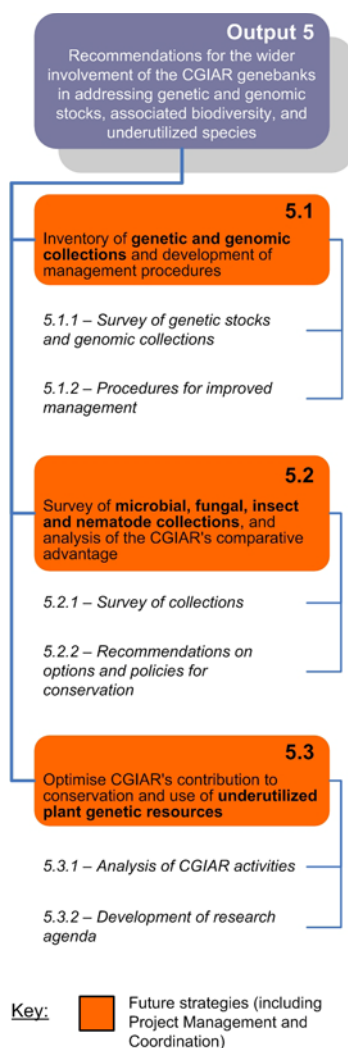
Preliminary results from geo-referencing (4.1.2) already indicate some priority areas for germplasm collecting and will help guide future activities in these areas.

Work on eco-geographic gaps (4.1.4) was fully finished and the documents/recommendations produced are currently being edited for publication. Gap identification will continue as it is connected to similar work ongoing at CIAT.

Work in Activity 4.2 was fully accomplished, public information is available online, research papers are being edited for publication, and this is being followed up by ICRISAT. Focal points identified in the CGKB will regularly update their pages and respond to any queries from users.

Progress towards achieving Outcome 4: The expected Outcome (4) of increasing the understanding of the diversity in the in-trust collections and making it useful for the breeding programmes is well underway. A large amount of enhanced passport data and standards is already available, gaps were identified, and more data will soon become available online in user-friendly formats.

OUTPUT 5: Recommendations for the Wider Involvement of CGIAR Genebanks in Addressing Genetic and Genomic Stocks, Associated Biodiversity and Underutilized Species



Overview

In addition to major mandate crops, Centre holdings include underutilized species, specialized collections, DNA and other genetic materials, plant pests and disease organisms, and other elements of associated diversity. Inventory and review of their status and availability will allow informed decision-making on their management within the System, and facilitate access to resources outside the System.

Implementation

The Activities under this output focused on exploring the comparative advantages of the CGIAR in the conservation of genetic resources, in addition to those of the major crop commodities managed in the Centres' genebanks. The Activities consisted of conducting surveys and inventories to document the status of these specialized collections. The inventory of genetic and genomic collections (5.1) was led by Bioversity with all the Centres and in close collaboration with the Generation Challenge Programme (GCP) and the Central Advisory Service on Intellectual Property of the CGIAR (CAS-IP). The inventory of microbial, fungal, insect and nematode collections (5.2) was led by IITA, and the inventory of neglected crops collections (5.3) was led by the Global Facilitation Unit on Underutilized Plant Species (GFU). Activity on the survey of genetic stocks (part of 5.1.1) had several difficulties from the beginning, due to the partners' failure to respond to the survey sent. Moreover, a great deal of support was expected from an existing CGIAR Genomics Task Force which later resigned. It was also difficult to collect information on the genomic resources and genetic stocks at the same time, because most scientists involved in genetic stocks are not the same ones involved in genomic resources. For these reasons, this part of the activity was dropped (2009), and more focus was placed on genetic stocks.

Detailed summaries per activity, tasks and milestones are in Annex

Key Products of Output 5:

- Report of survey on genetic stocks (5.1).
- Report of a workshop, Bologna, May 2010 (5.1).
- Background Study Paper No. 48 for FAO (2009), "The Impact of Climate Change on Countries' Interdependence on Genetic Resources for Food and Agriculture," Chapter 5: "The Impact of Climate Change on Interdependence for Microbial Genetic Resources for Agriculture," pp 37 - 47 (5.2).
- Presentation on "Impact of climate change on the interdependency between countries in the use and exchange of microorganisms at the Microbial Commons workshop: Analyzing Patterns of Exchange and Use in the Global Microbial Commons Second Workshop", 25-26 March 2009, Brussels (5.2).
- Presentation on "Future directions for microbial genetic resources," IITA, Mombasa workshop (SGRP) (5.2).
- Updated Inventory list of CGIAR collections. It now contains major constraints of each collection as identified through the survey, which can be used to address collections' needs differently in the future (5.2).
- Guidelines: World Federation for Culture Collections has updated their Guidelines for the establishment and operation of collections of cultures of microorganisms as of February 2010, now in its 3rd version (5.2).
- Position paper: "Characterization of non-plant taxa collections across the CGIAR and recommendations to improve conservation, awareness, utilization, access and benefit sharing to support sustainable agriculture in the developing world" (5.2).
- Side event during the CBD Ninth Meeting of the Ad Hoc Open-ended Working Group on Access and Benefit Sharing, Cali, Colombia, 22-28 March 2010; Leaving room for future ABS norm development under the International Regime – The example of agricultural microbial genetic resources; Presentation on the "Increased interdependence on agricultural microbial genetic resources as a result of climate change" (5.2).
- Paper on the comparative advantage of Centres in carrying out their ongoing or planned activities over other Centres or other stakeholders and mechanisms developed for research priority setting to ensure relevance to communities (5.3).
- Paper on "Recommendations to the CG for research suitable for collective action and to close identified gaps" (5.3).
- Paper on "Priority setting guidelines for underutilized crops including Subjects identified for research that can serve as models for a wide range of underutilized species within the same type" (5.3);
- Paper on "Ecological niche models for selected crops" (alternative geographic areas for production of identified underutilized species) (5.3).

The full list of products, CGIAR contributors and links is provided in Annex 3 and also at www.sgrp.cgiar.org.

Highlights

- A questionnaire on the status of genetic stocks and genomic collections was applied within and outside the System for non-CGIAR groups, including aspects of access and benefit sharing. Response was good for the genetic stocks but unsatisfactory for genomics (5.1).
- A workshop on genetic stocks allowed the compilation and review of procedures for managing, accessing and accessioning genetic stocks in publicly available collections. It also discussed recommended policies and best practices for managing and making genetic stocks available to researchers and breeders through the global system (CGIAR + other genebanks). It made recommendations on streamlined management of genetic stocks focusing on the following crops: rice, wheat, barley, maize, chickpea, cassava and banana (5.1).
- An online survey was conducted on microbial, fungal, insect and nematode collections. A database was developed listing the collections and their contents in CGIAR Centres and international repositories and an inventory of experts that curate collections in CGIAR Centres

was compiled. Various documents were presented and are now being published to raise awareness on non-plant taxa issues (5.2).

- A common definition for underutilized species was adopted by Centres and an electronic survey was conducted on this basis of ongoing and planned projects on underutilized species in national and CGIAR genebanks. The results were integrated into the existing GFU database on “who is doing what”. Groups of neglected and underutilized species were prioritized, and main areas of relevance for model development were defined in consultation with key stakeholders (5.3).
- The principles of participatory approaches were applied during research priority setting for the conservation and sustainable use of underutilized plant genetic resources, and guidelines were developed for assessing the benefits delivered to communities (5.3).
- An analysis was conducted on the ongoing and/or planned projects on underutilized species regarding their contribution to System Priorities 1b, 2b, 3a, 4d, 5b, 5d. Research gaps that needed to be addressed in order to achieve these priorities were identified. Comparative advantages of Centres in carrying out their ongoing or planned activities over other Centres or other stakeholders were analyzed. Alternative geographic areas were determined for potential production of identified underutilized species. Research topics suitable for collective action or serving as models for a wider range of underutilized species of the same type were also identified (5.3).

Next Steps

Similarly to some of the activities under Outputs 1 and 2, the majority of the work was conducted and the products have been developed and are now in place. Although their final adoption could not be fully achieved within the given timeframe of the project, some of the next actions are already planned:

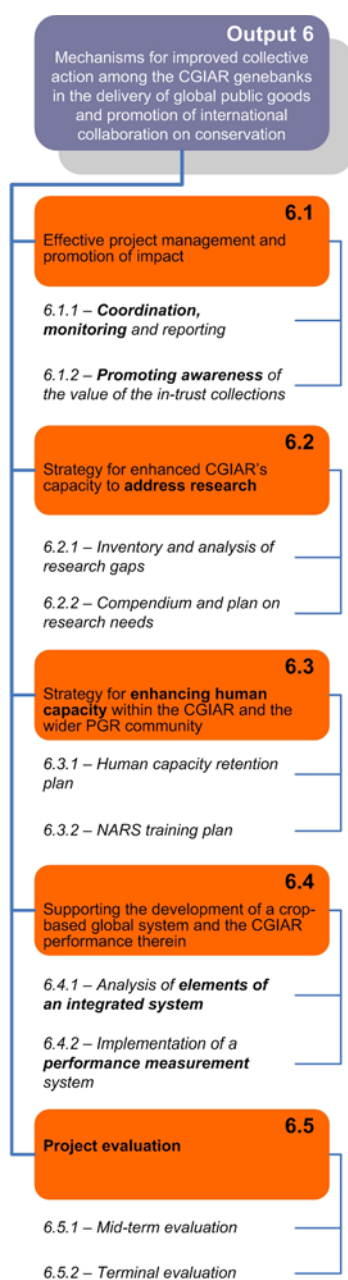
- Results from the study on underutilized species (5.3) are being published and are ready for dissemination. A draft document was shared with FAO as they have shown interest in redefining their strategies based on the results produced here, in order to directly benefit from our findings and proceed further.
- Results from the study on non-plant taxa (5.2) are being edited for publication, and will be very useful for informing the public about the range of non-plant tax collections documented in the study and their potential for increased use. It should also prompt many of the organizations that did not respond to the surveys, but that have similar collections, to join the interest group in updating the database with any missing information that they may be able to provide from their collections. For the many organizations that have these types of collections, it will be a base document to better define strategies and priorities to make better use of their resources, which are currently being neglected for some reason.
- Results from the study on genetic stocks (first part of 5.1.1) are being finalized, as this activity had a difficult start, due to the fact that many of the relevant people changed jobs; however, a group has now been established amongst various partners and will proceed with the work after GPG2 is finished. The outputs from this work, a baseline document with the most updated information about genetic stocks, will be very valuable in defining strategies and priorities amongst the wide range of organizations (ARI's, NARS, CGIAR) and researchers working on this field.

-
- Work in genomics (second part of 5.1.1) was found to be very difficult and impossible to complete.

All information recovered on these three distinct categories of genetic resources is already available online and links will be made to the published documents when publicly available. Focal points identified in the CGKB will regularly update the corresponding web pages and respond to any queries from users. Awareness is already being raised among other partners and users, in order to communicate that these important strategy documents will soon be made available to the public, so that they can be used by anyone to pursue further work in these areas.

Progress towards achieving Outcome 5: The expected Outcome (5) of having coherent strategies and plans in place for more effective conservation and use of specialized collections is well underway with several key papers and reports becoming public and ready to be used.

OUTPUT 6: Mechanisms for Improved Collective Action among CGIAR Genebanks in the Delivery of Global Public Goods and Promotion of International Collaboration on Conservation



Overview

An understanding of the components and functions of a global system for crop germplasm conservation and use is critical for defining and directing the CGIAR's role and contributions. Enhancing the CGIAR System's capacity to generate knowledge and technology and support and service national partners underpins its ability to contribute to the global system. Monitoring the CGIAR's performance therein is necessary to ensure the Centres' continued relevance and efficacy.

Implementation

All Activities implemented under Output 6 were led by the GPG2 Project Coordinator. Project coordination, including the external evaluations, was carried out in close consultation with the SGRP Coordinator, ICWG-GR Executive Committee, and Internal Audit Unit of the CGIAR. The public awareness Activities were linked to all other GPG2 Activities which had workplans including the production of information resources to be disseminated and promoted via web. The time needed to work collectively with full participation from all partners was underestimated, which led to some delays for both Sub-activities under Activity 6.4, where many of the milestones were not achieved until Year 3:

- 6.4.1. Analysis of the elements and functions and promotion of an integrated global system.
- 6.4.2. Development and implementation of a performance measurement system.

The development of a plan for providing training to NARS (Sub-activity 6.3.2), was not completed because it became evident that training was more appropriate at the crop and regional levels, and that system-wide training would not have met the partners' needs.

