The Second Report on
THE STATE OF THE WORLD's

PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

SYNTHETIC ACCOUNT

COMMISSION ON
GENETIC RESOURCES
FOR FOOD AND
AGRICULTURE

The Commission on Genetic Resources for Food and Agriculture at its Twelfth Regular Session in 2009 endorsed *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture* (SoWPGR-2) as the authoritative assessment of this sector. It requested FAO to prepare a synthetic account that contains the main findings and conveys the key messages of the report to policy-makers and others. Accordingly, a synthetic account of *the Second Report* has been prepared which presents the most significant changes in the conservation and use of plant genetic resources since the first report on *The State of the World's Plant Genetic Resources for Food and Agriculture* was published in 1998. It also provides an overview of the main challenges ahead and the efforts required to ensure that these vital resources continue to be available to present and future generations in the fight against hunger and food insecurity.

For the full report please visit: http://www.fao.org/agriculture/seed/sow2/

A Spotlight on PGRFA

By 2050, the world will need to produce twice as much food as was produced in 2000, but will have to do so from the same amount of land and using less water and other inputs. Climate change is also changing the environment in which crops are grown, presenting farmers with new challenges.

Better conservation and use of food plant diversity can help address these issues very effectively. The genetic diversity of the grains, legumes, vegetables and fruits that we grow and eat – referred to as *plant genetic resources for food and agriculture* or PGRFA – are the foundation of food production, and the biological basis for food security, livelihoods and economic development. PGRFA remain crucial for helping farmers adapt to current and future challenges, including the effects of climate change. It is vital that we conserve this diversity and increase its use in a sustainable and efficient manner.

The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture – SoWPGR-2 – provides a comprehensive overview of recent trends in PGRFA conservation and use around the world. It is based on information gathered from more than 100 countries, as well as from regional and international research and support organizations and academic programmes. The report documents the current status of plant genetic resources diversity, conservation and use, as well as the extent and role of national, regional and international efforts that underpin the contributions of PGRFA to food security. It highlights the most significant changes that have occurred in the sector since 1996, when the first report on *The State of the World's Plant Genetic Resources for Food and Agriculture* was produced by FAO, as well as the gaps and needs that remain for setting future priorities. The SoWPGR-2 provides the basis for the updating of the *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture* (GPA).

The synthetic account is a snapshot of the main changes and urgent needs in managing, safeguarding and using PGRFA, as well as in the area of national and international collaboration, to further increase PGRFA contribution to global food security.

Coverage of the SoWPGR-2

- **Current status of plant diversity, how it is being preserved and used;**
- **Main achievements at the global, regional and national level;**
- **Key technical and scientific advances;**
- **Major gaps and needs that require urgent attention.**

Core Messages from the SoWPGR-2

The SoWPGR-2 identifies the significant achievements in conservation and use of plant genetic diversity during the past decade and highlights the critical gaps and emerging challenges in this area. It underlines the fact that PGRFA are even more important today than in the past in face of the demands on agriculture to produce more food of higher quality while preserving the natural resource base.

The core messages are as follows:

- ***PGRFA are essential raw materials for helping farmers respond to climate change.*** **Plant breeding capacity needs to be strengthened and breeding programmes must be expanded to develop varieties with traits needed to meet this challenge.**
- ***Loss of PGRFA has reduced options for the agricultural sector.*** **The major causes of genetic erosion are land clearing, population pressures, overgrazing, environmental degradation and changing agricultural practices.**
- ***Local PGRFA diversity found in farmers' fields or*** **in situ** ***is still largely inadequately documented and managed.*** **There is now a growing awareness of the importance of this diversity and its contribution to local food security.**
- ***There has been progress in securing PGRFA diversity in a larger number of national genebanks.*** **However, much of the diversity, particularly of crop wild relatives (CWR) and underused species relevant for food and agriculture, still needs to be secured for present and future use.**
- ***Rapid scientific advances, especially in information technology and molecular biology, have introduced new techniques for PGRFA conservation and use.*** **Their wider application offers new opportunities to increase efficiency of the conservation–production chain.**
- ***Significant policy developments have changed the landscape of PGRFA management.*** **Many more countries have adopted national programmes, laws and regulations for biodiversity following the adoption of the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).**
- ***Better communication, collaboration and partnerships are needed among institutions dealing with PGRFA management – from conservation to plant breeding and seed systems.*** **These are the key factors for an integrated conservation and utilization strategy and delivering sustainable solutions to build a world without hunger.**

Managing Local PGRFA Diversity

Farmers usually grow traditional crops and local varieties of fruits and vegetables for cultural reasons, food preference, risk avoidance, local adaptation, and niche market opportunities or simply because of the lack of a better alternative.

