May 2011

منظمة الأغذية والزراعة للأمم المتحدة | 联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Agricultura y la Alimentación

Item 3.3 of the Provisional Agenda

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Thirteenth Regular Session

Rome, 18 – 22 July 2011

REPORT OF THE FIFTH SESSION OF THE INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON PLANT GENETIC RESOURCES FOR FOOD AND ARGICULTURE

Rome, 27-29 April 2011

For resaons of economy, this document is produced in a limited number of copies. Delegates and observers are kindly requested to bring their copies to meetings and to refrain from asking for additional copies, unless strictly necessary. The documents for this meeting are available on Internet at: http://www.fao.org

CGRFA/WG-PGR-5/11/REPORT

Commission on
Genetic Resources
for Food and Agriculture

Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture

Rome, Italy
27-29 April 2011

Fifth Session

Food and Agriculture Organization of the United Nations

CGRFA/WG-PGR-5/11/REPORT

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REPORT OF THE FIFTH SESSION

OF THE

INTERGOVERNMENTAL TECHNICAL

WORKING GROUP ON

PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Rome, Italy, 27-29 April 2011

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2011

The documents prepared for the Fifth Session of the Working Group on Plant Genetic Resources for Food and Agriculture of the Commission on Genetic Resources for Food and Agriculture are available on the Internet at the following address:

http://www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/itwg/5th/en/

They may also be obtained from:

Ms Kakoli Ghosh
Team Leader
Plant Genetic Resources and Seeds
Plant Production and Protection Division
Agriculture Department
Food and Agriculture Organization of the United Nations
00153 Rome, Italy

E-mail: kakoli.ghosh@fao.org

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

TABLE OF CONTENTS

COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

REPORT OF THE FIFTH SESSION OF THE INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Rome, Italy 27-29 April 2011

I. INTRODUCTION

1. The Fifth Session of the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture (Working Group) was held in Rome, Italy, from 27 to 29 April 2011. The list of delegates and observers is attached as *Appendix D*.

II. OPENING OF THE SESSION AND ELECTION OF THE CHAIR AND VICE-CHAIRS

2. Mr Ali Abdulla Al-Shurai (Yemen), Vice-Chair of the Working Group, opened the session and welcomed the delegates and observers. He noted that the Working Group continues to provide valuable advice to the Commission on Genetic Resources for Food and Agriculture (Commission) on issues related to the conservation and sustainable use of plant genetic resources for food and agriculture (PGRFA) and global food security.

3. The Working Group then elected Mr Brad Fraleigh (Canada) as Chair, and as Vice-Chairs, Mr Ali Abdulla Al-Shurai (Yemen) and Ms Isabelle Clément-Nissou (France). Ms Hanaiya Abbas Ahmed El-Atriby (Egypt) was elected *Rapporteur*.

4. In taking the Chair, Mr Fraleigh welcomed the delegates and observers, and thanked the former Chair of the Working Group, Ms Ana Berretta (Uruguay), and Mr Al-Shurai for his guidance and strong support to the Working Group and the Secretariat for the preparation of the current session. He noted the important task before the Working Group and invited all members to provide focused and concise inputs for the success of the meeting.

5. Mr Modibo Traoré, Assistant Director-General, Agriculture and Consumer Protection Department of the Food and Agriculture Organization of the United Nations (FAO), welcomed the delegates and observers. He stressed the importance of an integrated approach to the management of the world's plant genetic resources to address global challenges and he emphasized the need for securing a broad diversity of crop plants and increasing capacities for plant breeding and seed delivery worldwide.

6. Mr Traoré noted that the updated *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture* (*Global Plan of Action*) is a cornerstone of FAO's programme of work on genetic resources, a supporting component of the International Treaty on Plant Genetic Resources for Food and Agriculture (International Treaty), and an important pillar of the Multi-Year Programme of Work of the Commission. He thanked member countries for their generous contributions to the preparatory process of updating the *Global Plan of Action* and emphasized that additional resources and long-

term commitment will be required for its implementation at national, regional and international levels.

7. Ms Linda Collette, Secretary of the Commission, welcomed the participants and emphasized the important role of the Working Group in implementing the Commission's Multi-Year Programme of Work. She noted that *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture (Second Report)*, guided by the Working Group, was one of the Commission's major outputs. It was launched by the Director-General of FAO in October 2010 during the International Year of Biodiversity. She noted that this report will contribute, together with other global assessments of various sectors, to *The State of the World's Biodiversity for Food and Agriculture*.

8. Ms Collette emphasized that updating the *Global Plan of Action* was a natural follow-up to the global assessment of PGRFA and thanked all member countries for enabling and contributing to this process. She noted that despite the busy agenda, she was confident that the Working Group would provide sound advice and recommendations to the Commission, in particular with regard to the updated *Global Plan of Action*.

9. The Working Group adopted the Agenda, as given in *Appendix A*.

III. REVIEW OF THE DRAFT UPDATED *GLOBAL PLAN OF ACTION FOR THE CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE*

10. The Working Group considered the document, *Draft updated Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*[1], and took note of the information provided in the documents, *Summary report of the regional consultations for updating the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture*[2], and, *Comments on the draft updated Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture*[3].

11. The Working Group welcomed the draft updated *Global Plan of Action* that clearly reflects the gaps and needs identified in the *Second Report*, and considered that the finalized updated *Global Plan of Action* would be a major achievement. The Working Group also thanked governments that provided extra-budgetary resources and the Secretariat for facilitating the regional consultations, the inputs of which were well reflected in the draft updated *Global Plan of Action.*

12. The Working Group emphasized the importance of ensuring that adaptation of agriculture to climate change is adequately covered in the updated *Global Plan of Action*. Other issues raised by members of the Working Group included the importance of *in situ* conservation; genetic improvement by plant breeders and farmers; the need for increased trust among all parties involved in the conservation and sustainable use of PGRFA; and the need for enhanced communication and cooperation among the ministries and institutions concerned.

13. The Working Group agreed that effective indicators are very important for monitoring the implementation of the updated *Global Plan of Action*. It noted that indicators had been adopted by the Commission regarding the implementation of the first *Global Plan of Action*. There is also a need for higher-order indicators for the updated *Global Plan of Action*. It also noted that in the

[1] CGRFA/WG-PGR-5/11/2 Rev.1

[2] CGRFA/WG-PGR-5/11/Inf.1

[3] CGRFA/WG-PGR-5/11/Inf.2 Rev.1

development and adoption of such indicators, cooperation should continue with the International Treaty and the Convention on Biological Diversity.

14. The Working Group stressed the importance of ensuring that adequate funds are made available for the implementation of the updated *Global Plan of Action*, and in particular for developing human resources and infrastructure in developing countries. Some members indicated that the resources currently available through the Benefit-Sharing Fund of the International Treaty and the Global Crop Diversity Trust, while important, are not sufficient to fund all Priority Activities identified in the updated *Global Plan of Action*. Other members pointed out that the Funding Strategy of the International Treaty covers more than the Benefit-Sharing Fund and the Global Crop Diversity Trust, and includes reference to additional funding sources and possibilities both nationally and internationally. The Working Group recommended that the Commission call upon Governments and donors to make available financial resources for the implementation and monitoring of the updated *Global Plan of Action*.

15. The Working Group recommended that the Commission request FAO to prepare a synthetic account of the updated *Global Plan of Action*, as a supportive document to plant genetic resources stakeholders, highlighting its key components.

16. The Working Group went through the executive summary, the introduction and Priority Activity Areas 1 to 8 (para. 1 - 150) of the draft updated *Global Plan of Action* in detail and, while keeping the original text, incorporated recommended changes shown in curly brackets in *Appendix E* of this document. In cases where there was no consensus, the Working Group agreed to identify that text with square brackets. Text shown in square brackets and underlined was proposed by a Member of the Working Group but not agreed. Recommended deletions are shown as deleted with a line through them.

17. The Working Group recommended that the Commission consider the draft updated *Global Plan of Action,* as reviewed by the Working Group, as well as the remaining parts of the document, including individual suggestions by Working Group members (shown in square brackets after para. 150), as an early agenda item during its Thirteenth Regular Session, in order to ensure adequate time to reach agreement. The Working Group recommended that the review of the draft updated *Global Plan of Action* be completed at the Thirteenth Regular Session of the Commission so that the updated *Global Plan of Action* be finalized at that Session. The Working Group noted that the Council, if mandated accordingly by the FAO Conference, would be able to adopt at its session in November 2011, the updated *Global Plan of Action* as agreed by the Commission.

IV. REVIEW OF THE DRAFT UPDATED *GENEBANK STANDARDS*

18. The Working Group considered the document, *Preparation of the draft revised Genebank Standards*[4] and the information document, *Draft Revised Genebank Standards for the Conservation of Orthodox Seeds*[5].

19. The Working Group thanked FAO for preparing the draft revised *Genebank Standards*, and considered it a high quality draft document reflecting current scientific knowledge and developments in the international context for *ex situ* conservation of orthodox seeds. It agreed that a finalized document would be a useful instrument for facilitating the conservation and sustainable use of PGRFA.

[4] CGRFA/WG-PGR-5/11/3

[5] CGRFA/WG-PGR-5/11/Inf.3

20. The Working Group expressed its appreciation for the preparatory process that was undertaken to revise the *Genebank Standards*. This was conducted, as requested, in cooperation with the International Treaty, Bioversity International, other CGIAR centres, the Global Crop Diversity Trust and other international institutions, as well as in consultation with National Focal Points for plant genetic resources.

21. In considering the draft revised *Genebank Standards,* the Working Group noted the need for adequate financial support, especially for developing countries to be able to apply the standards; concern that the standards should not be used to exclude non-complying parties from funding; the importance of safety duplication; and the need to further enhance the readability of the document.

22. Due to time constraints, the Working Group did not review the draft revised *Genebank Standards* in detail. Some members of the Working Group provided written comments, including deletion of original text with proposed new text. The suggested deletions are shown in square brackets and the proposed additions are shown in square brackets and underlined in *Appendix F* of this document. The Working Group recommended that the Commission consider next steps to be taken with a view to finalize the revised *Genebank Standards*. The Working Group recommended that the Commission urgently request FAO to develop genebank standards for germplasm not covered by the revised *Genebank Standards*, in cooperation with the International Treaty, the CGIAR and other relevant international institutions. Finally, the Working Group recommended that the Commission urge members to provide the necessary budgetary resources to help countries implement the revised *Genebank Standards* and to participate in the process of developing standards for germplasm that is not covered in the revised *Genebank Standards*.

V. BIOTECHNOLOGIES AND THE CONSERVATION AND UTILIZATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

23. The Working Group considered the document, *Status and trends of biotechnologies applied to the conservation and utilization of genetic resources for food and agriculture and matters relevant for their future development*.[6]

24. In reviewing the document, the Working Group expressed its appreciation to the Secretariat, emphasized the importance and relevance of biotechnologies for the conservation and utilization of PGRFA and stressed that all countries should be on an equal footing regarding their possibilities to employ them. It also highlighted the importance of FAO's role in this area, noting that it should ensure complementarity and avoid duplication with other international organizations. The Working Group indicated that the document should be updated to account for developments that had taken place since the current version was written; should better explain the connection to the Commission's Multi-Year Programme of Work and the Commission's planned future activities in the area of biotechnologies; and should highlight the potential future outlook of molecular markers, particularly regarding their use for identifying priority genetic resources for conservation and for more effectively managing *ex situ* collections. Moreover, new biotechnological advancements should be reported on.

25. With regard to the future activities in relation to biotechnologies and genetic resources for food and agriculture (GRFA), the Working Group suggested that they be condensed and made more explicit in the recommendations to the Commission. While differing opinions were expressed about retaining and/or modifying some of the proposed activities, the Working Group recommended that the Commission:

i) Emphasize the need for the development of sector-specific standards and technical protocols for the molecular characterization of GRFA in order to generate reproducible and comparable data;

[6] CGRFA/WG-PGR-5/11/4

ii) Request FAO to increase its efforts to strengthen the national capacities of developing countries for priority-setting, policy formulation and the use of biotechnologies for the characterization, conservation and utilization of GRFA;
iii) Request FAO to strengthen activities for the regular dissemination of updated factual information on the role of biotechnologies for the characterization, conservation and utilization of GRFA through existing databases, networks and newsletters (e.g. DAD-IS, FAO-BiotechNews, WIEWS and ISAAA), emphasizing also communication of biotechnology developments to the public; and
iv) Request FAO to explore mechanisms for future cooperation with relevant international organizations, including for fostering North-South and South-South cooperation, for harnessing the benefits of biotechnologies for the characterization, conservation and utilization of GRFA.

VI. REVIEW OF THE COMMISSION'S MULTI-YEAR PROGRAMME OF WORK – PLANT GENETIC RESOURCES

26. The Working Group considered the document, *Review of the Commission's Multi-Year Programme of Work – Plant genetic resources*.[7] The Working Group acknowledged the key role of the Multi-Year Programme of Work as a strategic work plan in the medium and long term and recognized the instrumental value of the *Strategic Plan 2010-2017 for the implementation of the Multi-Year Programme of Work.*

27. The Working Group recommended that the Commission request its Secretariat to prepare for its consideration and adoption at its Fourteenth Regular Session, a set of indicators, including higher-order indicators, to enable stakeholders at all levels, including national governments and regional and international organizations, to effectively monitor the implementation of the updated *Global Plan of Action*. The Working Group also recommended that the Commission consider adding a new milestone to its Multi-Year Programme of Work to review the implementation of the updated *Global Plan of Action*. Some members proposed the review should take place at the Fourteenth Regular Session of the Commission, some others at the Fifteenth Regular Session. These proposals were based on the assumption that the updated *Global Plan of Action* would be agreed by the Commission at its Thirteenth Regular Session.

28. The Working Group agreed on the need to periodically revise and extend the Multi-Year Programme of Work to keep the Programme rolling and it recommended that the Commission extend the Multi-Year Programme of Work to its Eighteenth Regular Session.

29. The Working Group recognized that the preparation of State of the World reports required a significant investment of time as well as human and financial resources. It therefore agreed that the presentation of *The Third Report on the State of the World's Plant Genetic Resources for Food and Agriculture* (Third Report), currently foreseen for the Commission's Sixteenth Regular Session, may not be realistically achievable. The Working Group recommended that the Commission request FAO to propose, for consideration at its Fourteenth Regular Session, a possible preparation process for the Third Report, including a realistic timeline and budget, to enable the Commission to make an informed decision on whether the Third Report could still be presented at its Sixteenth Regular Session. Subsequently, the Commission could decide on when to plan the updating of the rolling *Global Plan of Action*.

30. Some Working Group members expressed their concern as to a possible postponement of the presentation of the Third Report, noting that *The State of the World's Biodiversity for Food and Agriculture*, foreseen to be presented at the Commission's Sixteenth Regular Session, should include up-to-date information on the status and trends of PGRFA.

31. The Working Group stressed the need for close collaboration between the Commission and the Governing Body of the International Treaty and recommended that the Multi-Year

[7] CGRFA/WG-PGR-5/11/5

Programme of Work be adjusted, as necessary, to take into account any future changes in the division of tasks and activities between the two bodies.

VII. POLICY COHERENCE AND COMPLEMENTARITY OF THE WORK OF THE COMMISSION AND THE GOVERNING BODY OF THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

32. The Working Group considered the document, *Policy Coherence and Complementarity of the Work of the Commission and the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture*[8]. The Working Group recommended that the Commission, its Bureau and its Secretariat continue to enhance cooperation with the Governing Body, its Bureau and its Secretariat. Different preferences were expressed with regard to the options for the functional division of tasks and activities between the Governing Body and the Commission. However, the option to transfer all activities related to PGRFA from the Commission to the Governing Body was not supported. Some countries proposed that activities be progressively transferred to the International Treaty such as the Facilitating Mechanism, the National Information Sharing Mechanism, the continued updating of the *Global Plan of Action* and the World Information and Early Warning System (WIEWS).

33. The Working Group recommended that the Commission join the Governing Body in requesting the Secretaries of the Commission and the Governing Body to prepare a paper on the legal, administrative and financial implications of transferring activities or tasks related to PGRFA from the Commission to the Governing Body of the International Treaty. It further recommended that the Commission Bureau accept the invitation by the Governing Body to continue exploring, in consultation with the Bureau of the Governing Body, options for close cooperation between the Commission and the Governing Body that may gradually lead to an agreed functional division of tasks and activities between the Commission and the Governing Body within the terms of the International Treaty, taking into account the legal, administrative and financial implications.

VIII. FOLLOW-UP TO OTHER RECOMMENDATIONS OF THE COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

34. The Working Group considered the document, *Follow-up to other recommendations of the Commission on Genetic Resources for Food and Agriculture*[9], and noted the information provided in the documents, *Strengthening plant breeding capacities*[10], *Strengthening Seed systems: Gap analysis of seed sector*[11], and *Options to promote food security: on-farm and in situ management of plant genetic resources for food and agriculture*[12].

35. The Working Group welcomed the development of the Facilitating Mechanism and emphasized both its valuable role in the implementation of the *Global Plan of Action* and the need for cooperation between the Commission and the International Treaty in this area. The Working Group recommended that the Commission call for extra-budgetary resources to advance the operation of the Facilitating Mechanism after considering its further development.

36. The Working Group stressed the importance of the National Information Sharing Mechanisms (NISMs) for informing decision-making on plant genetic resources at the national level and for the preparation of national, regional and global assessments of PGRFA. In

---

[8] CGRFA/WG-PGR-5/11/6

[9] CGRFA/WG-PGR-5/11/7

[10] CGRFA/WG-PGR-5/11/Inf.4

[11] CGRFA/WG-PGR-5/11/Inf.5

[12] CGRFA/WG-PGR-5/11/Inf.6

acknowledging the continued updating and improvement of the tools used by countries for applying the new monitoring approach, the Working Group recommended that the Commission provide further guidance on advancing the NISMs, taking into account the need for close cooperation between the Commission and the Governing Body of the International Treaty in the implementation and monitoring of the updated *Global Plan of Action*. Some members recommended that the Commission call for sustainable funding, through regular programme and extra-budgetary resources, to continue applying the new monitoring approach and to strengthen established NISMs. The Working Group stressed the need to further elaborate a vision for the development of the Global Information System in the context of Article 17 of the International Treaty, taking into account existing information systems such as WIEWS, NISMs, GENESYS and GRIN-Global.

37. The Working Group noted with satisfaction the achievements of the FAO-led Global Partnership Initiative on Plant Breeding Capacity Building (GIPB). The Working Group emphasized the importance of plant breeding to address climate change and stressed the need for capacity development and long term national strategies for strengthening linkages among the conservation of plant germplasm, crop improvement, and the dissemination of quality seeds and planting materials. The need for effective partnerships at national, regional and international levels was emphasized, including through public-private collaboration. A sustained commitment of resources would be required to maximize country participation in plant breeding capacity building initiatives and to ensure the availability of skilled personnel and adequate infrastructure. The Working Group recommended that the Commission reaffirm the importance of further work in the area of plant breeding and support the proposed conference of experts as a follow up to the World Seed Conference held in 2009. The Working Group recommended that the Commission urge FAO to strengthen synergies among relevant stakeholders in support of the implementation of the updated *Global Plan of Action* and Article 6 of the International Treaty. It further recommended that the Commission request FAO to continue to strengthen seed sector development at the national and regional levels and reaffirm the need for further collaboration in plant breeding capacity and seed systems development. The Working Group further recommended that the Commission request FAO to review the information document, *Strengthening Seed systems: Gap analysis of seed sector*, based on comments and suggestions the Working Group provided.

38. The Working Group emphasized the importance of and need for on-farm management of PGRFA and *in situ* conservation of crop wild relatives, especially in light of global challenges such as climate change. The Working Group welcomed the proposal for the development of a toolkit to guide national *in situ* conservation efforts. The Working Group also expressed support for the call by the Commission for the establishment of a global network for *in situ* conservation of crop diversity and recommended that the Commission consider establishing means to further consider the global network for *in situ* conservation and other important aspects of *in situ* conservation and on-farm management. The Working Group emphasized the need for coordination between the International Treaty and the Commission and collaboration between relevant stakeholders at national, regional and international levels to promote on-farm management and *in situ* conservation of plant diversity.

IX. REPORTS FROM INTERNATIONAL ORGANIZATIONS AND INSTRUMENTS

39. The Working Group considered the document, *Reports from International Organizations* and Instruments[13], and took note of the information provided in the documents, *Report from the Global Crop Diversity Trust to the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture*[14] and *Report from International Centers of Agricultural Research of the CGIAR to the Intergovernmental Technical Working Group on Plant Genetic*

[13] CGRFA/WG-PGR-5/11/8

[14] CGRFA/WG-PGR-5/11/Inf.7

Resources for Food and Agriculture[15]. The Working Group thanked the Global Crop Diversity Trust, the CGIAR Centres and the International Treaty for the information provided and stressed the need for collaboration between the Commission and international organizations and instruments.

40. The Working Group recommended that the Commission invite the CGIAR Centres to inform the Commission of the outcomes of the CGIAR Consortium Board-Commissioned Genetic Resources Scoping Study. The Working Group recommended that the Commission welcome the important work done by other organizations and instruments in the area of PGRFA, in particular the adoption of the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization* by the tenth meeting of the Conference of the Parties to the Convention on Biological Diversity.

41. The Secretary of the International Treaty informed the Working Group of the main outcomes of the Fourth Session of the Governing Body of the International Treaty, held in Bali, Indonesia, from 14 to 18 March 2011. He highlighted a number of outcomes that were of direct relevance to the work of the Commission and its Working Group. He emphasized the need for continuing the strong and effective collaboration between the International Treaty and the Commission.

42. The Working Group recommended that the Commission continue receiving reports from international organizations and instruments, and non-governmental organizations and the private sector, on their activities in relation to plant genetic resources as a means to disseminate experiences and contribute to collaborative learning.

X. CLOSING STATEMENTS

43. The Working Group expressed its gratitude to the Chair for his guidance and leadership during the session. It also thanked the Vice-Chairs and *Rapporteur* for their dedicated efforts as well as the Secretariat and all the staff from FAO for preparing and serving during the session. The Chair thanked all the delegates and observers for their constructive spirit throughout the meeting and acknowledged the hard work of all the staff, including those working behind the scenes including the translators and interpreters.

[15] CGRFA/WG-PGR-5/11/Inf.8

APPENDIX A

INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Fifth Session

Rome, Italy, 27-29 April 2011

AGENDA

1. Election of the Chair, the Vice-Chair(s) and the *Rapporteur*
2. Adoption of the agenda and timetable
3. Review of the draft updated *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*
4. Review of the draft updated *Genebank Standards*
5. Biotechnologies and the conservation and utilization of plant genetic resources for food and agriculture
6. Review of the Commission's Multi-Year Programme of Work – Plant genetic resources
7. Policy coherence and complementarity of the work of the Commission and the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculure
8. Follow-up to other recommendations of the Commission on Genetic Resources for Food and Agriculture
9. Reports from international organizations and instruments
10. Other Business
11. Adoption of the Report of the Working Group

APPENDIX B

LIST OF DOCUMENTS

WORKING DOCUMENTS

CGRFA/WG-PGR-5/11/1	Provisional Agenda
CGRFA/WG-PGR-5/11/1/Add.1	Provisional Annotated Agenda and Timetable
CGRFA/WG-PGR-5/11/2/Rev.1	Draft updated *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*
CGRFA/WG-PGR-5/11/3	Preparation of the draft revised *Genebank Standards*
CGRFA/WG-PGR-5/11/4	Status and trends of biotechnologies applied to the conservation and utilization of plant genetic resources for food and agriculture and matters relevant for their future development
CGRFA/WG-PGR-5/11/5	Review of the Commission's Multi-Year Programme of Work – Plant Genetic Resources
CGRFA/WG-PGR-5/11/6	Policy coherence and complementarity of the work of the Commission and the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture
CGRFA/WG-PGR-5/11/7	Follow-up to other recommendations of the Commission on Genetic Resources for Food and Agriculture
CGRFA/WG-PGR-5/11/8	Reports from International Organizations and Instruments

For resaons of economy, this document is produced in a limited number of copies. Delegates and observers are kindly requested to bring their copies to meetings and to refrain from asking for additional copies, unless strictly necessary. The documents for this meeting are available on Internet at: http://www.fao.org

INFORMATION DOCUMENTS

CGRFA/WG-PGR-5/11/Inf.1	Summary report of the regional consultations for updating the *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*
CGRFA/WG-PGR-5/11/Inf.2/Rev.1	Comments on the draft updated *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*
CGRFA/WG-PGR-5/11/Inf.3	Draft revised *Genebank Standards for the Conservation of Orthodox Seeds*
CGRFA/WG-PGR-5/11/Inf.4	Strengthening plant breeding capacities
CGRFA/WG-PGR-5/11/Inf.5	Strengthening seed systems: gap analysis of the seed sector
CGRFA/WG-PGR-5/11/Inf.6	Options to promote food security: on-farm and *in situ* management of plant genetic resources for food and agriculture
CGRFA/WG-PGR-5/11/Inf.7	Report from the Global Crop Diversity Trust to the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture
CGRFA/WG-PGR-5/11/Inf.8	Report from the International Agricultural Research Centres of the Consultative Group on International Agricultural Research to the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture
CGRFA/WG-PGR-5/11/Inf.9	Statutes of the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture, and Members elected by the Twelfth Regular Session of the Commission
CGRFA/WG-PGR-5/11/Inf.10	List of Documents
CGRFA/WG-PGR-5/11/Inf.11	Biotechnologies for Agricultural Development

APPENDIX C

MEMBERS OF THE INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE ELECTED AT THE TWELFTH REGULAR SESSION OF THE COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Rome, Italy, 27 – 29 April 2011

Composition (no. of countries per region)	*Country*
Africa (5)	Algeria Burkina Faso Kenya Madagascar Republic of Congo
Asia (5)	Bangladesh Cambodia Japan Malaysia Viet Nam
Europe (5)	France Norway Poland Spain Sweden
Latin America and the Caribbean (5)	Brazil Cuba Ecuador Guatemala Venezuela
Near East (3)	Egypt Kuwait Yemen
North America (2)	Canada United States of America
Southwest Pacific (2)	Cook Islands Samoa

APPENDIX D

قائمة المندوبين والمراقبين
LIST OF DELEGATES AND OBSERVERS
LISTE DES DELEGUES ET OBSERVATEURS
LISTA DE DELEGADOS Y OBSERVADORES

الرئيس	
Chair	: Brad FRALEIGH
Président	: (Canada – Canadá)
Presidente	
نائب الرئيس	: Ali Abdulla AL-SHURAI
Vice-Chairs	: (Yemen – Yémen)
Vice-Présidents	: Ms Isabelle CLÉMENT-NISSOU
Vicepresidentes	: (France – Francia)
المقرر	: Ms Hanaiya Abbas Ahmed El-Atriby
Rapporteur	: (Egypt – Égypte – Egipto))

أعضاء جماعة العمل الفنية الحكومية الدولية المعنية بالموارد الوراثية النباتية للأغذية والزراعة

MEMBERS OF THE INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

MEMBRES DU GROUPE DE TRAVAIL TECHNIQUE INTERGOUVERNEMENTAL SUR LES RESSOURCES PHYTOGENETIQUES POUR L'ALIMENTATION ET L'AGRICULTURE

MIEMBROS DEL GRUPO DE TRABAJO TECNICO INTERGUBERNAMENTAL SOBRE RECURSOS FITOGENETICOS PARA LA ALIMENTACION Y LA AGRICULTURA

ALGERIA - ALGÉRIE – ARGELIA – الجزائ

M. Salah CHOUAKI
Point Focal Ressources Phytogénétiques
INRA-A
2, rue des Frères
Ouaddek BP200 Hacen
Bld. du Belfort
El Harrach
Alger
Phone: +213 0 21521281
Fax: +213 0 21521283
Email: chouaki_salah@yahoo.fr

M. Abdel Hamid HEMDANI
Sous-Directeur
Protection des Patrimoines Génétiques
Ministère de l'Agriculture et du Développement Rural
12, Boulevard Amirouche
Alger
Phone: +213 66 19 56 697
Email: hhemdani@yahoo.fr

BANGLADESH

Md. Khalequzzaman Akanda CHOWDHURY
Member Director (Crops)
Bangladesh Agricultural Research Council (BARC)
Dhaka
Phone: +880 2 8118275/9126663
Email: md-crops@barc.gov.bd

BRAZIL - BRÉSIL - BRASIL

Ms Patricia BUSTAMANTE
National Center for Research on Genetic Resources and
Biotechnology (CENARGEN)
Brazilian Agricultural Research Corporation (EMBRAPA)
Parque Estação Biológica (PqEB)
Avenida W5 Norte (final)
Plano Piloto
Brasilia, DF
Caixa Postal 02372; CEP 70770-917
Phone: +5561 3348 4608/4700
Fax: +5561 3340 3624
Email: pgoulart@cenargen.embrapa.br;
pgbustamante2011@gmail.com

Mr Olyntho VIEIRA
Deputy Permanent Representative of Brazil to FAO
Permanent Representation of the Federative
Republic of Brazil to FAO
Via di Santa Maria dell'Anima 32
00186 Rome
Phone: +3906 68 30 75 76/68 39 84 26/67 89 353
Fax: +3906 68398802
Email: olyntho.vieira@brafao.it

Mr Fabiano SOARES
Alternate Permanent Representative of Brazil to FAO
Permanent Representation of the Federative
Republic of Brazil to FAO
Via di Santa Maria dell'Anima 32
00186 Rome
Phone: +3906 68 30 75 76/68 39 84 26/67 89 353; cell: +39
348 349 9305
Fax: +3906 68 39 88 02
Email: rebrafao@brafao.it; fabi@brafao.it

BURKINA FASO

M. Didier BALMA
Directeur de la Recherche Scientifique
01 BP 476 Ouagadougou 01
CREAF/Kamboinsé
Ouagadougou
Phone: +226 70 24 73 60
Email: dbal@fasonet.bf; balma_didier@yahoo.fr

CAMBODIA - CAMBODGE - CAMBOYA

Mr Ty CHANNA
Deputy Director
Cambodian Agricultural Research and Development
Institute (CARDI)
PO Box 01
Phnom Penh
Phone: +855 23 21 96 93
Fax: +855 21 98 00
Email: Tchanna@cardi.org.kh

CANADA - CANADÁ

Mr Brad FRALEIGH
Director
Multilateral Science Relations
International Science Cooperation Bureau
Research Branch
Agriculture and Agri-Food Canada
1341 Baseline Road, Tower 5-5-133
Ottawa, Ontario K1A 0C5
Phone: +1 613 773 1838
Fax: +1 613 773 1833
Email: brad.fraleigh@agr.gc.ca

Mr Ken RICHARDS
Research Manager
Plant Gene Resources of Canada
Agriculture and Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, Saskatchewan S7N 0X2
Phone: +1 306 956 7641
Fax: +1 306 956 7246
Email: Ken.Richards@agr.gc.ca

CONGO

H.E. Mamadou KAMARA DEKAMO
Ambassadeur
Phone: +39 06 84 17 422
Fax: +39 06 84 17 422
Email: ambacorome@libero.it

M. Marc MANKOUSSOU
Conseiller
Phone: +39 06 84 17 422
Fax: +39 06 84 17 422
Email: ambacorome@libero.it

COOK ISLANDS - ÎLES COOK - ISLAS COOK

Mr William WIGMORE
Director of Research
Ministry of Agricultuure
PO Box 96
Rarotonga
Phone: +68 22 87 11/25 403
Email: research@oyster.net.ck

CUBA

Mr Modesto FERNÁNDEZ DIAZ-SILVIERA
Senior Officer for Environment
Department of Environment
Ministry of Science, Technology and Environment
Havana
Phone: +537 20 96 576
Email: modesto@citma.cu

ECUADOR - ÉQUATEUR

Sr.J Cesar Guillermo TAPIA BASTIDAS
Jefe
Departamento Nacional de Recursos Fitogenéticos
(DENAREF)
Instituto Nacional Autonomo de Investigaciones
Agropecuarias del Ecuador (INIAP)
Avs. Eloy Alfaro No. 30-350 y Amazonas
Edificio del MAG Piso 4
Quito
Phone: +593 23 00 60 89
Fax: +593 23 00 60 89
Email: denareg@yahoo.com; cesar.tapia@iniap.gob.ec

EGYPT - ÉGYPTE - EGIPTO

Ms Hanaiya Abbas Ahmed EL-ATRIBY
President
National Gene Bank
Agricultural Research Center
Ministry of Agriculture and Land Reclamation
9, El Gamaa Street
Giza, 12619
Cairo
Phone: (+202) 35 69 32 41/35 69 32 48
Fax: +202 569 32 40
Email: hitriby@ngb.gov.eg

FRANCE - FRANCIA

Mr François BURGAUD
Directeur des relations extérieures
Groupement National Interprofessionel des Semences et plants
44, rue du Louvre
75001 Paris
Phone: +33 1 42 33 76 94
Fax: +33 1 40 28 40 16
Email: francois.burgaud@gnis.fr

Ms Isabelle CLÉMENT-NISSOU
Chef du service des relations internationales
Groupement National Interprofessionnel des Semences et plants
44, rue du Louvre
75001 Paris
Phone: +33 1 42 33 85 04
Fax: +33 1 40 28 40 16
Email: isabelle.clement-nissou@gnis.fr

Mr Ygor GIBELIND
Chef de délégation
Service de la Stratégie Agroalimentaire et du Développement Durable
Bureau du foncier et de la biodiversité
Ministère de l'Agriculture, de l'Alimentation, de la Pêche, de la Ruralité et de l'Aménagement du territoire
3, rue Barbet-de Jouy,
Paris
Phone: +33 1 49 55 60/59
Fax: +33 1 49 55 59 87
Email: ygor.gibelind@agriculture.gouv.fr

GUATEMALA

Sr. Juan Carlos CAMPOLLO SARTI
Viceministro
Viceministro de Desarrollo Económico Rural
Ministerio de Agricultura, Ganadería y Alimentación
7a Av. 12-90 zona 13
Ciudad de Guatemala
Phone: +502 24 13 70 00

Mr Arnoldo Roberto COBAQUIL GARCIA
Director
Dirección Fitozoogenética y Recursos Nativos
Viceministerio de Sanidad Agropecuaria y Regulaciones
7a avenida 12-90, Zona 13
Ministerio de Agricultura Ganadería y Alimentación
Ciudad de Guatemala
Phone: (+502) 24 13 74 69/24 13 74 68
Email: rcobaquil@maga.gob.gt; coba.vincent@gmail.co

JAPAN - JAPON - JAPÓN

Mr Tomotaro NISHIKAWA
Chief Researcher
National Institute of Agrobiological Sciences
2-1-2 Kannondai, Tsukuba
Ibaraki 305-8602
Phone: +81 29 83 87 458
Fax: +81 29 83 87 408
Email: tomotaro@affrc.go.jp

Ms Fumiko YAGIHASHI
Technical Official
Research Promotion Division
Ministry of Agriculture, Forestry and Fisheries
Chiyodaku, Kasumiga Seki
Tokyo
Phone: +81 3 35 02 74 36
Fax: +81 3 35 93 22 09
Email: fumiko_yagihashi@nm.maff.go.jp

KENYA

Mr Patrick OCHIENG
Chief Agricultural Officer
Office of the Agriculture Secretary
Ministry of Agriculture
PO Box 30028-00100
Nairobi
Phone: +254 02 02 72 57 23
Email: agriculturesecretary@kilimo.go.ke;
okakapato@yahoo.com

KUWAIT - KOWEÏT

Ms Fadila A. AL-SALAMEEN
Associate Research Scientist
Biotechnology Department
PO Box 24885 Safat
13109 Kuwait
Phone: +965 24 98 91 57
Fax: +965 24 98 90 69
Email: fslamian@safat.kisr.edu.kw

MADAGASCAR

M. Alain RAMANANTSOANIRINA
Chercheur
SRR/FOFIFA
PO Box 230 Antsirabe 110
Madagascar
Phone: +261 3 20 46 27 32
Fax: +261 22 25 929
Email: ntsoanirina@mel.moov.mg