Detailed summaries per activity, task and milestone are provided in Annex 1.

Key Products of Output 6:

- 35 Contracts (LoAs) – with duration of 3 years.
- 38 Annual workplans (for each of the 3 years) (28 for collective activities plus 10 for the Centre-own upgrading plans).
- 35 Annual financial reports (for each of the 3 years).
- 35 Annual technical reports (for each of the 3 years).
- 1 Annual compiled and summarized technical and financial report for the World Bank (for each of the 3 years).
- Financial audit reports of GPG2 expenditures in Centres.
- Sustainability Plan - first version 30 June 2008, updated version 27 October 2009.
- GPG2 project management tool (DotProject).
- Moving along the sustainability plan's roadmap.
- GPG2 meeting report (December 2009).
- Interim Report for GPG2 activities carried out during 2007-2010, prepared for the Final External Project Review.
- Policy strategy analysis developed with NARS for 4 countries in Africa, South America and Asia.
- Common performance indicators for monitoring genebank work.

The full list of products, CGIAR contributors and links is provided in Annex 3 and also at www.sgrp.cgiar.org.

Highlights

- Development of a draft Sustainability Plan to ensure long-lasting results from the investment in rehabilitating the collections and the Centres' capacity for meeting their in-trust commitments in the future. The draft Sustainability Plan (October 2009) was circulated to Centres for feedback (6.1.1).
- Activities 6.1.2 (promoting awareness and use), 6.2 (strategic planning for research), 6.3 (planning for enhancing human capacity) were implemented and incorporated into the sustainability plan (6.1.1).
- The SGRP website <http://www.sgrp.cgiar.org/> was redesigned to better promote awareness regarding the value of the in-trust collections amongst key audiences. The architecture of the website, its contents and overall design and functionality were improved and adjusted to include a user-friendly structure displaying all public products developed during the GPG2 project. A password-protected area was dedicated to archiving all internal reports and documents produced during the project (6.1.2).
- A public-awareness strategy and workplan were developed for promoting the in-trust collections by marketing the website to key audiences (6.1.2). Numerous awareness-raising activities were conducted at international meetings, conferences, and other relevant audiences (including popular media for the general public).
- Policy elements were agreed upon for a baseline study to be conducted in each country, identifying constraints to their participation in a global conservation system. Model countries were identified for the analysis of elements and functions of a global conservation system, and a workshop was held to design the baseline study. Papers were developed for each country, along with a cross-cutting paper comparing common features (6.4.1).
- A background paper was produced on the development and implementation of a performance measurement system for the CGIAR-managed in-trust germplasm collections. A preliminary set of indicators for measuring performance was developed, after discussions with the Centres' genebank managers and the Global Crop Diversity Trust. A revised set of performance

measurement indicators was produced based on a harmonization exercise that adopted the Global Crop Diversity Trust genebank performance indicators, as this set had been developed and rigorously tested, in close collaboration with the majority of CGIAR genebanks, and originally based on the initial GPG2 set. The set is available online (6.4.2).

Next Steps

There are still various documents being edited, which the authors and relevant collaborators assure will be finished and published soon. Part of this work is already available online at the CGKB and SGRP websites. Focal points identified in the CGKB will regularly update the corresponding pages and respond to any queries from users. Electronic links will be made as new publications become available. Products will be edited using a similar SGRP layout, either electronically or in paper copies.

The Sustainability Plan (6.1.1) was developed and revised after receiving feedback from relevant stakeholders. We recognize that this is an iterative work-in-progress and will continue to be developed further to reflect recent and upcoming changes within the CGIAR as well as in the global genetic resources arena. This Plan has been and will continue to be a vital document for future planning, given that it contains the most recent definition of priority genebank activities and the most updated estimated costs for critical genebank operations. The most recent draft of the Sustainability Plan (Nov. 2009) and an Addendum (July 2010) are presented in Annex 4. Please see Section 6 for an in-depth description of the Sustainability Plan's development.

A great deal of awareness-raising (6.1.2) was done and will be continued, now that so many relevant products are available.

The Activity on analyzing the elements of the global system (6.4.1) was developed in close collaboration with selected NARS regarding their national policies' impact on the implementation of the ITPGRFA, and several papers with the results are being prepared for publication. The NARS partners and Centre collaborators will ensure that these are finished and made available soon.

The performance indicators (6.4.2) were developed in close collaboration with the GCDT and are available online at the CGKB website. Monitoring the use of the indicators will be done in close collaboration with the GCDT and will continue after GPG2. Focal points identified in the CGKB will regularly update the corresponding web page and respond to any queries from users.

Progress towards achieving Outcome 6: The expected Outcome (6) to contribute to development of a global crop-based system is a long-term goal and the continuing efforts to reach it are still underway. This Outcome is perhaps the most difficult to quantify and define achievements. The relevant initiatives and documents developed here are already circulating in the relevant networks and will allow significant progress towards a global system in the near future.

3. Centre-Own Upgrading – Summary of Cumulative Achievements

The GPG2 project built directly upon the advances achieved by the GPG1 project, and ensured that CGIAR genebank collections maintained the international standards expected by stakeholders.

The Centre-own components of the GPG2 project allowed the removal of backlogs in the processing of accessions into storage, and complemented the safety backup of in-trust collection activities undertaken in parallel with deposits made to the Svalbard Global Seed Vault. 28.7% of all accessions processed for safety duplication were also sent (as a safety “triplicate”) to the Svalbard Global Seed Vault, while 71.3% were sent to various other host institutions for conventional safety duplication.

Improvements in the physical infrastructure at various genebanks resulted in greater overall security of their germplasm collections. Seed health testing and the monitoring of plant health during germplasm regeneration maintained a high level of seed quality for both conservation and distribution purposes. Overall expenditures and achievements per Centre are shown in Table 3.1. Total numbers of accessions processed by type of activity and Centre are shown in Tables 3.2, 3.3 and 3.4. The full details of the upgrading activities conducted by each Centre are shown in Annex 2 and presented in tables provided electronically on DVD (Annex 10).

Table 3.1 Centre-Own Upgrading - Total expenditures and number of samples of accessions planned and processed per Centre

Centre	Total Budget (US\$)	Budget Balance (US\$)	Total accessions planned for 3 years	Total accessions processed in 3 years	Achievement (%)
AfricaRice	314,000	0	50,200	51,175	102%
Bioversity	534,920	0	1,453	1,633	112%
CIAT	740,540	0	109,527	117,374	107%
CIMMYT	359,543	0	66,025	237,584	360%
CIP	382,877	13	5,699	5,569	98%
ICARDA	408,100	262	80,500	341,537	424%
ICRISAT	593,950	0	238,700	286,607	120%
IITA	726,636	0	70,055	65,810	94%
ILRI	389,435	0	20,935	23,238	111%
IRRI	336,639	0	78,500	101,970	130%
GRAND TOTAL	4,786,640	275	721,594	1,232,497	159%

Table 3.1 shows that the overall target of processing 721,594 accessions over three years was largely exceeded, by more than 50%. The highest numbers of accessions processed were achieved by ICRISAT, ICARDA and CIMMYT, with more than 200,000 accessions processed each. IITA and CIP were unable to fully reach the 100% achievement of their processing targets, mostly due to technical difficulties related to the clonal crops conserved in their genebanks, but increased achievements in parallel activities instead.

Table 3.2 Centre-Own Upgrading - Total number of samples of accessions planned and processed per Centre and type of activity

Type of Activity	Total planned for 3 years	Total processed in 3 years	Achievement (%)	Notes
AfricaRice				
Characterization	7,000	6,118	87%	
Documentation	17,000	15,872	93%	
Health testing	8,200	0	0%	
Regeneration	6,000	7,008	117%	
Safety backup	6,000	16,177	270%	
Viability testing	6,000	6,000	100%	
Total	50,200	51,175	102%	
Bioversity				
Characterization	500	513	103%	
Cryopreservation	250	244	98%	
Health testing	120	99	83%	
Regeneration	100	97	97%	
Safety backup	483	680	141%	
Total	1,453	1,633	112%	
CIAT				
Characterization	0	11,813	na	Additional task
Documentation	0	11,813	na	Additional task
Health testing	7,815	14,242	182%	
Packaging	26,728	20,630	77%	
Regeneration	7,815	13,355	171%	
Safety backup	32,669	21,874	67%	
Viability testing	34,500	23,647	69%	
Total	109,527	117,374	107%	
CIMMYT				
Characterization	480	558	116%	
Regeneration	20,468	26,061	127%	
Safety backup	36,867	182,702	496%	Additional task (2008)
Viability testing	8,210	28,263	344%	
Total	66,025	237,584	360%	
CIP				
Characterization	500	510	102%	
Cryopreservation	175	175	100%	
Documentation	2,000	2,000	100%	
Health testing	2,641	2,469	93%	
<i>In vitro</i> introduction	308	350	114%	
Safety backup	75	65	87%	
Total	5,699	5,569	98%	
ICARDA				
Characterization	10,500	33,711	321%	
Documentation	15,000	117,200	781%	
Evaluation	0	11,076	na	Additional task
Health testing	15,000	20,993	140%	
Regeneration	10,000	21,782	218%	
Safety backup	0	84,678	na	Additional task

Type of Activity	Total planned for 3 years	Total processed in 3 years	Achievement (%)	Notes
Storage	30,000	21,318	71%	
Viability testing	0	30,779	na	Additional task
Total	80,500	341,537	424%	
ICRISAT				
Characterization	11,500	11,570	101%	
Documentation	76,500	89,956	118%	
Health testing	21,000	29,361	140%	
Processing	28,700	28,903	101%	
Regeneration	14,800	23,487	159%	
Safety backup	70,000	85,560	122%	
Viability testing	16,200	17,770	110%	
Total	238,700	286,607	120%	
IITA				
Characterization	4,087	1,603	39%	
Distribution	3,415	8,619	252%	
Documentation	6,800	6,800	100%	
Health testing	7,150	7,403	104%	
<i>In vitro</i> introduction	2,000	993	50%	
Packaging	4,850	5,779	119%	
Processing	7,150	8,064	113%	
Regeneration	4,883	6,119	125%	
Safety backup	24,870	15,012	60%	
Viability testing	4,850	5,418	112%	
Total	70,055	65,810	94%	
ILRI				
Characterization	2,900	2,354	81%	
Documentation	11,535	13,197	114%	
Health testing	2,400	2,695	112%	
Regeneration	2,400	2,695	112%	
Viability testing	1,700	2,297	135%	
Total	20,935	23,238	111%	
IRRI				
Characterization	16,500	18,027	109%	
Documentation	62,000	83,943	135%	
Total	78,500	101,970	130%	
GRAND TOTAL	721,594	1,232,497	159%	

As Table 3.2 shows, the overall target of processing 721,594 accessions over three years was largely exceeded, by more than 50%. The majority of the targets for Centre-own activities were either fully met or overachieved. Some Centres more than doubled the targets set for safety backup (AfricaRice, CIMMYT), viability testing (CIMMYT), characterization, documentation and regeneration (ICARDA) and distribution (IITA). The few targets that were partially (< 50%) achieved (e.g. health testing at AfricaRice, characterization at IITA) were hindered by technical issues, such as the lack of suitable diagnostic methods or insufficient seed stock available to meet the targets within the timeframe of the project.

Table 3.3 Centre-Own Upgrading - Total number of samples of accessions planned and processed by type of activity

Type of activity	Centres	Total planned for 3 years	Total processed in 3 years	Achievement (%)	Notes
Characterization	All Centres	53,967	86,777	161%	Including CIAT as additional task
Cryopreservation	2 Centres	425	419	99%	
Distribution	1 Centre (IITA)	3,415	8,619	252%	
Documentation	8 Centres	190,835	340,781	179%	Including CIAT as additional task
Evaluation	1 Centre (ICARDA)	0	11,076	n/a	Additional task
Health testing	8 Centres	64,326	77,262	120%	
<i>In vitro</i> introduction	2 Centres	2,308	1,343	58%	
Packaging	2 Centres	31,578	26,409	84%	
Processing	2 Centres	35,850	36,967	103%	
Regeneration	8 Centres	66,466	100,604	151%	
Safety backup	8 Centres	170,964	406,748	238%	Including CIMMYT and ICARDA as additional tasks
Storage	1 Centre (ICARDA)	30,000	21,318	71%	
Viability testing	7 Centres	71,460	114,174	160%	Including ICARDA as additional task
GRAND TOTAL	All Centres	721,594	1,232,497	171%	Including all additional tasks

The type of genebank activity in which most accessions were processed was Documentation, followed closely by Safety back-up, with more than 400,000 accessions each (Table 3.3). This shows that a relatively large proportion (57%) of the Centre-own activities were devoted to reducing backlogs in documentation and increasing the security of the collections through safety back-ups.

