EIP-AGRI Focus Group

Genetic resources

STARTING PAPER
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1. Introduction

Agricultural genetic resources have an enormous contribution to make in addressing the food and nutrition security, while ensuring resilience of the production systems, and in coping with the impacts of climate change in the future. Face to an important loss of agricultural genetic diversity and variability due to modern agricultural practices (use of mainstream varieties and breeds) there is the need to reverse this trend.

The main (direct and indirect) stakeholders involved in genetic resources-related topics include public and private breeders and researchers, conservationists (genebank, *ex-situ* collection curators and *in-situ* conservation managers,...), farmers, farmers associations, seed industries, agro-food industries, retailers, consumers, policy makers (food and agriculture, economic development, environment), international organisations, non-governmental organisations. These stakeholders are involved at different levels and with different roles and interests in conservation and sustainable use of genetic resources. To some extent, interactions and co-operation between two or more of these categories of stakeholders are already established and operating.

The purpose of this discussion paper is to serve as an input to the first meeting of the EIP Focus Group on Genetic Resources, whose main task is to analyse existing co-operation models. As mentioned above, many stakeholders have potential interests in agricultural genetic resources. The work of the Focus Group will target co-operation models at the "first level" of users (seed- and cryo-banks, research institutes, seeds companies, breeding firms, informal sector, farmers, ...) so as to identify the bottlenecks that limit co-operation as well as the (available) means and factors that (would) make it successful. Effective co-operation would allow enlarging the genetic basis of breeds and crops present in the agricultural landscapes of the Union via newly developed seeds and breeds or via the (re)introduction of traditional breeds and crops in the value chain by making them commercially viable. Cross-cutting issues (*i.a.,* economic and legal aspects) will also be considered as factors influencing or impacting this co-operation.

The discussion paper and the results of the survey conducted among the Focus Group members provide the starting points and key questions for discussion at the first Focus Group meeting.

2. General considerations on conservation of genetic resources

2.1 Plant genetic resources

Plant genetic resources (PGR) are conventionally conserved as seeds in seed banks under low temperature and moisture content. Today, some 1750 gene banks maintain as a whole 7.5 million of germplasm samples (2.5 million in Europe only) mostly major crops. There is however a high level of duplication within these collections estimated to be around 70%. Moreover, not all seeds are amenable to drying and conservation at low temperatures. Such recalcitrant seed-bearing crops are conserved by other conservation techniques, such as *in vitro* techniques and cryopreservation, when

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protocols are available; otherwise they are simply conserved as live plants in field collections or field genebanks.

2.2 Animal genetic resources

In the case of animal genetic resources (AnGR), *ex-situ* conservation involves *in vitro* conservation and/or cryopreservation of gametes, embryos or somatic cells in liquid nitrogen. However the costs to collect, cryopreserve and reconstitute animal germplasm are much higher than for crops and consequently conservation has mostly focused on *in-situ* conservation approaches (FAO, 2007). However, *in-situ* conservation is mainly limited by the low number of breeds and individuals that farmers are willing to maintain.

It is commonly agreed that *ex-situ* conservation activities have to be complemented by *in-situ* conservation because the dynamic way by which conservation takes place in the field favours adaptation. Consequently, on-farm management of genetic resources and *in-situ* conservation in natural habitats (especially for wild relatives) are important components of the genetic resources conservation strategy.

One of the key advantage of *ex-situ* collections is the accessibility of the genetic resources materials by users of germplasm, especially breeders and others scientists. At the same time, collections facilitate the distribution of materials to users, including farmers.

2.3 *Ex-situ* conservation

The principal aim of *ex-situ* conservation is to maintain seeds and other germplasm materials alive as long as possible and to reduce the frequency of regeneration that may cause the loss of genetic diversity. Despite the fact that technologies for *ex-situ* conservation are well developed, there are still some key research challenges that include:

- Variability in seed longevity for different species, including crop wild relatives and neglected and underutilised species being conserved under similar conditions;
- Vulnerability of field genebanks to pests and diseases, natural disasters, political unrest, extreme weather, fire, vandalism and theft;
- Risks of somaclonal variation (variation seen in plants that have been produced by plant tissue culture) in *in-vitro* conservation (slow growth method);
- Understanding the underlying mechanisms of desiccation tolerance and the desiccation sensitivity of recalcitrant seeds (seeds that do not survive drying and freezing during *ex-situ* conservation);
- Development of commonly agreed cryopreservation protocols for genetic resources;
- Best practices for DNA storage facility and their management

