CLIMATE CHANGE AND GENETIC RESOURCES

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SUMMARY

Genetic resources for food and agriculture (GRFA) are the pillar of food security and provide the building blocks for farmers, breeders and biotechnologists to develop new plant varieties and animal breeds necessary to cope with unpredictable human needs and changing environmental conditions. The challenges we face with GRFA owing to climatic changes are two-fold: First, climate change will accelerate genetic erosion and create a critical need to collect and conserve endangered GRFA and wild relatives before is too late. Secondly, greater use of GRFA will become vital in the development of varieties able to adapt to new and unstable environmental conditions; that is to withstand conditions that are not only hotter or drier but also more variable. This will require new and innovative breeding approaches. It will also drastically increase countries' dependency on foreign GRFA and therefore the need for international cooperation. In addition, it should be noted that the use of diverse crops and diverse systems will allow farmers to adapt and to meet their needs more rapidly than through specific scientific breeding programmes. The presentation will discuss technical, socio-economic, legal and political action needed to face these challenges.

Introduction

Genetic resources are considered the storehouse which provides humanity with food, clothes and medicines. They are essential for sustainable agriculture and food security. Selection is only possible in the presence of diversity. Genetic diversity or Genetic resources for food and agriculture (GRFA) provides the building blocks for farmers, breeders and biotechnologists to develop new plant varieties and animal breeds necessary to cope with unpredictable human needs and changing environmental conditions, including those due to climate change.

The challenges we face with GRFA owing to climatic changes are two-fold: Firstly, climate change will accelerate genetic erosion and create a critical need to collect and conserve endangered GRFA and wild relatives before is too late. Secondly, greater use of GRFA will become vital in the development of varieties able to adapt to new and unstable environmental conditions, able to buffer and eventually overcome the negative effect of climate change in agriculture development and food production. In addition and because of the interdependency of countries on matters related to the GRFA, international cooperation becomes crucial. There are also important institutional and legal challenges.

Threat of Climate Change to GRFA

All the projected scenarios of the Intergovernmental Panel on Climate Change (IPCC) (www.ipcc.ch) will have major consequences for the geographic distribution of agriculture species, including crops, individual varieties and crop wild relatives. Some studies have used

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current and projected climate data to predict the impact of climate change on areas suitable for a number of staple and cash crops[2]. Jarvis *et al*. (2008)[3], focusing on three important crop genera such as *Arachis*, *Solanum*, and *Vigna,* predicts that 16–22 % of species in these genera will go extinct before 2055 and calls for immediate action to preserve crop wild relatives *in situ.* The intergovernmental Commission on Genetic Resources for Food and Agriculture has recently commissioned a report on the "Establishment of a global network for the *in situ* conservation of crop wild relatives: status and needs"[4]. This report identified conservation priorities and suggested reserve locations for 14 selected crops.

GRFA to face the effect of Climate Change in Agriculture

Undoubtedly a major **scientific and technical challenge** is the development of plant varieties and animal races adapted to changing climate conditions. Although there is substantial variation in agriculture species to cope with a wide range of conditions, we need to note the following:

a) The magnitude of change will require significant adaptation.

b) New genetic diversity, within and between species, is likely to be needed. This will increase the potential of underutilized crops and other promising species.

c) Novel and unstable production environments would require different breeding approaches.

d) There is an increasing need for adaptability and resilience, properties that to date have not been embedded in traditional breeding.

All of these will **require research not only on the diversity itself but on how it can be most effectively deployed to maintain productivity. There will also be research needed on how genetic resources can be used to support mitigation strategies**.

It needs to be emphasized that in all these areas it is not a simple question of finding specific traits from a pool of diverse materials. The research needs to be concerned with functional diversity and with diversity deployment in agricultural systems from farm fields to landscape, watershed and regional scales. The way in which diversity functions in different kinds of production systems including organic agriculture, conservation agriculture and the like, is also a relevant entry point

Neglected crops to face climatic changes

In addition many crops that are neglected today, as well as wild species are expected to play a critical role not only to face climate change, but also in food, medicine and energy production