Table 3.4 Centre-own Upgrading Activities relevant to facilities and equipment improvements

Activity area	Centres involved
Improved seed storage infrastructure	CIAT, CIMMYT, ICRISAT, IRRI
Improved cryopreservation infrastructure	CIP, IITA
Improved <i>in vitro</i> storage infrastructure	CIAT
Improved security for storage facilities	CIAT, ICRISAT
Improved field infrastructure	ICRISAT
Improved information management (includes barcoding system)	AfricaRice, Bioversity, CIMMYT, CIP, ICARDA, ICRISAT, IITA, ILRI
Potential duplicate identification	CIP
Improved herbarium (facilities, information..)	CIP, ICARDA, IRRI
Improved equipment	CIP, ICRISAT
Improved regeneration procedures	IITA
Improved seed health systems	CIMMYT, ILRI

A wide range of upgrades and improvements were done in various areas of the genebanks' infrastructure and management tools. Table 3.4 summarizes the material improvements that were carried out at each genebank. All Centres improved the security control and management systems in their main genebanks or field locations. IRRI expanded its seed storage capacity, and CIAT and ICRISAT made improvements to their cold rooms. IRRI, ICARDA and CIP expanded or improved their herbarium facilities. CIP used molecular techniques to identify and reduce duplicate accessions. At CIP and IITA, cryopreservation capacity was expanded with new equipment and techniques to develop more efficient methods for conserving sweetpotato, *Ullucus*, cassava and yam. Seed health capacity was upgraded at ILRI and CIMMYT. **All of the planned upgrades and improvements of facilities and equipment were completed by the end of the project.**

More than 35 crops were covered by the various Centre-own activities.

The impressive level of achievement that was reached in a relatively short time and on such a wide range of Centre-own activities was made possible due to the dozens of consultants, technicians, students and interns that were hired using project funds during the 3 years of the project's life. Most of these supplementary technical assistants benefited greatly from the training and experience they acquired, improving their professional knowledge and skills in germplasm management techniques and procedures. Some of these temporary hires were eventually integrated into the regular genebank staff.

Further details, by Centre, are provided in the summaries to follow.

Centre-Own Upgrading Activities – AfricaRice

Out of a total of eleven Centre-own activities, eight were fully achieved (i.e. viability testing, regeneration, characterization of *O. glaberrima* and *O. sativa*, all documentation -including verification and entering of passport data-, improvements of genebank facilities, equipment and systems, and training). One activity was over-achieved (safety duplication, 300%), and two others were partially achieved (health testing and characterization of wild species, both of 50%).

AfricaRice's entire rice collection had to be transferred from a repository in Cote d'Ivoire to a medium-term conservation facility in Cotonou, Benin. A new viability testing laboratory in Cotonou was completed, and the viability assessment for 6,000 accessions was achieved over the course of the project. A drying room was also completed and became operational in January, 2008, making it possible to accomplish the packing of accessions for safety back-up.

As of December 2009, 6,237 accessions were safety-duplicated at the USDA's National Center for Genetic Resources Preservation, in Fort Collins, Colorado, USA. An additional 9,940 accessions were sent to the Svalbard Global Seed Vault in Norway for safety-triplication. A total of 16,177 safety duplicates were sent to Fort Collins and Svalbard during the project, nearly three times more than initially planned. A total of 7,008 landraces brought from Cote d'Ivoire were regenerated in Benin to produce many of these safety back-up materials, as well as to increase the materials that needed to be characterized.

Health indexing and cleaning were delayed (begun in 2009) due to the late arrival of equipment and supplies. Morphological characterization of wild species also started late due to the delay in the completion of the two screen houses (which only became functional in 2008), and was further

delayed due to the need to train personnel and the need (not initially foreseen) to start by regenerating and multiplying seeds with low viability and quantity. Both of these activities will be completed during 2010/2011, using Centre funds.

Centre-Own Upgrading Activities – Bioversity International

The genebank upgrading under GPG2 was based on the Global Banana Conservation Strategy developed with partners, within the framework of Global Crop Diversity Trust. This calls for the greater part of known banana diversity to be held in long-term storage (cryopreservation) at the Bioversity International Transit Center with a subset (working collection) held *in vitro* in medium-term storage. The three main elements of Bioversity's GPG2 plan were to:

- Cryopreserve 250 accessions.
- Bring into long-term storage (rejuvenation, taxonomic verification and cryopreservation) of 100 accessions that were successfully cleaned of banana mild mosaic virus under GPG1.
- Complete the information support system upgrade and data entry verification.

Cryopreservation of the banana accessions was fully achieved, using the two most successful protocols, i.e. vitrification of proliferating sucrose pre-cultured meristem clumps (s) and vitrification of meristems excised from rooted plants (m). To decide whether an accession is successfully cryopreserved (probability of regenerating at least one shoot from the stored material is > 95 %), three independent experiments (each with 80-100 explants) must be performed. Over the three years of the project, 240 accessions were cryopreserved with 3 independent experiments, and 10 accessions with 0/1/2 experiments, thus accomplishing 98% of the target milestone.

Safety back-up (accessions transferred with a dry shipper to IRD and safely stored in black-box) was overachieved by 40%.

Regeneration was fully achieved, with a total of 97 accessions rejuvenated in medium-term storage after BamMMV sanitation. Seven accessions were fully cleaned of BSV instead of 35, and 77 accessions were virus-indexed after therapy instead of 100, due to the treatment applied (chemotherapy), which did not allow the plants to grow as fast as expected after treatment. 153 accessions were field-verified at BPI instead of 100 accessions, but this includes accessions from GPG1.

The barcoding system was optimized and is fully functional, as is the link to inventory systems. 360 accessions with passport data and characterization data were recorded, verified and entered in the Banana Genebank Management System (MGBMS) from ITC, as well as in the banana Germplasm Information System (MGIS) which is more widely used by the banana community.

Centre-Own Upgrading Activities - CIAT

Safety back-up in Svalbard now covers 72% of the bean collection and 55% of the forage collection. Targets were only partially reached (70-80%) for safety back-up, viability testing and packaging, mostly due to the limited number of seeds available. Health testing and regeneration exceeded their targets (nearly twofold), and more than 10,000 additional accessions were processed for characterization and documentation.

Upgrades and improvements on the cold rooms, *in vitro* lighting and security alarms were completed and have greatly improved the conditions of the genebank. Figures 3a, 3b and 3c show the amplitude of improvements, how the genebank structure was before, and how much was improved with the GPG2 funds.

Technological upgrades implemented during GPG1 and GPG2, such as barcoding and digital imagery for authentication and characterization (with 30,000 digital images currently on the website), were important steps for making the germplasm more quickly and safely available to the user community.

Figure 3a *In vitro* lighting at CIAT



Figure 3b Security alarms at CIAT



Figure 3c Cold room at CIAT



Centre-Own Upgrading Activities - CIMMYT

GPG2 brought the CIMMYT-held maize and wheat collections towards the international standards expected by stakeholders. The Centre-own activities resulted in an upgrade of equipment and systems (particularly inventory and seed health systems) and the removal of backlogs in regeneration, characterization, health and viability testing, documentation, and seed supply at CIMMYT. It was possible to achieve considerably more than the planned targets, particularly in the safety backup (fivefold) and viability testing (more than threefold).

Centre-Own Upgrading Activities - CIP

GPG2 activities have resulted in significant achievement of the backlog reduction targets to ensure the secure conservation, management and availability of CIP mandate crops' genetic resources. All planned targets were fully achieved, cryopreservation methods for sweetpotato and *Ullucus* were tested and best methodologies selected. Andean root and tuber crops (ARTC) accessions were introduced into *in vitro* culture and 65 duplicates were converted into botanical seed. A total of 1,941 accessions, comprising 1,115 potato, 795 sweet potato and 31 ARTC, were cleaned of targeted viruses and 528 sweetpotato accessions were cleaned of endogenous bacteria. Effort was concentrated in the improvement of virus elimination and health testing procedures for germplasm distribution. These activities will continue beyond GPG2, especially with regard to ARTC, where virus-indexing methods are still in stages of development. The identity of 300 potato and 160 sweet potato accessions was verified. Morphological characterization was completed for 50 ARTC accessions. Relevant data on biosystematics, herbarium, biotic traits and molecular markers were uploaded to the CIP database. The new equipment acquired through GPG2 has increased CIP's cryo-genebank capacities, and genebank monitoring has been upgraded by using improved barcode methods, especially at CIP's Experimental Station genebank facilities. Overall, significant

improvement of germplasm monitoring and distribution was achieved in CIP's genebank, which became the first genebank in the world to be awarded with ISO 17025 accreditation by the United Kingdom Accreditation Service (UKAS).

Centre-Own Upgrading Activities - ICARDA

For cereals, 8,924 accessions were processed into the active collection over the 3-year project, thus exceeding the planned amount by ten times. A large number of accessions had to be regenerated and multiplied in order to meet the increasing demand for distribution to partners, and the new accessions collected or acquired during 2008 had to be multiplied during 2009. In addition, 684 cereal accessions were introduced into the base collection during 2009. For food legumes, 6,760 total accessions were processed into the active collection, representing 68% of the planned amount. The *Lathyrus* material was not planted in 2009 due to lack of isolation facilities to prevent out-crossing. Only 72 accessions of legumes were processed into the base collection in 2009. For the forage and range species, a total of 30% of the planned accessions were processed into the active collection, and 21 accessions into the base collection during 2009 alone. This can be explained by the infrastructural limitations faced in handling the cross-pollinated and self-incompatible species. During 2009, ICARDA acquired 160 isolation cages to strengthen the regeneration and multiplication of these species in the near future.

Extra tasks were carried out:

- (1) Testing the viability of more than 30,000 accessions.
- (2) Evaluating more than 11,000 accessions.
- (3) Safety backup of a total of 85,560 accessions.

The acquisition of new germination cabinets, in 2009, increased the capacity for viability testing to 11,540 more accessions. The number of accessions regenerated/multiplied was 5,973 for cereals, 8,211 for food legumes, and 7,598 for forage and range species, translating to 597%, 274% and 127% of the total targets planned, respectively. This shows the efforts undertaken by ICARDA-Genetic Resources in handling the increasing requests for distribution from partners.

In 2009, two shipments of seeds, amounting to 63,787 accessions, were sent to Svalbard Global Seed Vault for safety duplication. ICARDA distributed 20,891 accessions to partners, including 9,002 accessions distributed to 11 countries using the SMTA. This large distribution placed a heavy burden on the regeneration and multiplication of accessions. The regeneration and multiplication of range and pastoral species is still not optimal and will require more effort and additional arrangements in terms of facilities and staffing for the future.

At ICARDA, all incoming and outgoing seed samples are tested for quarantine diseases and viruses, for a total of 20,993 accessions during the GPG2 project. Based on the 3-year plans for GPG2, 2,663 accessions of barley were tested for viruses (266% of those planned), but no accessions of chickpea were tested for viruses because of no known quarantine virus on this species. With regard to seed-borne fungi, 11,108 accessions of cereals (1,111% of planned), 4,408 of food legumes (147%) and 2,385 of forage legumes (40%) were tested. These figures reflect the high demand for cereal accessions compared to other species. It is to be noted that the cleaning of infected lots will require additional efforts and costs.

Centre-Own Upgrading Activities - ICRISAT

The GPG2 targets for the majority of the activities were achieved and substantially exceeded at ICRISAT Patancheru and the three regional genebanks - Niamey (Niger), Nairobi (Kenya) and Bulawayo (Zimbabwe). Over the course of the project, we have made considerable progress in processing germplasm for cold room storage at these locations, regeneration of critical/unadapted germplasm accessions, characterization of wild species accessions of sorghum, pearl millet, pigeonpea and groundnut. The perennial botanic garden is now well-established for maintaining non-seed producing wild species accessions of sorghum, pearl millet and pigeonpea, and we also secured seeds from some of the perennial species of *Sorghum*, *Pennisetum* and *Cajanus* for conservation and utilization. The inventory of the active collection at Patancheru identified several accessions with sufficient seed stocks and viability for safety back-up storage. Similarly, field regeneration of a large number of accessions resulted in a substantial increase in the base collection at Patancheru (107,115 accessions representing 90% of the entire collection) and the deposit of about 43,000 seed samples of mandate and small millet accessions at the Svalbard Global Seed Vault in Norway. At Patancheru, characterization of new germplasm added to the diversity of the conserved germplasm, and large sets of crop germplasm were evaluated for important morpho-agronomic and yield traits. This has resulted in the identification of several genetically diverse and trait-specific accessions for use in crop-improvement programmes. Improvements in the physical infrastructure enhanced the safety and security of the germplasm collections at these locations. Barcoding the conserved germplasm at Patancheru increased automation and efficiency in managing the collections. Seed health testing and monitoring plant health during germplasm regeneration resulted in maintaining the seed quality for conservation and distribution.