MALAYSIA - MALAISIE - MALASIA

Mr Azman Mohd SAAD
Agriculture Attaché and Alternate Permanent
Representative
Agriculture Attaché Office
Embassy of Malaysia
Via Nomentana, 297
00162 Rome
Phone: +39 06 84 15 808/84 19 296/84 11 339/84 15 764
Fax: +39 06 85 55 040/85 55 110
Email: agrimoa.rome@ambasciatamalaysia.it;
aa.rome@ambasciatamalaysia.it

Mr Azhar BIN MOHD ISA
Assistant Agriculture Attaché and Alternative Permanent
Representative
Embassy of Malaysia
Via Nomentana, 297
00162 Rome
Phone: +39 06 84 17 026
Fax: +39 06 85 55 040/85 55 110
Email: agrimoa.rome@ambasciatamalaysia.it;
aa.rome@ambasciatamalaysia.it

Ms Rosliza JAJULI
Research Officer
Persiaran MARDI-UPM
Malaysian Agricultural Research and Development
Institute Headquarters
43400 Serdang
Selangor
Malaysia
Phone: +603 81 43 73 49
Email: rosliza@mardi.gov.my

NORWAY - NORVÈGE - NORUEGA

Mr Åsmund ASDAL
Scientific Adviser
Norwegian Genetic Resource Centre
Norwegian Forest and Landscape Institute
PO Box 115
N-1431 Ås
Phone: +47 40 62 29 20
Fax: +47 64 94 80 01
Email: aasmund.asdal@bioforsk.no

Ms Elisabeth KOREN
Senior Adviser
Ministry of Agriculture and Food
Box 8007 Dep
N-0030 Oslo
Phone: +47 22 24 91 32
Fax: +47 22 24 27 53
Email: elisabeth.koren@lmd.dep.no

POLAND - POLOGNE - POLONIA

Ms Zofia BULINSKA-RADOMSKA
National Genetic Resources Coordinator
Plant Breeding and Acclimatization Institute
05-870 Blonie
Warsaw
Phone: +48 22 72 54 715
Fax: +48 22 72 54 714
Email: z.bulinska@ihar.edu.pl

Ms Dorota NOWOSIELSKA
Senior Specialist for Plant Genetic Resources
Ministry of Agriculture and Rural Development
30, Wspòlna Street
Warsaw 00 930
Phone: +48 22 62 32 612
Fax: +48 22 62 31 781
Email: dorota.nowosielska@minrol.gov.pl

Mr Wieslaw PODYMA
Deputy Director
Department of Plant Protection
Ministry of Agriculture and Rural Development
30, Wspòlna Street
Warsaw 00 930
Phone: +48 22 62 32 151
Fax: +48 22 62 31 781
Email: wieslaw.podyma@minrol.gov.pl

SPAIN - ESPAGNE - ESPAÑA

Sr. Juan FAJARDO VIZCAYNO
Centro Nacional de Recursos Fitogenéticos
INIA - Ministerio de Ciencia e Innovación
Autovia A-2 Km 36. Finca la Canaleja
Apdo. Correos 1045
Alcalá de Henares
28800 Madrid
Phone: +34 91 88 19 286 (ext.21)
Fax: +34 91 88 19 287
Email: fajardo.juan@inia.es

Sr. Elias GUÍA LÓPEZ
Representante Alterno de España ante la FAO y el PMA
Embajada de España
(Oficina de los Representantes Permanentes
Adjunto y Alterno)
Largo dei Lombardi, 21
00186 Roma
Phone: +39 06 68 78 762/68 69 539/68 19 20 17
Fax: +39 06 6873076
Email: eliasguia@tiscali.it

Sr. Santiago MENÉNDEZ DE LUARCA
Representante Permanente Adjunto de España ante la FAO
y el PMA
Embajada de España
(Oficina de los Representantes Permanentes
Adjunto y Alterno)
Largo dei Lombardi, 21
00186 Roma
Phone: +39 06 68 78 762/68 69 539/68 19 20 17
Fax: +39 06 68 73 076
Email: repfao@tiscali.it

Sr. Luis SALAICES SANCHEZ
Delegado
Jefe de Área de Registro de Variedades
Oficina Española de Variedades Vegetales
Ministerio de Medio Ambiente y Medio Rural y Marino
C/ Alfonso XII no. 62, 2a planta
28014 Madrid
Phone: +34 91 34 76 712
Fax: +34 91 34 76 703
Email: Luis.Salaices@marm.es

SWEDEN - SUÈDE - SUECIA

Ms Harriet FALCK REHN
Agr.lic. Senior Administrative Officer
Ministry for Rural Affairs
The Animal and Food Division
SE-103 33 Stockholm
Phone: +46 8 40 53 950; cell: +46 76 77 60 648
Email: harriet.falck-rehn@rural.ministry.se

Mr David STÅLBERG
Swedish Board of Agriculture
SE-551 82
Jönköping
Phone: +46 36 15 60 32
Email: david.stahlberg@jordbruksverket.se

Mr Jens WEIBULL
Associate Professor
Swedish Biodiversity Centre
PO Box 57
23053 Alnarp
Phone: +46 40 41 55 31; cell: +46 70 57 32 248
Email: jens.weibull@slu.se

TONGA

Mr Viliami KAMI
Principal Research Officer
Ministry of Agriculture, Food, Forests and Fisheries
PO Box 14
Nuku'alofa
Phone: +676 37 47 6
Email: maf-ento@kalianet.to

UNITED STATES OF AMERICA - ÉTATS-UNIS D'AMÉRIQUE - ESTADOS UNIDOS DE AMÉRICA

Mr Peter BRETTING
USDA/ARS, GWCC
Room 4-2212, Mailstop 5139
5601 Sunnyside Avenue
Beltsville, MD 20705-5139
Phone: +1 301 504 5541; cell: +1 301 346 7719
Fax: +1 301 504 6191
Email: peter.bretting@ars.usda.gov

Mr Peter TABOR
Director, Plant Division
Office of Agreements and Scientific Affairs
Foreign Agricultural Service
Department of Agriculture
Phone: +1 202 720 0765
Fax: +1 202 72 06 77
Email: peter.tabor@fas.usda.gov

VENEZUELA (BOLIVARIAN REPUBLIC OF) - VENEZUELA (RÉPUBLIQUE BOLIVARIENNE DU) - VENEZUELA (REPÚBLICA BOLIVARIANA DE)

Ms Margaret GUTIÉRREZ MULAS
Investigadora
Instituto Nacional de Investigaciones Agrícolas
Av. Universidad, Via El Limón. Frente a la Zona Educativa
CP 2103 Maracay
Phone: (+58 24 32 40) 4911/(Direct) 2975
Fax: +58 24 32 40 2644
Email: mgutierrez.margaret@gmail.com;
mgutierrez@inia.gob.ven

VIET NAM

Tuan Nghia LA
Director
Plant Resources Center
Hanoi
Phone: +84 4 33 65 65 43
Fax: +84 4 33 65 06 25
Email: latuannghia@agi.vaas.vn

YEMEN - YÉMEN

Mr Ali Abdulla AL-SHURAI
NFP-GRFA in Yemen
National Genetic Resources Centre
Sana'a PO Box 860
Phone: +967 1 22 22 959
Fax: +967 1 22 29 69
Email: shuraiaa@yahoo.com;
yemen_NFP_GRFA@ymail.com

OBSERVERS FROM MEMBER COUNTRIES OF THE COMMISSION OF GENETIC RESOURCES FOR FOOD AND AGRICULTURE
OBSERVATEURS DE PAYS MEMBRES DE LA COMMISSION DES RESSOURCES GENETIQUES POUR L'ALIMENTATION ET L'AGRICULTURE
OBSERVADORES DE PAISES MIEMBROS DE LA COMISION DE RECURSOS GENETICOS PARA LA ALIMENTACION Y LA AGRICULTURA

ANGOLA

M. Carlos Alberto AMARAL
Counsellor
Alternate Permanent Representative to
FAO, IFAD and WFP
Embassy of the Republic of Angola
Via Druso, 39
00184 Rome
Phone: (+3906)77 25 42 99/77 20 93 36
Fax: (+3906)77 20 93 36/77 59 00 09
Email: camaral@tiscali.it;
carlosamaral@tiscalinet.it

Mr Pedro Antonio MOÇAMBIQUE
Genebank Curator
Centro Nacional Recursos Fitogenéticos
Av. Revolução de Outubro
Luanda
Phone: +244 22 23 25 673
Email: pedmocamb@hotmail.com

ARGENTINA - ARGENTINE

Ms Andrea Martina CLAUSEN
Coordinator
Genetic Resources Projects
INTA
C.C. 2760 Balcarce

Mr Andrea S. REPETTI
Consejero
Representante Permanente Alterna ante la
FAO
Piazza dell'Esquilino, 2
00185 Rome
Phone: +39 06 48 07 33 00
Email: a.repetti@argfao.it;
repargentinafao@argfao.it

ARMENIA – ARMÉNIE

Mr Zohrab V. MALEK
Ambassador to FAO
Permanent Representative
Permanent Representation of the Republic
of Armenia to FAO
Via Camillo Sabatini 102
Mailing address: C.P. 64194
00100 Rome, Italy
Phone: +39 065201924
Fax: +39 065201924
Email: armambfao@virgilio.it

CYPRUS - CHYPRE - CHIPRE

Ms Christina PITTA
Alternate Permanent Representative
Permanent Representation of the Republic
of Cyprus to the UN Agencies in Rome
Piazza Farnese 44
00186 Rome
Phone: +39 06 68 65 75 8
Fax: +39 06 68 80 37 56
Email: faoprcyp@tin.it

CZECH REPUBLIC - RÉPUBLIQUE TCHÈQUE - REPÚBLICA CHECA

Mr Jírí MUCHKA
Permanent Representative of the Czech
Republic to FAO
Via dei Gracchi, 322
00192 Rome
Phone: (+3906) 360957/36095758-
9/3609571
Fax: +3906 32 44 466
Email: rome@embassy.mzv.cz

DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA - RÉPUBLIQUE POPULAIRE DÉMOCRATIQUE DE CORÉE - REPÚBLICA POPULAR DEMOCRÁTICA DE COREA

Mr Kim Hyk SIK
Deputy Permanent Represetnative of the
Democratic People's Republilc of Korea to
FAO
Embassy of the D.P.R. Korea
Viale dell'Esperanto, 26
00144 Rome
Phone: +3906 54 22 07 49
Fax: +3906 54 21 00 90
Email: ekodpr@alice.it

DEMOCRATIC REPUBLIC OF THE CONGO - RÉPUBLIQUE DÉMOCRATIQUE DU CONGO - REPÚBLICA DEMOCRÁTICA DEL CONGO

Mr Dely LIMBOMBE LISENDO
Chargé des Ressources Phytogénétiques
Direction de la Production et Protection des Végétaux
Ministère de l'Agriculture, Pêche et Elevage
Kinshasa
Phone: +243 81 72 52 161
Email: dhlobanga@yahoo.fr

EUROPEAN UNION (MEMBER ORGANIZATION) - UNION EUROPÉENNE (ORGANISATION MEMBRE) - UNIÓN EUROPEA (ORGANIZACIÓN MIEMBRO)

Ms Silvia RENDA
Intern of the European Union Delegation
Phone: +338 111 007
Email: silvia.renda@eeas.europa.eu

GERMANY - ALLEMAGNE - ALEMANIA

Mr Thomas MEIER
Deputy Head of Division
Federal Ministry for Food, Agriculture and Consumer Protection
Bonn Office, P.O. Box 14 02 70, 53107 Bonn
Phone: +49 (0) 228 99 529 4078
Email: Thomas.Meier@bmelv.bund.de

Ms Sarah SENSEN
Alternate
Federal Office for Agriculture and Food
Division 513 - Information and Coordination Centre for Biological Diversity
Deichmanns Aue 29
53179 Bonn
Phone: (+49) (0)2 28/68 45 35 43
Fax: +49 (0)2 28 / 68 45 -37 87
Email: sarah.sensen@ble.de

Mrs Swantje NILSSON
Deputy Permanent Representative
Permanent Representation of the Federal Republic of Germany to FAO
Via S. Martino della Battaglia, 4
00185 Rome
Phone: +39 06 49213280/492131
Fax: +39 06 49213281
Email: Swantje.Nilsson@diplo.de

GREECE - GRÈCE - GRECIA

Mrs Parthenopi RALLI
Agronomist, Responsible of the Greek Genebank
Agricultural Research Centre of Northern Greece
National Agricultural Research Foundation (NAGREF)
PO Box 60458
57001 Thermi
Phone: +30 23 10 47 11 10
Fax: +30 23 10 47 12 09
Email: kgeggb@otenet.gr

INDONESIA - INDONÉSIE

Mr M. Si HAMMIM
Agriculture Attaché
Embassy of the Republic of Indonesia
Via Campania, 55
00187 Rome
Phone: +39 06 42 00 91 50/42 00
Fax: +39 06 48 80 280/48 90 49 10 911
Email: indorom@indonesianembassy.it - indorom@uni.net

Mr Sutoro SUTORO
Researcher
ICABIOGRAD, AARD
Ministry of Agriculture
Jakarta
Phone: +62 251 833 79 75
Fax: +62 251 833 28 20
Email: storo8@gmail.com

IRAQ

Mr Raad ADWL
Expert
Ministry of Agriculture
Box 26028 Baghdad

ITALY - ITALIE - ITALIA

H.E. Pietro SEBASTIANI
Permanent Representative of Italy to FAO
Permanent Representation of the
Republic of Italy to FAO
Piazza Margana, 19
00186 Rome
Phone: +39 06 69 77 961
Fax: +39 06 67 96 352/69 77 9635
Email: rapp.ita.onu.rm@esteri.it

Mr Claudio MISCIA
Counsellor
Permanent Representation of the Republic
of Italy to FAO
Piazza Margana, 19
00186 Rome
Phone: +39 06 69 77 961
Fax: +39 06 67 96 352/69 77 96 35
Email: rapp.ita.onu.rm@esteri.it

Mr Stefano MARGUCCIO
First Secretary
Permanent Representation of the Republic
of Italy tol FAO
Piazza Margana, 19
00186 Rome
Phone: +39 06 69 77 961
Fax: +39 06 67 96 352/69 77 96 35
Email: rapp.ita.onu.rm@esteri.it

Mr Carlo FIDEGHELLI
Professor
Consiglio per la Ricerca e la
Sperimentazione in agricoltura
Centro di Ricerca per la frutticoltura
Via Fioranello 52
00134 Rome
Phone: +39 06 79 34 81 10
Fax: +39 06 79 34 01 58
Email: carlo.fideghelli@entecra.it

Mr Stefano CILLI
Direzione Generale della competitivitá per
lo sviluppo rurale
Ministry of Agriculture, Food
and Forestry Policy
Via XX Settembre, 20
00187 Rome
Phone: +39 06 46 65 164/48 24 702
Fax: +39 06 47 46 178/47 42 314
Email: s.cilli@politicheagricole.gov.it

Ms Lorenza COLLETTI
Corpo Forestale dello Stato
Via Giosuè Carducci, 5
00187 Rome
Italy
Phone: +39 06 46 651

MALTA - MALTE

Mr Karl GRIMA BEZZINA
Senior Agricultural Officer
Plant Biotechnology Centre
Ministry for Resources and Rural Affairs
Annibale Preca Street
Lija LJA 1915
Email: karl.grima-bezzina@gov.mt

MAURITANIA - MAURITANIE

M. Cheikh AHMED OULD SIDI ABDALLAH
Chef
Service des Productions Végétales
Direction de l'Agriculture
Phone: + 222 22 56 728/52 57 879
Email: cheikhahmedtlamid@yahoo.fr

NIGERIA - NIGÉRIA

Mr M.D. MAGAJI
Director
Plant Resources Department
Agricultural Research Council of Nigeria
Agricultural Research House,
Plot 223D, Cadastral Zone B6 Mabushi,
P.M.B. 5026
Wuse
Abuja
Phone: Mobile: +234 803 2875 745/708 7118 119
Email: mdmagaji2000@yahoo.co.uk

Mr Yarama Dakwa NDIRPAYA
Assistant Director
Plant Genetic Resources Division
Agricultural Research Council of Nigeria
Agricultural Reseaarch House
P.M.B. 5026
Wuse
Abuja
Phone: Mobile +234 803 5925 180
Email: yndirpaya@yahoo.com

PHILIPPINES - FILIPINAS

Mr Esteban PAGARAN
Alternate Permanent Representative
Embassy of the Republic of the Philippines
Viale delle Medaglie d'Oro, 112-114
00136 Rome
Phone: +39 06 39 74 66 21/39 74 66 22
Fax: +39 06 39 74 08 72
Email: enpagaran@yahoo.com

SAUDI ARABIA - ARABIE SAOUDITE - ARABIA SAUDITA

Mr Abdallah bin ALI AL BEIZ
Advisor
Ministry of Agriculture
Riyadh

Mr Ahmed bin KHALAF AL SHAMMARI
Engineer
Gene Bank
National Centre for Agricultural and Animal Research
Riyadh

SLOVAKIA - SLOVAQUIE - ESLOVAQUIA

Ms Denisa MEDVED'OVÁ
Permanent Representative of the Slovak Republic to FAO
Via dei Colli della Farnesina, 144
00194 Rome
Phone: +39 06 36 71 52 06
Fax: +39 06 36 71 52 66

SOUTH AFRICA - AFRIQUE DU SUD - SUDÁFRICA

Ms Natalie FELTMAN
Deputy Director
Plant Genetic Resources
Directorate: Genetic Resources
Department of Agriculture, Forestry and Fisheries
Private Bag X973
Pretoria 0001
Phone: +27 12 319 6366; cell: +27 82 65 32 713
Fax: +27 12 319 6385
Email: natalie@daff.gov.za

Ms Kwena KOMAPE
Agriculture Counsellor/Alternate
Permanent Representatiuve of South Africa
South African Embassy
Via Tanaro, 14
00198 Rome
Phone: +39 06 85 25 43 49; cell: +39 331 642 1744
Fax: +39 06 85 49 671
Email: agriculture@sudafrica.it

SURINAME

Mrs P. MILTON
Policy Advisor
Ministry of Agriculture, Animal Husbandry and Fisheries
Letitia Vriesdelaan 8-10
Paramaribo
Phone: +597 40 20 40/08 53 55 06
Fax: +597 47 59 19
Email: dirlvv@sr.net

SWITZERLAND - SUISSE - SUIZA

M. Christian EIGENMANN
Secteur Certification
Protection des Végétaux et des variétés
Office fédéral de l'agriculture
Mattenhofstrasse 5
CH-3003 Berne
Phone: +41 31 32 51 704
Fax: +41 31 32 22 634
Email: christian.eigenmann@blw.admin.ch

Mme. Madeleine KAUFMANN
Secteur Agriculture Durable Internationale
Office Fédéral de l'Agriculture
Mattenhofstrasse 5
CH-3003 Berne
Phone: +41 31 32 41 951
Fax: +41 31 32 22 634
Email:
madeleine.kaufmann@blw.admin.ch

**SYRIAN ARAB REPUBLIC -
RÉPUBLIQUE ARABE SYRIENNE -
REPÚBLICA ÁRABE SIRIA**

Mr Essam AL SHAHIN
Attaché
Embassy of the Syrian Arab Republic
Piazza dell' Ara Coeli, 1
00186 Rome
Phone: +39 06 6749801 (6 lines)
Fax: +39 06 6794989
Email: esaam78@yahoo.com

TURKEY - TURQUIE - TURQUÍA

Mr Fazu DÜSÜNCECI
Alternate Permanent Representative to
FAO
Embassy of the Republic of Turkey
Via Palestro, 28
00185 Rome
Phone: +39 06 44 59 41/44 59 42 49 (direct
Alternate)
Fax: +39 06 49 41 526
Email: turkemb.roma@mfa.gov.tr

**UNITED KINGDOM - ROYAUME-UNI -
REINO UNIDO**

Mr Julian JACKSON
ITPGRFA National Focal Point
Food and Farming Group
Plant Genetics Resource Policy
DEFRA - Department for Environment,
Food and Rural Affairs Science
5B Millbank
London SW1P 3JR
Phone: +44 (0) 20 72 38 68 13
Email: julian.jackson@defra.gsi.gov.uk

ZAMBIA - ZAMBIE

Mr Trevor SICHOMBO
First Secretary
Embassy of the Republic of Zambia
Via Ennio Quirino Visconti, 8
00193 Rome
Phone: (+3906)36 08 88 24/36 00 69 03
Fax: +3906 97 61 30 35
Email: zamrome@rdn.it -
info@zambianembassy.it

ZIMBABWE

Mr Kudzai KUSENA
Curator
Department of Research and Specialist Services
PO Box CY 550
Causeway
Harare
Phone: +263 4 704 531-9
Fax: +263 4 791 223
Email: ngbz@1wayafrica.co.zw

المراقبون من الدول الأعضاء فى هيئة الموارد الوراثية للأغذية والزراعة
OBSERVERS FROM INTERGOVERNMENTAL ORGANIZATIONS
OBSERVATEURS DES ORGANISATIONS INTERGOUVERNEMENTALES
OBSERVADORES DE LAS ORGANIZACIONES INTERGUBERNAMENTALES

GLOBAL CROP DIVERSITY TRUST
FOND FIDUCIAIRE MONDIAL POUR LA DIVERSITÉ VÉGÉTAL
FONDO MUNDIAL PARA LA DIVERSIDAD DE CULTIVOS

Mr Cary FOWLER
Executive Director
Global Crop Diversity Trust
c/o FAO
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 5705 3841
Email: Cary.Fowler@fao.org

Ms Jane TOLL
Project Manager
Global Crop Diversity Trust
c/o FAO
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 5705 6276

Mr Godfrey MWILA
Programme Scientist
Global Crop Diversity Trust
c/o FAO
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 5705 6280

Ms Charlotte LUSTY
Scientist
Global Crop Diversity Trust
c/o FAO
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 5705 4119

INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE
TRAITÉ INTERNATIONAL SUR LES RESSOURCES PHYTOGÉNÉTIQUES POUR L'ALIMENTATION ET L'AGRICULTURE
TRATADO INTERNACIONAL SOBRE LOS RECURSOS FITOGENÉTICOS PARA LA ALIMENTACIÓN Y LA AGRICULTURA

Mr Shakeel BHATTI
Secretary
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 34 41
Fax: +39 06 57 05 63 47
Email: Shakeel.Bhatti@fao.org

Mr Mario MARINO
Treaty Support Officer
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 50 84
Fax: +39 06 57 05 63 47
Email: Mario.Marino@fao.org

Mr Alvaro TOLEDO CHAVARRI
Technical Officer
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 44 97
Fax: +39 06 57 05 63 47
Email: Alvaro.Toledo@fao.org

Mr Daniele MANZELLA
Treaty Support Officer
International Treaty on Plant Genetic Resources for Food and Agriculture
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Phone: daniele.manzella@fao.org
Email: +39 06 57 05 61 30

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH
GROUPE CONSULTATIF POUR LA RECHERCHE AGRICOLE INTERNATIONALE
GRUPO CONSULTIVO SOBRE INVESTIGACIÓN AGRÍCOLA INTERNACIONAL

BIOVERSITY INTERNATIONAL

Mr Kwesi ATTAH-KRAH
Deputy Director-General
Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese
Rome, Italy
Phone: + 39 06 61 18 349
Fax: +39 06 66 11 84 05
Email: k.atta-krah@cgiar.org

Mr Ehsan DULLOO
Senior Scientist
Understanding and Managing Biodiversity Programme
Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese
Rome, Italy
Phone: +39 06 61 18 206
Fax: +39 06 611 97 96 61
Email: e.dulloo@cgiar.org

Mr Jan ENGELS
Genetic Resources Management Advisor
Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese
Rome, Italy
Phone: +39 06 61 18 222
Fax: +39 06 611 97 96 61
Email: j.engels@cgiar.org

Mr Michael HALEWOOD
Head Policy Research and Support Unit
Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese
Rome, Italy
Phone: +39 06 61 18 294
Fax: +39 06 61 97 96 61
Email: m.halewood@cgiar.org

Mr Toby HODGKIN
Principal Scientist
Global Partnerships Programme
Bioversity International
Via dei Tre Denari 472/a
00057 Maccarese
Rome, Italy
Phone: +39 06 6118212
Fax: +39 06 61979661
Email: t.hodgkin@cgiar.org

Mr Xiaoyong ZHANG
Research Fellow
Policy Research and Support Unit Organisation
Bioversity International
Via dei Tre Denari, 472/a
00057 Maccarese
Rome, Italy
Phone: +39 06 61 18 304
Fax: +39 06 61 97 96 61
Email: xiaoyong.zhang@cgiar.org

INTERNATIONAL UNION FOR THE PROTECTION OF NEW VARIETIES OF PLANTS
UNION INTERNATIONALE POUR LA PROTECTION DES OBTENTIONS VÉGÉTALES
UNIÓN INTERNACIONAL PARA LA PROTECCIÓN DE LAS OBTENCIONES VEGETALES

Mr Peter BUTTON
Vice Secretary-General
International Union for the Protection of New Varieties of Plants (UPOV)
34, chemin des Colombettes
CH-1211 Geneva 20
Switzerland
Phone: +41 22 338 86 72
Fax: +41 22 73 30 336
Email: peter.button@upov.int

منظمة الأغذية والزراعة للأمم المتحدة
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
ORGANIZACIÓN DE LAS NACIONES UNIDAS PARA LA ALIMENTACIÓN Y LA AGRICULTURA

Mr Shivaji PANDEY
Director
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 55 04
Fax: +39 06 57 05 3057.
Email: Shivaji.Pandey@fao.or

Ms Kakoli GHOSH
Team Leader
Seeds and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Phone: +39 06 57 05 45 33
Fax: +39 06 57 05 30 57
Email: Kakoli.Ghosh@fao.org

Mr Stefano DIULGHEROFF
Information Management Officer
Seeds and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 55 44
Fax: +39 06 57 05 30 57
Email: Stefano.Diulgheroff@fao.org

Mr Thomas Arthur OSBORN
Senior Agricultural Officer (Seed Policy)
Seeds and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 54 07
Fax: +39 06 557 05 30 57
Email: Thomas.Osborn@fao.org

Mr Chikelu MBA
Agricultural Officer (Plant Genetic Resources Use)
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 62 65
Fax: +39 06 57 05 30 57
Email: Chikelu.Mba@fao.org

Mr Philippe LE COËNT
Agricultural Officer (Seeds)
Seed and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 30 60
Fax: +39 06 57 05 30 57
Email: Philippe.LeCoent@fao.org

Mr Wilson HUGO
Agricultural Officer (Seeds)
Seeds and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 45 81
Fax: +39 06 57 05 30 57
Email: Wilson.Hugo@fao.org

Ms Barbara PICK
Consultant
Seed and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 30 91
Fax: +39 06 57 05 30 57
Email: Barbara.Pick@fao.org

Ms Denise Mackin
Consultant
Seed and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome, Italy
Phone: +39 06 57 05 32 30
Fax: +39 06 57 05 30 57
Email: Lucio.Olivero@fao.org

Ms Petra STABERG
Consultant
Seed and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Phone: +39 06 57 05 47 55
Fax: +39 06 57 05 30 57
Email: Petra.Staberg@fao.org

Mr Geoffrey HAWTIN
Consultant
Seed and Plant Genetic Resources
Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome
Email: geoffhawtin@hotmail.com

APPENDIX E

DRAFT UPDATED GLOBAL PLAN OF ACTION FOR THE CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Note: This appendix contains the draft updated Global Plan of Action, as reviewed by the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture, at its Fifth Session. The Working Group reviewed in detail the executive summary, the introduction and Priority Activity Areas 1 to 8 (para. 1-150) and, while keeping the original text, incorporated recommended changes shown in curly brackets in the text below. In cases where there was no consensus, the Working Group agreed to identify that text with square brackets. Text shown in square brackets *and* underlined was proposed by a Member of the Working Group but not agreed. Recommended deletions are shown as deleted with a line through them.

{text}: Recommended by the Working Group
[text]: Proposed deletion, but not agreed by the Working Group
[text]: Proposed addition, but not agreed by the Working Group
~~text~~: Deletion recommended by the Working Group

Executive Summary

1. Plant genetic resources for food and agriculture provide the biological basis for agricultural production and world food security. These resources serve as the most important raw material for farmers, their custodians, and for plant breeders. The genetic diversity in these resources allows crops and varieties to adapt to ever changing conditions and to overcome the constraints caused by pests, diseases and abiotic stresses. They are essential for sustainable agricultural production. There is no inherent incompatibility between conservation and use of these resources. In fact, it will be critically important to ensure that these activities are fully complementary. The conservation, sustainable use, and fair and equitable sharing of benefits from their use, are both an international concern and an imperative. These are the objectives of the International Treaty on Plant Genetic Resources for Food and Agriculture, which is in harmony with the Convention on Biological Diversity. In ~~reaffirming~~{the context of} the sovereign rights of states over their biological resources{ and the interdependence of countries regarding PGRFA}, this updated Global Plan of Action addressing plant genetic resources for food and agriculture is an appropriate manifestation of the international community's continued concern and responsibility in this area.

2. Over the last 15 years the Global Plan of Action has been the main reference document for national, regional and global efforts to conserve and sustainably use plant genetic resources for food and agriculture and to share equitably and fairly the benefits that derive from their use. As part of the FAO Global System for the conservation and sustainable use of plant genetic resources for food and agriculture, the Global Plan of Action has been the key element used by the FAO Commission on Genetic Resources for Food and Agriculture in fulfilling its mandate with respect to plant genetic resources, and has provided an important reference for other genetic resources sectors. The Global Plan of Action assisted governments in the formulation of national policies and strategies on plant genetic resources for food and agriculture. It was used by the international community to define priorities at the global level, to improve coordination of efforts and to create synergies. The Global Plan of Action has proven to be instrumental in the

reorientation and prioritization of the research and development agenda of relevant international organizations with regard to PGRFA-related activities.

3. The adoption of the Global Plan of Action by 150 countries in 1996 {in Leipzig }was a key milestone in the development of the international governance of plant genetic resources for food and agriculture. It set the stage for the successful completion of the negotiations of the International Treaty under the FAO Commission on Genetic Resources for Food and Agriculture.

4. Since its adoption, there have been a number of major developments with respect to the conservation and use of plant genetic resources for food and agriculture which call for an update of the Global Plan of Action. The recently completed and published Second Report on the *State of the World' Plant Genetic Resources for Food and Agriculture* has provided a solid foundation for, and guidance to, this updating process. The world is facing increasing food insecurity, reflected in unstable food prices and competition between food and fuel production. Climate change, increasing urbanization, the need for greater sustainability of agriculture {and the necessity of safeguarding plant genetic diversity }and {minimizing}~~continued~~ genetic erosion all require increased attention to both conservation and use of plant genetic resources for food and agriculture. At the same time, there are important new opportunities that can improve the management of plant genetic resources for food and agriculture, including powerful and widely available communication and information technologies as well as significant advances in biotechnology{ and bioproduct development arising from agriculture}. Furthermore, the policy environment has changed significantly, particularly with the entry into force of the International Treaty on Plant Genetic Resources for Food and Agriculture, and among others, the Cartagena Protocol on Biosafety{, as well as with the adoption of the Nagoya Protocol on Acces to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization}~~and the Nagoya Protocol on Access and Benefit Sharing of Biodiversity~~. The world has also experienced a renewed commitment towards agriculture and its research and development activities. An updated Global Plan of Action is needed to respond to, and reflect, these developments.

5. The updated Global Plan of Action addresses the new challenges and opportunities in its 18 Priority Activity Areas. The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture, a series of regional consultation meetings, as well as inputs from experts worldwide have provided the required inputs to make this Global Plan of Action up-to-date, forward looking and reflective of global, regional and national perspectives and priorities. The updating of the Global Plan of Action also serves the purpose of strengthening its role as a supporting component of the International Treaty on Plant Genetic Resources for Food and Agriculture.

6. Based on the various inputs listed above, it was possible to streamline the number of Priority Activity Areas, reducing them from 20 to 18. This was done by merging former Priority Activity Areas 5 and 8 (*Sustaining existing ex situ collections* and *Expanding ex situ conservation activities*) into the new Priority Activity Area 6, *Sustaining and expanding ex situ conservation of germplasm*. Former Priority Activity Areas 12 (*Promoting development and commercialization of underutilized crops and species*) and 14 (*Developing new markets for local varieties and 'diversity-rich' products*) have been merged into the new Priority Activity Area 11, *Promoting development and commercialization of farmers' varieties{/landraces} and underutilized species*. In addition, the focus of a number of other Priority Activity Areas has been adjusted in order to accommodate newly defined priorities. An effort has also been made, following guidance from the regional consultations, to simplify and clarify the document. The updated *Global Plan of Action* gives more emphasis and visibility to plant breeding, as reflected in Priority Activity Area 9, *Supporting plant breeding, genetic enhancement and base-broadening efforts*.

CONTENTS

Draft Updated Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture

Introduction

Continued need for plant genetic resources for food and agriculture and their conservation and sustainable use

1. Agriculture in the 21st century will face many new challenges. Food and fibre production will have to increase ~~drastically~~{dramatically} to meet the needs of a growing and modernizing population with a proportionally smaller rural labour force. Changes in diets and food habits will drive changes in crop and livestock production systems. Increased demand for biofuels for an expanding bio-energy market will [compete with][complement] food production. In many parts of the world, the effects of climate change will likely [exceed the adaptive capacity][require changes in the adaptability] of many crops and forages, increasing countries' interdependence for plant genetic resources for food and agriculture (PGRFA). Furthermore, climate change will lead to changes in production areas and practices, as well as in the occurrence of pests and diseases of crops and livestock. ~~Increasingly, voices can be heard that agriculture~~{Agriculture} will need to {continue to} reduce its negative impact on the environment and biodiversity and adopt more efficient and sustainable production practices. Land-use changes will limit the area available for agriculture and increase pressure on populations of crop wild relatives (CWR) and wild food plants.

2. PGRFA underpin agriculture's ability to cope with these changes, whether environmental or socio-economic. They will therefore have to play an increasingly important role in securing continuing improvements in agricultural production and productivity; not only through the provision of new genes for improved crop varieties, but also through contributions to effective agro-ecosystem function{ and bio-product development}. In many ~~poor~~ rural areas around the world, PGRFA, as a part of agricultural biodiversity, are an essential component of {indigenous and }local communities' livelihood strategies.

History of the Global Plan of Action

3. The Global Plan of Action (GPA) for the conservation and sustainable utilization of plant genetic resources for food and agriculture was formally adopted by representatives of 150 countries during the Fourth International Technical Conference on Plant Genetic Resources in Leipzig, Germany in 1996. During the same conference, the Leipzig Declaration, which provides a clear focus on the importance of PGRFA for world food security and commits countries to implement the GPA, was adopted. More than 150 countries, as well as the public and private sectors, actively participated in the preparation of the GPA. FAO committed itself to carry out the GPA, under the guidance of the intergovernmental Commission on Genetic Resources for Food and Agriculture (the Commission), as part of the FAO Global System for the Conservation and Use of Plant Genetic Resources.

4. At its Eighth Regular Session in 1999, the Commission reaffirmed that FAO should periodically assess the state of the world's PGRFA to facilitate analyses of changing gaps and needs and contribute to the updating process of the rolling GPA. At the Ninth Regular Session, the Commission agreed on the application of a new approach for monitoring GPA implementation based on internationally agreed indicators, which led to the establishment of the National Information Sharing Mechanisms (NISM). At its Twelfth Regular Session in 2009, the Commission endorsed the Second Report on the State of the World's PGRFA as an authoritative assessment of this sector and requested FAO to prepare the updated GPA, based primarily on the Second Report, and, in particular, on the identified gaps and needs, taking into account further contributions from Governments, as well as inputs received from regional meetings and consultations. It decided that the updated GPA would be considered at its Thirteenth Regular Session.

5. In 2001, the FAO Conference adopted the International Treaty on Plant Genetic Resources for Food and Agriculture (the International Treaty), which in its Article 14 recognizes the GPA as one of its supporting components and, in 2006, its Governing Body decided that the GPA's priorities are also priorities under the International Treaty's funding strategy. In 2009, the Governing Body of the International Treaty noted the need to ensure close collaboration between the Commission and the Governing Body with regard to the GPA, and invited the Commission, in

the GPA revision, to take into account specific issues of relevance to the International Treaty and to adequately reflect the provisions of the International Treaty in the updated GPA.

