



Preparatory action on EU plant and animal genetic resources

Final Report



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Final Report

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Abbreviations

AECM	Agri-environment-climate measure (in RDP 2014 -2020)
AEM	Agri-environment measure (in RDP 2007-2013)
AnGR	Animal genetic resources
AnGRFA	Animal Genetic Resources for Food and Agriculture
ANR	Agence National de Recherche (National Agency for Research)
ARVALIS	Institut technique des céréales (FR)
BBSRC	Biotechnology and Biological Sciences Research Council (UK)
CBD	Convention on Biological Diversity
CERAFEL	Comité Economique Agricole Régionale Fruits et Légumes de Bretagne (FR)
CIC	Community Interest Company
CWR	Crop Wild Relatives
DG	Directorate General
DG SANTE	DG Health and Food Safety
DNA	Deoxyribonucleic acid
EC	European Commission
ECPGR	European Cooperation Programme for Plant Genetic Resources
EIP-AGRI	European Innovation partnership for Agricultural Productivity and sustainability
ERFP	European Regional Focal Point for Animal Genetic Resources
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding
EU COST	European Cooperation in Science and Technology
EUFGIS	European Information System on Forest Genetic Resource
EUFORGEN	European Forest Genetic Resources Programme
EURISCO	European Search Catalogue for Plant Genetic Resources
FAO	Food and Agriculture Organization of the United Nations
FGR	Forest Genetic Resources
FP6	Sixth Framework Programme
FP7	Seventh Framework Programme
FSOV	French Fund to support Plant Breeding
GEVES	Groupe d'Etude et de contrôle des Variétés Et des Semences (French Group for the Study and Control of Varieties and Seeds)
GMO	Genetically Modified Organism
GPA	Global Plan of Action
GR	Genetic Resources
GRFA	Genetic Resources for Food and Agriculture
HACCP	Hazard Analysis and Critical Control Point
H2020	EU Framework Programme for Research and Innovation – Horizon2020
INRA	Institut National de la recherche agronomique (French National Research Institute for Agriculture)
INTERREG	Interregional Cooperation Programme
IP	Intellectual Property
IPPC	International Plant Protection Convention
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
JIC	John Innes Centre (UK)
MIGR	Microbial and Invertebrates Genetic Resources
MS	Member States
MTAs	Material Transfer Agreements
NCA	National Competent Authority
NGO	Non-Governmental Organisation
OBS	Organisation Bretonne de Selection (FR)

OIE	World Organisation on Animal Health
PDO	Protected designation of origin
PGI	Protected geographical indication
PGR	Plant Genetic Resources
PO	Producers organisation
PPP	Public-Private Partnership
PSR	ProSpecieRara (CH)
RDP	Rural Development Programme
R&D	Research and Development
SWOT	Strengths, Weaknesses, Opportunities, Threats
US	United States

PROJECT ABSTRACT

Abstract (EN)

A preparatory action on the conservation and sustainable use of EU plant and animal genetic resources in agriculture and forestry was carried over a period of two years (2014-2016).

Evidence was gathered through a variety of means in the context of the study. These included a mapping exercise of current activities and the stakeholders involved, a review of existing literature, over three hundred interviews with stakeholders and competent authorities, twenty-one case studies of good practices, and seven thematic workshops covering methodological issues. The findings of the study were shared with stakeholders and competent authorities across the EU28 during a conference which took place at the end of the preparatory action.

The analysis highlighted the need to develop an agro-biodiversity strategy towards the conservation and sustainable use of genetic diversity in the EU, while considering issues specific to each of the four domains of the study: plant genetic resources, animal genetic resources, forestry genetic resources; and microbial and invertebrate genetic resources.

Significant efforts have to be made by all stakeholders to secure an optimal conservation of genetic resources in the EU, and use these resources in a sustainable way in agriculture and forestry. This can be achieved through e.g. supporting partnerships and cooperation between stakeholders at all levels in the supply chain.

Résumé (FR)

Une action préparatoire concernant la conservation et la valorisation des ressources génétiques agricoles et forestières a été menée sur une période de deux ans (2014-2016).

Cette étude s'appuie sur une série d'outils de collecte d'information et plus particulièrement sur une cartographie des actions en cours et de leurs acteurs, d'un examen de la littérature existante, de plus de trois cent entretiens individuels, de vingt et une études de cas présentant des exemples de bonnes pratiques, et de sept ateliers thématiques portant sur différentes questions méthodologiques. Les conclusions de l'étude ont été partagées avec les parties prenantes et les autorités compétentes au cours d'une conférence qui a eu lieu à la fin de l'action préparatoire.

Cette analyse met en avant le besoin de développer une stratégie européenne en matière d'agro-biodiversité en tenant compte des questions spécifiques à chacun des quatre domaines étudiés: les ressources génétiques végétales, les ressources génétiques animales, les ressources génétiques forestières, et les ressources génétiques microbiennes.

Des nombreux efforts complémentaires doivent être entrepris par l'ensemble des acteurs dans l'objectif de s'assurer d'une conservation efficace de ces ressources génétiques et de leur valorisation optimale par la mise en réseau et la coopération entre acteurs des filières agroalimentaires et forestières.

Following an initiative tabled by the European Parliament in 2013, the European Commission (DG Agriculture and Rural Development) commissioned a "**Preparatory action on EU plant and animal genetic resources**".

The aim of this preparatory action is to deliver inputs on how to improve communication, knowledge exchange, and networking among all stakeholders potentially interested in activities related to the conservation of the diversity of genetic resources (GR). The preparatory action also aims to find ways towards a sustainable use of these resources.

The preparatory action covers the 28 EU Member States and the following domains:

- Plant genetic resources (PGR);
- Animal genetic resources (AnGR);
- Forest genetic resources (FGR); and
- Microbial and invertebrate genetic resources (MiGRs).

Structure of the report

This report is structured as follows:

- **Part 1** offers an introduction, through a presentation of the context and the methodology of the study;
- **Part 2** presents the general context of the preparatory action by describing the concept (definitions) of genetic resources adopted during the study as well as the general scope of the study;
- **Part 3** summarises the findings in response to each of the seven themes of the preparatory action;
- **Part 4** presents the overall conclusions of the research; and
- **Part 5** lists the practical recommendations (the vision) proposed by the study team.

PART 1: INTRODUCTION

1.1 Context to the preparatory action

Genetic resources in agriculture and food production are the biological basis of global food and nutrition security. Apart from the potential economic importance (ranging from the contribution of specific qualities to breeding programmes, to the production of quality meat and other products for niche markets), local or regional breeds and varieties can also be of ecological importance. For instance, they might be adapted to specific environmental conditions (e.g. landscape management in marginal areas that depend on grazing; or breeds that cope better than high-performance breeds with conditions of organic agriculture or extensive cultivation). Moreover, animal and plant genetic resources are part of our cultural heritage. In addition, forest genetic resources are an important source of renewable raw materials and energy. Their important role for the environment is undisputable, while forests and natural areas containing diverse genetic resources also offer ample opportunities for leisure and tourism. The diversity of microorganisms plays a major role in maintaining the biosphere and provides a vast and largely untapped resource for humankind.

Global losses of genetic resources for agriculture and food production have been substantial over the last 100 years (FAO 2007¹; FAO 2010²). Agricultural intensification with its focus on high yielding breeds and the change of land management with a strong decline of pastures has led to almost 50% of all European livestock breeds being extinct or having an endangered or critical status. The loss of plant genetic resources is poorly documented (Virchow, 1999)^{3,4}, however, it is obvious that there has been a concentration on fewer type of crops (FAO, 2007).⁵

Major drivers for the loss of genetic resources include the standardisation of production processes, consumer preferences, technological change (e.g. modern breeding techniques), as well as international competition and globalisation. Recent developments in genetic improvement (e.g. molecular breeding, genomics, etc.) have helped to increase agricultural productivity. However, concerns have been raised about risks related to pests and disease outbreaks, in regards to the short term strategy of relying on relatively few species, breeds and varieties. At the same time, hobby breeders are becoming increasingly important actors for the conservation of rare breeds, as well as of traditional crops and crop varieties, representing an opposing trend.

¹ FAO (2007) *The State of the World's Animal Genetic Resources for Food and Agriculture*. Barbara Rischkowsky & Dafydd Pilling (eds.). Food and Agricultural Organisation of the United Nations (FAO), Rome. 512p.

² FAO (2010) *The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*. Food and Agricultural Organisation of the United Nations (FAO), Rome. 399p

³ Virchow (1999) *Conservation of Genetic Resources: Costs and Implications for a Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*. Springer Verlag, Berlin. 253p

⁴ According to FAO (First Report of the State of the World's Plant Genetic Resources for Food and Agriculture (1997). <http://apps3.fao.org/wiews/docs/SWRFULL2.PDF>), approximately 30,000 edible plant species have been identified, of which more than 7,000 have been used in the history of humanity to meet basic human needs such as food, clothing, fiber, medicine, construction materials and fuel. At present no more than 150 species are commercially cultivated, of which 30 constitute 90% of the calories in the human diet and only three species (rice, wheat, maize) account for more than half of the energy supply.

⁵ CBD (2011) *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*. Secretariat of the Convention on Biological Diversity, United Nations Environmental Programme, Quebec, Canada. 25p

1.1.1 International agreements addressing genetic resources issues

The need to conserve biodiversity, including genetic resources in general, and more particularly in agriculture, is addressed through several international agreements which are accounted for in this section.

The **Convention on Biological Diversity (CBD)**⁶ signed in Rio de Janeiro in 1992 recognises that states have sovereign rights over genetic resources found within their jurisdiction and the authority to determine access to such resources. In this context, it obliges Parties to share in a fair and equitable way the results of research and development, and the benefits arising from the commercial and other utilisation of genetic resources with the Party providing these resources. The CBD established a thematic programme "*Agricultural Biodiversity*". Although it does not explicitly address the area of conservation of genetic resources in food and agriculture, it refers to the need to "*maintain genetic resources*" by means of *in situ* conservation, complemented by *ex situ* conservation.

The CBD was agreed alongside an agreement on the **Agenda 21** (1992), which has a high political importance and addresses conservation and sustainable use of animal and plant genetic resources. The Food and Agriculture Organization of the United Nations (FAO) took on the important role to promote the implementation of the Agenda 21 through its **Commission on Genetic Resources for Food and Agriculture** (CGRFA), which covers the forest, plant, animal, aquatic and microbial/invertebrate genetic resources domains.

A framework for **plant genetic resources** was set up by the FAO **Global Plan of Action for the Conservation and Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture** in Leipzig, 1996. This Global Plan of Action has been updated (FAO, 2011) based on a reviewed State of the World on PGRFA (FAO, 2010⁷). The Global Plan of Action for Plant Genetic Resources was complemented by the adoption of the **International Treaty on Plant Genetic Resources for Food and Agriculture** (ITPGRFA) by the FAO conference in 2001, as a response to the request from the Parties to the CBD to develop a specialised legal instrument for PGRFA. The ITPGRFA aims at the conservation and sustainable use of plant genetic resources, as well as facilitated access and equitable sharing of benefits of their use.

Concerning **animal genetic resources**, the first report on the **State of the World's Animal Genetic Resources** was adopted in 2007, followed by the adoption of the **Interlaken Declaration** and the **Global Plan of Action⁸ on Animal Genetic Resources** (2007). Regarding **forest genetic resources**, the first **State of the World's Forest Genetic Resources report** was published in 2014. The first **Global Plan for Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources** was adopted in May 2013. Regarding aquatic genetic resources, the launch of the first **State of the World's Aquatic Genetic Resources report** is planned for 2017. National reports should be prepared during the term 2015 and 2016.

The preparation of the **State of the World's Biodiversity for Food and Agriculture** is also under preparation and expected to be launched at the 16th regular session of the CGRFA in 2017⁹. This report is planned to go beyond the scope of the sector-specific assessments of the CGRFA, with the aim to present a more comprehensive analysis of

⁶ The Convention entered into force in December 1993.

⁷ FAO (2010) The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Food and Agricultural Organisation of the United Nations (FAO), Rome. 399p

⁸ Voluntary agreement

⁹ Planned in Rome in 2017

the conservation and use of the world's biodiversity for food and agriculture. Information about the situation of **micro-organisms and invertebrate** genetic resources will be included in this report for the first time in the Commissions' work.