Much important plant diversity can be found in farmers' fields or even in unmanaged agricultural ecosystems. However rapid urbanization has a growing impact on the state of diversity.

The SoWPGR-2 reviews the current state of knowledge regarding the amount and distribution of landraces, CWR and other useful plants and assesses the ongoing efforts to conserve and manage them *in situ* in their natural surroundings. It indicates that more attention is now being paid to using such crop diversity within production systems as a way to reduce risk, particularly in light of changes in climate, pests and diseases. Countries report a greater understanding of the amount and distribution of genetic diversity on-farm, and of the role of the 'informal' seed systems in maintaining such diversity.

Main changes so far

- **National and international efforts have increased in this area: protected areas have expanded by 30% leading to an increase in the conservation of CWR.**
- **The use of diversity in production systems for food security and as a risk-reduction strategy has improved.**
- **The socio-economic factors that encourage farmers to maintain plant diversity on their farms are better understood.**
- **The science behind *in situ* conservation has advanced, with the development of protocols and tools to assess and monitor PGRFA within agricultural production systems.**

The importance of crop wild relatives (CWR)

The SoWPGR-2 reports that there is a greater awareness of the importance and value of CWR and of the need to conserve them *in situ* (see Box 1). The number and coverage of protected areas has expanded, which has indirectly led to a greater protection of CWR. The International Union for Conservation of Nature has developed a Draft Global Strategy for CWR Conservation and Use, and there is a call for the creation of a network on CWR genetic reserves.

In situ conservation needs more attention

Many countries report that they have carried out surveys and inventories of agricultural biodiversity in natural or agricultural ecosystems and that new legal mechanisms enabling farmers to market genetically diverse varieties have been established. In some countries, marketing of geographically identified products provides additional incentives for farmers to conserve and use local crop genetic diversity. For example, the European Commission

Box 1
Conservation of CWR in protected areas: some examples

- **In Ethiopia, wild populations of *C. arabica* are being conserved in the montane rainforest.**
- **The Sierra de Manantlan Reserve in Southwest Mexico has been established specifically for the conservation of the endemic perennial wild relative of maize, *Zea mays*.**
- **The Erebuni Reserve has been established in Armenia to conserve populations of cereal wild relatives (for example *Triticum araraticum, T. boeoticum, T. urartu, Secale vavilovii, S. montanum, Hordeum spontaneum, H. bulbosum* and *H. glaucum*).**

adopted a directive (2008/62/EC) in 2008 to "protect seed varieties of agricultural crops, which may be threatened by genetic erosion," and enable small plant breeding companies to supply local markets with naturally adapted seed varieties.

However, much more needs to be done with respect to systematic inventorying and surveying of PGRFA *in situ*. There is lack of funding, human resources, knowledge and coordination and a low national priority given to this area. There is a widespread degradation of rangelands and little progress in conserving wild PGRFA outside of protected areas or in developing sustainable management techniques for plants harvested from the wild. There are few specific strategies for conserving PGRFA *in situ* or for managing crop diversity on-farm with the involvement of local communities. Effective policies, farmer incentives and a closer coordination between the agriculture and environment sectors are urgently needed to comprehensively assess the threats to *in situ* conservation of PGRFA and take action for their mitigation.

What needs to be done

- **Adopt clear policies and regulations to promote *in situ* and on-farm management of PGRFA and increase consumer demand for local produce.**
- **Expand inventories of PGRFA to cover more crops and species.**
- **Develop better indicators and methodologies to assess conservation status and threats.**
- **Increase efforts to stop widespread degradation of rangelands in establishing protected areas that cover important PGRFA and CWR.**
- **Enhance coordination between agencies dealing with agriculture and the environment to ensure conservation of PGRFA.**

Safeguarding PGRFA

For many years, plant diversity in the form of seeds, bulbs or tubers has been collected and conserved in genebanks and in botanic gardens around the world.

There has been a lot of progress in this area and the SoWPGR-2 documents the trends and efforts in *ex situ* conservation of PGRFA – from samples or 'accessions' of wild species, landraces, old varieties, advanced varieties and research materials, including breeding lines.

