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Item 9 of the Provisional Agenda

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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SUBMISSIONS BY INTERNATIONAL ORGANIZATIONS:

REPORT FROM THE INTERNATIONAL AGRICULTURAL RESEARCH CENTRES OF THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH (CGIAR) ON THEIR POLICIES, PROGRAMMES AND ACTIVITIES AND POTENTIAL CONTRIBUTIONS TO THE MYPOW IMPLEMENTATION

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I. INTRODUCTION

1. This document presents a report on the activities undertaken by the Centres of the Consultative Group on International Agricultural Research (CGIAR)[1] in relation to genetic resources for food and agriculture (GRFA).

2. The CGIAR System-wide Genetic Resources Programme (SGRP) has prepared the document on behalf of the Centres, with inputs from individual Centres. It presents an overview of activities since 2007, updating the document presented at the last session of the Commission[2] and a complementing report submitted to the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture in 2009[3].

3. Over the last reporting period, the CGIAR Centres have undertaken a significant range of activities in areas important to the Commission including contributions to the safe maintenance and use of *ex situ* conserved crop genetic resources as part of an evolving global system, implementation of the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (PGRFA), and developing work on farm animal genetic resources conservation. Recently, inputs have been made to the ongoing in-depth review of the programme of work on agricultural biodiversity of the Convention on Biological Diversity (CBD), in which FAO plays a key role. An overview of recent and current CGIAR activities on GRFA, describing actual and potential CGIAR contributions to the Commission's Multi-Year Programme of Work (MYPOW) are provided in Sections II-VII of this report.

4. The CGIAR is currently preparing to implement a new governance, funding and programmatic structure to enable the CGIAR to remain a relevant and effective player in global development. The CGIAR's Change Initiative[4], launched in 2008, is identifying how best to adapt to and anticipate global changes and challenges, and thereby ensure the continued supply of international public goods to help address them. This transformation should come to fruition in 2010 with a new business model that will enable the CGIAR do more and do better, as it fulfils its mandate to fight poverty and hunger while conserving the environment. The transition process to the new CGIAR is being overseen by a Transition Management Team[5] led by the CGIAR Chair. The CGIAR programme structure and content are to be unveiled at the Global Conference on Agricultural Research for Development (GCARD) in March 2010, and there is no doubt that agricultural biodiversity will play a prominent role. Anticipating discussions on the optimal incorporation of agricultural biodiversity into the CGIAR's programmatic structure, the SGRP convened a workshop in May 2009 to review genetic resources work in the CGIAR and discuss possible future scenarios. The outcome of the workshop – a position paper entitled *An integrated approach to genetic resources in support of the CGIAR's mission* – is appended to this report and is introduced in Section VIII.

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[1] Africa Rice Center (WARDA); Bioversity International (formerly International Plant Genetic Resources Institute IPGRI; including the International Network for the Improvement of Banana and Plantain INIBAP); Centro Internacional de Agricultura Tropical (CIAT); Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), Centro Internacional de la Papa (CIP); Center for International Forestry Research (CIFOR); International Center for Agricultural Research in the Dry Areas (ICARDA); International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); International Food Policy Research Institute (IFPRI, including the International Service for National Agricultural Research ISNAR programme); International Institute of Tropical Agriculture (IITA); International Livestock Research Institute (ILRI); International Rice Research Institute (IRRI); International Water Management Institute (IWMI); World Agroforestry Centre (ICRAF); WorldFish Center (WorldFish).

[2] CGRFA-11/07/19.2.

[3] IT/GB-3/09/Inf. 15.

[4] http://www.cgiar.org/changemanagement/index.html.

[5] http://www.cgiar.org/changemanagement/cm_transitionteam.html.

II. CROSS-SECTORIAL MATTERS

5. Issues that cut across the different sectors of agricultural biodiversity have long been a feature of the CGIAR's work and are becoming increasingly prominent as the Centres become progressively more involved in ecosystem approaches and in work that is applicable to multiple sectors. This section outlines some of the cross-sectorial work that has been undertaken in the reporting period and indicates related opportunities for supporting MYPOW implementation. Section VIII, as noted above, provides further insight into directions that the CGIAR might take towards integrating its work on the different sectors of agrobiodiversity.

System-wide Genetic Resources Programme

6. SGRP is a key mechanism for cross-sectorial genetic resources work in the CGIAR Centres, facilitating collaboration among the Centres and with national and international organizations, to enhance the CGIAR's contribution to global efforts to conserve genetic resources for use in agriculture, forestry and fisheries. This includes fulfilling representation and public awareness functions, and contributing to international agendas on the Centres' behalf. Bioversity International is the convening Centre of SGRP; representatives of the Centres, FAO and the International Treaty comprise its steering committee, the Inter-Centre Working Group on Genetic Resources (ICWG-GR).

7. For the past 15 years, the SGRP has been a regular mechanism for information exchange and collaboration between the FAO Commission CGIAR Centres. SGRP's strong focus over the past several years on crop genetic resources reflects, to a large extent, the great effort that was made by both the Commission and the Centres on the preparation, implementation, dissemination and promotion of the State of the World's PGRFA Reports, the GPA for PGRFA and the International Treaty. Through collaborative activities including the coordinating, consolidating and making publicly available the Centres' information on germplasm accessions, SGRP has demonstrated its effectiveness as an umbrella group that can marshal the collective voice and action of the Centres to provide their essential inputs and support to the Commission's initiatives. Through SGRP's coordination and consultation functions, the Centres are able to serve more effectively as a link and 'honest broker' to inform and engage the NARS, NGOs, CSOs and networks with whom we regularly partner in relation to the work of the Commission.

8. Collectively, in the context of the CGIAR Centres' own medium- and long-term planning, the Centres view the MYPOW as an opportunity of highest strategic importance, and one that will facilitate and help structure the complementary efforts of the Commission and those of the Centres in a lasting collaboration that will enhance our combined success in reaching our common objectives. In this context, it is appreciated that the Draft Strategic Plan 2010-2017 for the implementation of the MYPOW currently makes frequent mention of individual Centres. It is felt that there would be a benefit in terms of awareness and coordination in also making explicit reference to SGRP in the final version of the Strategic Plan. This would reflect SGRP's notable historic and ongoing cooperation with the Commission, and acknowledge the collective role of the Centres as facilitated through the coordinating function of SGRP. It would also recognize and endorse the increased confluence of the Commission's and the CGIAR Centres' missions and the greatly enhanced collaboration and mutual benefits envisioned in the milestones and long-term objectives described in the Draft Strategic Plan.

Access and benefit sharing

9. In support of the Commission's considerations of access and benefit sharing during its 12th session, Bioversity has been involved in the development of a number of documents for consideration by the Commission. In particular, Bioversity has:

- Developed an information document entitled *The use and exchange of microbial genetic resources relevant for food and agriculture,* in collaboration with the Catholic University of Louvain (Louvain-la-Neuve), Belgium. ICARDA and IITA participated in workshops held as part of the study.
- Coordinated development of an information paper entitled *The use and movement of forest genetic resources for food and agriculture.* ICRAF also contributed to that document.
- Contributed to a paper entitled *The use and exchange of animal genetic resources for food and agriculture.*
- Coordinated, through SGRP, development of a document for 12th Session of the Commission entitled *The impact of climate change on countries' interdependence on genetic resources for food and agriculture.* Various sections of this paper were authored by staff from Bioversity, CIAT, IITA, ILRI, World Agroforestry Centre (ICRAF) and WorldFish Centre.

10. In 2006, the International Treaty Secretariat, FAO and Bioversity created a joint programme to provide technical assistance to developing countries implementing the Treaty, with emphasis on the Treaty's multilateral system of access and benefit sharing. To date, the joint programme has provided support for activities in a number of countries and regions. More details about the joint programme will be posted on the International Treaty website[6].

Valuation of genetic resources

11. Paragraphs 61-66 in the Centres' report to the 11th Session of the Commission describe ongoing work on the valuation of genetic resources. Building on this work, and supporting Decision VIII/25 of the Eighth Conference of the Parties to the Convention on Biological Diversity (COP8), Bioversity has established a programme of work on *Economics of agrobiodiversity conservation and sustainable utilization,* which broadly seeks to:

- Identify, test and disseminate economic methods, decision-support tools and policy intervention strategies to support agrobiodiversity conservation, farmer livelihoods and policy.
- Provide the hub for a community of practice bringing together strategic partners with different skills in the field of the economics of agrobiodiversity conservation.
- Develop outreach strategies and mechanisms to assist national and international policy-makers to take agrobiodiversity economics research into consideration.

12. Projects initiated to date within the programme include the adaptation of payment for environmental services (PES) concepts to the issue of agrobiodiversity conservation *per se*, with a view to facilitating the 'capture' of public conservation values at the farmer level and thereby creating incentives for conservation and supporting poverty alleviation.

13. A research project carried out by Bioversity and IFPRI under the CAPRi programme has examined the role played by collective action and property rights play in controlling the diffusion and use of landrace varieties. This research addressed the fact that these factors have been largely overlooked in studies of the loss of agricultural biodiversity, which can reduce food security, increase economic uncertainty, and threaten the viability and sustainability of agricultural systems. The study highlighted some of the impacts that private property rights legislation could have on the conservation of plant genetic resources and suggested directions for future research in this emergent topic.

[6] http://www.planttreaty.org/index_en.htm.

14. Economic research carried out by Bioversity and IFPRI has shown that community plant breeding can support on-farm conservation by enhancing the value to farmers of some of the varieties they are growing, thereby creating in-kind incentives for farmers to continue growing varieties that benefit society at large by conservation crop genetic diversity.[7]

15. Bioversity has produced a major work[8] synthesizing the most recent research and developments in the on-farm management for crop, livestock and aquatic genetic resources, and associated diversity (e.g., pollinators and soil microorganisms), and the potential nutritional, ecosystem-service and financial values of this diversity. The publication has been translated into Russian, Chinese and Arabic to enhance its reach.

Platform for Agrobiodiversity Research

16. The Platform for Agrobiodiversity Research is a collaborative activity involving Bioversity, FAO and others to support the necessary knowledge generation and actions to stem the loss of biodiversity in and around areas of agricultural production, and promote sustainable agriculture. Key activities following the launching of the Platform were the formation in 2005 of a Secretariat based in Rome and Nairobi, the convening of the Platforms first International Stakeholder Meeting in 2006 and the consequent development of the Platform goal and objectives, guiding principles and programme priorities, operational guidelines and governance. Further information is available on the development of the Platform and its *modus operandi*[9].

17. In February 2008, the Platform started working on the project *The use of agrobiodiversity to manage climate change – charting experiences from rural communities and indigenous peoples*[10]. A second phase of this project, *Climate change and indigenous communities: strengthening adaptability, resilience, and innovation,* has started recently.

Contributions to the MYPOW on cross-sectorial matters

18. Collectively and individually, the CGIAR Centres are keen to contribute to the MYPOW in areas that cut across the different sectors of agricultural biodiversity and/or stand to make contributions that can translate from one sector to another. Examples of specific potential collaborations are given in the following paragraphs.

19. Participation is proposed by ICARDA in discussion panels and in the implementation of activities related to cross-sectorial matters including a facilitation role for regional contribution to policies on access and benefit sharing, development of biodiversity indicators and analysis of trends in biodiversity. Within its Socio-economic and Policy Research Program, ICARDA can conduct studies to provide evidence on the role of agrobiodiversity on the livelihoods of small-scale farmers and livestock keepers.

20. ICRAF is already providing information on exchange and use of agroforestry genetic resources and on the implementation of the SMTA for germplasm exchanges of non-Annex 1 agroforestry species.

21. Based on IFPRI's extensive work on socioeconomic impacts of biotechnology in developing countries, the Centre would be willing to support the review of ways and means for

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[7] Smale, M. (ed.) 2006. *Valuing crop biodversity: On-farm genetic resources and economic change*. CABI Publishing, Wallingford, UK, 336 pp.

[8] Jarvis, D.I., Brown, A.D.H., Imbruce, V., Ochoa, J., Sadiki, M., Karamura, E., Trutmann, P. and Finckh, M.R. 2007. Managing crop disease in traditional agroecosystems: the benefits and hazards of genetic diversity. In: Jarvis, D.I., Padoch, C. and Cooper, D., (eds.). *Managing biodiversity in agricultural ecosystems* Columbia University Press, New York, USA, pp 292-319.

[9] See http://www.agrobiodiversityplatform.org/blog/wp-content/uploads/2008/10/parreport2006.pdf

[10] http://www.agrobiodiversityplatform.org/climate_change

the application and integration of biotechnologies in the conservation and utilization of genetic resources. Furthermore, the biodiversity impacts as part of the biosafety assessment fall within the research agenda of IFPRI's Program for Biosafety Systems. Recognizing that economic drivers are very often determinant of the conservation and sustainable use of plant genetic resources, IFPRI would be very interested in conducting collaborative economic research that can support the development of indicators for the sustainable use of agricultural biodiversity.

22. In line with the CGIAR system vision, the genetic resources policy team at IFPRI is interested in pursuing further research on the resilience of agricultural production systems and its potential role in climate change adaptation, involving the development of economic tools and methods to estimate the contribution of intra and inter specific diversity to that resilience, contributing to reduce production and market risks, and thus lowering the vulnerability of farmers and rural households

23. ILRI is already providing information on exchange and use of germplasm of forages and implementation of the SMTA for non-Annex 1 crops. The Centre will facilitate access to new and improved biotechnologies for the management of forage and livestock diversity, providing capacity building through the Biosciences for East and Central Africa platform. ILRI is implementing research using an ecosystem approach on the impact of climate change on vulnerability and biodiversity management in grasslands and pastoral systems in Eastern Africa and will contribute to the development of a framework for the application of the ecosystem approach in management of biodiversity. In addition, ILRI is generating information on the contribution of livestock-based agriculture to the reduction of poverty, and is promoting environmentally sustainable systems intensification.

24. Bioversity is involved in a number of activities on plant, livestock, tree and microbial genetic resources with cross-cutting implications including inputs into the identification and assessment of policy and regulatory options for exchange, conservation and sustainable use, including in the context of access and benefit sharing issues. The Centre will continue to provide inputs into assessments of the potential impacts of climate change on genetic resources for food and agriculture, and potential policy and regulatory implications. It will also assess the potential for PES concepts to be applied to agrobiodiversity conservation issues, including animal genetic resources, and the potential for "Weitzman"-type diversity-maximising, cost-effective livestock genetic resource conservation programmes to be implemented in practice.