In regards to the conservation of genetic resources to avoid genetic losses, the CBD establishes general obligations on access to genetic resources and the sharing of benefits arising from their utilisation (**Access and Benefit Sharing - ABS**). The respective provisions, namely Articles 15 (Access to Genetic Resources) and 8(j) (Traditional Knowledge) are rather broad and have led to some ambiguity regarding the implementation¹⁰. In November 2001, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was adopted in the framework of the FAO as the first specialised international ABS instrument. It entered into force in 2004.

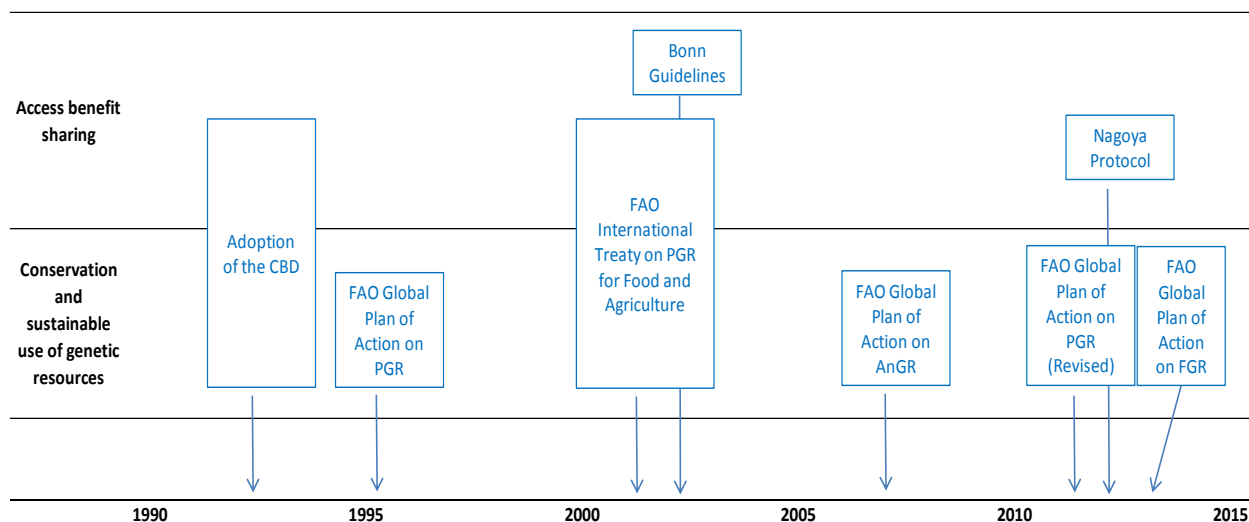
The non-binding **Bonn Guidelines**, adopted by the sixth CBD Conference of the Parties (COP6) in 2002, were intended to guide both users and providers of genetic resources in the implementation of the access and benefit-sharing provisions of the CBD. While these voluntary guidelines are comprehensive, they are not considered effective in regards to triggering concrete measures by providers and users. As a consequence, the **World Summit on Sustainable Development** (Johannesburg, September 2002) called for the negotiation of an international regime, within the framework of the CBD, to promote and safeguard the fair and equitable sharing of benefits arising from the utilisation of genetic resources.

After six years of negotiations, a supplementary agreement to the CBD was signed in October 2012 in Japan, called the **Nagoya Protocol**. This protocol provides an international legal framework for the effective implementation of the CBD objective related to fair and equitable sharing of benefits arising from the utilisation of genetic resources. It obliges its signatories to take measures to ensure that only legally acquired genetic resources and associated traditional knowledge are utilised within their jurisdiction.

The Nagoya Protocol explicitly refers to the interdependence of states in terms of genetic resources for food and agriculture (GRFA) and emphasises the role of the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA). Furthermore, it points out the importance of GRFA for achieving food security (NP Article 8). It also recognises the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (NP Article 4). In 2011, the CGRFA set-up a long-term work programme on ABS, establishing "Elements to facilitate domestic implementation of Access and Benefit-Sharing for different subsectors of Genetic Resources for Food and Agriculture".

Several other initiatives and international agreements have relevance as well. For example, the issue of how to protect the biodiversity of the high seas is also being discussed at the UN level.

¹⁰ Secretariat of the Convention on Biological Diversity (2011) Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity

Figure 1: History of adoption of the main international instruments addressing genetic resources issues

Source: compiled by Arcadia International

1.1.2 EU initiatives and policy background¹¹

The EU has been addressing the issues related to genetic resources and ABS since the signature of the CBD. Indeed, the EU and all its 28 Member States are parties to the CBD, as well as the ITPGRFA. Furthermore, most of EU MS have signed the Nagoya Protocol (Estonia, Latvia and Malta have not signed it yet). In this context, the EU and its MSs are committed to striving towards the implementation of these international agreements, as well as the ABS principles and obligations contained therein. To that purpose, in addition to the Member State-level implementation of the ITPGRFA, the Commission has adopted Regulation (EU) No 511/2014¹² on 16 April 2014 which provides the legal background for implementing the mandatory elements of the Nagoya Protocol in the European Union. It entered into force on 9 June 2014 and has been applied since the Nagoya Protocol itself entered into force for the Union, on 12 October 2014. The corresponding Implementing Regulation 2015/1866¹³ contains measures on specific aspects, as provided for in the EU ABS Regulation, in particular on registered collections, best practices and the monitoring of user compliance.

With regard to the challenges of conservation and sustainable use, the EU has been addressing genetic resources for agriculture since 1994. The first European programme, called GENRES, "on the conservation, characterisation, collection and utilisation of genetic resources in agriculture" finds its legal basis in **Council Regulation (EC) No**

¹¹ This Chapter introduces EU legislation directly related on genetic resources and not all the EU regulatory frameworks tackling indirectly genetic resources issues (e.g. Seed Marketing Directives, EU zootechnical legislation, Rural Development legislation, etc.). All these specific frameworks are listed and presented under Chapter 3.4)

¹² Regulation (EU) No 511/2014 of the European Parliament and of the Council on compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union

¹³ Commission Implementing Regulation (EU) 2015/1866 of 13 October 2015 laying down detailed rules for the implementation of Regulation (EU) No 511/2014 of the European Parliament and of the Council as regards the register of collections, monitoring user compliance and best practices. It was adopted by the Commission on 13 October 2015, with entry into force on 9 November 2015.

1467/1994. The objective of the Regulation was to “*coordinate and to promote at Community level work on the conservation, the characterisation, the collection and the utilisation of genetic resources in agriculture undertaken in the Member States, with a view to the establishment of the aims of the Common Agricultural Policy (CAP), and, in accordance with the principle of subsidiarity, to support and supplement the efforts made in the MS where current work appeared adequate*”. The Regulation established responsibilities for the Commission and for the MS to achieve these objectives. It provided for a first European programme for the conservation, characterisation, collection and utilisation of genetic resources in agriculture. This first programme was adopted on November 1994, for a period of five years with a budget of EUR 10 million approximately. Under Council Regulation (EC) No 1467/1994, 21 projects were approved for co-financing by the European Commission – one forestry project, sixteen projects on crop genetic resources and four projects in animal genetic resources. These projects started in 1996 and were completed in 2005.

A new programme (called GENRES II) was then established on the legal basis of **Council Regulation (EC) No 870/2004** containing a clear reference to multinational arrangements under the CBD and FAO. Regulation 870/2004 co-funded 17 actions (five in animal resources, one in forestry and eleven in plant GR), which started in 2007 for a maximum period of four years. The allocated budget was again EUR 10 million approximately.

The evaluation of this second Community programme on genetic resources in agriculture identifies the need for further action to improve the conservation of genetic diversity within agriculture and forestry. The evaluation also highlights the importance of the promotion of the exploitation of genetic diversity and the sustainable use of (traditional) varieties and breeds so as to make conservation dynamic and economically viable¹⁴.

Another financial support mechanism for the conservation of crop/animal biodiversity within the EU is based on the Rural Development policy. **Council Regulation (EC) No 1305/2013** enabled EU Member States to support rural development using funding from the European Agricultural Fund for Rural Development (EAFRD). Article 28 of the Regulation allows payments to farmers who have entered voluntary agri-environment schemes (EAM) (Appendix 1). **Commission Regulation (EC) No 808/2014** set out the detailed provisions for implementation of Council Regulation (EC) No 1305/2013.

The European multi-annual **Research Framework Programmes**¹⁵ (such as the Seventh Framework Programme) have been used to leverage “*cooperation in the field of Union research, technological development and demonstration with third countries and international organisations*”. The Framework Programmes and their successor legislation (**Horizon 2020**) are relevant as they foster genetic resources and related research.

LIFE+ was the EU's dedicated fund for the environment. It aimed to contribute to the implementation, update and development of EU environment policy and legislation, in particular by participating in the integration of environmental aspects into other policies and in sustainable development in the EU. The LIFE+ instrument expired in 2013. The legislative proposal on the post-2013 LIFE instrument suggests focusing part of the funding on the EU's commitments to implement international environmental regimes. The funding could thus be used to implement access and benefit-sharing measures. It could

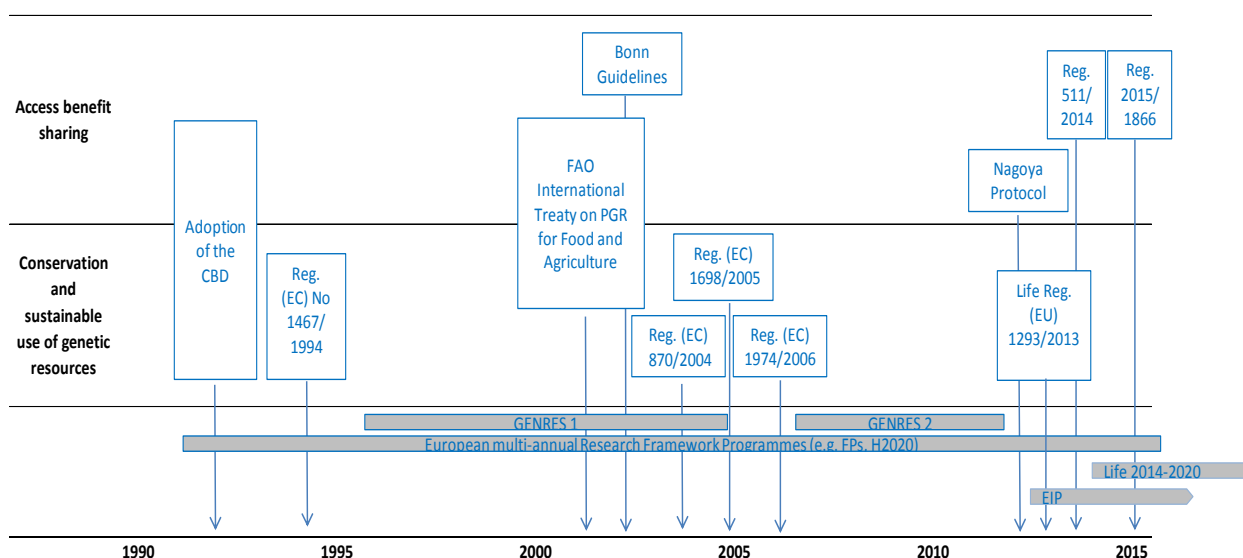
¹⁴ Commission staff working document accompanying the document Report from the Commission to the European Parliament, the Council and the Economic and Social Committee Agricultural Genetic Resources - from conservation to sustainable use {COM(2013) 838 final}

¹⁵ Decision No 1982/2006/EC of the European Parliament and of the Council concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007–2013)

also play a role with regard to compliance, by raising awareness among EU users of genetic resources on ABS matters.

European Innovation Partnership (EIP) is a recent approach to research and innovation in the EU. The EIP acts along the whole research and innovation chain, bringing together stakeholders to improve the coordination of the actions, so as to achieve better results faster. A specific EIP is dedicated to "Agricultural Productivity and Sustainability" (EIP-AGRI). It aims in particular to better connect science results and practices in the agricultural domain. Within the EIP AGRI a particular Focus Group was 2014 dedicated to genetic resources: co-operation models between seed and cryo-banks, research institutes, and private breeding companies. The objective of this group was to reflect on the current limits of cooperation between the different types of stakeholders and to propose actions on how to promote closer cooperation¹⁶.

