

## **SECOND GLOBAL PLAN OF ACTION FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE**

### **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, who are 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. Plant genetic resources are essential for sustainable agricultural production. There is no inherent incompatibility between the conservation and the use of these resources. In fact, it will be critically important to ensure that the two activities are fully complementary. The conservation, sustainable use and fair and equitable sharing of benefits from the use of genetic resources are international concerns and imperatives. 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 the context of the sovereign rights of states over their biological resources and the interdependence of countries with regard to plant genetic resources for food and agriculture, the Second Global Plan of Action for 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 past 15 years, the Global Plan of Action has been the main reference document for national, regional and global efforts to conserve and use plant genetic resources for food and agriculture sustainably 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 to fulfil its mandate with respect to plant genetic resources. The Global Plan of Action has also provided an important reference for other genetic resources sectors. It has assisted governments in the formulation of national policies and strategies on plant genetic resources for food and agriculture. It has also been used by the international community to define priorities at the global level, to improve coordination of efforts and to create synergies among the genetic resources stakeholders. The Global Plan of Action has proven to be instrumental in reorienting and prioritizing the research and development agendas of relevant international organizations with regard to activities related to plant genetic resources for food and agriculture.
3. The adoption of the Global Plan of Action by 150 countries in 1996 in Leipzig was a 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 negotiation of the International Treaty on Plant Genetic Resources for Food and Agriculture 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 published *Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture* has provided a solid foundation for this updating process. The world is facing increasing food insecurity, reflected *inter alia* in highly volatile food prices. Climate change, increasing urbanization, the need for more sustainable agriculture and the need to safeguard plant genetic diversity and minimize genetic erosion all require that greater attention be given to the 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 the development of bioproducts derived from agriculture. Furthermore, the policy environment has changed significantly over the past 15 years, 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 Strategic Plan for Biodiversity 2011-2020 and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. The world has also seen a renewed commitment to agriculture and related research and development activities. An updated Global Plan of Action is needed to respond to, and reflect, these developments.

5. The Second Global Plan of Action addresses the new challenges and opportunities through 18 Priority Activities. 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 inputs needed to make the Second Global Plan of Action current, forward looking and relevant to global, regional and national perspectives and priorities. Updating the Global Plan of Action also strengthens 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 has been possible to streamline the number of Priority Activities, reducing them from 20 in the original Global Plan of Action to 18. This was done by merging former Priority Activities 5 and 8 (*Sustaining existing ex situ collections* and *Expanding ex situ conservation activities*) into the new Priority Activity 6, *Sustaining and expanding ex situ conservation of germplasm*. Former Priority Activities 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 11, *Promoting development and commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species*.

7. In addition, the focus of a number of other Priority Activities has been adjusted so as to accommodate newly defined priorities. The Second Global Plan of Action gives greater emphasis and visibility to plant breeding, as reflected in Priority Activity 9, *Supporting plant breeding, genetic enhancement and base-broadening efforts*. An effort has also been made, based on guidance from the regional consultations, to simplify and clarify the document.

## CONTENTS

### Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture

	<b>Paragraphs</b>
<b>Introduction</b>	<b>1–23</b>
Continued need for plant genetic resources for food and agriculture and their conservation and sustainable use	
History of the Global Plan of Action	
Implementation of the Global Plan of Action	
The rationale for the Second Global Plan of Action	
Aims and strategies of the Second Global Plan of Action	
Structure and organization of the Second Global Plan of Action	
<b>Priority Activities</b>	
<b><i>In Situ</i> Conservation and Management</b>	<b>24–89</b>
1. Surveying and inventorying plant genetic resources for food and agriculture	
2. Supporting on-farm management and improvement of plant genetic resources for food and agriculture	
3. Assisting farmers in disaster situations to restore crop systems	
4. Promoting <i>in situ</i> management of crop wild relatives and wild food plants	
<b><i>Ex Situ</i> Conservation</b>	<b>90–141</b>
5. Supporting targeted collecting of plant genetic resources for food and agriculture	
6. Sustaining and expanding <i>ex situ</i> conservation of germplasm	
7. Regenerating and multiplying <i>ex situ</i> accessions	
<b>Sustainable Use</b>	<b>142–212</b>
8. Expanding the characterization, evaluation and further development of specific subsets of collections to facilitate use	
9. Supporting plant breeding, genetic enhancement and base-broadening efforts	

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

11. Promoting development and commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species

12. Supporting seed production and distribution

**Building Sustainable Institutional and Human Capacities**

**213–312**

13. Building and strengthening national programmes

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

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

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

17. Building and strengthening human resource capacity

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

**Implementing and Financing the Second Global Plan of Action**

**313–322**

**List of acronyms and abbreviations**

## **Introduction**

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

1. Agriculture in the twenty-first century will face many new challenges. Food and fibre production will have to increase 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. Faced with the world's food security, energy and sustainable development needs, countries will have to address the challenges and opportunities posed by the production and use of biofuels. In many parts of the world, the effects of climate change are likely to require changes in the adaptability of many crops and forages, increasing the interdependence of countries on plant genetic resources for food and agriculture (PGRFA). Climate change will also lead to changes in production areas and practices as well as in the occurrence of pests and diseases of crops and livestock. Agriculture will need to continue to reduce its negative impact on the environment and biodiversity and to adopt more efficient and sustainable production practices. Changes in land use will limit the area available for agriculture and increase the pressure on populations of crop wild relatives (CWR) and wild food plants.

2. PGRFA underpin the ability of agriculture to cope with changes, whether environmental or socio-economic. They will therefore have to play an increasingly important role in securing continued improvements in agricultural production and productivity, not only by providing new genes for improved crop varieties but also by contributing to effective agro-ecosystem function and bioproduct development. In many rural areas around the world, PGRFA are an essential component of the livelihoods strategies of indigenous and local communities.

### **History of the Global Plan of Action**

3. The Global Plan of Action (GPA) for the Conservation and Sustainable Utilization of PGRFA was formally adopted in 1996 by representatives of 150 countries during the Fourth International Technical Conference on Plant Genetic Resources in Leipzig, Germany. The same conference also adopted the Leipzig Declaration, which underlined the importance of PGRFA for world food security and committed countries to implementing the GPA. More than 150 countries, as well as the public and private sectors, actively participated in preparing the GPA. FAO committed itself to facilitating and monitoring the implementation of 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 to contribute to the process of updating the rolling GPA. At its Tenth Regular Session in 2004, the Commission agreed to apply a new approach for monitoring GPA implementation based on internationally agreed indicators, which led to the establishment of the National Information Sharing Mechanisms (NISMs). At its Twelfth Regular Session in 2009, the Commission endorsed the *Second Report on the State of the World's PGRFA* (Second Report) as an authoritative assessment of the sector and requested FAO to update the 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. The Commission decided that the Second 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), whose Article 14 recognizes the GPA as a supporting component. In 2006, the Governing Body of the International Treaty decided that the GPA's priorities are also priorities for the International Treaty's Funding Strategy. In 2009, the Governing Body noted the need to ensure close collaboration between itself and the Commission with regard to the GPA and invited the Commission, in revising the GPA, to take into account specific issues of relevance to the

International Treaty and to reflect adequately the provisions of the International Treaty in the Second GPA.

### **Implementation of the Global Plan of Action**

6. Since the formulation of the first GPA, based largely on information generated during the preparatory process for the *First Report on the State of the World's Plant Genetic Resources for Food and Agriculture* in the early 1990s, considerable progress has been made in the implementation of the GPA around the world. Nearly 20 percent more accessions are conserved in gene banks worldwide than was the case in 1996, reaching 7.4 million in 2010. Over 240 000 new samples have been collected and added to *ex situ* collections. There were 1 750 gene banks 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 PGRFA programmes has increased, often with a broader participation of stakeholders. Most countries have now either 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 grown. 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 in this field are reflected in improved information management at the national, regional and global levels.

7. Overall, international activity in the conservation and sustainable use of PGRFA has increased. The International Treaty has established a Funding Strategy with the activities of the rolling GPA as priorities. Many new regional and crop networks and programmes have been established, largely in response to the priority activities of the GPA. Networks remain very important for promoting cooperation, sharing knowledge, information and ideas, exchanging germplasm and carrying out joint research and other activities. Initiatives, such as the Global Crop Diversity Trust (the Trust), that promote and support more rational *ex situ* conservation especially for the crops included in the Multilateral System of Access and Benefit-sharing (Multilateral System) of the International Treaty (i.e. the Annex I crops), build on this type of network. The network of international *ex situ* collections of major crops played an important role in the negotiations of the International Treaty. These collections continue to form the backbone of the FAO Global System for the Conservation and Sustainable Use of PGRFA. The Svalbard Global Seed Vault 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 gene bank information management system are additional important steps towards the strengthening and more effective operation of a global system for *ex situ* conservation. Complementing this is the establishment of NISMs in more than 65 countries to facilitate access to relevant information, monitor GPA implementation and strengthen national decision-making processes as well as collaboration among stakeholders. The Global Partnership Initiative on Plant Breeding Capacity Building (GIPB) represents an effort to fill an important gap in national programmes, by linking the conservation of PGRFA to use in crop improvement. In addition, the GPA Facilitating Mechanism identifies and disseminates information on funding opportunities for all priority activities.

### **The rationale for the Second Global Plan of Action**

8. Since the GPA was formulated and adopted, a number of substantial changes have occurred with respect to the conservation and use of PGRFA, leading to new challenges and opportunities. These developments, which have been highlighted in the Second Report and which featured prominently in the discussions of the regional meetings and consultations, provide the justification and rationale for updating the GPA.

9. It is anticipated that the following **developments and trends in agriculture** will have significant impacts on the conservation and use of PGRFA:

- a) Throughout most of the developed world, the majority of 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 systems and strict market standards, often under monocropping and monoculture production

systems, but also to address biotic resistance, nutritional quality and yield stability. These developments have strengthened the downward trend in genetic and species diversity in farmers' fields.

- b) In the developing world, however, a substantial proportion of food is still produced with few, if any, chemical inputs and any food surplus from 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 continues to accelerate and it is expected that more than 70 percent of the world's population will live in cities in 2050 as compared with about 50 percent today. Income levels are expected to rise steadily to many times their current levels.<sup>1</sup> Nonetheless, the income disparity between rich and poor will remain very high.
- d) 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 to the previous point and needs close monitoring by the genetic resources community.
- f) According to national policies and needs, there is increasing implementation of the International Treaty's Article 9 on Farmers' Rights and greater recognition of the important role that farmers play in the conservation and sustainable use of PGRFA.

10. **Climate change** is an immediate and unprecedented threat to livelihoods and food security and may well be a major barrier to achieving the 70 percent increase in global food production that will be needed by 2050. The following strategic elements are needed to safeguard PGRFA and use them optimally to help cope with climate change:

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

11. Over the past 15 years, considerable information has become available about the extent and nature of the genetic erosion and vulnerability of PGRFA. Genetic erosion is reported to continue in many regions of the world and the genetic vulnerability of crops has further increased. The major causes of erosion include the replacement of farmers' varieties/landraces, land clearing, overexploitation, reduced water availability, population pressures, changing dietary habits, environmental degradation, changing agricultural systems, overgrazing, legislation and policy, pests, diseases and weeds. Changes in the seed sector and production methodologies have an impact on the vulnerability of crops. This vulnerability applies in particular to underutilized species that do not find much support from research, plant breeding and/or development/marketing, and are increasingly neglected by farmers. Yet these

---

<sup>1</sup> 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](http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf)

species have great potential in the context of climate change, eco-agriculture, dietary diversity and the sustainability of agricultural production systems.