25. IRRI's strategic plan was designed to focus on how IRRI can contribute to the MDGs through rice agriculture. The goals to which IRRI contributes most are 1 (end poverty and hunger through improved rice agriculture), 6 (environmental sustainability through cleaner agricultural practices) and 4 and 5 (child and material health through better dietary quality), with reach-through contributions to 2 (education) and 3 (gender equality). IRRI will collaborate wherever it can help achieve these goals

26. WorldFish continues to develop and review its policies on the transfer and dissemination of aquatic germplasm, including access and benefit sharing issues, particularly in relation to minimizing its potential impact on aquatic biodiversity. Understanding the potential impacts of aquaculture development on aquatic ecosystems and biodiversity is addressed through the development of ecological risk assessment and related research, to facilitate the development and identification of ecologically sustainable practices, particularly in relation to detrimental effects of importation of alien or genetically improved culture species.

III. PLANT GENETIC RESOURCES

27. The management of the in-trust collections lies at the heart of the CGIAR's Centres' work on plant genetic resources for food and agriculture. These collections currently hold over 650,000 accessions of some 3,000 staple crop, forage and agroforestry species essential to food security

and nutrition. This section covers policy aspects relating to Centre stewardship of the collections on behalf of the global community, followed by efforts to enhance the security and accessibility of the collections, and actual and potential Centre actions supporting implementation of the MYPOW.

28. The policy work covered below focuses on interactions between the Centres and the Governing Body of the International Treaty regarding the in-trust collections. In addition, Centres provide capacity-building and awareness-raising support to national partners on international policy developments including International Treaty negotiations and implementation.

Agreements between the CGIAR Centres and the Governing Body of the International Treaty

29. The history of the development of the agreements up to June 2007 is provided in paragraphs 12-16 of the CGIAR report to the 11th Session of the Commission. The 2nd Session of the Governing Body of the Treaty decided in October 2007 that that the Centres should use the Standard material Transfer Agreement (SMTA) to distribute non-Annex 1 materials. Accordingly, the Centres have been using the SMTA to distribute such materials since February 2008. Details concerning actual distributions by Centres of both Annex 1 and non-Annex 1 materials are included in reports that were developed, by Bioversity staff, through and on behalf of SGRP, to the 2nd and 3rd sessions of the Governing Body[11]. Together, those reports cover the period from 1 January 2007 to 31 July 2008. They provide key references for those who wish to understand the position and role of the Centres in the operation of the multilateral system of access and benefit sharing created by the International Treaty.

30. Through the System-wide Information Network for Genetic Resources (SINGER), Centres are participating in technical consultations convened by the Governing Body on Information technology support for the implementation of the multilateral system of access and benefit-sharing. Bioversity will host a transitional arrangement for the allocation of the persistent identifiers required for providers and recipients of germplasm under the multilateral system.

31. SINGER now provides access via a central entry point to more accurate information on the in-trust collections. Through a project to develop a global information portal, characterization and evaluation data will also be included. SINGER helps Centres answer questions about the origin of accessions and the distribution of material to users. Distribution statistics reveal the key service that Centres provide to developing country national agricultural research systems, which receive over 80% of all samples transferred to users.

32. SINGER is being developed further, with the creation of a central germplasm ordering gateway and other features to facilitate and enhance access to relevant information about the germplasm held at the Centres. Together with the European Plant Genetic Resources Search Catalogue (EURISCO) and The U.S. Department of Agriculture's Genetic Resources Information Network (GRIN), SINGER will be a key component of a global information portal providing accession-level data and addressing the needs of the International Treaty. The Centres are also developing global crop information registries for wheat, barley, chickpea, potato, forages, rice, cassava, and *Musa*. The registries will add value to the data in SINGER by adding cross referencing between samples conserved in different genebanks. The new features being added to SINGER will enable Centres to study gaps in collections using advanced geographic information system (GIS) tools.

[11] ftp://ftp.fao.org/ag/agp/planttreaty/gb2/gb2i12e.pdf and ftp://ftp.fao.org/ag/agp/planttreaty/gb3/gb3i15e.pdf

Management of the in-trust plant collections

33. Paragraphs 17-24 of the CGIAR report to the 11th Session of the Commission explain the developments that led to the first phase of the *Global Public Goods Rehabilitation* exercise (GPG1), and the successful completion of GPG1 in 2006. An External Review of GPG1 in 2005 recommended a second phase and, accordingly, *Collective Action for the Rehabilitation of Global Public Goods in the CGIAR Genetic Resources System: Phase 2* (GPG2) was developed and successfully submitted to the World Bank for funding. Implementation of GPG2 began in early 2007 and the project is now in its third and final year.

34. The purpose of GPG2 is to enable the CGIAR Centres to achieve effective stewardship of their in-trust collections and position them to provide leadership and technical backstopping to partners, with the goal of helping support the creation of a rational and sustainable global system of genetic resources conservation and use to combat poverty, enhance food security and health, and protect the environment. GPG2 is coordinated by SGRP on behalf of the CGIAR Centres.

35. More specifically, GPG2 aims to:

- Upgrade the CGIAR Centre genebanks and their standards of management.
- Ensure genebank efficiency and sustainability into the future.
- Strengthen capacity for collective action on genetic resources within the CGIAR.
- Facilitate access to the in-trust collections by users.
- Position Centres to play a leading role in building a comprehensive global system for conserving, managing and exchanging PGRFA.

36. GPG2's upgrading components will complete the improvement of Centres genebank facilities that was initiated by GPG1, and will bring the processing of germplasm accessions up to date. Impressive results have been achieved with the upgrading and improvements of the Centres' management of the in-trust collections, in terms of reducing backlogs in the processing of accessions into storage, including regeneration, characterisation, health and viability testing, documentation and supply. Safety backup of the in-trust collections in accordance with the System-wide principles and deposit strategy was improved and equipment and systems were upgraded, building upon the accomplishments made during the first phase of the project (GPG1).

37. The progress made towards the specific germplasm processing targets in the first two years of project implementation is shown below, by number of accessions processed:

Operation	To 31.12.08	Target for 31.12.09
processed for storage	115,918	200,000
safety duplicated	78,155	150,000
regenerated	58,991	70,000
health tested	43,827	64,000
characterized	43,877	50,000
documented	257,235	140,000

38. In addition to the genebank upgrading, GPG2 mobilizes collective action among Centres on technical and strategic issues to deliver the following outputs:

- Uniform genebank risk-management procedures.
- Best practices for genebank management.
- Unified protocols for locating and delivering germplasm, and for sharing information on crops held in common.

- Strategies and tools for enhancing knowledge on the diversity in the in-trust collections.
- Recommendations for wider CGIAR genebank involvement in managing genetic and genomic stocks, associated biodiversity and underutilized species.
- Strategic planning for training national programme partners and enhancing CGIAR genetic resources research capacity.
- Mechanisms for improved delivery of global public goods by the CGIAR genebanks and promotion of international collaboration.
- Analysis of the elements and functions of an integrated global system for crop genetic resources conservation and use.

Detailed information on the various outputs is available from the SGRP Secretariat, and some of the key achievements during the reporting period are provided below.

39. Guidelines were developed for risk-management procedures to ensure the security, quality and availability of in-trust collections with recommendation for linkages to Centre-wide risk management methodologies. Existing storage procedures for clonal crops in the CGIAR genebanks were reviewed and multi-crop guidelines on the status of *in vitro* techniques produced. A programme of technology transfer and capacity building was implemented to refine and standardize *in vitro* conservation for clonal crops. Current practices for safety backup procedures and arrangements at Centres and some non-CGIAR genebanks were reviewed and information compiled on options for technical issues, economic analysis, location, legal issues and risk assessment. Model agreements were developed and a System-wide strategy for safety backup elaborated.

40. Best practices for the germplasm management of nine specific seed and clonal crops important for food security were developed and harmonized with the risk management, performance management and decision support tool frameworks. A methodology and decision-making tool to enhance the cost-effectiveness of collection management through optimal resource allocation was developed. An online Crop Genebank Knowledge Base on best practices was developed[12], training materials on genebank management were compiled, and an exchange of technologies was facilitated between Centres. Information on regulatory and best practice methods for transgene detection and crop regeneration was compiled and linked to best practices for regeneration of accessions. Crop-specific guidelines were produced to maintain conventional germplasm accessions free from transgenic introgression and for conserving germplasm of transgenic crops.

41. Mechanisms were developed for sharing information on procedures for the safe movement of germplasm and a common compendium of country and regional quarantine regulations and diseases and pest incidence was established. Recommendations were made on harmonization of regulatory and phytosanitary requirements of CGIAR Centres and their host countries, and on the scientific/technical best practices for germplasm management.

42. SINGER is being developed further, with an improved public interface and the creation of a central germplasm ordering system. The current germplasm selection and ordering procedures employed by CGIAR Centres were analysed and standard functionalities and a common protocol agreed. A prototype germplasm ordering system using SINGER data has been developed and a help-desk established to support Centre implementation of the common SMTA protocols. A crop registry model for CGIAR priority collections and collections in common was further developed, with collaborating institutions within and outside the CGIAR.

[12] http://cropgenebank.sgrp.cgiar.org/.

43. Progress was made in activities relating to the broadening of the scope of the conservation activities of the Centres. A first attempt at assessing the status of genetic stocks and genomic collections was made within and outside the CGIAR System, including aspects of access and benefit sharing. Partners were identified for undertaking a survey of available microbial, fungal, insect and nematode collections within and outside the CGIAR. An on-line survey was conducted and a database was developed listing the collections, their contents, and an inventory of experts that curate these collections. This information will be used to analyze the CGIAR's comparative advantage for becoming more involved in the management of such collections. A survey was conducted on ongoing and planned projects dealing with underutilized species in the CGIAR and in national genebanks. Groups of underutilized species were prioritized and the main areas of relevance for model development were defined. The comparative advantages of Centres for carrying out activities in this area was analysed, and research suitable for collective action was identified along with research topics that can serve as models for a wider range of underutilized species.

44. A draft Sustainability Plan for the Centres' genebanks was developed in time for the Mid-term External Review of GPG2 in October 2008. The draft plan is being further developed and improved based on feedback received from the External Review team and a wide range of stakeholders, and will be completed and ready for implementation at the end of the project. Existing research needs and current capacities, and the current skills set and desired level of genebank staffing were also surveyed as contributions to the sustainability plan. Indicators to measure the performance of the CGIAR Centres in managing the in-trust collections were developed. Elements for a baseline study were agreed upon for the analysis of a global conservation system to be conducted in four country case studies, to identify actual and potential constraints to their participation in a global system.

45. The SGRP website was redesigned to better promote awareness of the value of the in-trust collections to key audiences. Strategic awareness-raising activities were conducted at a number of international meetings, including COP8 in Bonn, Germany and meetings of the FAO Commission, the International Treaty Secretariat and Governing Body, and at various regional fora.

46. GPG2 outputs represent concrete contributions to the aims of the International Treaty and the Global Plan of Action, offering vision, leadership and skills to partners in developing a global system, with the in-trust collections playing a central role. The Sustainability Plan will help ensure the continuity of the global public goods and services provided by the Centres. Numerous GPG2 collective actions and initiatives address the crucial area of partnerships beyond the CGIAR, defining targets, users, implementers and roles, with FAO and national programmes as important partners.

In situ and on-farm conservation of crop genetic resources

47. Bioversity will, in 2009, complete a five-year project on the conservation of 35 taxa of the wild relatives of crops *in situ* in protected areas and outside them, in 5 mega-biodiverse countries (Armenia, Bolivia, Madagascar, Sri Lanka and Uzbekistan). A compendium of those experiences is being developed as a manual of guidelines and lessons learned which others can use to develop their own strategies and actions for the conservation of these vital genetic resources. The project also developed a global portal for accessing information on crop wild relatives.[13]

48. In a study of on-farm conservation, varietal data from 27 crop species from five continents were drawn together to determine overall trends in crop varietal diversity on farm. Measurements of richness, evenness, and divergence showed that considerable crop genetic diversity continues to be maintained on farm, in the form of traditional crop varieties. The results of the analysis

[13] www.cropwildrelatives.org

suggested that diversity may be maintained as an insurance to meet future environmental changes or social and economic needs. Divergence estimates, measured as the proportion of community evenness displayed among farmers, underscore the importance of a large number of small farms adopting distinctly diverse varietal strategies as a major force that maintains crop genetic diversity on farm. This synthesis has also enabled the creation of a baseline for estimating future genetic erosion on-farm[14].

49. Bioversity has partnered with FAO to address five of the targets of the Global Strategy for Plant Conservation of the Convention on Biological Diversity:

- Target 6 (30% of production lands managed consistent with the conservation of plant diversity).
- Target 8 (60% of threatened species in accessible *ex situ* collections).
- Target 9 (70% of the genetic diversity of crops and other major socioeconomically valuable plant species conserved and associated indigenous and local knowledge maintained.
- Target 12 (30% of plant-based products derived from sources that are sustainably managed).
- Target 13 (The decline of plant resources and associated indigenous and local knowledge innovations and practices that support sustainable livelihoods, local food security and health care, halted).

Contributions to the MYPOW on plant genetic resources

50. The CGIAR Centres are well-placed to contribute to the implementation of the MYPOW through their past contributions to the preparation of the Global Plan of Action and to the first and second State of the World Reports with scientific and technical inputs. Bioversity (as IPGRI) in particular, supported the process culminating in the adoption of the Global Plan of Action in 1996.

51. Centres' work on the conservation and sustainable use of PGRFA addresses Global Plan of Action's priority activities with particular emphasis, as described above, on managing the in-trust collections and contributing to the development of a rational and sustainable global system. Centres are working in close collaboration with the Global Crop Diversity Trust, founded by Bioversity on behalf of the CGIAR Centres and FAO, to secure unique germplasm collections of global importance, especially in providing technical support to regeneration of threatened collections. Crop specific regeneration guidelines have been produced by the Centres, on behalf of the Trust to help in this effort.

52. The CGIAR Centres are assisting FAO and national partners through activities including participation in Global Plan of Action implementation workshops and capacity building at global, regional and national levels to support improved management of PGRFA. Capacity-building efforts through group and individual training are directed principally at national programme scientists, but are also available to other stakeholders. In addition, the Centres publish manuals and teaching materials for use by partners.