Figure 2: History of adoption of the main legal and funding EU instruments addressing genetic resources issues



Source: compiled by Arcadia International

1.2 Objectives and scope of the preparatory action

The **EU Biodiversity Strategy** to 2020 includes an action on conserving Europe's agricultural genetic diversity by encouraging the uptake of agri-environmental measures (see above) and exploring the scope for developing a strategy for the conservation of genetic diversity.

Following an initiative taken by the European Parliament, a Community budget was set aside for a preparatory action for an EU programme for the conservation and sustainable use of plant and animal genetic resources in agriculture.

The evaluation of the second Community programme on genetic resources (Council Regulation (EC) No 1305/2013, see above) highlighted the need for further actions in

¹⁶ <http://ec.europa.eu/eip/agriculture/en/content/genetic-resources-cooperation-models>

relation to the sustainable use of genetic resources. Particular attention needs to be given to the potential of further developing genetic diversity, to adjust to changing local conditions, integrate the use of genetic diversity along the whole production chain and make conservation and use, including locally adapted breeding, a cost-effective and profitable business. The tender specifications of this preparatory action further highlight that dedicated efforts to increase the economic viability of managing, using and breeding local and/or underutilised breeds and crops should be undertaken.

Therefore, the objectives of this preparatory action are twofold:

- To **provide a comprehensive description and analysis of the state of the art of genetic resources-related activities in the EU** for:
 - Plant genetic resources (PGRs);
 - Animal genetic resources (AnGRs);
 - Forest genetic resources (FGRs); and
 - Microbial and invertebrate genetic resources (MiGRs).
- To provide **practical recommendations** to ensure the effective conservation and sustainable use of genetic resources in agriculture as a matter of general interest, not only by looking at research and breeding activities but also considering the complete agro-food supply chain. Recommendations will take into consideration differences between MS regarding the state of agro-biodiversity and related (conservation) policies.

The analysis addresses the objectives stated above across a series of seven different themes which are summarised in Table 1.

Table 1: The seven preparatory action themes

Theme	Description
1	Improvement of the communication between MS concerning best practices and the harmonisation of efforts in the conservation and sustainable use of genetic resources
2	Enhancing networking among key stakeholders and open-users in view of exploring marketing (and other cooperation) opportunities, such as provided by quality schemes and short supply chains
3	Improvement of the exchange of knowledge and research on genetic diversity in agriculture systems
4	Adaptation of breeding methods and legislation to the need of conservation and sustainable use of genetic resources
5	Contribution to the successful implementation of rural development measures concerning genetic diversity in agriculture
6	Explore bottlenecks and enabling conditions for the sustainable use of genetic resources in agriculture
7	Reduction of unnecessary administrative burden so as to provide better access to actions

The preparatory action outputs reflected in this report provide a wide ranging overview of efforts towards the conservation and sustainable use of agricultural genetic resources in the EU, and in particular address the following terms of reference:

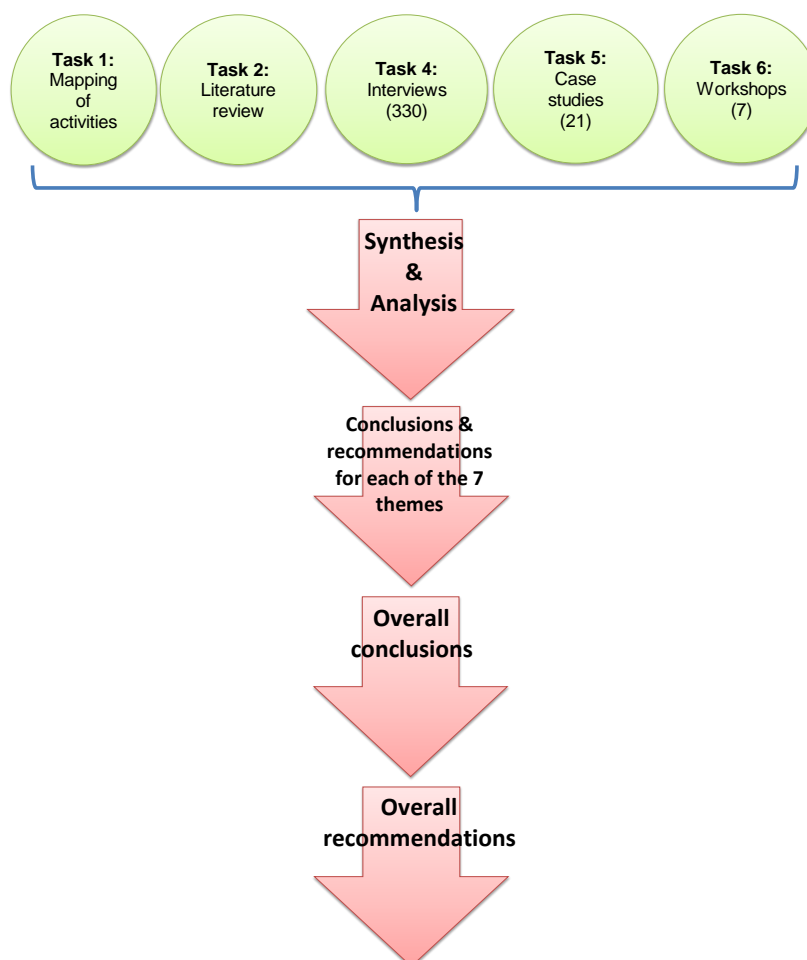
- **Identify, describe and analyse the activities on the conservation and sustainable use of agricultural and forest genetic resources**, in order to provide relevant information concerning the seven different themes described above; and
- **Identify missing links and areas to be addressed in future actions** on the conservation and sustainable use of genetic resources in agriculture and forestry i.e. as a contribution to the exploration of the scope for developing a strategy on the conservation of genetic diversity in the EU.

The geographic coverage of the preparatory action has been the EU-28.

1.3 Preparatory action methodology

The research was organised as a set of structured tasks. Figure 3 provides an overview of the method of approach, listing the data collection process and the general approach leading to recommendations.

Figure 3: Summary of methodology



The remainder of this section of the report provides a brief explanation of the approach behind the primary research activities undertaken for the preparatory action.

Mapping of activities and actors

An extensive mapping exercise in the EU was completed during the first six months of the project to provide a picture of genetic resource-related efforts relevant to the preparatory action. To that end, a survey was launched and distributed in all EU Member States through the national focal points and relevant national competent authorities. A total of 900 responses were received. The results are presented online and are available on the project's dedicated website¹⁷.

Literature review

The literature review was undertaken with the objective to create an overview of scientific issues relevant to this preparatory action. It focused on recent literature and tried to identify the 1) main topics and outcomes of past research in genetic resources relevant to the EU; 2) trends in genetic resource research; and 3) implications for the conservation and use of genetic resources in the EU and globally.

The methodology covered a total of 228 papers mainly from the last six years, concentrating on scientific literature, and only using grey literature when highly relevant (for instance FAO reports). In the literature search, preference was given to review papers, as far as these were available. An expert for each domain developed a synthesis around ten pages long. Based on these four reports, an overall synthesis was developed, adding a number of additional references of a generic nature.

Interviews

The objective of the interviews was to obtain further details regarding the initiatives on genetic resources described in the mapping exercise, and to gather material for the analysis of the study themes. Interviewees were selected from the list of stakeholders identified in the mapping exercise, taking into account the expertise and experience of the interviewee, the geographical coverage of EU Member States, the coverage of the four GR domains of the study (PGR, AnGR, FGR, and MIGR), and the relevance of the activity/interviewee for the seven study themes. 330 semi structured interviews of circa 45 minutes each were conducted with interviewees in 13 different stakeholder groups. Interview questionnaires were developed for each of the groups in consultation with the Commission. After each interview, a report was drafted to summarise the most important aspects of the interview and to provide key findings per themes discussed during the interview. Upon completion, the reports were sent to the interviewees by email for validation.

Case studies

The objective of the case studies was to carry out an in-depth analysis of representative initiatives with different geographical, institutional and operational features, linked to the seven study themes. Based on initial discussions with the Commission, and ongoing work performed within the preparatory action, a list of over 40 cases was generated. For the establishment of this list, several criteria were taken into account (e.g. economic viability of the projects; multi-stakeholder engagement; variety in agricultural production sectors (balance between PGR and AnGR, and the inclusion of at least one FGR case, and one MIGR case); variety in agricultural production systems; and geographical balance). A final selection was made by the Commission resulting in 21 cases, as follows (sorted in alphabetic order):

AEGILOPS (EL). This network for Biodiversity and Ecology in Agriculture aims to build on a number of pillars including seed collection, organic breeding, and seed schools. A

¹⁷ www.geneticresources.eu

variety of activities is undertaken in order to maintain and develop local cereal varieties and to strengthen the role of organic farmers in the conservation of genetic resources. Participatory processes with farmers and other stakeholders in the food chain were adopted by AEGILOPS for the evaluation and the selection of local cereal varieties.

Beer brewed from heritage barley (UK). Within the context of different research projects, scientists from the John Innes Centre and Sunderland University have re-discovered a Victorian barley variety (Chevallier) with important traits related to quality, taste and disease resistance. This re-discovery resulted in bringing this variety back to the market of beer brewing, as well as its use in breeding activities to improve modern barley varieties.

Breedwheat (FR). This research project combines genetics, genomics, and ecophysiology with high-throughput phenotyping and genotyping. The research project has 26 participating organisations, including 14 public research institutes (e.g. INRA and GEVES), one technical institute (Arvalis), one competitiveness cluster (Céréales Vallée), and 10 private companies. Breedwheat is therefore a key public private partnership project aiming at pre-breeding activities to the benefit of private wheat breeders.

Conservation of sweet cherry varieties (DE). This project led to the establishment of a living collection of old varieties in the form of a cherry variety garden, as well as the reintroduction of the use of the cherries through the development of consumer products and tourism around these products. Stakeholders involved include the municipality of Hagen, research institutes, regional Slow Food initiatives and the tourism association.

Crop for the Shop (UK). This scheme has the aim of increasing the consumption of local food products at a fair price while changing the current food culture. Other objectives include raising awareness on the importance of short supply chains and local products, including products made from old and traditional varieties. The Crop for the Shop scheme consists of local shops selling products that are brought in by local growers, who in return will receive a share of the sales.

Eternal Kale (NL). The case study looks into the national network Eternal Kale which aims to maintain and grow old agricultural varieties, as well as provide information to the public. The network consists of around 100 initiatives, mostly conducted through pensioner and hobby activities. Other stakeholders include historical gardens, city gardens, museums and vegetable growers. The network operates on a voluntary basis and collaborates with CGN, the SAVE Foundation, and ProSpecieRara.

Genebank for Crop Wild Relatives for Food and Agriculture (DE). The genebank is a network which includes the Botanical Gardens Berlin, Karlsruhe, Osnabrück and Regensburg, as well as the Karlsruhe University of Education, and is coordinated by Osnabrück University. Collections in four different parts of the country were carried out in the 2010-2013 period. Seeds of CWRs are distributed for the purpose of breeding, research, and education.

ITEM microbial culture collection (Institute of Sciences of Food Production) (IT). The ITEM microbial culture collection's main objectives are the development of microorganisms for the food production sector and the development of useful tools for quantifiable and significant reductions in toxin contamination for food and feed. One of the concrete outputs of the research activities is the development a new *Penicillium* species (*Penicillium salami*) which may be used for the seasoning of dry-cured meat. The commercialisation of this new *Penicillium* strain is currently explored.

Future Tree Trust (UK/IE). The charity Future Trees Trust aims to improve the timber quality of broadleaved trees planted in the UK and Ireland, concentrating on seven

different species. Objectives include planting and commercialising better quality, faster growing and well adapted trees, in view of climate change and disease resistance.