Centre-Own Upgrading Activities - IITA

The GPG2 project allowed the removal of backlogs in the cleaning (5,684 accessions), viability monitoring (5,418 accessions), packaging (5,779 accessions) and regeneration (6,119 accessions) of cowpea, Bambara groundnut (BGN) and African yam bean (AYB). All targets set for these activities were reached. The cowpea regeneration process was improved by the construction of pollination cages to limit potential gene introgression. The project also allowed us to index 5,130 accessions of seed crops. Out of these, 2,040 were certified as clean and are now available for international distribution. Part of the newly harvested seed was processed for safety duplication in Canada (Saskatoon). 52% of the cowpea, 72% of soybean, 75% of wild *Vigna*, 57% of BGN, and 69% of AYB collections are now safety-duplicated. In the case of maize, the germplasm will be safety-duplicated in Mexico (CIMMYT), where it will be integrated with the main international maize collection. Shipment of the samples is still pending due to quarantine issues. 100% of the Bambara groundnut and 82% of the African yam bean collections are now characterized. The characterization goal was not reached for wild *Vigna*, and this work will be carried out using core funds over the next 2 to 3 years. Also note that the number of samples to be characterized was overestimated for Bambara groundnut and wild *Vigna*. As regards clonal crops, germplasm transfer from the field to *in vitro* storage conditions progressed well for cassava. 68% of the cassava collection is now stored *in vitro*. In the case of yam, and despite many *in vitro* introduction attempts (over 2,000 accessions processed), only 31% of the *in vitro* introduction target was reached. This was mainly due to the difficulties with yam meristems that remain a bottleneck to yam *in vitro* genebanking. Researchers are presently engaged in solving this problem. The indexing targets of the clonal crops were over-achieved for cassava (139%) and underachieved for yam (74%). Clonal and seed crop distribution targets were significantly overachieved for all crops, except banana (17%). One of the main Centre-

own achievements of the GPG2 project was the implementation of a barcoding system for the management of the seed and *in vitro* genebanks. Equally important were the acquisition of cryobanking equipment by the Genetic Resources Center and the initiation of cryopreservation trials on cassava and banana germplasm. A cryopreservation protocol was developed for cassava and will be up-scaled in the coming year.

Centre-Own Upgrading Activities - ILRI

The project has allowed progress to be made in all areas of activity. Additional efforts were made in order to catch up on backlogs and complete as much of the re-scheduled work as technically feasible without compromising quality. The activity on taxonomic identification did not achieve its target because the work was more complex and took more time than expected. Upgrading of the laboratory facilities was completed. Figures 4a, 4b and 4c show the upgraded seed health laboratory at the ILRI genebank with dedicated and expanded work areas for molecular disease diagnostics and tissue culture for virus elimination.

Figure 4a Health laboratory at ILRI genebank



Figure 4b Last fittings in the new upgraded health laboratory at ILRI genebank



Figure 4c Trainees from southern Africa using the upgraded laboratory



The main achievements in Centre-own upgrading at ILRI were a reduced backlog in germination monitoring, health testing and regeneration of disease-free seeds for the genebank and an upgraded seed health laboratory facilities with dedicated and expanded work areas for ELISA/TBIA; molecular diagnostics using NASH, qPCR and RT-PCR; and tissue culture for virus elimination. The project generated information and shared knowledge about the diversity of the in-trust forage collection, through morphological and nutritional characterization, taxonomic studies, evaluation for drought tolerance and updating the information system. This work also benefited from other GPG2 information activities on geo-referencing, scanning original collection data and the forage crop registry and allowed updates to be made with regard to both the forage genebank database and information on the forage websites.

Centre-Own Upgrading Activities - IRR

All milestones of this activity were fully met or exceeded the target:

- A new long-term cold store was constructed, tested, and put into operation with capacity for 220,000 accessions--twice the size of the old facility.
- A humidity-controlled room was constructed and a herbarium of wild rice specimens was established within it.
- 16,411 cultivated and 1,616 wild rice accessions were characterized (109% of target).
- Historical data entry (of characterization and germplasm distribution data) was completed for 62,430 cultivated and 2,081 wild accessions (156% and 104% of target, respectively).
- Historical health inventory data entry was completed for 19,432 accessions (97% of target, but 100% of available records).

Some General Conclusions Regarding the Centre-Own Upgrading Activities

The processing of materials from vegetatively propagated crops, such as cassava, banana, potato, sweetpotato, and yam, presented technical challenges, particularly for *in vitro* conservation and safety-duplication for the Centres managing these crops (i.e. Bioversity, CIAT, CIP and IITA). Likewise, at Centres such as ICARDA, ICRISAT and ILRI, the management of certain crops was particularly challenging with regard to the regeneration of out-crossing species and the germination and viability testing of the crops' wild relatives. Despite these challenges, excellent achievements and overachievements were made in most cases.

4. Project Monitoring and Evaluation

GPG2 Collaborators Meetings

The GPG2 project involved partners working in numerous locations around the world. In order to plan the work for the various activities, establish networks and decide who was doing each task, face-to-face meetings were initially considered vital to ensuring progress, and this proved to be true as obstacles were regularly tackled and resolved during these meetings. Since many Activity leaders were also Task Force members in other Activities, there was a key group of people who were involved in various Activities. Several meetings were held back-to-back in order to better utilize time and resources. There were also several meetings on the sustainability plan and the information component. The number of meetings increased as the project progressed, given that many issues had to be discussed and clarified, and problems identified and solved.

A list of the most relevant meetings is provided below:

January 2007 – Inception workshop at the ICWG-GR in Addis Ababa

October 2007 – Performance indicators meeting in Lunteren, the Netherlands

February 2008 – Project meeting (with the ICWG-GR) in Rome

May 2008 – Sustainability Plan workshop in Rome

November 2008 – Mid-term Project meeting in Rome

May 2009 – Project meeting (with the ICWG-GR) in Mombasa

June 2009 – Sustainability plan workshop in Rome

August 2009 – SINGER/Information components in Beltsville, USA

December 2009 – Final general meeting in Rome

Project Management Tool

DotProject, a computerized, open-source project management tool, was adopted to help manage and monitor the large number of partners, workplans, activities, sub-activities, tasks and milestones in this project. With the help of an information assistant who was hired for this purpose, the DotProject application was successfully adapted to the specific structure and needs of the GPG2 project. This application greatly facilitated the coordination and management of the project's many Letters of Agreement, and enabled the effective monitoring of the progress on their numerous Activities and Sub-activities and the achievement of their milestones.

GPG2 External Reviews (Review Reports, Recommendations and SGRP Responses)

The GPG2 project included provisions for external reviews to be conducted, including measures to ensure that the reviews were independent and unbiased (Activity 6.5-Project evaluation). External reviews were conducted at mid-term (October 2008) and at the end of the project (May 2010). The CGIAR Secretariat, on behalf of the World Bank, was involved in developing of the Terms of Reference, the selection of the Review Panel members, and in any other areas considered to be critical to the success of the project and review, including direct interactions with the Review Panel.

Mid-Term External Review

The Mid-term External Review Panel was composed of Henry Shands (chair), Theo Van Hintum and Leonor Castiñeiras. The Review Panel addressed the following six elements, as specified in their terms of reference:

- Progress since GPG1 Final Report and the impact of GPG2.
- Efficiency and effectiveness of the collective actions.
- Relevance and practicality of the Sustainability Plan.
- Recommendations for implementation of the final 18 months of the project.
- Format and detail of reporting, including the project monitoring and evaluation plan.
- Recommendations for the project's final review in 2010.

The Mid-term Review Panel was impressed by the progress made in most areas covered by the project. Given that the project implementation effectively started six months into 2007, the Panel felt that it was remarkable that delays were so limited. It noted that most activities were largely on schedule, and some were already having impact. Also, the performance of the Project Coordination Team was applauded, despite being underfunded. In terms of products, the Review Panel was concerned about their availability and, in some cases, their quality. They suggested that in order to optimize the potential impact, appropriate quality assurance measures should be implemented and access should be maximized by presenting the project's products in an accessible way on the internet.

The full report of the Mid-term External Review is available electronically in Annex 10.

Final External Review

The Final External Review Panel was composed of Henry Shands (chair), Theo van Hintum and Maria Jose Sampaio. The review evaluated the effectiveness of the implementation of the GPG2 Project Activities and Sub-activities, focusing on the following areas:

- Accomplishments since the GPG2 Mid-term Review (October 2008), and the extent to which recommendations made by Mid-term Review Panel were addressed by the GPG2 Project team.
- Efficiency and effectiveness of the collective actions towards rationalizing activities and sharing responsibilities for the conservation and use of PGRFA in terms of collaboration between Centres and with relevant NARS.
- Critical review of GPG2 completed products, their quality and timely dissemination, taking into account justifiable changes in approach which accommodate new insights gained during the project.
- Suitability of the Sustainability Plan as a strategic document for Centres in meeting their commitments for long-term conservation and use of the CGIAR in-trust collections under the International Treaty for PGRFA.

- Effectiveness of communication and information exchange between Activity Coordinators and Task Force members, and the overall project coordination including the project monitoring and self-evaluation plan.
- Financial management and planning of the project's implementation; internal financial audit reports commissioned by the project and any external audit reports should be examined given the concerns raised by the Mid-term Review regarding the flow of GPG2 funds.
- Recommendations on the key issues raised during the self-assessment exercise conducted prior to the Final Review.
- Recommendations regarding the proposed integrated approach to genetic resources research, policy, conservation and use within the CGIAR.

The Review Panels also presented a concise set of recommendations for areas of future emphasis or action to improve the adoption, implementation and further development of GPG2 project outputs and products in the future. The findings of the Final External Review are summarized below.

Evaluation of the Implementation of the Mid-Term Review Panel Recommendations

The GPG2 Final External Review Panel examined the actions taken on the recommendations of the GPG2 Mid-term External Review. It found that the SGRP Secretariat and the Centres had acted upon all the recommendations, and had implemented the actions in a forthright and expeditious manner. The Panel felt that the actions taken were conducted and accomplished in the spirit of good management, and they expressed their satisfaction with the results.

Efficiency and Effectiveness of the Collective Actions

GPG2 provided a learning process for collaborative activities in the CGIAR, and the review panel applauded the large number of valuable products that were produced through collective action. However, some pitfalls were encountered. The cascading effect of some delays caused difficulties for some activities that were not always possible to solve, and the quality control and peer-reviewing recommended by the Mid-term Review was not always achieved. Ways should be sought to finalize the few products that were not completed within the timeframe of GPG2.

Review of GPG2 Products

The Panel found that the quality of the GPG2 products was generally very good, although some areas were late in delivering, due to partners underestimating the time needed for comprehensive inter-Centre collaboration in the CGIAR community.

Access to most of the products via the Crop Genebank Knowledge Base platform¹ is good. The Panel recommended that this should be further expanded to include other products. A sustainable continuation of this platform after finalization of GPG2 is planned, not only to maintain the value of the products created, but also to allow other actors in the field of PGR conservation to share similar products.

¹ <http://cropgenebank.sgrp.cgiar.org/>

Sustainability Plan

This document was essential in describing the way the valuable collections held in-trust by the CGIAR will be secured for the future. The document has seen major improvements since the Mid-term Review. However, it still needs further discussion and improvements in order to achieve its objectives, especially that of reaching a shared and comprehensive view on the position of the Centres' genebanks in the Global System of PGR conservation and uniformity in costing of the required activities.

Project Coordination

The performance of the GPG2 Project Coordination Team was applauded. The solutions found for managing a programme of this complexity were creative and effective. The project proposal was excellent, though somewhat overambitious. The fact that not all deviations from this proposal could be controlled had more to do with the lack of resources for enforcing decisions, than the lack of an overview.

Financial Management and Planning of the Project

The concerns of the Mid-term Review Panel regarding the allocation of GPG2 funds by some of the Centres were not substantiated by the financial audit reports of the Internal Audit Unit (IAU). The efforts of the GPG2 Project Coordination Team in addressing the concerns expressed were considered sufficient by the Final Review Panel.