2.4 On-farm conservation

On-farm conservation/management involves the maintenance of traditional varieties and breeds on-farm and is also essential to maintain traditional knowledge necessary to support sustainable use. Currently some of the main constraints include:

- Inadequate knowledge concerning the (genetic) diversity of local varieties and breeds maintained on-farm;
- Inadequate monitoring of PGR and AnGR on-farm including their wild relatives, old species and varieties, endangered and vulnerable species;
- Insufficient linkages between the informal (seed) sectors and the network of *ex-situ* gene banks;
- Limited access by farmers to available diversity and to information on different local varieties and breeds;
- Appropriate incentives for maintaining local varieties and breeds.

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2.5 *In-situ* conservation of Crop Wild Relatives (CWR)

There is evidence in the literature (Prescott-Allen and Prescott Allen, 1986; Hajjar and Hodgkin, 2007) to demonstrate the extent to which CWR have contributed with genes and traits for crop improvement as well as the monetary value of such contribution. Some of the challenges that have to be tackled to effectively make use of CWR are:

- Acknowledgement of the contribution that CWR may bring to the adaptation of utilised varieties;
- Identification of useful traits to be used in breeding activities;
- Increase the knowledge of CWR distribution;
- Reduce the gaps in *ex-situ* collections of CWR;
- Reduce the risks of extinction of threatened CWR as a result of climate and environmental changes.

3. Input in preparation of the Focus Group

3.1 Provided by external sources

Recently, in the context of the EU FP7 PGR Secure project[1], a workshop entitled 'On the conservation and sustainable use of plant genetic resources in Europe: a stakeholder analysis' (Frese et al., 2013) brought together researchers, breeding companies, governments, agro NGOs and gene banks. A survey carried out to prepare this workshop identified *inter alia* the following challenges faced by stakeholders of plant genetic resources:

Funding

- Sufficient and continuous funding is needed for maintaining genetic resources;
- Insufficient level of funding for organisational and technical infrastructures that can coordinate existing national components

Information system

- Inadequate information system for PGR for food and agriculture;
- Lack of visibility of genebank collections on internet

Availability of data and information

- Paucity of passport
- Need for further characterisation and evaluation data of PGR
- Availability of data and information on germplasm collections.
- Adequate knowledge of amount and distribution of genetic diversity present in priority genepool
- Lack of long term crop specific pre-breeding programmes

Acquisition

- Physical acquisition of PGR (considered as a problem by breeders)
- Clear understanding of and practical issues related to Access Benefit Sharing (ABS)

[1] EU FP7 Project 266394- Novel characterization of crop wild relative and landrace resources as a basis for improved crop breeding – (Project acronym PGR Secure).

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Co-operation between stakeholders

- Improve/achieve real joint cooperation between stakeholders (in particular between genebanks and breeders)
- Smaller breeding companies have limited capacities for scientific cooperation and for their own pre-breeding programmes
- Limited involvement of NGO groups in national and EU PGR units
- Insufficient communication between stakeholders, especially between breeders and consumers

3.2 Provided by Focus Group members

Members of EIP AGRI Focus Group in Genetic Resources in their application have indicated a number of issues that the Focus Group should address. To better prepare the work of the Focus Group, a survey has been designed to collect preliminary ideas (see survey results document).

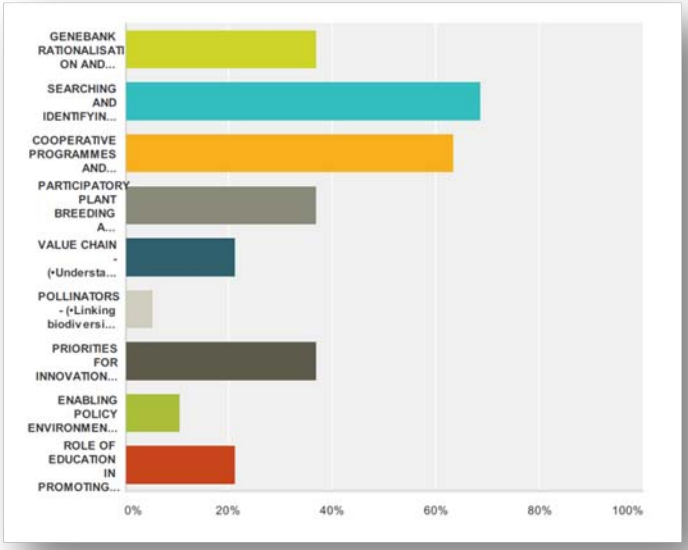
Priorities for cooperation

Among the proposed issues, most of members identified as priority topics:

- The search for new traits for biotic and abiotic stresses for climate change adaption
- Defining cooperative programmes and interdisciplinary approaches for conservation and use of genetic resources

Topics voted by some members were:

- Rationalization and harmonization of gene banks
- Participatory plant breeding and use of Neglected and Underutilized species(NUS), local breeds, varieties and wild relatives
- Priorities for innovation actions.



Other participants mentioned the value chain and the role of education as important topics.

Bottlenecks and challenges for cooperation

Co-operation needs to involve three groups of actors, namely: ***ex-situ* conservation actors** (*e.g.* gene bank curators), ***in-situ* conservation actors** (*e.g.* farmers, communities/custodian farmers) **and users** (*e.g.* breeders and other users). Each of these groups has specific needs which have to be taken into consideration to achieve an effective co-operation. In this respect, the members of the EIP AGRI Focus Group identified the following key factors as being important in creating cooperation models for genetic resources conservation and use:

- **Clear objective of cooperation models** with a clear definition of the priority areas, ownership and valorization of results; common platform for sharing views and promoting dialogue and provide a win-win situation for all participants;
- **Coordination** - Lead by a key person(s) to facilitate the cooperation model; regular meetings between teams;
- **Willingness** of all categories of stakeholders to engage in real cooperation with mutual understanding and respect;

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- **Communication -** Dissemination of scientific developments, including trials, results and personal experiences; ability to communicate across the entire production chain and its different stakeholders; encourage two-way dialogue; personal contact;
- **Knowledge –** ensure a broad knowledge on the topic and its challenges; access to technical tools such as artificial insemination; information on resources available in gene banks and harmonization; national inventories and characterization of genetic resources;
- **Education -** better integrate genetic resources in education programs;
- **Market potential and value chain -** identification of flagship projects in order to design (new) co-operation models acceptable for all stakeholders along the value chain that could generate economic interest and gain; understanding the potential of the value chain;
- **Methodologies** – adapted methodologies to include participatory plant breeding in the cooperation models; schemes for on-farm management;
- **Policies and legal framework -** understanding of and compliance with the Nagoya protocol (Access and Benefit Sharing) for material coming from *in-situ*; breeders and farmers rights; seed legislation;
- **Access and availability** - of animal, plant, forest and microbial genetic resources;
- **Financial mechanisms** - to support co-operation model

4. Key outputs expected from the focus group

- Identify and analyze the different types of agreements between the stakeholders in the field and the successful factors in existing cooperation
- Propose models and strategies to motivate public and private stakeholders to engage in cooperation models
- Prepare a gap analysis indicating where new solutions for cooperation models need to be found
- Identify priorities for further research actions: list the main needs (*i.a.*, pre-breeding and breeding priorities) concerning the generation of knowledge in order to maximize intra and inter-specific variation for the benefit of agriculture and of society at large
- Identify the priorities for areas of work for the different stakeholders in order to maximize intra and inter-specific variation for the benefit of agriculture and of society at large
- Propose ways to promote the use of locally adapted and under-utilized crops, varieties and breeds
- Propose ways to broaden the genetic basis used in plant and animal breeding so as to strengthen the development of varieties and breeds particularly adapted to social, economic and ecological conditions, also in marginal areas suggest potential projects of practical operational groups and other project formats to test new methods for advancing cooperation in the area of genetic resources

Additional questions

1. What specific co-operation mechanisms are required for identifying desirable adaptive traits from genetic resources for crop/breed improvement?
2. How can co-operation between stakeholders support and promote the use of locally adapted breeds and varieties? What is the role of the farmer in this process?
3. What kind of agreements between stakeholders would better fit cooperative activities?

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