[2] Fischer, G. *et al*. 2002. Impacts of climate on agro-ecology. Chapter 3 in "Climate Change and Agricultural Vulnerability". Report by the International Institute for Applied Systems Analysis. Contribution to the World Summit on Sustainable Development, Johannesburg, 2002.
[3] Jarvis, A. *et al.* 2008. The effect of climate change on crop wild relatives. Agriculture, Ecosystems and Environment, 126 (1) 13-23.
[4] Maxted, N. & Kell, S.P. 2009. Establishment of a Global Network for the In Situ Conservation of Crop Wild Relatives: Status and Needs. FAO Commission on Genetic Resources for Food and Agriculture, Rome, Italy. 266 pp.<http://www.fao.org/nr/cgrfa/cgrfa-back/en/?no_cache=1>

in the near future. The FAO first report on the State of the World on Plant Genetic Resources estimates that some 7 000 species have been used by mankind to satisfy human basic needs, whereas today no more than 30 cultivated species provide 90 % of human caloric food supplied by plants[5]. Furthermore, 12 plant species and 5 animal species alone provide more than 70 % of all human caloric food and just 4 plant species (potatoes, rice, maize and wheat) and 3 animal species (cattle, swine and chickens) provide more than half.

International cooperation: legal and institutional challenges

There are also legal and institutional challenges[6], as well as a need to promote international cooperation, to ensure conservation and continuous access to GRFA especially though the implementation of the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA), and the development of the FAO Multi-year Programme of Work (MYPOW) in other sectors of GRFA.

No country is self-sufficient in terms of genetic resources[7]. Geographical and intergenerational dependency on genetic resources for food and agriculture is very high and access to them continues to be a prerequisite for effective agricultural research and breeding. The European countries are amongst the most depending ones on foreign genetic resources. Climate change will greatly increase the level of interdependency among countries, and international cooperation is therefore a must (see Box 1).

The negotiation by country and wide ratification of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)[8] at the beginning of the century has been a significant achievement and a hope for the conservation, sustainable use, and continuous availability of Plant Genetic Resources (see Box 2). However many efforts are still needed, including efforts to fully implement the Treaty both at national and international levels.

For sectors other than plants, such as farming animals, forests, fisheries and microbial genetic resources for food and agriculture, the MYPOW[9] and its road map as negotiated and agreed by the representatives of the agricultural sector of all member countries in FAO through its intergovernmental Commission on Genetic Resources for Food and Agriculture, needs to be timely implemented.

Taking into consideration the urgent imperative to face climate change, it may be needed to review relevant provisions of international legal agreements to render operational the potential of plant genetic resources to feed the human beings in a changing and challenging socio-

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[5] FAO (1998).The state of the world's plant genetic resources for food and agriculture. [online], http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPS/Pgrfa/pdf/swrfull.pdf

[6] Esquinas-Alcázar, J.T. 2005. Protecting crop genetic diversity for food security: political, ethical and technical challenges. (Nature Reviews, Genetics. Vol. 6, December, 2005) (946-953).

[7] Flores Palacios, X. (1998). Contribution to the estimation of countries' interdependence in the area of plant genetic resources. CGRFA Background Study Paper No. 7 Rev. 1 < ftp://ftp.fao.org/docrep/fao/meeting/015/j0747e.pdf >.

[8] FAO (2001). International Treaty for Plant Genetic Resources for Food and Agriculture. FAO Conference, Rome, < http://www.planttreaty.org>.

[9] FAO. 2007. Report of the Commission on Genetic Resources for Food and Agriculture, 11th Regular Session, 11-15 June, 2007, Rome, Italy. CGRFA-11/07/Report. <http://www.fao.org/nr/cgrfa/cgrfa-meetings/cgrfa-comm/eleventh-reg/en/>

economic environment. Below there are four suggestions of legal agreements that could be reviewed.

- **The International Treaty of Plant Genetic Resources for Food and Agriculture**: the species coverage of the Multilateral System for access and benefit sharing should be broadened to include diversity necessary to cope with climate change

- **The Convention of Biological Diversity:** especially in the context of the ongoing negotiations of its International Regime on Access and Benefit Sharing.

- **The agreements dealing with intellectual property rights, such as the UPOV and the WTO (especially the TRIPs)**: to avoid legal obstacles to the development and trade of plant varieties with needed adaptability and resilience to cope with climate change. This would imply reducing the degree of uniformity and stability currently required for the commercialization of new varieties. For instance, the current UPOV provisions on Distinctness, Uniformity and Stability (DUS) might not be adequate.

- **The Convention on Climate Change:** to ensure a more proactive action to reduce the lost of genetic diversity due to climatic events, and to promote universal access and use of this diversity to buffer the effect of climate change in food production and agriculture.

Conclusion

To deal with climate changes in a global and interdependent world is not only a tremendous challenge, but also a unique opportunity to build up an equitable and sustainable world in harmony with the environment. This is not just an alternative but a must for the survival of our own species. Our generation is the first one forced to deal with this responsibility, but could also be the last.