New efforts for *ex situ* conservation

The SoWPGR-2 reports on two new initiatives by FAO with CGIAR centres and member countries:

- The Global Crop Diversity Trust (GCDT) that was established in 2004 as an endowment fund with the objective of providing a permanent source of funds to support the long-term conservation of PGRFA.
- The Svalbard Global Seed Vault that was established in 2008 by Norway. Nicknamed the Doomsday Vault by the media, it provides the ultimate global security backup collection of crop diversity. At present it holds over 400 000 accessions collected from all around the world.

The SoWPGR-2 also reports on the progress made in broadening the range of crops conserved in genebanks around the world. National genebanks conserve about 6.6 million of the total 7.4 million accessions held worldwide, 45% of which are held in only seven countries, down from 12 countries in 1996. Recent collecting efforts have focused on increasing national genebanks' collections of minor crops, landraces, wild species and obsolete varieties. For instance, since 1996, Ghana has collected some 9 000 new accessions of legumes, maize, roots and tubers, and fruits and nuts, while Iran has doubled its holdings in its national genebank.

Main changes so far

- **The total number of accessions in collections held in genebanks worldwide has increased by approximately 20% since 1996, reaching 7.4 million. It is estimated that only about 25–30% of these are distinct accessions, the remainder being duplicates.**
- **Since 1996 at least 240 000 new plant materials have been collected and added to *ex situ* genebanks.**
- **Both the number and size of genebanks have increased. There are some 1 750 individual genebanks worldwide, with about 130 of them each holding more than 10 000 accessions (Figure 1).**
- **The number of botanical gardens has increased from about 1 500 to more than 2 500. These gardens are important repositories of crop wild relatives.**

Genebank collections still at risk

Although many of the accessions held in genebanks are duplicates, not all collections are systematically duplicated, and those that are not are at risk of losing unique accessions due to technical failures, disease

Figure 1. Geographic distribution of gene banks with holdings of >10 000 accessions in national and regional gene banks (blue); CGIAR centre gene banks (beige); Svalbard Global Seed Vault (green)

Source: WIEWS 2009; Country reports; USDA-GRIN 2009

or any of a host of possible calamities. Coverage of crops is also uneven. For some, such as wheat and rice, much of the genetic diversity is already represented in collections, but for many others there are still large gaps. Indeed, many useful plant species are found only in the wild or as landraces in farmers' fields. Much more needs to be done to rationalize genebank collections.

There is great concern regarding the lack of regeneration of aging stocks of accessions and the paucity of documentation, including characterization and evaluation data in many genebanks. Many countries report shortages of funding and skilled staff to operate their genebanks. Lack of data standardization means that sharing of data with other users is difficult, if not impossible. The GCDT is funding regeneration and documentation efforts, but greater efforts are needed to build a truly rational global system of *ex situ* collections. This will require policy vision, trust and technical cooperation among all members engaged in this cause.

What needs to be done

- **Promote the use of PGRFA stored in genebanks, by strengthening the linkages between genebank managers and plant breeders.**
- **Rationalize genebank collections. Increase regeneration of aging accessions and systemic duplications to avoid gradual or unwanted losses of PGRFA collections.**
- **Increase informative documentation, characterization and evaluation of the genebank material. Adopt new tools, such as geographic information systems and molecular techniques within national PGRFA programmes.**
- **Target collecting missions – especially for underutilized species, minor crops and CWR – to be better prepared in the face of rapidly changing climate.**
- **Strengthen linkages between *ex situ* and *in situ* conservation through increased communication amongst the stakeholders.**

Increasing the Use of PGRFA

According to FAO, agricultural production, and in particular crop production, will need to increase substantially in order to meet the needs of a population that is projected to grow by some 40% over the period from 2005 to 2050.

An additional one billion tonnes of cereals will be needed annually by 2050. Crop improvement by plant breeding combined with effective seed delivery systems is still the most important way to use plant genetic diversity for food security.

The SoWPGR-2 shows that progress in this area has been very variable so far. Most breeding programmes continue to focus on a handful of staples, and target yield as their major goal. Biotechnology has advanced rapidly and is increasingly used in plant breeding. There is a greater use of wild species and landraces for crop improvement as well as a greater involvement of the farming community in breeding programmes. Many countries are also beginning to support some form of public-private plant breeding system and formulating national policies accordingly (Figure 2).