12. Major **advances in key areas of science and technology** have occurred over the past 15 years that are relevant to PGRFA conservation and use. The most important of these advances 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 developments in molecular biology.

- a) **Information management and exchange technologies** have greatly advanced over the past 15 years. There is significantly greater access to information as well as enhanced analytical capacity available to genetic resources workers. The latter includes geographic information systems (GIS) and satellite-based methods such as Global Positioning System (GPS) and remote sensing, which allow PGRFA data to be combined with a wide range of other data in order to locate specific areas of diversity or to identify material from particular habitats.
- b) Recent **advances in molecular and genomic methods** 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 in the development of strategies for 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 past 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 wild food plants, and to an even greater extent, on-farm conservation. The experience gathered and knowledge created have resulted in the recognition of the importance of an integrated, multidisciplinary approach, in which farmers and indigenous and local communities play a leading part and livelihoods and well-being perspectives are fully reflected.

13. There have been major policy developments with respect to the conservation and use of PGRFA. These include the adoption in 2000 of an Agricultural Biodiversity Programme of Work by the Conference of the Parties to the Convention on Biological Diversity (CBD), 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 of its Multi-Year Programme of Work (MYPOW), which includes substantial work on PGRFA, in 2007.

14. Undoubtedly, the most important development has been the entry into force of the International Treaty in 2004. Article 14 of the Treaty recognizes the importance of the rolling GPA and commits Contracting Parties to promoting 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 also recognize that the ability – particularly of developing countries and countries with economies in transition – to implement priority activities, plans and programmes on PGRFA, taking into account the GPA, will depend largely upon the effective implementation of Articles 6 (Sustainable use of PGRFA) and 13 (Benefit-sharing in the Multilateral System) and 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 its strategic use in catalysing the sustainable use and conservation of PGRFA. The Second GPA will be an important resource for identifying future priorities.

15. At its tenth meeting in 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 objective 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 also relate to the conservation and sustainable use of plant genetic resources.<sup>2</sup> The Second GPA aims to contribute significantly to the achievement of these targets. Work has been initiated on international indicators related to these targets. The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, adopted in 2010, may, when in force, also have implications for access and the use of certain plant genetic resources.

16. The GPA mandates the Commission to develop a procedure for reviewing the GPA. Such a review should deal with progress made at the national, regional and international levels in the 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 Second Global Plan of Action**

17. At its Twelfth Regular Session in 2009, the Commission recommended that the Second GPA be focused, so as to assist priority setting, including identifying priorities for the Funding Strategy of the International Treaty. The Second GPA is based on clear, succinctly stated aims and principles and includes a strategy and information on each priority activity.

18. The main aims of the Second GPA, as agreed by the Commission at its Thirteenth Regular Session and approved by the FAO Council at its 143<sup>rd</sup> Session in 2011, 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, in order to foster economic development and to reduce hunger and poverty, particularly in developing countries, as well as to provide options for adapting to and mitigating climate change, addressing other global changes and responding to food, feed and other needs;
- d) to promote the exchange of PGRFA and the fair and equitable sharing of the benefits arising from their use;
- e) to 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;
- f) to assist countries, regions, the Governing Body of the International Treaty and other institutions responsible for conserving and using PGRFA to identify priorities for action;

---

<sup>2</sup> Including **Target 2** (By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems), **Target 5** (By 2020, the rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced), **Target 6** (By 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits), **Target 7** (By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity), **Target 11** (By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes), **Target 12** (By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained), **Target 18** (By 2020, the traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels).

- g) to create and strengthen national programmes in particular, to 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 sustainably use PGRFA.

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

- a) A large and important amount of PGRFA, vital to world food security, is stored in *ex situ* collections. Whereas the maintenance of genetic resources in gene banks and by 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 their regeneration and safety duplication is a key strategic element of the GPA. In general, there is a need to establish standard operating procedures for all routine gene bank 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 advanced information technologies, will be an important prerequisite to achieving this objective. This will not only increasingly include molecular and genomic information, but also morphological and agronomic data on PGRFA, which will need to be linked to, and analysed together with, the characterization and evaluation data managed in gene bank databases.
- c) Enhancing capacity at all levels is a key strategy for supporting the individual activities of 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 their application to the conservation and use of PGRFA.
- d) Strengthening the efforts of, and partnerships between, 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 the sustainable and long-term conservation and use of PGRFA.
- e) *In situ* conservation and development of PGRFA occur in two contexts: on farm and in nature. Farmers and indigenous and local communities play a crucial role in both. Enhancing their capacity through linkages to extension agencies, the public and private sector, non-governmental organizations and farmer-owned cooperatives, as well as through providing incentives for *in situ* conservation, will help promote food security, adaptability and resilience, particularly among communities that live in areas with 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 indigenous and local communities 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 described above will require due attention and efforts at all levels, including coordination with the numerous initiatives underway within countries, regionally and globally (the CBD, the UN Framework Convention on Climate Change, etc.).

### **Structure and Organization of the Second Global Plan of Action**

21. The Second GPA has 18 priority activities. 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 activities relate and are relevant to more than one group.

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

- a) The Background section provides a rationale for the priority activity and a summary of achievements since 1996, mainly based on the findings reported in the Second Report.
- b) The Objectives section specifies the ultimate and intermediate objectives to be accomplished under the priority activity. The explicit articulation of objectives can aid the international community in judging the extent of implementation of the priority 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 approaches, priorities and visions.
- d) The Capacity section indicates the human and institutional capabilities that should be developed or provided through the implementation of the priority activity.
- e) The Research/technology section, which includes 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 such issues might be approached as the priority activity is planned and implemented. The focus of this section has mainly been limited to the national level to avoid repetitions, as the need further to strengthen collaboration with relevant international organizations and agricultural research centres and to increase the sharing of information among all organizations and stakeholders applies in all priority activities. 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 particular priority activity. This is not meant to imply their exclusion from activities where they are not mentioned. Such references are used to highlight a role that is particularly critical or that 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 in Article 5 of the International Treaty. In order to elaborate policies and strategies for the conservation and sustainable 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 in this regard (for example in the Programme of Work on Agricultural Biodiversity). Wider accessibility to georeferencing tools has facilitated surveying, and the development and application of modern molecular biology techniques have assisted in assessing the extent of genetic diversity and, in some cases, of genetic erosion. During the past decade, most surveys have been restricted to individual crops or limited areas, although some progress has been made in inventorying CWR and establishing specific sites for their *in situ* conservation. Nonetheless, efforts in protected areas to survey, inventory and conserve PGRFA have been limited in comparison with those devoted to other components of biodiversity. Several international organizations have contributed to monitoring the conservation status of wild plants of agricultural relevance regionally and globally, but stronger partnerships with organizations in the environment sector need to be pursued, especially at the country level.

25. **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 to promote monitoring of the status and trends in PGRFA and thereby to ensure their adequate conservation.

26. To develop and apply methodologies for surveying and inventorying PGRFA *in situ* and *ex situ*, including GIS, satellite-based methods (for example 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. The surveying and inventorying of PGRFA, as needed, should be considered as the first step in the process of conservation and reducing the rate of biodiversity loss. Without the capacity to conserve and/or use biodiversity, however, such work may be of marginal utility. Thus, surveying and inventorying should 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 directly assessing genetic vulnerability and genetic erosion. There is also an urgent need to develop improved indicators, including proxy indicators, of diversity, genetic erosion and vulnerability that can be used to establish national, regional and global baselines. These indicators should be objective and balanced, taking into account the systems in use at the national level. They should not establish punitive measures, nor affect country sovereignty over genetic resources, nor impose specific information systems. General agreement needs to be pursued on the design and use of such indicators.

28. Local and indigenous knowledge should be recognized as an important component of survey and inventory and should be carefully considered and documented where appropriate and with the prior informed consent of indigenous and local communities.

29. **Capacity:** Countries should provide, and may benefit from, financial and technical support for surveying and inventorying PGRFA. There are numerous obstacles to surveying and inventorying PGRFA, including a lack of adequately trained staff. Training and capacity building should be undertaken in several areas of research, including plant identification, population biology, ethnobotany, use of GIS and GPS, and molecular tools. The capacity to gauge the impact of climate change and to assess adaptation is also increasingly relevant, particularly if genetic diversity conserved *in situ* is to be maintained sustainably over 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 agro-ecological 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 the *in situ* conservation of PGRFA. More complete inventories are needed to enable better targeting of *in situ* conservation activities. If such inventories were associated with actual or predicted data on specific traits of interest, they would have even more value and would provide a useful link to *ex situ* conservation and use. Existing information sources should be used 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 the 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 agriculture, environment, research, science and technology, and regionally, given 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 links 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 to raise crop yields, improve resistance to pests and diseases and enhance the diversity and quality of agriculture and food products, especially in favourable environments. Farmers choose to grow modern varieties for many reasons, 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 increasingly in developed countries, continue to maintain significant crop genetic diversity in their fields. This diversity constitutes an important element in the livelihood strategies of farmers because of its ability to adapt to marginal or heterogeneous environments. Crop diversity is also maintained to meet changes in market demands, labour availability and other socio-economic factors, as well as for cultural and religious reasons.

36. A range of initiatives and practices has become available to help farming communities continue to benefit from maintaining and using local crop genetic diversity in their production systems. Building capacity and leadership in communities and local institutions is a precondition for implementing such community-based initiatives. Promoting and supporting on-farm management of genetic resources have become firmly established key components of crop conservation strategies. As a result, on-farm 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 improving the 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 fewer greenhouse gases. They will underpin the breeding of new adapted crop varieties that will be needed for agriculture to cope with future environmental conditions. There will be an increased need for linkages between local seed systems and gene banks and networks to secure new germplasm adapted to changed climates.

39. **Objectives:** To use the knowledge generated during the past two decades in order to promote and improve the effectiveness of 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 the national and regional levels and according to national legislation and priorities. To promote the equitable sharing of benefits arising from the use of 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 maintain traditional seed exchange and supply systems, including community gene banks, and strengthen local markets for products, especially for small-scale and subsistence farmers in developing countries and taking into account phytosanitary constraints. To take full account of the role of women in agricultural production in many developing countries, particularly regarding on-farm management of PGRFA. To foster successful selection and breeding, particularly in the light of climate change.