[14] Devra I. Jarvis, Anthony H. D. Brown, Pham Hung Cuong, Luis Collado-Panduro, Luis Latournerie-Moreno, Sanjaya Gyawali, Tesema Tanto, Mahamadou Sawadogo, Istvan Mar, Mohammed Sadiki, Nguyen Thi-Ngoc Hue, Luis Arias-Reyes, Didier Balma, Jwala Bajracharya, Fernando Castillo, Deepak Rijal, Loubna Belqadi, Ram Ranag Seddik Saidi, Jeremy Ouedraogo, Roger Zangre, Keltoum Rhrib, Jose Luis Chavez, Daniel Schoen, Bhuwon Sthapit, Paola De Santis, Carlo Fadda, and Toby Hodgkin**,** 2008. A global perspective of the richness and evenness of traditional crop-variety diversity maintained by farming communities. PNAS April 8, 2008 vol. 105 no. 14:5326-5331.

53. After completing pilot testing of the Global Plan of Action - National Information Sharing Mechanism tool, Bioversity in collaboration with FAO, and with financial support from the Government of Canada, provided technical backstopping between 2007 and 2008 to a selected number of sub-Saharan African countries to collect data and implement the Global Plan of Action monitoring process. In addition to this specific activity, Bioversity has continued to provide many forms of technical backstopping and advice to country preparation and reporting for the Second State of the World's Plant Genetic Resources for Food and Agriculture, and sub-regional networks in Sub-Saharan Africa.

54. SINGER makes updated information on the in-trust collections available the FAO's World Information and early Warning System (WIEWS). The Centres also maintain a range of specialized databases relevant to Global Plan of Action priority activities. SGRP has been active in coordinating, consolidating and making publicly available the Centres' information on germplasm accessions via SINGER[15], and specialized crop-specific information via the Crop Genebank Knowledge Base[16].

55. The Centres welcomed all opportunities to make inputs to the second State of the World's Plant Genetic Resources for Food and Agriculture (SOW2) regarding their research and collaborations with national partners and others. Bioversity, on behalf of all Centres was invited by FAO to be part of the task force on the preparation of the SOW2. Bioversity's contributions to the development of SOW2 included Bioversity staff leading the development of two of the report's eight chapters, and hosting a three-day Expert Consultation meeting to review a full draft of the SOW2 on 9-11 June 2009 in Rome. Various Centres' scientists served as authors or reviewers to thematic background studies, while all Centres contributed to the review and finalization of the SOW2 report.

56. A significant proportion of the work on plant genetic resources as carried out by the CGIAR Centres has direct relevance to the implementation of the MYPOW. The annual reports and websites of the Centres provide information on their respective plant genetic resources activities in far more detail than can be covered in this report. The actual and potential areas of cooperation suggested by some of the Centres and provided in the following paragraphs are just examples that convey the breadth and depth of the scope for collaboration.

57. The Africa Rice Centre (WARDA) has identified three potential areas for collaboration. First, appreciating the asset represented by a strong partnership with NARS, the Centre is revitalizing its breeding network in sub-Saharan Africa, involving IRRI with support from Japan. Recognizing that breeding and genetic resources management should act in unison, if a genetic resources management network were to become fully operational through FAO-WARDA collaboration along with the strengthened breeding network, this would produce synergistic benefits. Second, FAO and WARDA are initiating collaboration on capacity building in molecular biology in 2009 and this activity has the scope to be broadened to cover genetic resources management in general. A third promising area of collaboration is in seed management, reflecting the need to strengthen NARS capacity to produce quality seed, to provide support to varietal release systems and to enhance public-private sector collaboration.

58. Bioversity has a long history of wide-ranging collaborations with FAO in the area of plant genetic resources and examples appear elsewhere in this report. Capacity building will be another strong area of collaboration in the future. The potential for capacity building in areas relevant to the MYPOW can be illustrated by some recent activities undertaken by Bioversity including: a regional workshop for Sub-Saharan Africa on mainstreaming agrobiodiversity in higher education; training of Asian scientists on cryopreservation and genebank management; the development of training materials on agricultural biodiversity; and the development of an e-

[15] http://singer.cgiar.org/

[16] .http://cropgenebank.sgrp.cgiar.org/.

learning course on prebreeding to encourage increased and sustainable use of genebank collections, in collaboration with the Global Initiative on Plant Breeding and with support from the Global Crop Diversity Trust.

59. A number of collaborative contributions are already coming from CIAT, such as inputs to the State of the World reports, and genetic resources specialist in the Centre are expected to contribute to the indicators defined in the MYPOW. Promoting plant breeding is another area of potential cooperation, as is capacity building where there is scope for renewing joint training activities on specialised topics such as biotechnology, as organized in the past by CIAT and FAO. There is also scope for collaboration through the participation of Commission members in programme reviews in their areas of expertise.

60. ICARDA is keen to play an active role in the NENA region for the development of the Global Plan of Action and the State of the World report, and in implementing activities in strategic areas. With its strong collaboration with NARS in the CWANA region, ICARDA can contribute to the development of regional PGRFA analysis and thematic studies. The Centre can help review and update information on PGR conservation and utilization, crop improvement, use of biotechnology tools and on strengthening seed production systems. ICARDA is planning to develop a centre at its headquarters for training of young plant breeders, and can provide training and technical backstopping for the establishment of operational formal or informal seed production and supply systems and in the harmonization of seed legislations among countries. These contributions can be realised through strengthening of networking, the organization of joint workshops and conferences, joint projects, training courses, and participation in evaluation missions and expert consultations.

61. ICRISAT foresees supporting implementation of MYPOW in enhancing the use of germplasm in crop improvement by promoting and making available core and mini core collections to breeders and other partners in developing countries. At ICRISAT, mini core collections have been established for chickpea (211 accessions), pigeonpea (146), groundnut (184), sorghum (242), pearl millet (238) and finger millet (80). These sets are available for NARS scientists for evaluating and identifying the traits of economic importance such as biotic stresses (diseases, insect pests), abiotic stresses (drought, salinity), grain quality and agronomic traits. On request, ICRISAT has provided about 100 such sets to scientists in 22 countries for use in their crop improvement programmes. ICRISAT has the basic infrastructure and competent scientific personnel and commitment to develop and deliver international public goods such as mini core and trait-specific germplasm. ICRISAT and FAO can collaborate effectively by assisting scientists in developing countries to establish mini core collections for other crops for which such sets are not currently available, so that the global scientific community can accelerate the use of germplasm in their research and development programmes.

62. IFPRI will continue to pursue economic and policy research to support the implementation of the International Treaty, particularly regarding Article 6 on the sustainable use of plant genetic resources. Specific areas of research foreseen include pursuing fair agricultural policies that promote the development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources. For example, ‘best practice’ methods will be defined for assessing the economic and social impacts of transgenic crops in smallholder farming systems. Policy dialogues will be promoted and supported to inform policy makers and the general public on the relevant issues and consequences of decision-making outcomes. Market-related means of promoting the expanded use of local and locally adopted crops, varieties and underutilized crops will be identified through case studies in Mali, Kenya, and India. PGR conservation and use methodologies will be evaluated to assess constraints to the adoption of improved varieties in Ghana, with special emphasis on the demand for improved varieties of maize and rice; and a diagnostic report of the Ghana seed industry and a strategy for developing the seed industry in Ghana will be produced.

63. ILRI has identified several areas of collaboration in forage genetic resources that will contribute to global efforts, including participation in regional meetings that contribute to the implementation of the Global Plan of Action. Cooperation with the International Treaty is ongoing and includes a large collection of species that are outside the multilateral system as well as some more common forage species that are listed in Annex 1 of the International Treaty. ILRI will continue providing information on its forage germplasm transfers, using the SMTA for species that fall both within and outside the multilateral system. The Centre continues to provide information to WIEWS and will provide additional information on the forage genetic resources inventory through the global forage crop registry. ILRI will continue to work with national and international partners, providing training and information to support their activities in genebank management, forage development and forage seed production. The Centre will collaborate to provide technical input on development of forage seed systems and promote conservation and sustainable use of and research on forages as underutilized species essential for food security. It will also continue to provide training in conservation and characterization of forage diversity and will act as a one-stop source of relevant information through the Crop Genebank Knowledge Base (as noted in connection with GPG2 in Section III).

64. IRRI signed an agreement with the Governing Body of the International Treaty in 2006 that placed the in trust collection of rice germplasm under the purview of the Treaty. As such it complies with its obligations to provide reports on the provision of germplasm from IRRI. In addition it has gone beyond obligations to the Treaty in terms of voluntarily using the SMTA to distribute large numbers of breeding lines, and as the basis for international cooperation on multi-location breeding trials through the International Network for the Genetic Evaluation of Rice (INGER). It has developed the “gold standard” for providing access to information on the germplasm it distributes through its web site. It has participated in several technical consultation exercises and joint initiatives with the Treaty Secretariat and with Bioversity. It has undertaken a number of specific training courses to familiarise national programmes and others with the Treaty, and has developed an online self-study course and a set of FAQs on the SMTA. IRRI has already provided information to WIEWS and will continue to provide additional information on the rice genetic resources inventory through the global rice crop registry. IRRI will collaborate to provide technical input on development of rice seed systems and promote conservation and sustainable use of and research on rice as underutilized species essential for food security. IRRI is already providing training in conservation and characterization of rice diversity and acts as a one stop source of information through the Crop Genebank Knowledge Base.

IV. LIVESTOCK GENETIC RESOURCES

65. CGIAR research on livestock genetic resources is conducted principally by ICARDA and ILRI. Work by these centres up to 2007 is documented in the report to the 11th session of the commission in paragraphs 31-45 and covers characterization and documentation, use and conservation, and training and capacity development.

Contributions to the MYPOW on livestock genetic resources

66. More recent activities and potential inputs to the implementation of the MYPOW are detailed below. A number of other activities conducted by Bioversity have been included in Section II in view of their cross-sectorial implications.

67. The main emphasis of ICARDA's work is on sustainable utilization of animal genetic resources (AnGR) in the context of range-crop-livestock production systems. ICARDA is monitoring performance of indigenous sheep and goat breeds on-farm and testing alternative management strategies to improve their productivity. This includes the identification and targeting of market opportunities at local, regional and international level in order to adapt production practices and product quality to market requirements. Studies on markets and consumer behaviour also help to identify adverse trends on small ruminant genetic diversity. Genetic improvement of

local breeds is considered an important contributor to sustainable utilization of AnGR. ICARDA is developing optimized breeding schemes for indigenous small ruminant breeds based on the demands and opportunities of poor livestock keepers. The research activities in different countries aim at developing a conceptual model for community-based breeding schemes jointly with ILRI, Ismailia Agricultural Research Station (IARS) and FAO.

68. ICARDA is fully involved in the characterization and management of small ruminants in the non-tropical drylands. The Centre welcomes the efforts of the Commission on AnGR and supports the processes for the development of the Global Plan of Action and State of the World Report on AnGR. ICARDA's livestock scientist participated as observer in the 5th session of Intergovernmental Technical Working Group on Animal Genetic Resources (ITWG-AnGR).

69. ICARDA is prepared to work closely with FAO in implementing the GPA within its mandate on *Improvement of small ruminant production in non-tropical dry areas* and to act as a host of the Regional Focal Point for AnGR. ICARDA can play an important role in strengthening a collaborative network among WANA countries jointly with the FAO Regional Office through organizing planning meetings, training workshops and co-organizing relevant regional and international conferences. ICARDA will contribute to the implementation of the Global Plan of Action for AnGR with research activities and capacity building within the four Strategic Priority Areas, in particular on *Inventory, monitoring and characterization* and *Sustainable use and development*. Capacity building for member countries will be conducted through joint research programmes, in close collaboration with NARS, ILRI, IARS and FAO.

70. ICARDA will continue documentation and characterization of small ruminant genetic resources with national programmes in the non-tropical dry areas with special emphasis on characterizing adaptive traits of local/indigenous genetic resources to harsh climates. The results have been made available through DAGRIS, ILRI's information system on AnGR which is directly linked with FAO's information system DAD-IS. Improved knowledge on adaptive traits will contribute to developing adaptation strategies for resource-poor livestock keepers to the expected effects of climate change. ICARDA is also supporting FAO in the development of technical guidelines in this area.

71. ILRI continues to support and populate DAGRIS and will continue to work to maintain the database. This is a key resource which complements FAO's DAD-IS system in that it holds different kinds of data with different kinds of quality control and validation. DAGRIS will become the basis of a systems level approach using well-defined environmental ontologies. As much of this data as possible will be made available through publicly available systems through common data platforms.

72. DAGRIS will shortly undergo a significant series of improvements, including options that help enhance the monitoring and objective and comprehensive documentation of the status and trends. It is equally important that monitoring of threats to farm AnGR, especially pathogens, parasites etc. is undertaken alongside the genetic resources themselves as part of a systems approach. ILRI is keen to partner with other interested parties to pursue this approach, given its comparative advantage in research on animal diseases, parasites etc.

73. Through GEF-funded activities, ILRI is extremely active in work on the roles of small-scale livestock keepers, with major projects in West Africa and Asia primarily intended to understand the use, opportunities and limitations of locally adapted breeds for local agriculture, including their use in well planned crossbreeding programmes as part of conservation programmes.

74. ILRI is already active in the development of technical guidelines for the management of AnGR, with significant capacity-building activities in design, execution and evaluation of breeding programmes and in molecular analysis and database use. ILRI is interested in extending

this to developing standards and methods for *ex situ* conservation and are in discussion with partners in South Korea with well-established systems. In addition, plans for in-depth assessment of the existing institutional frameworks and livestock related breeding infrastructure in East, Central and Southern Africa regions in partnership with Swedish institutions are well underway. These initiatives are aimed at strengthening such institutions in order for them to adapt the technical guidelines to local realities so as to effectively facilitate and enhance sustainable use and conservation of farm AnGR. Of particular interest is how, through such regional focus, two or three countries can agree on and begin joint pilot *ex situ* conservation activities with the support of ILRI and its partners, such as South Korea and Brazil.

75. ILRI will develop biobanks of livestock and pathogen genome resources documented using biotechnological approaches for *ex situ* conservation. ILRI will support national systems in implementing *ex situ* conservation, and where possible broker catalyze regional institutional frameworks, agreements on piloting agreed joint bilateral/regional *ex situ* conservation activities. Where urgent rescue is necessary, ILRI will explore the possibility of directly implementing *ex situ* conservation using the biobank and data protocols described earlier. Any *ex situ* collections will always be complemented by matching DNA and comprehensive phenotypic descriptions.