Implementation of the Global Plan of Action

6. Since the formulation of the first GPA, based largely on the information generated during the preparatory process of the First Report on the *State of the World's Plant Genetic Resources for Food and Agriculture* in the early 1990's, considerable progress has been made with the implementation of the GPA around the world. One of the main changes that can be reported when comparing the situation in 2010 with that in 1996 is an increase of almost 20% in the number of accessions that are conserved in genebanks worldwide, reaching 7.4 million in 2010. Over 240,000 new samples have been collected and added to *ex situ* ~~genebanks,~~{collections.} {Genebanks identified in 2010 were }1,750 ~~of which were identified in 2010~~ compared to approximately 1,450 in 1996. The number of botanical gardens has grown from about 1,500 in 1996 to more than 2,500 in 2010. The number of national programmes on PGRFA has increased often with a broader participation of stakeholders. Most countries have now adopted or revised national legislation dealing with PGRFA and seed systems. The application of modern plant biotechnologies in the conservation and use of PGRFA has increased; farmers increasingly participate in breeding programmes; and the conservation and use of CWR and landraces has improved. The important role of information in the conservation and use of PGRFA, and technological advances, are reflected in the improved situation with regard to information management at the national, regional and global level.

7. Overall, international activity in conservation and sustainable use of PGRFA has increased. Many new regional and crop networks and programmes have been set up, also in response to the action priorities of the GPA. Networks remain very important for promoting cooperation, sharing knowledge, information and ideas, exchanging germplasm, and for carrying out joint research and other activities. [The International Treaty has established a funding strategy with priority activity areas of the rolling GPA as priorities.]Initiatives, such as the efforts of the Global Crop Diversity Trust (the Trust), to contribute to more rational *ex situ* conservation, especially for the crops covered under the Multilateral System of the International Treaty (i.e. the Annex I crops), build on such networks. The existing network of international *ex situ* collections of major crops played an important role in the negotiations of the International Treaty, and they continue to form the backbone of the FAO Global System for the Conservation and Sustainable Use of PGRFA. The Svalbard Global Seed Vault (SGSV) now provides an additional level of security to existing *ex situ* collections. Furthermore, the development of a global portal of accession level data and the imminent release of an advanced genebank information management system are other important steps towards the strengthening and more effective operation of a global system for *ex situ* conservation. Complementary to this is the establishment of NISMs in more than 65 countries to facilitate access to relevant information, monitor GPA implementation and strengthen partnerships among stakeholders and national decision-making processes. The Global Partnership Initiative on Plant Breeding Capacity Building (GIPB) represents an effort to fill an important gap in national programmes, i.e. linking the conservation of PGRFA to use in crop improvement. In addition, the GPA Facilitating Mechanism has been established to identify and disseminate information on funding opportunities for all priority activity areas.

The rationale for the updated Global Plan of Action

8. Since the GPA was formulated and adopted, a number of substantial changes and new challenges and opportunities with respect to the conservation and utilization of PGRFA have occurred. These new developments, which have been highlighted in the Second Report on the *State of the World's Plant Genetic Resources for Food and Agriculture* and which featured prominently in the regional meetings and consultations, provide the justification and rationale for updating the GPA. The most important issues are discussed below.

9. The following **developments and trends in agriculture** are expected to have significant impacts on the conservation and use of PGRFA:

a) Throughout most of the developed world, most food is supplied by industrialized food production systems which are driven by strong consumer demand for cheap food of

uniform and predictable quality. Crop varieties are bred to meet the requirements of these ~~high-input~~ systems and strict market standards, often under mono-cropping and monoculture production systems{, but also to address biotic resistance, nutritional quality and yield stability}. [These developments have strengthened the downward trend in species and genetic diversity in farmers' fields.]

b) In the developing world, however, a substantial portion of food is still produced with few, if any, chemical inputs and any food surplus of subsistence farming or home gardens is sold locally. Many millions of small-scale farmers throughout the world depend on locally available PGRFA for their livelihoods and well being.

c) Urbanization will occur at an accelerated pace and it is expected that more than 70% of the world population will be urban in 2050 (compared with about 50% today). Income levels are expected to rise steadily to many times their current levels.[16] Nonetheless, income disparity between rich and poor will remain very high.

d) [Another trend, related to globalization, is the significant concentration of international seed companies. International seed trade has increased, but it is dominated by fewer and larger multinational seed companies than in 1996.][There has been a major increase in the international seed trade which is dominated by fewer and larger multinational seed companies.]

e) The ever increasing production and marketing of genetically modified varieties for a growing number of crops is closely related with the previous point and needs close monitoring by the genetic resources community~~, especially to avoid contamination of existing collections during regeneration activities and/or when germplasm is being collected in farmers' fields or in nature~~.

f) {According to national policies and needs, there}~~There~~ is increasing [recognition of Farmers' Rights, as included in Article 9 of the International Treaty, and][implementation of Article 9 on Farmers' Rights and recognition] of the important role farmers have been playing in the conservation and sustainable use of PGRFA.

10. **Climate change** represents an immediate and unprecedented threat to livelihoods and food security and may well be a major barrier to achieving the required increase of 70% in global food production by 2050. The following strategic components are needed to secure PGRFA and use them optimally to help cope with climate change:

- An increased emphasis on *in situ* conservation of genetically diverse populations, especially of CWR, to allow evolution to continue and thus permit the continued generation of adaptive traits;
- A significantly expanded programme of *ex situ* conservation, especially of CWR, to ensure maintenance of diversity of species, populations and varieties adapted to extreme conditions and from areas expected to be highly impacted by climate change;
- {Increased reasearch and improved}~~Improved~~ availability of information on the characteristics of material held *ex situ* which will become useful under new conditions;
- Increased support for access and movement of materials to meet the increased interdependence resulting from the new environmental conditions;
- Increased support for building capacity in plant breeding and seed systems management that make effective and sustainable use of PGRFA;
- A targeted and increased involvement of farmers and farming communities in national and local crop improvement activities, including support to participatory research and plant breeding.

11. Over the last 15 years considerable information has become available with respect to the extent and nature of genetic erosion of PGRFA and the extent of genetic vulnerability. Genetic erosion is reported to continue in many regions of the world and the genetic vulnerability of crops

[16] FAO 2009. How to Feed the World in 2050.
http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf

has further increased over the past 15 years. The major causes of erosion that have been identified include replacement of farmers' varieties{/landraces}, land clearing, over-exploitation, [water availability,] population pressures, [changing dietary habits,] environmental degradation, changing agricultural systems, over-grazing, legislation and policy, and pests diseases and weeds. Changes in the seed sector and production methodologies have a{n} ~~major~~ impact on the vulnerability of crops. This vulnerability applies in particular to ~~those species~~ {neglected and underutilized species} that do not find much, if any, support from research{,} ~~and/or~~ plant breeding and{/or development/marketing, and} are increasingly neglected even by farmers. These so-called neglected and underutilized species have a great potential in the context of climate change, eco-agriculture, dietary diversity and in general for the sustainability of agricultural production systems.

12. Major **advances in key areas of science and technology** relevant to PGRFA conservation and use have occurred over the last 15 years. Of these the most important have been the rapid development of information and communication technologies (ICT), which include the internet and mobile phones, the management and analysis of information, and the developments in molecular biology.

a) **Information management and exchange technologies** have greatly advanced over the last 15 years. There is significantly increased accessibility to information as well as enhanced analytical capacity available to genetic resources workers. The most important element of the latter has been the way in which Geographic Information Systems (GIS) and satellite-based methods such as Global Positioning System (GPS) and remote sensing have been developed so that PGRFA data can be combined with a wide range of other data to locate specific areas of diversity or to identify material from particular habitats.

b) The ~~dramatic~~ **advances in molecular and genomic methods** over the last 15 years have already had a profound impact on key areas of GPA implementation. These methods allow the generation of additional and much more detailed information on the extent and distribution of genetic diversity and can be used as part of the planning strategies of PGRFA conservation and use. In addition, significantly improved technologies for identifying and transferring genes between related and even unrelated species open completely new horizons for the exploitation of genetic diversity.

c) Whereas relatively few major developments have occurred with respect to ***ex situ* conservation** practices and procedures over the last decade, the new information and molecular tools have the potential to make the conservation and use of PGRFA more effective and efficient. Much work has been undertaken on ***in situ* conservation**, both of CWR and, to an even greater extent, on-farm[/in garden conservation]. The experience gathered and knowledge created have resulted in the recognition of the importance of an integrated, multi-disciplinary approach, in which farmers and {indigenous and local} communities play a leading part and in which livelihood and well-being perspectives are fully reflected.

13. There have been major policy developments with respect to conservation and use of PGRFA. These include the adoption by the Conference of the Parties of the Convention on Biological Diversity (CBD) of an Agricultural Biodiversity Programme of Work in 2000, the adoption of the Millennium Development Goals in 2000, the establishment of the Global Strategy for Plant Conservation in 2002, the establishment of the Global Crop Diversity Trust in 2004 and the adoption by the Commission on Genetic Resources of the Multi-Year Programme of Work (MYPOW) in 2007, which includes substantial work on PGRFA.

14. Undoubtedly, the most important development has been the entry into force of the International Treaty in 2004. Contracting Parties recognize that the rolling GPA is important to this Treaty in Article 14, and that they should promote its effective implementation, including through national actions and, as appropriate, international cooperation to provide a coherent framework, among others, for capacity-building, technology transfer and exchange of information, taking into account the provisions of benefit-sharing in the Multilateral System. Contracting Parties {to the International Treaty }also recognize that the ability to [fully]implement [prioritiy activities, plans and programmes taking into account]the GPA, in particular

of developing countries and countries with economies in transition, will depend largely upon the effective implementation of {Article 6, Sustainable Use of PGRFA, of }Article 13, Benefit-sharing in the Multilateral System {including 13.1}, and of the Funding Strategy as provided in Article 18. The GPA framework has been taken into account by the Governing Body of the International Treaty in establishing the priorities of the Benefit-Sharing Fund to enable the strategic use of the fund to catalyze the sustainable use and conservation of PGRFA. The updated GPA will be an important resource for the identification of future priorities.

15. At its 10th meeting (2010), the Conference of the Parties to the CBD adopted the Strategic Plan for Biodiversity for the period 2011-2020, with 20 Targets. Target 13 of the "Aichi Biodiversity Targets" is the key target relating to genetic diversity: "By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity". A number of the other targets would also relate to the conservation and sustainable use of plant genetic resources.[17] The updated GPA aims to contribute significantly to the achievement of these targets. Work on international indicators related to these targets has been initiated. The recently adopted Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation, may, when in force, also have implications for the access to and utilization of certain plant genetic resources.

16. The GPA itself mandates the Commission to develop a procedure for the review of the GPA. Such a review should deal with the progress made at national, regional and international levels in implementation, elaboration, and adjustment as appropriate, of the GPA, thus making it a "rolling" plan as recommended in Agenda 21.

Aims and strategies of the Global Plan of Action

17. At its Eleventh Regular Session the FAO Commission agreed that the GPA should be based on clear, but succinctly stated, aims and principles, and should include, among others, a strategy and information on each proposed priority activity. It agreed that the aims would refer to, and draw upon, as appropriate, applicable international agreements.

18. The main aims of this updated GPA are:

a) [to strengthen the implementation of the International Treaty;]
b) to ensure the conservation of PGRFA as a basis for food security, sustainable agriculture and poverty reduction by providing a foundation for current and future use;
c) to promote sustainable use of PGRFA ~~by enhancing the capacity to use the resources for crop improvement~~, in order to foster economic development and to reduce hunger and poverty, particularly in developing countries, as well as provide options for adaptation to and mitigation of climate change[, other global changes and response to food, feed and other needs];
d) to promote {the exchange of PGRFA and the} fair and equitable sharing of the benefits arising from ~~the~~{their} use ~~of PGRFA, in recognition of the enormous contribution that the local and indigenous communities and farmers of all regions of the world, in particular those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production throughout the world~~;
e) to ~~enable~~{assist} countries, as appropriate, and subject to their national legislation, to take measures to protect and promote Farmers' Rights, as provided in Article 9 of the International Treaty;

[17] Including target 2 (biodiversity values integrated into national and local development and poverty reduction strategies and planning processes etc.), target 5 (rate of loss of natural habitats halved etc.), target 6 (all aquatic plants harvested sustainably etc.), target 7 (areas under agriculture, aquaculture and forestry are managed sustainably etc.), target 11 (protected areas etc.) target 12 (extinction of known threatened species prevented), target 18 (traditional knowledge, innovations and practices etc.).

f) to assist countries, regions, the Governing Body of the International Treaty, as well as other institutions responsible for conserving and using PGRFA, to identify priorities for action;
g) to create and strengthen national programmes in particular, and increase regional and international cooperation, including research, education and training, on the conservation and use of PGRFA, and to enhance institutional capacity;
h) to promote information sharing on PGRFA among and within regions and countries.
i) to set the conceptual bases for the development and adoption of national policies and legislation {as appropriate }for the conservation and sustainable use of PGRFA{;
j) to reduce unintended and unnecessary duplication of actions in order to promote cost efficiency and effectiveness in global efforts to conserve and sustainbly use PGRFA}.

19. The GPA is based on the fact that countries are interdependent with respect to PGRFA and therefore that substantial regional and international cooperation will be necessary to meet its aims effectively and efficiently. In this context, the GPA has developed a broad strategic framework comprised of seven basic and interrelated aspects:

a) A large and important amount of PGRFA, vital to world food security, is stored *ex situ*. Whereas the maintenance of genetic resources in genebanks{ and networks} is a well established procedure in most countries, many of the existing collections need to be further developed and strengthened. Securing adequate storage conditions for the genetic materials already collected and providing for its regeneration and safety duplication is a key strategic element of the GPA. In general, there is a need for standard operating procedures for all routine genebank operations.
b) Linking conservation with use and identifying and overcoming obstacles to the greater use of conserved PGRFA are necessary if maximum benefits are to be obtained from conservation efforts. Effective information management, including the sharing of relevant information widely with users by taking full advantage of the advanced information technologies will be an important prerequisite to achieve this. This will {not only }increasingly include molecular and genomic{, but also morphological and agronomic} data on PGRFA, which will need to be linked to, and analyzed together with, the characterization and evaluation data managed in genebank databases.
c) Enhancing capacity at all levels is a key strategy used in the individual activities in the GPA. The GPA seeks to promote the pragmatic and efficient use and development of institutions, human resources, cooperation, and financial mechanisms, among others by enhancing the mobility of human and financial resources as a contribution to the establishment of a true global system for PGRFA. Furthermore, there is a need to enhance linkages between scientific and technological innovation and its application to the conservation and use of PGRFA.
d) Strengthening the efforts and partnerships of public and private sector breeders to {conserve and} use PGRFA is essential. In addition, participatory breeding and selection, as well as participatory research in general, with farmers and farming communities, need to be strengthened and recognized more broadly as appropriate ways of achieving sustainable and long-lasting conservation and use of PGRFA.
e) *In situ* conservation and development of PGRFA occur in two contexts: on-farm and in nature. Farmers, {indigenous and local}~~rural~~ communities ~~and indigenous peoples~~ play a crucial role in both. Enhancing ~~the~~{their} capacity ~~of farmers and communities~~ through linkages to extension agencies, the {public and }private sector, NGOs and farmer-owned cooperatives, as well as through the provision of incentives for the *in situ* conservation of PGRFA, will help promote food security, adaptability and resilience, particularly among {such communities}~~the many rural people~~ who live in areas of low agricultural potential.
f) Considering the importance of CWR for crop improvement and the fact that they have not been given adequate attention, specific conservation and management activities will be required, including their better protection through improved land-use practices, nature conservation and strengthened community involvement.
g) Conservation and use strategies at the community, national, regional and international levels are most effective when they are complementary and well-coordinated. *In situ*

conservation, *ex situ* conservation and sustainable use, need to be fully integrated at all levels.

20. Resource mobilization to allow the timely and adequate implementation of the strategic elements above will require due attention and efforts at all levels, including coordination with the numerous initiatives underway within countries, regionally and globally (e.g. CBD, UNFCCC, etc.) ~~to realize much needed synergies~~.

Structure and Organization of the Global Plan of Action

21. The updated GPA has 18 priority activity areas. For pragmatic and presentational purposes, these are organized into four main groups. The first group deals with ***In Situ* Conservation and Management**; the second with ***Ex Situ* Conservation**; the third with **Sustainable Use**; and the fourth with **Building Sustainable Institutional and Human Capacities**. As the GPA is a set of integrated and intertwining activities, the placement of the activities into four groups is intended simply to help order the presentation and guide the reader to areas of particular interest. Many priority activity areas relate and are relevant to more than one group.

22. For each priority activity there is a basic set of headings or sections to aid in the presentation of the proposed priority activity. In some cases, recommendations found under one heading might as appropriately have been placed under another. While no strict section definitions are considered necessary, a few explanatory remarks might be useful:

a) The Background section provides a rationale for the priority activity area and a summary of the achievements made since 1996, mainly based on the findings reported in the Second Report on the *State of the World's Plant Genetic Resources for Food and Agriculture*.
b) ~~The Long-term Objectives and Intermediate Objectives~~{The Objectives} section~~s specify~~{specifies} the ultimate and intervening objectives ~~respectively~~ to be accomplished by the priority activity. The explicit articulation of goals can aid the international community in judging the extent of implementation of the activity over time.
c) The Policy/strategy section proposes national and international policies and strategic approaches to implement the objectives of the priority activity. In some cases there are recommendations for new international policies; in other cases there are proposals for changes in approach, priorities, and visions.
d) The Capacity section indicates what human and institutional capabilities should be developed or provided.
e) The Research/technology section, including technology development and transfer, identifies areas of scientific, methodological, or technological research or action relevant to the implementation of the priority activity.
f) The Coordination/administration section addresses how these issues might be approached as the priority activity is planned and implemented. The focus of this section has been mainly limited to the national level to avoid repetitions as the need to further strengthen collaboration with relevant international organizations and agricultural research centres, and to increase sharing of information among all organizations and stakeholders applies throughout all priority activity areas. International collaboration is critical to gaining maximum benefits under legal and policy instruments such as the CBD and the International Treaty and to meet associated obligations.

23. On occasion, institutions or constituencies are specifically identified in the body of a Priority Activity Area. This is not meant to imply their exclusion in other Activities. Such references are used to highlight a role which is particularly critical, or one which may otherwise be overlooked, or both.

In Situ Conservation and Management

1. Surveying and inventorying plant genetic resources for food and agriculture

24. **Background:** Rational conservation of PGRFA (*in situ* and *ex situ*) begins with surveys and inventories, as highlighted by the International Treaty in Article 5. In order to elaborate policies and strategies for conservation and use of PGRFA, national programmes need to know what resources exist in their countries, their distribution and the extent to which they are already being conserved. Countries that have ratified the CBD have acknowledged specific responsibilities concerning this (for example in the Programme of Work on Agricultural Biodiversity). Wider accessibility to geo-referencing tools has facilitated surveying, and development and application of modern molecular biology techniques have assisted in assessing the extent of genetic diversity and {in some cases }genetic erosion. During the past decade most surveys have been restricted to individual crops or limited areas, although some progress has also been made in inventorying CWR and establishing specific sites for their *in situ* conservation. Nonetheless, efforts in protected areas regarding surveying, inventorying and conservation of PGRFA have been limited in comparison with those devoted to many other components of biodiversity. Several international organizations have contributed to monitoring the conservation status of wild plants of agricultural relevance regionally and globally, but improved partnerships with organizations in the environment sector need to be pursued, especially at the country level.

25. ~~**Long-term objectives**~~**{Objectives}:** To facilitate the development, implementation and monitoring of complementary conservation strategies and national policies related to the conservation and sustainable use of PGRFA. To strengthen linkages between ministries of agriculture and of the environment and promote monitoring of the status and trends in PGRFA and thereby ensure their adequate conservation.

26. ~~**Intermediate objectives:**~~ To develop and apply methodologies for surveying and inventorying *in situ* and *ex situ* PGRFA, including GIS, satellite-based methods (e.g. GPS and remote sensing) and molecular markers. To identify, locate, inventory, and assess threats to PGRFA, particularly from land-use and climate changes.

27. **Policy/strategy:** {The ability to identify species will be a key element for this priority activity area. }The surveying and inventorying of PGRFA{, as needed} should be considered as the first step in the process of conservation and of reducing the rate of biodiversity loss. Without the capacity to conserve and/or use biodiversity, however, such work may have marginal utility{ with regards to sustainable use}. Thus, surveying and inventorying should ~~ideally~~ be linked to specific objectives and plans for *in situ* conservation, collecting, *ex situ* conservation and use. Standard definitions and methods need to be promoted for assessing genetic vulnerability and genetic erosion directly. There is also an urgent need to develop improved indicators, including proxy indicators, of diversity, genetic erosion and vulnerability that can be applied to establish national, regional and global baselines. {These indicators should be objective and balanced, taking into account systems in use at national level. They should not establish punitive measures, nor affect country sovereignity over genetic resources, nor impose specific information systems. }General agreement on the design and use of such indicators needs to be pursued.

28. Local and indigenous knowledge should be recognized as an important component of surveying and inventorying activities and should be carefully considered and[, where appropriate and with the prior informed consent of indigenous and local communities,] documented.

29. **Capacity:** Countries should provide and [may need] [may benefit from] financial and technical support to survey and inventory PGRFA. There are numerous obstacles to surveying and inventorying PGRFA, including lack of adequately trained human resources. Training and capacity-building should be undertaken in several areas of research, including plant identification, population biology, ethno-botany, use of GIS and GPS, and molecular tools. The capacity to gauge climate change impact and assess adaptation is also increasingly relevant, particularly if *in situ* conserved genetic diversity is to be maintained sustainably in the longer-term.

30. **Research/technology:** Adequate support should be given to developing better methodologies for surveying and assessing inter- and intra-specific diversity in agroecological systems. There is also a strong need to develop scientifically sound and easily implemented indicators for monitoring the status and trends of PGRFA, especially at the genetic level.

31. There are specific research needs related to ~~on-farm management and~~ *in situ* conservation of PGRFA. More complete inventories are needed to enable better targeting of *in situ* conservation activities. If these were associated with actual or predicted data on specific traits of interest, they would have even more value, and provide a useful link to *ex situ* conservation and use. Existing information sources should be used in research to determine the extent to which CWR exist in protected areas.

32. A particularly important research area is the development of indicators that can be used to monitor changes in extent and distribution of diversity at different scales and to aggregate information on individual species and populations. This research will materially strengthen national conservation planning and decision-making.

33. **Coordination/administration:** Coordination must take place in-country between ministries {dealing with }~~of~~ agriculture{,} ~~and of the~~ environment{, research, science and tecnology}, and regionally, realizing that species cross national boundaries. Regional and global level coordination is needed to strengthen linkages between existing *ex situ* and *in situ* conservation efforts.

34. Strong linkages need to be established with national, regional and crop networks and with the users of PGRFA (breeders, researchers and farmers) in order to inform, direct and prioritize the entire conservation process. Countries should collaborate in surveying and inventorying activities in order to build capacity.

2. Supporting on-farm management and improvement of plant genetic resources for food and agriculture

35. **Background:** Plant breeding has helped raise crop yields, improve resistance to pests and diseases and enhance {diversity and }quality of {agriculture and }food products, especially in favourable environments. [Farmers choose to grow modern varieties for many reasons][Much more is known about the reasons farmers choose to grow modern or traditional varieties], including market conditions, family food security and environmental sustainability. Although these choices often result in significant genetic erosion, the last two decades have provided substantial evidence that many farmers in the developing world, and increasing numbers in developed countries, continue to maintain significant crop genetic diversity in their fields. This diversity constitutes an important element for the livelihood strategies of farmers because of their adaptation to marginal or heterogeneous environments. This diversity is also maintained to meet changes in market demands, labour availability and other socioeconomic factors, and for cultural and religious reasons.

36. A range of initiatives and practices has become available to help farming communities continue to benefit from the maintenance and use of local crop genetic diversity in their production systems. Building capacity and leadership in ~~local~~{such} communities and their institutions is a precondition for implementing such community-based activities. Promoting and supporting the on-farm management of genetic resources has become firmly established and systematized as a key component of crop conservation strategies. As a result, on-farm[and garden] management of PGRFA is one of the three first priorities of the Benefit Sharing Fund of the International Treaty.

37. Despite this progress, significant technical and methodological questions remain. In particular, there is room for improvement in coordination of on-farm management with *ex situ* conservation and use. In order to realize the full potential of on-farm improvement, these practices need to be fully integrated into rural development policies.

38. Concerns about the impact of climate change on agriculture have grown substantially over the past decade. Farmers may no longer be able to grow their own traditional varieties and landraces in changed climates, and they will therefore need access to new germplasm. Furthermore, agriculture is both a source and a sink for atmospheric carbon. PGRFA are becoming recognized as critically important for the development of farming systems that are resilient to climate change, capture more carbon and produce less greenhouse gasses. They will underpin the breeding of the new adapted crop varieties that will be needed for {the adaptation of }agriculture ~~under~~{to} future environmental conditions. There will be an increased need for linkages between local seed systems and genebanks{ and networks} to secure new germplasm adapted to changed climates.

39. ~~**Long-term objectives**~~**{Objectives}:** To use the knowledge generated during the past two decades to promote and improve the effectiveness of existing on-farm conservation, management, improvement and use of PGRFA. To achieve a better balance and integration between *ex situ* and *in situ* conservation. To realize Farmers' Rights as detailed in Article 9 of the International Treaty, at regional and national levels{ according to national legislation and priorities}. To promote the equitable sharing of benefits from PGRFA as called for in Article 13 of the International Treaty. To foster the future emergence of public and private seed companies and cooperative enterprises that address local needs as an outgrowth of successful on-farm crop selection and breeding. To ~~encourage~~{maintain, especially for small-scale and subsistence farmers in developing countries,} [taking into account phytosanitary constraints] traditional seed exchange and supply systems, including community genebanks, and strengthen local markets for products. To take full account of the role of women in agricultural production, particularly regarding on-farm management of PGRFA, in many developing countries. To foster successful ~~traditional and innovative~~ selection and breeding, particularly in the light of climate change.

40. ~~**Intermediate objectives:**~~ To address gaps in knowledge about the dynamics, methodologies, effects, and potential of on-farm conservation and crop improvement. To establish or strengthen programmes and networks for on-farm management of farmers' varieties{/landraces}, CWR, wild food plants and rangeland genetic resources, and integrate their work into rural development policies and activities. To extend the role of national, regional and international genebanks{ and networks} to include support for, and provision of materials to, on-farm improvement programmes in a more integrated manner. To build on-farm programmes based on local and traditional systems of knowledge, institutions and management, ensuring local participation in planning, management and evaluation. To focus greater public and scientific attention on the diverse roles that gender and age play in production and resource management in rural households.

41. **Policy/strategy:** Although on-farm management activities have now moved beyond the stage of small-scale research of methodological projects, these activities still need to be fully integrated into wider conservation and development strategies and/or action plans. On-farm activities are complementary to more formal crop variety development and strengthen seed supply systems. Institutional flexibility will be needed in working with farming communities. Specific strategies for conserving PGRFA *in situ*, and for managing crop diversity on-farm and in protected areas, need to be developed. Special attention should be paid in these strategies to conservation of CWR in their centres of origin, ~~major~~ centres of diversity and biodiversity hotspots. Working examples must be disseminated of conservation and sustainable use of PGRFA that support and maintain the social, economic and cultural values of local and indigenous communities and improve the quality of life. This will be best achieved by involving {such}~~local~~ communities in all aspects of management and improvement of PGRFA on-farm.

42. Governments should consider how production, economic incentives, and other policies, as well as agricultural extension and research services, might facilitate and encourage on-farm management and improvement of PGRFA. Increasingly, the value of conservation activities needs to be demonstrated in terms of continued provision of ecosystem services. The importance of PGRFA as one of these services is just beginning to be fully recognized, and efforts should continue and intensify to document the value of CWR and landrace diversity in this regard.

43. There will be a specific need to integrate CWR and landrace conservation into existing conservation strategies to ensure that agricultural biodiversity and more general biodiversity are not addressed as separate entities. This will require that conservation of agricultural biodiversity becomes a feature of wider biodiversity conservation initiatives and programmes {at the national, regional and international levels}.

44. Where appropriate, national policies should aim to strengthen the capacity of {indigenous and }local communities to participate in crop improvement efforts. Decentralized, participatory and gender sensitive approaches to crop improvement in order to produce varieties that are specifically adapted to socio-economically disadvantaged environments in particular need to be strengthened. This may require new policies and legislation, including appropriate ~~intellectual property~~ protection{, variety release} and seed certification procedures for varieties bred through participatory plant breeding, in order to promote and strengthen their use and ensure that they are included in national agricultural development strategies.

45. Greater attention needs to be paid to on-farm conservation and use of underutilized species, many of which can make a valuable contribution to improving diets and incomes. In order to capture the potential market value of such crops there needs to be greater cooperation among different actors in the production chain, from the development and testing of new varieties, through value-added activities, to the opening up of new markets. Increasingly, the value of conservation activities needs to be demonstrated in terms of continued provision of ecosystem services. The importance of agricultural biodiversity as one of these services is just beginning to be fully recognized, and efforts should continue and intensify to document the value of CWR and landrace diversity in this regard.

46. **Capacity:** Adequate support should be given to community-based organizations and user groups engaged in providing practical assistance to on-farm conservation and improvement work. The ability of farmers, indigenous and local communities and their organizations, as well as extension workers and other stakeholders, to manage agricultural biodiversity sustainably on-farm needs to be strengthened.

47. Considering the needs, and numbers, of the farmers served, genebanks{, networks} and national/international organizations should consider identifying appropriate farmers' varieties{/landraces} for multiplication and/or developing new breeding populations that incorporate specific traits into locally adapted materials for on-farm improvement activities. ~~Step-by-step incorporation and improvement should be encouraged rather than the hasty replacement of existing on-farm diversity. As a general practice, the quantities of seed and planting materials distributed should encourage experimentation by farmers, and not be so large as to displace normal seed supply sources or on-farm seed management.~~

48. Interdisciplinary training programmes should be developed for extension workers, NGOs and others in facilitating and catalyzing on-farm activities, including selection and breeding techniques appropriate to supplement and improve those already used by farmers.

49. The focus of training programmes should be on helping farmers to gain new knowledge and technologies and explore new markets for their products, and researchers to become better enablers and supporters of farmers. Training should be aimed at four different groups: scientists (including plant breeders, researchers and agricultural economists), technical support staff, extension agents (including NGOs), and farmers. Support for advanced degree work should include relevant work in the biological and social sciences. Training of extension agents should aim to increase their skills in ethno-botany, participatory selection and breeding, seed maintenance and using ICT.

50. Training of farmers should {be carried out in the context of the whole production chain and mainly focusing}~~focus~~ on the identification of plant traits, selection/breeding, utilization and maintenance of local crops, and the promotion of product sales. It is important to develop farmers' skills in selecting plants at the vegetative state and not only after harvest.

51. Training programmes should be designed in close collaboration with the National Agricultural Research System (NARS) and farmers{,} ~~and~~ their organizations{ and other stakeholders}, and be based on particular needs as they see them. Such programmes should not neglect the central role that women play in both influencing and directing the evolution of crops. Programmes should consider the different uses of biological resources by women and men, including women's concern for the multiple uses and processing requirements of crops.

52. **Research/technology:** Seven basic types of rigorous, multi-disciplinary scientific research are needed:

a) further ethnobotanical and socio-economic/socio-cultural research to understand and analyze farmer knowledge, selection/breeding, utilization, and management of PGRFA, consistent with the approval of the farmers involved and with applicable requirements for protection of their knowledge and technologies;

b) population and conservation biology to understand the structure and dynamics of genetic diversity in local farmers' varieties{/landraces} (including population differentiation, gene flow{ including introgression}, ~~genetic pollution,~~ degree of inbreeding, and selective pressures);

c) crop improvement research, including participatory breeding, as a means of increasing crop yields and reliability without significant losses of local biodiversity;

d) research and extension studies for neglected and underutilized crops, including production, marketing and distribution of seed and vegetatively propagated planting materials;

e) studies of the most effective ways to integrate on-farm and *ex situ* conservation [considering the complementarity of formal and local seed systems];

f) studies on the extent and nature of possible threats to existing diversity on-farm and *in situ*, particularly regarding threats represented by climate and land use change (including their effects on pollinators);

g) spatial analysis to identify varieties likely to have climate-adapted traits to aid plant breeding[;

h) studies to quantify genetic erosion].

53. Scientific research should, when possible, be coupled with on-farm activities in order that the context and purpose of the work are fully ~~appreciated~~{evaluated.} {Phenotyping techniques could be used for the characterization of farmers' varieties/landraces in relation with specific traits and adaptation to various field conditions}. Research should assist in the monitoring, evaluation, and improvement of on-farm activities. Research should be undertaken in a participatory and collaborative manner to foster interaction and cooperation [between rural people][among farmers, breeders] and the staff of national institutions. Other institutions must be involved appropriately whenever necessary.

54. Methods should be developed and assistance provided for integrating *in situ*, {on }farm and [in][garden] management and conservation of PGRFA with national and regional genebanks{/networks} and research institutes.

55. **Coordination/administration:** Coordination efforts in this area should allow for and encourage local, community-level initiatives in proposing programmes. Small, grass-roots projects should receive priority in funding and support services. Priority should be placed on farmers{-initiated technical projects promoting crop diversity and} ~~with a technical project promoting the maintenance of pre-existing diversity and on~~ collaboration between communities and research institutions. Subject to satisfactory progress, programmes should be sufficiently long (10 years or more) to achieve results.

56. Links between organizations primarily concerned with conservation of PGRFA and those dealing with its use are often weak or absent in many countries and require strengthening.

3. Assisting farmers in disaster situations to restore crop systems[[18]]

57. **Background:** Natural disasters and civil strife often challenge the resilience of crop systems, in particular affecting small-scale and subsistence farmers in developing countries. Seed security is a key component of such resilience. Whereas immediate seed assistance can help the farmers affected by an acute disaster, a more systematic approach to re-establishing seed security and crop systems is needed in the case of chronic stresses. In particular, there has been recognition over the past decade of the extent and nature of the threats posed by climate change to seed and food security, and the importance and potential of PGRFA in helping agriculture to remain productive and robust under changed conditions. When crop varieties are lost from farmers' fields in an area, they can often be re-introduced over time from surrounding areas, with some support, through local markets and farmer-to-farmer exchange. They can also be re-introduced from additional sources, in particular national, regional or international genebanks{ and networks}. However, genebanks themselves are sometimes compromised by natural and man-made disasters and in these cases their ability to support restoration of crop systems will rely on access to materials held in other genebanks. The International Treaty, in Article 12, provides a sound basis for improving and facilitating such access. National, regional and global information systems are needed to support such restoration activities.

58. Food aid, combined with the importation of often poorly adapted seed varieties, can lower yields and keep them low for years. In the long run, inappropriate food and seed aid practices can exacerbate hunger, undermine food security, distort local seed systems and increase costs of donor assistance. Realizing this, a fundamental shift in thinking has occurred in the past decade, based on the seed security framework. The objective is to investigate in detail the functioning of seed systems and to describe the seed situation in terms of availability, access and quality. After disasters, farmers often have difficulty accessing seeds of locally-adapted varieties, even though they may be available, because they have lost financial and other assets. The new thinking engendered by the seed security framework has led to better coordination among agencies and new types of seed interventions, moving beyond direct distribution of seeds and other inputs to farmers. These include market-based approaches such as seed vouchers and input trade fairs and community-based seed multiplication initiatives for both farmers' and improved varieties.

59. ~~**Long-term objectives**~~**{Objectives}:** To rehabilitate affected crop systems based on locally adapted PGRFA, including the restoration of germplasm as appropriate, in support of [farming]community livelihoods and sustainable agriculture.

60. ~~**Intermediate objectives:**~~ To develop capacity to assess and establish seed security, including helping farmers to access locally adapted PGRFA.

61. To establish institutional responsibilities and mechanisms for the identification, acquisition, multiplication and delivery of appropriate PGRFA.