Main changes so far

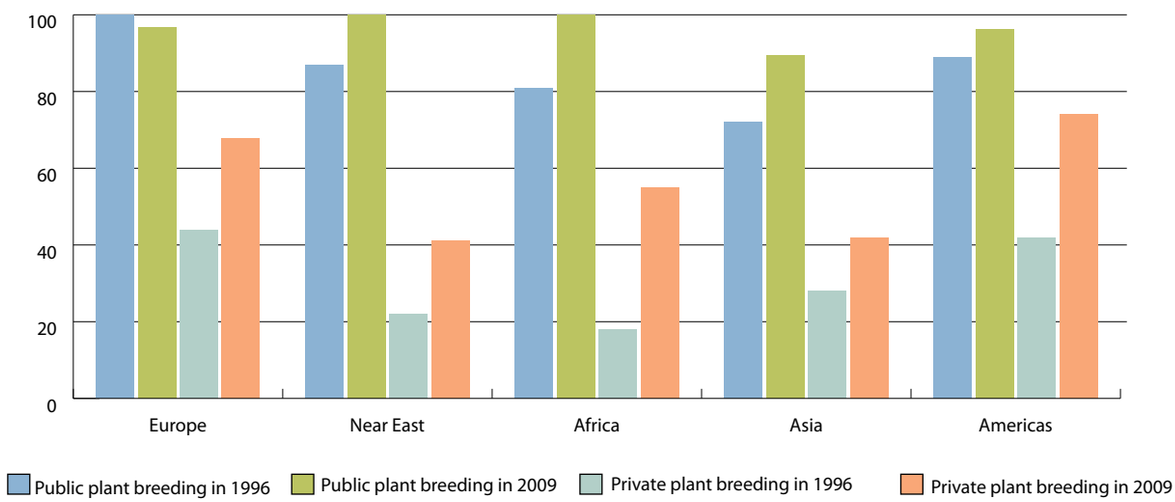
- **The application of plant biotechnologies has increased in plant breeding programmes.**
- **Involvement of farmers in breeding programmes has generally expanded.**
- **CWR are being increasingly used in cereal breeding programmes.**
- **New initiatives have been launched to promote sustainable use of PGRFA including The Global Partnership Initiative for Plant Breeding Capacity Building (GIPB), the Generation and Harvest Plus Challenge Programs and Crops for the Future.**
- **New crop varieties are being bred to address the changing needs with respect to dietary diversity, biofuel and climate change.**

Plant breeding needs a boost

As the SoWPGR-2 points out, plant breeding capacity globally has not changed significantly since 1996. Public organisations are still the single largest source of plant germplasm used by breeders in national programmes (Figure 3). Some countries report a modest increase in the number of plant breeders but others report a steep decline. Public sector plant breeding has continued to shrink, and in some cases the private sector is taking over. This has implications for smallholder subsistence farmers – the private sector largely focuses on only a few crops for which farmers buy seeds each season and often these are not the crops that are the basis of food security in most developing countries.

The key challenges include a lack of skilled human resources, funds and facilities combined with limited information on the PGRFA collections in genebanks

Figure 2. Percentage of countries that reported the existence of public and private breeding programmes in the first and second SoW reports



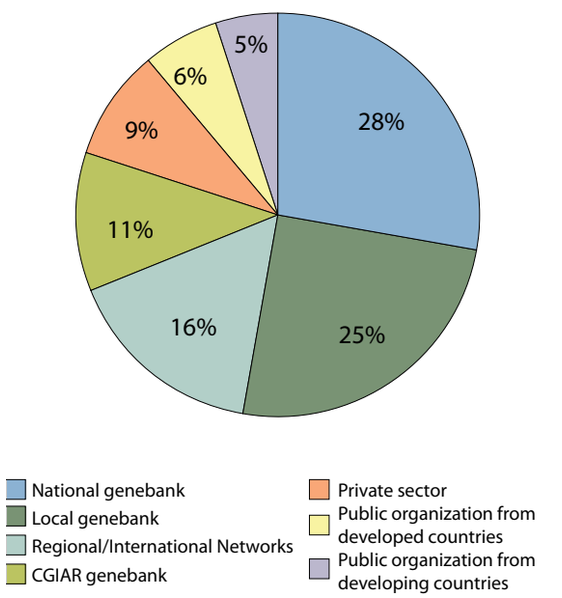
Source: Data from a set of similar countries that presented country reports for both the first and second SoW reports, complemented with information from the GIPB-PBBC database (available at: http://km.fao.org/gipb/pbbc/).

and poor cooperation and linkages between curators, researchers, breeders, and farmers. Given the time needed to breed new crops and make them available to farmers, it is essential that national plant breeding capacities are increased right now and breeding programmes expanded in developing countries.