Landrace inventories (PT). The case study compares two projects – one ongoing research project with another one carried out in 2007. The 2007 project had the aim of making an inventory of grapevine landraces in two Portuguese regions but without any actual connection with national stakeholders in the field. However, the ongoing project aims to perform a national landrace inventory and includes a close collaboration with the Portuguese national genebank which is linked to the Portuguese Ministry of Agriculture.

Monteleone di Spoleto Emmer (IT). The objective of this initiative is to foster the economic revival of the Monteleone di Spoleto Emmer. Very low levels of production for this specific emmer variety were reached in the 1970s, but the variety was then rediscovered by a farmer who appreciated its importance. In the 1990s, the emmer variety started to develop significantly due to the involvement of researchers from Perugia University and Monteleone di Spoleto municipality. This case presents a successful multi-stakeholder engagement involving research organisations, local government, and farmers.

NordGen (SE/Nordic countries). This case study concerning NordGen provides an example of regional collaboration encompassing the Nordic countries. Its main objective is to collaborate in *ex situ* conservation. NordGen supported the Baltic countries in setting up their National GR Programmes demonstrating that the activities of NordGen go further than conservation.

Nordic Food (DK). A Nordic Food Manifesto was signed in 2004 by famous chefs from different Nordic countries. This Nordic Food Manifesto initiated the development of more recent Nordic food movements. Nordic cuisine has come to imply pure and healthy ingredients from land and sea in the Nordic region, which in many cases include rare breeds or landraces. This concept of Nordic Food has promoted short supply chains involving stakeholders in restaurants, food manufacturing, and agriculture.

Organisation Bretonne de Sélection (OBS) (FR). OBS is a conventional and organic plant breeding company funded by local producers over 40 years ago. The main breeding objectives of OBS include optimising the yield and quality of the different vegetables at field level, developing new varieties resistant to pests and diseases, and further engaging in research and breeding activities on the shape and taste of the vegetables.

On farm management of lentils (DE). An extensive research project assessing the effects of on-farm management on the regional adaptation and genetic diversity of landraces was conducted by the University of Göttingen (Dr Bernd Horneburg). In the field experiments, three landraces of the self-pollinating crop species of lentil were tested from 1997-2001 and from 2006-2010 under three different pedoclimatic conditions. Natural and experimental selection was carried out and the plants were characterised phenotypically.

Production and valorisation of the traditional variety hanging Tomato (“Tomate de Colgar”) (Spain). Tomatoes de Colgar are winter storage tomatoes, with a long shelf life at room temperature. They are mostly produced in the North East of Spain near the Mediterranean Sea where relative humidity is very high, especially in winter. This type of tomato became very popular at the early 1900s, when every family/farm had their own variety.

RAF Tomatoes (ES). The RAF tomato is the product of a selection of traditional tomatoes, and is resistant to Fusarium. Despite the revival of traditional tomato culture,

old varieties are not part of the Spanish industrial tomato production. The RAF tomato is the exception. Consumers pay between 10 and 15 EUR per kg for the tomato.

SAVE Foundation (EU). SAVE is a European NGO network working to safeguard agricultural varieties. Officially founded in 1998, its main aims include the endorsement and facilitation of networking and bringing together (national) organisations that strive to halt and reverse the trend of the genetic erosion of biodiversity in agriculture. While SAVE is not part of the supply chain, it supports its partners to strengthen their position in the supply chain.

Slow Food (NL/IT). The case study provides an overview of Slow Food and compares the agendas of Slow Food in the Netherlands and in Italy. The initial aims of the organisation were to defend regional traditions, good food, gastronomic pleasure, and a slow pace of life. Today, it is a global movement involving thousands of projects and millions of people in over 160 countries.

Swiss vegetables and supply chain development (CH). The private organisation ProSpecieRara (PSR), in cooperation with the supermarket Coop, has developed a dedicated supply chain for traditional varieties. The supply chain includes all the stages from seed production to retail under a specific ProSpecieRara label.

Turopolje pig breed (HR). The Lonjsko Polje Nature Park is one of the key players in the work to save the Turopolje pig breed from extinction. Once an increase of the breed's population is achieved, objectives are to involve the population, educate visitors, and develop a national trademark for traditional products emanating from the breed.

Workshops. A series of seven workshops was organised during the second part of the preparatory action. The workshops gave an opportunity to discuss specific issues that had been detected or proposed during the interviews, case studies, or directly by the study team or the Commission. Particularly, the workshops were either dedicated to topics/issues linked to a specific regional context or to cover sectoral or methodological issues. The topics of each of the seven workshops were validated by the Commission on the basis of a proposal by the study team. Table 2 presents the topics selected for this series of workshops.

Table 2: The seven workshops

	Title	Location, Date
1	Better integration of ex-situ and in-situ approaches towards conservation and sustainable use of GR.	Brussels, June 2015
2	Forest Genetic Resources in Europe in a changing climate: challenges and needs for conservation	Amsterdam, June 2015
3	Microbial Genetic Resources	Utrecht, November 2015
4	The impact of climate change on the conservation and utilisation of crop wild relatives in Europe	Barcelona, December 2015
5	Genetic resources for value chain developments	Brussels, January 2016
6	Access regimes on genetic resources for food and agriculture in the EU	London, February 2016
7	Implementation of the Global Plan of Actions (FAO): which role for the EC?	Bonn, April 2016

PART 2: DEFINITIONS AND SCOPE OF THE STUDY

The data collection led to a common agreement regarding the definition of genetic resources, which in practice varied according to the actors that were met and interviewed. Therefore, this Section presents the definition that has been adopted for the purpose of the preparatory action and describes the overall scope (the various genetic resource domains) of the study. In addition, the terms “conservation” and “sustainable use” of genetic resources are also analysed. Finally, a typology of stakeholders and business sectors covered by the preparatory action is provided.

2.1. Diversity in definitions of genetic resources

The definition of “genetic resources” most commonly used nowadays is that of the Convention on Biological Diversity (1992) which in its Article 2 defines “genetic resources” as “genetic material of actual or potential value.” It further defines “genetic material” as “any material of plant, animal, microbial or other origin containing functional units of heredity.”

The OECD defines “genetic resources” as “genetic material of plants, animal or micro-organisms of value as a resource for future generations of humanity”.

Accordingly, “genetic resources” can be defined as “any material of plant, animal, microbial or other origin containing functional units of heredity and having actual or potential value”. The key elements of this definition (“heredity”, “plant, animal, microbial or other origin” and “actual or potential value”) are found in other definitions, highlighted below:

Dunster J & K (2011 - Dictionary of Natural Resource Management) discuss the heritable characteristics of a plant or animal of real or potential benefit to people by indicating that “genetic resources are the heritable characteristics of a plant or animal of real or potential benefit to people. The term includes modern cultivars and breeds; traditional cultivars and breeds; special genetic stocks (breeding lines, mutants, etc.); wild relatives of domesticated species; and genetic variants of wild resource species. A “wild genetic resource” is the wild relative of a plant or animal that is already known to be of economic importance”.

The term “modern cultivars and/or breeds” is often associated with the expression “improved material” and often refers to material improved by modern breeding techniques as shown below:

- “In the broad sense, any cultivar obtained by conscious human activity. The term is generally used, however, to refer only to those cultivars obtained by private companies or public institutions dedicated to plant breeding.” (Wilkinson & Castelli, 2000. The Internationalization of Brazil's Seed Industry: Biotechnology, Patents and Biodiversity).
- “Varieties or cultivars of crops that have been improved through breeding or genetic engineering” (RE-FARM database).

The term “improved material” can be used in a wider sense, referring to material improved by mankind. In this wider sense, improved material (plant varieties or animal breeds) may also stem from farmers’ activities, including (1) Variety or breed enhancement (i.e. selection within a variety/breed under certain conditions to re-establish preferred traits), (2) Selection from segregating populations obtained from public institutions, and (3) Further autonomous selection from traditional farmers’

varieties/breeds, resulting in new varieties and breeds with new properties. For example, landraces are commonly understood to be the result of unconscious selection under given climatic and eco-system conditions, whereas the term farmers' variety is often used to indicate the products which result from conscious farmer breeding and selection.

For the American Genetic Resources Alliance (1998) genetic resources are "the genes, stored as germplasm (seeds, tubers or other reproductive parts of plants), that can be used to develop new crops and crop varieties or to protect existing crops from pests, diseases or environmental stresses". This definition considers only the plant domain.

Cooper et al. (1992) present genetic resources in a strict sense as "the physical germplasm (heredity materials) which carries the genetic characteristics of life forms". Cooper adds that in a broad sense genetic resources includes "technologies and social and environmental systems through which germplasm is a cash economic resources".

The term "germplasm" is used by Cooper and many other scientists as a synonym to "genetic resources" or "genetic material", with "germplasm" being defined as "any living material; can be used for propagation and breeding purposes, emphasis on its genetic contents" (Almekinders & Louwaars, 1999. Farmers' seed production: new approaches and practices).

With regard to the term "potential value", Reintjes et al. (2010) indicates that genetic resources are "plant and animal stock with distinct inheritable characteristics of (potential) use within the agroecosystem". Kemp R.H. (1993) adds to the above that "genetic resources" can be defined as the "economic, scientific or social value of the heritable materials contained within and between species". Therefore "potential value" should not only be seen by looking at the economic dimension of the "value" but also by considering additional scientific and socio-economic factors.

All in all, the definition of "genetic resources" selected for the study is the simplest definition containing the three key elements mentioned above: "Any material of plant, animal, microbial or other origin containing functional units of heredity and having actual or potential value". De facto, this definition includes all material, whether it is improved (in its wider sense as described above) or not.

2.2. The different domains of genetic resources covered by the preparatory action

This project focused on the domains of plant, animal, forest, microbial and invertebrate genetic resources for food and agriculture. It largely adopted the FAO scope for these genetic resources.

The assessment of plant genetic resources addressed all food crops but excluded ornamental crops as well as crops cultivated for other purposes, such as for bio-fuel, pharmaceutical or cosmetic use.

The assessment of animal genetic resources for food and agriculture included all farm animals; however aquatic species were not addressed.

Forest genetic resources did not only include species for food and agriculture but all species for which the genetic resources are actively managed in Europe.

The assessment of microbial genetic resources for food and agriculture addressed beneficial microbes as well as pathogens in agriculture, as well as those species used in food processing.

Genetic resources endemic in those areas under European jurisdiction outside the European continent were not covered.

Finally, both genetic resources kept under *in situ* and on-farm conditions and those kept in the form of *ex situ* collections were studied.

2.3. "Conservation" of genetic resources

2.3.1. Definition and objectives

The fundamental objective of genetic resource conservation is the maintenance of broad based genetic diversity within each of the species (i.e. intra-specific genetic diversity) with a known or potential value in order to ensure availability for exploitation by present and future generations.

2.3.2. The major conservation approaches

The approaches for the conservation of genetic resources vary widely. The most important distinction is the one between *in situ* and *ex situ* approaches.

Literally, *ex situ* means "out of place". In the context of the conservation of species, breeds or crop varieties, it means "activities that take place outside of their natural habitat" (Article 2 of the CBD Convention, 1992). As defined by the Convention on Biological Diversity (CBD, 1992) and the International Treaty on Plant Genetic Resources (FAO, 2001), *in situ* conservation means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated plant species, in the surroundings where they have developed their distinctive properties". The CBD regards the *in situ* conservation approach as central, and *ex situ* efforts a complementary. Such interpretation does not apply well to European agriculture, for which in particular for plant genetic resources the *ex situ* approach has become central due to the industrialisation of agricultural production.

The Crop Genebank Knowledge Base¹⁸ gives the following definitions:

- *In situ* conservation is a conservation method that attempts to preserve the genetic integrity of genetic resources by conserving them within the evolutionary dynamic ecosystems of their original habitat or natural environment;
- *Ex situ* conservation is the conservation of biodiversity outside its natural habitat; in the case of plant genetic resources this may be in seed genebanks, in vitro genebanks or as live collections in field genebanks.

For farm animal genetic resources, the following definitions and characteristics are presented in the FAO 2nd (draft) State of the World's AnGR.