62. To strengthen the capacity of [rural][farming] communities and farmers to identify and access relevant PGRFA held *ex situ*.

63. To ensure that crop varieties delivered to stressed communities are adapted to local conditions.

64. **Policy/strategy:** Governments, with the co-operation of relevant farmers' organizations and communities, UN bodies and regional, intergovernmental and NGOs, should establish necessary policies at all levels that allow implementation of appropriate seed security activities in response to disasters, including climate change.

65. Governments should develop policies and strategies for disaster risk planning and response which take fully into consideration seed security issues, and the location-specific conditions and

[18] [Proposal to merge PAA 3 with PAA 16.]

requirements of seed security interventions. This will include promoting seed security assessments, and developing guidelines for best practices for seed interventions.

66. Efforts are needed to conserve farmers' varieties{/landraces} and CWR before they are lost as a result of changing climates, or other threats. Special efforts are needed to identify species and populations most at risk and that carry potentially important traits.

67. There is a need for countries to establish or strengthen genetic erosion monitoring systems, including easy-to-use indicators. Support should then be given to urgent collecting farmers' varieties{/landraces} in especially vulnerable or threatened areas, where these are not already held *ex situ*, so that they can be multiplied for immediate use and also conserved for future use. There should be duplication of national genebank collections outside of the country, such as in genebanks of neighbouring countries, and/or regional or international genebanks{ and networks}. A systematic global assessment is needed of the extent to which existing collections are backed-up, to avoid excessive duplication.

68. Genebanks{ and networks} should make available characterization and evaluation information that will assist in identification of useful accessions to be deployed for restoration of crop systems, respecting access and benefit sharing agreements. The Multilateral System of the International Treaty should facilitate this process.

69. **Capacity**: National and international agricultural research institutions should collaborate with FAO and other appropriate agencies to establish mechanisms for rapid acquisition and multiplication, restoration and provision of PGRFA to countries in need. Such agencies should ensure that capacity is sufficient for the task. Cooperation with NGOs[, public] and private organizations is an important component of efforts to distribute locally adapted germplasm in regions that are recovering from disasters.

70. Information systems must be established to identify and obtain appropriate germplasm for reintroduction.[Arrangements for repatriation of PGRFA that could have been lost or damaged due to extreme situations should be foreseen.]

71. Governments and international emergency agencies should consider making available adequate funds for multiplication of seed of locally adapted PGRFA in response to emergency demand after disasters.

72. Response interventions can be complemented by preventive national and community-based seed multiplication initiatives, and governments should strengthen capacities to cope with disasters and support the re-emergence of local seed supply networks and crop systems.[The farmers' role in conserving local varieties/landraces should be recognized as this represents an important source of genetic diversity for restoration.]

73. **Research/technology**: Studies are needed on the extent and nature of possible threats to existing diversity on-farm and *in situ*. Previous experience should be reviewed and options developed to enhance preparedness for rescue of *ex situ* collections and seed collecting in the context of emergencies, including civil strife, industrial accidents and natural disasters. These efforts will benefit from close collaboration among governments of countries affected, donors, NGOs and private organizations, national, regional and international agricultural research institutes, regional plant genetic resource networks as well as relevant inter-governmental agencies. Research on how rural communities can identify, obtain and use PGRFA held *ex situ* is also needed.

74. Studies are also needed on pre-disaster seed production and delivery systems, including crop agro-ecologies, crop calendars, local seed flows, seed markets and stocks. Information that would assist planners in disaster risk reduction and response is lacking, especially regarding the anticipated effects of climate change.

75. **Coordination/administration**: At the national level, coordination will be needed among ministries of agriculture, the environment and agencies involved in disaster preparedness and response. NGOs will have a particularly important role to play. Public awareness efforts are

needed to sensitize the donor community and NGOs to the importance of adapted PGRFA in relief and rehabilitation efforts. Such efforts should also increase awareness of the need for safety duplication of *ex situ* collections in other countries.

4. Promoting *in situ* {conservation and }management of crop wild relatives and wild food plants

76. **Background**: Natural ecosystems contain important PGRFA, including rare, endemic and threatened CWR and wild food plants. These species are becoming increasingly important as providers of new traits for plant breeding. CWR and wild species are ideally conserved *in situ*, where they can evolve under natural conditions. Unique and particularly diverse populations of these species must be protected *in situ* when under threat. Most of the world's ~~8,500~~ national parks and other protected areas, however, were established with little specific concern for the conservation of genetic diversity of any plants, let alone specifically CWR and wild food plants. Management plans for protected areas are not usually specific enough to conserve genetic diversity of these species, but could be modified to complement other conservation approaches. It can be argued that actively conserving CWR genetic diversity in protected area networks significantly raises the understanding of their value in ecosystem services, which in turn underpins the long-term security of the protected area itself.

77. Many protected areas are also under threat of degradation and destruction. Climate change represents an additional serious threat. It is therefore necessary to complement conservation in protected areas with measures aimed at conserving genetic diversity that lies outside such areas, and also with *ex situ* conservation as appropriate. *In situ* conservation implies comprehensive planning, which should consider and accommodate the often conflicting demands of environmental protection, food production and genetic conservation.

78. ~~**Long-term objectives**~~**{Objectives}**: To use genetic resources of CWR and wild food plants sustainably and conserve them in protected areas and on other lands not explicitly listed as protected areas.

79. ~~**Intermediate objectives:**~~ To promote planning and management practices in important *in situ* conservation areas for CWR and wild food plants. To assess the threats to, and conservation status of, priority CWR and wild food plants and develop management plans for their protection *in situ*. To improve knowledge of the uses of wild plants as sources of income and food, in particular by women.

80. To create a better understanding of the contributions of CWR and wild plants to local economies, food security, and environmental health. To improve management and planning, and promote complementarity between conservation and sustainable use in parks and protected areas by, among other things, increasing the participation of {indigenous and }local communities and ensuring the active conservation of CWR and wild food plant genetic diversity.

81. To establish better communication and coordination among various bodies engaged in *in situ* conservation and land use management, nationally and regionally, especially between the agriculture and environment sectors.

82. **Policy/strategy**: Governments, subject to national legislation, with {stakeholders and}~~the~~ NGOs, and taking into account the views of farmers{, indigenous} and local communities, should:

a) include as appropriate, among the purposes and priorities of national parks and protected areas, the conservation of PGRFA, including appropriate forage species, CWR and species gathered in the wild for food{ or feed, which could include hotspots of and genetic reserves for CWR and wild food plants};
b) consider integrating conservation and management of PGRFA, particularly CWR and wild food plants in their centres of origin, major centres of diversity and biodiversity hotspots, in national land use plans. Recognizing that the centres of diversity are primarily located in developing countries where resources may be limited and capacity

building and [resource][technology] transfer required. *In situ* conservation strategies need to be ~~linked better~~ {complementary }with *ex situ* strategies;

c) support the establishment of national and local objectives for protected area management through broad based participation, involving in particular groups most dependent on wild food plants;
d) support the creation of advisory panels to guide management of protected areas. Where appropriate, involve farmers, indigenous communities, PGRFA scientists, local government officials (from various ministries), and community leaders, according to national legislation;
e) [note the interrelationship between genetic resources and traditional knowledge, their inseparable nature for indigenous and local communities, the importance of the traditional knowledge for PGRFA, and for the sustainable livelihoods of these communities, especially][recognize the rights of indigenous {and local }communities to PGRFA]in protected areas according to national legislation;
f) recognize that women are a valuable source of information on the feasibility of *in situ* conservation and management practices;
g) adopt improved measures to counter the threat of invasive alien species that could impact negatively on *in situ* conservation of CWR and wild food plants;
h) support indigenous and local community efforts to manage CWR and wild food plants in protected areas~~, or where existing aboriginal or treaty rights are recognized~~;
i) review existing environmental impact statement requirements to incorporate an assessment of the likely effect of the proposed activity on local biodiversity for food and agriculture, particularly on CWR;
j) integrate genetic conservation objectives into the sustainable management of CWR and wild food plants in protected areas and other managed resource areas;
k) collate information on CWR and wild food plants and make the information available through national information sharing mechanisms and specialized global information systems.[19]

83. Governments, in cooperation with the relevant UN bodies and regional, intergovernmental and NGOs and the farming, indigenous and local communities living in non-protected areas, should seek, where possible and appropriate, to:

a) develop national strategies for CWR conservation and use as a basis for *in situ* and *ex situ* conservation action and sustainable use;
b) take conservation action to maintain the diversity of CWR and wild food plants as an integral component of land-use planning;
c) encourage {indigenous and }local communities to conserve and manage CWR and wild food plants, and provide for participation in decisions relating to local conservation and management.

84. As appropriate and feasible, protected area policies should promote and sustain, rather than restrict, those human activities that maintain and enhance genetic diversity within and among plant species. Participatory approaches to protected and related area management should also be encouraged to reconcile the sometimes conflicting goals of conservation and local livelihood security.

85. In parallel with the national approach there is also a need for a complementary global perspective that focuses on securing the *in situ* conservation of the world's most important CWR species, including the establishment of a global network of genetic reserves. While it is recognized that the prime location for *in situ* conservation of CWR diversity will be existing protected areas, because these are already established for ecosystem conservation, the possibility of *in situ* conservation of CWR outside of protected area should also be evaluated.

86. FAO should promote the adoption and implementation of a global strategy for CWR management that can serve as a guide for government action, recognizing there is a requirement for action at both the national and global levels.

[19] Crop Wild Relatives Portal and Genesys.

87. **Capacity**: Governments should, whenever possible, and as appropriate:

a) develop a prioritized plan, particularly for those ecosystems in which high levels of diversity of CWR and wild food plants are found, and conduct national reviews to identify management practices needed to safeguard the desired level of genetic diversity for CWR and wild food plants;
b) assist {indigenous and }local communities in their efforts to identify, catalogue and manage CWR and wild food species;
c) monitor the holdings, the distribution and diversity of CWR and wild food plants, integrate and link data and information from *in situ* conservation programmes with that from *ex situ* programmes and encourage private and nongovernmental organizations to do likewise.

88. **Research/technology:** Research needs relating to *in situ* management of CWR and wild food plants includes{:}

a) studies on their reproductive biology and ecological requirements~~. Strengthened research capacity is also required in areas such as~~ {;}
b) species {classification and }identification~~,~~{and ethnobotany;}
c) {description of }gene pools ~~description~~ and population {surveys}~~surveying~~{,} using new molecular tools{, as well as models for assisted migrations of populations of CWR that may be threatened in their natural habitats;}~~. Research should also target~~
d) understanding the value of CWR *in situ* and the role they play in ecosystem services.

89. **Coordination/administration:** Governments should, as appropriate:

a) link protected area planning and management with organizations responsible for the conservation and sustainable use of CWR and wild food plants, such as centres for crop genetic resources, national crop genetic resources coordinators, national protected area network managers and botanical gardens, and including organizations involved in the environment sector;
b) designate focal points, as appropriate, to catalyze coordination of *in situ* protection programmes and liaise with other countries in the region;
c) establish mechanisms for periodic review and modification of conservation plans;
d) link information on CWR to specialized global information systems to aid information exchange and dissemination.

***Ex Situ* Conservation**

5. Supporting targeted collecting of plant genetic resources for food and agriculture

90. **Background:** The prime motivating forces behind most collecting are gap-filling, imminent risk of loss and opportunities for use. The germplasm currently conserved in genebanks does not represent the total variation in PGRFA. Many major crops have generally been well collected, but some gaps still exist. Collections of most regional, minor, and underutilized crops are much less complete. CWR, even of major crops, have received little attention relative to their potential importance in breeding. The global crop strategies supported by the Trust make an attempt to identify gaps in global holdings of some major food crops. However, in the absence of comprehensive analysis of all the genetic diversity represented in the world's genebanks, these conclusions remain tentative. In addition, collecting missions conducted with inadequate methodologies may not have successfully sampled diversity. Also, the extent and distribution of diversity in wild populations and farmers' varieties{/landraces} (particularly for annual crops) changes over time. Sub-optimal conditions in genebanks may also have led to the loss of collected materials, requiring re-collection.

91. Global threats to PGRFA *in situ* and on-farm have increased during the past 20 years{ due to the increased impact of human activities on land}. Major threats to landraces and CWR {conservation }are [<u>linked to the lack of funds and long term impact in relation to agricultural</u>

policies][the introduction of modern varieties], climate change, alien invasive species, and land use change, including urbanization. A recent assessment indicates that up to 20% of plant species may be threatened with extinction globally. It is unlikely that the figure is lower for CWR. An urgent need for resistances to biotic and abiotic stresses and nutritional and other traits often warrant further collecting.

92. ~~**Long-term objectives**~~**{Objectives}**: To collect and conserve diversity of PGRFA together with its associated information, in particular diversity that is missing from *ex situ* collections, under threat or of anticipated usefulness.

93. ~~**Intermediate objectives:**~~ To identify priorities for targeted collecting in terms of missing diversity, potential usefulness and threatened environments.

94. **Policy/strategy**: Policy makers need to be made aware of the continuing need to improve the coverage of diversity in *ex situ* collections, including CWR, farmers' varieties{/landraces} and wild food plants{ and forages}. Collecting best practices should be developed and documented with regard to the objectives and obligations set forth in the CBD and Article{s} 5 {and 12.3 h }of the International Treaty, for example the right of Contracting Parties {of the CBD }to require prior informed consent before providing access to genetic resources{,} and ~~the~~{their} obligations ~~of Contracting Parties~~, subject to their national legislation, to respect the knowledge of indigenous {and local }communities regarding the conservation and sustainable use of biological diversity.

95. **Capacity**: Collected material should be deposited in facilities with the capacity to manage them in the country of origin, and elsewhere for safety duplication, as agreed by the country of origin prior to collection. Where such facilities do not exist in the country of origin, they should be developed, as appropriate, and in the meantime, the materials could be managed in other countries as agreed ~~in~~{with} the country of origin prior to collection.

96. Full consideration should be given to the capacity to conserve the material collected effectively and sustainably before collecting is initiated.

97. Training should be undertaken in scientific collecting methods for PGRFA, especially in connection with the use of tools and methods that enhance collecting efficiency and effectiveness, such as GPS, spatial modelling programs and ecogeographic surveying.

{97 bis. **Research/technology**: Research is needed to identify gaps in existing *ex situ* collections to ensure the entire genepool is adequately represented; this will require access to and availability of accurate passport and other data. The use of GIS and molecular technologies can also facilitate the identification of gaps and planning of collecting missions. In the case of some CWR, research may be needed on the taxonomy and botany of the targeted species.}

98. **Coordination/administration**: Coordination, as appropriate, should take place within a country, in particular between genebanks and herbaria and other institutes with taxonomic expertise. Regional and international level coordination is needed to provide linkages with *ex situ* collections and gap-filling and regeneration efforts. Such coordination might concern the identification of global needs or specific national needs that could be met by PGRFA in another country.

99. Strong linkages need to be established with regional and crop networks and with the users of PGRFA (breeders, researchers and farmers) in order to inform, direct and prioritize the entire conservation process, including surveying, inventorying and collecting.

100. Mechanisms need to be developed at all levels for emergency collection of PGRFA{, in particular endangered CWR}. These mechanisms should make full use of, and therefore should be closely linked with, information and early warning systems at all levels.

101. As part of national PGRFA programmes, governments should designate a focal point for administering requests for collecting.

6. Sustaining and expanding [existing]*ex situ* conservation of germplasm

102. **Background**: Currently seed, field and in vitro genebanks conserve approximately 7.4 million germplasm accessions, about a quarter of which are estimated to be distinct samples duplicated in several collections. These are complemented by over 2,500 botanical gardens worldwide that grow over one third of all known plant species and maintain important herbaria and carpological collections. Driven by an increasing need for diversification, interest in collecting and maintaining collections of underutilized crops, wild food species{, forages} and CWR is growing, but such species tend to be more difficult to conserve *ex situ* than major food {or forage }crops. Even many important crop species do not produce seed that can be stored under conditions of low temperature and humidity and the conservation of genetic resources of such plants, with recalcitrant seeds or vegetatively propagated, is still not being given appropriate attention.

103. Globally, governments and donor agencies need to invest more in conservation infrastructure, in particular for species that cannot be conserved in seed banks, taking particular account of maintenance costs. This will stem the steady deterioration of many facilities and enhance their ability to perform basic conservation functions. The severity of the threat to *ex situ* collections is reflected in the high percentage of accessions reported as being in need of regeneration in many national reports, as well as the lists of technical and administrative problems associated with maintaining genebank activities. The Trust aims to support better planning and more coordination and cooperation {in order to limit redundancy and promote rationalisation} at the global level, to reduce the overall cost of conservation work and place genebank operations on a scientifically sound and financially sustainable basis. Options need to continue to be explored for more cost-effective and rational conservation.

{103bis. Regionally, the collaboration on *ex situ* conservation has to be strengthened.}

104. The Svalbard Global Seed Vault opened in 2008, and represents a major new international collaborative initiative to improve the safety of existing collections of orthodox seeds. Similar efforts are not yet planned for recalcitrant species and vegetatively propagated crops.

105**. ~~Long-term objectives~~{Objectives}**: To develop a rational, efficient, goal-oriented, economically efficient and sustainable system of *ex situ* conservation and use, covering both seed- and vegetatively-propagated species.

106. ~~**Intermediate objectives**:~~ To develop and strengthen national, regional and international networks, including the existing Multilateral System of the International Treaty. To develop sufficient capacity to provide options to countries for the voluntary storage of appropriate genetic materials and their duplicates. To develop management strategies for *ex situ* conservation of vegetatively propagated and non-orthodox seeded plants, as well as for species {and genetic and genomic stocks }neglected in current conservation activities. To promote the development and transfer of appropriate technologies for the conservation of such plants and to encourage and strengthen the involvement of botanic gardens in the conservation of PGRFA. To promote access to and exchange of information about PGRFA.[To set priorities for conservation using more data from characterisation and evaluation of PGRFA.]

107. To reduce unnecessary redundancy of germplasm accessions in current conservation programmes, make use of available storage space and promote access to and exchange of information about PGRFA in line with {national priorities and laws, and }applicable {regional or }international agreements, including the International Treaty. To provide for the planned replication and safe storage of materials not currently {safety }duplicated.

108. **Policy/strategy**: The international community has interests in and responsibilities for the *ex situ* conservation of PGRFA. It is this understanding which provides the basis for an effective, integrated and rational global plan to secure existing collections. Countries have national sovereignty over, and responsibility for, the PGRFA they conserve, but there is a need for greater rationalization of the global system of *ex situ* collections. ~~This is the objective of the work of the Trust.~~

109. Governments, international agricultural research centres, NGOs and funding agencies, should provide adequate, appropriate and balanced support for the conservation of vegetatively propagated and recalcitrant seeded plants in addition to the support provided for conservation of seeds of orthodox species. In this regard, botanic gardens and field genebanks should be strengthened in their capacity to conserve important neglected and underutilized species.

110. Full use should be made of existing facilities, including national, regional and international centres. Conserved materials should be replicated and stored in long-term facilities meeting international standards, in accordance with applicable international agreements. Unintended and unnecessary duplications between collections should be reduced to promote cost efficiency and effectiveness in global conservation efforts. Countries could be assisted in identifying which genetic resources are already stored and duplicated in long-term facilities.

111. FAO, in co-operation with countries and with relevant institutions, should facilitate the formalizing of agreements to safeguard diversity in *ex situ* collections in conformity with applicable {regional or }international agreements, including the International Treaty. This would allow those countries so desiring to place collections voluntarily in secure facilities outside their boundaries.

112. **Capacity**: Personnel should be ~~recruited and~~ trained at all levels to implement and monitor the above policies and agreements. National institutions should evaluate current genebank management practices to create more rational, efficient, and user-oriented *ex situ* conservation systems. Appropriate facilities, human resources and equipment should be made available to national programmes.

113. Ongoing conservation of collections of PGRFA should be secured, and particular care must be taken to safeguard the original accessions of threatened collections.

[114. Simple, low-cost botanic gardens, arboreta and field genebanks associated with universities, schools and other institutions should be strengthened and encouraged to promote education and public awareness.] [20]

115. Support should be given to training in in vitro techniques and other new and appropriate technologies. In accordance with national, sub-regional and regional needs and priorities, support should be given to establishing the capacity to use such technologies.

116. Support should be given to defray expenses incurred by institutions providing designated storage and related conservation and research/documentation services for other countries. This support could help all unique material to be identified, suitably duplicated, stored safely, and characterized, regenerated, evaluated, and documented. This would include the identification of materials both inadequately and excessively duplicated. Materials not yet duplicated should be suitably multiplied and placed in secure storage, with the full observance of applicable international agreements and national legislation. Additional *ex situ* duplications of accessions would be maintained at the discretion of countries. Expansion of some existing storage facilities and the creation of new facilities may be desirable.

117. **Research/technology**: Research should be aimed at the development of improved conservation methods, including in vitro and cryopreservation, and in particular, reliable low-cost techniques appropriate to local operating conditions. Technologies and procedures directly transferred from temperate climates may not be appropriate for conditions in tropical countries and vice versa.

118. Research based on the improved documentation foreseen under the GPA should be undertaken to assist decision-making on developing a rational, effective system. This might include, among other things, research on identifying priority germplasm and duplications, on methods of identifying duplicates as well as of testing viability of accessions, procedures for the rational conservation and duplication of vegetatively-propagated species, and on the modalities

[20] [Proposed to be moved to Priority Activity Area 18]

and technologies of conserving genes, genotypes and gene complexes.

119. Research needs to be done on the best storage conditions for orthodox seeds, non-orthodox seeds and vegetative material. Genomic and phenotypic studies need to be undertaken that better link molecular data with phenotypic descriptor data. Protocols should be developed for in vitro conservation and other conservation technologies for important vegetatively propagated and non-orthodox seed plants, and an assessment should be made of the conservation needs of other species for food and agriculture that are not adequately conserved.

120. **Coordination/administration**: Coordination should take place within the country, among {all PGRFA stakeholders, including }the national genebank[(s)], national crop working groups, ~~and all users of PGRFA (~~breeders, researchers, farmers and NGOs~~)~~. Strong links need to be established with regional networks and international centres.

121. Periodic administrative and technical reviews should be encouraged to assess the effectiveness of the actions taken. Subject to these reviews, as well as the specific provisions of relevant agreements, financial support should foster long-term security and allow efficient planning.

122. NARS, crop and regional networks, as well as relevant international botanic garden organizations, with the support of international agricultural research centres and regional organizations, should regularly assess the state of conservation of vegetatively propagated and non-orthodox seeded plants, and make recommendations and take action when necessary.

123. Botanic gardens should be encouraged to participate actively in the activities of international associations. Linkages between organizations such as the International Association of Botanic Gardens and Botanic Gardens Conservation International and those responsible for and engaged in conservation of PGRFA (e.g. FAO, Bioversity International and other international agriculture research centres) should be strengthened. Similar linkages should be made between organizations, including those in the private sector (such as the nursery trade), at the national level. Practical cooperation should be encouraged as a matter of priority.

7. Regenerating and multiplying *ex situ* accessions

124. **Background:** As accessions stored *ex situ* decline in viability, both genes and genotypes are lost. Even under optimal *ex situ* storage conditions, all accessions eventually require regeneration. Capacity for regenerating was often not considered when assembling collections and disseminating accessions, with the unintended consequence that much material collected in the past cannot now be properly maintained. Consequently, a large backlog of materials developed. Low initial sample size, low viability and frequent demand for samples from long-term storage facilities can shorten the regeneration/multiplication cycle. But, because proper long-term storage conditions should obviate the need for regeneration for decades, average, routine, on-going annual regeneration requirements (as opposed to multiplication needs) amount to fewer than 10% of conserved accessions. However, some 55% of countries contributing information on regeneration to the World Information Sharing Mechanism on GPA implementation (WISM) report continuing significant backlogs, and that regeneration capacity has declined in 20% of genebanks. Global crop strategies supported by the Trust indicate that regeneration backlogs occur in all crops and regions. However, significant advances have been made, including at the global level as a consequence of the funding provided to the CGIAR centres for the 'Global Public Goods' projects, and at the national level through funding by the Trust. The Trust has also supported the development of regeneration guidelines for a number of Annex I crops. Inadequate documentation of accessions continues to represent a constraint to a rational global approach to regeneration, although the necessary information is now increasingly available electronically. Many countries cite lack of facilities for handling cross-pollinated species and inadequate funds and human resources as major problems. Good planning and coordination will minimize the amount of material to be regenerated, but continued intervention is necessary to maintain viability of much of the stored genetic diversity of PGRFA.

125. ~~**Long-term objectives**~~**{Objectives}:** To regenerate and multiply *ex situ* accessions to satisfy needs for conservation, distribution and safety duplication.

126. ~~**Intermediate objectives:**~~ To establish the processes, partnerships and capacity needed for regeneration and multiplication of *ex situ* collections to satisfy needs for conservation, distribution and safety duplication.

127. **Policy/strategy:** Priority should be given to:

a) regenerating samples currently in long-term storage or intended for placement in long-term conditions and experiencing a loss of viability;
b) regenerating samples which meet the criteria of being globally unique, threatened, and having the potential of maintaining the diversity of the original sample.

128. Input from crop and regional networks should be sought in refining priorities and identifying priority germplasm for regeneration and multiplication.

129. Identification of specific samples for regeneration and multiplication should be made in cooperation with national programme breeders and curators, who often have intimate and detailed knowledge of collections and of the availability of similar materials from *in situ* locations.

130. Regeneration and multiplication efforts should strive to maintain the allelic and genotypic diversity and adapted complexes of the original sample. Minimizing the frequency of regeneration is an important goal and consequence of other activities under the GPA.

~~131. Efforts should be encouraged to reduce unneeded redundancies within and among collections as a means of improving efficiency and minimizing on-going conservation costs.~~

132. Governments, the private sector, organizations, including in particular the CGIAR, and NGOs should:

a) cooperate to make efficient use of existing capacity and to ensure that regeneration and multiplication can take place, if scientifically, technically and administratively feasible, at sites where conditions approximate to those from where the sample was collected;
b) promote and facilitate access to PGRFA stored *ex situ* to minimize the need for storing identical samples in several locations, and the consequent need to regenerate each of them.

133. Characterization activities should be undertaken in conjunction with regeneration without compromising the effectiveness or scientific goals of the regeneration exercise. Characterization should be developed in line with globally accepted standards.

134. **Capacity:** Proper facilities, adequate human resources, appropriate technology, and necessary equipment should be available to national programmes and international organizations involved in regeneration and multiplication activities undertaken as part of the GPA. Particular attention should be given to establishing or strengthening capacity for the regeneration and multiplication of cross-pollinated, vegetatively propagated and recalcitrant species{, including building capacity for their safety duplication}. Consideration should also be given to involving the private sector, farmers, and NGOs.

135. Genebanks should ensure monitoring and have the capacity to determine the status of their accessions and prioritize those in need of regeneration and multiplication.

136. Training programmes should take into consideration the differences in regeneration and multiplication requirements among species.

137. **Research/technology:** Guidelines for regeneration, including standards and specific technologies, should continue to be developed, especially for cross-pollinated, vegetatively propagated and recalcitrant species.

138. There is a need to reinforce research to improve conservation technologies in various key areas: lengthening of the interval between regeneration cycles (orthodox seeds), physiological

mechanisms linked to low temperature tolerance and dehydration (recalcitrant seeds), and *in vitro* conservation technologies.

139. Research should be undertaken to increase the effectiveness and efficiency of regeneration efforts, including methodologies for minimizing genetic drift, to identify markers associated with seed longevity to assist in devising regeneration strategies, to develop an understanding of the causes of mutations in conserved germplasm, to eliminate seed-borne pests. Important questions remain regarding breeding systems, reproductive biology, dormancy mechanisms and technical problems associated with regeneration practices.

~~140. Data on existing accessions in *ex situ* collections should be assembled and analyzed in order to assist in planning and implementation.~~

141. **Coordination/administration:** The active involvement of crop and regional networks is important to the success of regeneration and multiplication efforts, particularly in the identification and prioritization of germplasm to be regenerated and multiplied. Similarly, national plans for regeneration should be formulated, particularly with regard to PGRFA of national priority.

142. There should be on-going monitoring of the need for regeneration and multiplication, including consideration of the necessity for adequate duplication, storage behaviour of the species, storage conditions, and individual accession viability.

[Sustainable Use]|[Sustainable utilization of PGRFA]

8. Expanding characterization, evaluation and further development of specific collection sub-sets to facilitate use[21]

143. **Background:** Genebank collections should help users respond to new challenges and opportunities, to improve productivity, enhance sustainability and respond to change, particularly climate change{ and pest resistance, and human needs related to PGRFA}. It is widely recognized that crop germplasm collections house much of the diversity that will be needed to meet these challenges. In order for plant breeders, researchers and other users of PGRFA to make the most effective use of collections they need to quickly identify a manageable number of genotypes that possess or are likely to possess the many different traits needed in their programmes. Improved characterization and evaluation can encourage greater and more efficient use of collections. Understanding genetic variability and expression are also important for improving use of plant genetic resources. The development of limited sets of material based on either capturing total diversity in a small number of accessions or the variation in particular traits has been found to improve use of collections. These efforts require close collaboration between germplasm curators and plant breeders in the delineation of manageable collection sub-sets. {Characterisation and evaluation}~~Evaluation~~ can also aid the identification of germplasm of potential for {further improvement by breeders, farmer breeders as well as }~~more~~ direct use by farmers{ for production and marketing}.

144. In the past decade, significant progress has been made in the characterization and evaluation of crop germplasm collections. Many countries have acquired the capacity for using molecular techniques in germplasm characterization, a development that is leading to the generation of more comprehensive and reliable data. Efforts will have to continue in developing such capacity where it is still needed. Significant advancements have also been made in the development of high throughput phenotyping techniques and related infrastructure. In order to ~~characterize~~ efficiently {characterize and evaluate }germplasm accessions and breeding materials for traits associated

[21] ["Characterization is the recording of highly heritable characters that can be easily seen and are expressed in all environments. Evaluation is the recording of those characteristics whose expression is often influenced by environmental factors." Reference: Rao NK, Hanson J, Dulloo ME, Ghosh K, Nowell D and Larinde M. 2006. Manual of seed handling in genebanks. Handbooks for Genebanks No. 8. Bioversity International, Rome, Italy. ISBN 978-92-9043-740-6]

with adaptation to, and mitigation of, the effects of climate change, {and response to consumer demands, }it is equally important to continue developing phenotyping capacity.

145. Despite such overall progress, there are still large data gaps and much of the existing data are not easily accessible. The lack of adequate characterization and evaluation data, and of the capacity to generate and manage it, remain serious constraints to the use of many germplasm collections, especially of underutilized species and CWR. With improved access to molecular and computational biology techniques, information technology and GIS, the utility of PGRFA collections could be greatly enhanced by increasing the types and volume of data on germplasm. Efforts should equally be invested in developing standard descriptors and uniform characterization methodologies for more crops and species. Increased funding and capacity building will contribute to increasing the breadth and depth of germplasm characterization efforts and consequently lead to greater ease for mining genebanks for traits of interest.

146. ~~**Long-term objectives**~~**{Objectives}**: To enhance the use and management of conserved plant genetic resources. To identify germplasm of potential value for research and crop improvement [by scientists and breeders, including farmer breeders,]and for direct use by farmers in the rehabilitation of degraded ecosystems, and other forms of direct use in agro-ecosystems.

147. ~~**Intermediate objectives:**~~ To develop innovative, crop specific characterization and evaluation [programmes][activities]{, with participatory approaches as appropriate}, including for underutilized species, to identify potentially useful accessions and genes for improved productivity and sustainability, especially in the context of climate change.

148. To improve the efficacy of the evaluation process by developing and adapting high throughput evaluation methods such as rapid, computerized assays of genetic diversity and metabolic content; new biochemical analyses; and novel methods for rapidly-capturing morphological and structural variation in the field via hand-held devices, for identifying accessions with valuable traits.

149. To establish sub-sets of material including trait specific collections for crops of global importance.

150. To improve and facilitate exchange and access to quality characterization and evaluation data across genebank{ and network} collections, including through national, regional and global information systems.

151. **Policy/strategy**: Governments with the co-operation of the relevant UN bodies and regional, intergovernmental organizations and NGOs, international agricultural research centres, [regional networks,]and including the private sector, and taking into consideration views of the scientific community[, breeders' organisations] and farmers' organizations [and their communities]should:

a) establish baseline characterization and evaluation data, define priorities and periodically assess progress in evaluation in relation to the different needs of the various users of PGRFA, with emphasis on identifying traits that counter limits to production in staple crops and of crops of national economic importance[and crops of dietary interest];
b) support collaboration and complementarities between breeders, researchers, extension services, farmers and genebanks;
c) encourage access to, and exchange of, characterization and evaluation information, including through networking of genebank databases within and among countries;
d) note that access to PGRFA is subject to applicable [regional or]international agreements such as the International Treaty. In compliance with such agreements, users of PGRFA should be encouraged to agree to provisions for sharing relevant evaluation data with source institutes, giving also due regard to the special needs of commercial users for appropriate confidentiality;
e) use characterization and evaluation data to help improve *in situ* management of landraces, crop wild relatives, other wild food plants, and forages;
f) give appropriate financial support for characterization and evaluation programmes for crop species of primary or exclusive importance to food security in their countries, given

the importance of medium and long-term financing, and promote synergies with existing funding mechanisms (e.g. BSF of the International Treaty)[

g) promote the use of close up high quality photographs of specific phenotypic traits (e.g. whole cereal heads) and embed these into internet-accessible databases].

152. Crop networks and genebanks should be encouraged to identify useful traits and establish trait specific and other collections of limited size of interest to users with special focus on adaptation to climate change, sustainability and food security. Characterization and evaluation should be strengthened and standardized and the data made more accessible through improved information system.

153. **Capacity:** Support should be given to continue targeted characterization and evaluation programmes for selected priority germplasm. The characterization and evaluation process would begin with an assessment of current information and an effort to assemble, collate, computerize and make available existing information contained in notes, reports, punched cards, etc. Much evaluation work needs to be done in a use-oriented, site-specific manner.

154. Governments and appropriate organizations should identify institutions and individuals who may have the capacity and expertise to carry out germplasm characterization and evaluation for specific stresses and should develop a national portfolio of such expertise, including [breeders, farmers breeders,]farmers in high stress areas who may perform preliminary evaluation to identify subsets of accessions that hold promise for further evaluation under more stringent scientific conditions. The cost efficiency of sub-contracting evaluation work should also be investigated as well as cooperative programmes between national programmes and the private sector.

155. National programme staff should receive training in germplasm characterization and evaluation techniques on a crop-specific basis. Such training should begin with crops deemed important nationally, and for which there are current or planned breeding programmes. Capacity building should target the development of a critical mass of personnel that are skilled in the use of standardized characterization methodologies, including molecular biology techniques and data management using modern information technology platforms.

156. Training of [local breeders, including farmer breeders,]farmers, including women farmers, participating in on-farm PGRFA evaluation programmes, in the necessary relevant skills should be supported. As their responsibilities often extend from the propagation, production and harvesting of crops to the processing, storage and preparation of foods[/feeds], women's knowledge of the uses and usefulness of plants is often extensive.

157. Young students should be educated and trained in basic topics related to characterization, evaluation and use of plant genetic resources.

158. **Research/technology:** Various kinds of research must be undertaken if the cost effective use of current collections is to be encouraged. This should include:

a) access to the latest technology and support from plant breeding [and]research to improve the use of molecular methods in characterization and evaluation to identify useful genes and understanding their expression and variation;

b) improved methods of germplasm characterization and evaluation using biochemical assays and rapid high throughput phenotyping, in particular for adaptation and mitigation of climate change and nutritional features;

c) improved data exchange through further development and harmonization of standards for characterization and evaluation data.

159. Research is also needed to develop more useful sub-sets of material, including core collections, mini and micro-cores and specific trait collections. This will require systematic development and testing of different sampling procedures[as well as improving the research infrastructure through improved availability of characterisation and evaluation data through the

respective documentation systems]. Further work is also needed on optimizing the ways in which such sub-sets are used by breeders to access best-bet materials from the full collection.