The full report of the Final External Review evaluation and recommendations are in Annex 6a and the SGRP responses in Annex 6b.

GPG2 Self-Assessments

To help ensure that the Centres would learn from the review, self-assessments were conducted as a part of the overall review process and provided input to the Review Teams. The SGRP Coordinator, GPG2 Project Coordinator and other relevant personnel served as resource persons to the reviews and carried out the self-assessment surveys before the reviews.

Mid-Term Self-Assessment

A mid-term self-assessment exercise was conducted in September 2008, involving all project partners (Activity coordinators and Task Force members) as a part of the overall review process and to provide input to the Mid-term External Review Panel. The objectives of the mid-term self-assessment were to:

- Allow collective reflection on progress to date and suggest possible readjustments in project (sub-activity) scope, timing or resources.
- Detect opportunities for adjustments that could improve GPG2 project management in Year 3 (e.g. plans made by the end of 2008 at the latest).
- Inform the External Review Panel of identified issues for concern, in order to receive their guidance and recommendations.

The mid-term self-assessment covered the two main components of the GPG2 project: (1) Collective activities and (2) Centre-own upgrading activities. It assessed the progress of activities and outputs covering the period of January 2007 to August 2008, and identified key issues for improvement. Web-based surveys were completed by the Coordinators of the project's 38 Activities/Sub-activities and all Task Force members -- a group of about 75 people. The full report of the self-assessment is archived on the SGRP website, password protected.

Critical areas identified during the mid-term self-assessment are listed below:

Collective Activities

- Difficult collaboration and responses.
- Lack of incentives to cooperate (understaffing, excessive work, limited executive powers, difficult communications, priority for publications).
- High cost versus benefits.
- Conflict of interests between Centre-own and system-wide priorities.
- Interdependencies caused delays in many activities.
- Scope of GPG2 took a lot more time and resources than planned.
- Limited sharing of progress across activities and at a higher level.

Centre-Own Activities

- Good information at activity level but not at project level.
- Some limitations on budget control and disbursements.
- Some backlogs still occur during GPG2.

Final Self-Assessment

The final self-assessment was carried out in March/April 2010, involving the GPG2 Activity teams (all Task Force members, estimated 80 people), SGRP, Donor (WB/CG Secretariat). The objectives of the GPG2 final self-assessment were to:

- Collectively reflect on the work accomplished over the past 3 years, major achievements, challenges and difficulties.
- Inform the External Review Panel of identified issues for concern to be addressed in the review.
- Identify strengths and weaknesses to improve any further work in the future.

The scope of self-assessment covered the main two components of GPG2: (1) Collective activities and (2) Centre-own upgrading activities. It assessed the achievements and challenges of activities and outputs covering the full duration of the project (from January 2007 to March 2010), including the No-Cost Extension (NCE) period. The responses for the self-assessment survey were gathered during 23 March – 8 April 2010.

Critical areas identified during the final self-assessment are listed below in order of importance:

- 1) Lack of sufficient time available to carry out the numerous project tasks.
- 2) Timely availability of human resources-- some people were involved in many activities so there were often constraints on overlapping priorities.
- 3) In some cases technical expertise in specific areas was difficult to find, particularly in Spanish-speaking countries.
- 4) Financial resources were usually sufficient but sometimes their timely availability was a constraint.

The following aspects of the project were identified as having worked well:

- The focus on crops in common helped people with common interests to collaborate effectively.
- The Centre-own activities (regeneration, upgrade, documentation, safety-duplication) followed the positive experience from GPG1 and allowed more flexibility on management and implementation.
- Some of the key reasons for the success of many activities were the personal commitment and responsibility taken by many of the activity leaders and collaborators.
- A lot of the work capitalized on existing expertise.
- The usefulness and quality of products motivated many to work on them and improve them.
- The reporting tools were good and helped to adjust workplans and identify problems that needed addressing.
- A lot of the collaborative work went well, and several collaborators were identified as good assets and champions who had key roles in ensuring the success of the project.

The full report of the final self-assessment is archived on the SGRP website (password protected).

5. Project Outputs and Outcomes

The declared purpose of the GPG2 project was to enable the CGIAR Centres to achieve effective stewardship of their in-trust collections and provide leadership to partners in developing a global crop-based conservation and use system. To achieve this, the project activities were developed around six main Outputs, resulting in tangible products that contribute to the Outcomes.

Briefly stated, the project Outputs and expected Outcomes are:

- **Output 1: Risk management implemented in CGIAR genebanks**
Outcome 1: The CGIAR Centres meet the commitments made in the in-trust agreements regarding security, and provide an example and guidance to partners on risk management.
- **Output 2: Best practices implemented in CGIAR genebanks**
Outcome 2: The in-trust collections are more effectively and efficiently managed according to agreed and promoted best practices.
- **Output 3: Increased access to germplasm and information from CGIAR genebanks**
Outcome 3: Users have safer and more effective and efficient access to the in-trust collections.
- **Output 4: Enhanced knowledge on the diversity held in the in-trust collections**
Outcome 4: Increased understanding of the diversity in the in-trust collections renders them more useful to Centre breeding programmes and to partners.
- **Output 5: Wider CGIAR involvement with genetic stocks and underutilized species**
Outcome 5: Coherent strategies and plans are in place for more effective conservation and use of genetic and genomic stocks, associated biodiversity and underutilized species in achievement of CGIAR System and Centre objectives.
- **Output 6: Better collaboration among CGIAR genebanks for delivering global public goods**
Outcome 6: The CGIAR contribution to the development of a global crop-based conservation and use system is enhanced.

Adoption and Uptake of Products – Outcomes

The project Outcomes serve as reference points against which the effectiveness of its products can be evaluated. The six expected Outcomes are listed below, followed by some representative examples of products that are delivering—or expected to deliver—on those Outcomes.

Outcome 1: *The CGIAR Centres meet the commitments made in the in-trust agreements regarding security, and provide an example and guidance to partners on risk management.*

This Outcome is focused on the benefits that will accrue to the society at large by ensuring the Centres ability to fulfill their short-, medium- and long-term responsibilities regarding their management of the in-trust collections, and to underpin the global system by providing guidance and technical support to national partners in managing risk with regard to *ex situ* germplasm conservation.

Facilities upgraded and backlogs reduced: The upgrading of the Centres' genebank facilities and the reduction of backlogs in the processing of accessions into storage have had an immediate positive impact on the Centres' ability to meet the commitments of their in-trust agreements. All Centres with genebanks have benefited from these activities. Most importantly, the benefits derived from these activities are not limited to the Centres; they are passed on--as global public goods--to the users outside the CGIAR. The Centres' contribution to the global system has been enhanced by providing partners with greater access to more and higher-quality germplasm and associated knowledge and information.

Risk management: Guidelines for risk-management procedures were produced to ensure the security of in-trust collections, and they have been already implemented by IRRI and by PhilRice. The guidelines include recommendations for additional linkages between Centres to strengthen system-wide adoption of risk management practices. The adoption of risk management procedures by the CGIAR genebanks serves as a model for national partners and exemplifies the leadership role that the Centres play in underpinning the global system.

In vitro protocols: The collective approach taken to develop standard *in vitro* protocols involved Bioversity, CIAT, CIP and IITA bringing together a group of experts in five major clonally propagated crops. Strong network linkages and bonds were established and will remain after the project is finished. A community of practice is now established and continue working on testing current viable protocols across Centers and adjusting and validating them for specific germplasm as needed.

Outcome 2: The in-trust collections are more effectively and efficiently managed according to agreed and promoted best practices.

Outcome 2 concerns the adoption of improved germplasm management techniques, protocols, strategies and standards within the CGIAR and its partners. This area of work represents a key opportunity for the Centres to take advantage of their comparative strengths in this area and provide much-needed leadership and technical backstopping to the global system.

Dissemination of best practices: The large-scale review, updating and improvement of many genebank procedures and tasks, including the incorporation of new technologies, was an important system-wide outcome whose beneficial repercussions will be reach far beyond the Centres themselves. The dissemination and broad adoption of the guidelines to the best practices and related products is greatly expedited by the Crop Genebank Knowledge Base (CGKB). The CGKB is an attractive, user-friendly and easily accessible online source of a wealth of authoritative information about genebank and germplasm management practices, and while a highly successful product in its own right, serves as the dissemination platform for numerous other important products that contribute to this Outcome. The CGKB, with its wealth of high-value content, represents one of the most visible and directly useful outputs of the GPG2 project, and constitutes a significant contribution to global efforts to conserve plant genetic resources *ex situ*. It has been already adopted by ILRI, ICARDA, CIMMYT and Bioversity International to support training activities and to update of staff and students on best practices. The CGKB has also been used extensively by RDA (South Korea) to train genebank staff from numerous ASEAN countries. Some examples of the utility of the best practices available on the CGKB are mentioned below.

Conservation methods: Updated storage procedures for seven seed crops and revised protocols for four clonal crops were developed, with updated guidelines for medium- and long-term conservation. These updated procedures and guidelines serve as models for updating the

conservation methods for other crop species, which can then be readily adopted by national partners in the global system.

Management of transgenes: Specific guidelines were developed for three crops to ensure that conventional germplasm accessions could remain free from transgenic introgression, and for conserving germplasm of transgenic crops. These guidelines are being used to initiate management of transgenic accessions, but the prescribed methodology is not yet fully adopted.

Safety backup: Procedures and model agreements for a system-wide strategy help ensure the safety of the germplasm collections and keep track of where intentional safety duplicates are deposited to avoid unnecessary or unintentional duplication.

Inventory management: Model genebank inventory systems were developed, including guidelines for bar-coding specifications to assist Centres in the implementation of this technology in their genebanks. Bar-coding has been implemented by most genebanks, where it has noticeably increased the efficiency of managing the collections through the automation of some critical procedures. Upgrades on bar-coding and massive use of digital imagery used in authentication and characterization (30,000 digital images on the CIP website) are important steps for making the germplasm more quickly and safely available to the user community.

Cost-effectiveness: A methodology and a costing decision-support tool were developed to enhance the cost-effectiveness of collection management for optimal resource allocation. Adjustments to the methodology have been made by most CGIAR genebanks and some of the resulting cost estimates were used for developing the sustainability plan. This interactive tool has already been used for genebank training.

Quality management systems: A complementary GPG2 activity assessed quality management systems and their applicability to genebank operations, which included the compilation, review and updating of standard operating procedures. This is especially relevant now that CIP's became the first genebank in the world to be awarded with ISO 17025 accreditation by the United Kingdom Accreditation Service (UKAS), and CIMMYT is currently undertaking ISO 9001:2008 certification. It is foreseen that ISO or similar quality management systems will eventually be adopted by most if not all CGIAR Centre genebanks. Because best practice standard operating procedures for genebanks are now more clearly defined and described, the requirements to receive quality management certification will be more easily fulfilled.

Outcome 3: Users have safer and more effective and efficient access to the in-trust collections.

This Outcome is based on expedited access to and mobilization of genetic diversity contained in the in-trust collections, and also within and between countries. This is a key Outcome for downstream impact as it directly increases partners' access to and use of genetic resources and other global public goods produced by the Centres.

Online access: SINGER provides easy online access to accession-level data on more than half-a-million samples of crop, forage and tree diversity held in the Centres' germplasm collections. Once the user identifies materials of interest from the online passport information, her access to the germplasm is now greatly facilitated thanks to the new one-stop-shop feature for requesting germplasm that was incorporated into SINGER. The one-stop-shop germplasm request feature allows the user to build a germplasm request that combines accessions from different genebanks. SINGER then automatically generates and sends separate e-mails to the relevant genebank curators, indicating only those accessions that will be provided by the corresponding genebank. Since web traffic monitoring was installed on the new website

interface in July 2009, there have been 5,232 unique visitors to the site from 141 countries. In the first months of the one-stop-shop feature's introduction, 18 germplasm requests were made using the new feature, which resulted in 130 accessions ordered from CIP, ILRI, CIMMYT, IRRI, ICRISAT, ICARDA and IITA.