Effective seed systems are a must

Progress in seed sector development varies greatly. The international seed trade has substantially increased, dominated by five companies that account for over 30% of the global market. The market for transgenic seeds has also grown dramatically, increasing from US$280 million in 1996 to US$7 billion in 2007. At the same time, in parallel with plant breeding, investment by the public sector in seed production has decreased significantly. For farmers in many countries, access to improved varieties and quality seeds is critically limited. While there is some recognition of the role of informal seed systems in maintaining agricultural biodiversity and in improving farmers' access to seeds, more efforts are required to boost local seed production, improve access to quality seeds and develop small-scale seed enterprises. Moreover, plant breeding and seed production are most often isolated from each other. Sustainable use of PGRFA can only be realized through full coordination between crop research, seed production and effective delivery systems that ensure that farmers obtain adequate quality seeds in a timely manner.

Figure 3. Sources of PGRFA used by breeders working in national breeding programmes



Source: NISM 2008 (available at: www.pgrfa.org/gpa). The figures are based on the response of 268 breeders from 39 developing countries to a question on the origin of the PGRFA used in their breeding programmes.

What needs to be done

- **Increase plant breeding capacity worldwide.**
- **Characterize and evaluate genebank collections to make the data more accessible to plant breeders.**
- **Mainstream new biotechnologies for plant breeding and characterization of plant diversity collections.**
- **Increase the use of underutilized crops and CWR in breeding programmes. Establish effective and functional seed systems for farmers' access to quality seeds and markets.**
- **Increase capacities for information exchange and implementation of seed policies and legislation in developing countries.**
- **Promote awareness among policy-makers, donors and others on the necessity of forging strong linkages between plant breeding and seed systems for increasing food production.**

Strong Collaboration Builds Stronger Programmes

National programmes are the foundation of global efforts to conserve and use PGRFA. The SoWPGR-2 reports that the number of national PGRFA programmes has increased significantly, in large part due to the adoption of the GPA.

These programmes are largely led by government institutions and involve various stakeholders including private-sector companies, NGOs, farmers' organizations and educational institutions. Universities are also playing their part by offering higher-degree training in conservation and use of PGRFA. Still, certain elements – such as publicly accessible databases on PGRFA or public awareness initiatives – are missing even in well organized national programmes. Many countries also report that funding is inadequate for these programmes.

Overall, most countries have enacted or revised national legislation dealing with PGRFA issues including breeders' rights, biosafety, intellectual property rights, phytosanitary aspects, seed systems, access and benefit sharing, and Farmers' Rights. There are ongoing efforts to harmonize seed laws across regions, particularly in Africa and Europe. At the international level, the entry into force of the ITPGRFA in 2004 to promote conservation and sustainable use of PGRFA and the fair and equitable sharing of the benefits arising out of their use, is probably the most significant development.

The SoWPGR-2 also reports on the strong and extensive international cooperation that plays a vital role in promoting conservation, exchange and use of PGRFA across national and regional boundaries. Major initiatives like the GCDT and the Global Forum on Agricultural Research, as well as networks such as crop-specific networks on cacao, coffee, bamboo, and rice genomics, and on seed production, have been established. However, most existing networks suffer from a shortage of operating funds.

Main changes so far

- **Number of national PGRFA programmes has increased with a greater engagement of stakeholders.**
- **Most countries have adopted or revised legislation dealing with PGRFA and seed systems.**
- **ITPGRFA entered into force in 2004 and has been ratified by some 125 countries.**
- **Several new initiatives, networks and foundations have been established to coordinate agricultural research and to support activities in PGRFA.**

Fostering institutional linkages

Many countries have expressed the need for assistance – both advice and capacity building – in implementing the ITPGRFA and its Multilateral System for Access and Benefit Sharing (see Box 2). Assistance is also needed in ensuring a proper interface between the ITPGRFA and the CBD. Clearly, greater collaboration is needed at all levels,

between donors, policy-makers and farmers, and, within countries, between the public and private sectors, to enable the PGRFA community to fully contribute to sustainable development and food security. However, strong and fully effective institutional links between national genebanks, plant breeders and farmers are comparatively rare, especially in developing countries. There is a need for strengthening the linkages among all relevant institutions dealing with PGRFA and food security at the global, regional, national, and local levels.