160. **Coordination/administration:** Characterization and evaluation efforts should be planned and implemented with the active participation of national programmes, [plant breeders]and crop and regional networks. As appropriate, [breeders' organisations,]farmers' organizations, private companies and their associations, and others should also be involved.

161. Limited user-friendly collections such as trait specific collections, core or micro-core collections should be developed with the active participation of breeders and other users as well as relevant crop networks. Work on such collections must be considered within and integrated firmly in the context of the entire effort to improve utilization.

162. Cooperation and exchange of information are needed, especially by developing country genebanks that manage very diverse collections but do not have staff with expertise in all of the species conserved.

9. Supporting plant breeding, genetic enhancement and base-broadening efforts

163. **Background:** The germplasm collections maintained in genebanks can be used both to identify specific alleles useful for developing new varieties adapted to new conditions[and needs], and to broaden the overall genetic base of breeding programmes. While some materials can be used directly by breeders for either of these purposes, pre-breeding or genetic enhancement is often necessary to produce material that can be easily used by breeding programmes.[Newly bred cultivars are the principal means by which PGRFA are delivered to farmers.]

164. The challenge of using PGRFA is hampered by the stagnant or dwindling capacity at all stages of the plant breeding process in many countries. There is now a shortage of plant breeders in the public [and private]sector[s] and a declining enrolment in conventional plant breeding courses in universities[/agricultural schools], with students opting rather for disciplines offering careers paths in what are seen as more modern sciences such as molecular biology. There is a compelling need to redress this situation. The role of conventional plant breeding in crop varietal development is irreplaceable. Modern biotechnologies can only offer increased efficiencies, and cannot take the place of traditional crossing selection and field evaluation.

165. Currently, the challenges of [climate change][global change, especially climate change,] is placing increasing demands on breeding programmes, and this is likely to intensify. Significantly strengthened human capacity and infrastructure are necessary for such programmes to deliver varieties with enhanced tolerance to biotic and abiotic stresses needed for adaptation to climate change[, but also for diversification and food security]. Such capacity enhancements must go together with a re-thinking of strategies. Breeding must be needs-based, with greater integration of farmers' [and other consumers']perspectives in setting priorities and defining goals. The efficiency of traditional plant breeding activities must be enhanced by the judicious integration of cost-efficient novel biotechnology and phenotyping strategies.

[165bis.] Pre-breeding and genetic enhancement activities must be encouraged, including by pooling the resources of both germplasm curators and plant breeders, so that the most appropriate germplasm can be identified and used in addressing clearly defined objectives. Greater emphasis must be paid to improving the less studied crops that constitute important staples in many parts of the world. Crop wild relatives must be used more systematically to identify the genes needed for generating the resilient crop varieties needed to safeguard food security in the face of changing climatic conditions.

166. Improving the sustainability, resilience and adaptability of crop production will require the use and deployment of increased amounts of diversity in terms of both the crops and varieties available to farmers. An important contribution can be made through base broadening strategies

which seek to widen the genetic diversity in plant breeding programmes and in the products of such programmes.

167. An example of a multilateral effort in capacity enhancement is the FAO-convened Global Partnership Initiative for Plant Breeding Capacity Building (GIPB). This multi-stakeholder partnership of public and private sector parties from developing and developed counties was created in direct response to the need for capacity for implementing Article 6 of the International Treaty. It aims to enhance the plant breeding capacity and seed delivery systems of developing countries and improve agricultural production through the sustainable use of PGRFA. The Generation Challenge Programme (GCP), an initiative of the CGIAR that aims to create improved crops for small farmers through partnerships among research organizations, is another example of public multi-stakeholder initiatives that promote the use of PGRFA in crop improvement. GCP focuses on using novel biotechnology tools, including genomics, molecular breeding and bioinformatics, to enhance efficiencies in crop varietal development.

168. ~~**Long-term objectives**~~**{Objectives}**: To contribute to food security and improved farmers' livelihoods through the deployment of adapted crops and the development of resilient crop varieties that guarantee high yields under adverse environmental conditions and minimal input agricultural systems. To increase the use of genetic resources and thus provide further tangible incentives for their conservation.

169. ~~**Intermediate objectives:**~~ To reduce vulnerabilities in cropping systems by increasing genetic diversity in the production systems themselves, as well as in crop breeding programmes through the utilization of CWR, farmers' varieties{/landraces}, and [modern varieties][introductions] as appropriate. To increase sustainability of agricultural systems and the capacity for adaptation to environmental changes[and consumers' needs].To strengthen the capacity of [public sector][, as appropriate,] plant breeding programmes and encourage participatory breeding. To provide tools and resources necessary for sustained increases in the genetic diversity used by breeding programmes for both major and minor crops through appropriate base-broadening and genetic enhancement approaches.

170. **Policy/strategy**: Governments, international organizations, NGOs and funding sources should:

a) recognize the importance of providing long-term funding and logistical support to plant breeding and research, pre-breeding, genetic enhancement and base-broadening activities;
b) recognize the importance of providing adequate support for the routine integration of novel biotechnology tools, computational biology and information technology platforms in PRGFA management, especially in germplasm characterization and in facilitating the introgression of desired traits into breeding materials;
c) encourage the development of public-private and other partnerships that foster participatory approaches to the setting of crop improvement priorities and goals and their implementation;
d) develop policies and legislation that support participatory breeding, including appropriate regulatory frameworks for varieties developed through participatory plant breeding;
e) encourage the institutionalization of participatory, gender and youth-sensitive approaches to plant breeding as part of national PGRFA strategies in order to facilitate the adoption of new crop varieties;
f) help to improve access by plant breeders to the widest possible genetic diversity in order to identify the traits needed for developing crop varieties adapted to novel climatic conditions; and
g) in devising national strategies and fostering collaborations, be fully cognizant of the provisions of the Multilateral System of Access and Benefit Sharing of the International Treaty, through which material can be accessed "for the purposes of utilization and conservation for research, training and breeding for food and agriculture."

171. **Capacity:** Support should be given to national systems, regional networks, international agricultural research centres, NGOs, universities[, breeders] and other relevant organizations to

carry out plant breeding, including genetic enhancement and base-broadening activities. Priority should be given to addressing problems identified by crop and regional networks, regional research and development forums, other competent scientific bodies and institutions, [breeders' organisations]and farmers' organizations. Efforts should extend beyond addressing the most pressing problems identified in the crops of Annex I of the International Treaty, to include crops that support local food security around the world.

172. Capacity building will require greater attention being paid to producing skilled personnel in traditional as well as modern plant genetic improvement techniques. In addition, capacity for both field and laboratory evaluation must be strengthened. Capacity building must be accompanied with the provision of adequate incentives, such as structured career opportunities, to facilitate the attraction and retention of experienced staff. Improved international collaboration could help cut training costs and reduce unnecessary duplication of investments. In this regard, regional centres of excellence may be a means of reducing costs and duplication.

173. **Research/technology**: Institutions, should further develop, adapt and use validated efficiency-enhancing biotechnologies and ancillary tools for genetic enhancement, and extend research and development activities to include increased domestication efforts and to optimize the use of CWR in breeding programmes. These contain important genes for biotic and abiotic stress resistance and improved productivity and can be important sources for base broadening. Procedures are needed to improve useful gene identification and transfer.

174. Research is needed to develop selection procedures and breeding methods that support base broadening and improve sustainability at the same time as enhancing productivity. This is likely to include research on the selection of appropriate base materials for breeding programmes and population breeding procedures.

175. **Coordination/administration**: Activities should be planned and undertaken in close collaboration with national programmes, crop and regional networks, other scientific bodies and institutions, [breeders' organisations]and farmers' organizations taking cognizance of prevailing relevant international initiatives. Close communication among genebank curators, plant breeders and other scientists in both the public and private sector should be encouraged. Networking among breeders communities of practice should be encouraged as vehicle for mentoring and exchange of ideas. The cooperation of key stakeholders in the development of crop value chains at the national level is another effective way of coordinating the necessary activities and efforts to ensure sustainable progress.

10. Promoting diversification of crop production and broadening crop diversity for sustainable agriculture[and food]

176. **Background**: Despite progress in the diversification of crop production, monoculture and genetically uniform crops increasingly dominate agricultural systems, resulting in serious risk of yield losses to pests, diseases and abiotic stresses, as well as lack of stability and resilience. Several new challenges have been recognized in the past decade that will require strengthening of diversification efforts. These include: the need for long-term sustainability in agricultural practices; increasing competition [on food and forage uses] from biofuel [crops][uses]; declining nutritional security undermining health; increasing rural poverty in some parts of the world; [food security and food sovereignty]and climate change.

177. To cope with the coming challenges, agricultural systems will need to incorporate a broader range of [crop][plant] varieties and of crops[and forage], including crops that produce raw materials for agroindustry and energy, crops that are now underutilized and wild food plants[and forages]. Similarly, plant breeders will need to incorporate more diversity into their improvement programmes. The participatory evaluation, selection and improvement of farmers' varieties{/landraces} and early breeding lines are measures which could bring higher levels of diversity, adaptation and stability to crops. Diversification at the species and genetic level should be complemented with diversification of production systems. Diverse production systems will both provide enhanced ecosystem services and be better able to benefit from the services provided

by surrounding landscapes. Together with solutions such as rotations, varietal mixtures[, synthetic varieties] and multi-lines, these practices will [improve][participate in the improvement,] the resilience and stability of agricultural systems and thus help ensure food, nutritional and income security.

178. ~~**Long-term objectives**~~**{Objectives}:** To promote sustainable agriculture through diversification among and within crops.

179. ~~**Intermediate objectives:**~~ To review periodically genetic vulnerability in crops and encourage breeders, and other relevant groups, to take the necessary mitigating action nationally, regionally and internationally.

180. To develop models for diversified production consistent with higher productivity [and stability]as well as consumers' preference.

181. **Policy/strategy:** Governments and relevant intergovernmental organizations, in cooperation with crop networks, research institutions, extension agencies, the private sector, farmers' organizations and NGOs, should:

a) regularly monitor genetic [uniformity][diversity] and assess vulnerability in crops;
b) promote policies that support diversification programmes and [non trade-distorting] incentives to include new species in production systems;
c) increase diversification by planting mixtures of adapted varieties and species[where appropriate];
d) promote awareness among policy makers, donors and the general public of the value of diversified production systems;
e) encourage countries to adopt appropriate and effective strategies, policies, legal frameworks and regulations that promote diversified productions systems;
f) support [breeders', farmer breeders',]farmers' management of diversity;
g) increase investment in the improvement of underutilized crops and the development and use of traits in major crops of relevance to human and environmental health and to the effects of climate change.

182. Funding agencies should be encouraged to continue to provide support to international agricultural centres, national agricultural research systems, [breeders]and other relevant research bodies and NGOs, for work aimed at enhancing levels of diversity in agricultural systems.

183. **Capacity:** Governments, and their national agricultural research systems, supported by the International Agricultural Research Centres and other research and extension organizations should:

a) increase their capacity to develop and use multilines, mixtures and synthetic varieties;
b) increase their capacity to adapt different integrated pest management strategies to their production systems;
c) develop strategies for the deployment and use of a range of varieties;
d) explore and, in appropriate circumstances, make use of decentralized and "participatory" plant breeding strategies to develop plant varieties specifically adapted to local environments;
e) make use of biotechnological techniques to facilitate broadening of the genetic base of crops[; and
f) strengthen the ability of farmers, indigenous and local communities and their organizations, as well as extension workers and other stakeholders, to manage agricultural biodiversity and ecosystem services sustainably].

184. **Research/technology:** Support efforts to identify those plant breeding and agronomic practices that foster diversification of crop production. This might include reviews of the track record of different practices.

185. Research should be promoted on the domestication of wild species, increased use of underutilized crops for the development of nutritionally enhanced adapted cultivars, and on developing crops and crop varieties adapted [notably]to climatic change.

186. It will be important to develop improved tools and methodologies for assessing the genetic vulnerability of crops, the provision of services by agroecosystems, including pollination and application of the ecosystem approach to sustainable agriculture.

187. **Coordination/administration:** There is a need for close collaboration between ministries of agriculture and the environment in the development and implementation of policies and strategies for diversification of crop production for sustainable agriculture. Such policies should be coordinated at regional level to be truly effective.

11. Promoting development and commercialization of [plant varieties, including improved varieties,]farmers' varieties{/landraces} and underutilized [crops and]species

188. **Background:** Commercial production is increasingly dominating agricultural systems. In such commercial systems, [a limited number of varieties][plant varieties] of a few major crops provide for a large proportion of global needs. However, a large number of species, and indeed of farmers' varieties{/landraces} of both major and minor crops, are used by [farmers,]{indigenous and }local communities to meet local demand for food, fibre, energy and medicine. Knowledge concerning the uses and management of these varieties and species is often localized and specialized. Increasingly, this diversity at both the species and variety levels is being replaced by [a certain level of]uniformity in the agricultural marketplace. In support of the commercial production system, varieties are bred to meet the [strict]needs of [high-input]production, industrial processing and demanding market[s' and consumers'][standards].[Breeding activities resulting in the creation of improved varieties adapted to various agroenvironmental conditions meet also the needs of farmers and farming communities.]

189. Farmers' varieties{/landraces} and underutilized species are not fully participating in the trend towards [evolution and]modernization of agriculture, and are being lost, along with the knowledge associated with them. Although there has been a modest increase in efforts to conserve such species *ex situ*, overall, their diversity is not yet adequately represented in collections. Also, many underutilized crops are not included in Annex I of the International Treaty. Nonetheless, many of these species and varieties have great potential for wider use[, in particular in breeding,] and could contribute significantly to sustainable livelihoods through improved food and nutritional security, income generation and risk mitigation.

190. There is, however, growing global recognition of the value of farmers' varieties{/landraces} [neglected]and underutilized species in the face of uncertain climates, malnutrition and rural poverty. For example, there is evidence of growing awareness both by the public and policy-makers of the importance of traditional vegetables and fruits and of potential new energy crops. So-called "niche" or "high-value" markets are expanding as consumers are increasingly willing to pay higher prices for better quality, novel or indeed heritage foods, from sources they know and trust. New legal mechanisms are enabling farmers to market "lost" heritage crops and farmers' varieties{/landraces} and legislation supporting the marketing of geographically identified products are available, providing incentives for farmers to conserve and use local crop genetic diversity.

191. In order to capture the potential market value of farmers' varieties{/landraces} and underutilized species, there is a need for greater integration of the efforts of individuals and institutions having a stake in different parts of the production chain. In particular, the involvement of [indigenous and]local communities is essential, and fully taking into account traditional knowledge systems and practices.

192. Recently, a new organization, Crops for the Future, which evolved from the International Centre for Underutilized Crops and the Global Facilitation Unit for Underutilized Species, has been established. It is dedicated to the promotion of neglected and underutilized plant species as a contribution to humanity.

[192 Bis. The creation of new improved varieties by local breeders is also of main relevance for the adaptation of the agriculture to environmental changes and human needs. There is a need for a

greater transfer of these varieties from the research part to development and commercialisation until the field of the farmers.]

193. ~~**Long-term objectives**~~**{Objectives}:** To contribute to sustainable livelihoods, including improved food and nutritional security, income generation and risk mitigation, through the sustainable management of [agro-environmental improved varieties,]farmers' varieties{/landraces} and [neglected and]underutilized species.

194. ~~**Intermediate objectives:**~~ To stimulate stronger demand and more reliable markets for [agro-environmental improved varieties,]farmers' varieties{/landraces} and [neglected and] underutilized species and their products. To promote local processing, commercialization and distribution of the products of [such][farmers'] varieties{/landraces} and [underutilized]species. To increase public awareness of [the][their] value[of farmers' varieties{/landraces} and underutilized species].

195. **Policy/strategy:** Governments and their national agricultural research systems, with the support of the international agricultural research centres, and NGOs, and taking into account the views of [breeders' organisations,]farmers' organizations[, including seed producers, indigenous and local] [and their]communities[, private seed sector] are encouraged:

a) to promote policies consistent with the sustainable use, management and development of [neglected and]underutilized species, as appropriate, identified as having a potential to make significant contributions to local economies and food security;

b) to develop and adopt policies in extension, training, pricing, input distribution, infrastructure development, credit and taxation which serve as incentives for crop diversification and the creation of markets for biodiverse food products;

c) to create enabling environments to manage and monitor local diversity as well as to develop local and export markets for a wider range of traditional and new products originating from [farmers' varieties{/landraces} and underutilized][such]crops;

d) to foster public-private partnerships and put in place legislation to promote benefit sharing that targets [stakeholders, including]farmers and traditional custodians.

196. **Capacity:** Training and capacity building for scientists and extension specialists and for [breeders, seed producers,]farmers{, indigenous} and local communities, with particular emphasis on women, should be provided in establishing, running and advising local small-scale enterprises concerned with the commercialization of [neglected and]underutilized species and farmers' varieties{/landraces}, [agro-environmental improved varieties,]including

a) identifying [agro-environmental improved varieties, neglected and]underutilized species and farmers' varieties{/landraces} with potential for increased commercialization and sustainable use;

b) developing and implementing sustainable management practices for underutilized species of importance to food and agriculture;

c) developing [or adapting]post-harvest processing methods for [farmers' varieties{/landraces} and underutilized species][such varieties and species];

d) developing marketing methods for [agro-environmental improved varieties,]farmers' varieties{/landraces} and [neglected and]underutilized species; and

e) documenting local and traditional knowledge on farmers' varieties{/landraces} and [neglected and]underutilized species.

197. Appropriate bodies, including NGOs, should promote public awareness on the value of [agroenvironmental improved varieties, neglected and]underutilized species and farmers' varieties{/landraces} in various media and through appropriate mechanisms, such as street fairs, initiatives in schools, etc.

198. Appropriate bodies should promote awareness of policy makers and entrepreneurs on

the value of [underutilized species and farmers' varieties{/landraces}][such species and varieties].

199. **Research/technology:** Research should be undertaken to:

a) develop sustainable management practices for [agroenvironmental improved varieties,][farmers' varieties{/landraces} and [neglected and]underutilized species of importance to food and agriculture];

b) characterize and evaluate farmers' varieties{/landraces} and[neglected and] underutilized species;

c) document ethnobotanical information on farmers' varieties{/landraces} and underutilized species;

d) develop post-harvest processing and other methods to improve marketing possibilities of [agroenvironmental improved varieties,]farmers' varieties{/landraces} and [neglected and]underutilized species;

e) develop marketing strategies and brand development for [agroenvironmental improved varieties,]farmers' varieties{/landraces} and [neglected and]underutilized species.

200. Commercialization processes and activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of agricultural biodiversity should be identified and their effects monitored.

201. **Coordination/administration:** Coordination should be strengthened between gene banks, [farmers, breeders, indigenous][farmers'] and local communities in order to identify material of potential value. Regional networks together with national programmes and in cooperation with international agricultural research centres, NGOs and other relevant organizations, should regularly review the status of [agroenvironmental improved varieties,]farmers' varieties{/landraces} and [neglected and]underutilized species in their region, to:

a) identify possibilities for commercialization;

(b) identify common research and development needs; and

(c) facilitate and, as appropriate, coordinate requests for relevant financial and technical assistance.

12. Supporting seed production and distribution[22]

202. **Background:** Effective seed systems need to be in place to ensure that farmers have access to planting material in adequate quantity and quality, in a timely manner and at reasonable cost. Only in this way will farmers benefit from the potential of both local and improved varieties to increase food production and adapt to climate change. In the last 20 years, there has been a significant growth of the private seed sector in developed and developing countries; however, the main focus of its interest has been high value products, such as [hybrid, genetically modified and vegetable seed][maize, wheat, rice, oil crops, and vegetable crops]. [The expansion of the seed trade has been accompanied by the development of increasingly complex seed regulatory frameworks. In recognition of some concerns about such frameworks, seed harmonization has been promoted at regional and sub-regional levels over the last decade.][The expansion of the seed trade over the past decade has been accompanied by the promotion of seed regulatory harmonization at regional and sub-regional levels.] Investment by the public sector in seed production, already at a low level in most developed countries in 1996, has also decreased significantly, in many developing countries, where access to improved varieties and quality seed remains limited. In many developing countries farmers' seed systems remain the main

[22] The term "seed" refers to all planting materials in this priority activity area.

purveyor of seed of local and, in some cases, improved varieties also. Farmers' seed systems and formal seed systems often operate side by side, but with different levels of success depending on the crop, the agro-ecological zone and output market opportunities. There is therefore a need to develop integrated approaches which strengthen both systems and the connections between them in order to produce and distribute seed of crop varieties that are useful for diverse and evolving farming systems.

203. ~~**Long-term objectives**~~**Objectives:** To increase the availability of high quality seed of a wider range of plant varieties, including improved and farmers' varieties{/landraces}.

204. To contribute to the maximization of both agro-biodiversity and productivity.

205. ~~**Intermediate objectives:**~~ To improve the complementarity in seed production and seed distribution between public and private sectors, as well as between [the formal and farmers' seed] [regulated and unregulated seed distribution] systems.

206. To develop and expand viable local-level seed production and distribution [mechanisms in the formal and farmer's] systems for varieties and crops important to [small-scale farmers] [farmers, including small-scale farmers].

207. To help make new crop varieties available to farmers and to make suitable germplasm materials that are stored *ex situ* available for multiplication and distribution to farmers to fulfil their needs for sustainable crop production.

208. To develop/review seed regulatory frameworks that facilitate the development of seed systems [and the harmonisation at regional levels,]and take into account the specificities of the formal and the farmers' seed systems.

209. **Policy/strategy:** Governments and their national agricultural research systems and seed producers, subject to national laws and regulations as appropriate, with support from international agricultural research centres, regional [or bilateral]cooperation programmes and NGOs, and taking into account the views of the private sector, farmers' organizations and their communities, should:

a) develop appropriate policies that provide an enabling environment for the development of both [both local,]formal and farmers' seed systems, including small-scale seed enterprises. Efforts of governments should focus in particular on the crops and varieties needed by resource-poor farmers, especially women farmers. Such an approach should be complemented by policies that facilitate the development of commercial seed companies to meet the needs of larger-scale, commercial farmers. Governments should prioritise major and minor crops that are not adequately covered by the private sector where appropriate. These policies should be integrated in general agriculture policies;

b) strengthen linkages between genebanks{, networks}, plant breeding organizations, seed producers, and small-scale seed production and distribution enterprises to ensure a wide utilization of available germplasm;

c) consider seed quality control schemes, particularly those appropriate to small-scale enterprises[so they can meet plant health requirements];

d) adopt legislative measures which create adequate conditions for the deployment of [improved varieties,]farmers' varieties{/landraces}[, neglected and underutilised species] in [both formal and farmers'][local] seed systems, taking into account their specificities; and

e) develop sub-regional/regional agreements which streamline[seed control and] certification, plant quarantine requirements and other standards in order to facilitate the development of cross-border seed trade.

210. **Capacity:** Governments, subject to regional harmonized legislations, national laws, regulations and policies as appropriate, and in conjunction with international aid agencies, NGOs

and existing seed enterprises should:

a) establish/strengthen systems, based on a public/private partnership, to ensure the maintenance of plant breeding programmes for significant crops and the multiplication of early generation seed;

b) encourage existing seed production systems, in particular seed enterprises, to increase the range of varieties they offer, by strengthening the link with genebanks{, networks} and agriculture research institutes;

c) strengthen capacities to implement efficient seed quality assurance systems;

d) provide appropriate incentives, credit schemes, etc., to facilitate the emergence of seed enterprises, paying attention as appropriate in each country, to the needs of the small farming sector, of women and of vulnerable or marginalized groups;

e) provide infrastructural support and training to small-scale seed enterprises in the field of seed technology[, seed analyses] as well as in business management in order to facilitate the establishment of a sustainable quality seed supply system;

f) improve the linkages between [breeders' organisations,]farmers' organizations and seed producers (public or private) so that farmers, and in particular women and vulnerable or marginalized groups, can access high quality seed of the varieties they need; and

g) provide training and infrastructural support to farmers on seed technology, in order to improve the physical and genetic quality of [farmer-saved seeds][seeds produced by farmers].

211. **Research/technology:** Governments should:

a) assess current incentives and disincentives as well as needs for support to seed production and distribution systems, including small-scale, farmer-level efforts; and

b) [develop][consider developing] approaches to support small-scale, farmer-level seed distribution, learning from the experiences of community and small-scale seed enterprises already underway in some countries.

212. **Coordination/administration:** National capacity for farmers to acquire appropriate seed should be regularly monitored by governments. Coordination is needed in the seed sector among the public sector, the private sector and farmers to ensure that farmers have access to high quality seed of the crops and varieties they need to response to the challenges of increased food production.

Building Sustainable Institutional and Human Capacities

13. Building and strengthening national programmes

213. **Background:** National PGRFA programmes are the foundation of regional and global PGRFA efforts, contributing to the objectives of international instruments such as the GPA, the CBD, the International Treaty[, and other trade and Intellectual Property Rights (IPR) agreements]. Especially in the context of climate change, they are the key to maximizing the contribution of PGRFA to food security, rural development, poverty alleviation, and sustainable development. Strong national programmes are needed to fully contribute to, and take full advantage of, international cooperation on access to PGRFA and the fair and equitable sharing of the benefits arising from their use. Effective national programmes provide the enabling policies, supportive strategies and concrete action plans that are necessary for setting well-defined goals and clear priorities, allocating resources, distributing roles and responsibilities, identifying and strengthening linkages between all relevant stakeholders. The success of national programmes requires commitment from governments to provide funding, and design policies and legal and institutional frameworks.

214. PGRFA activities are carried out by public entities, private companies, NGOs, botanic gardens, [farmers, indigenous and local] communities and individuals from the agriculture, [research,]environment and development sectors. The integration of such different PGRFA activities in the framework of a [unified]national programme[s] provides the opportunity to add value to such diverse efforts, so that the whole is bigger than the sum of its parts.

215. During the last decade, there has been considerable progress in establishing national programmes and enhancing stakeholder participation in national strategies and action plans, especially as regards the private sector, NGOs, [breeders' organisations,]farmer[s'] organizations and research and educational bodies. The commitment that this suggests is also seen in the fact that several important agreements relating to PGRFA have been negotiated, adopted or revised at the international level in this period, including the International Treaty, the International Plant Protection Convention[,] [and]the Cartagena Protocol on Biosafety of the CBD[and the recently adopted Nagoya Protocol on Acces to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization]. National legislation has also been enacted in many countries with respect to phytosanitary regulations, biosafety, seed regulations, and IPRs, including [Plant Breeders' Rights, Patent or other IPRs, in addition to][plant breeders' rights and] Farmers' Rights[as stated in Article 9 of the International Treaty and subject to national legislations].

216. However, many countries still lack adequate policies, strategies and/or action plans for PGRFA. Many existing national programmes suffer from inadequate and unreliable funding and isolation from related activities. Areas that require particular attention include setting priorities, enhancing collaboration between the public and private sectors, national and international cooperation, strengthening the links between PGRFA conservation and use, developing information systems and publicly accessible databases (e.g. the NISM on the implementation of the GPA), identifying gaps in the conservation and use of PGRFA (including CWR), increasing public awareness, and implementing national policies and legislation and international treaties and conventions.

217. Many of the countries that do not have strong national programmes, or appropriate long-term conservation facilities, often have the most urgent food security problems, even if they have rich sources of PGRFA. Efficient management of PGRFA collections is often limited by weak national programmes.

218. National *ex situ* collections are an integral part of national PGRFA programmes. Genebanks work best as dynamic centres that foster integration of conservation, documentation and use. Overemphasis on conservation can detract from sustainable use, which has supported progress in agriculture together with conservation of PGRFA. The increasing impacts of climate change make it essential to support activities related to crop adaptation, including genetics, genomics and breeding. Capacity for such adaptation is an essential part of an efficient and effective management of PGRFA. Since 1996 public-private research and development partnerships have increased in most countries, especially in plant breeding and biotechnology. However, public organizations alone often manage conservation and plant breeding in developing countries, which can result in inefficiencies, reduced benefits and lost opportunities.

219. ~~**Long-term objectives**~~**{Objectives}:** To meet needs identified at the national level for the conservation and sustainable use of PGRFA through rational, effective, coordinated and sound approaches for the benefit of present and future generations.

220. To maintain an adequate national capacity in all technical and political aspects of conservation, access and use of PGRFA, as well as the fair and equitable sharing of the benefits arising from their use.

221. ~~**Intermediate objectives:**~~ To [make use of synergies between the different national actors and to]establish and strengthen the essential elements of an integrated national programme: (i) recognized national status; (ii) appropriate policy, legal and institutional frameworks including mechanisms for coordinated planning and action; [and](iii) a programme strategy, including well-defined goals, clear priorities, and adequate and sustainable funding[; and (iv) appropriate

participation of all stakeholders]. Where appropriate, to upgrade conservation and use facilities at the national or regional level.

222. To improve institutional and sectoral linkages, enhance synergies among all stakeholders involved in conservation, development and use of PGRFA, including seed systems, and strengthen integration of institutional and community efforts.

223. To develop, strengthen and regularly update national capacities in the technical, managerial, legal and policy areas.

224. **Policy/strategy:** National programmes should have a formally recognized status and be given high priority within the national development agendas. Their contribution to the objectives of international instruments, including the GPA, the CBD, the International Treaty, and various other trade and IPR agreements, should be highlighted. The ecological, economic, social and aesthetic values of PGRFA, including the importance of crop improvement in increasing food security, mitigating climate change and meeting other global challenges, should be recognized in national planning and policies and in the prioritization and deployment of [medium and]long-term financial and other resources. These could include financial incentives for the[training and] retention of qualified staff and for [breeders to develop improved diverse varieties responding to various needs and]farmers to maintain and make local varieties available. Specific funding allocations should be made to PGRFA programmes in the budget process of national governments. In this regard, awareness of policy-makers and donors should be raised.

225. National commitment to provide adequate and sustainable funding for national programmes and projects is essential; however, regional or international support [is][may often be] a necessary complement to domestic efforts.

226. National programmes should set well-defined goals and clear priorities, including priorities for assistance sought from regional and international agricultural development programmes. National programmes should develop the capability to assess and determine the PGRFA required to meet national conservation and development needs and related international obligations and should have supporting policies and strategies on conservation, access and use of PGRFA, and on the fair and equitable sharing of the benefits arising from their use. National programmes should provide for the periodic adjustment of strategies as necessary. National programmes should make available, as appropriate, the widest possible representative collection of PGRFA to meet farmers' [breeders' and other consumers']needs, and for the improvement of[varieties, including] farmers' varieties{/landraces}. Governments, in cooperation with national, regional and international institutions should monitor the development of new technologies relevant to the conservation, characterization and sustainable use of PGRFA. In addition, the adoption and implementation of appropriate, non-conflicting and complementary national legislation related to the conservation, exchange and sustainable use of PGRFA, should be fostered, taking into account the needs and concerns of all stakeholders.

227. National programmes should establish or strengthen coordination and linkages among all relevant individuals and organizations involved in conservation, crop improvement, seed production and seed distribution. National programmes should link with regional and international activities wherever possible[, look for synergies and possibilities for division of tasks]. National strategies should encompass conservation, development and use of PGRFA, including seed systems, and should coordinate with organizations in the environment and agriculture sectors. Broad based national committees will help in organization and coordination in most countries.

228. The structure and organization of a national programme will depend on the infrastructure and capacities available in the country and policy decisions will determine strategies and modes of operation, in particular regarding regional and international collaboration. In countries with limited capacity, the strategy may include use of facilities and expertise from outside the country.

229. Existing programmes should consider establishing or strengthening partnerships with private enterprises, NGOs, rural, indigenous [and local]communities, [breeders' organisations, farmers'

organisations]and research and educational organizations. Cross-sectoral links should be forged with agencies engaged in national planning and other programmes involved in agriculture, land reform, and environmental protection.

230. Institutional links should be promoted, as appropriate, among national institutions and entities specialized in technology transfer, in order to assist national bodies in negotiation for the acquisition of technologies needed for the conservation, characterization and sustainable utilization of PGRFA and associated data processing[, in accordance with ITPGRFA, CBD and IPR rules][, under fair and most favourable terms, including on concessional and preferential terms, as mutually agreed to by all parties to the transaction. In the case of technology subject to patents and other IPR, access and transfer of technology should be provided on terms that recognize and are consistent with the adequate and effective protection of IPRs].

231. **Capacity:** Assistance from regional and international institutions should be provided on request to facilitate regular national planning, priority setting and coordinated fundraising. High priority should be placed on the assessment and improvement of management practices in genebanks and research stations. The capacities of farmers, indigenous and local communities, [breeders,]extension workers and other stakeholders, including entrepreneurs and small-scale enterprises, to manage [and use]PGRFA sustainably, should be strengthened.

232. **Research/technology: [**Research is particularly needed in on-farm management, [*ex situ* and]*in situ* conservation, [participatory]plant breeding [including participatory,]and crop improvement.] Research is [also] needed on management of national PGRFA programmes, including testing of institutional frameworks; evaluating use needs; database management; the economic efficiency of different approaches to conservation and use; the value of PGRFA; strengthening agricultural market information systems; and developing accurate and reliable measures, standards, indicators and baseline data for monitoring and assessing the specific role of PGRFA in food security and sustainable agricultural production.

233. Specific policy, legal and institutional issues, including those related to ownership, IPR, [including Plant Breeders' Rights,]access and benefit-sharing, Farmers' Rights[in accordance with national needs and priorities], traditional knowledge, exchange, transfer, biosafety, trade and awareness-raising, including seed systems, are increasingly important for national programmes. Assistance in developing policies, strategies, legislation, regulations and practical measures in these areas is needed from bodies such as the FAO and the International Treaty[with regard to access and benefit-sharing and Farmers' Rights]. Coordination is needed to provide national programmes with information on these issues and to assess the impact of international developments in these fields on the conservation and exchange of PGRFA, and to incorporate new research developments into national systems and practices.

234. **Coordination/administration:** Coordination mechanisms should be implemented nationally to ensure prioritization in deploying financial and other resources. Strong linkages should be established between all relevant in-country stakeholders involved in conservation, development and use of PGRFA, including seed systems, as well as between the agriculture and environment sectors, in order to ensure synergy in developing and implementing policies, strategies, legislation, regulations and activities and realize PGRFA's full potential. Governments should periodically review their policies to evaluate effectiveness and adjust their strategies accordingly. Coordinated and prioritized action at the national level should be complemented by an international system that is likewise coordinated and prioritized. International organizations involved in conservation and use of PGRFA, agricultural production, sustainability and food security, as well as related areas such as environment and health, should coordinate their efforts and activities. International collaboration is necessary in a world where countries are interdependent and where they wish to establish practical, rational and economical means to conserve PGRFA, enhance their use, and encourage access and share benefits. PGRFA networks and regional and international fora provide useful mechanisms through which countries can coordinate activities and agree on common policies, as appropriate

14. Promoting and strengthening networks for plant genetic resources for food and agriculture

235. **Background:** The extent of interdependence among countries with respect to their need to have access to PGRFA and information held by others is arguably more important than ever, as the world faces [the increasing need in food/feed production and]the new environmental conditions and pest and disease spectra that will result from climate change. Networks not only facilitate the exchange of PGRFA, but they also provide a platform for scientific discussion, information sharing, technology transfer, and research collaboration. The regional and global crop strategies developed with support from the Trust highlight the value of networks in identifying and sharing responsibilities for such activities as collecting, conservation, distribution, evaluation, genetic enhancement, documentation, safety duplication and crop improvement. In addition, they can serve to help set priorities for action, develop policy, and provide the means whereby crop-specific and regional views can be conveyed to various organizations and institutions. [The importance of networks is recognized by the International Treaty under Article 16.][International plant genetic resources networks are recognized as a supporting component of the International Treaty under Article 16.]

236. Many regional, crop-specific and thematic networks now operate, some of which have been either established, or significantly strengthened, in the past decade. Each has an important role to play in supporting the coordination of efforts [and to promote cost efficiency and effectiveness]in the sustainable conservation and use of PGRFA. The synergistic relationship between national programmes and these networks is the key to the sustainability of both; networks support national programmes and national programmes support networks. As such, networks are of particular importance in regions where there is limited national capacity in PGRFA (for example, many of the least developed countries and small island states) as it gives them easier access to information, technology and materials, and, importantly, a stronger voice in the development of global policies and actions. Crop-specific networks have a particular role to play in bringing conservation and use closer together. Thematic networks are an effective means to bring together experts and interested parties around a common theme, thereby strengthening coordination and avoiding duplication of efforts. One of the challenges faced by all types of networks, however, is the long-term availability of resources. Countries should also be prepared to contribute to supporting them in a sustainable fashion.