76. ILRI will emphasize the study and understanding of functional diversity. An important aspect of this will be development of additional databases and data sharing systems based on understanding genome diversity at the individual genome level, as opposed to the breed level ('breed' is a sometimes useful but often misleading concept in developing world livestock). These will attempt to integrate functional molecular descriptions with rich phenotypic descriptions, and will particularly leverage a number of ongoing projects and existing GIS systems to allow an 'extended phenotype' to be derived. The biggest challenge here is obtaining comparable phenotypic data; the use of geospatial proxies for phenotype to supplement 'true' on-ground phenotype will be explored.

V. AQUATIC GENETIC RESOURCES

77. Through improved use and characterization of aquatic genetic resources for aquaculture and its incorporation into aquaculture development activities throughout Africa and Asia, The WorldFish Center contributes to the reduction of poverty and food shortages across many developing nations. WorldFish's research and capacity-building endeavours in aquatic genetic resources are developed and coordinated through its Aquaculture and Natural Resources Management programmes.

78. The main purpose of WorldFish's genetic resources research is to ensure that, in pursuing the enormous benefits to be derived from genetically improved strains, researchers, managers, farmers and policy-makers employ appropriate tools and methods to understand, conserve and sustainably use aquatic biological diversity. WorldFish also strives to ensure that the national breeding programmes supported by the Centre maintain and further develop strains for distribution to farmers, and implement measures to conserve the genetic diversity of aquaculture species. Further details of the work and its relation to WorldFish's mission and goals, can be found in the Centre's Medium Term Plan[17]. The details below update information provided paragraphs 46-50 in the report to the 11th Session of the Commission.

Characterization and documentation

79. FishBase is the world's most comprehensive information system on finfishes, covering all described species (>31,000 to date). Initiated in 1990 by WorldFish (formerly ICLARM), the development team remains based at the WorldFish office in the Philippines, with research directions from a consortium of nine global institutions. It is the most frequently used Internet

[17] http://www.worldfishcenter.org/resource_centre/WF_1042.pdf

resource within the CGIAR, with ca. 30 million hits per month and over 14 million user-sessions in 2008. Information is freely accessible on eight mirror web-sites. A new system called SeaLifeBase[18] went on-line in 2007, providing information on all other marine groups. SeaLifeBase now covers 106,000 of the estimated 245,000 marine species. Both systems, while presently holding primarily species-level information, can readily be modified to hold information on genetic diversity.

Conservation and use

80. Much fundamental research is urgently needed into the genetic diversity of farmed aquatic organisms. However, most of the aquatic genetic diversity upon which aquaculture might draw still resides in the wild. WorldFish continues to promote the conservation and wise use of these resources through various measures, including the recent appointment of a full-time member of staff to lead the development of a better understanding of risks involved in the use of improved strains and their management. The Centre has recently collaborated with FAO in the preparation of technical guidelines on the dissemination of genetically improved strains[19]. It has also recently reviewed the likely impacts of climate change on aquatic genetic resources and how these are best protected[20].

81. Through an 18-year selective breeding programme, WorldFish and partners have developed the Genetically Improved Farm Tilapia (GIFT), which grows more than 60% faster and has a high survival rate than previously available strains. GIFT have been transferred to 11 countries in Asia, with significant economic impacts[21]. WorldFish has developed a Policy and Code of Practice for the transfer of GIFT to Africa[22]. Genetic improvement programmes for Nile tilapia are ongoing in Egypt and Ghana, and for indigenous tilapia *(Oreochromis shiranus*) in Malawi, supported by WorldFish staff. Collaborative research on genetic improvement of farmed carp species, focusing on disseminating improved strains to farmers, and work on the giant freshwater prawn, *Macrobrachium rosenbergii*, continues in Asia.

Contributions to the MYPOW on aquatic genetic resources

82. A number of areas of collaboration in MYPOW activities that would contribute to global efforts and would benefit from collaboration with FAO as well as from the integration of various partners have been identified by WorldFish. An example of a current WorldFish collaborative activity that has high relevance to the activities of the CGRFA is the ongoing FAO project: GCP/RAF/417/SPA *Aquaculture investments for poverty reduction in the Volta Basin: Creating opportunities for low-income African fish farmers through improved management of tilapia genetic resources*.

83. When possible and appropriate, WorldFish will participate in regional meetings relating to the preparation of the report on the State of the World's Aquatic Genetic Resources, and will provide information on its contributions to development of the report on request from the Commission. A recent example is WorldFish's contribution to the CGRFA-convened *Expert meeting on the use and exchange of aquatic genetic resources* held in Chonburi, Thailand, in

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[18] http://www.sealifebase.org/.

[19] FAO Technical Guidelines on Responsible Fisheries, 5.3: Genetic Resources Management. FAO, Rome Italy. ftp://ftp.fao.org/docrep/fao/011/i0283e/i0283e.pdf.

[20] Brummett, R., Beveridge, M.C.M. and Ponzoni, R. 2009. Interdependence of countries in the management of aquatic genetic resources for aquaculture and fisheries in the face of climate change. In: *The impact of climate change on countries' interdependence on genetic resources for food* (Fujisaka, S., Halewood, M. and Williams, D., eds). CGIAR, Rome, Italy (in press).

[21] Asian Development Bank. 2005. *An Impact Evaluation of the Development of Genetically Improved Farmed Tilapia and their Dissemination in Selected Countries*. ADB, Manila. pp 124.

[22] http://www.worldfishcenter.org/v2/files/GIFT_Africa_Policy.pdf.

April 2009. Related to this, the Centre will continue its involvement with FishBase through technical and administrative input to the ongoing effort to maintain and expand this database.

84. WorldFish currently has an active role in capacity building of genetic resource management and diversity maintenance in aquaculture operations, assisting local government and research institutes in sub-Saharan Africa. An expansion of these activities to other regions of Africa or Asia would benefit from continued collaboration with FAO.

85. The characterization of wild and cultured aquatic genetic resources using various modern methodologies is a current and ongoing activity of WorldFish, allowing conservation-use management priorities to be developed and implemented. This also includes improving and developing sustainable programmes and strategies for the dissemination of improved strains for aquaculture, thereby maximizing the genetic benefits to the poor whilst minimizing genetic erosion and dependence on valuable wild genetic resources.

VI. FOREST GENETIC RESOURCES

86. Bioversity, CIFOR and the World Agroforestry Centre (ICRAF) are involved in research on forest and tree genetic resources. Bioversity works on conservation and use of the genetic resources of forest tree species, with a focus on those harvested from the wild. Bioversity's future research will concentrate on conservation of intraspecific diversity in tropical tree species and maximising use of biodiversity in forest restoration forest genetic resources networks are an important mechanism for collaboration it national partner (see below).

87. Bioversity has contributed to the preparation of the report on the State of the World's Forest Genetic Resources (SOW-FGR) by hosting regional and subregional events of its partners in regional Forest Genetic Resources Networks (APFORGEN in Asia, SAFORGEN in Africa and LAFORGEN in Latin America) where FAO representatives presented the SOWFGR and received inputs from national representatives on the content and process for developing that analysis. Such events took place 21-28 September 2008 in Turrialba, Costa Rica; 13-18 October 2008 in Kuala Lumpur, Malaysia; 19-20 January 2009 in Nairobi, Kenya; 20-21 February 2009 in Ouagadougou, Burkina Faso, and will take place 9 October 2009 in Kuala Lumpur, Malaysia.

88. Bioversity has also contributed to the development of two thematic studies for the SOW-FGR, by developing, with colleagues from ICRAF, a chapter on international interdependence and forest genetic resources in the face of climate change; and by hosting a workshop for FAO on *The use and movement of forest reproductive material* in March, 2009, at which invited experts from around the world presented the situation in their regions and discussed and refined the outline for this thematic study.

89. During the reporting period, Bioversity has trained 50 forest genetic resources professionals in Africa (2008) and Latin America (2009). Work is ongoing to develop a global training module on to strengthen capacity for management of forest genetic resources.

90. ICRAF has established and manages field genebanks in regions that support *in situ* conservation for recalcitrant seed producing species. It also supports national systems in implementing *ex situ* conservation of tree species. ICRAF helps achieve MDG goals by growing trees on farms. This is important for sustaining livelihoods and agroecosystems and also brings significant gains in the overall productivity of small farming systems, a marked reduction in poverty, and significant improvement in environmental quality. Trees on farms provide environmental and social benefits to local communities.

Contributions to the MYPOW on forest genetic resources

91. ICRAF will facilitate access to new and improved biotechnologies for the conservation, characterization and use of forest tree species diversity and provide capacity building on the usefulness of various tree species. ICRAF will participate in regional meetings where appropriate and will provide information on its contributions to implementation of the Global Plan of Action on request from the Commission. ICRAF will collaborate to provide technical input on development of agroforestry seedling and seed systems and promote conservation and sustainable use of and research on underutilized agroforestry species, including mostly indigenous dry land fruit tree species, fodder shrubs, species suitable for management of climate change, as well as underutilized species useful for food. ICRAF also collaborates with external genebanks for long-term conservation of plant genetic resources.

92. ICRAF is committed to evaluating the value of different species in terms of carbon sequestration and will conduct research on how climate change affects seed sources and tree ecology. It will contribute to developing a framework for the application of the ecosystem approach in the management of biodiversity by species selection. This will involve implementing research using an ecosystem approach on the impact of climate change for vulnerable species and biodiversity management for agroforestry germplasm in a global perspective.

VII. MICROBIAL AND INVERTEBRATE GENETIC RESOURCES

93. The CGIAR is giving increasing attention to wider agricultural biodiversity in the form of microbial and invertebrate genetic resources. This increasing attention relates to the key role played by these groups in ecosystem resilience for durable food production, and is manifested, e.g., in the inclusion of these groups in the GPG project as discussed in Section III. This wider diversity was also the subject of particular attention in the discussions that contributed to the development of the CGIAR position paper on *An integrated approach to genetic resources in support of the CGIAR's mission*, as presented in Section VIII.

94. Investment is urgently required to better understand and utilize these taxa in terms of characterization (taxonomic and functional), documentation, use and conservation, training and capacity development, policies to promote awareness and exchange. Their diversity far exceeds crop GRFA in terms or richness and functionality, and the utilization of crop GRFA can never be achieved in a sustainable manner unless combined with an understanding and use of a wider agricultural biodiversity including microbes and invertebrates.

95. Farming occurs in an ecological context involving interactions between crop germplasm and beneficial taxa (biological control agents of pests, nutrient cycling organisms) and antagonistic taxa (diseases, toxin contamination). Agriculture intensification, land use management, globalization, and the wide distribution of crop germplasm create selection pressures on these wider taxa, which, in turn, create a matrix of positive and negative pressures on food production systems. To predict risk (including climate change) and develop appropriate adaptation strategies to such drivers, the CGIAR and governments will become increasingly reliant on information and genetic resources that originate, or are found, in other countries or centres for the purpose of research, training, or direct use in agriculture. Collections form the mechanism through which information and access to these taxa can be achieved.

96. Specifically, formal systems are urgently required to acquire and manage information on collections in the CGIAR and to compare the CGIAR's comparative advantage with that of international repositories. GPG2 has developed an understanding of the existing status – and constraints to continuation – of some collections, but this information was collated from good-will contributions from collection managers and is not comprehensive. Furthermore, CGIAR collections are often managed by individuals or on behalf of projects and not as institutional

facilities/capacity; international repositories are often managed for profit and not for the provision of public goods.

97. The capacity to maintain reference collections for exchange of information and live accessions of the GRFA of these wider taxa, combined with human expertise, cannot be feasibly housed in every country or each CGIAR Centre, so a system of centres of excellence operated by highly trained staff linked to global information outlets needs to be established in combination with an enabling policy environment.

Contributions to the MYPOW on microbial and invertebrate genetic resources

98. IITA has been a significant partner in GPG2 and proposes a number of areas where collaboration with the MYPOW would be feasible regarding microbial and invertebrate resources. Potential collaborations on microbes could involve the provision of:

- Science-based advice on laws and policies regarding movement and sharing of resources among national partners and promotion of availability in the public domain.
- Advice on key issues of conservation relating to prioritization of key taxa that are drivers in ecosystems for food and agriculture (toxin-producers, soil health, etc.), and prioritization of key taxa that are drivers of/subject to change: climate change, land degradation, etc.
- A focal point for a virtual/real network on collections in the public domain and in developing countries.

99. With respect to invertebrate genetic resources, IITA suggests the potential areas of collaboration including provision of:

- Again, science-based advice on laws and policies regarding movement and sharing of resources among national partners and promotion of availability in the public domain.
- Advice on key issues of conservation relating to prioritization of key taxa that are drivers of/subject to change: climate change, land degradation, etc. (emerging diseases because of shifts in vectors, etc.), and biological control (classical, conservation, augmentative).
- A focal point for a virtual/real network on collections in the public domain and in developing countries.

100. As well as its existing interests in plant and animal GRFA, ICARDA has expressed a specific interest in joining collaborative efforts on microbial GRFA to achieve the goals of the MYPOW.

VIII. PROPOSED INTEGRATED APPROACH TO GENETIC RESOURCES FOR THE CGIAR

101. As the Commission moves on to successive stages of its MYPOW as set out in the Draft Strategic Plan 2010-2017, the CGIAR Centres are also confirming their own growth and evolution, and are now, through the auspices of SGRP, proposing the adoption of an integrated multi-sectorial programme that is closely aligned with the MYPOW.

102. At an SGRP workshop held in Mombasa in May 2009, the ICWG-GR met to review genetic resources work in the CGIAR and discuss possible future scenarios. This was with a view to informing developments that might come about through ongoing CGIAR change processes and to better align the work of the CGIAR to that of key partners such as FAO. At the workshop, the Centres developed an integrated vision for their work in genetic resources, based on a sustainable

ecosystem approach that embraces livestock, forest, aquatic, microbial and invertebrate - as well as crop – genetic resources.

103. A position paper, entitled *An integrated approach to genetic resources in support of the CGIAR's mission*, emerged from the Mombasa workshop. The position paper, which is appended to this report[23], articulates the collective vision of the Centres' genetic resources community and strongly reflects the common objectives and approach that is shared by the Commission's MYPOW, leading to the eventual integration of a rational global system of genetic resources conservation and use.

104. The fundamental premise underlying the ICWG-GR discussions was that the survival of the human race depends upon access to the agricultural biodiversity that enables plant and animal species to evolve and adapt to different growing conditions and that underpins the sustainability of ecosystems. Despite this widely-held view, agricultural biodiversity has been undervalued and squandered, with the result that it is at greater risk now than at any other time in history. The position paper likens the threats to agricultural biodiversity to a perfect storm – a scenario in which the combination of negative forces will, if allowed to develop, lead to an irreversible deterioration of the very systems that sustain life. Yet the potential to halt that negative trend and achieve truly sustainable agriculture is within our reach, and can be realized through bold and creative investment in science, people and genetic resources.