40. 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 to integrate their work into rural development policies and activities. To extend the role of national, regional and international gene banks 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 through methodological projects, these activities still need to be fully integrated into wider conservation and development strategies and/or action plans. On-farm activities complement more formal crop variety development and strengthen seed supply systems. Institutional flexibility will be needed in working with farming communities. Specific strategies need to be developed for conserving PGRFA *in situ* and for managing crop diversity on farm and in protected areas. Special attention should be paid in these strategies to conserving CWR in their centres of origin, centres of diversity and biodiversity hotspots. Best practices must be disseminated on 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 communities in all aspects of managing and improving 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 the on-farm management and improvement of PGRFA. Increasingly, the value of conservation needs to be demonstrated in terms of its continued provision of ecosystem services. The importance of PGRFA as one of these services is just beginning to be fully recognized and efforts to document the value of CWR and landrace diversity in this regard should continue and intensify.

43. There will be a specific need to integrate CWR and landrace conservation into existing conservation strategies to ensure that agricultural biodiversity and biodiversity more generally are not addressed as separate entities. This will require that the conservation of agricultural biodiversity becomes a feature of wider biodiversity conservation initiatives and programmes at 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 need to be strengthened in order to produce varieties that are specifically adapted to socio-economically disadvantaged environments. This may require new policies and legislation – including appropriate 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 must be greater cooperation at different stages in the production chain, from the development and testing of new varieties, through value-adding activities, to the opening up of new markets.

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. To support on-farm improvement activities, gene banks, networks and national and international organizations should consider identifying appropriate farmers' varieties/landraces for multiplication and/or for developing new breeding populations that incorporate specific traits into locally adapted materials.

48. Interdisciplinary training programmes should be developed for extension workers, non-governmental organizations and others to facilitate and catalyse on-farm activities, including selection and breeding techniques appropriate to supplementing and improving those already used by farmers.

49. The focus of training programmes should be on helping farmers to gain new knowledge and technologies and to explore new markets for their products and on helping 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 non-governmental organizations) and farmers. Support for advanced degree work should include relevant training in the biological and social sciences. Training for extension agents should aim to increase their skills in ethnobotany, participatory selection and breeding, seed maintenance and the use of ICT tools.

50. Training for farmers should be carried out in the context of the whole production chain and mainly focus on the identification of plant traits, selection/breeding, use 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), farmers, farmer organizations and other stakeholders, and should be based on the needs expressed by these partners. Such programmes should not neglect the central role that women play in influencing and directing the evolution of crops. Training programmes should consider the different uses of biological resources by women and men, including the concern of women for the multiple uses and processing requirements of crops.

52. **Research/technology:** Eight types of rigorous, multidisciplinary scientific research are needed:

- a) further ethnobotanical and socio-economic/sociocultural research to understand and analyse farmers' knowledge, selection/breeding, use 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, 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 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 different seed systems;
- f) studies on the extent and nature of possible threats to existing diversity on farm and *in situ*, particularly climate and land-use change, including their effects on pollinators;
- g) spatial analysis to identify varieties likely to have climate-adapted traits as an aid to plant breeding;
- h) studies to quantify genetic erosion.

53. Scientific research should, when possible, be combined with on-farm activities so that the context and purpose of the work can be fully evaluated. Phenotyping techniques can be used to characterize farmers' varieties/landraces in relation to specific traits and adaptability to various field conditions. Research should assist the monitoring, evaluation and improvement of on-farm activities. Research should be undertaken in a participatory and collaborative manner to foster interaction and cooperation among stakeholders, including farmers, breeders and the staff of national institutions. Other institutions should be involved appropriately when necessary.

54. Methods should be developed and assistance provided for integrating *in situ* and on-farm management and conservation of PGRFA with national and regional gene banks/networks and research institutes.

55. **Coordination/administration:** Coordination efforts in this area should encourage community-level initiatives to support on-farm management and improvement of PGRFA. Small, grassroots projects should receive priority funding and support services. Precedence should be given to farmer-initiated technical projects that promote crop diversity and collaboration between farming communities and research institutions. Such projects should be sufficiently long in duration (10 years or more) to guarantee significant results.

56. Links between organizations that are primarily concerned with conservation of PGRFA and those concerned with its use are often weak or absent in many countries and these should be strengthened.

### 3. Assisting farmers in disaster situations to restore crop systems

57. **Background:** Natural disasters and civil strife often challenge the resilience of crop systems; this especially affects small-scale and subsistence farmers in developing countries. Seed security is a key component of resilience. Whereas immediate seed assistance can help 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 stress. In particular, there is growing recognition of the threats posed by climate change to seed and food security and the potential role that PGRFA can play in helping agriculture remain productive and robust under changed conditions. When crop varieties are lost from farmers' fields, they can often be re-introduced over time from nearby areas, with some support, through local markets and farmer-to-farmer exchange. They can also be re-introduced from national, regional or international gene banks and networks. However, gene banks are sometimes themselves compromised by natural and human-induced disasters and, in such cases, their ability to support the restoration of crop systems will rely on their capacity to access materials held in other gene banks. Article 12 of the International Treaty provides a sound basis for improving and facilitating such access. National, regional and global information systems are needed to support crop restoration activities.

58. Grain imported as food aid is often used as seed and is often poorly adapted to local conditions. This can result in reduced yields for years. Imported seed of poorly adapted varieties has the same effect. In the long run, inappropriate food and seed aid practices can exacerbate hunger, undermine food security, distort local seed systems and increase the cost of donor assistance. In recognition, a



fundamental shift in thinking over the past decade has led to a seed security framework. The objective of the framework is to investigate the functioning of seed systems and to describe the situation in terms of availability, access and quality of seed. 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 has led to better coordination among agencies and to new types of seed interventions that go beyond direct distribution of seeds and other inputs to farmers. These interventions include market-based approaches such as seed vouchers and input trade fairs, and community-based seed multiplication initiatives for both farmers' varieties and improved varieties.

59. **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. To develop the capacity to assess and establish seed security, including helping farmers to access locally adapted PGRFA.

61. To establish institutional responsibilities and mechanisms to identify, acquire, multiply and deliver appropriate PGRFA.

62. To strengthen the capacity of relevant rural 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 cooperation of relevant farmers' organizations and communities, UN bodies and regional, intergovernmental and non-governmental organizations should establish policies at all levels to allow the 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 that fully consider seed security issues and the location-specific 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 due to changing climates and other threats. Special efforts are needed to identify the species and populations that are most at risk and that carry potentially important traits.

67. Countries need to establish or strengthen genetic erosion monitoring systems, including easy-to-use indicators. Support should be given to collecting farmers' varieties/landraces in particularly vulnerable or threatened areas, where these are not already held *ex situ*, so that these genetic resources can be multiplied for immediate use and conserved for future use. National gene bank collections should be duplicated outside the country, for example in the gene banks of neighbouring countries, and/or in regional or international gene banks. To avoid excessive duplication, a systematic global assessment is needed of the extent to which existing collections are backed-up.

68. Gene banks and networks should make characterization and evaluation information available to assist in identifying useful accessions for restoring 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 rapidly acquiring, multiplying and providing PGRFA to countries in need. Such agencies should ensure that they have adequate capacity for the task. Cooperation among public, private and non-governmental organizations is an important contribution to efforts to distribute locally adapted germplasm in regions that are recovering from disasters.

70. Information systems must be established to identify, and assist in obtaining, appropriate germplasm for restoration or reintroduction.

71. Governments and international emergency agencies should consider making adequate funds available to multiply seeds of locally adapted PGRFA in response to emergency demand following 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 role of farmers 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 gene bank preparedness to rescue *ex situ* collections and to collect seed in the context of emergencies, including civil strife, industrial accidents and natural disasters. These efforts will benefit from close collaboration among governments of the countries affected, donors, non-governmental and private organizations, national, regional and international agricultural research institutes, regional plant genetic resource networks and relevant intergovernmental 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 agro-ecologies, crop calendars, local seed flows, seed markets and seed stocks. Information that can assist planners in disaster risk reduction and response is lacking, especially regarding the anticipated impacts of climate change.

75. **Coordination/administration:** At the national level, there is a need for coordination among ministries of agriculture and the environment and agencies involved in disaster preparedness and response. Non-governmental organizations will have a particularly important role to play. Public awareness efforts are needed to sensitize the donor community and non-governmental organizations 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 sources of new traits for plant breeding. Ideally, CWR and wild species are 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 national parks and other protected areas, however, were established with little specific concern for the conservation of genetic diversity of any plants, let alone CWR and wild food plants. Management plans for protected areas do not specifically address 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 will significantly improve the understanding of their value in ecosystem services, which in turn will underpin the long-term security of the protected area itself.

77. Many protected areas are 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 outside such areas, including through *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 resources conservation.

78. **Objectives:** To use the genetic resources of CWR and wild food plants sustainably, and conserve them both in protected areas and on lands not explicitly listed as protected areas.

79. 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, particularly 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 in ensuring the active conservation of CWR and wild food plant genetic diversity.

81. To establish better communication and coordination among the various bodies engaged in *in situ* conservation and land-use management at national and regional levels, especially between the agriculture and environment sectors.

82. **Policy/strategy:** Governments, subject to national legislation, in collaboration with stakeholders and non-governmental organizations and taking into account the views of farmers and indigenous and local communities, should:

- a) include, as appropriate, among the purposes and priorities of national parks and protected areas, the conservation of PGRFA, in particular appropriate forage species, CWR and species gathered for food or feed in the wild, including in their biodiversity hotspots and genetic reserves;
- b) consider integrating the conservation and management of PGRFA, particularly CWR and wild food plants, in land-use plans in their centres of origin, centres of diversity and biodiversity hotspots. The centres of diversity are primarily located in developing countries, where resources may be limited and capacity building and technology transfer required. *In situ* conservation strategies should be complementary to *ex situ* strategies;
- c) support the establishment of national and local objectives for protected area management through broad-based participation, involving the groups of people who are most dependent on wild food plants;
- d) support the creation of advisory panels to guide the management of protected areas. Where appropriate, involve farmers, indigenous and local 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 traditional knowledge for PGRFA and for the sustainable livelihoods of these communities, especially 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 affect negatively the *in situ* conservation of CWR and wild food plants;
- h) support efforts by indigenous and local communities to manage CWR and wild food plants in protected areas;
- i) review existing requirements for environmental impact statements to include 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 NISMs and specialized global information systems.

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

- a) develop national strategies for CWR management considering *in situ* and *ex situ* conservation and sustainable use;
- b) take action to conserve 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 their 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 the management of protected and related areas should also be encouraged in order 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 through the establishment of a global network of genetic reserves. While it is recognized that the prime locations for the *in situ* conservation of CWR diversity will be in existing protected areas, because these have been established with ecosystem conservation in mind, the possibility of *in situ* conservation of CWR outside protected areas 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 that there is a requirement for action at both national and global levels.

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 of 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, distribution and diversity of CWR and wild food plants, integrate and link data and information from *in situ* conservation programmes and *ex situ* programmes, and encourage private and non-governmental organizations to do likewise.

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

- a) studies on their reproductive biology and ecological requirements;
- b) species classification and identification and ethnobotany;
- c) description of gene pools and population surveys, using molecular tools as well as models for assisted migrations of CWR populations that may be threatened in their natural habitats;
- 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 that are 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, including organizations involved in the environment sector;

- b) designate focal points, as appropriate, to catalyse the 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) include information on CWR in 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 for most collecting are gap filling, imminent risk of loss and opportunities for use. The germplasm currently conserved in gene banks 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 gene banks, 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, change over time. Suboptimal conditions in gene banks may also have led to the loss of collected materials.