Crop registries: The development of web-based crop registries was an opportunity to recover missing information about crops in common to complete Center-own databases and identify unique samples as well as duplicates samples held in different genebanks. This information is useful, not only for assessing the total amount and diversity of materials conserved in genebanks, but it also facilitates efforts to rationalize these collections for greater cost efficiency, availability and conservation security. For example, the crop registries revealed that between some Centres that have crops in common—such as cassava at CIAT and IITA, and forages at CIAT and ILRI—there was very little duplication of effort. When the cassava registry was shown to the genebank staff from EMBRAPA (Brazil), they immediately recognized its potential and expressed interest in participating with data from their collections. In the case of the rice registry, it is already fully integrated into IRRI's regular database, where it is used daily for germplasm management. IRRI views the rice registry as one of the primary tools for implementing the global rice strategy. The National Bureau for Plant Genetic Resources in India has expressed an interest in adding their data to the rice registry. Crop registries address more directly the needs of plant breeders, who seek the broadest possible view of the germplasm accessions currently available for their crop, regardless of the institution that is holding it.

Safe-movement of germplasm: Guidelines on best practices for the safe-movement of germplasm are now available for 20 crops, including updated methodologies for pathogen detection. While these improved methods are already being implemented by the Centres, the guidelines will serve as authoritative and practical references for their adoption by national partners. To facilitate the adoption by national partners, a collaborative platform was developed with recommendations for harmonization of the regulatory and phytosanitary requirements of the CGIAR Centres with those of their host countries. The collaborative platform is expected not only to expedite the flow of germplasm into and out of the Centre genebanks, but also to strengthen scientific cooperation between the Centres and their host countries.

Outcome 4: Increased understanding of the diversity in the in-trust collections renders them more useful to Centre breeding programmes and to partners.

Outcome 4 deals with the improved usefulness of germplasm through enhanced data quality and analysis of the genetic diversity contained within the in-trust collections. This is an area where the Centres have a clear comparative advantage and can make important technical contributions to non-CGIAR partners in the global system. While some of the activities were aimed at improving Centres' management of the in-trust collections, many of the outputs produced under this Outcome can be readily and directly taken up by partners outside the CGIAR and can serve as the basis for capacity building efforts.

Access to quality data: By updating and augmenting the quality of the passport data in the Centres' databases and SINGER, and making this information readily available to users, the value of the germplasm has increased. For example, by having more complete and accurate geo-referenced data for the collections, GIS tools can be applied to do more in-depth analyses of the collections that combine other geo-referenced data sets. Such data improvement enabled an analysis protocol to be applied to wild species from 10 gene pools and cultivated materials for 14 crops, to identifying eco-geographic gaps in the collections.

Gap analysis: The gap analyses conducted to see the extent that in-trust collections are representative of the total diversity that exists in the crops' gene pools revealed that the gap is still significant, indicating that much germplasm collecting and exchange is still needed. Notable exceptions include some crop wild relatives for which targeted explorations were carried out in the past. The gap analysis required that quality data for the crop wild relatives accessions held in-trust be recovered from older records, as mentioned above.

Diversity research: Existing phenotypic characterization strategies in use at the Centres were reviewed for selected mandate crops (chickpea, rice, maize, potato, banana, pigeonpea, sorghum), and patterns of demand for trait-specific germplasm were studied to determine potential value and usefulness of the strategies across Centres. Recommendations for reducing and managing the loss of genetic integrity of conserved germplasm were developed for four crops, and the current procedures to reduce the loss of genetic integrity of conserved maize germplasm were described. Through collective action, the Centres are uniquely positioned to conduct this kind of meta-level research of crop diversity, and apply the results not only for improving the management and use of the in-trust collections, but also to make the methods and findings available to outside partners, in the context of the global system.

Outcome 5: Coherent strategies and plans are in place for more effective conservation and use of genetic and genomic stocks, associated biodiversity and underutilized species in achievement of CGIAR System and Centre objectives.

This Outcome aims at assessing the current strengths, limitations and opportunities for the Centres to address a wider range of strategically important genetic resources, and their potential for enhancing the CGIAR's impact in terms of its development mission. Important progress towards this Outcome was made in several areas:

Specialized collections: A survey of genetic stocks collections within the CGIAR and in national genebanks revealed that there are a large number of such collections and that they are frequently not directly associated with regular genebank collections. Principles were identified for decision-making on adding genetic stocks to genebank collections, and information on procedures for their management was compiled. These specialized collections are of great importance and value to breeding efforts, and efforts need to be made to harmonize the management of their materials and associated information with that of the genebanks, indicating an important area for future action.

Neglected and under-utilized plant species: Groups of underutilized species were prioritized, main areas of relevance for development were defined in consultation with key stakeholders, and guidelines were prepared for assessing the benefits to communities offered by these species. The comparative advantage of Centres for carrying out activities and research suitable for collective actions was also assessed, as an area for strategic future action.

Survey of collections of non-plant taxa: A broad survey was conducted on the presence of collections of microbial, fungal, insect and nematode species of agricultural importance within the CGIAR, as well as at prominent national and international organizations. Information on the current inventories and management procedures for these non-plant taxa revealed that, international standards for managing the collections exist, but in the absence of common strategies, policies or best practices for moving those materials internationally. With its strong track record in the field of plant genetic resources, this is an area where the CGIAR is in a uniquely advantageous position to address these strategic issues for the benefit of the global community.

Outcome 6: The CGIAR contribution to the development of a global crop-based conservation and use system is enhanced.

Outcome 6 is focused on taking advantage of the many opportunities for collective action among the Centres to enhance the CGIAR's contribution to the global system through the delivery of global public goods and increased international collaboration. Some key Activities that made important progress toward this Outcome include:

Sustainability plan: The purpose of the sustainability plan is to ensure a durable result from the recent investments in rehabilitation of the collections, and to support the fulfilment of the Centres' in-trust commitments in the future. The opportunity to collectively address the crucial issue of sustainable funding for the CGIAR genebanks served to galvanize the GPG2 community, who devoted large amounts of time and effort to this important task. One of the innovative steps taken in developing the plan was the standardization of a rigorous methodology for costing the genebank operations across Centres and types of crops. For the practical purposes, the costing of genebank operations was considered in two dimensions: critical custodianship operations, and user-oriented operations. Through an iterative process involving extensive inputs and feedback from project partners, Centre management, the Alliance, the GCDT, and the mid-term and final external reviews of the project, a series of internal versions and two publicly released drafts were produced. Throughout its evolution, the sustainability plan has stimulated collective thinking and strategic planning within the CGIAR genebank community and has attracted much-needed attention to the genebanks by Centre management and donors. It has become clear that the development of a sustainability plan is neither a simple nor a straightforward undertaking, and will require further discussion and consultation before a practical and viable plan is agreed upon and eventually adopted by the Centres. Nevertheless, there is now wide recognition that this is an important and worthwhile activity that is already generating benefits in terms of Centres' awareness of and commitment to their genebank's sustainability, and its development should be continued. Another important future outcome of the sustainability plan—as highlighted by the Final External Review panel—be to more precisely define the role the CGIAR genebanks within the greater context of the global system.

Performance measurement: A set of performance measurement indicators were produced in close collaboration with the Global Crop Diversity Trust. The GPG2 project produced a preliminary set of indicators which the GCDT found to be immediately useful and incorporated elements of those indicators in their Long-Term Grant agreements with the Centres. A revised set of performance measurement indicators was produced based on a harmonization exercise that adopted the GCDT's genebank performance indicators, as this set had been rigorously tested and improved with input from all of CGIAR genebanks. Having commonly-agreed and jointly-developed indicators for assessing performance adopted by both supporters and managers of the in-trust collection has greatly improved the efficacy and transparency of the genebank management practices, and contributes directly to the enhanced security, quality and availability of in-trust collections. The indicators developed are specific, yet generic enough to be relevant to all genebanks who contribute to the global system. The adoption of performance measurement indicators by the CGIAR genebanks serves as a model for national partners, and exemplifies the leadership role that the Centres play in underpinning the global system.

Development of the global system: For a rational global system of genetic resources conservation and use to be functionally effective, widespread adoption of International Treaty (ITGPRFA) and participation in its Multi-Lateral System of Access and Benefit Sharing (MLS) are policy prerequisites. Nevertheless, adoption and implementation by developing countries has

been—to date—negligible. The disincentives facing developing countries in their implementing the IT and the MLS were studied through a series of case studies that were commissioned in four developing countries (Kenya, Morocco, Peru, Philippines). The authors of those studies then met together with representatives from the Centres, the ITPGRFA, FAO, and other international policy experts at a workshop in February 2010. The workshop was an opportunity to discuss and compare the results of the individual studies and come up with specific recommendations to address and overcome those disincentives at both the national and international levels. The recommendations of the workshop, as well as revised versions of the country studies, are being prepared as formal papers that will be published as book on the subject by Earthscan. The focus on national programmes and the full involvement of their scientists in the case studies, discussions and recommendations ensures that the products are relevant and will facilitate their downstream uptake by the target countries and other stakeholders.

Project Purpose and Achievements

The purpose of GPG2 was achieved in three main areas of work: (1) improving procedures for managing genetic resources, (2) increasing the value and use of the collections, and (3) planning for the future (see Project achievements in box below). To achieve this, the project generated a wide range of products, varying in both size and type as well as in the nature of their uptake and impact on beneficiaries. In many cases, the products were readily adopted by the CGIAR Centre genebanks and have produced an immediate positive impact on their operations, which translates directly into increased benefits for their stakeholders. Examples include the Centre-own upgrading of the genebank facilities and the elimination of processing backlogs, the risk management tool, the Crop Genebank Knowledge Base, the online ordering tool, and the performance indicators.

In other cases, while its importance and ultimate value is clear, the product represents an initial stage in a process or an approach whose development and adoption will contribute significantly to the outcome in the long-term, but whose benefits cannot yet be easily measured. Examples of such products include the draft Sustainability Plan, the decision cost tool, the analysis of policy elements of an integrated system, the strategies and procedures for diversity analysis, and the survey of non-plant genetic resources collections in the CGIAR, amongst others.

The Centre-own upgrades, including the elimination of backlogs and the implementation of improved genebank management procedures, have already contributed to the impact pathway by enabling more cost-effective stewardship of the in-trust collections, greater efficiencies in the management of crops in common, and have demonstrably enhanced the Centres' delivery of genetic resources and associated knowledge as global public goods. The Centres are now in a much better position to provide support to NARS partners through more streamlined and user-friendly access to useful germplasm, and making available research tools, methods and approaches that will strengthen the NARS' capacity to better serve their own stakeholder communities.

The collective action emphasis of the GPG2 project is likewise benefiting the Centre genebanks through the coordination of strategic activities that contribute to the CGIAR's overall mission, while at the same time strengthening each Centre's capacity to discharge their respective individual mandates. The products of the collective activities have directly improved the Centres' capacity to generate and deliver international public goods, individually and as a system. Some examples of these enhanced capacities are described below in the context of the project's expected Outcomes.

Project Achievements:

1. Improving procedures for managing genetic resources

Best management practices for seed and clonal crop collections in the CGIAR and for optimum conservation and use were developed and compiled into an online knowledge base, including training materials and exchange of technologies between Centres, targeting the following areas of germplasm management:

- a. **Conservation:** Storage procedures for 7 seed crops and protocols for 4 clonal crops with guidelines for medium- and long-term conservation.
- b. **Reducing loss of genetic integrity:** Recommendations for reducing and managing the loss of genetic integrity of conserved germplasm for 4 crops.
- c. **Management of transgenes:** Specific guidelines for 3 crops to maintain conventional germplasm accessions free from transgenic introgression and for conserving germplasm of transgenic crops.
- d. **Safety backup:** Procedures and model agreements for a System-wide strategy.
- e. **Inventory management:** Model genebank inventory systems and guidelines for bar-coding specifications to assist Centres in implementation.
- f. **Safe-movement of germplasm:** Safe-movement guidelines of best practices for 20 crops, including methodologies for pathogen detection and a collaborative platform with recommendations on harmonization of regulatory and phytosanitary requirements of the CGIAR Centres and their host countries.
- g. **Risk-management:** Guidelines for risk-management procedures including assessment of risk and a map of risk mitigations to ensure the security, quality and availability of in-trust collections with recommendation for linkages to Centre-wide risk management.
- h. **Cost-effectiveness:** A methodology and a decision-support tool to enhance the cost-effectiveness of collection management for optimal resource allocation.
- i. **Reducing backlogs:** Upgrading and improvements of the Centres' management of the in-trust collections, in terms of reduced backlogs in the processing of accessions into storage, including regeneration, characterisation, health and viability testing, documentation, and safety-duplication in accordance with the System-wide principles and deposit strategy, building on the accomplishments of the first phase of the project (GPG1). By the end of 2008, of the 241,662 accessions planned to be processed, 381,356 accessions were actually processed (an over-achievement of 158%).