105. The Mombasa workshop provided an opportunity to analyze the CGIAR's achievements in the sustainable management of genetic resources against a background of other ongoing activities at the global level and of exciting developments in the science and technology of genetic resources conservation and use. These developments enable the CGIAR to transform the approach it takes to its work and greatly enhance its capacity and that of its partners to respond to global needs. It is also clear that the CGIAR must develop a state of readiness, to ensure a capability to respond in an agile way to new and unforeseen challenges.

106. The position paper defines a number of cross-cutting areas on which the CGIAR will focus its attention: understanding diversity; promoting the use of diversity through applied research; conservation technologies and strategies; information and documentation; capacity building, awareness and advocacy; economic analysis, and science-based policy. Milestones for the coming decade have been identified in the different focal areas. The examples quoted in Box 1 give a flavour of the approach with its mix of biodiversity-wide thrusts and needs-based sector-specific elements.

107. The paper foresees that an integrated approach to the conservation of all GRFA will have a significant impact on the food security and overall livelihoods of the world's poor. This will be achieved through harnessing the high genetic and functional diversity of production systems for enhanced delivery of superior primary products in environments that are cleaner, healthier and more productive. The approach will mitigate risks, maintain or increase ecosystem resilience, and increase external input efficiency through enhanced ecosystem services. It will promote the sustainability of the impact by ensuring that future generations have access to diversity to address as yet unknown development challenges presented by changed climates, pests and diseases and markets.

[23] Also available at www.sgrp.cgiar.org or by request from the SGRP Secretariat.

Box 1: Examples of ten-year milestones identified in the CGIAR position paper

Understanding, conserving and using diversity

- Diversity characterized at the ecosystem level using molecular techniques
- Biobanks of genomic resources for all agricultural biodiversity sectors including DNA, BAC libraries and genetic stocks
- On-farm management strategies implemented for model crop, tree, fish and livestock species
- Services providing germplasm for crops and some trees, with a brokering provision for other trees and livestock

Knowledge and information sharing

- A CGIAR-wide comprehensive information platform and global portal
- Knowledge bases for e-learning
- Capacity built among a wide range of stakeholders through training, collaborative research, backstopping and mentoring
- Strategies for effective public awareness and advocacy developed and implemented, partnering with others to advance global agendas

Policies and economics

- System-wide adoption of policies and related legal instruments that support the Centres' scientific work and performance as participants in evolving global systems of conservation and use of GRFA
- Influence on the development of international and national policies, laws and administrative practices relating to GRFA
- Influence on the design of economic policies in support of sustainable agriculture and livelihoods.

108. Nature does not draw a line between plants, animals and microbes, and the agricultural ecosystems they inhabit. It recognizes their uniqueness at the same time as their interactions and their interdependence. The CGIAR appreciates the dynamic interaction across sectors and seeks to promote a holistic approach to all genetic resources for food and agriculture (GRFA), and incorporate a stronger emphasis on conservation in ecosystems in future work. The holistic element involves identifying the underlying similarities across the various sectors of agricultural biodiversity that offer opportunities for common approaches and shared technologies. Despite seeking out these similarities, the proposed approach is far from being one that brings homogenization of ideas – to the contrary, it will stimulate creativity and use the collective body of knowledge and experience to achieve specificity in addressing the particular challenges among and within sectors that call for tailored approaches and specialized research.

109. The point of departure for the new approach is the strategy that has worked for the Centres in the area of crop diversity: a single-minded, systematic effort based on common policies, coordination and collaborative research involving partners from all over the world. As well as being a sound strategy for work in other sectors of agricultural biodiversity, it will lend strength and validity to cross-sectorial aspects.

110. Working together brings many benefits including more effective priority setting, increased efficiency in multidisciplinary research, economies of scale, improved services to clients in, e.g., the provision of information, increased visibility, and more effective representation in intergovernmental processes. The CGIAR Centres are already heavily involved in collaborative research, with a conspicuous element of collective action on areas such as genetic resources policy and the conservation of crops held in common. Through the position paper, the ICWG expresses its commitment to continued and enhanced collaboration. This commitment is supported by a shared vision of the role of GRFA in food security, recognition of opportunities

for increased efficiency and effectiveness in the CGIAR system, intractable bottleneck problems in common, and a shared enthusiasm for using cutting-edge science to solve those problems. There will be numerous areas in which collaborative identification of research priorities will lead to activities and outputs that do not need to be carried out by all but will stand to benefit all. Examples include best practices for DNA banking, basic research on diversity and ecosystem resilience, and exploration of genetic stability under different conservation regimes.

Contributions to the MYPOW enabled by an integrated approach

111. The CGIAR Centres are already heavily involved in efforts to develop a global system of PGRFA conservation and use, and have well-defined long-term obligations relating in particular to the International Treaty, and the development and implementation of the Global Plans of Action for PGRFA and AnGR. The CGIAR's approach as described in the position paper builds upon these existing activities and obligations. Moreover, it is very consistent with the approach taken by the MYPOW, which recognizes that, while the components of agricultural biodiversity represent distinct contributors to food security, they also share common features and threats. Thus, the developments reflected in the position paper are entirely consistent with and lend substance to the commitment that the Centres have made to support the implementation of MYPOW.

112. Carrying forward the longstanding cooperation between the Centres and the Commission, and as a consequence of the even greater convergence of our stated goals and approaches, the Centres, through their coordinated efforts, will continue to be major partners and active protagonists in the implementation of the MYPOW Strategic Plan 2010-2017.

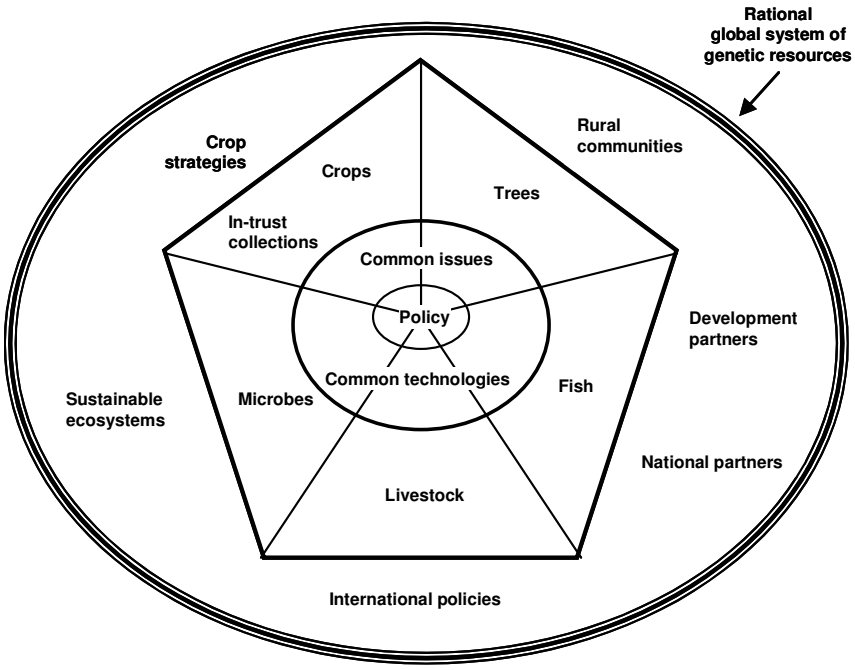
113. The Centres work in the coming years, integrating the application of the ecosystem approach to the conservation and use of genetic resources for food and agriculture, will be conducted in concert with the MYPOW. It is expected that, in this context, the Centres will be able to conduct groundbreaking research and make significant contributions to the First Report on the State of the World's Biodiversity for Food and Agriculture, to be presented at the Commission's Sixteenth Regular Session (CGRFA 16) in 2016.

ANNEX 1

AN INTEGRATED APPROACH TO GENETIC RESOURCES IN SUPPORT OF THE CGIAR'S MISSION

An Integrated Approach to Genetic Resources in Support of the CGIAR's Mission

A position paper developed by the Inter-Centre Working Group on Genetic Resources



In a world threatened by unprecedented challenges of hunger and malnutrition, climate change, water shortages, loss of biodiversity and rising energy and food prices, all compounded by financial instability, sustainably harnessing the potential of genetic diversity is more than ever basic to survival. The impact of the CGIAR's achievements in the future will become increasingly dependent on an integrated approach to conserving and using genetic resources for food and agriculture. We cannot afford to do otherwise.

An Integrated Approach to Genetic Resources in Support of the CGIAR's Mission

1. THE CHALLENGE

The threats that imperil human wellbeing and ecological sustainability have been likened to a perfect storm – a scenario in which the combination of negative forces will, if allowed to develop, lead to an irreversible deterioration of the very systems that sustain life on this planet. Yet the basic knowledge to turn back the tide and the means to do so are at hand. What is needed is the will to make a bold and creative investment in the science, the people and the genetic resources that, together, can chart a future in which agriculture is sustainable.

The momentum, the vision and the commitment that exist today in the CGIAR genetic resources community have prompted it's leaders[24] to propose the implementation of an integrated, ecosystem approach to biodiversity conservation and use – embracing microbes, fish, livestock, crops and forest trees. Aside from its solid scientific merits, this approach has wide appeal and applicability to NARS partners in all regions, who share production constraints and environmental protection challenges. The possibilities for upscaling and transfer between regions are considerable. The proposed approach builds on current partnerships and ecoregional experiences within the CGIAR, as well as presenting opportunities for engaging other national and international organizations and for integrating partnerships across the different sectors of genetic resources.

The vision presented here follows upon years of successful collaboration – collaboration that now needs to be lifted to a higher level to respond effectively to the new challenges before us. The in-trust germplasm collections held by the Centres represent some of the most vitally important global public goods that the CGIAR makes available to the world. Working together is patently both feasible and fruitful and, were it not for the collaborative initiatives taken in the context of the System-wide Genetic Resources Programme (SGRP), these in-trust collections would be at greater risk of genetic erosion, less well described, and in some cases unavailable to realise their huge potential for improving people's lives.

There are continuing challenges in the crops sector with particular issues in the area of underutilized crops and *in situ* conservation. But even greater challenges are presented in the other sectors of genetic resources for food and agriculture (GRFA).

Looking firstly at aquatic genetic resources (AqGR), many of the world's poorest billion people are dependent on fish as the major source of dietary animal protein. However, current fisheries supply cannot sustainably satisfy the demands of an exploding global population - half of all wild fisheries are harvested to full capacity; a quarter

Box 1: Aquatic genetic resources (AqGR) – the challenge

About 20% of the 10,000 known freshwater fish species have become threatened, endangered or extinct in the last few decades. To increase food supplies and further develop aquaculture production without compromising vital genetic diversity there is an urgent need to:

- maintain intra-specific genetic diversity in farmed stocks to prevent genetic erosion and over-reliance on wild broodstock
- understand and minimize the potential genetic impacts of farmed stock on wild AqGR
- identify and characterize wild and farmed diversity to provide the information essential for improving management practices, informing breeding programmes and prioritizing conservation efforts.

[24] The Inter-Centre Working Group on Genetic Resources (ICWG-GR)

Box 2: Forest tree genetic resources (ForGR) – the challenge

Thousands of forest tree genetic resources are threatened by overharvesting and/or forest conversion. Selection and breeding to enhance desirable traits have a huge potential to increase the use and value of these trees. However, little is known about the ecology, reproductive biology, or genetic diversity of the vast majority of these species. The studies that have been conducted reveal numerous obstacles to domestication, particularly for tropical trees. *Ex situ* conservation is similarly challenging, due to seeds that cannot be readily conserved, to the large size of the trees, and the long time before first fruiting. Scientific challenges include:

- biological questions such as documenting the diversity of useful traits within populations and species, reproductive and seed biology, and growth rates
- socioeconomic questions regarding the value of those traits to users
- ecological questions such as their distribution and potential distribution, and
- evaluating the current status, trends and threats to wild populations.

are over-exploited and at risk of collapsing.

Forest tree genetic resources (ForGR) are the diversity of useful trees at the level of species and populations. The term "forest trees" differentiates the trees from which the products (fruits, resins, timber, etc.) are harvested from wild populations, from the long-domesticated fruit and nut tree cultigens. There are tens of thousands of species of useful forest trees, most of them in the tropics; yet only a few dozen have been domesticated. Many are managed in wild settings; while most are simply wild-harvested.

Livestock and farm animal genetic resources (AnGR) present some unique challenges for their conservation and use for development. Up to 70% of the world's rural poor depend on indigenous livestock for food and income, with high interdependence among countries. There is a rapid decline in livestock diversity, especially of small and highly adapted local types. In most cases, the basis for adaptation to particular conditions is not even described, let alone understood. Agricultural research and 'improvement' is itself often responsible for loss of livestock diversity by encouraging the use of exotic genetic resources; sometimes appropriately, sometimes not. We must not stand in the way of genetic improvement of livestock, but we must ensure that the changes are evidence-based and appropriate for the farming systems they are being applied to, and we must retain the ability to use this highly adapted and precious diversity as requirements change.

Box 3: Microbial genetic resources (MicGR) – the challenge

Microbial biodiversity constitutes by far the most diverse yet least studied component of agricultural ecosystems, with an untapped economic potential that could and should be harnessed. Yet the capacity and infrastructure to study microbes is lacking, especially in the developing world. Microbial collections are few, disjointed, often without long-term commitments for their maintenance, and legal guidelines and policies for sharing microbial germplasm are lacking. As a result, concerted and long-term efforts to study the functionality of this important group, especially in relation to their interactions in the ecosystem, are virtually non-existent.

Box 4: Livestock genetic resources (AnGR) – the challenge

Securing AnGR:

- The livestock breeds classification system for the livestock diversity of the developing world is at best only partly applicable to the livestock genetic resources of Africa and Asia.
- The driver for *ex situ* biobanking of livestock genetic resources should be diversity and adaptation rather than documenting breeds, but our knowledge here is still incomplete.
- Methodology and protocols for *ex situ* biobanking are incomplete (e.g. for poultry).

Putting AnGR to use:

- Direct *in situ* characterization of phenotype and adaptation on-farm remain daunting tasks, calling for innovative multidisciplinary approaches (e.g. GIS-supported).
- The link between molecular diversity and productive traits is just beginning to be explored. The molecular tools are already available, however, and they present us with a unique opportunity to unravel many persistent questions about livestock genetic diversity.
- Livestock-agroecosystem interactions are poorly studied, and require an ecosystem approach to achieve sustainable improvements in productivity.