- In vivo conservation is conservation through the maintenance of live animal populations. It encompasses both *in situ* conservation and *ex situ* in vivo conservation;
- *In situ* conservation is conservation through continued use of live animal populations by livestock keepers in the production system in which the respective populations evolved or are now normally found and bred;
- *Ex situ* in vivo conservation is conservation through the maintenance of live animal populations not kept under normal management conditions (e.g. in a

¹⁸ <http://cropgenebank.sgrp.cgiar.org/> consulted September 30th 2015

zoological park or a governmental farm) and/or outside the area where they evolved or are now normally found and bred; and

- *Ex situ* in vitro conservation is conservation through the maintenance, under cryogenic conditions, of cells or tissues that have the potential to be used to reconstitute live animals and populations at a later date.

Microbial genetic resources are to a very large extent kept in the form of culture collections, i.e. under *ex situ* conditions.

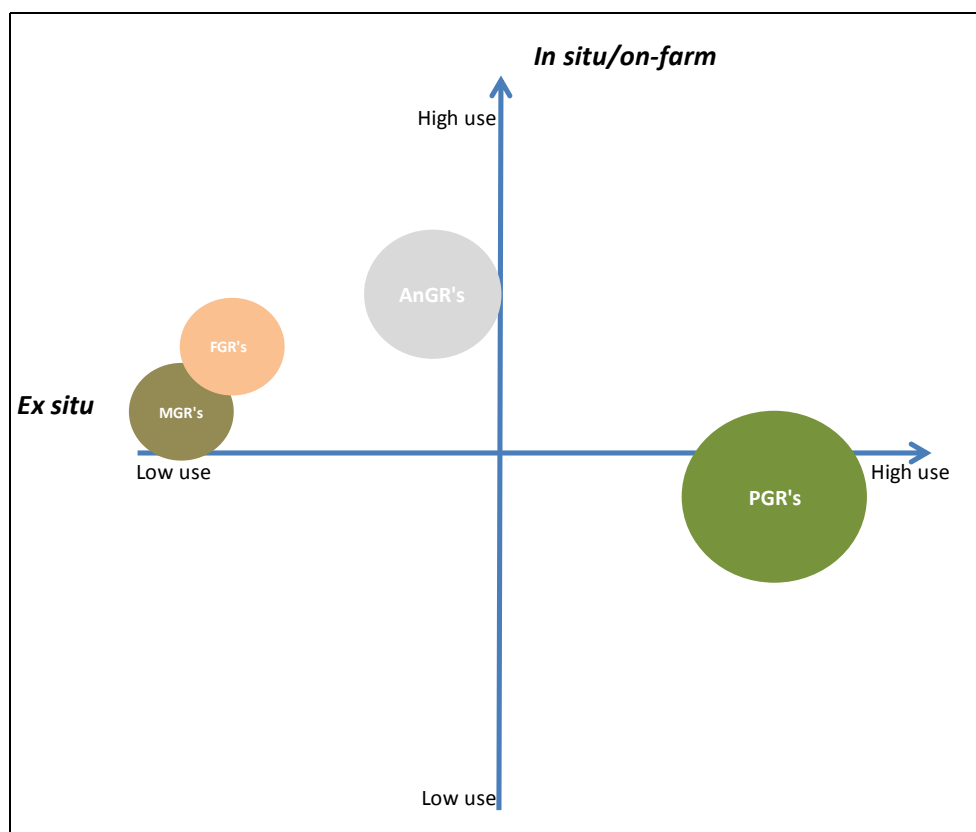
Multiple publications have indicated that *ex situ* and *in situ*/on farm approaches are complementary to promote the conservation and sustainable use of genetic resources. These complementary conservation strategies each have advantages and disadvantages with respect to specific conservation objectives, and individual strategies can include a wide range of activities to support the conservation and sustainable use of genetic resources. There is a variety and large number of stakeholders, contributing to or leading particular conservation strategies. Historically, intensive debates in conferences organised by FAO have addressed the pros and cons of these approaches, largely taking into account the interest of various stakeholders. Whereas farmers are in control of *in situ* approaches, academic institutions funded by governments keep the *ex situ* collections, rendering the balance between the approaches not only a technical but also a socio-economic and political affair.

In situ conservation is the default conservation method that was unconsciously applied since the dawn of agriculture some ten thousand years ago. Farmers grew crop diversity in their fields, herded their animal diversity, and the related wild species were retained in nature. The adaptation of domesticated species to new habitats and new producer and consumer demands developed slowly but continuously, creating the diversity that existed when scientific breeding, both in crop plants and in animal breeds started in the nineteenth and early twentieth century. The new scientific methods had a revolutionary effect on the yield and quality, but also the homogeneity of the resulting breeding products. The Green Revolution in developing countries in the sixties of the previous century lifted this development for crop plants to another level and as a result modern homogeneous varieties started replacing on a global scale the original diversity. A similar process took place in the livestock sector. Specialised, high productive breeds were developed. Specialised breeds gradually replaced local breeds, and many farm animals are now kept under controlled conditions. Furthermore, human influences on the environment destroyed the natural habitats of wild relatives. These combined factors caused a loss of diversity in the crop and animal species that was coined "genetic erosion". Since diversity functions as the raw material and basis of the breeding process, the active conservation of the diversity was considered necessary to be able to continue to breed for improved materials, and from this notion the various conservation approaches developed.

Whereas forest species are generally conserved by protecting their natural stands (*in situ*) or creating collections of growing populations (*ex situ*), microbial diversity is generally conserved and stored *ex situ*, mostly at low temperature, e.g. in liquid nitrogen (cryo conservation), or in dried form (lyophilized; lyo conservation). Animal genetic resources are usually conserved in live breeding populations, managed by individual farmers/breeders, breed societies, breeding industry or hobbyists (*in situ*), but also to a lesser extent *ex situ*, keeping sperm, egg cells or embryos at low temperatures, as a complementary strategy to the *in situ* approach. Plant genetic resources are mainly conserved in seed collections (*ex situ*), as these are cost-effective and secure. However, where this is not possible field collections of living plants have to be made or alternatives such as in vitro collections (i.e. tissue cultures in tubes with a growing medium) are used or embryonic tissue is stored in liquid nitrogen (all *ex situ*). For crop wild relatives the preferred conservation approach is *in situ*. Conserving cultivated crops in their original

farming systems, is termed on-farm conservation, and is such part of the *in situ* approach. For conservation purposes this method generally has its limitations within Europe, due to the low remaining diversity in the hands of farmers and hobbyists. However, on-farm conservation holds large advantages regarding the improvement of the visibility of, access to and use of these resources.

Figure 4: Relative importance of *in situ* vs. *ex situ* conservation methodologies per domain

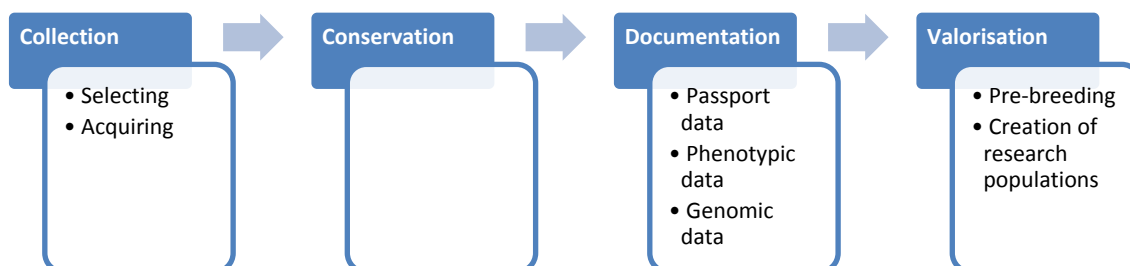


Note: The size of each group indicates the volume of conservation activities per domain (estimated by the study team based on the results of the mapping exercise and desk research).

2.3.2.a. The different steps of *ex situ*

Ex situ conservation consists of various steps, which are outlined below.

Figure 5: Main activities of *ex situ* collections



Collection

Collecting material for an *ex situ* collection has three components: selecting the material, collecting it and making it ready for conservation.

The first component, **selecting the material for conservation**, involves the decision regarding size, domain and composition of the collection. For example, a barley collection can consist of 50 local landraces from Germany, but can also be a global collection of 5,000 accessions, with 2,000 landraces, 2,000 modern varieties, and 1,000 crop wild relatives. Obviously the composition of these sub-groups also needs to be decided in a similar way. However, this step of conscious composing is often neglected in the creation of a collection; decisions regarding the composition are usually taken on an opportunistic basis, resulting in highly unbalanced collections.

The second component of collecting is **acquiring the material**, for which the methods used vary highly between types of material. Modern varieties can simply be requested from companies or bought in shops, old varieties from research organisations, but landraces and crop wild relatives generally need to be collected *in situ*. The appropriate methodologies have to be followed for sampling the genetic material in terms of sampling the genetic composition of populations, and acquiring sufficiently high quality material. Whatever the collecting methodology, the appropriate legal requirements have to be met. Depending on the type of material and the origin countries, these requirements can include material transfer agreements, phytosanitary or veterinary certificates, import permits, etc. following national legislation and international arrangements, including the Convention on Biological Diversity and the Nagoya Protocol.

Once the biological material has been acquired, a final round of quality check (germination and health) and regeneration (to increase quantity or quality) can be required. When possible the identity of the material should also be confirmed.

Conservation

Once the material is available, it needs to stay available. This implies that the quality and quantity need to be maintained, and if one of these drops below pre-defined levels, action needs to be taken to improve quality, often via rejuvenation, or quantity, often via multiplication. Methodologies vary per type of material. For most crop plants, seeds can be produced which can be dried and frozen, provided that the seeds are orthodox. Other approaches are needed if the seeds are recalcitrant, or if the material needs to be conserved clonally. These approaches include "field genebanks" with perpetually growing plants, including fruit trees, or tissue culture on growth media, so called *vitro* culture, or in liquid nitrogen, so called in cryo preservation. For other domains, other approaches are more common. Animal genetic resources are generally conserved as sperm in cryo, forest species in field genebanks, and microorganisms either in cryo, dried form or growing in media.

Documentation

The third step, gathering the information needed to make the material useful, is rather straightforward. What information is needed to help the potential user select the material for inclusion in his/her breeding or research programme? In the first place, this includes information about the identity of the material, the so-called **passport information**; taxonomic classification, ancestry, variety name, collecting site, etc. In the second place, it is the **phenotypic properties** of the material. These can be generated in simple screenings or by making field observations, and include traits such as disease resistance, growing speed, milk production, ability of microbes to assimilate specific carbon or nitrogen sources and/or ferment different carbon sources or colour of the flower. But often screening these traits will involve complex evaluation techniques, inoculation with specific strains of the disease, experimental plots with highly controlled conditions, complicated chemical assays, long experiments, etc. that will not always be feasible for

the collection holder. Therefore, collaboration with other actors will often be required. This is also true for the third category of information needed, as it concerns **genomics and other types of -omics data** that not only require specialist knowledge and equipment for collecting and processing, but also cause new challenges in terms of processing and valorising the information. Finally, creating the user interfaces allowing potential users to optimally use the available information to select the most appropriate material is a largely unexplored area with potential.

Valorisation

The final step in increasing access and adding value to potential users involves manipulating the genetic composition of the material. This can be **pre-breeding**, i.e. bringing exotic genes in an adapted genetic background via backcrosses or in evolutionary breeding schemes, but can also involve **creating research populations** (RIL's, NIL's, SSD- or MAGIC-populations) allowing the better identification of individual genes and their location in the genome. This step also requires specialist expertise which is generally not accessible to the collection holder, and is often not even considered part of the mandate of GR collection management.

2.4. Definition of "sustainable use" of genetic resources and methodologies

The "sustainable use" of genetic resources is defined in Article 2 of the CBD. It is the use of components of biodiversity in a way and at a rate that does not lead to the long-term decline of biodiversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. The term includes specificities related to the type of genetic resource considered. They read as follows:

Plant Genetic Resources for Food and Agriculture

Sustainable use of plant genetic resources for food and agriculture in its broadest sense means to encompass the whole range of actions involved in the conservation, diversification, adaptation, improvement and delivery to farmers through seed systems. Plant breeding acts as a bridge between conservation in genebanks and seed systems that deliver improved and local varieties to farmers, whether they are produced by breeding companies and institutions or by farmers.