91. Global threats to PGRFA *in situ* and on farm have increased during the past 20 years as a result of the increased impact of human activities. Major threats to landraces and CWR conservation are linked to the lack of funds and the long-term impact of agricultural policies, as well as the replacement of such varieties by modern varieties, climate change, alien invasive species and land-use change, including urbanization. A recent assessment indicates that up to 20 percent of plant species may be threatened with extinction globally. It is unlikely that the figure is lower for CWR. An urgent need for resistance to biotic and abiotic stresses, as well as for nutritional and other traits, also warrants further collecting.

92. **Objectives:** To collect and conserve the diversity of PGRFA and associated information, focusing on diversity that is missing from *ex situ* collections, under threat or anticipated to be useful.

93. 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. Best practices should be documented with regard to the objectives and obligations set forth in the CBD and Articles 5 and 12.3 h of the International Treaty, for example the right of Contracting Parties to the CBD to require prior informed consent before providing access to genetic resources and their obligation, subject to 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 the collecting mission. 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 with the country of origin prior to the collecting mission.

96. Full consideration should be given to the capacity to conserve collected material effectively and

sustainably before collecting is initiated.

97. Training in scientific collecting methods for PGRFA should be undertaken, 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.

98. **Research/technology:** Research is needed to identify gaps in existing *ex situ* collections in order to ensure that the entire gene pool 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 help to identify gaps and facilitate the planning of collecting missions. In the case of some CWR, research may be needed on the taxonomy and botany of the targeted species.

99. **Coordination/administration:** Coordination in the country concerned, as appropriate, should involve gene banks and herbaria and other institutes with taxonomic expertise. Regional- and international-level coordination may be needed to provide linkages with certain *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.

100. 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.

101. Mechanisms must be developed at all levels for emergency collecting 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.

102. Governments should designate a focal point within their PGRFA programmes for administering collecting requests.

## 6. Sustaining and expanding *ex situ* conservation of germplasm

103. **Background:** Currently, seed, field and *in vitro* gene banks 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; however, such species tend to be more difficult to conserve *ex situ* than major food or forage crops. Many important crop species do not produce seed that can be stored under conditions of low temperature and humidity, and the conservation of such plants, with recalcitrant seeds or vegetatively propagated, is still not being given sufficient attention.

104. 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 over the long term. 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 identified as needing regeneration in country reports<sup>3</sup>, as well as in the lists of technical and administrative problems associated with maintaining gene bank activities. The Trust aims to support better planning and more coordination and cooperation in order to limit redundancy and promote rationalization at the global level. The goal is to reduce the overall costs of conservation and place gene bank operations on a scientifically sound and financially sustainable basis. Options need to be further explored for more cost-effective and rational conservation.

105. Regional collaboration on *ex situ* conservation must be strengthened.

106. The Svalbard Global Seed Vault, which opened in 2008, represents a major new international initiative to improve the safety of existing collections of orthodox seed. Similar efforts are not yet

---

<sup>3</sup> Submitted for the preparation of the Second Report.

planned for recalcitrant species and vegetatively propagated crops.

107. **Objectives:** To develop a rational, efficient, goal-oriented, economically efficient and sustainable system of *ex situ* conservation and use for both seed and vegetatively propagated species.

108. 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 useful 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 that have been neglected in current conservation activities. To promote the development and transfer of appropriate technologies to conserve such plants and to encourage and strengthen the involvement of botanic gardens in the conservation of PGRFA. To promote the exchange of information about PGRFA in gene banks. To set conservation priorities using more complete characterization and evaluation data.

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

110. **Policy/strategy:** The international community has interests in and responsibilities for the *ex situ* conservation of PGRFA. It is this understanding that 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; nevertheless, greater rationalization of the global system of *ex situ* collections is needed.

111. Governments, international agricultural research centres, non-governmental organizations 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 to conserve the seeds of orthodox species. In this regard, botanic gardens and field gene banks should be strengthened in their capacity to conserve important underutilized species.

112. 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 that meet 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 have already been stored and duplicated in long-term facilities.

113. FAO, in cooperation with countries and with relevant institutions, should facilitate the formalization 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 to voluntarily place collections in secure facilities outside their boundaries.

114. **Capacity:** Relevant personnel should be trained at all levels to implement and monitor the policies and agreements described above. National institutions should evaluate current gene bank management practices with the aim of creating more rational, efficient and user-oriented *ex situ* conservation systems. Appropriate facilities, human resources and equipment should be made available to national PGRFA programmes.

115. Existing PGRFA collections should be secured. Particular care must be taken to safeguard the original accessions in threatened collections.

116. Support should be given to training on *in vitro* techniques and other new and appropriate technologies. In accordance with national, subregional and regional needs and priorities, backing should be given to establishing the capacity to use such technologies.

117. Support should be given to defray expenses incurred by institutions that are providing storage and

related conservation and research/documentation services for other countries. This support could help ensure that all unique material is identified, suitably duplicated, stored safely, characterized, regenerated, evaluated and documented. This would include the identification of both inadequately and excessively duplicated materials. Materials not yet duplicated should be multiplied and placed in secure storage, in accordance with relevant international agreements and national legislation. Additional *ex situ* duplications of accessions would be maintained at the discretion of countries. The expansion of existing storage facilities and the creation of new facilities may be desirable in some countries.

118. **Research/technology:** Research should aim to develop improved conservation methods, including *in vitro* and cryopreservation, and, in particular, reliable low-cost techniques that are appropriate to local operating conditions. Technologies and procedures that are transferred from temperate climates might not be appropriate for conditions in tropical countries and vice versa.

119. Research based on the improved documentation foreseen under the GPA should be undertaken to assist decision-making on the development of a rational, effective system. Such research might include, among other things, identifying priority germplasm and duplications, developing methods to identify duplicates and test the viability of accessions, expanding procedures for the rational conservation and duplication of vegetatively propagated species, and working out modalities and technologies for conserving genes, genotypes and gene complexes.

120. Research is needed on the best storage conditions for orthodox seeds, non-orthodox seeds and vegetative material. Genomic and phenotypic studies should be undertaken that better link molecular data with phenotypic descriptor data. Protocols are needed for *in vitro* conservation and other conservation technologies for important vegetatively propagated and non-orthodox seeded plants. An assessment should be made of the conservation needs of plant species for food and agriculture that are not adequately conserved.

121. **Coordination/administration:** In-country coordination of this priority activity should involve all PGRFA stakeholders, including national gene bank(s), national crop working groups, breeders, researchers, farmers and non-governmental organizations. Strong links need to be established with regional networks and international centres.

122. Periodic administrative and technical reviews should be encouraged in order to assess the effectiveness of any initiatives under this priority activity. Subject to these reviews, as well as to the specific provisions of relevant agreements, financial support should foster long-term security and allow efficient planning.

123. NARS, crop and regional networks and 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 where necessary.

124. Botanic gardens should be encouraged to participate actively in the activities of international associations. Links should be strengthened between organizations such as the International Association of Botanic Gardens and Botanic Gardens Conservation International and the organizations responsible for PGRFA conservation (for example FAO, Bioversity International and other international agriculture research centres). 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

125. **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. Regeneration capacity 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, there is a large backlog of materials needing regeneration. 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, ongoing annual regeneration requirements (as opposed to multiplication needs) amount to fewer than 10 percent of conserved accessions. Nevertheless, some 55 percent of countries reporting on regeneration to the World Information Sharing Mechanism on GPA implementation (WISM) indicated that capacity has declined in 20 percent of the national gene banks and this has resulted in significant backlogs. The global crop strategies supported by the Trust point out that regeneration backlogs occur in all crops and regions. However, significant advances have been made, including at the global level as a consequence of funding provided to the Centres of the Consultative Group on International Agricultural Research (CGIAR) for the “Global Public Goods” projects, and, at the national level, as a result of funding from the Trust. The Trust has also supported the development of regeneration guidelines for a number of Annex I crops. Inadequate documentation about accessions continues to be 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 that needs to be regenerated, but continued intervention is necessary to maintain viability of much of the stored genetic diversity of PGRFA.

126. **Objectives:** To regenerate and multiply *ex situ* accessions to satisfy needs for conservation, distribution and safety duplication.

127. To establish the processes, partnerships and capacities needed to regenerate and multiply *ex situ* collections to satisfy needs for conservation, distribution and safety duplication.

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

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

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

130. The 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.

131. Regeneration and multiplication 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 in the GPA.

132. Governments, the private sector, international organizations, including in particular the CGIAR, and non-governmental organizations 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 those 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 should be undertaken in conjunction with regeneration without compromising the effectiveness or scientific goals of the regeneration exercise. Characterization should be conducted 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 to regenerate and multiply 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 non-governmental organizations in the activity.

135. Gene banks should ensure that monitoring systems are in place and should be able to determine the current status of their accessions and to 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 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 to minimize genetic drift, to identify markers associated with seed longevity in order to assist in devising regeneration strategies, to develop an understanding of the causes of mutations in conserved germplasm and to eliminate seed-borne pests. Important questions remain concerning breeding systems, reproductive biology, dormancy mechanisms and technical problems associated with regeneration practices.

140. **Coordination/administration:** The active involvement of crop and regional networks is important to the success of regeneration and multiplication efforts, particularly in identifying and prioritizing germplasm to be regenerated and multiplied. National plans for regeneration should be formulated with their assistance, particularly with regard to PGRFA of national priority.

141. There should be ongoing monitoring of the need for regeneration and multiplication, which should include giving consideration to the necessity for duplication, storage behaviour of the species, storage conditions and the viability of individual accessions.

## **Sustainable Use**

### **8. Expanding characterization, evaluation and further development of specific subsets of collections to facilitate use**

142. **Background:** Gene bank collections should help users respond to new challenges and opportunities to improve crop productivity, enhance sustainability and respond to change – particularly climate change and pest resistance – and meet human needs related to PGRFA. Today, germplasm collections of major crops 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 quickly to 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 is also important for improving the use of plant genetic resources. The establishment of limited sets of genetic material – based on either capturing total diversity in a small number of accessions or the variation in particular traits – has been found to improve the use of collections. These efforts require close collaboration between germplasm curators and plant breeders in the delineation of manageable collection subsets. Characterization and evaluation can also aid the identification of germplasm with potential for further improvement by breeders and farmers, as well as for direct use by farmers for production and marketing.

143. 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 needed. Significant advancements have also been made in developing high-throughput phenotyping techniques and related infrastructure. In order to efficiently characterize and evaluate germplasm accessions and breeding materials for traits associated with adaptation to, and mitigation of, the effects of climate change, and with response to consumer demand, it is equally important to continue developing phenotyping capacity.

144. Despite such overall progress, there are still large data gaps and many of the existing data are not easily accessible. The lack of adequate characterization and evaluation data and the capacity to generate and manage them, remain serious constraints to the use of many germplasm collections, especially those containing 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 available. Efforts should equally be invested in developing standard descriptors and uniform characterization methodologies for more crops and species. Greater funding and more capacity building will help increase the breadth and depth of germplasm characterization efforts, making it easier to mine gene banks for traits of interest.