237. ~~**Long-term objectives**~~**{Objectives}:** To foster partnerships and synergies among countries to develop a more rational and cost-effective global system for PGRFA conservation and use.

238. ~~**Intermediate objectives:**~~ To ensure the sustainability of networks by analyzing and identifying the benefits of participation, highlighting the contribution they make to achieving sustainable conservation of PGRFA at the national, regional and global levels.

239. To facilitate the setting of integrated eco-regional, regional and thematic goals and priorities for the conservation and sustainable use of PGRFA.

240. To promote the participation of all stakeholders in networks, in particular women farmers[, local breeders] [and NGOs]and ensure the involvement of public-private partnerships.

241. **Policy/strategy:** Governments should as a matter of policy support the active participation of public and private institutions in regional, crop and thematic networks. Participation should be seen as benefiting countries and providing a means by which countries with similar challenges can pool efforts, and benefits can be shared. The funding constraints experienced by networks require sustainable and innovative solutions, which are mindful of the often intangible, though no less important, benefits of networks. As such, [studies are required][some additional information may be gathered] to highlight these benefits, which will both strengthen government support and assist in accessing funds. To underpin funding strategies, increased efforts are needed to raise awareness among policy makers and the general public of the value of PGRFA, the interdependence of nations and the importance of supporting increased international

collaboration. Both cash and in-kind contributions by governments to the networks should be considered as a priority.

242. Networks provide the means by which gaps can be identified, systems developed and new initiatives promoted. Given that international germplasm exchange is a key motivation behind many networks, additional attention is needed both to promote the effective implementation of International Treaty, and in particular its Multilateral System of Access and Benefit Sharing, as well as to develop arrangements for those other crops that are not currently included in the system but that are within the overall scope of the International Treaty.

243. **Capacity:** The building of networks requires not only technical expertise, but substantial coordination, communication and organization skills. Resources and capacity should be available for such activities as: planning; communication, including travel; meetings; network publications such as newsletters and reports of meetings; servicing and strengthening of the network. The importance of resources to sustain networks requires that networks have the capacity to prepare successful projects for submission to donors.

244. For regional networks, priority should be given to strengthening existing networks. Inter-network collaboration also needs enhancing and would have a significant impact on capacity building and technology transfer. The added value from this level of collaboration would highlight the importance of networks and illustrate how existing networks can be more effectively utilized. Countries with more advanced PGRFA facilities and programmes are encouraged to support network activities through the sharing of expertise and greater capacity development opportunities.

245. **Research/technology:** [Regional, interregional and global networks][Networks] provide a vehicle for collaborative research in mutually agreed priority areas. Funding obtained through research projects creates a basis on which networks can continue to cement relationships and develop. As appropriate and feasible, research, training and technology transfer in PGRFA should be planned and/or implemented in collaboration with networks. The ease of planning and implementation using a network platform is especially evident when networks cover regions that are very fragmented but at the same time face common challenges.

246. **Coordination/administration:** Resources should be made available to continue to service existing networks as appropriate and to organize and facilitate the development of new regional, crop and thematic networks where appropriate. Effective use of resources is essential and, as such, coordination is not merely required within networks but among networks to ensure efforts are not duplicated and resources are used efficiently.

15. Constructing and strengthening comprehensive information systems for plant genetic resources for food and agriculture

247. **Background:** Transparent and rational decision-making in the conservation and sustainable use of PGRFA must be based on reliable information. Along with the revolution that communication and information management systems have gone through during the past 15 years, there have been important improvements in the availability and accessibility of PGRFA information. Several decisions of the Commission since the adoption of the first GPA aimed at increasing the availability and accessibility of PGRFA information, including the further development of WIEWS, the adoption of the indicators and reporting format for monitoring GPA implementation, the establishment of NISMs and the preparation of the SOW-2. Information exchange is given high importance throughout the International Treaty and in particular [is recognized as a supporting component of the Treaty]in Article 17, the Global Information System, and is one of the main mechanisms for sharing fairly and equitably the benefits derived from the use of PGRFA under its Multilateral System.

248. Recent developments aimed at supporting documentation and exchange of genebank information include the release of GRIN-Global, a genebank management information system with built-in networking features, and of Genesys, a plant genetic resources portal that gives

breeders and researchers a single access point to information on about a third of the world´s genebank accessions, including those in the international collections managed by the CGIAR, the USDA National Plant Germplasm System and EURISCO.

249. Despite this progress significant gaps in documentation and information sharing on PGRFA still persist and need to be addressed, as they represent a serious obstacle to efficient planning and to the increased use of PGRFA in crop improvement and research. Much of the existing data is not accessible electronically and documentation of on-farm genetic resources and CWR is particularly inadequate. A significant imbalance exists among regions and even among countries within regions. Many countries still lack national strategies and/or action plans for the management of diversity, or they are not fully implemented, and as such they do not maintain an integrated national information system on PGRFA. This situation is exacerbated by the fact that at the national and institutional level, data management and documentation activities are often given an inappropriately low priority in the allocation of funding.

250. ~~**Long-term objective**~~**Objectives:** To facilitate the better management and use of PGRFA through improved access to, and exchange of, high quality, up-to-date information.

251. ~~**Intermediate objectives:**~~ To develop and strengthen national information systems, including but not limited to accession level information systems, to better manage PGRFA data, and to support their participation in, and use of, global information systems.

252. To enhance the use of regional and global information systems through continual improvement of the overall functionality and productivity of the genebank-user interaction.

253. To strengthen the exchange and use of information, and the sustainability of current systems by promoting compatibility and usability among datasets through the establishment and adoption of common descriptors.

254. To monitor the effectiveness of systems and ensure that differences between systems are addressed to facilitate interoperability and promote use.

255. **Policy/strategy:** High priority should be given at all levels to developing, staffing and maintaining user-friendly documentation and information systems for PGRFA based on international standards. Such systems should be able to contribute to decision-making not just in PGRFA conservation and use but also on the specific role played by PGRFA in wider issues of agricultural development and food security. Efforts should be made to develop more accurate and reliable standards and indicators and collect baseline data for sustainability and food security that will enable a better monitoring and assessment of the progress made in these areas, and of the contribution made by PGRFA.

256. The effective management of collections and increased use of the germplasm requires strengthening and harmonization of documentation, characterization and evaluation, based on adoption of common standards for data exchange. Better standardization of data and information management systems is needed not only to facilitate access but to support technology transfer and global, regional and national assessments for PGRFA.

257. Information on PGRFA will be acquired and disseminated in accordance with [Article 8(j) of the CBD and Article 17 of the International Treaty] [the provisions of Article 8(j) of the CBD, as regards the knowledge, innovations and practices pertaining to *in situ* conservation of indigenous and local communities in embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity, and of Article 17 of the International Treaty].

258. **Capacity:** Planning assistance should be provided to national programmes, and, where appropriate, regional programmes, to encourage the development of rational and compatible strategies for information management and sharing. Such strategies must promote the application of standards for interoperability and exchange among systems.

259. Despite progress, data and information still exist in vulnerable and inaccessible systems. These data need to be verified and compiled into a usable and easily accessible form.

260. Access by national programmes to basic scientific, research and bibliographic information should be facilitated.

261. National and regional genebanks{/networks} should have sufficient personnel to manage information, thereby improving user accessibility and ensuring participation in global information systems. Appropriate training in data management and information systems should be supported as essential to the move to rationalize genetic resources efforts at the global and regional levels.

262. Appropriate self-teaching and/or e-learning should be developed as needed. Technical support should be provided on a continuing basis to improve management of data and information and to support the adoption of new, appropriate technologies.

263. **Research/technology:** Research should be supported to:

a) develop appropriate and low-cost methodologies and technologies for compilation and exchange of data;

b) develop methods for adapting these technologies at the local level as appropriate;

c) facilitate easy access and use of data by electronic means and through the internet;

d) develop means and methodologies to make useful information easily available to non-specialists, including NGOs, [breeders' organisations,]farmers' [organisations]and indigenous [and local communities][peoples' organizations];

e) develop descriptors based on international standards for new and underutilized crops[and CWR].

264. **Coordination/administration:** With the development of new information systems at the national, regional and global level coordination and collaboration is essential to ensure that these systems are compatible and useful. The harmonization of descriptors, as well as expansion to cover new crops, remains very important.

265. Global and regional assessment, oversight, planning, and coordination are needed to promote cost efficiency and effectiveness.

16. Developing and strengthening systems for monitoring [and safeguarding genetic diversity and minimising genetic]erosion of plant genetic resources for food and agriculture

266. **Background:** Erosion of PGRFA [can][may] occur in *ex situ* collections, in farmers' fields and in nature. With modern molecular genetic techniques, it has been possible in the past decade to generate some data on the extent and nature of genetic erosion in particular crops in particular areas. The picture that is emerging is complex and it is not possible to draw clear conclusions about the magnitude and extent of these effects. In addition, there remains, in many countries, continuing concern over the extent of genetic erosion and the need for a greater deployment of diversity. Better techniques and indicators are needed for monitoring genetic diversity, for establishing baselines and monitoring trends. The 2010 Biodiversity Indicators Programme brings together a large number of international organizations to develop indicators relevant to the CBD, including ones for monitoring trends in genetic diversity of crops. However, to date no really practical and internationally accepted indicators of genetic [erosion][diversity] are available and their development should be a priority.

267. Various factors, both natural phenomena and the results of human behaviour, including urbanization, agricultural development, civil strife and war, have historically been recognized as drivers of erosion of PGRFA. Loss of genetic resources in crops occurs mainly through adoption of new crops[or new varieties], with the consequent abandonment of traditional ones without appropriate conservation measures. More recently, climate change and modern dietary preferences have also been seen as a threat. In some countries, [the contamination of PGRFA, both crops and wild relatives, by geneflow from genetically modified plants][genetic introgression from other crops and wild relatives] is considered as contributing to genetic erosion.

The threat of alien invasive species needs also to be considered. The loss of PGRFA varies within countries and from country to country. Support should be provided to establish monitoring mechanisms at all levels.

268. Following a review in 1997, the WIEWS application for remote search, update and reporting of genetic erosion, has been published on the web. In addition, the scope of the information covered by WIEWS has been expanded to host NISMs, which also address issues related to genetic erosion.

269. ~~**Long-term objectives**~~**{Objectives}:** [To minimize genetic erosion and its impact on sustainable agriculture through]effective monitoring of genetic diversity and the drivers of genetic erosion[, and the implementation of appropriate remedial or preventative action as required].

270. ~~**Intermediate objectives:**~~ To establish and implement monitoring mechanisms to ensure the timely transfer of information to appropriate points designated as responsible for analysis, coordination and action. To expand the use of advanced technologies for monitoring degradation of most threatened species[and CWR].

271. **Policy/strategy:** Governments should periodically review and report on the situation of PGRFA, designating a focal point to convey this information to FAO, [the Governing body of the International Treaty,]the Conference of the Parties to the CBD, and other appropriate bodies. Article 5 of the International Treaty requires Contracting Parties to monitor PGRFA, assessing threats and to minimize or, where possible, eliminate them. Special efforts are needed to identify those species and populations that are most at risk and that are most likely to harbour traits that will be important in the future; this is particularly important with farmers' varieties{/landraces} and CWR. Improving the linkages between *in situ* and *ex situ* conservation strategies will reduce the risk of inadvertent loss of biological and cultural information.

272. Indicators and methods for assessing over time genetic[diversity and minimising genetic] erosion and its drivers are required in order to be able to establish national, regional and global baselines for monitoring diversity and developing effective early warning systems. Efforts should be made to ensure that relevant information generated by extension services, local NGOs, the seed sector and farming communities can be linked to early warning systems at the national and higher levels. Novel ICTs, including now widespread devices such as mobile telephones, can greatly facilitate the reporting and collation of information from such disparate sources. All development projects should be required to carry out an assessment of likely impacts on genetic diversity.

273. **Capacity:** Strengthened capacity is required in gathering and interpreting information on PGRFA, and in particular CWR species identification, and conducting inventories and surveys using new molecular and ICT tools and tools for spatial analysis of diversity. Training should also be provided for [breeders,]farmers and [indigenous and]local communities. Training materials, including self-teaching tools, should be produced in different local languages as needed.

274. Realizing the importance of global monitoring and early warning of loss of PGRFA, the efficiency, purpose and value of the WIEWS should be re-evaluated[, taking into consideration the potential role of WIEWS as part of the Global Information System on Plant Genetic Resources as foreseen under Art. 17 of the Treaty].

275. **Research/technology:** Research is required to improve methods for surveying PGRFA, which would be useful in the development of monitoring systems. Continued research into the development of practical and informative indicators of genetic [erosion][diversity] is required.

276. Technical experts, representatives of national programmes, the United Nations Environment Programme (UNEP), the Consultative Group on International Agricultural Research (CGIAR) [and other international institutions involved in PGRFA conservation], the International Union for Conservation of Nature (IUCN), NGOs, and the private sector, should be invited by FAO to continue discussions on the development of monitoring systems for [plant] genetic [diversity and minimising genetic]erosion.

277. Further research into applying GIS technology to monitoring [genetic diversity] and predicting [and minimising genetic]erosion of PGRFA, and the incorporation of the resulting information into comprehensive information systems, is required. [Additional study is needed to understand the nature and extent of possible threats to existing diversity on farm and *in situ*.]

278. **Coordination/administration:** Multi-sectoral collaboration and coordination needs to be strengthened at the national level, especially between the agriculture, environment and development sectors. National programmes should consider alerting regional and international networks of imminent risk of genetic erosion.

17. Building and strengthening human resource capacity

279. **Background:** Improvements in PGRFA conservation and use are very dependent on human resource capacity and its continuous development. There has been an increase in donor interest in, and funding of, capacity building over the past 15 years, which in particular has resulted in stronger collaboration in training among national, regional and international organizations. Training courses are more frequent and new training materials and facilities have been developed. Higher education possibilities have also expanded and there are now more universities offering a wider range of courses in areas related to PGRFA, especially in the application of biotechnology to conservation and crop improvement.

280. Despite these efforts, however, human resource capacity is still far from being adequate at virtually all levels and in all disciplines related to PGRFA conservation and use. In many countries, genebank staff are too few and inadequately trained to collect, classify, conserve, regenerate, characterize, document and distribute PGRFA. This poses a serious threat to establishing and managing valuable PGRFA collections, especially those of underutilized crops and CWR. Limited [taxonomic,]plant breeding and pre-breeding capacity in most developing countries severely limits effective and sustainable use of PGRFA. In the context of on-farm[or garden][-]conservation, in many cases extension services and NGOs also lack qualified personnel to impart appropriate training to farming communities.[There is also a lack of qualified personnel in relation with seed production, seed quality analyses, plant breeding and taxonomy.]

281. ~~**Long-term objectives**~~**{Objectives}:** To ensure the long-term availability of adequate human resources capacity in all areas of PGRFA conservation and use, including management, legal and policy aspects[, plant breeding].

282. ~~**Intermediate objectives:**~~ To develop national and regional capacity for training at all levels and to establish effective collaborative arrangements between organizations in developed and developing countries in order to strengthen and regularly upgrade capacities of all PGRFA stakeholders. To maintain adequate national capacity in critical areas, and to stem the loss of trained personnel from developing countries.

283. To develop quality courses and educational materials in primary and secondary education in priority subjects at the national, regional and global levels. To encourage undergraduate and post-graduate educational institutions to include aspects of PGRFA in courses and programmes, including the use of e-learning and distance education.

284. To foster access to external training among those countries lacking national capacity and encourage advanced institutions managing PGRFA to offer capacity development opportunities.

285. To develop a sound research agenda to bridge the gap between the science of PGRFA and its application to management and genebank activities[and the sustainable use of PGRFA, including plant breeding, seed analyses, seed technology].

286. To develop opportunities for hands-on learning, mentoring and leadership development in research[/development] and policy areas at policy and research organizations at national, regional and/or international levels.

287. **Policy/strategy:** Governments should recognize the importance of education in PGRFA in primary, secondary and advanced education. In collaboration with relevant organizations, governments should commit to providing training and advanced educational opportunities for young researchers[, technicians] and development workers, and regularly upgrade the knowledge and skills of existing staff. Training opportunities and advanced education programmes should include all technical and scientific aspects of conservation, exchange and use of PGRFA, and their application in curricula for biology, agriculture, the environment, economics and health. Particular emphasis should be placed on training in conservation biology, especially with respect to agricultural biodiversity.

288. Regular assessments of human resource capacity and needs should be made, the results of which should assist in developing education and training strategies at national, regional and global levels.

289. **Capacity:** Support should be given to developing national and regional organizations and programmes able to update curricula, provide advanced education and strengthen research and technical capacity in all relevant aspects of PGRFA conservation and use. Support should also be given to students on undergraduate and postgraduate programmes[and continuous professional training]. Collaboration should be encouraged between developed and developing country academic institutions, including with the private sector, and internships and staff exchanges should be promoted. Access to the internet will be particularly important to promote e-learning, communication, and data and information exchange.

290. As national and regional organizations are strengthened, existing capacity in developed countries should be used and supported, particularly when tailored to the capacity needs of developing countries.

291. In addition to current efforts, specialized training courses, including practical hands-on training and mentorship programmes, should be developed and regularly held in all regions. Technical topics, including links between conservation and use, and management, law, policy and public awareness, should be addressed to improve understanding of international agreements and treaties.

292. Expertise in technology transfer related to the conservation, characterization, exchange and sustainable use of PGRFA should be enhanced. National organizations in developing and developed countries, and international organizations, should play important roles in facilitating this, especially through staff exchanges.

293. Consideration should be given to developing educational material that is widely applicable and usable in different regions, but that maintains a distinctive regional focus. Where feasible, courses should be offered in the language most appropriate for the region.

294. Special consideration should be given to gender integration, especially to on-site training for rural women, as they play a significant, but sometimes under-appreciated, role in maintaining and developing PGRFA and associated knowledge and traditions.

295. Capacity to develop training materials and offer or coordinate training courses should be enhanced at the international level.

296. **Research/technology:** Where possible training should be linked to ongoing research and development in educational [and professional]establishments and national programmes. Efforts should be made to involve university students in field, [professional staff]as well as research activities.

297. **Coordination/administration:** Training courses should be developed and offered in close collaboration with international and regional networks and national programmes. In addition, advanced programmes should be developed in cooperation with relevant international and regional academic consortia or associations in response to national needs.

18. Promoting and strengthening public awareness on the importance of plant genetic resources for food and agriculture

298. **Background:** Public awareness is the key to mobilize popular opinion and to generate and sustain appropriate political action nationally, regionally and internationally. Communicating effectively the widespread benefits that PGRFA can bring to food security and sustainable livelihoods is critical to the success of any conservation programme. Recent years have seen an increased understanding of the importance of PGRFA in addressing the challenges posed by climate change. Interest is growing in neglected and underutilized crops, in recognition of their potential as novel crops that will be productive under different climate scenarios. They also provide opportunities for high-value niche products. There is increasing recognition in the scientific community of the potential of CWR for contributing to sustainable intensification of production, but this has not yet reached a wider audience. Concern over the global increase in lifestyle related diseases has led to a growing interest in the nutritional benefits that can be gained from exploring and exploiting PGRFA. Many countries are aiming to reduce the cost of imported food by revitalizing local food production, which often has cultural value. The new social networking tools provide an extremely effective way to get such messages through to a significant mass of people, in particular the young generation. However, raising the awareness of policy makers, donors and the general public of the value of PGRFA is a continuing challenge.

299. A targeted public awareness programme can promote the development of international linkages and collaborative mechanisms such as networks, involving different sectors, agencies and stakeholders. Within countries, public awareness can support efforts to involve [private sector,]communities and local and non-governmental organizations in national genetic resources activities, thus ensuring a broader base for conservation[,] [and]improvement[and sustainable use of PGRFA]. Working with the media at local and national level is a key aspect in raising awareness. Strong linkages between public awareness work implemented by international organizations and national programmes and organizations can increase effectiveness and reduce costs. Effective awareness programmes can bring financial rewards, as evident by the success of the Trust, established in 2004 as a specialized fund dedicated to supporting the conservation of PGRFA and promoting its use worldwide.

300. ~~**Long-term objectives**~~**Objectives:** To ensure continued support of PGRFA conservation and use by policy makers and the general public.

301. ~~**Intermediate objectives:**~~ To support and strengthen mechanisms, particularly in developing countries, for coordinated public awareness activities which involve and target all stakeholders. To fully integrate public awareness into all national, regional and international programme activities.

302. **Policy/strategy:** Greater efforts are needed to estimate the full value of PGRFA, to assess the impact of its use and to bring this information to the attention of policy makers and the general public. Public awareness and the roles that specific target audiences can play in sustaining plant genetic resources activities should be considered when developing any national programme activity.

303. National strategies should recognize the role of all stakeholders in PGRFA conservation and use, who should be involved in the development of public awareness activities. Governments should recognize and encourage the work of NGOs in raising public awareness, and efforts should be made to foster the development of public-private partnerships. The important role of [indigenous and]local communities in any *in situ* conservation or on-farm management effort, and their traditional knowledge systems and practices, needs to be fully taken into account.

304. Public awareness needs to be done in appropriate languages to facilitate broad use within countries, and exploit all available ICT options.

305. Public awareness needs to be adequately resourced to be effective—both human and financial resources.

306. **Capacity:** PGRFA programmes should have a trained focal point for public awareness who works closely with programme managers on public awareness related issues and develop the appropriate tools. Failing this, all people working within PGRFA programmes should develop some capacity to articulate the importance of the programme goals and activities in the broader context of sustainable agriculture and development. They should be able to communicate their message to all stakeholders using appropriate tools, and keep abreast of new and innovative approaches.

307. National programmes should work with well-known and influential people to increase access to the media and attract attention. Efforts are required to develop and strengthen relationships with the local media and to encourage them to cover PGRFA issues on a regular basis, involving them in awareness raising PGRFA workshops and meetings to gain a better understanding of the subject area.

308. National genetic resources programmes should draw on public awareness tools and technologies generated at the regional and international level for use in their own information efforts. These tools – and the messages they convey – may have to be adapted to reflect national priorities and circumstances. However, it is likely that many of the regional and global messages will prove useful in supporting national public awareness strategies and activities. This will substantially reduce costs to the national programme. This does not detract, however, from the need to enhance capacity for producing public awareness materials at the national level.

309. Awareness of the value of PGRFA, and of the role of scientists, plant breeders, farmers and communities in maintaining and improving them, should be promoted in schools at all educational levels, as well as in specialized agricultural research institutions. This can be catalyzed through the production of education/training materials adapted using local case studies. This requires working relationships with national education institutions. The important role that botanic gardens play in promoting awareness must also be utilized by the PGRFA community.

310. **Research/technology:** Research into, or consideration of, the information needs of targeted audiences should be made before launching major public awareness initiatives. The information provided, or the activity through which the message is given, have to be relevant. Further research is required to provide information to underpin the development of appropriate policies for the conservation and use of genetic diversity, including the economic valuation of PGRFA. At the international level, research into the use of the new ICTs to meet public awareness needs should be undertaken. The impact of promotional materials should not be assumed; there is need for impact analysis of promotional materials so that limited resources can be used for maximum impact

311. **Coordination/administration** Coordination and facilitation is needed at all levels to rationalize and bring cost efficiencies to public awareness work. National programmes and others can take advantage of materials developed at [the][regional and]international level[s]. Linkages between [regional and]international organizations[, private seed sectors] and NGOs will facilitate the identification of opportunities for collaborative activities. The value gained in involving the private sector must also be considered. A coordinated multi-sectoral and multi-agency approach enhances the strength of the message.

Implementation and Financing of the Updated Global Plan of Action

312. The updated GPA provides an important internationally agreed framework for the conservation and sustainable use of plant genetic resources for food and agriculture. The updated GPA is [in harmony with][a supporting element of] the International Treaty[under its Article 14] and the implementation of the updated GPA will be an essential contribution to the achievement of the objectives of the International Treaty. It will also facilitate implementation of the CBD in the area of agricultural biodiversity and help reach targets of the Strategic Plan for Biodiversity 2011-2020.

313. The follow-up processes call for action at local, national, regional and international levels and should involve all relevant stakeholders: the national governments, local and regional authorities, regional and international organizations, both inter-governmental and nongovernmental, the scientific community, the private sector, {indigenous and }local communities[, breeders] and farmers and other agricultural producers and their associations.

314. Overall progress in the implementation of the rolling updated GPA and of the related follow-up processes will be monitored and guided by the national governments and other Members of FAO, through the Commission. In order to discharge this function, the Commission will plan within its Multi-Year Programme of Work the review of the implementation of the updated GPA as well as the review of the updated GPA itself in close cooperation with the Governing Body of the International Treaty. The review of implementation should deal with the progress made at national, regional and international levels in implementation, elaboration, and adjustment as appropriate, of the updated GPA. A first review of the implementation of the updated GPA should be undertaken at the Commission's Fifteenth Regular Session.

315. To this end, the Commission, at its Fourteenth Regular Session, will, in light of past experiences, agree on formats for receiving progress reports as well as on criteria and indicators for monitoring the implementation of the updated GPA[building on previous work done by the Commission to develop such indicators]. The conclusions of the Commission should be brought to the attention of concerned governments and international institutions to fill gaps, rectify imbalances or lack of coordination, and to consider new initiatives or activities. The conclusions of the Commission which have major policy implications will also be brought to the attention of the FAO Council and Conference, to the Governing Body of the International Treaty and to the Conference of Parties to the CBD and/or to the Commission on Sustainable Development for action, endorsement or information, as appropriate.

316. The full implementation of the updated GPA requires a significant increase in the activities currently taking place. The updated GPA will have to be implemented progressively, and adequate financial resources commensurate with the scope of the updated GPA should therefore be mobilized. Each country should determine its own priorities in the light of those agreed in the updated GPA and in the framework of its food and agriculture development needs.

317. Significant, but indeterminate, funding for plant genetic resources for food and agriculture is currently provided by national governments and other domestic sources of funds, from bilateral and regional sources and multilateral organizations.

318. Given the importance of the contribution of domestic sources, including both public and private sectors, each country should make every possible effort to provide, in accordance with its capacities, financial support and incentives with respect to its national activities which are intended to achieve the objectives of the updated GPA, in accordance with its national plans, priorities and programmes.

319. International cooperation for conservation and sustainable utilization of plant genetic resources for food and agriculture should be strengthened, in particular to support and complement the efforts of developing countries and countries with economies in transition. The Governing Body of the International Treaty will play a key role in this regard. The extent to which developing countries and countries with economies in transition will effectively implement

their commitments under the updated GPA will [largely][to a certain extent] depend on the effective implementation of the International Treaty and its funding strategy. Two key elements of the funding strategy that will support the implementation of the updated GPA are the Benefit-sharing fund and the Trust. Funds of the Benefit-sharing Fund are under the direct control of the Governing Body and are used by the Governing Body to play a catalytic role in international cooperation in the area of plant genetic resources for food and agriculture taking the rolling GPA into account.[23] The Trust is an essential element of the Funding Strategy and promotes [the cost effective and efficient]conservation activities in accordance with the GPA.[24] Every effort should also be made to seek new, additional and innovative sources of funding within the process of the implementation of the updated GPA.

320. Through the monitoring of the Funding Strategy of the International Treaty, the Governing Body will be able to monitor resources available for the implementation of the updated GPA. The priorities for support under the Funding Strategy are the priority activity areas of the rolling GPA. The monitoring of the Funding Strategy covers resources under the Benefit-sharing Fund as well as resources not under the Governing Body's direct control.

321. In order to enlist the widest participation and support for its implementation the updated GPA should be reported to the major international, regional and national bodies and fora dealing with food and agriculture and biodiversity, including, in particular, the FAO Conference, the Conference of the Parties to the CBD, the Commission on Sustainable Development of the United Nations, and the governing bodies of the United Nations Environment Programme, the Global Environment Facility, the United Nations Development Programme, the International Fund for Agricultural Development, the World Bank, the Common Fund for Commodities, Regional Development Banks, the Consultative Group on International Agricultural Research and the Trust, and their member constituencies should be invited to promote and take part as appropriate in the implementation of the updated GPA.

[23] The three current priority areas are: 1. Information exchange, technology transfer and capacity-building (reflecting priority activities 15 and 19 of the *first* Global Plan of Action[, roughly corresponding to priority activities 13 and 17 of the current GPA]); 2. Managing and conserving plant genetic resources on-farm (reflecting priority activity 2 of the *first* Global Plan of Action[, roughly corresponding to priority activity 2 of the current GPA]); and 3. The sustainable use of plant genetic resources (reflecting priority activities 9, 10, and 11 of the *first* Global Plan of Action[, roughly corresponding to priority activities 8, 9 and 10 of the current GPA]).

[24] The objective of the Trust is to ensure the long-term conservation and availability of plant genetic resources for food and agriculture with a view to achieving global food security and sustainable agriculture. The Trust, in accordance with its Constitution shall in particular, without prejudice to the generality of the foregoing, (a) endeavour to safeguard collections of unique and valuable plant genetic resources for food and agriculture held *ex situ* , with priority being given to those that are plant genetic resources included in Annex I to the International Treaty or referred to in Article 15.1(b) of the International Treaty ; (b) promote an efficient goal-oriented, economically efficient and sustainable global system of *ex situ* conservation in accordance with the International Treaty and the Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture (hereinafter referred to as "the Global Plan of Action"); (c) promote the regeneration, characterization, documentation and evaluation of plant genetic resources for food and agriculture and the exchange of related information; (d) promote the availability of plant genetic resources for food and agriculture; and (e) promote national and regional capacity building, including the training of key personnel, with respect to the above.

List of acronyms and abbreviations

BSF	Benefit-Sharing Fund of the International Treaty
CBD	the Convention on Biological Diversity
CGIAR	the Consultative Group on International Agricultural Research
CWR	Crop wild relatives
GCP	Generation Challenge Programme
GIPB	Global Partnership Initiative for Plant Breeding Capacity Building
GIS	Geographic Information Systems
GPA	Global Plan of Action
GPS	Global Positioning System
GRIN	Genet Resources Information Network
ICT	Information and Communication Technologies
IPR	Intellectual Property Rights
MYPOW	Multi-Year Programme of Work of the Commission
NARS	National Agricultural Research System
NISM	National Information Sharing Mechanisms on GPA implementation
PGRFA	Plant genetic resources for food and agriculture
SGSV	Svalbard Global Seed Vault
the Commission	the Commission on Genetic Resources for Food and Agriculture
the International Treaty	the International Treaty on Plant Genetic Resources for Food and Agriculture
the Trust	the Global Crop Diversity Trust
UNFCC	United Nations Framework Convention on Climate Change
WIEWS	World Information and Early Warning System on PGRFA
WISM	World Information Sharing Mechanism on GPA implementation

APPENDIX F

DRAFT REVISED GENEBANK STANDARDS FOR THE CONSERVATION OF ORTHODOX SEEDS

Note: This appendix contains the *Draft Revised Genebank Standards for the Conservation of Orthodox Seeds.* It was not reviewed by the Intergovernmental Technical Working Group on Plant Genetic Resources for Food and Agriculture at its Fifth Session, due to time constraints. However, some members of the Working group provided written comments including deletion of original text with proposed new text. The suggested deletions are shown in square brackets and the proposed additions are shown in square brackets and underlined.

[text]: Proposed deletion
[<u>text</u>]: Proposed addition

Table of Contents

INTRODUCTION

1. Genebanks around the world hold collections of a broad range of plant genetic resources, with the overall aim of long-term conservation and accessibility of the plant germplasm to plant breeders, researchers and other users. A sustainable conservation of these plant genetic resources depends on effective and efficient management of genebanks through the application of standards and procedures that ensure the survival and availability of plant genetic resources at present and in the future. For any conservation effort to be sustainable and successful it should also be cost effective and well managed.

2. The draft revised *Genebank Standards* arises from the revision of the FAO/IPGRI *Genebank Standards*, published in 1994. The revision was undertaken at the request from the Commission on Genetic Resources for Food and Agriculture (CGRFA) in light of the changes in the global policy landscape and advances in field of science and technology. The main policy developments that impact the conservation of plant genetic resources in genebanks lie within the context of availability and distribution of germplasm arising from the adoption of international instruments such as Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources (ITPGRFA) [in relation with plant genetic resources] and the International Plant Protection Convention (IPPC) [and WTO/SPS agreement in relation with plant pest rules]. In 2010, the CBD adopted the Nagoya Protocol on Access to Genetic Resources and Equitable Sharing of Benefits Arising from their Utilization – that could have an impact on germplasm exchange. On the scientific front, advances in seed storage technology, biotechnology, and information and communication technology (ICT), have added new dimensions to plant germplasm conservation.

3. The draft revised *Genebank Standards* is concerned solely with the conservation of seeds of orthodox species, including wild species, i.e. those species whose seed can survive considerable desiccation, and in which longevity can be improved by reducing seed storage moisture content and/or temperature. The standards are underpinned by a set of broad underlying principles that provide the overarching framework for an effective and efficient management of genebanks. These key principles at the core of a genebank operation are the preservation of germplasm identity, maintenance of viability and genetic integrity, promoting access including the associated information to facilitate use of the stored plant material in accordance with relevant national and international regulatory instruments. The standards provide the specificity to ensure that a genebank can adhere to these underlying principles.

4. It is noted that these standards are voluntary and nonbinding and have not been developed through a formal standard-setting procedure. They should be viewed as targets for developing an efficient, effective, rational and transparent global system of *ex situ* conservation that provide optimal maintenance of seed viability and genetic integrity in genebanks, thereby ensuring access to and use of high quality seeds of conserved plant genetic resources.

5. These standards do not cover *ex situ* conservation of non- orthodox seeds or clonally propagated crops. Appropriate standards for such collections will be developed in due course.

6. The draft revised *Genebank Standards* can be aimed at by all genebanks for conserving orthodox seed collections, but they should not be used uncritically because there are continuous technological advances in conservation methods, much of it species-specific, as well as in the context of the purpose and period of germplasm conservation and use. It is therefore recommended that the draft revised *Genebank Standards* be used in conjunction with other reference sources, particularly references to species-specific information.

7. This document is divided into three parts, namely the Underlying Principles, Standards and the Appendices. The standards are detailed in nine sections and a selective list of references is provided for all the standards.

UNDERLYING PRINCIPLES

8. Genebanks globally share many of the same basic goals, but their missions, resources, and the systems they operate within often differ. As a result, curators have to optimize actively their own overall genebank system and this objective requires management solutions which may differ substantially across institutions, but that would still lead to the same goals. Underlying principles explain why and for what purpose plant genetic resources are being conserved. These principles provide the basis for establishing the norms and standards essential for the smooth operation of a genebank. The major underlying principles for conservation are described in the section below.

Identity of accessions

9. Care should be taken to ensure that the identity of seed sample accessions conserved in genebanks is maintained throughout the various processes, beginning with acquisition through to storage and distribution. Proper identification of seed samples conserved in genebanks is closely related to careful documentation of data and information about the material. This will begin with recording passport data including collecting information and, if applicable, donor information; information should also be recorded for older collections in the genebanks for which passport data was not recorded earlier or is incomplete. Often herbarium voucher specimen and seed reference collections may play an important role in the correct identification of seed samples. Modern techniques such as [accession labels with printed barcodes and molecular markers] can greatly facilitate the management of the germplasm without incurring errors and thus ensuring the identity of the accessions in question.