The sustainable use of PGRFA can involve different technical solutions and actions, such as the intensification of production, plant breeding, characterisation, evaluation and number of core collections, genetic enhancement and base-broadening, diversification of crop production and broader diversity in crops, development and commercialisation of under-utilised crops and species, supporting seed production and distribution, as well as developing new markets for local varieties and "diversity-rich" products. The sustainable use of PGRFA also includes the fair and equitable sharing of the benefits arising from the use of PGRFA and agrobiodiversity management, through appropriate strategies and the participatory involvement of stakeholders. Seed systems include both the dominating commercial seed system as well as alternative local seed systems maintained by hobbyists, gardeners and non-governmental organisations.

In order to reach food security, to increase livelihoods and sustainability in production systems, and to respond to climate change, crops need to be improved. The **starting point for improvement in plant cultivation** is to record, assess and use genetic variation among plant genetic resources, for characteristics such as capacity to resist heat and dryness as well as diseases and pests. The basic prerequisite for choosing parents to cross PGR and the following selection cycles is characterisation and evaluation. In the context of research on plant cultivation, the challenge is to record this genetic variation safely and effectively, and to use it rapidly. This is the overall objective of pre-breeding. For this purpose, there are cell and tissue culture procedures available today,

and also molecular techniques allowing the recording of characteristics at the level of genetic material. The basis for work of this kind is as large as possible a spectrum of plant genetic resources.

Increasing the genetic diversity in elite-cultivated material can be reached through different approaches, which range from storing individual resistance genes from wild forms to producing so-called introgression lines, containing defined chromosome segments from wild forms or respectively wild species. Beyond this, composite crosses can greatly contribute to making plant genetic resources usable and to developing them further.

Apart from using plant genetic resources in the context of research or plant cultivation, they can also be used to market so-called **"diversity products"**, i.e. products from certain varieties or other species, currently rarely used.

Within this, potential should also be attributed to those procedures which succeed in integrating important goals of biodiversity protection into productive (i.e. economically viable) systems of use, e.g. in the classic uses for production of food and animal feed, in the main activity areas arable land, grassland management and fruit farming/wine growing. However, "renewable raw materials", "organic energy" and "climate protection" are increasingly acquiring importance as **areas of production**, in terms of conserving and sustainably using plant genetic resources. As stated above, these latter activities have not been addressed in the context of this preparatory action.

Animal Genetic Resources for Food and Agriculture

As with plant genetic resources, the sustainable use of animal genetic resources is related to their current and potential value. The current economic value consists of the contribution of animal genetic resources to the agricultural value chain. Even rare breeds have a current value e.g. by contributing specific characteristics to breeding programmes of commercial lines and populations. In addition, the characteristics of regional breeds are important for niche demands and programmes. Animal production in marginal areas and nature areas and extensification programmes require breeds that differ genetically from the dominating populations in intensive production systems. Great ecological value is attributed to certain breeds used in nature protection and landscape management. The potential economic value of animal genetic resources is their genetic diversity itself, which one day may be used for new innovative breeding purposes. It is expected that with advanced application of molecular biotechnology in breeding, useful genes that determine product quality, animal vitality and disease resistance will be found even in rare breeds, making them valuable for future breeding programmes.

The sustainable use of animal genetic resources is based on herd-book management. This involves the identification, tagging and registration of farm animals in herd-books together with the documentation of their ancestry. In the EU these essential principles are regulated for a couple of species in the EU zootechnical legislation. Agri-environmental programmes (Art. 28, Council Regulation (EC) No 1305/2013) are an important EU agricultural policy for the sustainable use of rare breeds, too.

At present, even organic farming is dominated by high-performance breeds. By using genetic resources from rare breeds, some livestock keepers seek to maintain healthy livestock because it is assumed that these breeds are more appropriate for production under organic conditions.

Breeds are also a cultural and historical achievement of previous generations. They therefore have to be valued as bio-cultural heritage and be preserved from extinction. This becomes more important for the tourism sector, where the display of historical

landscapes, traditional production systems and lifestyles with these traditional breeds attracts visitors and tourists.

Forest Genetic Resources for Food and Agriculture

Forest genetic resources are essential for the adaptation and evolutionary processes of forests, trees and shrubs as well as to improve their productivity. Genetic adaptedness and adaptability ensure that the forests are sufficiently stable to serve all forest functions and are able to cope with climate change. The ability of the forest ecosystem to react to damaging biotic and abiotic factors is of high importance for all forest functions. In particular, in light of the non-foreseeable consequences of climate change, forests with manifold species composition and broad genetic amplitude offer the best prerequisite for adaptable forest ecosystems that will remain stable in the future.

The first concept of sustainable forest management was defined in 1713 by Hans Carl von Carlowitz. Nowadays, sustainable forest management is defined, according to Forest Europe, as "the stewardship and use of forest lands in a way and at a rate that maintains their productivity, biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil now and in the future relevant ecological, economic and social functions at local, national and global levels and that does not cause damage to other ecosystems."

Multifunctional forest management ensures an efficient and sustainable timber production. The amount and quality of timber is partially determined by genetically influenced factors such as growth characteristics, timber quality, type of stem and other wood characteristics (density, ability to branch, heating value, etc.). Therefore, the availability of suitable forest reproductive material with a high degree of adaptability, good growth potential and high quality is of great significance to the regeneration of forests.

In addition, the protective functions of the forest for water, soil, ecosystem, and species protection and as a carbon dioxide sink as well as its recreational function are of high cultural, social, ecological and economic value (ecosystem functions).

Microbial and Invertebrates Genetic Resources for Food and Agriculture

Microorganism and invertebrate genetic resources exist all along the agro-food value chain (from agricultural inputs to final products).

Microorganisms have a history of being cultivated and technologically used. Lactobacillus or Acetobacter species or pure breeding yeasts (*Saccharomyces cerevisiae*) are inoculated for the treatment and processing of food and feedstuff as well as in the production of beverages. The main uses of MiGRs are:

- In plant breeding (resistance breeding for introgression of genes in cultivars to allow plants to be resistant to pathogens; and therefore reducing the use of pesticides);
- To benefit human, animal and plant health. Identifying and introducing resistances in food to protect it and then human, animals, and plant health threatened by numerous microorganisms and invertebrates (example: black rust, mycotoxins);
- For biological control. Vertebrates and microbiological control agents are used in agriculture and horticulture to decimate pests or perform other useful functions in increasing or stabilising yield by protecting crops and plants and enhancing their nutritional functions;
- Soil organisms. Soil organisms are the basis for the health status of plants and thus also for the yield and quality of the harvest. Microbial symbioses (e.g. mycorrhizae) can contribute to improved plant growth under unfavourable conditions;

- Pollinators. Most flowering plants depend on fertilisation through insects. Consequently, a significant number of invertebrate pollinator species are essential as a source of pollinators for crops. The diversity of these pollinators must be maintained to maintain the crops; and
- Energy and material use of biomass. Biochemical conversion processes such as the production of biogas or ethanol production are based on fermentation processes (enzymes). These microbial metabolic products are used to produce renewable energies. There are biological communities of different genera and species of bacteria in biogas plants.

2.5. The actors of the conservation and sustainable use of genetic resources and the business activities covered by the preparatory action.

Many actors are involved in the conservation and sustainable use of genetic resources. The importance and role of each of this type of actor differ from one category of GR to the other. This chapter aims at briefly presenting the different group of actors (the stakeholders), the dynamic of which is largely discussed in Part 3.

Therefore, this chapter lists and describes the different groups of actors/stakeholders (in alphabetical order) based on the scope of the preparatory action as presented in Section 2.2 above).

- **Advisory services (extension and agricultural):** Agricultural advisory services are defined as services that make new knowledge available to farmers and assist farmers in developing their farming and management skills. The terms “advisory services” and “extension” are used interchangeably in the framework. The services may include:
 - Dissemination of information;
 - Training and advice of groups of farmers or individual farmers;
 - Testing new technologies on-farm;
 - Developing and disseminating farm management tools¹⁹.
 - Technical institutes, “chamber of agriculture”, “Landwirtschafts-kammer” are well-known examples of advisory services in agriculture. In general terms, this group of stakeholders is not recognised as a major actor in the conservation and sustainable use of GRs;
- **Botanical gardens:** a botanical garden is a garden dedicated to the collection, cultivation and display of a wide range of plants. Botanical gardens are often run by universities or other scientific research organisations, and often have associated research programmes in plant taxonomy or another aspect of botanical science. In principle, their role is to maintain documented collections of living plants for scientific research, conservation, display, and education, although this depends on the resources available and the special interests pursued in each specific garden. Two networks allow the exchange of GR material, experience and good practices. The European Botanic Gardens Consortium acts as the network for National networks in Europe. It provides a valuable conduit for information flow and co-operation between the national associations of botanical gardens as well as between individual institutions. As well as organising regular European Botanic

¹⁹ Neuchatel Group, 2006, “Demand Driven Agricultural Advisory Services” available at: <http://www.g-fras.org/fileadmin/UserFiles/Documents/Frames-and-guidelines/New-paradigms/Demand-Driven-Agricultural-Advisory-Services.pdf>

Gardens Congresses (Eurogard), the Consortium has also promoted and helped to lead other significant international initiatives, such as the IPEN - the International Plant Exchange Network. The second network is the Botanic Gardens Conservation International which is the foremost source for information on Botanic Gardens at global level, particularly on the Global Strategy for Plant Conservation. The plant search facility allows plants to be located in botanical gardens throughout the world.

- **Breeders:** Animal and plant breeding is the science of changing the traits of animals and plants in order to produce desired characteristics. Breeding is practiced worldwide by individuals such as gardeners and farmers, or by professional plant breeders employed by organisations such as government institutions, universities, crop-specific industry associations and research centres. Breeding can be accomplished through many different techniques ranging from simply selecting plants with desirable characteristics for propagation ("conventional breeding"), to more complex molecular techniques ("modern breeding"). Appearances of modern techniques have led to the set-up of a new breeding phase which takes place before conventional breeding (so-called "pre-breeding"). This group also includes the farm animal breeding industry, which engages in the breeding and reproduction of farm and companion animals.
- **Experts in charge of agricultural GR:** This group includes dedicated experts in genetic resources who are present in several coordination bodies, particularly in:
 - European Cooperative Programme for Plant Genetic Resources (ECPGR)
 - European Forest genetic Resources Programme (EUFORGEN)
 - Microbial Resources Research Infrastructure (MIRRI)
 - European Regional Focal Point for Animal Genetic Resources (ERFP)
 - International organisation (at least FAO, ITPGRFA and CBD).

In most of cases, these experts have a scientific background and are acting in the research sector.

Under this category we also include specialists in the conservation of GRs (e.g. gene bank and culture collection managers, curators, database specialists, etc.).

- **End-users:** The end-users group is composed of different sub-groups of stakeholders. These include:
 - Restaurants which are promoting the consumption of rare breed meat and/or minor crops;
 - Short supply chain initiatives;
 - Tourism sector;
 - Retailers; and
 - Consumers.

In the conventional supply chains based on traditional breeding, it can be considered that end-users of e.g. new varieties and improved animal breeds are not consumers (the stakeholders at the end of the food chain) but rather producers and farmers. When the added value of the improved variety or breed is well known by farmers, breeders and producers, this value is often not recognised by other downstream actors in the food chain. This may explain why genetic resources are often perceived by consumers as something that covers only rare breeds, neglected/underutilised varieties and old material.