The *ex situ* conservation and use of crop plant genetic resources (PGR) has been a major thrust of the CGIAR since its inception, and these activities have generated enormous impact, often with extremely high rates of return on investment (see e.g.: www.croptrust.org/documents/newsletter/newsletter_croptrust_v4_final.htm).

The CGIAR is not alone in identifying the importance of focusing on aquatic, forest tree, livestock, and microbial as well as crop genetic resources, and of taking an overall ecosystem approach to them. The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) expresses the same level of importance and heightened sense of urgency on these issues in its multi-year programme of work (MYPOW). The MYPOW creates opportunities to organize CGIAR system-wide work in the global context of an inter-governmental process, linking our efforts to those of our key partners and increasing the relevance and uptake of the global public goods that we produce.

Box 5: Crop plant genetic resources (PGR) – the challenge

The most significant challenges to PGR conservation include:

- the development of improved techniques to keep genebank material alive and healthy, especially for clonal crops and species with recalcitrant seeds.
- the development of methodologies to maintain the genetic integrity of conserved material
- low data-quality standards, and
- the need for strategies for effectively conserving the diversity of crop genepools with minimal gaps in coverage and minimal unwanted duplication.

The most significant challenge to PGR use is simply that we don't know which accessions to use – we don't know which accessions contain the genes needed for a development objective, because we lack the relevant data and we don't have good search strategies to locate them. Numerous species of fully domesticated yet little-known crops remain neglected by science, underutilized, underprotected, and threatened by genetic erosion or extinction even before their attributes and can be studied, improved, and applied to the betterment of human welfare.

In situ management of crop genetic resources has received insufficient attention. *In situ* conservation strategies have been developed, and there is good general appreciation of the importance of diverse farming systems for sustainable livelihoods, but translating these potential benefits into real impacts remains a major challenge. We only begin to know how to design diverse systems to be more productive, more resilient, and deliver more ecosystem services, because of a basic lack of required ecological understanding. There is a critical need for a broad range of basic and applied ecological research, at all scales from microcosm to landscape to achieve this fundamentally important goal.

An ecosystem focus has strong grass-roots appeal, resonating with the reality that farmers confront, and expanding the research scope to capitalize on NARS and farmer expertise in local agroecosystem management. The holistic approach proposed combines the traditional *ex situ* conservation approach within a broader ecosystem conceptual framework, and presents significant opportunities for innovative science by cutting across the old barriers between disciplines and commodity sectors to tackle complex and urgent challenges. This approach also changes the human face of the CGIAR's work, by attracting and retaining a highly skilled and creative workforce employing the best science in an unrivalled research-for-development professional environment. The non-negotiability of the CGIAR stepping forward now to secure agricultural biodiversity, as a constant element in an otherwise uncertain future, is clear. What remains is to make the commitment to take that most important step up to an integrated approach.

2. AN INTEGRATED APPROACH

The secure conservation and optimal use of diversity – the building blocks of agriculture and the basis for adaptation to change – has long been the concern of the CGIAR. Proposals for change in the CGIAR system have provided the opportunity to analyse the CGIAR's achievements to date in the sustainable management of genetic resources against a background of exciting developments in the underlying science and

technology. These developments stand to transform the way we approach our work, to realign it to global thinking and enhance its response to global needs. Moreover, it is clear that we must develop a state of readiness to take advantage of future, as yet undefined, developments. The approach that emerged from the analysis based on the experience of years of collaborative work is that:

The CGIAR will promote the sustainable management of all genetic resources relevant to food and agriculture to achieve food security and environmental stability. This will be achieved through developing, implementing, coordinating and supporting science-based contributions to the conservation of genetic diversity and its use in productive and resilient ecosystems. The CGIAR genetic resources community will focus on safeguarding, generating and sharing global public goods in the form of germplasm and knowledge within an enabling policy framework.

Seemingly prosaic, this approach incorporates some significant departures: a holistic approach to all genetic resources for food and agriculture (GRFA) and an emphasis on conservation and ecosystems. How does this translate into practical terms? It translates into recognising a common challenge that identifies the underlying similarities across the various sectors of agricultural biodiversity that offer opportunities for common approaches and shared technologies, while at the same time highlighting the unique challenges among and within sectors that call for tailored approaches built upon a collective body of knowledge and experience.

In brief, the antidote to the perfect storm is a convergence of ideas, materials and solid expertise in traditional technologies, plus exciting new ones that, together, will enable us to respond to a challenge that is larger and more urgent today than at any other time in the history of the CGIAR.

3. IMPACT

The impact that is foreseen from the approach that we are recommending (see Box 6) touches people and environments, and brings immediate benefits as well as a more sustainable future.

The counterfactual situation is alarming. Failure to elucidate the nature and function of genetic diversity will compromise our ability to harness that diversity for improving ecosystem resilience and human livelihoods. Attempts to alleviate poverty without regard for diversity in production systems will cause greater genetic erosion and long-term environmental damage. Failure to conserve genetic diversity will compromise our capacity to respond to new development challenges. And it will compromise the ability of future generations to meet their own needs, because such failure denies them access to the genetic resources required to so do.

Box 6: Impact
An integrated approach to the conservation and use of genetic resources for food and agriculture meets the needs of the world's poor by improving their food security and overall livelihoods.
This target will be achieved through enhanced delivery of superior primary products of agriculture, arboriculture and aquaculture, in environments that are cleaner, healthier and more productive by harnessing the high genetic and functional diversity of production systems.
The approach proposed will mitigate risks, maintain or increase ecosystem resilience, and increase external input efficiency through enhanced ecosystem services. Moreover, it will promote the sustainability of the impact by ensuring that future generations will have access to the genetic diversity that they will need, to address their, as yet unknown, development challenges including changed climates, pests and diseases, and markets.

To achieve this impact, the work outlined in Section 5: 'A shared vision', must be coordinated with partners outside the CGIAR, and have downstream links to ensure that the germplasm, technologies and information developed through the CGIAR effort are ultimately delivered to those whose livelihoods depend on them. Coordination with other thematic areas within the CGIAR is also essential, including germplasm

enhancement and breeding, natural resources management, the economic and social sciences, and capacity building.

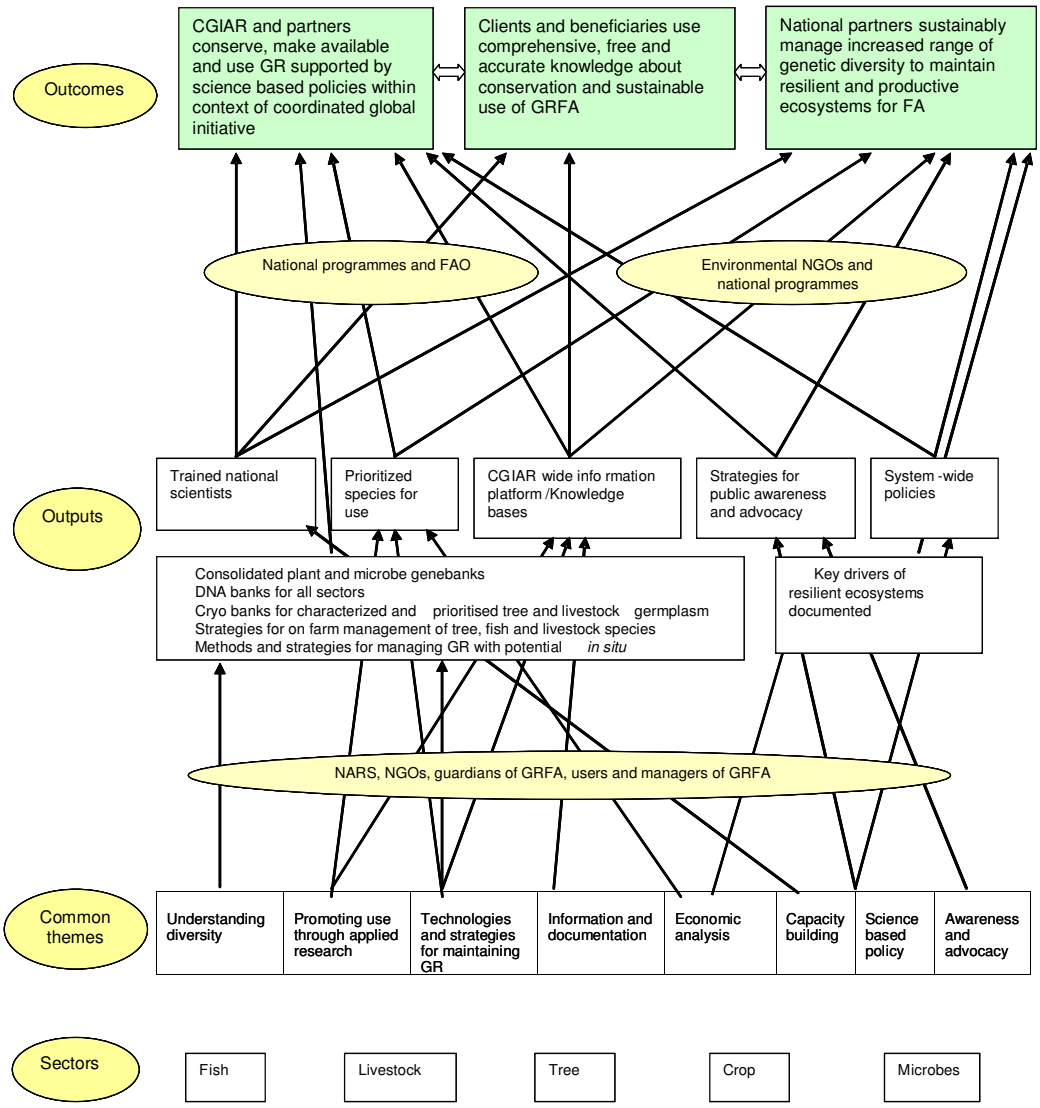


Figure 1: Outcome map for the CGIAR's genetic resources effort.

The work cuts across the three recognized levels of biological diversity: ecosystem, species and genetic. Past work in the CGIAR has acknowledged and involved the three levels but with an overriding emphasis at the genetic level, on using genetic diversity – particularly the diversity present in genebanks – for crop improvement. The deployment of genetic resources at the level of the agro-ecosystem and landscape also plays a crucial role in contributing to increases in productivity, resilience, and conservation, and implies the integration of all sectors of agricultural biodiversity. An integrated approach lies at the heart of sustainable agriculture that produces and facilitates access to sufficient food for all people, and contributes to livelihoods and socio-economic development while protecting the environment.

The approach that we are proposing achieves its impact through three outcomes (see Box 7). As ever, partners' contributions are required to move from the direct outputs of our work to these outcomes and on to impact. Thus, the work must be embedded in an integrated global approach to conservation and use of biodiversity in the wider context of sustainability.

. **Box 7: Outcomes**

1. The CGIAR and partners conserve, make available and use a broad range of genetic resources for food and agriculture, supported by science-based policies within the context of coordinated global initiatives.
2. A wide range of clients and beneficiaries use comprehensive, freely-available and accurate knowledge about the conservation and sustainable use of genetic resources for food and agriculture.
3. National partners, NGOs, civil society, the private sector, and people at the grass roots – farmers, fisherfolk, herders and foresters – sustainably manage a broader range of genetic diversity to maintain resilient and productive ecosystems for food and agriculture.

Figure 2 illustrates the pathways to impact and presents a holistic approach that builds upon the complementarity of *ex situ* and *in situ* conservation, with resilient and productive ecosystems as the foundation for future agriculture. The pathways to impact are discussed further in Section 7: 'Mapping the future'.

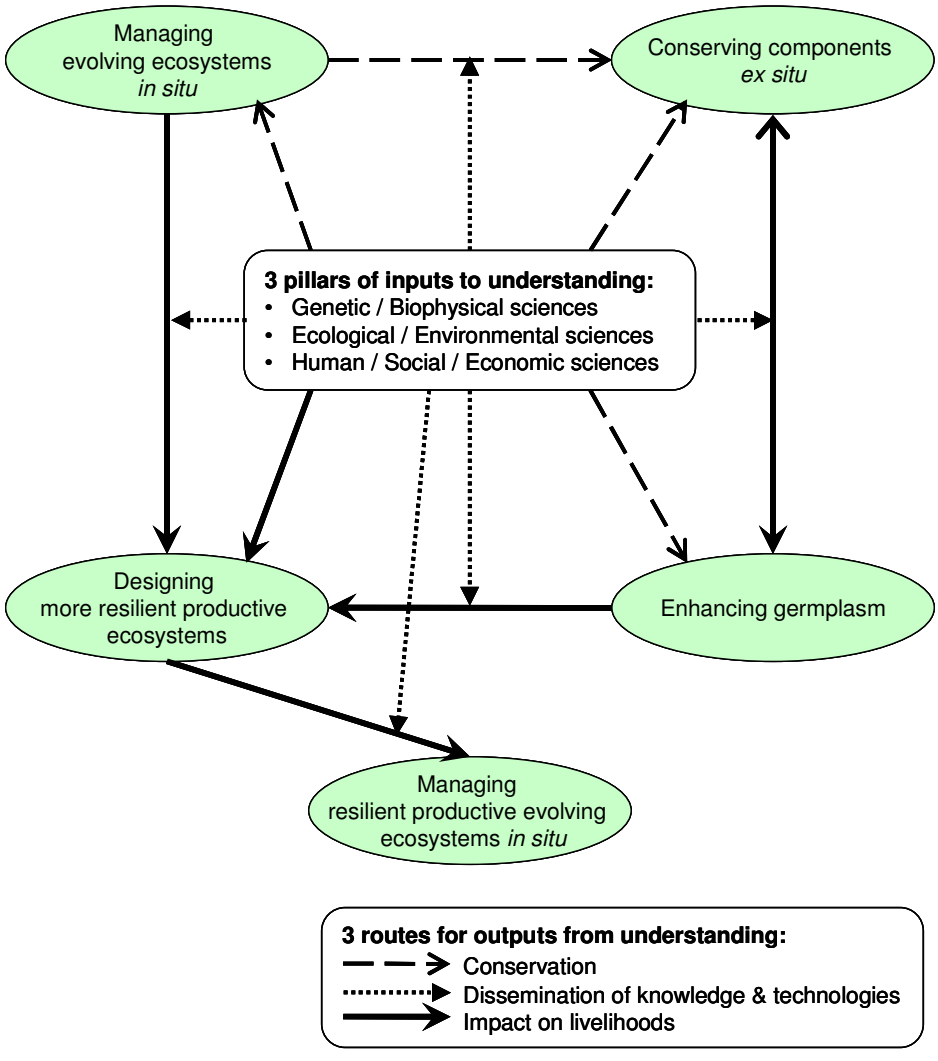


Figure 2: Pathways to impact, illustrating the three pillars of inputs to understanding that deliver outputs via three routes.