2. Increasing the value and use of the collections

- a. **One stop entry point:** A germplasm ordering system prototype using SINGER data and a help-desk to support Centres' implementation.
- b. **Eco-geographic gaps:** Geo-referenced data checked and an analysis protocol for identifying basic eco-geographic gaps in the diversity of wild species and cultivated materials applied to wild species from 10 genebanks.
- c. **Diversity research:** Existing phenotypic characterization strategies on selected crops in the CG (chickpea, rice, maize, potato, banana, pigeonpea, sorghum) and patterns of demand for trait-specific germplasm reviewed to determine potential value and usefulness across Centres.

3. Planning for the future

- a. A draft **strategic plan** for enhancing CGIAR System capacity to identify A **sustainability plan** to ensure a durable result from the investment in rehabilitation of the collections, and to support the fulfilment of the Centres' in-trust commitments in the future. The plan includes a costing of the custodianship operations as well as the strategic, user-oriented impact-focused operation. Key feedback from the GCDT and the former Alliance on the latest version of the document reinforced the need for continuing the process for developing a sustainability plan. A tentative action plan has been drawn up for discussion with the Consortium in the context of the new CGIAR, with the understanding that discussions are currently underway between the Consortium and the Fund Council on options for genebank funding. Meanwhile, some Centers have made detailed sustainability plan for the period 2010-2013, taking into account the full cost recovery policy that the Centers are expected to have that in place by 2011.
- b. **Survey of projects dealing with specialized, non-crop, and neglected and under-utilized plant species** in the CGIAR and in national genebanks. Groups of species prioritized, main areas of relevance for model development in consultation with key stakeholders, guidelines for assessing benefits delivered to communities and comparative advantages of Centres for carrying out activities and research suitable for collective actions.
- c. A set of **indicators to measure the performance** of the CGIAR Centres in managing the in-trust germplasm collections.

6. Sustainability Plan development

Background

One of the expectations of the donor was that, upon completion, the GPG2 project would improve the management of the in-trust collections to a level where steady-state maintenance would be feasible without further upgrading investment, and that the resources would be forthcoming from the hosting Centres to support that steady-state of genebank maintenance. Some of the project partners expressed concerns about the Centres' ability to fully meet these expectations. These concerns included:

- The funds provided through GPG1 and GPG2 were never sufficient to cover all backlogs, which are continually accumulating.
- The collections are constantly growing with new accessions.
- Other large investments will be needed in future as monitoring and regeneration of the collections need to be repeated periodically.
- New procedures and opportunities

These reservations notwithstanding, as a prerequisite for their approval of funding for the GPG2 Project, the World Bank specified that a sustainability plan for the Centres' genebanks--and the in-trust germplasm collections that they host--would be developed during the course of the project, and that a draft plan would be prepared in time for the mid-term external review of the project.

Concept

The intended purpose of the plan is to help ensure that the Centres can and will continue to sustain the in-trust germplasm collections to international standards, and fulfill their obligations and responsibilities under the International Treaty of Plant Genetic Resources for Food and Agriculture, in the context of a global system. As originally conceived by the project partners, the content of the sustainability plan would include:

- Summary of critical issues and broad approach to achieving sustainability.
- Overview of coordination, rationalization and other strategic approaches to enhance efficiency and hence sustainability.
- Overview of awareness-raising activities in support of sustainability.
- Individual Centre funding requirements, resource mobilization strategies and Centre statements of intent.
- Collective action funding requirements, resource mobilization strategies and SGRP statement of intent.

Development

A project meeting was held to agree on future vision for the genebanks (not all Centres were able to participate in this meeting). The meeting was an opportunity for a large group of genebank managers and other genetic resources experts with the CGIAR to engage in a collective visioning

exercise and agree on the elements of shared priority across all of the Centres' germplasm collections and associated activities. It was agreed that the sustainability plan would address:

- Elements of a global system (short, medium and long term).
- "Mission critical" activities that must be sustained at any cost.
- "User oriented" activities that, while also extremely important, relate to use of the collections and could be delayed if necessary.
- Partnerships with institutions outside the CGIAR.
- Human resource requirements.
- Standardised costing of operations to get uniformity and comparability across Centres.

To generate the information necessary to provide this content, it was agreed that:

- Each Centre will assemble the required costing information for their genebank operations.
- A standardized costing tool will also be developed and used to calculate costs.
- Centres will make a comparison of their costs against tool costs to finalise their figures.
- A survey will be conducted of the Centres' impact oriented activities and future needs.
- A meeting will be held to revise earlier drafts and develop the final draft of the plan.

Feedback and Response

A preliminary version of the Plan, entitled "*Mapping Our Future: Sustaining the CGIAR Centres' Genebanks for Greater Impact*", was circulated to the Alliance Deputy Executive for Science (ADE–Science) for discussion at their June 2008 meeting in Penang, where it was tabled in the minutes but no substantive feedback on its content was provided. This preliminary version was also presented to the World Bank in October 2008, just prior to the project's Mid-Term External Review. In its Terms of Reference, the Mid-Term External Review panel was explicitly tasked by the World Bank to assess the Sustainability Plan and its implementability. The Mid-Term External Review panel made two specific recommendations for improving the Sustainability Plan (Recommendations 6 & 7, see box).

Mid-Term External Review Recommendations for the Sustainability Plan

- 6. *The Sustainability Plan should be revised to more clearly reflect the future Custodian Role of the CGIAR genebanks in the conservation and use of PGR, within the context of a rational global system comprised of a collaborative network of national and international actors.***
- 7. *The Sustainability Plan should contain a robust estimation of costing of the Custodian Role of the Centers based on a transparent costing model.***

In October 2009, a second version of the sustainability plan was produced, incorporating the responses to the recommendations made by the Mid-Term External Review. Major improvements in the second version included:

- A roadmap to achieve the desired future scenario for 2020.
- A discussion of rationalization approaches and goals.
- An analysis of the resource requirements for critical genebank operations using more robust and more comprehensive costing methods (i.e., application of a standardized decision-support tool for calculating the cost of genebanks operations, and the full costing of both direct and indirect operational costs).
- A description and rough estimation of the resource requirements for complementary user-oriented activities that should be also be carried out in addition to the genebanks' most basic custodianship operations.

The second version of the Sustainability Plan was submitted to the Alliance Executive (AE) in December 2009 for them to review, provide feedback and, ultimately, give its endorsement for the submission of the Plan to the World Bank. This second version of the Sustainability Plan was also sent to the Global Crop Diversity Trust, and a detailed 12-page response was received from them, dated 2 March 2010, in which numerous questions and differences of opinion were expressed. While feedback was received from a few Centre directors in their individual capacities, a consolidated response on the Sustainability Plan was received from the AE on March 10, 2010, in the form of additional comments and observations inserted within the text of the response sent the previous week by the GCDT (which the GCDT had copied to all Centre directors). While supportive of many aspects of the Plan, the Centre directors expressed concern about the increased costing estimates for the genebanks, and how those additional costs would be borne by the Centres when they are faced with ever-decreasing levels of unrestricted funding.

The recently-concluded Final External Review of the GPG2 project was also tasked with assessing progress on the Sustainability Plan. The panel was impressed with the progress made over the initial version, yet felt that the Plan was still too inward-looking and needed to take into account the roles of national programmes and other actors in the context of the Global System. The panel made two specific recommendations for its further development (Recommendations 4 & 5, see box).

Final External Review Recommendations for the Sustainability Plan

- 4. To allow for a proper estimation and comparison of the costs of the custodian components of the PGR activities in the Centres, the costing of these activities should be further harmonized by distinguishing the genetic resources categories (such as self- or cross-pollinated plants, and in vitro conservation). To allow for the development of a more cost-efficient system of germplasm maintenance, the possibility of outsourcing activities should be further examined, while assuring the many quality parameters essential to good PGR management.***
- 5. To develop a realistic and credible Sustainability Plan for the PGR conservation activities in the Centres, it is essential for the Centres to recognize, understand and articulate the role of the CGIAR in the existing Global System of conservation and utilization of PGR.***

While significant progress on the development of a Sustainability Plan has been made through GPG2, the valuable feedback received from the Final External Review, the GCDT, and from the AE makes it clear that there remain a number of outstanding issues to be resolved. Additional consultation and deliberation will be necessary before a consensus can be reached regarding the concept, scope and purpose of the Sustainability Plan. This iterative process will need to be continued and periodically reviewed to ensure that primary stakeholders such as the Centre directors and the Global Crop Diversity Trust, as well as partners outside of the CGIAR, feel that their concerns and interests are adequately reflected in this strategic document. The costing element of the draft sustainability plan is a point of particular importance and has been the source of much debate. The standardization of costing of genebank operations was greatly strengthened by the application of the decision support tool developed through GPG2, but this will need to be further revised and improved in the future to include full cost recovery.

The most recent draft of the Sustainability Plan (Nov. 2009) and an Addendum prepared in July 2010 are presented in Annex 4.

7. Financial Management

Funding Patterns and Financial Reporting

Disbursement of funds was carried out via contracts in the form of Letters of Agreement (LOAs) issued by Bioversity International in early 2007, on behalf of the SGRP, detailing the work to be undertaken by the respective partners, as set out in the proposal, between 1 January 2007 and 31 December 2009. The LOAs were issued for the duration of the work involved, indicating the total funding available, but transferred in tranches; those other than the first depended upon satisfactory technical progress and financial reporting. Recipients were required to report expenditures annually against financial plans, indicate annual expenditures as percentages of the total, justify any deviations, and ensure that any over-expenditure was balanced either by savings or by Centre-own funds. Due to initial delays and difficulties in performing activities dependent on the outputs of others, in December 2009, 17 of the project activities received a no-cost extension (NCE) until 30 June 2010.

A total of 6 disbursements were received by Bioversity International, from the World Bank, between 2006 and 2009 and are shown below. The seventh and final balance is due in July 2010, after the Final Report is submitted.

Funds received:

30 June 2006	\$ 2,000,000
10 April 2007	\$ 1,985,000
29 May 2008	\$ 1,500,000
19 June 2008	\$ 500,000
23 December 2008	\$ 1,766,293
23 October 2009	\$ 2,400,000

Upon receiving and approving the respective annual technical and financial reports, disbursements were made from Bioversity to the other Centres. Most Centres fully utilized the resources to meet the outputs of the project. In a few cases (see details for collective activities in table 2.1 and for Centre-own in table 3.1), the achievements of some collective activities were realized with less resources than anticipated. The ICWG-GR as the steering committee for GPG2 (during the ICWG-GR meeting held in Rome in May 2010) agreed that those funds should be re-allocated in order to improve the quality and raise awareness on some relevant products, namely: improving the user-friendly format of registries (Activity 3.3), improving some components of the decision support (Activity 2.4) and risk management tool (Activity 1.1), finalizing editing for the English version of the CGKB (Activity 2.1.3), and completing the Spanish translation of the CGKB (new task to improve awareness of relevant products and make them widely available). This also followed the recommendations of the GPG2 Final External Review Panel in May 2010.

A copy of the final financial report is included as Annex 5.

Internal Financial Audits

Financial management was overseen by the CGIAR Internal Auditing Unit (IAU), with funds allocated within the project management budget to engage the assistance of the Unit. A cycle of internal financial audits of GPG2 project activities was carried out over 2008-2010, by the 11 participating CGIAR Centres, as a component of the monitoring and evaluation activity of the project. The audits used the financial reports prepared by the Centres as the basis for the audits. The programme of activities which the IAU has established with the Centres after concurring on the cycle with the GPG2 Project Coordinator is as follows:

	2008 (audits of 2007 financial reports)	2009 (audits of 2007 and 2008 financial reports)	2010 (audits of 2008 and 2009 financial reports)
Bioversity	✓	✓	✓
ICARDA	✓		
CIMMYT	✓		
ICRISAT		✓	
IRRI	✓		
IITA	✓		
CIAT	✓	✓	✓
CIP		✓	
ILRI		✓	
Africa Rice		✓	
IFPRI		✓	

Bioversity is serving as the host Centre for the SGRP Secretariat and the GPG2 project coordination. The Bioversity-led component was audited each year, while most other Centres were audited in either 2008 or 2009. The audits have been incorporated in the annual workplans the IAU establishes with Centre Boards and management, and results are reported to the Centres in the same way as other audit assignments. The audits were carried out by CGIAR-IAU staff or Centre internal auditors working under CGIAR-IAU supervision.

The Internal Audit Unit completed a total of 15 audit reports for participating CGIAR Centres regarding the GPG2 Internal financial audits from 2008 to 2010. Centres agreed to share the internal audit reports and follow up information on the status of audit recommendations with the GPG2 Project Coordinator.