- **Farmers:** This group includes farmers' networks and farming organisations covering all different types of agriculture, e.g. conventional farming as well as organic farming, involved in actions aiming at promoting the use of neglected crops and rare breeds as well as in the dynamic conservation of genetic resources (*in situ* and on-farm conservation). The number of part-time farmers and hobbyists keeping farm animals and landraces is increasing in Europe. These hobbyists play an important role in the conservation of local GRs;
- **National governments:** First, this group refers to different competent authorities involved in the promotion of the conservation and sustainable use of GRs. In countries where conservation programmes are established, national authorities play a central role in the development and funding of such activities (e.g. via research policies). Authorities in charge of implementing and monitoring the different EU policy frameworks related to the agro-food supply chain (e.g. CAP, food safety, environmental, and research policies, Nagoya Protocol) as well as authorities implementing national obligations related to EU agreements (e.g. ITPGRFA, national focal points for GRs) are also included in this category. Secondly, there are many types of governmental institutions, including scientific and technical institutes, farm parks and museums in which GRs are conserved.
- **Gardeners' networks, gardeners' organisations and amateurs' groups:** Gardeners and amateurs play a significant role in preserving genetic resources and biodiversity as a whole. Their role in preserving biodiversity in both landscape and urban areas is increasingly recognised.
- **NGOs.** NGOs conserve and stimulate the maintenance of local GRs through (often part-time) farmers and hobbyists. These NGOs and their members play a crucial role in the conservation of local GRs in both the plant and animal sectors. In general, the participation of individual breeders in breeding and conservation programmes is often on a voluntary basis. Therefore, the sustainability of the conservation of GRs through these projects can be uncertain. In many countries research institutions and universities provide expertise and professional support for conservation activities carried out by breed associations. Seed saver networks (e.g. Peliti in Greece) and seed savers' organisations (e.g. Arche Noah in Austria) are often NGOs. Several NGOs are also promoting the use and consumption of products from rare breeds and neglected/underutilised crops (e.g. Slow Food);
- **Researchers.** Research plays are key actors in the identification and functional classification of genes, as well as the detection of genome sequences that correlate with desirable phenotypes. These activities have helped harmonise the objectives of molecular genetics and breeding. This work is mainly performed by academic scientists at university and research institute levels. In many cases, scientists are also genebank managers and culture collections curators. Botanic gardens can also be considered as part of this group as their role is i.e. to "hold documented collections of living plants for the purposes of scientific research, conservation, display and education". Many universities and research institutes try to conserve regionally developed GRs, which are no longer used by the industry. They pay a lot of attention to the maintenance of genetic diversity within these populations. However, their role is threatened by cuts in public funding.

PART 3: ANALYSIS OF THE THEMES OF THE PREPARATORY ACTION

This chapter presents the findings and conclusions for each of the seven themes of the preparatory action:

- Improvement of the communication between MS concerning best practices and the harmonisation of efforts in the conservation and sustainable use of genetic resources (Theme 1);
- Enhancing networking among key stakeholders and open-users in view of exploring marketing (and other cooperation) opportunities, such as provided by quality schemes and short supply chains (Theme 2);
- Improvement of the exchange of knowledge and research on genetic diversity in agriculture systems (Theme 3);
- Adaptation of breeding methods and legislation to the need of conservation and sustainable use of genetic resources (Theme 4);
- Contribution to the successful implementation of rural development measures concerning genetic diversity in agriculture (Theme 5);
- Explore bottlenecks and enabling conditions for the sustainable use of genetic resources in agriculture (Theme 6); and
- Reduction of the unnecessary administrative burden so as to provide better access to actions (Theme 7).

The analysis of each theme starts with background information as well as the preparatory action's team understanding of the issues at stake. Findings are then reported. The analysis ends with a list of the main conclusions for each of the seven themes. Finally, practical recommendations are made.

Thereafter, these conclusions per theme are discussed under Part 4: General conclusions where they are used to form recommendations, presented in Part 5.

3.1 Theme 1: Improvement of the communication between MS concerning best practices and the harmonisation of efforts in the conservation and sustainable use of genetic resources

This theme addresses the improvement of the communication between the various stakeholders and actors in the MS concerning best practices and the harmonisation of efforts in the conservation and sustainable use of genetic resources. Harmonised and coordinated activities are supposed to help bring about synergies and EU added value while limiting overlaps. This theme was targeted towards actors and stakeholders at the national level; however relevant activities at regional level were also taken into account.

3.1.1. Comprehension of Theme 1

Theme 1 of the preparatory action covers communication activities related to conservation and use of genetic resources in agriculture in the EU Member States, in particular concerning best practices and harmonisation of efforts regarding plant (crops and forestry species), animal, microbe and invertebrate genetic resources.

Thus, this theme first concentrated on information about stakeholders at national level in each Member State, their activities at the national level, and best practices, covering the variety of areas involved in the conservation and sustainable use of genetic resources.

These areas include the management of populations *in vivo* and/or *in situ*, the management of genetic resources in *ex situ* collections including safety duplicates, documentation of collections, as well as of breeds and varieties held *in vivo*, characterisation and evaluation of genetic resources, and supporting national inventories, databases and services offered to the user communities.

This theme first intended to assemble information concerning the communication channels presently used by the national authorities on genetic resources; and, secondly, on the ways and means by which a variety of actors and stakeholders share and exchange knowledge. Communication channels between the non-institutional actors are also discussed under Theme 2 and Theme 3. This theme also considers relationships and interactions between the main conservation approaches and the communication channels of the actors involved (in particular the relationship between *in situ* and *ex situ* conservation efforts).

This theme considers on the one hand the participation in formal networks (including regional networks) in which both MS authorities and experts are active. Furthermore, this theme investigates the communication activities aimed at the regional harmonisation of efforts in the conservation and use of genetic resources, based on regional initiatives such as the European Regional Focal Point for Animal Genetic Resources (ERFP), the European Forest Genetic Resources Programme (EUFORGEN), the Microbial Resources Research Infrastructure (MIRRI), the European Cooperative Program for Plant Genetic Resources (ECPGR) and its associated networks, the European Genebank Integrated System (AEGIS), and the EURISCO Web Catalogue, and others.

The analysis of the information gathered for this theme, which came from interviews, and various case studies and workshops, allows a thorough display of best institutional communication practices available in the areas described. The analysis also serves to identify those areas and practices that offer room for improvement based on proficiency, efficiency and effectiveness. Furthermore, it provides an indication of potential overlaps. The analysis also reveals the effectiveness of current institutionalised communication linkages and activities as they relate to the harmonisation of practices for the conservation and sustainable use of genetic resources across Member States.

Finally, the analysis of information obtained helps detect gaps (e.g. in capacity) that prevent both effective institutional communication between countries and stakeholder groups, as well as the implementation of best practices.

3.1.2. Methodology and tools for Theme 1

Several data sources were used to collect data and information on this theme. First, the mapping exercise (Task 1) helped to identify a multitude of actors and describe the main communication channels functioning within the EU. Interviews (Task 4) and the case studies (Task 5) and workshops (Task 6) were the major further data sources for this theme.

A preliminary analysis of the results of the interviews and case studies led to the conclusion that collaboration and integration between *in situ* and *ex situ* communities, especially in the plant genetic resources sector, was a perceived weakness and a subject of concern. Therefore, a dedicated workshop (Task 6) was conducted to discuss and evaluate this relationship between *in situ* and *ex situ* approaches. The workshop provided significant additional information which has been used in the analysis of this theme. Moreover, a workshop on the implementation of FAO's Global Plans of Actions for GR in the EU gave relevant information about communication mechanisms between the MS.

3.1.3. Analysis of Theme 1

Several communication channels exist in the field of genetic resources, the main ones being:

- Communication between stakeholders involved in *ex situ* conservation (e.g. through ECPGR, ERFP, EUFORGEN, MIRRI) and additional sub-regional platforms;
- Communication between stakeholders involved in *in situ* management (peasant networks, hobby breeders and seed savers networks, NGOs, mushroom growers); and
- Exchanges between the two communities.

The effectiveness of current communication mechanisms was a topic discussed during the interviews with a majority of stakeholder groups. While the perspectives differed depending on the characteristics of the stakeholder groups, the overall patterns identified seemed to align and to provide for a coherent picture.

Most interviewees reported cross-border cooperation involving stakeholders in other EU Member States (MS), and in many cases also in other European countries. The nature and extent of the collaboration varied according to the stakeholder group, domain and objectives of the organisation or network interviewed. Information gathered is summarised below:

1. European regional networks, such as the European Cooperative Programme for Plant Genetic Resources (ECPGR), the European Regional Focal Point for Animal Genetic Resources (ERFP), and the European Forest Genetic Resources Programme (EUFORGEN), and the Microbial Resources Research Infrastructure (MIRRI) play a major role. National governments are members of each of these networks and represented in their governance structures, while national stakeholders are involved in activities within the networks.

ECPGR was founded on the basis of the recommendations provided by the UN organisations UNDP and FAO and by the European organisation for plant breeding EUCARPIA. Currently, ECPGR has organised itself in 21 working groups involving experts from genebanks, research institutions, breeding institutes, and NGOs. ECPGR also established EURISCO, a common search catalogue providing information about *ex situ* plant collections maintained in Europe, and AEGIS, a virtual European collection which aims to provide germplasm accessions and their related information registered in AEGIS by making high-quality samples readily available and easily accessible to users under standard conditions. ECPGR's activities are strongly focused on *ex situ* conservation, although it also features two working groups on *in situ* conservation of wild relatives and on-farm management of genetic resources.

ERFP is structured in a similar way but supports equally both *in situ* and *ex situ* conservation efforts. The ERFP network of National Coordinators was initiated as the European part of FAO's global coordination structure for AnGR. ERFP initiated the development of the European database for animal genetic resources (EFABIS), which provides information at breed level. More recently, ERFP established the European Gene Bank Network for Animal Genetic Resources (EUGENA), dedicated to *ex situ* collections.

EUFORGEN is similar to the above mentioned networks, and also supports both *in situ* and *ex situ* conservation efforts, but with a strong focus on *in situ* approaches. The origins of its establishment are again different from those of ECPGR and ERFP. The regional programme was initiated based on Strasbourg Resolution S2 (Conservation of forest genetic resources) of the first Forest Europe Ministerial Conference held in 1990, and it has as the overall goal to promote the conservation and appropriate use of FGR as an integral part of sustainable forest management in Europe. EUFORGEN maintains

EUFGIS, the European information system on dynamic gene conservation units of forest trees.

MIRRI is a pan-European multi-locational research infrastructure which aims to support microbial research and development in the field of biotechnology. It is currently in its preparatory phase, with construction phase starting in May 2016.

The first three European regional networks are funded either by annual membership fees or voluntary donations from the participating countries. The European Commission is not a member and it does not provide direct, institutional funding for any of these activities. However, members of the networks are effectively participating in EU research projects, and thereby make use of funding opportunities for research, networking and innovation. According to interviews from the MiGR field, a comprehensive country involvement is still being sought for MIRRI. Only if this is obtained, stable financial support will be assured and the coordinated activities within MIRRI will actively continue.

Both the work performed by the national representatives in these formal networks, and the work and activities performed by stakeholders within the various working groups and activities of ECPGR, ERFP and EUFORGEN respectively are of great importance in the view of many interviewees.

One of the strengths of the networks is the involvement of a variety of stakeholders, including collection holders, public research organisations, NGOs and private sector breeding companies, and their associations. In particular, ECPGR was mentioned as providing a valuable platform for plant breeders to engage in working group activities. In addition, many EU research projects have been initiated by these networks. Nevertheless, the limited amount of MS funding for projects focusing on conservation has often formed an obstacle to progress, which has often been slow as a consequence of the resulting reliance on in-kind contributions by the partner organisations involved.

It was also underlined by interviewees that the value of the European regional networks lies in the fact that they focus on practical collaboration between stakeholders active in this field, while at the same time national governments involved in its governing bodies tended to give political priority to the work of the FAO Commission on Genetic Resources for Food and Agriculture and the International Treaty on Plant Genetic Resources for Food and Agriculture, as is evident from an overview and comparison of government representatives in these different bodies. Many interviewees were of the opinion that processes at the FAO level were slow and therefore of less immediate practical relevance for the work of stakeholders in the EU MS.

Suggested means to improve communication between actors in EU MS included the facilitation of more frequent physical meetings, as well as increased efforts to disseminate knowledge, best practices and agreed plans and approaches amongst the actors in the European Union MS. These suggestions were variously made in the interviews, relevant case studies, in particular on on-farm management of genetic resources, and in the workshops on the FAO GPAs and the relations between the *ex situ* and *in situ* conservation communities respectively.

2. Sub (macro) regional cooperation through initiatives such as in the form of the Nordic Genetic Resources Centre NordGen, established by five Nordic countries, forms another type of cooperation that was reported as very positive and successful.