Box 2
The Multilateral System of Access and Benefit-sharing of the ITPGRFA

The ITPGRFA's truly innovative solution to access and benefit-sharing is its declaration that 64 of our most important crops - crops that together account for 80 percent of all human consumption - will comprise a pool of genetic resources that are accessible to everyone.

On ratifying the ITPGRFA, countries agree to make their genetic diversity and related information about the crops stored in their gene banks available to all.

This gives scientific institutions and private sector plant breeders the opportunity to work with, and potentially to improve, the materials stored in gene banks or even crops growing in fields. By facilitating research, innovation and exchange of information without restrictions, this cuts down on the costly and time consuming need for breeders to negotiate contracts with individual gene banks.

The Multilateral System sets up opportunities for developed countries with technical know-how to use their laboratories to build on what the farmers in developing countries have accomplished in their fields.

What needs to be done

- **Develop national integrated strategies for the PGRFA management. Strengthen linkages between stakeholders involved in conservation, genetic improvement and seed production and distribution.**
- **Develop reliable measures and indicators to monitor and assess the contribution of PGRFA to food security and sustainable development.**
- **Increase training and educational opportunities to strengthen national programmes, especially in legal and policy issues.**
- **Assist developing countries in implementing the policies, regulations and legislation on PGRFA through financial and technical support.**
- **Improve coordination among funders to ensure long-term financial support for PGRFA activities.**

The Road Ahead

The SoWPGR-2 report demonstrates the value of PGRFA as a strategic resource for sustainable development, alleviation of hunger and poverty, and as an insurance against environmental calamities.

Though food production on the global scale is derived from very few major crops, at the local and regional level a great many more crops and other plants are critically important for food, forage, industrial uses, and cultural practices. Nations are already interdependent with regards to PGRFA – now more than ever, greater access to PGRFA is needed to tackle the myriad crop production challenges.

Therefore, the report emphasizes the vital role of sound PGRFA management in strengthening national food security and improving livelihoods. While some good progress has been made within the PGRFA conservation and use chain, the report shows that this is no time to rest on our laurels. Climate change and growing food insecurity are major challenges to the world's agricultural systems – challenges that can only be addressed through greater use of PGRFA.

Countries have emphasized that much still remains to be done to promote a comprehensive, rational system for conservation and use of PGRFA, both in technical and policy areas. There is a need for more accurate standards and indicators to measure and monitor the specific contributions of PGRFA, as a key component of biodiversity, to food security. This will require redoubling of efforts both to raise awareness and understanding among policy makers and the general public of the enormous cumulative contribution of PGRFA to global food security and agriculture and to generate the necessary resources to support them.

"While genetic diversity represents a 'treasure chest' of potentially valuable traits…, it is under threat and special efforts are needed to conserve it both *in situ* and *ex situ*, as well as to develop a strong capacity to use it, especially in the developing world".

FAO. 2010. *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture.* Chap. 8, The Contribution of PGRFA to Food Security and Sustainable Agricultural Development. pp.184–185. FAO. Rome, Italy.

The Food and Agriculture Organization of the United Nations (FAO) leads international efforts to defeat hunger. Achieving food security for all is at the heart of FAO's efforts - to make sure people have regular access to enough high-quality food to lead active, healthy lives. FAO's mandate is to raise levels of nutrition, improve agricultural productivity, better the lives of rural populations and contribute to the growth of the world economy.

Biodiversity for food and agriculture is among the earth's most important resources to ensure food security. The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA), established in 1983, is a permanent forum where governments discuss and negotiate matters relevant to biodiversity for food and agriculture. The main objectives of the CGRFA are to ensure the conservation and sustainable utilization of genetic resources for food and agriculture, as well as the fair and equitable sharing of benefits derived from their use, for present and future generations.

The Seeds and Plant Genetic Resources team of FAO's Plant Production and Protection Division (AGP) assists Member Countries in developing effective policies and capacities for an integrated approach to conservation and sustainable use of plant genetic resources for food and agriculture including seed systems, for increasing crop production and achieving food security.

FOR FURTHER INFORMATION ON:

- FAO, please visit: www.fao.org/
- CGRFA, please visit: www.fao.org/nr/cgrfa/en/
- AGP, please visit: www.fao.org/agriculture/crops/agp-home/en/