A total of 32 recommendations were issued and followed up this year with the Centre's managers and staff.

Recommendations that are still in progress, or have yet to be implemented, concern more general issues which retain ongoing relevance for Centre operations, and will continue to be included in the annual review of audit recommendations made in past audit reports per Centre.

Audit Report	Total	Implemented	Implementation Underway	Agreed upon but not yet Implemented	Superseded
ILRI FY 2009-02	11	8	3		
ICRISAT FY 2009-10-01	7	3	2		2
CIMMYT FY 2008-05	2			2	
WARDA FY 2009-01	7	6		1	
ICARDA FY 2008-05	5	5			
TOTAL	32	22	5	3	2

All the prescribed internal audits of the 2007-2009 financial statements of participating Centres were concluded. The overall financial management at the managing unit level as well as at the Centre institutional level of the CGIAR Centres was satisfactory. Identified areas of improvement for promoting effective and efficient project management have been reviewed as well.

The audits were of value in providing assurance to the Centre management and GPG2 Project Coordinator on the financial reporting by Centres for this complex project.

8. Lessons Learned

Internal Assessment and Learning

The project partners assessed the planning, implementation and reporting during the project to identify what worked well and what could be improved for future collective action projects. Several sources and methods were used to gather this information, which was analyzed and the conclusions drawn in the following areas of project implementation:

Planning and implementation

- Project implementation and management were done through many contracts and LoAs which were very specific and often raised for very small amounts. This resulted in many reporting requirements per each activity. It would have been more efficient to aggregate similar activities and regional activities to fewer larger contracts for reporting.
- Adequate time at the beginning of the project for start-up activities and team building would have reduced the initial delays experienced and should be taken into consideration in future project planning.
- Interdependency of activities should have been taken into account when estimating time schedules, workplans and budget allocation. Regular monitoring of progress of activities against milestones was important to decide when alternative solutions needed to be considered to meet commitments.
- More uniform participation and full engagement from all partners would have facilitated activities to progress in parallel and avoid some of the delays.

Many of the challenges encountered in the implementation of the multi-Centre project served to highlight the weaknesses of the decentralized management structure of the CGIAR. The difficulties encountered in implementing the collective actions were due in many instances to the existing “corporate culture” within the CGIAR of competition, historic limited collaboration among Centres, heterogeneous financial management and germplasm documentation systems, genebank management practices, etc. Many of the GPG2 Project activities sought specifically to standardize and harmonize to increase efficiency and collaboration within and amongst Centres.

Communication

- Communication among partners was essential to deliver outputs in such a complex project but we recognized that care must be taken to avoid information overload. When dealing with dispersed project partners across continents and time zones, a diversity of media should be used to communicate and whenever possible, more direct communication and personal interactions should be used.
- It would be very helpful for future collaborative initiatives to identify one champion/communicator per Centre early in the project to support communication and information sharing.

- As planned, most GPG2 products were only completed towards the end of the project. Greater efforts to promote and disseminate these outputs and products over a longer period of time, and planning their sustainability after the project ends, would increase their usefulness.

Looking towards the future

- Many of the products of the project are dynamic and will require regular updates to remain relevant. Products with high potential for further improvement should continue to be supported by Centres after the end of the project.
- The project succeeded in moving the Centres' work on genetic resources in the direction of a more unified, rational, and coherent "system", complementing one of the objectives of the CGIAR Change Process. In this regard, the GPG2 project for Collective Action could serve as a model for the new CGIAR.

External Review

The two external project evaluation teams made useful and relevant recommendations to improve project implementation (mid-term review) and enhance the impact of project results (final review) and are detailed in the annexes of this report. Important changes that were made in response to the mid-term external review include:

- The IAU audits were completed to assure the adequate management of funds. Consultants were employed to support the project coordination.
- The quality control system for products was formalized and improved.
- The SGRP website was improved to create more awareness and facilitate dissemination of information during, as well as after, the project.
- Development of the sustainability plan allowed the time and space for strategic thinking and planning about the role of Centre genebanks in the wider global genetic resources system. The future visioning process is ongoing in parallel with the change management process within the CGIAR and future activities may need to be adjusted accordingly.

Relevant changes were also made in response to the final external review:

- The quality of specific products was further improved with friendly formats of easy access.
- All unfinished products were ultimately finished.
- More awareness was created about the GPG2 results and products to maximize their use to the full potential.

General Lessons Learned

A lot was learned about the ground rules required to more effectively work together amongst the CGIAR genebank community. New links were created between the scientists using knowledge

sharing mechanisms which supported the easier dissemination of GPG2 products. Attribution was identified as a key issue to foster collaborative works and for the products of collective actions which are made available as Global Public Goods. Important steps were taken to address this need and provide guidelines for attribution in this and future collaboration. Guidelines on attribution were initiated in GPG2 for information sharing using social media.

Getting attribution right is a key to the success of collaborations in the agricultural development sector assuring that contributions are properly identified and properly recognized. This is a key responsibility of project managers and should always explicitly be in the 'terms of reference' documents for project managers. An attributions checklist should be developed that would provide project managers with clear guidance on how to deal with IP and with attribution issues throughout the life of a project, particularly in projects involving multiple Centres and/or partner institutions.

Interdependencies where some activities could only proceed after results were available from others resulted in inevitable delays during the first two years of the project and led to a heavy workload to finally complete activities. The transaction costs of working together were higher than expected, requiring more efforts than initially expected.

SGRP proved to be a highly effective platform from which to coordinate, promote, and report on such a large system-wide project based on collective action. This approach was instrumental in instilling a "system mindset" amongst the project partners, enabling them to focus on larger problems, larger goals, and greater impacts than may be addressed by individual Centres.

9. Conclusions and Recommendations

The conclusions drawn from the GPG2 project can be grouped into three main areas, within which a total of six recommendations are made.

Integrating the GPG2 Outputs into On-Going Genebank Activities

GPG2 was an important project with many valuable products generated by both Centre-own and collective activities. It was not possible to test or validate all products during the life of the project, and some products are still being internalized into genebank operations. GPG2 also provided a learning experience that will guide partners in the CGIAR system in future collaboration and established useful networks. Given the important benefits of working together in areas of common interest, this community of practice should be nurtured and supported, irrespective of the current re-structuring of the CGIAR system.

GPG2 also provided a learning experience that will guide partners in the CGIAR system in future collaboration and established useful networks. The significant successes and cumulative benefits of the GPG1 and GPG2 projects were achieved to a very large extent through a collaborative, system-wide approach to genetic resources. The CGIAR can continue to take advantage of the intellectual capital of this group of specialists to identify and address new areas of work that would benefit from a collective approach to research and strategic thinking. The ongoing efforts by the Consortium Board to assess the needs and determine the means of support to the genebanks are appreciated, and the CGIAR genetic resources community is keen to contribute to these efforts and, ultimately, to the development objectives of the CGIAR as a whole.

Recommendation 1: Efforts should be made by each Centre to identify the relevant outputs and incorporate them into their routine planning and implementation of genebank operations, aiming at achieving greater efficiency, cost effectiveness and rationalization in management, conservation and use of genetic resources system-wide.

Recommendation 2: The Centres' commitment to system-wide collective action in the area of genetic resources should be continued. Drawing upon the conclusions of the scoping study on genetic resources being commissioned by the Consortium Board, a mechanism should be put in place to ensure the continuity, adoption and use of many of the products and practices initiated in GPG2.

Guiding Activities to Completion

Some of the GPG2 tasks could not be finished as planned due to either lack of time (requiring more time than planned) or due to the interdependency with closely linked activities that were only ready towards the end of the project. Unfinished tasks considered as relevant such as the assessment of gaps due to loss of collected samples (4.1.3) could be completed in due course.

Recommendation 3: Centres should commit to use the collection data made more easily available during GPG2 to verify and expand their databases and perform gap analysis to have a more precise idea of lost material, gaps in current collection and the need to complement crop collections to achieve a good coverage of diversity.

Significant progress was made in reaching a common understanding among the Centres' genetic resources staff on a future vision as part of the development of the Sustainability Plan for CGIAR genebanks. Substantive inputs and recommendations were recently received from the Global Crop Diversity Trust and the Alliance Executive on the Plan. This iterative, consultative process need to be continued so that a practical Plan is developed that will serve as a reference point, justifying the basis for mobilizing the sustained support that is required for the adequate maintenance of the invaluable germplasm collections that are held in-trust as international public goods for the global community.

Recommendation 4: Genebank managers from each Centre should commit to actively participate in the further development of the Sustainability Plan, addressing stakeholders' concerns and incorporating their ideas so that the Plan can be endorsed by Centre management within the Strategy and Results Framework and by other key stakeholders. This Sustainability Plan should form an integral part of the funding strategy for the CGIAR-supported genebanks.

Building a Global System

Achieving a strengthened global system will require more effective partnerships among those working in conservation and use efforts worldwide to enhance the visibility and understanding of the role that plant genetic resources play in development. Currently there are different views of the global system among the diverse players and a lack of clarity on the concept and vision of a global system. Current visions, while not mutually exclusive, are not yet well articulated or coordinated.

Recommendation 5: A consultation process should be implemented among key stakeholders to more clearly describe a shared vision of the nature and function of the global system of genetic resources conservation and use.

Recommendation 6: The CGIAR, as one of the larger groups managing crop diversity as Global Public Goods, needs to articulate more clearly its role in the global system in order to take a more active part in it.

10. Acknowledgements

Faced with the challenges inherent to such an ambitious project, the commitment and teamwork demonstrated by the partners and their dedication to the goals of the project were important driving forces behind the numerous achievements that often surpassed our expectations. The significant additional time and effort devoted to the project's success was contributed to a large degree by the individual scientists themselves. This personal dedication exemplifies one of the added values of collective action, as reflected in the cooperative spirit engendered by this project. The full value of this sort of personal dedication and collective commitment is very difficult if not impossible to quantify, but deserves recognition here.

The SGRP Secretariat acknowledges the important contributions made by those valiant individuals who agreed to assume the responsibility of coordinating this large project: Jane Toll coordinated the GPG1 project and was instrumental in the development and submission of the GPG2 proposal in 2006; Michael Bolton began the project as interim coordinator in 2007 and put the dozens of contractual agreements in place with the numerous partners; Brigitte Laliberté assumed full-time project coordination in September 2007 and capably guided it for more than two years until the end of 2009; after which Alexandra Jorge took over for the six-month no-cost extension period and brought the project to successful closure in June 2010. Numerous people at the SGRP Secretariat and Bioversity International provided invaluable technical, logistic and administrative support, including Tamara Bruce, Nicole Demers, Laura Vuerich, Sara Hutchinson, Pedro Ferreira, Aixa Del Greco, Nicolle Browne, Elizabeth Fox and Sean Landerz. We want to give a special note of gratitude to the members of the mid-term and final external review panels: Henry Shands, Theo van Hintum, Leonor Castiñeiras, and Maria Jose Sampaio, who generously contributed their time, vast experience and international reputations, and worked extremely hard to provide the project team with sound guidance, constructive criticism and supportive recommendations to help ensure the success and continuity of the project's outputs. We are grateful to our colleagues John Fitzsimon and Gerardo Carstens of the Internal Audit Unit for their patience, guidance and support throughout the implementation of this administratively complex and fiscally challenging project. We also would like to express our sincere appreciation for the keen interest, support and sound guidance received from our friends at the CGIAR Secretariat: Manny Lantin, Harry Palmier, Su Ching Tan, Shey Tata, Ren Wang and Iftikhar Mostafa. Many thanks are given to Allison Smith of the Bioversity Grants Office and Robert Chapman of the Planning, Evaluation and Learning Unit for their expert advice and kind collaboration. The support of Gerry O'Donoghue, Giorgia Beltrame and Melanie Glover of the Bioversity Budget Office is also gratefully acknowledged.

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11. Annexes

- Annex 1. Collective Activities – Milestones and Status of Achievement**
- Annex 2. Centre-Own Upgrading – Milestones and Status of Achievement**
- Annex 3. List of GPG2 Products, URL Links and Collaborating Centres**
- Annex 4. Sustainability Plan (Nov. 2009) with Addendum (July 2010)**
- Annex 5. Final Financial Report**
- Annex 6a. Final External Review Report and Recommendations**
- Annex 6b. SGRP Response to the Final External Review Recommendations**
- Annex 7. List of Partner Organizations Involved in the Project**
- Annex 8. List of GPG2 Task Force Members and Relevant Affiliation**
- Annex 9. List of Acronyms**
- Annex 10. Electronic Annex on DVD: List of Contents**