145. **Objectives:** To enhance the use and management of plant genetic resources in gene banks. To identify germplasm of potential value for research and crop improvement and for direct use by farmers in the rehabilitation of degraded ecosystems and other forms of direct use in agro-ecosystems.

146. To develop innovative, crop-specific characterization and evaluation 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.

147. To improve the efficacy of the evaluation process by developing and adapting high-throughput evaluation methods for identifying accessions with valuable traits. These methods include 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.

148. To establish subsets of genetic material including trait-specific collections for crops of global importance.

149. To improve and facilitate exchange of and access to quality characterization and evaluation data across gene bank collections, including through national, regional and global information systems.

150. **Policy/strategy:** Governments, with the cooperation of relevant UN bodies and regional, intergovernmental and non-governmental organizations, international agricultural research centres, regional networks and the private sector, and taking into consideration the views of the scientific community, breeders' 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 crops of national economic importance, as well as underutilized crops and crops of dietary interest;
- b) support collaboration and complementarities between breeders, researchers, extension services, farmers and gene banks;
- c) encourage the exchange of characterization and evaluation information, including through networking gene bank databases within and among countries;
- d) note that access to PGRFA is subject to applicable regional or international agreements, such as the International Treaty. To comply with such agreements, PGRFA users should be

encouraged to agree to provisions for sharing relevant evaluation data with source institutes, giving due regard to the special needs of commercial users for confidentiality as appropriate;

- e) use characterization and evaluation data to help improve the *in situ* management of landraces, CWR, wild food plants and forages;
- f) give appropriate financial support to characterization and evaluation programmes for crop species of primary importance to food security, given the importance of medium- and long-term financing, and promote synergies with existing funding mechanisms (for example the Benefit-sharing Fund of the International Treaty).

151. Crop networks and gene banks should be encouraged to identify useful traits and establish trait-specific and other small collections of interest to users with a 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 systems.

152. **Capacity:** Support should be given to continuing targeted characterization and evaluation programmes for selected priority germplasm. The characterization and evaluation process begins 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. A great deal of evaluation work needs to be done in a use-oriented, site-specific manner.

153. Governments and appropriate organizations should identify institutions and individuals who may have the capacity and expertise to characterize and evaluate germplasm for specific stresses and develop a national portfolio of such expertise, including breeders and farmers in high-stress areas who may perform preliminary evaluations to identify subsets of accessions that hold promise for further evaluation under more stringent scientific conditions. The cost efficiency of subcontracting evaluation should also be investigated as should the feasibility of cooperative programmes involving national programmes and the private sector.

154. National programme staff should receive training in germplasm characterization and evaluation techniques on a crop-specific basis. Such training should begin with crops that are important nationally and for which there are current or planned breeding programmes. Capacity building should aim for 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 platforms.

155. Support should be given to training breeders and farmers who participate in on-farm PGRFA evaluation programmes. Emphasis should be placed on the extensive knowledge that women have about the uses and usefulness of plants, as their responsibilities often range from propagating, producing and harvesting crops to processing, storing and preparing food/feed.

156. Students at all levels should be trained in basic topics related to the characterization, evaluation and use of PGRFA.

157. **Research/technology:** Various types of research must be undertaken in the effort to achieve cost-effective use of current collections. Using the latest technology, and with support from plant breeding, research should seek to:

- a) improve the use of molecular methods in characterization and evaluation in order to identify useful genes and understand their expression and variation;
- b) improve methods of germplasm characterization and evaluation using biochemical assays and high-throughput phenotyping, in particular for adapting to and mitigating climate change and increasing nutritional values;
- c) improve data exchange through further development and harmonization of standards for characterization and evaluation data.

158. Research is also needed to develop more useful subsets 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 increasing the availability of characterization and evaluation data through improved documentation systems. Further work is also needed to optimize the way in which such subsets are used by breeders to access best-bet materials from the full collection.

159. **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' and farmers' organizations, private and public companies and related associations and other relevant stakeholders should also be involved.

160. 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 integrated firmly in the context of the entire effort to improve use.

161. Cooperation and exchange of information are needed, especially by developing-country gene banks that manage very diverse collections but do not have staff with expertise in all of the species they conserve.

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

162. **Background:** Germplasm collections can be used both to identify specific alleles that are 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, prebreeding or genetic enhancement is often necessary to produce material that can be easily used by breeding programmes. Newly bred varieties are a means to deliver PGRFA to farmers.

163. The challenge of using PGRFA is made more difficult by the stagnant or dwindling plant-breeding capacity in many countries. There is a serious shortage of plant breeders in both public and private sectors and a declining enrolment in conventional plant breeding courses in agricultural universities/schools and institutions, with students opting for careers paths in what are seen as more modern sciences, such as molecular biology. There is a compelling need to redress this situation as the role of conventional plant breeding in crop varietal development is irreplaceable.

164. Currently, global challenges, in particular climate change, place increasing demands on breeding programmes, and these are likely to intensify. Significantly strengthened human capacity and infrastructure are necessary for breeding programmes to deliver varieties with the enhanced tolerance to biotic and abiotic stresses needed for adaptation to climate change, as well as for diversification and food security. Such capacity enhancement must be accompanied by a rethinking of strategies. Breeding must be needs based, with greater integration of the perspectives of farmers and other users on 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.

165. Prebreeding and genetic enhancement must be encouraged, including by pooling the resources of 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. CWR 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 diversity of both the crops and the varieties available to farmers. An important contribution can be made through base-broadening strategies that seek to widen the genetic diversity in plant breeding programmes and in the products of such programmes.

167. An example of a multilateral effort to enhance capacity in breeding 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 countries was created in direct response to Article 6 of the International Treaty. GIPB aims to enhance plant-breeding capacity and seed delivery systems in developing countries and to 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 a multi-stakeholder initiative that promotes the use of PGRFA in crop improvement. The GCP focuses on using novel biotechnology tools, including genomics, molecular breeding and bioinformatics, to enhance efficiencies in crop varietal development.

168. **Objectives:** To contribute to food security and improved farmer 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 ways to conserve them.

169. To reduce vulnerabilities by increasing genetic diversity in production systems as well as in crop-breeding programmes through the use of CWR, farmers' varieties/landraces, improved varieties and introductions, as appropriate. To increase the sustainability of agricultural systems and the capacity to adapt to environmental changes and to emerging needs. To strengthen the capacity of national plant breeding programmes and other sectors, where required and as appropriate, and to encourage participatory breeding. To provide the tools and resources needed to increase 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 and non-governmental organizations, and funding sources should:

- a) recognize the importance of providing long-term funding and logistical support to plant breeding and research, prebreeding, genetic enhancement and base-broadening activities;
- b) recognize the importance of providing adequate support for the routine use of novel biotechnology tools, computational biology and information technology in PGRFA management, especially in characterizing germplasm and facilitating the introgression of desired traits into breeding materials;
- c) encourage the development of public-private and other partnerships that foster participatory approaches to setting and implementing crop-improvement priorities and goals;
- 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 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) when devising national strategies and fostering collaborations, as appropriate, be fully cognizant of the provisions of the Multilateral System of the International Treaty, according to which material can be accessed "for the purpose of utilization and conservation for research, breeding and training for food and agriculture."

171. **Capacity:** Support should be given to national systems, regional networks, international agricultural research centres, non-governmental organizations, universities, breeding programmes and other relevant organizations to carry out plant breeding, including genetic enhancement and base-broadening. Priority should be given to addressing problems identified by crop and regional networks, regional research and development forums, other competent scientific bodies and institutions and,

breeders' and farmers' organizations. Efforts should extend beyond addressing the most pressing problems facing crops on Annex I of the International Treaty to include crops that support local food security around the world.

172. Capacity building under this activity should give priority to creating personnel skilled in traditional as well as modern plant genetic improvement techniques. In addition, capacity needs to be strengthened in both field and laboratory evaluation. Capacity building should be accompanied with adequate incentives – such as structured career opportunities – in order to facilitate the attraction and retention of experienced staff. Greater international collaboration – for example, with regional centres of excellence – could help cut national training costs and reduce unnecessary duplication of investments.

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

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 and breeders' and farmers' organizations. Close communication among gene bank curators, plant breeders and other scientists in both the public and private sectors should be encouraged. Networking among communities of practice for breeders should be promoted as a vehicle for mentoring and exchanging ideas. The cooperation of key stakeholders in the development of crop value chains at the national level is another effective way to coordinate the activities and efforts needed to ensure sustainable progress in this priority activity.

## **10. Promoting diversification of crop production and broadening crop diversity for sustainable agriculture**

176. **Background:** Despite progress in the diversification of crop production, various crop production systems, which increasingly dominate agricultural systems, could result in yield losses due to pests, diseases and abiotic stresses, as well as a lack of stability and resilience. Several new challenges have been recognized in the past decade that will require strengthening diversification. These include the need for long-term sustainability in agricultural practices, the challenges and opportunities posed by the production and use of biofuels, food and nutritional security and rural development, and climate change.

177. To cope with such challenges, a broader range of crop varieties and species will need to be incorporated into agricultural systems. These include crops that produce raw materials for agro-industry and energy, crops that are currently underutilized, wild food plants and forages. Similarly, plant breeders will need to include more diversity in their improvement programmes. The participatory evaluation, selection and improvement of farmers' varieties/landraces and early breeding lines are measures that could bring higher levels of diversity, adaptation and stability to crops. Diversification at the species and genetic level should be complemented by 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 rotation, varietal mixtures and multilines, these practices will help to improve the resilience and stability of agricultural systems and thus ensure food, nutritional and income security. The development of varieties by local breeders is highly relevant to adapting agriculture to environmental changes and meeting the demands of farmers and farming communities. There is a need, however, for

varieties that are adjusted to practical and local requirements to move more rapidly from development to commercialization.

178. **Objectives:** To promote sustainable agriculture through diversification among and within crops.

179. To periodically review genetic vulnerability in crops and encourage breeders, and other relevant groups to take the necessary mitigating action at national, regional and international levels.

180. To develop models for diversified production that are consistent with higher productivity and stability as well as meeting consumer preference.

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

- a) regularly monitor genetic diversity and assess crop vulnerability;
- b) promote policies that support diversification programmes and the inclusion of 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 production systems;
- f) support the management of diversity by breeders and farmers;
- g) increase investment in improving underutilized crops and the development and use of traits in major crops that are relevant to human and environmental health and to the effects of climate change.

182. Funding agencies should be encouraged to continue to provide support to indigenous and local communities, national agricultural research systems, international agricultural centres, breeding programmes and other relevant research bodies and non-governmental organizations for work aimed at enhancing levels of diversity in agricultural systems.

183. **Capacity:** Governments and 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 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 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 plant breeding and agronomic practices that foster the diversification of crop production. This might include reviewing the track records of different practices.



185. Research is needed on domesticating wild species, increasing the use of underutilized crops to develop more nutritious adapted varieties, and developing crops and varieties adapted 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 agro-ecosystems, 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 of 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 the regional level to be truly effective.