Box 1: The International Treaty on Plant Genetic Resources for Food and Agriculture

The Treaty provides a bridge between agriculture, commerce and the preservation of the environment, and is the result of 23 years of debate, including 7 years of formal negotiations among UN Member Nations in FAO. This process also involved participation by representatives from non-governmental institutions and the private sector.

The Treaty became operational with the first meeting of its Governing Body in Madrid in June 2006. Its objectives are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits that arise from their use. The core of the treaty is its innovative Multilateral System of Access and Benefit-sharing, which ensures continuous availability of important genetic resources for research and plant breeding, while providing for the equitable sharing of benefits, including monetary benefits that are derived from commercialization. Another innovative feature is its provisions for farmers' rights. The ITPGRFA relies on several supporting components that were previously developed by the CGRFA, in particular the Global Plan of Action, the Global Information System, international networks, and terms and conditions for the conservation of and access to *ex situ* collections that are maintained by the International Agricultural Research Centers (IARCs).

An essential element for its funding strategy is the *Global Crop Diversity Trust* (http://www.croptrust.org/main/). This was established under international law as an independent organization in October 2004. It was constructed largely as an endowment fund, with a target of USD$-260 millions. As per June 2009, USD-$ 152 millions have been pledged out which USD-$ 124 millions have already been paid, with contributions coming from both public and private sources. The Trust is being used to ensure financial sustainability for the conservation of the world's most important crop diversity *ex situ* collections, as a 'genetic pantry' for mankind.

The Treaty has already been ratified by 121 countries. Only from August 2007 to July 2008 in more than 440.000 accessions from the Multilateral System have been sent to possible users through the Standard Material Transfer Agreement agreed by Contracting Countries, which represents more than 8 500 per week.

The Third Session of the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) took place from 1-5 June 2009, in Tunis, Tunisia. Delegates agreed to: a set of outcomes for implementation of the funding strategy, including a financial target of USD-$ 116 million for the period July 2009 to December 2014; a resolution on the implementation of the Treaty's Multilateral System including the setting up of an intersessional advisory committee on implementation issues; a resolution on farmers' rights; and procedures for the Third Party Beneficiary. They also adopted the work programme and budget for the next biennium, established intersessional processes to finalize compliance procedures by the Fourth Session, and review the Standard Material Transfer Agreement. The Fourth Session of the Governing Body is scheduled to be held in the in 2011, in Indonesia (ftp://ftp.fao.org/ag/agp/planttreaty/gb3/gb3repe.pdf).

Society benefits from the Treaty in different ways: consumers benefit because of a greater variety of foods and agricultural products, as well as increased food security; the scientific community benefits through access to the plant genetic resources that are crucial for research and plant breeding; IARCs benefit because their collections have been put on a safe and long-term legal footing by the Treaty; and both the public and private sectors benefit because they are assured facilitated access to a wide range of genetic diversity for agricultural development.

Box 2: Estimated range of dependency (%) for each EURAGRI member country from genetic resources from elsewhere[10]

EURAGRI Member Countries	Minimum (%)	Maximum (%)
AUSTRIA	80.94	97.54
BELGIUM/LUSEMBOURG	82.26	97.73
BULGARIA	88.17	99.36
CYPRUS	78.93	90.19
CZECH REPUBLIC	87.87	97.40
DENMARK	81.18	91.96
ESTONIA	86.66	95.13
FINLAND	88.96	98.99
FRANCE	75.55	90.67
GERMANY	83.36	98.46
GREECE	54.24	68.94
HUNGARY	86.85	98.04
IRELAND	84.59	99.45
ITALY	70.82	81.21
LATVIA	81.15	90.42
LITHUANIA	91.66	97.87
MALTA	84.35	98.15
NETHERLANDS	87.94	98.49
NORWAY	90.67	98.94
POLAND	90.06	99.32
PORTUGAL	78.86	90.88
ROMANIA	90.34	99.44
SLOVAK REPUBLIC	85.10	96.60
SLOVENIA	89.99	98.81
SPAIN	71.41	84.84
SWEDEN	88.79	98.70
SWITZERLAND	81.79	98.43
UNITED KINGDOM	89.23	99.10
AVERAGE	**83.27**	**94.82**

[10] Based on the study by X. Flores Palacios (ftp://extftp.fao.org/ag/cgrfa/BSP/bsp7E.pdf). The table shows countries' degree of dependency on crop genetic resources which have their primary centre of diversity elsewhere. The indicator used is the food energy supply in the national diet provided by individual crops. On the basis of the primary area of diversity of each crop, it has been calculated the estimated dependency that has maximum and minimum indices, showing there is a high rate of dependency by practically all cases.