4. CONCEPTUAL FRAMEWORK

A holistic approach to the conservation and use of GRFA is intrinsically more successful in the long term because it brings together work in microbes, crop plants, forest trees, livestock and fish. These sectors have their own specific challenges as noted earlier, but have much in common, especially when considering the underlying science. This conceptual framework (see Fig. 3) is consistent with intergovernmental initiatives such as the FAO Commission and other international efforts to integrate a rational global system of genetic resources conservation and use. The elements depicted for the crop sector in Fig. 3 serve as an example of the mechanisms and processes specific to that sector, and which will be somewhat different for each of the other sectors. Every sector can benefit from the experiences, precedents and solutions of other sectors. The integrated approach facilitates such cross-sectorial solutions and responses.

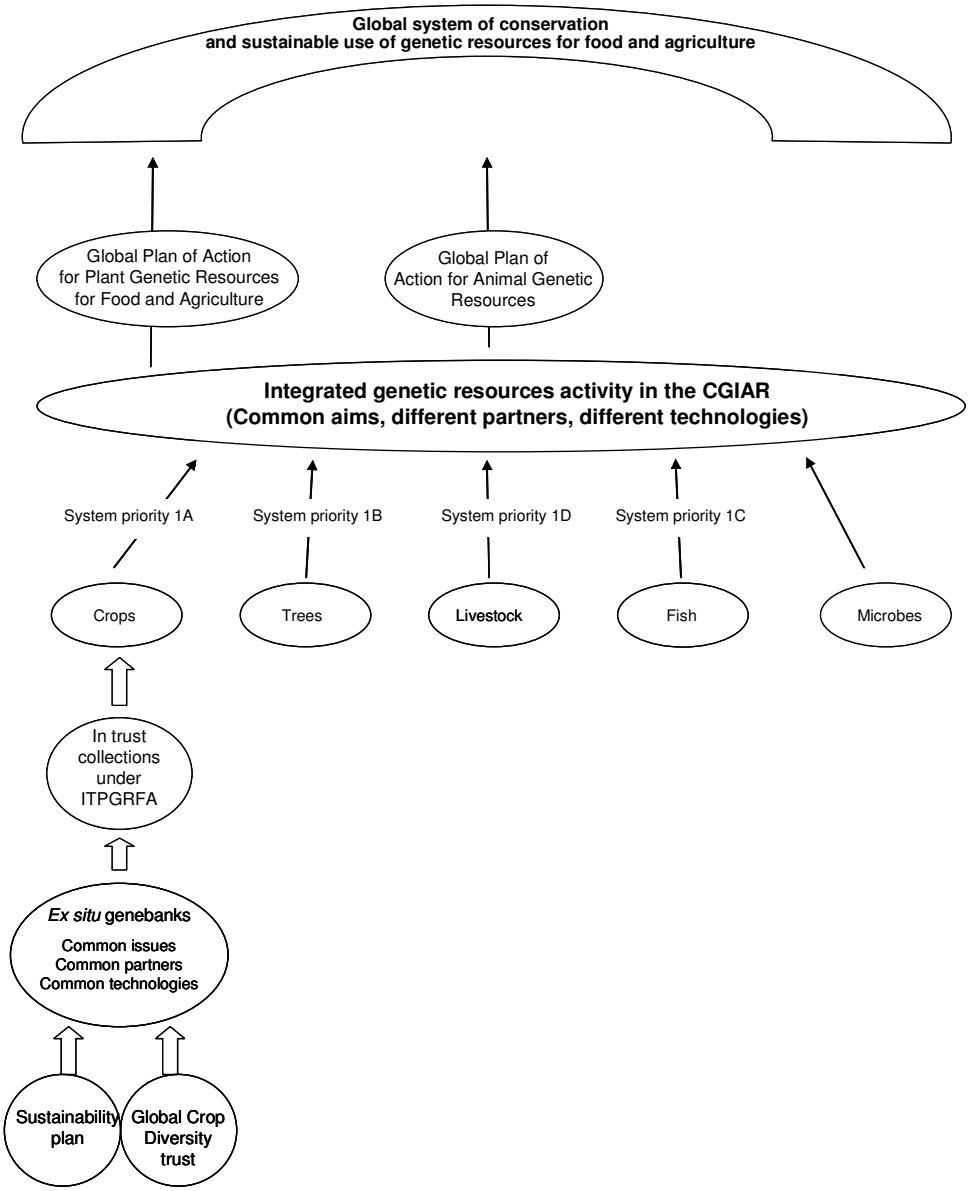


Figure 3: Conceptual framework

To many people in agricultural research, the term 'conservation' conjures up images of a crop genebank, and they might wonder why there is any need for attention to improving biobanking technology and its application. However, a simple schematic diagram showing the applicability of *ex situ* conservation to crops does not show a uniform success story, i.e., a comforting clustering near "ALL" (See Figure 4). While many important staple crops can be conserved as seed stored at low temperatures in genebanks, a significant number cannot because they are vegetatively propagated or because their seeds die at low temperatures or when dried. It is hoped that *in vitro* technology, including cryopreservation, will provide an answer for recalcitrant crops and there has been significant progress in that direction, but it is far from routine or universally applicable. There remains much to be done to open the *ex situ* conservation option to all crop diversity.

What does become evident, though, when other sectors of biodiversity are plotted on the same scale is that, even though crops are not fully served by *ex situ* conservation technology, they are dramatically better served than any of the other sectors. There are clear opportunities for using what we currently know about the conservation of crops *ex situ* to help develop parallel technologies for the other sectors as well as extending the coverage for crops themselves. An investigation of, for example, underlying physiological processes accompanying exposure of living tissues to storage conditions would likely lead to progress in all sectors.

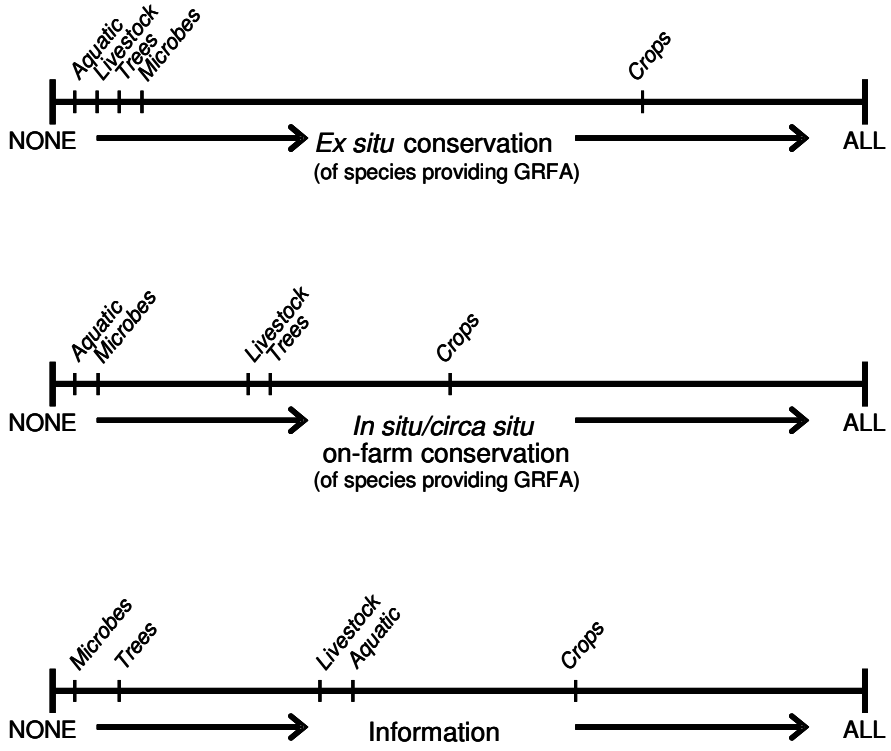


Figure 4: Representation of the relative states of development of different approaches to conservation and component disciplines for the different sectors of agricultural biodiversity. Note that this schematic is not intended as a quantitative measure, but rather as a relative expression of progress in the different sectors.

Policies in support of *ex situ* management of major crops are much more advanced than for other sectors. Not surprisingly, international and national organizations' policies in support of *ex situ* conservation of minor crops and microbial, animal, and aquatic genetic resources are considerably less well developed. Likewise, policies in support of *in situ* or *circa situ* management of most GRFA, including farmers' informal systems of innovation, are underdeveloped.

Concerning information management, there is still some way to go for crops to be well served with comprehensive and accessible information systems. This is especially the case for underutilized crops and crop wild relatives. The situation for fish and livestock is somewhat worse, despite some important efforts in that regard, and for microbes and trees, the information management efforts have barely begun. As might be expected with these disparate states of development, very little has been done to integrate information from the different sectors that would support an ecosystem-based study.

5. A SHARED VISION

Despite some intrinsic differences in the challenges faced by the different sectors of agricultural biodiversity, there are common themes running throughout that identify common responses. Thus, there are opportunities for working together, working in parallel, for cross-fertilization of ideas and methods, and for taking a 'think-tank' approach to previously intractable problems. A common approach is far from being one that brings homogenization of ideas – to the contrary, it can stimulate creativity, and use the collective body of knowledge to achieve specificity.

Working together maximises opportunities to have an agile response to new, as yet unforeseen, developments. In many of the disciplines explored below, it is crucial to stay abreast of new developments and target them appropriately to solve commonly experienced problems, at the same time valuing, sustaining and advancing the more traditional science that has given the CGIAR such a solid foundation for playing a major role in the global genetic resources arena of the future.

Based on addressing the different focal areas described below, our vision is that, in the space of the next decade, we shall witness significant developments as represented by the milestones shown in Boxes 8–10. The CGIAR is uniquely placed to play a pivotal role in bringing these developments about through its wide range of partners and its activity in global arenas.

5.1 Understanding diversity

In this most basic of studies, new technologies stand to make a dramatic impact. Cutting-edge molecular research in genetic diversity and its role in productive ecosystems will include the use of genomics to characterize agricultural biodiversity at the ecosystem level, and to define key indicators of functional diversity in plants, livestock, fish and soils – with practically identical methodology for each sector. Comparative genomics studies offer the possibility of conducting mega-sequencing of livestock, aquaculture and crop diversity for gene and gene network discovery for adaptive traits. Expanding the scope of the work to include non-plant and non-livestock taxa such as insects and nematodes will contribute key information for responding to climate change, promoting resilient ecosystems, crop intensification and productivity, input use efficiency, integrated management of pests and pathogens, and monitoring genetic erosion.

5.2 Promoting use through applied research

The development of tools and methodologies for sustainable use, including *in situ* (in the wild), *circa situ* and on-farm management of genetic diversity, and selection and evaluation for traits of economic importance, will involve partners more closely in the

conservation-use continuum. Demonstrating and disseminating information about the nutritional importance of diversity will impact directly on human health. The development of strategies for using genetic diversity for adapting to climate change will tackle a key threat. Pre-breeding and sharing the knowledge on the traits present in large crop collections will move raw germplasm more rapidly into breeding programmes and accelerate the development of improved varieties. A seamless linkage with breeding programmes will be crucial to ensure and facilitate enhanced utilization of the broadest possible range of crop diversity available in the collections.

5.3 Conservation technologies and strategies

Dynamic conservation strategies that combine the complementary strengths of both *ex situ* and *in situ* approaches will be used to remove bottlenecks, and the development of decision-making tools will support the optimal application of alternative conservation methods. Research is urgently needed to improve methodologies and develop guidelines and policies to promote and strengthen *in situ* and on-farm conservation in all sectors, to map out where diversity is maintained, to identify the threats – including climate change – and how to best address them.

Attention will be given to expanding the reach of *ex situ* conservation (biobanking) through improving conventional methods and developing alternatives, including cryopreservation (e.g., for livestock and fish gametes), slow-growth *in vitro* (for clonal crops), field biobanks and *circa situ* conservation stands (e.g., for tree species), and DNA banking.

At the interface of genetic diversity studies and conservation, the CGIAR will provide global leadership in the assessment of genetic erosion, developing and using geographic information system (GIS) tools to integrate and analyze genetic, geophysical and socioeconomic data to help target and prioritize collecting, conservation and development interventions. GIS-supported analyses and methods are already being widely applied to crop genetic resources, and this is a striking example of how an inter-sectorial approach could be readily implemented.

Box 8: Milestones in understanding, conserving and using diversity

- Diversity characterized at the ecosystem level using molecular techniques
- Key drivers for resilient ecosystems characterized and in use for research
- Key species prioritized for enhanced use based on a socioeconomic assessment, evaluation against major biotic and abiotic stresses, and value as models for wider application (e.g. in wild tree species)
- Consolidated biobanks for crops and microbes, with greater diversity captured
- Critical tree and livestock diversity prioritised for cryopreservation
- Biobanks of genomic resources for all sectors including DNA, BAC libraries and genetic stocks
- On-farm management strategies implemented for model crop, tree, fish and livestock species
- Methods and strategies for conserving wild species with potential for food and agriculture developed and implemented in natural ecosystems and protected areas
- Participatory research to sustain production in the face of climate change and other threats
- Services providing germplasm for crops and some trees, with a brokering provision for other trees and livestock

The implementation of global strategies will be promoted, together with strengthening of NARS to assume their own conservation roles and responsibilities. For example diversity will be restored to national collections, decentralized seed and seedling systems will be promoted, and support will be given to the management of genetic resources in fisheries. The concept of partnership in conservation will have a wide definition, taking advantage of the expert knowledge and enthusiasm of less formal but expert groups such as local seed savers, breed fancy clubs and farmer organizations whose contributions will be essential for, e.g., livestock diversity.

5.4 Information and documentation

The CGIAR, as a knowledge organization, will provide leadership and global services in the area of genetic resources knowledge gathering, sharing and management, facilitating interconnectivity across national and international information systems. These global informatics platforms will allow scientists, farmers and policy makers at all levels to directly interrogate the data and contribute to our understanding of the role and function of diversity. The informatics platforms and services will be instrumental to identify information gaps, develop data standards and ontologies, facilitate multi-layer data analysis, and provide core inputs to underpin and help integrate a growing constellation of information systems and initiatives worldwide. This, above all, would provide cohesion to an inter-sectorial global system of conservation and use.