## **11. Promoting development and commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species**

188. **Background:** Commercial production increasingly dominates agricultural systems. In commercial production systems, a few major crops provide for a large proportion of global needs. However, many more species, including farmers' varieties/landraces of both major and minor crops, are used by farmers and indigenous and local communities to meet local demands for food, fibre 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 as varieties are bred to meet the needs of production, industrial processing and demanding market standards.

189. Underutilized species, farmers' varieties/landraces and other crop varieties not commonly used in agricultural production systems are being lost, along with associated knowledge. 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. Nor are many underutilized crops included in Annex I of the International Treaty. Nonetheless, many of these species and varieties have great potential for wider use, particularly in breeding, and could contribute significantly to sustainable livelihoods through improved food and nutritional security, income generation and risk mitigation.

190. However, there is a growing global recognition of the value of farmers' varieties/landraces and underutilized species in the face of uncertain climates, malnutrition and rural poverty. For example, there is evidence of increasing awareness both among the public and among 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 grow more willing to pay higher prices for better-quality, novel or heritage foods from sources they know and trust. New legal mechanisms enable farmers to market farmers' varieties/landraces, and legislation supporting the marketing of geographically identified products is increasingly available, providing ways 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 to better integrate the efforts of individuals and institutions with a stake in the different stages of the production chain. In particular, the involvement of indigenous and local communities is essential and must fully take into account traditional knowledge systems and practices.

192. Recently, a new organization, Crops for the Future<sup>4</sup>, has been established to promote the use and conservation of underutilized plant species.

193. **Objectives:** To contribute to sustainable livelihoods, including improved food and nutritional security, income generation and risk mitigation, through the sustainable management of all varieties, focusing primarily on farmers' varieties/landraces and underutilized species.

194. To stimulate stronger demand and more reliable markets for all varieties, primarily farmers' varieties/landraces and underutilized species, and their products. To promote local processing,

---

<sup>4</sup> Crops for the Future evolved from a merger of the International Centre for Underutilized Crops and the Global Facilitation Unit for Underutilized Species.

commercialization and distribution of the products of such varieties/landraces and underutilized species. To increase public awareness of their value.

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

- a) to promote policies that are consistent with the sustainable use, management and development of underutilized species, as appropriate, identified as having the potential to make significant contributions to local economies and food security;
- b) to develop and adopt policies on extension, training, pricing, input distribution, infrastructure development, credit and taxation that will serve as incentives for crop diversification and the creation of markets for biodiverse food products;
- c) to create enabling environments for managing and monitoring local diversity and to develop local and export markets for a wider range of traditional and new products originating from plant varieties, primarily farmers' varieties/landraces and underutilized species;
- d) to foster public-private partnerships and put in place legislation to promote benefit sharing targeting farmers and traditional custodians.

**196. Capacity:** Training and capacity building should be provided for scientists, breeders, and extension specialists and for seed producers, farmers, indigenous and local communities (with a particular emphasis on women) on the topics of establishing, running and advising local small-scale enterprises concerned with the commercialization of all varieties, primarily farmers' varieties/landraces and underutilized species. The training should include lessons on:

- a) identifying all varieties, primarily farmers' varieties/landraces and underutilized species, 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 such varieties and species;
- d) developing marketing methods for all varieties, primarily farmers' varieties/landraces and underutilized species; and
- e) documenting local and traditional knowledge about farmers' varieties/landraces and underutilized species.

197. Appropriate bodies, including non-governmental organizations, should promote public awareness of the value of all varieties, primarily farmers' varieties/landraces and underutilized species, in various media and through additional mechanisms such as street fairs and school initiatives.

198. Appropriate bodies should promote awareness among policy-makers and entrepreneurs of the value of such species and varieties.

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

- a) develop sustainable management practices for all varieties, primarily farmers' varieties/landraces and underutilized species, of importance to food and agriculture;
- b) characterize and evaluate farmers' varieties/landraces 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 for all varieties, primarily farmers' varieties/landraces and underutilized species;

- e) develop marketing strategies and brand development for all varieties, primarily farmers' varieties/landraces and underutilized species.

200. Commercialization processes and activities that 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, breeders, farmers and indigenous 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, and non-governmental and other relevant organizations, should regularly review the status of all varieties, primarily farmers' varieties/landraces and underutilized species, in their regions, to:

- a) identify possibilities for commercialization;
- b) identify common research and development needs; and
- c) facilitate and, as appropriate, coordinate requests for financial and technical assistance.

## 12. Supporting seed production and distribution<sup>5</sup>

202. **Background:** Effective seed systems must be in place to ensure that farmers have access to planting materials 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. Over the last 20 years, the private agricultural sector has grown significantly in developed and developing countries; however, the main focus of its interest has been high-value products, such as maize, wheat, rice, oil crops, pulse crops and vegetable crops. The expansion of the seed trade over the past decade has been accompanied by the promotion of seed regulatory harmonization at regional and subregional levels. Investment by the public sector in seed production, already low 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 purveyors of seed for local and, in some cases, even improved varieties. Different seed systems often operate side by side, with different levels of success depending on the crop, the agro-ecological zone and market opportunities. There is therefore a need to develop integrated approaches that strengthen seed systems and the connections between them in order to ensure the production and distribution of seed of crop varieties that are useful for diverse and evolving farming systems.

203. **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 agrobiodiversity and productivity.

205. To improve the complementarity of seed production and seed distribution in the public and private sectors as well as between different seed systems.

206. To develop and expand viable local-level seed production and distribution systems for varieties and crops that are important to farmers, including small-scale farmers.

207. To make new crop varieties available to farmers and to make suitable germplasm 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 harmonization at regional level, taking into account the specificities of different seed systems.

209. **Policy/strategy:** Governments, NARS and seed producers, subject to national laws and

---

<sup>5</sup> In this priority activity the term "seed" refers to all planting materials.

regulations as appropriate, with support from international agricultural research centres, regional and bilateral cooperation programmes and non-governmental organizations, and taking into account the views of the private sector, farmers' organizations and indigenous and local communities, should:

- a) develop appropriate policies that provide an enabling environment for the development of different seed systems, including small-scale seed enterprises. The efforts of governments should focus in particular on the crops and varieties needed by resource-poor farmers, especially women. 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 prioritize major and minor crops that are not adequately addressed by the private sector where appropriate. These policies should be integrated with general agriculture policies;
- b) strengthen links between gene banks, networks, plant breeding organizations, seed producers and small-scale seed production and distribution enterprises to ensure wide use of available germplasm;
- c) consider seed quality-control schemes, particularly schemes that are appropriate for small-scale enterprises and enable them to meet plant-health requirements;
- d) adopt legislative measures that create adequate conditions for deploying all varieties, primarily farmers' varieties/landraces and underutilized species, in different seed systems, taking into account their specificities; and
- e) develop subregional/regional agreements that streamline seed quality control, certification, plant quarantine requirements and other standards in order to facilitate the development of cross-border seed trade.

210. **Capacity:** Governments, subject to regional legislation, national laws, regulations and policies, as appropriate, and in conjunction with international aid agencies, non-governmental organizations and existing seed enterprises, should:

- a) establish/strengthen seed systems, based on public-private partnerships, 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 links with gene banks, networks and agriculture research institutes;
- c) strengthen capacities to implement efficient seed quality systems;
- d) provide appropriate ways to facilitate the emergence of seed enterprises, as appropriate, paying attention in each country to the needs of the small farming sector, women and other vulnerable or marginalized groups;
- e) provide infrastructural support and training to small-scale seed enterprises in the fields of seed technology and business management in order to facilitate the establishment of a sustainable quality seed-supply system;
- f) improve the linkages between breeders' and farmers' organizations and seed producers (public or private) so that farmers, in particular women and other 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 and conservation in order to improve the physical and genetic quality of seeds.

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

- a) assess current incentives and disincentives as well as the needs of seed production and distribution systems for support, including small-scale, farmer-level efforts; and
- b) develop approaches for supporting small-scale, farmer-level seed distribution, drawing on the

experiences of community and small-scale seed enterprises already established in some countries.

212. **Coordination/administration:** Governments should regularly monitor the degree to which farmers are able to acquire appropriate seed. Coordination is needed in the seed sector among the public and the private sectors and farmers to ensure that farmers have access to high-quality seed of the crops and varieties they need to respond to the challenges of increasing 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 and the International Treaty. Especially in the context of climate change, national programmes 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 contribute fully 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, support strategies and concrete action plans that are necessary for setting well-defined goals and clear priorities, allocating resources, distributing roles and responsibilities and identifying and strengthening linkages between all relevant stakeholders. A successful national programme requires commitment from governments to providing funding and designing supportive policies and legal and institutional frameworks.

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

215. Over the past decade, considerable progress has been made in establishing national PGRFA programmes and enhancing stakeholder participation in national strategies and action plans, especially with regard to the private sector, non-governmental organizations, breeders' and farmers' organizations, and research and educational bodies. The commitment that this indicates is seen also in the fact that several important international agreements relating to PGRFA have been negotiated, adopted or revised during this period, including the International Treaty, the International Plant Protection Convention, the Cartagena Protocol on Biosafety and the Nagoya Protocol on Access 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, plant breeders' rights and Farmers' Rights as defined in Article 9 of the International Treaty and subject to national legislations.

216. Nevertheless, many countries still lack adequate policies, strategies and/or action plans for PGRFA. Many existing national programmes suffer from inadequate and unreliable funding and are isolated from related activities. Areas that require particular attention include priority setting, enhancing collaboration between the public and private sectors, national and international cooperation, strengthening links between PGRFA conservation and use, developing information systems and publicly accessible databases (for example the NISMs 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. Often, the countries that lack strong national programmes and appropriate long-term conservation facilities have the most urgent food security problems, even if they have rich sources of PGRFA. Weak national programmes often limit efficient management of PGRFA collections.

218. National *ex situ* collections are an integral part of national PGRFA programmes. Gene banks work best as dynamic centres that integrate conservation, documentation and use. Overemphasis on

conservation can detract from sustainable use, which supports progress in agriculture together with conservation of PGRFA. The increasing impact of climate change makes it essential to support national activities related to crop adaptation, including genetics, genomics and breeding. Indeed, the capacity to carry out crop adaptation is essential to the efficient and effective management of PGRFA. Since 1996, public–private research and development partnerships have increased in most countries, especially in the plant breeding and biotechnology sectors. However, in developing countries, public organizations are often on their own in managing conservation and plant breeding, which can result in inefficiencies, reduced benefits and lost opportunities.

219. **Objectives:** To meet national needs to conserve and use PGRFA sustainably through rational, effective, coordinated and sound approaches for the benefit of present and future generations.

220. To maintain 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 that use.

221. 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; (iii) programme strategy, including well-defined goals, clear priorities and adequate and sustainable funding; (iv) appropriate participation by all stakeholders; and (v) where appropriate, effective conservation and use facilities at the national and/or regional levels.

222. To improve institutional and sectoral linkages, enhance synergies among all stakeholders involved in conserving, developing and using PGRFA, including seed systems, and to strengthen the integration of institutional and community efforts.