Maintenance of viability

10. Maintaining viability [, and] genetic integrity [and quality] of seed samples [in genebanks] and making them available for use is the ultimate aim behind genebank management. It is, therefore, critically important that all [genebanks] processes adhere to the standards necessary to ensure that acceptable levels of viability are maintained. [A high initial viability can ensure the attainment of a maximum period of conservation under long-term conditions, thus decreasing the frequency of regeneration to avoid loss of alleles]. To meet these aims, particular attention needs to be paid to standards on germplasm acquisition, processing and storage. In general, seed samples accepted into the genebank at the point of acquisition should have high viability and as far as possible meet the standards for acquisition of germplasm. Collecting the seeds as close as possible to the time [of natural dispersal] [of maturation and prior to natural dispersal, avoiding the collection of dispersed seeds from the ground or that are soiled and may have saprophytic or pathogenic fungi/ bacteria,] can ensure the highest physiological seed quality. [Genebanks should also ensure that collected germplasm is genetically representative of the original population as well as taking into account the number of live propagules, such as the quality of the sample is not compromised.] A monitoring system should be in place to check viability status of stored samples at appropriate intervals depending on expected seed longevity. Costly regeneration can be avoided or at least delayed if correct attention is paid to post-harvest handling, drying and storage.

Maintenance of genetic integrity

11. The need to maintain genetic integrity is closely related to maintenance of viability and diversity of the original collected sample. All genebank processes, starting from collecting and acquisition through to storage, regeneration and distribution, are important for the maintenance of genetic integrity. Adequately representative seed samples of good quality and sufficient quantity should be obtained during acquisition as far as possible. [However, it is recognised that when the objective is to collect particular traits, then the sample may not necessarily be representative of the original population.] Ensuring that viability is maintained according to the standards contributes to the maintenance of genetic integrity. To minimize genetic erosion it is important to

follow recommended protocols for regenerating seed accessions, with as few regeneration cycles as possible, sufficiently large effective population sizes, [balanced sampling] as well as pollination control. A special mention is made here on the importance of safety duplication to respond to risks that can occur in genebank facilities.

Maintenance of seed health

12. Genebanks should strive to ensure that the seeds they are conserving and distributing are free from quarantine [seed-borne diseases] and [regulated] pests [(bacteria, virus, fungi and insects)] to the extent possible. Often genebanks do not have the capacities or the resources necessary to test themselves whether samples collected or acquired and samples harvested from regeneration/multiplication plots are free from quarantine [seed-borne diseases and] pests. This is particularly the case with germplasm received from third parties. So it is important that relevant import and phytosanitary certificates accompany seeds materials when exchange of germplasm takes place to ensure the health status of samples received. Some infected/infested samples may be easily cleaned, while others may require more elaborate methods for cleaning.

Physical Security of collections

13. An underlying principle of germplasm conservation is that the physical structures of the genebank facilities in which germplasm are conserved are of adequate standard to secure the materials from any external factors including natural disasters, [and human-caused damage] [thefts and riots]. Adequate security systems are also required to ensure that genebank cooling equipment is in good running conditions and monitoring devices are available to track the essential parameters against time. Another important security issue for genebanks is to ensure materials are safely duplicated in one or more locations such that if the collection is destroyed for some reasons, it can be restored from the duplicated sets.

Availability and use of germplasm

14. The conserved material must be available for current and future use. It is, therefore, important that all processes in genebank operations and management contribute to this goal. There will be a need to maintain sufficient quantities of seed and related information on the accessions.

Availability of information

15. In order to ensure communication of information and accountability, essential, detailed, accurate, and up-to-date information at all stages should also be recorded, including historical as well as current information, especially in relation to the management of individual accessions, subsequent to their acquisition. Access, availability and sharing of this information should be treated with high priority, as it leads to better and more rational conservation. Search-query interactive databases containing phenotypic evaluation data can assist germplasm clients in the targeting of germplasm requests, and in turn feedback of further evaluation data adds to the value and utility of the collection. [If information on the conserved germplasm is made easily available and accessible it will enhance germplasm use. Further this will help the genebank curators to better plan their multiplication and regeneration activities in order to keep adequate stocks of their accessions.]

Proactive management of genebanks

16. Sustainable and effective conservation of genetic resources depends on active management of the conserved germplasm material. Proactive management is critical for ensuring that germplasm is efficiently conserved and made timely and in adequate quantity available for further use by plant breeders, farmers, researchers and other users. It emphasizes the importance of securing and sharing material as well as the related information, and sets in place a functional

strategy for management of human and financial resources for a rational system. It includes a risk management strategy and encourages a participatory role of genebanks in the efforts to conserve biodiversity. Adherence to the legal and regulatory frameworks at national and international levels, in particular as they relate to access, availability and distribution of materials and plant and seed health is necessary. A Standard Material Transfer Agreement (SMTA) should be used [in all cases][for crops] under the Multilateral System of the ITPGRFA. The IPPC regulations provide the framework for quarantine and health regulations to prevent the introduction and spread of plant pests and diseases. Above all, there is a need for long-term and continuous commitment of the institutions holding genebanks with regards to the availability of human and financial resources.

17. Furthermore, proactive management would encourage application of practical experiences and knowledge to new germplasm in a genebank and seek to apply the genebank standards to the extent possible under the locally prevailing conditions. This could sometimes mean that although a particular standard is not entirely met but precautionary measures are taken to uphold the underlying principles of genebank management.

STANDARDS – STRUCTURE AND DEFINITIONS

18. The Standards as described in this document, define the [lowest] level of performance of a routine genebank operation below which there is a high risk of losing genetic integrity (e.g. a probability of five percent or more of losing an allele in an accession over the storage period). Each section is divided into:

A. Standards

B. Context

C. Technical aspects

D. Contingencies

E. Selected references

The **Standards** are detailed in nine sections: acquisition, seed drying and storage, viability monitoring, regeneration, characterization, documentation, distribution, safety duplication and security/personnel.
The **Context** provides the basic necessary information in which the standards apply. It provides a brief description of the routine genebank operation for which the standards are defined and the underlying principles for them.
The **Technical Aspects** explain technical and scientific principles important to understand and underpin the standards.
The **Contingencies** provide recommendations in the case that standards cannot be applied to a given species, for example exceptions, alternative routes, and risk management options.
Selected sources of information and references are provided in all sections.

3.1. STANDARDS FOR ACQUISITION

A. Standards

3.1.1. All seed samples added to the genebank collection have been acquired legally with relevant technical documentation.
3.1.2. Seed collecting is made as close as possible to the time of [maturation and prior to] natural seed dispersal [,avoiding potential genetic contamination,] to ensure maximum seed quality.
3.1.3. To maximize seed quality, the period between seed collecting and transfer to a controlled drying environment is [within 3 to 5 days or] as short as possible [, bearing in mind that seeds should not be exposed to high temperatures and intense light and that some species require after-ripening to achieve embryo maturation.]
3.1.4. All seed samples are accompanied by a [at least a] minimum of associated data as detailed in the FAO/IPGRI multi-crop passport descriptors.
3.1.5. The minimum size of a seed sample [should aim at capturing] [~~.~~must capture] 95 percent of alleles [or the effective population size (N_e)] in the sampled population. [For most practical purposes this can be achieved by collecting between 30-60 plants, depending on the breeding system of the target species].

B. Context

19. Acquisition is the process of collecting or requesting seeds for inclusion in the genebank, together with related information. The material should be legally acquired, be of high seed quality and properly documented.

20. Acquisition is made in accordance with relevant international and national regulations such as phytosanitary/quarantine laws, ITPGRFA or CBD access regulations, and national laws for genetic resources access. Adherence to Standard 3.1.1 will allow the export of seeds from the origin/donor country and the import into the country of the genebank, and determine the management and distribution regime (for example SMTA or bilateral Material Transfer Agreements (MTA)).

21. There is a need to ensure maximum seed quality and avoid conservation of immature seeds and seeds that have been exposed for too long to the elements. The way that seeds are handled after collection and before they are transferred to controlled conditions is critical for seed quality. [Unfavorable extreme] [High~~]~~ temperatures and humidity during the post-collecting period and during transport to the genebank could cause rapid loss in viability and reduce longevity during storage. The same applies to post-harvest handling within the genebank. The seed quality and longevity is affected by the conditions experienced prior to storage within the genebank. [It is recommended that a germination test be conducted immediately after collection as a way to determine the quality of the seed collected].

22. During the acquisition phase, it is important to ensure that passport data for each accession is as complete as possible and fully documented [, especially georeference data which can help to relocate collection sites]. Passport data are crucial in identifying and classifying the accession and will function as an entry point in selecting and using the accession.

C. Technical aspects

[23. For material collected outside the genebank country, there must be a Material Acquisition Agreement (MAA) or Access and Benefit Sharing Agreement (ABSA) drafted and signed by the authorized person in the country of collecting, and according to the national laws for genetic resources access for the country where the collecting will take place (ENSCONET, 2009).

Phytosanitary regulations and any other import requirements must be sought from the relevant national authority of the receiving country. For material donated both from within and external to the genebank country, the provisions for the donation, if any, should be made explicit i.e. as SMTA or other type of MTA.]

[23. Access to PGRFA, which are inside the multilateral system of the International Treaty, has to be accompanied with the SMTA. For material acquired or collected outside the country in which the genebank is located, the acquirers should comply with the relevant provisions of the International Treaty for PGRFA or the Nagoya protocol on ABS, i.e. there must be a MTA including Benefit Sharing Arrangement drafted and signed by the authorized person in the country of collecting, and according to the national laws for genetic resources access for the country where the collecting will take place (ENSCONET, 2009). In addition when required by the providing country, the access should be subject to the prior informed consent of the country. Phytosanitary regulations and any other import requirements must be sought from the relevant national authority of the receiving country.]

24. Seeds that are freshly harvested from the field may have high water content and need to be ventilated to prevent fermentation. They should be placed into suitable containers that allow for good air circulation, and that ensure the contents do not become moist through inadequate air exchange and are neither mixed nor damaged during collecting and transport. Monitoring the temperature and relative humidity (RH) to ensure that seeds are not exposed to conditions above 30 °C or 85 percent RH after collecting and transport, as well as during post-harvest processing will help to maintain seed quality. If fully mature seeds need to be processed and dried in the field, technical recommendations for the particular or similar species should be applied to reduce the risk of deterioration.

25. [During collecting a] [A]ppropriate collecting forms should be used [to capture collection data]. These forms should include information such as the initial taxonomic classification of the sample, the global positioning system coordinates of the collecting site, a description of the habitat of the collected plants, the number of plants sampled and other relevant data that are important for proper conservation. If possible, the FAO/IPGRI multi-crop passport descriptors should be used (FAO/IPGRI, 2001). Very useful additional information, such as cultural practices, previous generations of seed history and origin, uses etc, can be obtained with farmer interviews when seed is collected from farmer fields/stores. [During collecting, the collector should also be sensitive to the depletion of the natural population targeted for collecting. It may also be useful to repeat sampling from a particular site to maximize capture of genetic variability that may be present at various points in time.]

[25.bis The collection sample should be sufficient to include at least one copy of 95 percent of the alleles that occur within the target population with a frequency greater than 0.05 (Brown and Marshall 1975). A random sample of 59 unrelated gametes is sufficient to achieve this objective and in a species mating complete at random this equates to 30 individuals whereas in a completely selfing species, this target requires 60 individuals (Brown and Hardner, 2000). Thus the sample size to capture 95 percent of the alleles can vary between 30 and 60 plants depending on the breeding system of the target species].

26. In case of donation of the seeds (from a seed company, research programme or genebank), the taxonomic classification, donor, identification number of the donor, and names in addition to the available passport data should be provided. Adequate information about how the germplasm received was maintained should be sought from the donor, [including pedigree or lineage information, as well as chain of custody informtion where available]. Seeds should be assigned a unique identification number (either temporary or permanent, according to the practice used in the genebank) that accompanies the seeds at all times, and that will link the seeds to the passport data and any other collected information, and guarantee the authenticity of the seed sample. Whenever possible a herbarium voucher specimen collected from the same population as the seed samples should be taken, and a record should be made of the method and reason for

acquisition.

D. Contingencies

27. Collecting should not take place without meeting the legal requirements especially if the germplasm is taken out of the country of collection afterwards.

28. Seeds collected in the field are rarely in such condition (physiological and phytosanitary status) that long-term conservation is automatically guaranteed. In this case multiplication in controlled conditions for the specific purpose of long-term conservation is recommended.

29. When collections contain a significant proportion (>10 percent) of immature seeds or fruits, measures should be taken to encourage post-harvest ripening. This can usually be achieved by holding material in well ventilated, ambient conditions protected from rainfall. Visual improvements in maturity should be monitored and the material should be transferred to controlled drying conditions as soon as the collected seeds are deemed more mature.

30. Allowances [in terms of above standards (e.g. sample size)] will have to be made for [wild and] rare species where seeds might not be available in optimal conditions or quantity.

E. Selected references

[Brown AHD and Hardner (2000). Sampling the genepools of forest trees for *ex situ* conservation. Pp.185-196: IN A. Young, D. Boshier and T. Boyle *Forest conservation genetics. Principles and practice*. CSIRO publishing and CABI.

[Brown AHD and Marshall (1975). Optimum sampling stratgies in genetic resources conservation. Pp 3-80. IN: O.H. Frankel and J.H. Hawkes (eds.) Crop genetic resources for todaya nd tomorrow . Cambridge University press Cambridge

Engels, J.M.M. & Visser L. eds. *A guide to effective management of germplasm collections*. IPGRI Handbooks for Genebanks, No. 6. IPGRI, Rome, Italy, 2003.

ENSCONET *Seed Collecting Manual for Wild Species*, ENSCONET. 2009. ISBN: 978-84-692-3926-1 (www.ensconet.eu).

Eymann, J., Degreef, J., Häuser, C., Monje, J.C., Samyn, Y. & VandenSpiegel, D. eds. 2010. *Manual on Field Recording Techniques and Protocols for All Taxa Biodiversity Inventories and Monitoring, Vol. 8*. Chapters can be downloaded from: http://www.abctaxa.be/volumes/volume-8-manual-atbi

FAO/IPGRI. 2001. *Multi-Crop Passport Descriptors*. FAO, Rome, 4 pp. Available online from:
http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showUid]=2192

Genebank Standards 1994 FAO/IPGRI, Rome
ftp://ftp.fao.org/docrep/fao/meeting/015/aj680e.pdf

Guarino, L., Ramanatha Rao, V. & Reid, R. eds. 1995 *Collecting Plant Genetic Diversity: Technical Guidelines*, Wallingford: CAB International on behalf of IPGRI. in association with FAO, IUCN and UNEP, 748 pp.

Guerrant, E.O., Havens, K. & Maunder, M. eds. 2004. *Ex Situ* Plant Conservation: supporting species survival in the wild. Island Press, Washington D.C. USA.

Lockwood, D.R., Richards, C.M. & Volk, G.M. 2007. *Probabilistic models for collecting genetic diversity: comparisons, caveats and limitations*. Crop Science 47: 859-866.
Model MAA and source of authorized persons (CBD, Treaty focal points)

Probert, R.J. 2003. Seed viability under ambient conditions and the importance of drying, pp 337-365 In: R.D. Smith, J.D. Dickie, S.H. Linington, H.W. Pritchard, R.J. Probert eds. *Seed Conservation: turning science into practice*: Royal Botanic Gardens, Kew, UK.

Probert, R., Adams, J., Coneybeer, J., Crawford, A. & Hay, F. 2007. Seed quality for conservation is critically affected by pre-storage factors. *Australian Journal of Botany* 55, 326-335.

RBG, Kew, Millennium Seed Bank Technical information sheet 04: post-harvest handling of seed collections: http://www.kew.org/msbp/scitech/publications/04-Post%20harvest%20handling.pdf

SGRP. Crop Genebank Knowledge Base (http://cropgenebank.sgrp.cgiar.org)

Smith, R.D., Dickie, J.D., Linington, S.L., Pritchard, H.W.& Probert, R.J. 2003. *Seed Conservation: turning science into practice*: Royal Botanic Gardens, Kew. Chapters can be downloaded from: http://www.kew.org/msbp/scitech/publications/sctsip.htm

Upadhyaya H. D. & Gowda C.L.L. 2009. *Managing and enhancing the use of germplasm – Strategies and methodologies*. Technical Manual no. 10. International Crops Research Institute for the Semi-Arid Tropics. 236 pp. Patancheru 502 324, Andhra Pradesh, India.

3.2. STANDARDS FOR DRYING AND STORAGE

A. Standards

3.2.1. All seed samples are dried to equilibrium in a controlled environment of 5-20°C and [10] [15]-25 percent of relative humidity[, depending upon species].
3.2.2. After drying, all seed samples need to be sealed in a suitable air-tight container [for long term storage; in some instances where collections that need frequent access to seeds or likely to be depleted well before the predicted time for loss in viability, it is then possible to store seeds in non –airtight containers] [prior to storage at the chosen temperature and relative humidity of 15 percent ± 3 percent.]
3.2.3. Most-original-samples and safety duplicate samples are stored under long-term conditions [(base collections)] at a temperature of -18 ± 3°C[and relative humidity of 15 percent ± 3percent].
3.2.4. For medium-term conditions [(active collection)]samples are stored under refrigeration at 5-10 °C[and relative humidity of 15 percent ± 3percent].

B. Context

31. Maintaining seed viability is a critical genebank function that ensures germplasm is available to users and is genetically representative of the population from which it was acquired (i.e. the most-original-sample). A critical objective of seed drying and storage standards is to reduce the frequency of regeneration of the most-original-sample by maximizing seed longevity, thereby reducing the cost of genebanking and the risks of genetic erosion. For this purpose, long-term storage is required for all most-original samples and for safety duplication of the collection (see Standards for safety duplication). In addition storage standards are also required for circumstances where the objective is to store seeds over the medium- or short-term to keep them alive long enough for distribution to users and evaluation of germplasm. In such cases the standard need not be as stringent as in the case of long-term conservation.

32. Prior to storage, seed samples need to be dried to appropriate moisture content. A variety of methods can be used for seed drying, the most common being the use of a desiccant or using a dehumidified drying chamber. The methods chosen will depend on the available equipment, number and size of the samples to be dried, local climatic conditions and cost considerations. However, there is a limit to which drying can increase longevity. At a critical moisture level, maximum longevity for the storage temperature is attained and drying below this level does not increase seed longevity further. To realize the full benefit of refrigerated or freezer storage, it is recommended that genebanks dry seeds to the critical moisture level. Various RH-temperature combinations can be used during drying, with faster drying possible at higher temperatures but the potential for physiological aging reduced by lower drying temperatures.

33. Long-term storage conditions as recommended above are expected to provide high seed quality for [long periods, the actual timing is species-specific] [about 100 years for seed of most agricultural species]; medium-term storage conditions are adequate for 30 years and will generally require refrigerated storage. Short-term storage is expected to provide high quality seed for at least eight years and may be accomplished at ambient temperatures (under as cool and stable temperatures as possible but not more than 25 °C) for some longer-lived species if relative humidity is controlled according to Standard 3.2.2. It should be pointed out that the longevity of mature, high quality seeds may vary among species and even among seed lots of the same species (Probert *et al*. 2009; Nagel and Börner 2009; Crawford *et al*. 2007; Walters *et al*. 2005). The variation among species and among seed lots of the same species, particularly if seeds are harvested with variable maturity, requires the genebank curator's vigilance to monitor viability (see Standards for viability monitoring).

34. As seed equilibrium moisture content varies depending on oil content, the best measurement for the drying standard is equilibrium relative humidity (eRH) which is constant depending on the relative humidity and temperature of the drying environment. However, it should be noted that in sealed containers during storage, seed eRH will fall or increase if the storage temperature is lower or higher than the drying temperature.

C. Technical aspects

35. Seed longevity is determined by interactions of biological factors intrinsic to the seed and the quality and consistency of the storage environment, namely the storage temperature and the control of seed moisture content (equilibrium relative humidity) [as well as being species dependent]. It is well known that seed longevity increases as the seed moisture content and storage temperature decreases, within limits (Ellis and Roberts, 1980; Harrington, 1972). Studies have demonstrated that drying seed beyond a certain critical seed moisture content provides little or no additional benefit to longevity (Ellis *et al*. 1995; Ellis and Hong, 2006) and may even accelerate seed-aging rates (Vertucci and Roos 1990; Walters, 1998). The storage standards as presented are intended to ensure that seeds are stored at this optimum moisture content. However, it has been shown that lowering the storage temperature increases the optimum seed moisture content level (Walters and Engels, 1998; Ellis and Hong, 2006), which suggests there might be danger of over-drying seeds. Conversely, there are reports of successful long-term storage of seeds under 'ultra-dry' conditions (Pérez-García *et al*. 2009). However, there is still uncertainty and requires further research (Ellis and Hong, 2006; Vertucci and Roos 1990; Walters, 1998).

36. Drying conditions that achieve the critical moisture level at the storage temperature should be determined using water sorption isotherms which show the relationship between the amount of water in the seeds, usually expressed as a percentage of the total seed weight, and their RH. There could be different combinations of relative humidity and drying temperature for given species. Isotherm relationships, predicted based on seed oil content, are available online at the Kew Seed Information Database (SID) website (see references). Genebank operators should clearly understand the relationship between relative humidity and storage temperature to be able to decide about the best combination for their seed drying environment.

37. As soon the seeds have reached the desired moisture content they should be packaged and stored. After drying, seed moisture should be maintained using moisture-proof containers. [Different types of containers can be used including glass, tin, plastic containers, and aluminium foils, each with their advantages and disadvantages (Gomez-Campo, 2006). For example, it is considered that glass containers may collect moisture in humid environments and aluminized plastic bags are much better than glass, provided that the seeds will fit in those containers. In any case either] [Either] glass containers that are sufficiently thick to avoid breakage or laminate packaging with a metal foil layer [of at least 20 µm thickness][of adequate thickness] will maintain desired moisture levels for up to 40 years, depending on the ambient relative humidity at the genebank's location and the quality of the seal. [For example in Germany the genebank uses laminated aluminium foils which are 11µm thick while the accessions held in Svalbarg are held in 20µm laminated aluminium foils.]Seed moisture content or eRH should be measured periodically to confirm that storage moisture is adequately maintained.

38. The storage temperature defines the maximum longevity possible for a seed sample and a stable storage environment is critical to maintaining seed viability. However, there are limited data from long-term storage at a range of low temperatures. Storage at -18 °C has been recommended in the past for long-term storage as it is the lowest temperature that can be achieved with a single stage standard deep freezer compressor. For long-term stored seeds, all attempts should be made to maintain storage temperatures within ±3 ^{o}C of the set temperature and to limit the total duration of fluctuations outside this range to less than one week per year. Genebanks should maintain records of storage temperature deviations and periods when seed accessions are removed from the storage environment. For short-term storage, the seeds should be dried at the same temperature as they are stored, e.g. if ambient condition is 20°C, seeds should then be dried at that same temperature.

D. Contingencies

39. Seeds in long-term storage should be removed rarely and only when samples in medium-term storage are exhausted. Desired storage conditions are not achieved when mechanical environmental controls fail or when seeds are repeatedly removed from controlled storage environment. Back-up generators with an adequate fuel supply should be available on-site.

40. All containers leak and seed moisture will eventually equilibrate to environmental conditions within the storage vault. This occurs faster in containers for which thermal plastics are used as the moisture barrier or if glass or foil laminate containers have faulty seals or imperfections. Seeds may need to be re-dried occasionally and containers or gaskets replaced within 20-40 years.

41. If clear [(for example, glass)] containers are used, perforated transparent plastic sachets containing self-indicating silica gel, equilibrated to the drying environment, can be used to monitor container performance during long-term storage. A change in colour of the silica gel inside the sachet (stored alongside the seeds) will indicate moisture ingress if the container seal fails.

42. Orthodox seeds with short life spans or seeds with low initial quality may deteriorate more rapidly in storage and not meet long-term storage standards unless cryogenic conditions are used.

E. Selected references

Dickie J.B., Ellis, R.H., Kraak, H.L., Ryder, K. & Tompsett, P.B. 1990. Temperature and seed storage longevity. *Annals of Botany*, 65: 197-204.

Ellis, R.H. & Roberts, E.H. 1980. Improved equations for the prediction of seed longevity. *Annals of Botany*, 45: 13-30.

Ellis, R.H. & Hong, T.D. 2006. Temperature sensitivity of the low-moisture-content limit to negative seed longevity-moisture content relationships in hermetic storage. *Annals of Botany*, 97: 785-91.

Engels, J.M.M. & Visser, L. *A guide to effective management of germplasm collections*. IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy.

Gomez-Campo, C. 2006. Erosion of genetic resources within seedbanks: the role of seed containers. Seed Science Research 16:291-294

Harrington, J.F. 1972. Seed storage longevity. In: T.T. Kozlowski, ed. *Seed biology, Vol. III*. pp. 145-245 Academic Press, New York, USA.

Kew Seed Information Database: predict seed viability module (http://data.kew.org/sid/viability/percent1.jsp; Convert RH to water content (http://data.kew.org/sid/viability/mc1.jsp) and Convert water content to RH (http://data.kew.org/sid/viability/rh.jsp)

Nagel, M. & Börner A. 2009. The longevity of crop seeds stored under ambient conditions. *Seed Science Research*, 20: 1-12.

Pérez-García, F., Gómez-Campo, C. & Ellis, R.H. 2009. Successful long-term ultra dry storage of seed of 15 species of *Brassicaceae* in a genebank: variation in ability to germinate over 40 years and dormancy. *Seed Science and Technology*, 37(3): 640-649.

Probert, R.J., Daws, M.I. & Hay, F.R. 2009. Ecological Correlates of *Ex Situ* Seed Longevity: a Comparative Study on 195 Species. *Annals of Botany*, 104 (1): 57-69.
Smith, R.D., Dickie, J.D., Linington, S.L., Pritchard, H.W. & Probert, R.J. 2003. Seed Conservation: turning science into practice: Royal Botanic Gardens, Kew. Chapters can be downloaded from: http://www.kew.org/msbp/scitech/publications/sctsip.htm (see chapters 17 and 24).

Vertucci, C.W. & Roos, E.E. 1990. Theoretical Basis of Protocols for Seed Storage. *Plant Physiology*, 94:1019-1023.

Walters, C. 1998. Understanding the mechanisms and kinetics of seed aging. *Seed Science Research*, 8:223-244.

Walters, C. 2007. Materials used for Seed Storage Containers. *Seed Science Research*, 17: 233-242.

Walters, C., Wheeler, L.J. & Stanwood, P.C. 2004. Longevity of cryogenically-stored seeds. *Cryobiology*, 48: 229-244.

Walters, C. & Engels, J. 1998. The effect of storing seeds under extremely dry conditions. *Seed Science Research*, 8. Supplement 1, pp 3-8.

Walters, C., Wheeler, L.J. & Grotenhuis, J. 2005. Longevity of seeds stored in a genebank: species characteristics. *Seed Science Research* 15:1-20.

3.3. STANDARDS FOR SEED VIABILITY MONITORING

A. Standards

3.3.1. The initial seed viability test is conducted after cleaning and drying the accession or at the latest within 12 months after receipt of the sample at the genebank.

3.3.2. The initial germination value should exceed 85 percent for most seeds [of cultivated crop species. For some specific accessions and wild and forest species which do not normally reach high levels of germination, a lower percentage could be accepted.] [e.g. cereals, and 75 percent for some vegetables and lower for some wild or forest species, which do not normally reach high levels of germination]

3.3.3. Viability monitoring test intervals [to] [should] be set at one-third of the time predicted for viability to fall to 85 percent[25] [or lower depending on the species or specific accessions] of initial viability [but no longer than 40 years]. If this deterioration period cannot be estimated and accessions are being held in long-term storage at -18°C in hermetically closed containers, the interval should be ten years for species expected to be long lived and five years or less for species expected to be short lived.

3.3.4. The viability threshold for regeneration or other management decision such as re-collection [is][should be] 85 percent [or lower depending on the species or specific accessions] of initial viability.

B. Context

43. Good seed storage conditions maintain germplasm viability, but even under excellent conditions viability declines with period of storage. [Genebanks are concerned with viability in terms of germination potential for conservation as well as germination tests in order to establish a regenerating population.]It is therefore necessary to assess viability periodically. The initial viability test should be conducted as early as possible before the seeds are packaged and enter the storage, and subsequent tests are conducted at intervals during storage. If for practical reasons of workflow and efficiency the initial viability test cannot be made prior to storage, it should be made as soon as possible and not later than 12 months after [storing] [receiving]. This can be the case of multi-species genebanks, where a wide range of germination regimes is required and samples of the same species are tested all together once a year.

44. The purpose of viability monitoring is to detect loss in viability during long-term storage before viability has fallen below the threshold for regeneration. The important guiding principle is one of active management of the collection. Too frequent monitoring will result in unnecessary waste of seeds and resources. On the other hand, significant viability decline may not be detected if monitoring is delayed or infrequent; advanced aging of the sample may result in genetic changes (random or directed selection), unrepaired mutations fixed in the sample, or ultimate loss of the accession.

45. When it is predicted that viability will fall to 85 percent before the next scheduled retest, the time of the retest should be anticipated or the accession directly scheduled for regeneration.

46. Risk of genetic erosion during storage is lower for homogeneous samples and germination decline to less than 85 percent is allowable as long as plant establishment during regeneration remains adequate. For heterogeneous samples such as wild species and landraces, the 85 percent standard should be adhered. For some [landraces, specific accessions,] wild species [and forest species] [such as cereal and legume wild relatives], a viability of 85 percent in newly replenished seed is rarely achievable. In these situations, the curator can set the viability standard trigger for selected species to a lower threshold, such as 70 percent [or lower].

47. Models to predict seed longevity from ambient to freezer conditions are available for

[25] The time for seed viability to fall can be predicted for a range of crop species using an online application based on the Ellis/Roberts viability equations (see http://data.kew.org/sid/viability/)

diverse agricultural species. Genebank staff should use available predictive tools documented for particular species and storage conditions to anticipate duration that seeds will maintain high viability and to guide other genebank operations such as viability monitoring and regeneration frequencies (see Standards for viability monitoring and regeneration). Longevity predictions based on general species characteristics should be considered as estimates with large confidence intervals. Genebanks are encouraged to develop and report new information that describes and updates species responses to storage conditions.

C. Technical aspects

48. Viability monitoring intervals should be adjusted according to the data received from germination tests. As soon as a significant decline is detected, monitoring intervals should be reduced in order to 'fine tune' the prediction of time to reach the viability standard.

49. Accessions with very high initial viability (> 98 percent) may show a statistically significant decline in viability long before the predicted time for viability to fall to 85 percent, when germination is still well above 90 percent. Regeneration or recollection at this point is probably too soon and unnecessary. However, future retest intervals should be brought forward (for example from ten years to five years) in order to track the decline more accurately.

50. For accessions of lower quality, the accession might be dangerously close to the tipping point if viability declines comparatively rapidly. Such accessions should be managed carefully and the first viability monitoring tests should be after 3-5 years of storage intervals at first. Infrequent (for example ten-year) monitoring might fail to detect rapid deterioration and the viability threshold of 85 percent could be missed with negative consequences to the genetic integrity of the collection. [In this respect the use of statistical models can help to predict the tipping point and predict a time frame for appropriate regeneration.]

51. [Viability testing should give the manager an approximation of the viability of the sample. The goal should be to detect differences of +5% or so, rather than differences of +0.1%]. Sample sizes for viability monitoring will inevitably be dependent upon the size of the accession but should be maximized to achieve statistical certainty. [However, the sample size should be minimized to avoid wasting seed. Seed in a genebank is a valuable resource and should not be wasted.]

52. It is difficult to establish a strict standard for the number of seeds for germination tests in genebanks. As a general guideline 200 seeds are recommended to be used for initial germination tests (ISTA, 2008) followed by sequential testing, if the initial germination is less than 90 percent (Ellis *et al*. 1985) during storage. [However, in the event that there are not sufficient seeds, 100 or even smaller seed samples are also adequate and should be conducted with replications. The germination test is a guide of viability and even small seed samples can give the manager useful information.] But in practice the actual sample size for germination will depend on the size of the accession, which in general is very limited ([ideally] the recommended minimum size for self pollinated is 1500 and for cross pollinated species 3000 seeds) in genebanks. It is important to minimize the use of valuable seeds required for germination tests. For small accession sizes (as is often the case for wild species) sample sizes of 50 seeds or less could be acceptable. However it must be realized then that there may be a higher chance of germination being below the threshold. The genebank curator should assess the risk of this occurrence.

53. The germination test should always be used in preference to alternatives such as the tetrazolium test. However, in circumstances where it is not possible to remove seed dormancy, alternative tests may be carried out. It is recommended that germination often be measured at two different times so as to have an idea of fast and slow germinating seeds. Records of the number of abnormally germinating seeds should also be kept. Slower germination and increasing abnormals are often early indicators that deterioration is occurring.

54. Every effort should be made to germinate all viable seeds in a collection using optimum conditions and appropriate dormancy-breaking treatments where needed. Non-germinated seeds remaining at the end of a germination test should be cut-tested to assess whether they are dead or dormant. Seeds with firm, fresh tissue are likely to be dormant and should be counted as viable seeds.

55. All data and information generated during viability monitoring should be recorded and entered into the documentation system.

D. Contingencies

56. It is recognized that viability monitoring is an expensive activity and that genebanks would wish to seek cost-cutting procedures. One such procedure may entail measuring seed quality in a subsample of accessions of the same species grown in the same harvest year. This practice may reveal overall trends on the effect of harvest year on seed quality, but will not take genotype x harvest year interactions into consideration that are known to be important for seed quality. In the event that subsampling is unavoidable, it should be undertaken with sufficient statistical rigor to ensure usefulness of the data in future analyses. For example, performing germination tests on less than ten accessions may not provide sufficient statistical power to compare accessions harvested in different years. [Hence, should] [If]a subsampling strategy [should] be used, at least 10 percent of same-species accessions harvested in the same year should be evaluated with a minimum of ten accessions evaluated. [However it should be borne in mind that such a 10% strategy could fail to detect viability decline in some specific accessions, due to inherent variation among accessions. Such a strategy should only be used when absolutely necessary.]

57. Where different harvest conditions occur over a wide range of maturities across accessions, then a sampling strategy can be from separate sub groups harvested. An additional strategy would be to focus retesting on the accessions that gave the lowest viability result in the initial tests. Retest data from these accessions should provide an early warning on the performance of the batch as a whole.

58. The initial germination test at harvest for known hard seeded species and accessions frequently found in some forage legume species and Crop Wild Relatives can be as low as 45 percent, and increases after 10-15 years to 95 percent or more and remains so for long periods of time. If the initial germination is less than 90 percent, then regenerate/recollect at first detectable significant decline established by an appropriate statistical test.

59. However it is recognized that intra-specific variation among accessions has been observed for a wide range of accessions, thus there are risks associated with the above strategies, which should be considered. Viability monitoring of accessions of wild species is generally more problematic compared with crop species. Seed dormancy is likely to be much more prevalent and small accession sizes often mean that smaller minimum sample sizes have to be adopted for germination tests, as this will inevitably affect the ability to detect the onset of seed deterioration.

60. With reference to the initial seed viability testing it is also possible that genebanks receive small quantities of seeds. In that case it is not necessary to carry out initial seed viability testing since the samples is sent for regeneration. However the regenerated seeds must then be tested for viability prior to storage.

[61. The initial germination test at harvest for known hard seeded species and accessions frequently found in some forage legume species and WCR's. can be as low as 45 percent, and increases after 10-15 years to 95 percent or more and remains so for long periods of time. If the initial germination is less than 90 percent, then regenerate/recollect at first detectable significant decline established by an appropriate statistical test.]

62. The range of inherent longevity is also wider in wild species with some species from Mediterranean and tropical dryland habitats expected to be extremely long lived and conversely some species from cold, temperate regions expected to be short lived. For the latter, retesting intervals of as few as three years should be considered as well as duplication into cryo-storage as a precautionary measure. In the event that storage conditions are not met (as will occur if there is a prolonged power cut when seeds are stored in refrigeration units), viability will be affected negatively depending on the species, length of disruption and conditions during the disruption. In such an event a disaster management plan should be activated. For example some representative samples may need to be tested immediately following resumption of adequate storage conditions.

E. Selected references

Association of Official Seed Analysts (AOSA) 2005. Page 113 in: Capashew, ed. *Rules for Testing Seeds*, 4-0, 4-11. Las Cruces, New Mexico, USA.

Dickie, J.B., Ellis, R.H., Kraak, H.L., Ryder, K. & Tompsett, P.B. 1990. Temperature and seed storage longevity. *Annals of Botany*, 65:197-204.

Ellis, R.H. & Roberts, E.H. 1980 Improved equations for the prediction of seed longevity. *Annals of Botany*, 45, 13-30.