5.5 Capacity building

As well as striving to build partners' skills and enlarge the ranks of genetic resources practitioners in national programmes, future work will involve providing a platform for developing and applying research guidelines, manuals, training materials and curricula. Specialized courses will continue to target national partners, who will also be increasingly involved in all stages of research activities to boost their research capacity, as well as being supported in their own research through technical backstopping. In addition to the more traditional areas that tend to focus on conservation, capacity building will take a more comprehensive approach and give greater attention to farmers, processors, marketing agents, researchers and decision-makers. With the goal of enhancing the use of biodiversity, these efforts will cover disciplines ranging from understanding diversity, to nutrition, marketing and policies.

Box 9: Milestones in knowledge and information sharing

- A CGIAR-wide comprehensive information platform and global portal
- Leadership in the development of a global information system
- Knowledge bases for e-learning
- Inventories of genetic diversity by sector and region to inform collecting and conservation priorities
- Capacity built among a wide range of stakeholders through training, collaborative research, backstopping and mentoring
- Strategies for effective public awareness and advocacy developed and implemented
- Environmentalists and policy-makers promote the sustainable use of GRFA

5.6 Awareness and advocacy

There is a significant task to be carried out to influence 'hearts and minds' at all levels, from the general public to decision-makers, to increase the appreciation of the central role that GRFA play in human well-being and environmental sustainability. Thus, the CGIAR will actively promote and publicize the importance of genetic resources at the global level and in international fora, and will seek recognition and collaboration with international and national conservation organizations, as well with national ministries of agriculture, the environment, education, tourism and finance.

5.7 Economic analysis

The cross-cutting but hitherto under-researched area of economic analysis will develop methods for assessing the market and non-market value of genetic resources, and develop standardized costing tools for genebank management operations and options. It will also generate economic models for complementary conservation strategies (see Section 5.3), impact assessment and evaluation, as well as methodologies for adding value to genetic resources, including neglected and underutilized species and breeds. Economic tools and methods will be developed to estimate the contribution of intra- and inter-specific diversity to the resilience of

production systems, to the reduction of production and market risks, and thus to the reduction of farmers' and rural households' vulnerability. The outputs will include tools to help policy-makers evaluate the trade-offs of managing highly diverse agricultural production systems to demonstrate positive impacts on nutrition, health and incomes and validate the maintenance of such systems.

5.8 Science-based policy

The CGIAR has amassed considerable expertise and recognition as an 'honest broker' over the last 15 years of international policy-making affecting the management of PGRFA, and the CGIAR Centre-held *ex situ* collections in particular. Most recently, these efforts have been directed at the negotiations of the International Treaty on Plant Genetic Resources for Food and Agriculture and related Standard Material Transfer Agreement, and the implementation of the Treaty's multilateral system of access and benefit-sharing. That work will have to continue covering the Centres' own implementation of their agreements with the Governing Body of the Treaty; making technical contributions to ongoing international negotiations concerning implementation-related issues; and assisting national and regional partners to implement the Treaty.

Box 10: Milestones in policies and economics

- System-wide adoption of policies and related legal instruments that support the Centres' scientific work and performance as participants in evolving global systems of conservation and use of GRFA
- Influence on the development of international and national policies, laws and administrative practices relating to GRFA
- Influence on the design of economic policies in support of sustainable agriculture and livelihoods.

There is huge potential for applying the CGIAR's unique experience and reputation to other sectors of biodiversity in the context of the FAO Commission's MYPOW, which opens up opportunities to address key scientific issues and guide policy development, at the global level, on the conservation and use of microbial, invertebrate, tree, aquatic, livestock and crop GRFA, and all of them together at the ecosystem level. The Centres, as a group, need to continue to monitor and contribute to policy-making processes that affect genetic resources under the aegis of the CBD, WIPO, and possibly WTO.

6. WORKING TOGETHER

The CGIAR Centres will work together to improve the management of and research on a broad range of GRFA, and will significantly increase the use of the genetic resources in their care by building upon their long history of collaboration. This integrated approach reflects a clear recognition of the common challenges that exist across sectors and the benefits that accrue from working together to address them.

Most recently, the Centres have collaborated in taking collective approaches to commodities in common, while still maintaining their respective areas of specialization and independent governance. This track record of fruitful collaboration and mutual support lays a solid foundation for even greater integration of all genetic resources activities system-wide, enabling the Centres to respond better to emerging opportunities and challenges, and contribute more effectively to the strategic objectives of the CGIAR. The system-wide collective action formula, already conspicuous in the work of SGRP, is one that should characterize the new CGIAR. The opportunities for working together are many and varied, and the added value to be derived therefrom is significant, as spelt out in more detail in Box 11.

Thus, the need for collaboration is essential. Here we present arguments for continued and enhanced collaboration, with a preferred option of its formalization through a system approach that enables synergies across sectors, ensures needed financial stability, and provides a research environment that nurtures creativity and

innovation in the context of collective action. The system approach we are proposing for conserving and using GRFA is supported by:

- A common vision of GRFA management and use as the biological basis for achieving long-term food security
- Common issues hampering the conservation and use of GRFA (such as lack of awareness, technical inadequacies, lack of supportive policies)
- Synergies in strategies and approaches across sectors, including opportunities to learn from each other
- Availability of cutting-edge science to resolve previously intractable problems
- Opportunities for rationalization to improve efficiency and effectiveness across the CGIAR system
- Partnerships across sectors as an integral part of the global genetic resources community, with flexibility of partnerships within a common framework
- Increased awareness of the importance of an agroecosystem approach for GRFA conservation and its role in the improvement of agricultural productivity.

Box 11: The benefits of system-wide collaboration

Management
- Common objectives addressed through common outputs
- More effective priority setting
- A greater critical mass buffering the risks associated with innovation
- Greater visibility and a common voice in dealing with donors

Research implementation
- Support for a holistic approach essential to reorientation towards an ecosystem focus
- Greater efficiency of multidisciplinary research incorporating social science, economics, molecular biology, etc
- Economies of scale with the development of common tools and opportunities for sharing facilities and equipment, avoiding duplication of efforts

Information systems
- Enhanced interoperability in information systems developed through collaboration
- A common gateway for users
- A better service to clients leading to enhanced use of diversity

Impact
- Synergy, complementarity and cross-learning will enhance scientific impact
- Elevated impact on crucial development challenges, e.g., through common benchmark sites
- Greater capacity to mitigate intellectual isolation of NARS partners on technical and policy aspects
- Effective representation at, interaction with, and positive influence on intergovernmental processes (e.g., FAO-MYPOW, Convention on Biological Diversity).
- Enhanced visibility of the CGIAR, delivering a bigger public awareness message of wider relevance (e.g., across ministries).

Two contrasting models have been considered for including work on genetic resources within the new CGIAR programmatic structure: (1) to continue as a network (á la SGRP) with a broadened agenda, or (2) to develop into a structured GRFA programme. An analysis of risks does not reveal any strikingly negative differences between the network and programme approaches. Whichever model is ultimately chosen for the Results and Strategies Framework in the CGIAR, certain modalities of working together in genetic resources will need to be implemented. Coordinated efforts will cover both system-wide collective activities (policy, technical issues, broad ecosystem work, awareness raising), and sectorial activities (work on crops-in-common or on trees, sector-focused ecosystem studies), and these will be encouraged through:

- Joint planning and implementation in areas of common interest
- Coordinated representation at international fora (CBD, International Treaty, FAO Commission on GRFA, sectorial meetings)
- Use of information and communications technologies for inter-meeting interactions
- Joint proposal development and coordinated interactions with the Consortium and donors
- Inter-disciplinary inputs to problem solving
- Selection of partners for a coordinated approach

A key feature of the integrated approach will be cross-cutting science that all sectors need and will benefit from, but do not all necessarily need to carry out directly. Examples include: best practices for DNA banking; basic ecological research on diversity and ecosystem resilience; genetic stability under different conservation regimes (e.g., cryopreservation, seed storage, *in situ,* etc.). Collective priority-setting, planning and resource allocation for such activities will help ensure that the right research is carried out, and carried out well. Effective communications within and across sectors will ensure that the needs of the collective are well-articulated and the outputs of the research reach potential users in a timely way.

It does not pass unnoticed that there may arise the need – indeed, the opportunity – for some players to relinquish responsibilities and to share recognition within a rational, collective approach. Streamlining operations through collaboration will result in efficiencies of scale to release resources that can then be put to better use within the overall schema.

In working together, we shall continue to place high value on the human diversity that is part of the intellectual dynamism of the genetic resources community. We fully recognize the advantages of our rich diversity of thought, philosophy, culture, gender, and nationality. Pursuing dogma will not nourish creativity, and the different ways of thinking in different sectors will stimulate innovation. We must support and encourage diverse and complementary approaches. By the same token, we must appreciate and promote diversity among our partners – large and small, developed and developing, public and private – recognizing the part that each plays in achieving the CGIAR's development objectives.

7. MAPPING THE FUTURE

Genetic resources activities in the CGIAR already constitute an important component of the global efforts in the conservation and sustainable use of genetic resources for food and agriculture. The CGIAR is therefore only a partner in a larger system of FAO, NARS, NGOs, private sector and development agencies. This global system is governed by the policy framework of the inter-governmental bodies of the FAO Commission on Genetic Resources and the Convention on Biological Diversity. The crop component is further governed by the International Treaty on Plant Genetic Resources for Food and Agriculture. Both the crop and livestock sectors have their respective Global Plans of Action that were developed through consultative processes of national and international partners, and have been adopted by the international community to implement their global responsibility in conservation, sustainable use and development of plant and animal genetic resources. By virtue of their central role in these activities and processes, the CGIAR Centres have important, well-defined long-term obligations and responsibilities to fulfil in the context of the global system.

Commonalities across sectors have led the Inter-Centre Working Group on Genetic Resources to propose an integrated holistic approach to management and use of these genetic resources within the CGIAR, while recognizing that the biological and policy requirements of different sectors will also require individual approaches and research. This integrated approach is harmonious with the FAO Commission on Genetic Resources' Multi-Year Programme of Work and its draft Strategic Plan 2010-2017. Additionally, the CGIAR crop-based Centres have to meet their commitments under their agreements with the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture through management of the *ex situ* crop collections that they hold in-trust for the global community. The Global Crop Diversity Trust is committed to providing long-term funding for this work.

The pathways to the projected outcomes of this integrated approach, including common themes, outputs and outcomes are described and mapped in Section 3. Detailed outcome maps and plans of work will be developed for each sector. An

example of future planning in the crop genetic resources sector is the draft sustainability plan currently under development for the crop and forage genebanks, from which the Executive Summary is attached here as Annex 1.

ANNEX 1. DRAFT SUSTAINABILITY PLAN FOR THE CGIAR CROP GENEBANKS

Mapping Our Future: Sustaining the CGIAR Genebanks for Greater Impact

(SGRP/GPG2 Sub-activity 6.1.1 - Draft Sustainability Plan)

Executive Summary

Efforts to put the CGIAR genebank system on a more sound organisational and financial footing date back to 1994[25] when inter-Centre collaboration on genetic resources was in its early stages and the System-wide Genetic Resources Programme (SGRP) was only recently established. Today, the System has matured into a coordinated deliverer of international public goods, based on a network of well-maintained, well-documented in-trust collections[26]. The system-wide network of crop collections is now completing its 2nd multi-million dollar, 3-year improvement and upgrading project (GPG2). In the near future, the CGIAR genebanks will assume even greater international responsibilities, partnering with others in lead and supporting roles, to better serve more users. The Global Crop Diversity Trust has committed to providing long-term funding for this work, but is still in the process of building its endowment.

The SGRP members have developed this Sustainability Plan as part of the ongoing World Bank-funded Global Public Goods 2 Project, which is supporting improvements in genebank operations, methods, and standards through collective action. The World Bank, which funded GPG Project Phases 1 & 2, stipulated the development of a long-term sustainability plan to help ensure adequate funding for the genebanks to help ensure that the GPG investment will bear lasting fruit. However, the scope of this Plan is greater than that. It initiates an iterative SGRP strategic planning process, for which it acts as a baseline for plant genetic resources within the context on an integrated approach to genetic resources (microbial, aquatic, livestock, trees and crops/plants) in support of the CGIAR's mission. The SGRP ICWG-GR is committed to moving ahead with the Plan, which will involve review and eventual endorsement from senior CGIAR management. That is why the Plan is addressed to Centre management and other decision-makers in the CGIAR Change Process, the World Bank and other donors, as well as to SGRP's key external partners (Global Crop Diversity Trust, ITPGRFA Secretariat, FAO, NARS), without whom this Plan could not be fully realised.

This updated version of "*Mapping our Future*"[27] builds upon the GPG2 Mid-term External Review Panel's recommendations and describes where the CGIAR System's genebanks aim to be by 2020. This future vision foresees the genebanks as major players in a rational global system of germplasm conservation and use, serving many more users in a more partnership-oriented *modus operandi* shaped by crop-specific and regional networks, covering greater numbers of in-trust crops and underutilised crops and crop wild relatives, and employing more innovative methods and technologies for increasingly effective conservation, identification and mobilization of genetic material in response to users' needs.

The Plan also describes a roadmap of how we intend to arrive at that envisioned future in 2020, based on where the genebanks stand today. One facet of the roadmap is a concrete proposal for changes to existing system-wide governance and funding mechanisms, referencing the ongoing CGIAR Change Process. This includes a rigorously applied standardized model for calculating the actual and projected cost of basic (critical) genebank operations that is a necessary component for determining the increase in stable funding that will be required to ensure the long-term safety and availability of the in-trust collections and the fulfilment of the CGIAR's international obligations with respect to those collections. Further strategic planning to incorporate the PGR-focused Sustainability Plan into the CGIAR's new integrated approach to genetic resources, and to begin costing the expansion of genebanks' "core" operations to include more user-oriented activities, is described at the end of this Plan.

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[25] TAC-commissioned Stripe Study, with external panel led by Henry Shands, who also chaired the GPG2 Mid-term External Review Panel in 2008.

[26] In-trust as defined by Annex 1 of the International Treaty (ITPGRFA), which entered into force 2004.

[27] The first version was presented at the June'08 ADE meeting, as well as to the World Bank via the CGIAR Secretariat and the chair of the CGIAR Independent Review Panel.