223. To develop, strengthen and regularly update national capacities in 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 agenda. The contribution of national programmes to the objectives of international instruments, including the GPA, the CBD and the International Treaty, should be highlighted. The ecological, economic, social and cultural values of PGRFA, including the importance of crop improvement for 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, particularly, long-term financial and other resources. The latter could include financial support for the training and retention of qualified staff, for farmers to maintain and make local varieties available and for breeders to improve them. Specific funding allocations should be made to PGRFA programmes in the governmental budget process. In this regard, awareness among policy-makers and donors of the value of PGRFA to national development should be raised.

225. Government commitment to providing adequate and sustainable funding for national programmes and projects is essential; however, regional or international support is a necessary complement to domestic resources.

226. National programmes should set well-defined goals and clear priorities, including priorities for assistance from regional and international agricultural development programmes. National programmes should have the capability to assess and determine what PGRFA are required to meet national conservation and development needs and related international obligations. They should have supporting policies and strategies on the conservation, access and use of PGRFA, as well as on the fair and equitable sharing of the benefits arising from their use. National programmes should provide for the periodic adjustment of these policies and strategies as necessary. They should make available, as appropriate, the widest possible representative collection of PGRFA to meet the needs of farmers, breeders and other users 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 that are 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, looking for synergies and possibilities for the division of labour. National strategies should encompass the 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 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. Policy decisions will determine strategies and modes of operation, in particular with regard to regional and international collaboration. In countries with limited capacity, the strategy may include the use of facilities and expertise from outside the country.

229. Existing programmes should consider establishing or strengthening partnerships with private enterprises, non-governmental organizations, rural, indigenous and local communities, breeders' and farmers' organizations, 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. The creation or strengthening of links should be promoted, as appropriate, among national institutions and entities specialized in technology transfer, in order to assist national bodies to negotiate the acquisition of technologies needed to conserve, characterize, and use PGRFA and associated information, in accordance with the International Treaty, the CBD and intellectual property rights (IPR).

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 assessing and improving management practices in gene banks 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:** National programmes need to conduct research into on-farm management, *in situ* and *ex situ* conservation, plant breeding, including participatory plant breeding, and crop improvement. Research is also needed on the management of national PGRFA programmes, including testing 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, as well as 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 FAO and the International Treaty. Coordination is needed to provide national programmes with information on these issues, to assess the impact of international developments in the conservation and exchange of PGRFA, and to incorporate new research developments into national systems and practices.

234. **Coordination/administration:** National coordination mechanisms should be established to set priorities for deploying financial and other resources. Strong linkages should be set up 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 to realize the full potential of PGRFA. Governments should periodically review policies to evaluate their effectiveness and adjust them 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 in 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 there is a need 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 increasing needs for food/feed production, new environmental conditions, and the pest and disease spectra that will result from climate change. Networks not only facilitate the exchange of PGRFA, but 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, networks can help set priorities for action, develop policy and provide the means for conveying crop-specific and regional views to various organizations and institutions. International PGRFA networks are recognized as a supporting component of the International Treaty under Article 16.

236. Many regional, crop-specific and thematic networks are now in operation, some of which have been established or significantly strengthened over the past decade. Each network has an important role to play in supporting the coordination of efforts and promoting cost efficiency and effectiveness in the conservation and sustainable 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 particularly important in regions where there is limited national capacity in PGRFA (for example, many of the least developed countries and small island states) as they provide easy 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 subject, thereby strengthening coordination and avoiding duplication of efforts. One of the challenges faced by all networks, however, is the long-term availability of resources to keep them going. Countries should be prepared to contribute to supporting networks in a sustainable fashion.

237. **Objectives:** To foster partnerships and synergies among countries in order to develop a more rational and cost-effective global system for PGRFA conservation and use.

238. To ensure the sustainability of networks by analysing and identifying the benefits of participation, highlighting the contribution they make to achieving the sustainable conservation and use of PGRFA at the national, regional and global levels.

239. To facilitate setting integrated ecoregional, 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 and local breeders, and to 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 for countries with similar challenges to pool efforts and share benefits. The funding constraints experienced by networks require sustainable and innovative solutions that are mindful of the often intangible, though no less important, benefits of networks. In countries where it is required, studies should be developed and information should be gathered to highlight these benefits, which will both strengthen government support and assist in accessing funds. To underpin funding strategies, greater efforts are needed to raise awareness among policy-makers and the general public of the value of PGRFA, the interdependence of nations with regard to PGRFA and the importance of supporting international collaboration. Both cash and in-kind contributions by governments to networks should be considered as a priority.

242. Networks provide a way to identify gaps, develop collaborative systems and promote new initiatives. Given that international germplasm exchange is a key motivation for many networks, additional attention is needed both to promote the effective implementation of the International Treaty, and in particular its Multilateral System, and to develop arrangements for those crops that are not currently included in the Multilateral System but fall within the overall scope of the International Treaty.

243. **Capacity:** Building networks requires not only technical expertise, but also substantial coordination, communications and organizational skills. Resources and capacity should be available for activities such as planning, communications, travel, meetings, network publications such as newsletters and meeting reports, and network strengthening, including the preparation of successful proposals for submission to donors.

244. In the regional context, priority should be given to strengthening existing regional networks. Collaboration among networks 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 they can be used more effectively. Countries with more advanced PGRFA facilities and programmes are encouraged to support network activities by sharing expertise and providing greater capacity-development opportunities.

245. **Research/technology:** Networks provide a vehicle for collaborative research in mutually agreed priority areas. Funding obtained through research projects creates a basis from which networks can continue to cement relationships and develop further. 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. The effective use of resources is essential, and as such, coordination is not merely required within networks but also 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 undergone over the past 15 years, there have been important improvements in the availability and accessibility of PGRFA information. Several recent decisions of the Commission have aimed to increase 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 Second Report. Information exchange is given a high priority throughout the International Treaty. In particular, it is recognized as one of the supporting components of the International 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 the documentation and exchange of gene bank information include the release of GRIN-Global, a gene bank management information system with built-in networking features, and 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 gene bank accessions, including those held in the international collections managed by the CGIAR, the National Plant Germplasm System of the United States Department of Agriculture and the European Internet Search Catalogue (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 the increased use of PGRFA in crop improvement and research. Many of the existing data are still not accessible electronically and the documentation of on-farm genetic resources and CWR is particularly inadequate. A significant imbalance exists among regions and even among countries within regions with regard to their ability to access, manage and disseminate information. Many countries still lack national strategies and/or action plans on PGRFA management, 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 levels, data management and documentation activities are often given an inappropriately low priority in the allocation of funding.

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

251. To develop and strengthen national information systems including, but not limited to, accession-level information systems, to better manage PGRFA data and to support the participation of countries in global information systems.

252. To enhance the use of regional and global information systems through continual improvement of the overall functionality and productivity of gene bank–user interactions.

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

254. To monitor the effectiveness of information 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 on 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 to collect baseline data for sustainability and food security that will enable better monitoring and assessment of the progress made in these areas and of the contribution made by PGRFA to such progress.

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

257. Information on PGRFA will be acquired and disseminated in accordance with the provisions of Article 8(j) of the CBD, as regards the knowledge, innovations and practices pertaining to *in situ* conservation by 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 usable and easily accessible forms.

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

261. National and regional gene banks/networks should have sufficient personnel to manage information, thereby improving user accessibility and ensuring participation in global information systems. Appropriate training on data management and information systems should be supported as an essential element to rationalize genetic resources activities at the regional and global 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 the management of data and information and to support the adoption of new technologies.

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

- a) develop appropriate and low-cost methodologies and technologies for compiling and exchanging data;
- b) develop methods for adapting these technologies to 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 readily and easily available to non-specialists as well as to stakeholders, including non-governmental organizations, breeders' and farmers' organizations and indigenous and local communities;
- 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 levels, coordination and collaboration are essential to ensure that these systems are compatible and useful. The harmonization of descriptors, as well as their expansion to cover new crops, remains very important.

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

## **16. Developing and strengthening systems for monitoring and safeguarding genetic diversity and minimizing genetic erosion of plant genetic resources for food and agriculture**

266. **Background:** The erosion of PGRFA occurs 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 for particular crops in specific areas. The picture that is emerging is complex and it is not possible to draw clear conclusions about the magnitude of these effects. Nevertheless, in many countries there remains continuing concern over the extent of genetic erosion and the need for greater deployment of diversity. Better techniques and indicators are needed for monitoring genetic diversity, for establishing baselines and monitoring trends. The Biodiversity Indicators Partnership has brought together a large number of international organizations to develop indicators relevant to the CBD's 2010 biodiversity target, including for monitoring trends in genetic diversity of crops. However, to date, no really practical and internationally accepted indicators of genetic erosion or genetic diversity are available; 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 the erosion of PGRFA. The loss of crop genetic resources occurs mainly as a result of the adoption of new crop varieties, with the consequent abandonment of traditional varieties without appropriate conservation measures being taken. More recently, climate change and modern dietary preferences have also been seen as a threat. In some countries, the threat of invasive alien species should also be considered, as these may contribute to genetic erosion. 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 searching, updating and reporting on genetic erosion, was published on the Internet. More recently, the scope of the information covered by WIEWS has been expanded to host NISMs, which also address issues related to genetic erosion.

269. **Objectives:** To effectively monitor genetic diversity and the drivers of genetic erosion and to implement appropriate remedial or preventative action as necessary.

270. To establish and implement monitoring mechanisms to ensure the timely transfer of information to contact points designated as responsible for analysis, coordination and action. To expand the use of advanced technologies for monitoring the degradation of the most threatened diversity in crops, CWR and wild food species.

271. **Policy/strategy:** Governments should periodically review and report on the situation of PGRFA, designating a focal point to convey this information to FAO, and, as appropriate, to the Governing Body of the International Treaty, the Conference of the Parties to the CBD and other relevant bodies. Article 5 of the International Treaty requires Contracting Parties to monitor PGRFA, assessing threats and minimizing or, where possible, eliminating them. Special efforts are needed to identify the species and populations that are most at risk and are most likely to harbour traits that will be important in the future; this is particularly important with regard to 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 genetic diversity over time and minimizing 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 non-governmental organizations, the seed sector and farming communities can be linked to early warning systems at the national and higher levels. Novel ICT tools, including mobile telephones, can greatly facilitate reporting and collating information from such disparate sources.

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

274. Realizing the importance of global monitoring and early warning of the loss of PGRFA, the efficiency, purpose and value of the WIEWS should be re-evaluated, taking into consideration the potential role that the WIEWS can play as part of the Global Information System on Plant Genetic Resources as foreseen under Article 17 of the International 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 is needed on the development of practical and informative indicators of genetic erosion or genetic diversity.

276. Technical experts, representatives of national programmes, the United Nations Environment Programme, the CGIAR and other international institutions involved in PGRFA conservation, the International Union for Conservation of Nature, non-governmental organizations and the private sector

should be invited by FAO to continue discussions on the development of monitoring systems for plant genetic diversity and minimizing genetic erosion.

277. Further research is needed on the use of GIS technology to monitor genetic diversity and to predict and minimize genetic erosion and on the incorporation of the resulting information into comprehensive information systems. Additional study is required in order to understand the nature and extent of possible threats to existing diversity on farm and *in situ*.