Ellis, R.H., Hong, T.D. & Roberts, E.H. 1985. Sequential germination test plans and summary of preferred germination test procedures. *Handbook of seed technology for genebanks: Vol I .Principles and methodology*, Chapter 15, pp 179-206. International Board for Plant Genetic Resources. Rome, Italy.

Engels, J.M.M. &. Visser, L. eds. 2003 *A guide to effective management of germplasm collections*. IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy.

ENSCONET manual: http://www.ensconet.eu/PDF/Curation_protocol_English

Harrington, J.F. 1972. Seed storage longevity. In: T.T. Kozlowski, ed. *Seed biology, Vol III*, pp.145-245, Academic Press, New York, USA.

International Seed Testing Association (ISTA). 2008. *International Rules for Seed Testing*. Bassersdorf, Switzerland.

Nagel, M. and Börner. A. 2010: The longevity of crop seeds stored under ambient conditions. Seed Science Research 20, 1-12

Nagel, M., Rehman Arif, M.A., Rosenhauer, M. and Börner, A, 2010: Longevity of seeds - intraspecific differences in the Gatersleben genebank collections. Tagungsband der 60. Jahrestagung der Vereinigung der Pflanzenzüchter und Saatgutkaufleute Österreichs 2009, 179-181.

Royal Botanical Gardens, Kew Seed Information Database (SID):at http://data.kew.org/sid/

Smith, R.D., Dickie, J.D., Linington, S.L., Pritchard, H.W. & Probert, R.J. 2003. Seed *Conservation: turning science into practice*. Royal Botanic Gardens, Kew. Chapters can be downloaded from: http://www.kew.org/msbp/scitech/publications/sctsip.htm (see chapters 17 and 24).

3.4. STANDARDS FOR REGENERATION

A. Standards

3.4.1. Regeneration should be carried when the viability drops below 85 percent of the initial viability [or when the remaining seed quantity is less than what is required for three sowings of a representative population of the accession]. The most-original-sample should be used to regenerate those accessions.

3.4.2. The sample size of the accession to-be-regenerated [should] contain[s] a minimum number of plants which capture at least 95 percent of alleles with a minimum frequency of 0.05 .

3.4.3. The regeneration has to be carried out in such a manner that the genetic integrity of a given accession is maintained. [for example regenerated material should] [Species specific regeneration measures should be taken to prevent admixtures or genetic contamination arising from pollen geneflow] [contain less than 1 percent of contamination arising from geneflow of pollen] that originated from other accessions of the same species or from other species [around the regeneration fields].

3.4.4. [If possible at] [At] least 50 seeds of the original and the subsequent most original samples are archived in long-term storage for reference purposes.

B. Context

63. Regeneration is a key operation and an integral responsibility of any genebank that maintains orthodox seeds. It is a process that leads to an increase of the stored seeds (also called "multiplication") in the genebank and/or to an increase of the viability of the seeds equal to or above an agreed minimum level, which is referred to as the regeneration threshold. An accession will be regenerated when it does not have sufficient seeds for long-term storage (e.g.1 500 seeds for a self-pollinating species and 3 000 for an out-crossing species) or when its viability has dropped below an established minimum threshold (i.e. below 85 percent of initial germinability of the stored seeds). [Regeneration should also occur when the seed numbers has been depleted due to frequent use of the accession. If an accession is rarely requested and seed viability is fine, then seed numbers can be below 1,000 prior to regeneration. Each regeneration of especially out-crossing species runs the risk of losing rare alleles or changing the genetic profile for the sample. Regeneration frequency should be minimized. High seed numbers are not needed for rarely requested accessions or species.]

64. As regeneration is an activity that could easily affect the genetic composition of an accession (and thus its genetic integrity) utmost care is required. Consequently, genebank operators will have to strike a delicate balance between avoiding regeneration as much as possible versus the potential loss of viability and thus, the risk of affecting the genetic integrity of an accession. Active management of the collections will greatly help to decide on the best moment to regenerate.

65. Regeneration should be undertaken with the least possible change to the genetic integrity of the accession in question. This means that in addition to sampling considerations (see paragraph below) of the accession in question we need to pay due attention to the environment in which the activity will be undertaken, as such environment might cause severe selection pressure on the accession. It has been suggested that the regeneration environment should be as similar as possible to that at the collecting site, in particular when a population collected in the wild is being regenerated, in order to minimize genetic drift and shift as well as to produce the best possible quality of seeds. It can often be difficult to harvest sufficient quantity of seed from wild relatives due to lower seed/plant numbers compared to other species, or plant dispersal mechanisms such as seed shattering. It is therefore necessary to ensure that appropriate technical practices are used to capture as much seed as possible (i.e. nets to capture dropped seeds). Repeat regeneration cycles may also be required to ensure that sufficient seed is conserved. [For regeneration, it's

better to create favourable environmental conditions for seed production and minimize plant-to-plant competition. Conditions at the original collection sites are often unfavourable in one or more ways for maximizing seed production. So there should really be a compromise between generalized, favourable conditions and those special signals (whether photoperiodic, nutritional or climatic) that are specific to local adaptation of individual accessions. This is part of the art of curation. If the genebank site does not provide favourable conditions locally, a curator should explore means to have it regenerated in a favourable environment; replication of the collection environment should not necessarily be the curator's goal.]

66. To preserve the genetic integrity of genebank collections during seed regeneration, it is important that sampling of accessions be carried out effectively. The number of seeds to be used for the regeneration process must be of sufficient size to be representative of the genetic diversity in an accession and to capture one or more rare alleles with a certain probability.

67. The methodology to be used for regeneration might vary from species to species and depends, among other [factors], on the population size, breeding system and pollination efficacy. Therefore, it is of significant importance to collate as much as possible of the relevant biological information related to the species in question. In addition, when possible and meaningful, it is recommended that the regeneration event be used also for the characterization of regenerated accessions (see Characterization Standards). [However for cross pollinating species, it is often difficult, to use the regeneration process to carry out characterization due to logistical reasons.]

C. Technical aspects

68. In order to maintain the genetic integrity of accessions it is recommended to use seeds from the most-original-sample for regeneration. For multiplication it is recommended to use seeds from the working collection for up to five cycles of multiplication without returning to the most original sample (IPGRI, 2003).

69. It should be noted that in cases where the original collection or donation is a small sample, it is necessary to regenerate immediately following receipt of the material in order to obtain an adequate quantity of seeds for long-term storage. It is important to record the number of the regeneration cycle and enter the information into the documentation system. It is recommended that the receiving genebank always keep some seeds from the initial seed sample for future reference purposes. Even if these original seeds lose their viability, they can be useful in confirming morphology or genotype of later generations of the respective accession.

70. The size of the seed sample to be used in the regeneration activity has to reflect the genetic composition of the accession, i.e. the reproductive biology of the species in question as well as the degree of homogeneity/heterogeneity of the accession. For this purpose the effective population size (N_e) is a key parameter that will have a bearing on the degree of genetic drift that is associated with the regeneration of the accession. This minimal size of N_e to minimize loss of alleles can be estimated for individual accessions based on the pollination biology, growing conditions and harvest techniques [see paragraph 25b].

71. To avoid geneflow/contamination it is critically important to use proper isolation methods between plots of accessions of cross-pollinated species being regenerated. This also applies to self-pollinated species, depending on the regeneration environment. [The principle of disjunctive cultivation, that is planting accessions of different taxa in adjacent plots, has been recommended (Lehmann and Mansfeld 1957).] For species that depend on specific pollinators, isolation cages and the corresponding pollinators should be used (Dulloo, M.E. *et al*. 2008). Contamination and genetic drift/shift can be assessed with morphological, enzymatic or other distinctive traits that can be used as markers (e.g. flower colour; seed colour, etc.), or with molecular markers.

72. Reference collections (herbarium specimen, photographs and/or descriptions of the original accessions) are essential for conducting the true-to-type verification (Lehmann and

Mansfeld 1957). Close inspections of obtained seeds and during the first regeneration of a new genebank accession are required to collect important reference information.

73. In order to avoid differences in seed maturity in a seed sample, multiple harvests should be carried out during the fruiting season.

D. Contingencies

74. The management of a genebank and of a germplasm collection is a multifaceted task in which scientific considerations have to be combined with economical, infrastructural, personnel and other aspects and where an optimum balance must be aspired. However, as already indicated, the underlying principles such as genetic integrity and identity have to be given the highest attention while regenerating accessions. Nevertheless, there will always be a risk management dimension to the curatorship role. Solid biological knowledge of the species in question is a key factor in making the best possible decisions under constrained conditions. Aspects such as sample size, distance between individual accessions and other forms of isolating accessions, respecting established thresholds for viability loss, growing conditions and others, all need to be given due attention when planning the regeneration activity.

75. In view of this complexity it is not meaningful to look for possible contingencies. In case of emergency it would be advisable to seek advice from experts and/or collaboration with other genebanks that could provide assistance.

E. Selected references

Breese, E.L. 1989. *Regeneration and multiplication of germplasm resources in seed genebanks: the scientific background*. Available online at: http://www2.bioversityinternational.org/publications/Web_version/209/

Crossa, J. 1995. Sample size and effective population size in seed regeneration of monecious species. In: J.M.M. Engels, R. Ramantha Rao, eds. *Regeneration of seed crops and their wild relatives. Proceedings of a consultation meeting,* 4-7 December 1995. ICRISAT, Hyderabad, India. International Plant Genetic Resources Institute, Rome, Italy. pp.140–143.

Dulloo, M.E., Hanson, J., Jorge, M.A. & Thormann, I. 2008. Regeneration guidelines: general guiding principles. In:M.E. Dulloo, I. Thormann, M.A. Jorge & J.Hanson, eds. *Crop specific regeneration guidelines* [CD-ROM]. CGIAR System-wide Genetic Resource Programme (SGRP), Rome, Italy. 6 pp.

Engels, J.M.M. Ramantha Rao, R. editors. 1995. Regeneration of seed crops and their wild relatives. Proceedings of a consultation meeting, 4-7 December 1995. ICRISAT, Hyderabad, India. International Plant Genetic Resources Institute, Rome, Italy. pp.140–143.

Engels, J.M.M. & Visser, L. 2003. *A guide to effective management of germplasm collections.* IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy.

Lawrence, L. 2002. *A comprehensive collection and regeneration strategy for ex situ conservation. Genetic resources and crop evolution* 49 (2): 199-209.

Lehmann C.O. & Mansfeld R. 1957. Zur Technik der Sortimentserhaltung. Kulturpflanze 5: 108-138.**Rao, N.K., Hanson. J., Dulloo, M.E., Ghosh, K., Nowell, D. & Larinde, M**. 2006. *Manual of seed handling in genebanks. Handbooks for Genebanks* No. 8. Bioversity International, Rome, Italy.

Sackville Hamilton, N.R. & and Chorlton, K.H. 1997. *Regeneration of accessions in seed collections: a decision guide*. J. Engels, ed. Handbook for Genebanks No. 5. International Plant Genetic Resources Institute, Rome, Italy.

SGRP Crop genebank knowledge base http://cropgenebank.sgrp.cgiar.org

3.5. Standards for characterization[26]

A. Standards

3.5.1. Around ~~[~~95] [60] percent of accessions [are] [should be] characterized within five [to seven] years of acquisition [during] or the first regeneration cycle.

3.5.2. Characterization is based on standardized and calibrated measuring formats and characterization data follow internationally agreed descriptor lists and are made publicly available.

B. Context

76. Characterization is the description of plant germplasm. It determines the expression of highly heritable characters ranging from morphological, physiological or agronomical features to seed proteins and oil or molecular markers.

77. Characterization can be carried out at any stage of the conservation process, as long as there are sufficient numbers of seeds to sample. It is essential that the germplasm being conserved is known and described to the maximum extent possible to assure their maximum use by plant breeders. Therefore, characterization should be carried out as soon as possible to add value to the collection. The use of a minimum set of phenotypic physiological and seed qualitative traits and morphological descriptors and information on the breeding system, such as those published by Bioversity is helpful for characterisation. Useful descriptors can also be found in the publications of the International Union for the Protection of New Varieties of Plants [, USDA National Plant Germplasm System (NPGS) descriptors]. Use of internationally agreed standards for characterization data increases the usefulness of the published data.

78. With the advances in biotechnology, molecular marker technologies , genomics are increasingly used for characterization (de Vicente, *et* al. 2004). Characterization will allow for detecting intra-accessions diversity. Means such as splitting samples may be necessary for ensuring the preservation of rare alleles or for improving access to defined alleles. Documentation of observations and measures taken is extremely important.

C. Technical aspects

79. Characterization is time consuming and expensive. Effort can be made to combine characterization with multiplication or regeneration to the extent possible. Curators should make all possible efforts to record characterization data. [However, it is advisable to encourage the use of replication for characterization of highly heritable traits.]

80. Characteristics and traits for crops are defined by crop experts and/or curators in consultation with genebank managers. A wide range of crop descriptor lists has been developed for example by Bioversity International and also minimum sets of key descriptors for utilization have been established for several of these. Furthermore there are regional and national descriptor lists available[such as USDA NPGS descriptors]. Data recording needs to be carried out by trained staff using calibrated and standardized measuring formats as indicated in the internationally agreed and published crop descriptor lists. The data need to be validated by curator and documentation officers before being uploaded into the genebank database and made publicly available. It is also recognized that reference collections (herbarium specimens, seed herbarium, photographs) play an essential role for true-to-type identification.

[26] [Add Standards for Evaluation]

D. Contingencies

81. Reliability of data might vary among data collectors if they are not well trained and experienced. Therefore trained technical staff in the field of plant genetic resources should be available during the entire growth cycle to record and document characterization data. Access to expertise in taxonomy, seed biology and plant pathology (in-house or from collaborating institutes) during the process of characterization is desirable.

82. Characterization is very labor-intensive and requires sufficient funding to allow for good quality data. Carrying out full characterization of accessions during regeneration cycles may reduce the number of accessions which can be regenerated per cycle.

83. The incidence of pests and diseases can limit the collection of quality data. The determination of some traits like oil or protein content requires laboratory assays which are not always available or could be costly.

E. Selected references

Bioversity Crop Descriptor Lists available online at: http://www.bioversityinternational.org/research/conservation/sharing_information/descriptor_lists html and from the SGRP Crop Genebank Knowledge Base Bioversity

Bioversity International. 2007. Developing crop descriptor lists, Guidelines for developers. Bioversity Technical Bulletin No. 13. Bioversity International, Rome, Italy. 71p. Available online at: http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showU id]=3070

de Vicente, M.C., Metz, T. & Alercia, A. 2004. *Descriptors for Genetic Marker Technologies*. International Plant Genetic Resources Institute, Rome, Italy. 30p. Available online at: http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showU id]=2789

FAO/IPGRI. 2001. *Multi-Crop Passport Descriptors*. FAO, Rome, 4 pp. Available online from: http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showU id]=2192
[NPGS : http://www.ars-grin.gov/cgi-bin/npgs/html/croplist.pl]

Lehmann C.O. & Mansfeld R. 1957. Zur Technik der Sortimentserhaltung. Kulturpflanze 5: 108-138.

UPOV : [(http://www.upov.int/en/publications/tg_rom/tg_index.html)]

3.6. STANDARDS FOR DOCUMENTATION

A. Standards

3.6.1. Passport data of 100 percent of the accessions are documented using FAO/IPGRI multi-crop passport descriptors.

3.6.2. All data and information generated in the genebank relating to all aspects of conservation and use of the material are recorded in a suitably designed database.

B. Context

84. Information about accessions is essential for the genebank to manage and maintain their collection; it is also important to share this information and make it available publicly for potential germplasm users, and should be attached to any distributed material. Passport data are the minimum data that should be available for each accession to guarantee proper management, and international standards such as the FAO/IPGRI multi-crop passport descriptors (FAO/IPGRI 2001) should be used to record passport data. The use of internationally agreed standards will very much facilitate data exchange.

85. Major advances in information technology and bioinformatics have taken place over the last decade or so and much of it is available online. A majority of genebanks also have access to computers and the internet. This new technology makes it possible to record and exchange data and information efficiently. Ultimately conservation and usability of conserved germplasm are promoted through good data and information management. All data and information generated throughout the process of acquisition, registration, storage, monitoring, regeneration, characterization, evaluation, and distribution should be recorded in a suitably-designed database and employed to improve conservation and use of the germplasm. Such data and information ranges from details of the genetic characteristics of individual accessions and populations to distribution networks and clients. [It is important to put in place a back up of the database system off-site.]

86. Documentation of characterization and evaluation data is particularly important to enhance the use of the respective collection and help identification of distinct accessions.

87. With advances in biotechnology, there is a need to complement phenotypic trait data with molecular data. Efforts must be made to record the molecular data being generated through genomics, proteomics and bioinformatics.

C. Technical aspects

88. Computer-based systems for storing data and information allow for more comprehensive storage of all information associated with genebank management. The adoption of data standards which today exist for most aspects of genebank data management helps to make the information management easier and to improve use and exchange of data. For example, the FAO/IPGRI List of Multi-crop Passport Descriptors should be used for documenting passport data as it is instrumental for data exchange among different genebanks and countries.

89. Germplasm information management systems exist, such as GRIN-Global, which have specifically been developed for genebanks and their documentation and information management needs. Another germplasm information management system is the International Crop Information System (ICIS) platform in which germplasm data from 1 or more genebanks can be stored, and published online with a search-query capacity to allow users to set criteria for selection of germplasm by single or by multiple trait criteria, as well as bounded by GPS coordinates for a region and/or overlaid with climatic and soil maps, for targeted selection of germplasm.

90. Evaluation data are often produced by the users to which seeds have been distributed. The genebank should solicit the user to share the evaluation data, which should then be included in the genebank's documentation system. Such information could address resistances to biotic and abiotic stresses, growth and development features of the accession, quality characteristics of yield etc. Adding this type of information allows more focused identification of germplasm to meet prospective client needs.

91. However, it is recognized that using information generated by users may not be so simple and may involve copy right and institutional issues.

D. Contingencies

92. Lack of documentation or loss of it compromises the optimal use of the seeds or can even lead to their loss, if it impedes planning regeneration properly.

Selected references

de Vicente, C., Alercia, A. & Metz, T. 2004. *Descriptors for Genetic Marker Technologies*. International Plant Genetic Resources Institute, Rome, Italy. 30p. Available online at: http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showUid]=2789.

FAO/IPGRI. 2001. *Multi-Crop Passport Descriptors*. FAO, Rome, 4 pp. Available online at: http://www.bioversityinternational.org/index.php?id=19&user_bioversitypublications_pi1[showUid]=2192

ICIS International Crop Information System. http://irri.org/knowledge/tools/international-crop-information-system.

3.7. STANDARDS FOR DISTRIBUTION [AND EXCHANGE]

A. Standards

3.7.1. Seeds are distributed in compliance with national laws and relevant international treaties and conventions.
3.7.2. Seed samples are provided with all relevant documents required by recipient country.
[3.7.3. At least 95 percent of the accessions and associated data are readily available for distribution and the remaining after multiplication/regeneration.]
3.7.4. The time span between receipt of a request for seeds and the dispatch of the seeds is kept to a minimum.
3.7.5. [For most species a] sample of a minimum of 30-50 viable seeds is supplied for accessions with sufficient seeds [in stock]. For accessions with too little seed at the time of request and in the absence of a suitable alternative accession, samples are supplied after regeneration/multiplication, based on a renewed request.[For some species and some research uses, smaller numbers of seeds are an acceptable distribution sample size.]

B. Context

93. Conservation should be linked to utilization. Germplasm distribution is the supply of a representative sample of seed accessions from a genebank in response to requests from plant germplasm users. The CBD and ITPGRFA emphasize this continuum between conservation and sustainable utilization, along with facilitated access and equitable sharing of benefits arising from use.

94. There is a continuous increase in demand for genetic resources to meet the challenges posed by climate change, by changes in virulence spectra of major pests and diseases and by invasive alien species. This demand has led to wider recognition of the importance of using germplasm from genebanks - which ultimately determines the germplasm distribution. The time between receipt of a request for seeds from a user and the following response and dispatch of seeds (along with relevant information) should be kept as short as possible.

95. The diversity of the legal systems with respect to their procedural rules governing access to courts and to arbitration, and the obligations arising from international and regional conventions applicable to these procedural rules is recognized.

96. The ITPGRFA within the framework of its Multilateral System both to facilitate access to Plant Genetic Resources for Food and Agriculture and to share, in a fair and equitable way, the benefits arising from the utilization of these resources, on a complementary and mutually reinforcing basis, has developed the SMTA for Annex1 crops. While other distribution models also exist, the SMTA can also be used for non-Annex1 crops.[, although other distribution or exchange standards or model clauses could be applied.]

97. [Genebanks should aim at making available to users as many accessions as possible including associated data. When stock is depleted, the accessions should be multiplied to meet the demands of users as a matter of priority.] Genebanks [that hold working collections] should promote the availability of genetic resources for uses including research, breeding, education, farming and repatriation. Internationally, genebanks can be a source of land race germplasm re-supply to countries which are initiating their own genebank, or which suffered a disaster such as fire, flood or civil strife.

[97bis. It is to be noted that the minimum number of seeds to distribute is species dependent and usage dependent. Genebank accessions are not only used for pre-breeding and applied plant breeding, but also for research activities. In the latter case, often very few seeds are needed.]

98. [When a user requests an accession from a genebank, the user is responsible for

indicating the national requirement for seed importation, in particular the phytosanitary regulations, in their country in order to avoid the spread of quarantine or regulated pests or invasive species that could seriously affect national production].[The exchange of seeds is not accompanied by the risk of spreading some quarantine diseases, insects or invasive and exotic weed species that could seriously affect national production.]

C. Technical aspects

99. Germplasm should be distributed in a way that ensures the germplasm reaches its destination in good condition. Environmental conditions can be harmful to the quality of seed during transport therefore seeds should be carefully packed and sealed in airtight envelopes for protection during transit.

100. Samples to be distributed should comply with the requirements of the quality standards as defined in this document and the requirements of seed health as requested by the recipient country. The distribution should also comply with national regulation laws. [The elements of national regulation laws, in particular seed health requirement has to be provided by the user or the national phytosanitary authorities.]

101. Easy and speedy clearance of shipments from customs offices and plant protection departments will most often necessitate the availability of documents required by the recipient country and the requestor.

102. Phytosanitary certificate, [additional declarations,] certificate of donation, certificate of no commercial value and import permit [and others] are among the documents required by the recipient country. It is therefore important to maintain and update the list of documents requested by different countries. [If additional costs (phytosanitary certificates, ISTA bulletin, specific envelopes or other) are necessary for the seed distribution or exchange, these costs have to be at the charge of the user, or otherwise determined by both parties. A major problem with international distributions is that genebanks have to declare that a particular disease was not found in the seed production field. Genebanks cannot meet additional declaration requirements for seed that was produced 20-30 years ago. Countries that receive seed should be responsible for quarantine procedures to handle seed where additional declaration requirements cannot be met.]

103. The list of the material and associated information (passport data as a minimum) should be provided to the recipient together with any legal agreement related to access and use of genetic resources provided.

104. It is highly recommended to reduce as much as possible the time between the dispatch and the delivery of the shipment. When seeds are not available responses include a detailed description of the reason, an estimated date when the accession will be available, and alternative accessions that may suit the requestor's needs.

105. Genebank [clients][accession recipients] are encouraged to do their own seed bulking for their trials needs and experiments. This is particularly relevant for wild species for which seed stock are often low, and for replicated field trials where supply of the required seed quantity cannot be considered.

106. [For material distributed outside the Multilateral system of the Treaty,] the distributing genebank should [encourage] [on] the flow back of information about the usefulness of the supplied germplasm[from the recipient to the provider according to the terms of the MTA].

D. Contingencies

107. Political decisions or crisis situations or bureaucratic delays might extend the time span between receipt of a seed request and the distribution of the material. Limitations related to

regeneration and/ or multiplication of the accessions may also affect and delay the distribution process.

E. Selected references

Convention on Biological Diversity (CBD). 1992.
http://www.cbd.int/convention/convention.shtml

Engels, J.M.M. & Visser, L. 2003. *A guide to effective management of germplasm collections*. IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy.

FAO/IPGRI. 1994. Genebank Standards.
International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA):
http://www.itpgrfa.net/International/

Rao, N.K., Hanson, J., Dulloo, M.E., Ghosh, K., Nowell, D. & Larinde, M. 2006. *Manual of seed handling in genebanks*. Handbooks for Genebanks No. 8. Bioversity International, Rome, Italy.

SGRP. Crop Genebank Knowledge Base: http://cropgenebank.sgrp.cgiar.org

Standard Material Transfer Agreement (SMTA): http://www.itpgrfa.net/International/

3.8. STANDARDS FOR SAFETY DUPLICATION

A. Standards

3.8.1. A safety duplicate sample for every original accession is stored in a geographically distant area, under the same or better conditions than those in the original genebank.
3.8.2. Each safety duplicate sample is accompanied by relevant associated information

B. Context

108. Safety duplication is that of a genetically identical subsample of the accession to mitigate the risk of its partial or total loss caused by natural or human-caused catastrophes. The safety duplicates are genetically identical to the long-term collection and are referred to as the secondary most original sample (Engels and Visser, 2003). Safety duplication includes both the duplication of material and its related information [,including database back-up] [and these] [the safety duplication of the materials] are deposited in long-term storage at a different location, [often outside the country]. The location is chosen to minimize possible risks and provides the best possible storage facilities. [To minimize risks that can arise in any individual country safety duplication will be ideally undertaken outside that country.]

109. Safety duplication is generally made under a 'black-box' approach. This means that the repository genebank has no entitlement to the use and distribution of the germplasm. It is the depositor's responsibility to ensure that the deposited material is of high quality, to monitor seed viability over time and to use their own base collection to regenerate the collections when they begin to lose viability. The germplasm is not touched without permission from the depositor and is only returned on request when the original collection is lost or destroyed. Recall of the deposit is also possible when it is replaced with newly regenerated germplasm. It is recognized however that the black-box is not the only approach. There may be cases where the safety collection is also taken care of by the recipient genebank.

110. Safety duplication should be made for all original seeds collected by the genebank or when only held by the genebank. [However, the genebank should still retain a set of the original samples to facilitate access for regeneration or other managerial decisions.] Seeds which are duplicates from other collections can usually be retrieved from those collections and do not require safety duplication unless there is doubt about their security in the other collection.

111. Any safety duplication arrangement requires a clearly signed legal agreement between the depositor and the recipient of the safety duplicate that sets out the responsibilities of the parties and terms and conditions under which the material is maintained.

112. This safety duplication is now available at the Svalbard Global Seed Vault on Spitsbergen island, Norway. [Institutions depositing seeds retain ownership and access to samples stored in Svalvard is grantedto the depositor only.][Countries which have joined the ITPGRFA are eligible to deposit, and retain ownership and management of their own duplicate collection. Sealed "Black Box" arrangements for quarantine clearance can be made with the relevant quarantine authority for countries requiring a generation in quarantine for restricted plant types. The prearranged quarantine clearance makes the germplasm available for immediate use upon return from Svalbard.]

C. Technical aspects

113. When selecting the location for safety duplication, primary consideration is given to the geographic location and environmental conditions of the location. Facilities must ensure low radiation (radioactivity) and stability (low probability of earthquakes). The facility must be

situated at an elevation that guarantees proper drainage during seasonal rains and eliminates the risk of flooding in the event of rising sea levels due to global warming. Equally important is economic stability and socio-political certainty. Koo *et al*. (2004) suggest that safety duplicate samples should be located away from the risk of political embargo, military action or terrorism that could disrupt international access.

114. Samples are prepared for safety duplication in the same way as for the base collection. Conditions should be at least as stringent as those for long-term storage of germplasm in a genebank and the quality of seed preparation (i.e., drying) is important.

115. In some cases it is helpful to sort material according to short, medium and long living seed groups before sending for safety duplication.

116. [Sample size should not be restricted to a certain minimum number.]Sample size should be sufficient to conduct at least three regenerations. [A safety backup is not just for future regeneration; it may also provide a minimum sample to regenerate an accession that was lost. A "critical" safety backup with a minimal amount of seed at a second location is better than no backup at all.] [AIf possible, a] safety duplicate of an accession in a seed genebank should contain at least 500 viable seeds for outbreeders and heterogeneous accessions with high diversity and a minimum of 300 seeds for genetically uniform accessions. For accessions with seeds of low viability more seeds are necessary. Storage temperatures should be –18°C to –20°C.

117. The packaging material for safety duplication should be of trilaminate material of which the middle metal foil layer should be [of adequate thickness] [at least 20 μm in thickness]. It should be formed into a pouch seamed on all four sides with no gusset. This would provide an adequate water barrier for transport and storage at -18^{o}C for at least 30 years.

118. An outer and inner label should be placed on each packet of seeds to ensure that the germplasm is properly identified.

119. As the storage conditions for the safety duplicate should be the same or better than that of the base collection, seed viability can be monitored on seed lots of the same accession maintained in long-term storage in the genebank and extrapolated to the safety duplicate if basic standards for storage conditions are met and the same containers are used. In some cases, samples for germination testing may be sent in a separate box with the safety duplicate and monitored for germination by agreement with the depository.

120. Strong cold-resistant boxes (thick carton or polypropylene boxes) are the best options for transporting and storing seeds. Boxes should be sealed properly. Shipment should consider the fastest means of transport available either by air freight, courier or by land to avoid deterioration of seed quality during transit.

121. Samples should be renewed from the sender when the viability of the samples in similar storage conditions in the base collection of the sender starts to decline. The duplicate samples can be either destroyed or returned to the sender and replaced with a new batch.

D. Contingencies

122. When extrapolating the viability of the safety duplicate from viability monitoring results of the sample in the base collection, some caution should however be taken. Seeds may age at different rates if there is a difference in ambient RH at the two sites and/or differences in extent or frequency of temperature fluctuations, though the average storage temperature is the same.

123. Issues of liability may occur related to sending samples in sealed black-box conditions. One issue is on liability for contents of the sealed box and handling by customs officers and other

authorities for entry into a country. In some cases boxes are opened and special seals are applied by the authorities to confirm that the samples are not medicinal or other prohibited plants. Another issue is that on liability of the recipient institution should material be damaged or lose viability earlier than expected as a result of stress during transit, faulty seal of containers, or temperatures that fluctuate from specified standards. Under the conditions described here, the safety duplicate repository should only be "liable" if the temperature becomes uncontrollable; this should be reported immediately to the primary institution so that they can decide on what action to take. The primary institution should bear full responsibility for transport disasters or uncontrolled moisture.

124. The standards and technical aspects may be difficult to implement for some species due to the inherent biology of the samples, e.g. short-lived seeds, large-seeded species where space and cost may be limiting.

E. Selected references

Engels, J.M.M. & Visser L. 2003. *A guide to effective management of germplasm collections*. IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy. Available in English (1.4 MB) and Spanish (1.5 MB).

SGRP. Crop Genebank Knowledge Base. The page on safety duplication, available on line at http://cropgenebank.sgrp.cgiar.org/index.php?option=com_content&view=article&id=58&Itemid=207&lang=english contains detailed background documents, a list of references and a standard safety deposit agreement template.

3.9. STANDARDS FOR SECURITY AND PERSONNEL

A. Standards

3.9.1. A genebank should have a risk management strategy in place which includes inter alia measures against power cut, fire, flooding and earthquakes.
3.9.2 A genebank should follow the local Occupational Safety and Health (OSH) requirements and protocols [where applicable]
3.9.3 A genebank employs the requisite staff to fulfil all the routine responsibilities to ensure that the genebank can acquire, conserve and distribute germplasm according to the standards.

B. Context

125. Achieving a genebank's goal of acquisition, conservation and distribution of germplasm not only require adequate procedures and equipment for germplasm handling be in place, but that properly trained staff be employed to carry out the required work and to guarantee the security of the genebank.

126. Active genebank management requires well-trained staff, and it is crucial to allocate responsibilities to suitably competent employees. A genebank should therefore have a plan or strategy in place for personnel, and a corresponding budget so as to guarantee that a minimum of properly trained personnel is available to fulfill the responsibilities of ensuring that the genebank can acquire, conserve and distribute germplasm. Access to specialists in a range of subject areas is desirable, depending on the mandate and objectives of each individual genebank. However, staff complements and training will depend on specific circumstances. The health and usefulness of the seeds stored in the genebank depend also on issues related to safety and security of the genebank. Arrangements need to be in place for electricity back-up; fire extinction equipment has to be in place and regularly checked genebank buildings need to be earthquake-proof if situated in a seismic-prone area, to mention some. A genebank should therefore implement and promote systematic risk management that addresses the physical and biological risks in the every-day environment to which the collections and related information are exposed.

C. Technical aspects

127. Staff should have adequate training acquired through certified training and/or on-the-job training and training needs should be analyzed.

128. Genebank personnel should be aware of and trained in safety procedures to minimize risks to the germplasm.

129. The genebank facilities should be constructed so as to withstand natural disasters, such as hurricanes, cyclones, earthquakes, or floods that are known to occur in the location where the genebank has been built.

130. Storage facilities should be protected with standard security facilities such as fences, alarm systems, security doors and any other system that helps to shield the genebank from burglars and other intruders. Security of the seed collections in the genebank will be enhanced by allowing entry strictly to authorized personnel into the actual storage facilities.

131. Protective clothing should be provided and used in the storage area. Adequate precautions should be taken and safety equipment, including alarms and devices to open doors from inside drying rooms and refrigerated rooms, should be installed.

132. Refrigeration will almost certainly be reliant on electrical power and it is therefore necessary that the power supply is adequate and reliable. Failure in power supply can result in

complete loss of genebank accessions. Consideration should be given to the provision of a back-up generator that automatically cuts in when the main power supply fails. This will require stockpiling adequate amounts of fuel to run the generator during power cuts.

133. Monitoring devices for temperature should be available in the drying and storage room to track the actual parameters against time.

134. It should be considered whether it is better to store seed without refrigeration if refrigeration is inherently unreliable. If refrigeration is to be used to conserve germplasm, it must meet necessary standards as unreliable refrigeration can be far more damaging than non-refrigerated storage.

135. If refrigeration and/or electric power are unreliable, a facility can be built in the soil at a depth of 10-20 m, where temperature can be averaged at 10 °C. This could be attractive in several tropical regions under no risk of flooding. Drying should be well carried out however, and seeds should be kept in properly-sealed vials.

136. Fire alarm and fire-fighting equipment is required in the genebank. Most fires begin from faulty electrical circuits and therefore periodic checks should be made on the electrical circuitry to ensure compliance with safety standards. Firefighting equipment will include extinguishers and fire blankets. For areas affected by thunderstorms, a lightning rod should be fitted to the genebank.

D. Contingencies

137. When suitably trained staff is not available, or when there are time or other constraints, it might be a solution to outsource some of the genebank work or to approach other genebanks for assistance. The international community of genebanks should be informed, if the functions of the genebank are endangered.

138. Unauthorized entry to genebank facilities can result in direct loss of material, but can also jeopardize the collections through inadvertent introduction of pests and diseases and interference in management systems.

E. Selected references

Engels J.M.M. & Visser, L. 2003. *A guide to effective management of germplasm coll*ections. IPGRI Handbooks for Genebanks No. 6. IPGRI, Rome, Italy. Available in English (1.4 MB) and Spanish (1.5 MB).

SGRP. Crop Genebank Knowledge Base, Section on risk management: http://cropgenebank.sgrp.cgiar.org/index.php?option=com_content&view=article&id=135&Itemid=236&lang=english.

APPENDIX

List of acronyms and abbreviations

ABSA	Access and Benefit Sharing Agreement
CBD	the Convention on Biological Diversity
CGIAR	the Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
FAO	Food and Agriculture Organisation
GPS	Global Positioning System
GRIN	Germplasm Resources Information Network
ICT	Information and Communication Technologies
ICIS	International Crop of Information Systems
IPPC	International Plant Protetcion Convention
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
ISTA	Intenational Seed Testing Association
MAA	Material Acquisition Agreement
MTA	Material Transfer Agreement
PGRFA	Plant Genetic Resources for Food and Agriculture
RH	Relative Humidity
SID	Seed Information Database
SMTA	Standard Material Transfer Agreement

Glossary to be added.