278. **Coordination/administration:** Multisectoral collaboration and coordination need to be strengthened at the national level, especially among the agriculture, environment and development sectors. National programmes should consider alerting regional and international networks as to when and where there are imminent risks 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. Donor funding for capacity building has increased over the past 15 years, which 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 as regards the application of biotechnology to conservation and crop improvement.

280. Despite these efforts, however, human resource capacity is still far from adequate at virtually all levels and in all disciplines related to PGRFA conservation and use. In many countries, gene bank staff are too few and are inadequately trained to collect, classify, conserve, regenerate, characterize, document and distribute PGRFA. This lack of capacity poses a serious threat to establishing and managing valuable PGRFA collections. Limited taxonomic plant breeding and prebreeding capacity in most developing countries severely limits the effective and sustainable use of PGRFA. In the context of on-farm conservation, extension services and non-governmental organizations often lack qualified personnel to deliver appropriate training to farming communities. There is also a lack of qualified personnel in relation to seed production and seed technology.

281. **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.

282. To develop national and regional ability to deliver training on PGRFA at all levels and to establish effective collaborative arrangements between organizations in developed and developing countries in order to strengthen and regularly upgrade the 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 training courses and educational materials for primary and secondary education in priority subjects at the national, regional and global levels. To encourage undergraduate and postgraduate educational institutions to include aspects of PGRFA in courses and programmes, including through the use of e-learning and distance education.

284. To facilitate access to external training for countries lacking national capacity. To encourage advanced institutions that manage 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 gene bank activities and the sustainable use of PGRFA, including plant breeding and seed technology.

286. To expand opportunities for hands-on learning, mentoring and leadership training in research and development and policy areas at policy and research organizations at the national, regional and international levels.

287. **Policy/strategy:** Governments should recognize the importance of including 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, as well as to regularly upgrading the knowledge and skills of existing staff. Training opportunities and advanced education programmes should include technical and scientific aspects of the conservation, exchange and use of PGRFA in curricula for biology, agriculture, the environment, economics and health. Particular emphasis should be placed on providing training in conservation biology, especially with respect to agricultural biodiversity.

288. Regular assessments of human resource capacity and needs should be made; the results should assist countries to develop education and training strategies at the national, regional and global levels.

289. **Capacity:** Support should be given to enable national and regional organizations and programmes to update curricula, provide advanced education and strengthen research and technical capacity on all relevant aspects of PGRFA conservation and use. Support should also be given to students in undergraduate and postgraduate programmes and to continuous professional training. Collaboration should be encouraged between academic institutions in developed and developing countries, including in 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 the links between conservation and use, management, law, policy and public awareness, should be addressed to improve understanding of international agreements and treaties.

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

293. Consideration should be given to preparing educational materials that are widely applicable in different regions, but that maintain 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 underappreciated, role in maintaining and developing PGRFA and the associated knowledge and traditions.

295. The capacity to produce 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 organizations and national programmes. Efforts should be made to involve university students and professional staff in field and 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 prepared 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 mobilizing popular opinion and to generating and sustaining appropriate political action nationally, regionally and internationally. Communicating

effectively about the many benefits that PGRFA can bring to food security and sustainable livelihoods is critical to the success of any conservation programme. Recent years have seen a growing understanding of the importance of PGRFA in addressing the challenges posed by climate change. Interest in underutilized species is on the rise in recognition of their potential to be productive under different climate scenarios and to provide opportunities for high-value niche products. There is also an increasing recognition by scientists of the potential of CWR to contribute to the 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 an increasing interest in the nutritional benefits that can be gained from exploring and exploiting PGRFA. Many countries aim to reduce the cost of imported food by revitalizing local food production, which often has cultural value as well. Social networking tools provide an extremely effective way to get such messages across to a significant number of people, in particular the young generation. Nevertheless, raising awareness among 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 links and collaborative mechanisms such as networks, involving different sectors, agencies and stakeholders. Within countries, public awareness can support efforts to involve the private sector, indigenous and local communities, and local and non-governmental organizations in national genetic resources activities, thus ensuring a broader base for conserving and sustainably using PGRFA. Working with the media at the local and national levels is a crucial aspect of raising awareness. The creation of strong links between public awareness campaigns implemented by international organizations and national programmes and organizations can increase their effectiveness and reduce costs. Successful awareness programmes can bring financial rewards, as can be seen in the case of the Trust, established in 2004 as a specialized fund dedicated to supporting the conservation of PGRFA and promoting its use worldwide.

300. **Objectives:** To ensure continued support for PGRFA conservation and use from policy-makers and the general public.

301. To support and strengthen mechanisms, particularly in developing countries, for coordinated public awareness activities that 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 their 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 should be considered when developing any PGRFA activity.

303. National strategies should recognize the role that all PGRFA stakeholders have to play in the development of public awareness activities. Governments should recognize and encourage the work of non-governmental organizations in raising public awareness, and efforts should be made to foster the development of public–private partnerships around public awareness campaigns. The important roles of indigenous and local communities in any *in situ* conservation or on-farm management effort, and their traditional knowledge systems and practices, need to be fully taken into account.

304. Public awareness materials should be produced in appropriate languages to facilitate broad use within countries and should exploit all available ICT options.

305. To be effective and ensure adequate reach, public awareness needs to be sufficiently supported in terms of both human and financial resources.

306. **Capacity:** National PGRFA programmes should have a trained focal point for public awareness to work closely with programme managers and develop the appropriate tools. Failing this, all staff in PGRFA programmes should develop at least some capacity to articulate the importance of the programme goals and activities within 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 to raising awareness.

307. National PGRFA 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 communications workshops and meetings to gain a better understanding of the subject area.

308. National PGRFA programmes should draw on public awareness tools and technologies generated at the regional and international levels to use in their own communication 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 messages they contain will be useful in supporting national public awareness strategies and activities. Adapting existing tools will substantially reduce costs to national programmes. 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 indigenous and local communities in maintaining and improving these valuable resources should be promoted in schools at all educational levels as well as in specialized agricultural research institutions. This will involve producing education and training materials based on case studies. This would require working relationships with national education institutions. The important role that botanic gardens play in creating awareness should also be taken into account and promoted by the PGRFA community.

310. Simple, low-cost botanic gardens, arboreta and field gene banks associated with universities, schools and other institutions should be strengthened and encouraged to promote education and public awareness.

311. **Research/technology:** Research on the information needs of targeted audiences should be carried out before launching any major public awareness initiative. Policy-makers will undoubtedly be a critical target audience for any awareness campaign, and research is required to underpin the promotion of appropriate policies for the conservation and use of genetic diversity, including the economic valuation of PGRFA. At the international level, research should be carried out on the use of ICT tools to meet public awareness needs. The impact of promotional materials should not be assumed; there is need for impact analysis of awareness products so that limited resources can be used for maximum impact.

312. **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 levels. Links between regional and international organizations, the private seed sector, and non-governmental organizations will facilitate the identification of opportunities for collaborative activities. A coordinated multisectoral and multi-agency approach enhances the strength of the message.



## **Implementing and Financing the Second Global Plan of Action**

313. The Second GPA provides an important internationally agreed framework for the conservation and sustainable use of PGRFA. The Second GPA is a supporting component of the International Treaty as per its Article 14 and its implementation will be an essential contribution to achieving the objectives of the International Treaty. It will also facilitate the implementation of the CBD in the area of agricultural biodiversity and help reach the targets of the Strategic Plan for Biodiversity 2011-2020.

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

315. Overall progress on the implementation of the rolling Second GPA and the related follow-up processes will be monitored and guided by governments and other FAO Members through the Commission. In order to discharge this function, the Commission will plan the review of the implementation of the Second GPA as well as the review of the Second GPA itself within its Multi-Year Programme of Work, in close cooperation with the Governing Body of the International Treaty. The review should deal with the progress made at the national, regional and international levels in the implementation, elaboration, and adjustment, as appropriate, of the Second GPA. A first review of the implementation of the Second GPA should be undertaken by the Commission at its Fifteenth Regular Session, including an assessment of its achievements as well as gaps and financial and other needs for its implementation, in accordance with Resolution 1/2011 of the Commission.

316. To this end, the Commission, at its Fourteenth Regular Session, will agree on formats for progress reports as well as on criteria and indicators for monitoring the implementation of the Second GPA, building on previous work done by the Commission in the development of such indicators and reporting format. 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 consider new initiatives or activities. Any conclusions of the Commission that have major policy implications will be brought to the attention of the FAO Council and Conference, the Governing Body of the International Treaty and the Conference of the Parties to the CBD and/or the Commission on Sustainable Development for action, endorsement or information, as appropriate.

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

318. So far, the most significant funding for PGRFA for the majority of regions has been provided by governments and other domestic sources of funds. Substantial funding sources for PGRFA also include bilateral and regional sources and multilateral organizations.

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

320. International cooperation for the conservation and sustainable use of PGRFA 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 meet their commitments under the Second GPA will largely depend on the effective implementation of the International Treaty and its Funding Strategy. Two relevant elements

of the Funding Strategy that will support the implementation of the Second GPA are the Benefit-sharing Fund and the Trust. Funds in the Benefit-sharing Fund are under the direct control of the Governing Body and are used by the Governing Body to catalyse international cooperation in the area of PGRFA, taking the rolling GPA into account.<sup>6</sup> The Trust is an essential element of the Funding Strategy and promotes cost-effective and efficient conservation activities in accordance with the GPA.<sup>7</sup> Every effort should also be made to seek new, additional and innovative sources of funding within the course of the implementation of the Second GPA.

321. 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 Second GPA. The priorities for support under the Funding Strategy are the priority activities 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.

322. In order to enlist the widest participation and support for its implementation, the Second 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, 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 CGIAR and the Trust, and their member constituencies should be invited to promote and take part, as appropriate, in the implementation of the Second GPA.

---

<sup>6</sup> The three current priority areas are: 1. Information exchange, technology transfer and capacity building (reflecting priority activities 15 and 19 of the GPA, roughly corresponding to priority activities 13 and 17 of the Second GPA); 2. Managing and conserving plant genetic resources on farm (reflecting priority activity 2 of the GPA, roughly corresponding to priority activity 2 of the Second GPA); and 3. The sustainable use of plant genetic resources (reflecting priority activities 9, 10, and 11 of the GPA, roughly corresponding to priority activities 8, 9 and 10 of the Second GPA).

<sup>7</sup> 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; (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

CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CWR	crop wild relatives
EURISCO	European Internet Search Catalogue
FAO	Food and Agriculture Organization of the United Nations
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	Germplasm Resources Information Network
ICT	information and communication technologies
IPR	intellectual property rights
Multilateral System	Multilateral System of Access and Benefit Sharing
MYPOW	Multi-Year Programme of Work of the Commission
NARS	National Agricultural Research System
NISM	National Information Sharing Mechanism on GPA implementation
PGRFA	plant genetic resources for food and agriculture
Second Report	Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture
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
WIEWS	World Information and Early Warning System on PGRFA
WISM	World Information Sharing Mechanism on GPA implementation