Many interviewees highlighted the importance of cooperation between countries in specific sub regions with climatic and cultural similarities. Sub regional collaboration has also been established in the Baltic area and between the Balkan countries. The highly formalised Nordic cooperation involving NordGen is a key example of such a macro regional collaboration, which is complemented with other less formal initiatives, such as between countries on the Balkan. The practical focus of NordGen's activities is illustrated by its investments in yearly seminars where concrete and practical questions are

discussed, aiming to reach out to a larger public. In addition, NordGen manages a shared *ex situ* collection of plant genetic resources, and organises joint evaluations of its collections, and allocates specific responsibilities with one or more of the five member countries. NordGen also developed a private-public partnership (PPP) on pre-breeding, at the request of the Nordic Council of Ministers in 2011, with the purpose of supporting the development of Nordic plant breeding to satisfy the long-term needs of the agricultural and horticultural sector.

It was suggested in the report of the case study on Nordgen that the Nordic cooperation may be used as a model for European cooperation in other subregions.

3. Communication mechanisms associated with cross-border NGO and farmer/breeder networks were more often highlighted by interviewees from research institutes and other experts, in comparison to the forms of cooperation mentioned above, which were mostly acknowledged by government representatives. Initiatives referred to include those relating to crops, *inter alia* the Réseau Semences Paysannes in France, the Red de Semillas in Spain and the Rete Semi Rurali in Italy, and seed savers organisations such as Arche Noah. Their members are farmers, conservationists, consumers and scientists working together in order to reconsider the scientific, technical and legal aspects of diversity maintenance and seed management. New varieties resulting from some of these activities are often designated 'peasant varieties', a concept that was expressed in two different ways: the seed, the reproductive part of the plant linked to its terroir, and the variety, shaped by history and coevolved with farmers. While some of the objectives seem to be similar to those of the aforementioned networks, the initiatives described here tend to focus on alternative approaches, such as the conservation of genetic diversity through *in situ*/on-farm management, whereas these activities often include advocacy, e.g. regarding the protection of farmers' interests and farmers' rights, the sustainable use of genetic resources, and the possibilities for farmers to use, exchange and sell farm-saved seeds. Other networks mentioned included the SAVE Network (with a strong focus on AnGR), EAAP Cattle Network, and the European Federation for Mountain Cattle Breeds. It was indicated that the EAAP cattle network had increased its activities over the past 15 years, including on information exchange, conferences and face-to-face meetings focusing *inter alia* on the harmonisation and standardisation of breeding methods, and genomic selection against genetic diseases.

4. Botanical Gardens form another stakeholder group involved in the management of genetic resources and are mainly organised within the European Botanic Gardens Consortium. In addition, there are active sub regional groupings, such as the network of Botanic Gardens in the Baltic Sea Region.

5. Research groups and other stakeholders collaborate with many parties in various EU countries mainly through different types of **research projects** funded by the EU (FP7, Horizon2020, COST, INTERREG, etc.), by regional funding mechanisms, or by joint programming and national funding. The latter is sometimes easier to achieve due to common interests and objectives in a specific geographical area (e.g. NordGen focusing on the Nordic countries). The scientific research community in Europe plays an important role in developing and exchanging knowledge on genetic diversity and on the conservation and sustainable use of genetic resources, including through the European Federation of Animal Science (EAAP) and EUCARPIA.

6. Private sector collaboration involving genetic resources for food and agriculture was highlighted by some stakeholders (in particular from the agro-food industry and by end users). In addition, the cooperation between fine dining restaurants and associations protecting and promoting underutilised, rare, and/or local products was mentioned on various occasions. The latter initiatives may not always be easily distinguished from the activities undertaken by NGOs and similar organisations.

As an example, the international Slow Food movement involves collaboration between local producers and restaurants, but also retains a strong advocacy agenda, similar to the Swiss-based NGO Pro Specie Rara that has established product channels in cooperation with national supermarket chains (SPAR, Coop). Exchange of information and close collaboration between different stakeholders in the industry sector (e.g. bio-industry) are often difficult to carry out due to confidentiality issues.

The **large majority of interviewees communicated positive results** emanating from the aforementioned forms of collaboration. The different types of collaboration were often described as useful, valuable, and positive with regard to sharing best practices, knowledge, genetic materials, techniques, exchanges of ideas and approaches, on top of the exchanges facilitated by the established Europe-wide networks.

Furthermore, cooperation towards the development of common databases, information systems, standards, best practices and management regimes were highlighted as particularly valuable (e.g. EUFGIS, AEGIS, and EURISCO).

In practice, cooperation takes many forms and results in various activities, including conferences, workshops, publications, trainings and courses, as well as the joint establishment and maintenance of databases. Face-to-face meetings were mentioned by several interviewees as particularly important, and the lack of funding was stressed as limiting the number of possible meetings. Specific research activities of value include the description and evaluation of collections, obtaining knowledge on sampling diversity from the field, identification and preservation of mixed microbial environmental samples, as well as pre-breeding and farmer-breeding activities.

Obstacles and weaknesses to communication and cooperation between various actors in the EU MS which were often mentioned during interviews include the lack of sufficient funding available for sustained exchange and communication mechanisms, and the consequent lack of commitment from stakeholders which often have to cover expenses from their own scarce financial resources. This was particularly stated in relation to the European networks where collaboration of actors is voluntary and needs to be paid by the institutions in the member countries involved.

Representatives of some stakeholder groups (both government representatives and NGOs) indicated that they were not much involved in collaboration with stakeholders from other countries. In some cases, interviewees expressed that there was a need to cooperate more and they could see the added value of such collaboration. In other cases, however, interviewees did not see the added value, and instead they preferred working mainly within the national context (e.g. the Czech botanic garden, the Spanish GENFORD Forest genetic trials network).

Most interviewees expressed that they would prefer **further collaboration with stakeholders in other countries** and that structures for cooperation could be further improved. Some suggestions justifying further cooperation included the need to avoid duplication of efforts, e.g. to promote the *in situ*/on-farm conservation by exchange of best practices, to achieve a more coherent and complementary way of genebanking, or to establish a network/overview of genebanks in Europe enabling different actors to know where to find specific material. It should be noted that in some domains such databases are indeed already in place and can be searched on the internet. Another area of potential collaboration was risk reduction through the enhanced creation of duplicate collections in different countries to protect the genetic material contained in the genebanks.

Several interviewees also reported an issue not related to the communication channels of the networks but rather to the discussions that are taking place within these networks. For these interviewees, these networks are too much directed to research activities

whereas they should also be platforms for discussing other issues, in particular regulatory matters and Access-Benefit Sharing (ABS) obligations. With the implementation of the ABS obligations, these interviewees believe that these networks should also serve to disseminate good practices in the field of ABS. This is not yet the case, and it will be difficult to achieve as these networks are mainly composed of technical experts, whereas legal/regulatory expertise is required to communicate on Nagoya Protocol obligations.

Cross-border research projects of various nature were generally mentioned as useful, since these collaborations created major research results, and also facilitated the exchange between partners and the establishment of a more sustainable network. At the same time, it was highlighted that some EU research projects could be highly demanding in terms of administrative burden, in particular in relation to application procedures and reporting obligations. The short term nature of some projects was also viewed as a problem. One interviewee proposed to establish a common and single portal where all information on international grants could be collected and published to facilitate access to the different funding mechanisms. In addition to EU funded projects, sub-regional and national funding had also resulted in a number of research projects. The topics of such projects included research on the genetic diversity in various crops and farm animals, sources for resistance to different pathogens and diseases, and the evaluation and characterisation of genetic resources for other traits. It was noted that such research projects were considered useful for plant breeding companies since the research allowed identification of material to be used in breeding activities.

A number of interviews conducted with competent authorities provided further significant input for this theme on EU-wide communication. Some suggested issues were addressed in more depth in the context of the case studies summarised below.

- The **SAVE Foundation** formed the topic of one of the case studies. It is a European NGO with the aim of safeguarding traditional breeds and varieties. A core objective of this organisation is to support national organisations across Europe striving to reduce genetic erosion in agriculture, together with awareness raising and lobbying for the *in situ* conservation of endangered animal breeds and crop varieties. While SAVE's activities enable an important knowledge exchange through annual meetings, an electronic magazine, and research projects, involving national organisations from different countries, the lack of funding appears to limit its activities and communication efforts, as well as the further development of the organisation, to a great extent;
- **NordGen** is an example of sub-regional cooperation including activities such as conservation in the form of *ex situ* collections, and networking in the sub-region to support *in situ* management, including in the form of thematic seminars. The rationale for this level of sub-regional cooperation is that such activities focus on a specific geographical area and climate, that provides for issues and priorities related to genetic resource management which are typical for the sub-region;
- **Research projects** featuring informal and long-lasting contacts in addition to formal roles and relations were mentioned as providing important added value. This has been exemplified by various case studies, including a study on landrace inventories in Portugal, exhibiting a strong collaboration between researchers in the UK (Birmingham University) and the national genebank in Portugal. This cooperation is seen as crucial to the success and long-term impact of the research project. The partnership between these two stakeholders resulted from networking in ECPGR, in which both stakeholders are actively involved; and
- **Conservation NGOs** were mentioned in the interviews as often facing difficulties in exchanging experiences and best practices even within the country. The case studies involving local projects confirmed this notion and demonstrated that local

initiatives which are small in size may have difficulties to understand how relevant national policy and measures function within their own country and how this impact on the activities undertaken. An example from the case studies is the Lonjsko Polje Nature Park in Croatia where the staff responsible for the Nature Park are aware of the funding mechanisms and are in contact with responsible staff at national level, but do not have relevant information about whether any calls will be launched in the future to support the funding and marketing of the Turopolje pig breeds. Many local *in situ* management activities particularly struggle with these issues. This can often be related to the limited size of the activities and the resulting lack of time and capacity to keep track of various funding mechanisms and opportunities and to maintain well established relations and communication with other stakeholders. In contrast, managers of larger *ex situ* collections seem to have a better understanding of existing policy and funding mechanisms within a specific country, and therefore these stakeholders are more confident in accessing relevant information at national level. Providing accessible and targeted information for the smaller stakeholders might be helpful to their role in the *in situ* management of endangered genetic diversity.

On the one hand, formal regional networks, in particular the European Regional Focal Point for Animal Genetic Resources (ERFP) and its subsidiary, the European Gene Bank Network for Animal Genetic Resources (EUGENA); the European Forest Genetic Resources Programme (EUFORGEN) and its European Information System on Forest Genetic Resources (EUFGIS), the European Cooperative Program for Plant Genetic Resources (ECPGR) and its subsidiaries, the European Genebank Integrated System (AEGIS), and the EURISCO Web Catalogue; the European Culture Collection Organization (ECCO), the Microbial Resources Research Infrastructure (MIRRI), as well as other regional and sub-regional structures such as NordGen and the SAVE Foundation, and the many bilateral connections across Member States focusing on specific genetic resources, have resulted in essential EU wide collaboration with a relatively strong focus on *ex situ* conservation. The level of activities is limited by the exclusive reliance on national or stakeholder membership contributions to these networks and the lack of sustained funding for EU wide cooperative efforts, and for communication and exchange mechanisms.

On the other hand, a large set of smaller actors focuses on the *in situ*/on-farm management of genetic resources, often with only local or national span and confined to their specific agro-environment, as they lack capacity, time, funding, the network, as well as language capabilities to establish collaboration outside of their traditional geographic area. Whereas these stakeholders might not all benefit from the establishment of a wider technical coordination at the EU level given their focus on specific areas and species, lack of coordination and exchange of experiences strongly limits their impact and visibility and hence their capacity to effectively raise funds. Dedicated coordination at a more national level might still strengthen these initiatives considerably, and national platforms enabling networking between stakeholders involved in *in situ*/on-farm management might still provide considerable added value.

Multiple publications have indicated, including the FAO Global Plans of Action on Genetic Resources, that *ex situ* and *in situ*/on-farm approaches are/should be complementary to best effectuate the conservation and sustainable use of genetic resources. This complementarity has also been enshrined in major international legal instruments to which the EU and the MS are Parties, i.e. the Convention on Biological Diversity and the International Treaty of Plant Genetic Resources for Food and Agriculture. A dedicated workshop was organised to discuss issues on the relations between *in situ* and *ex situ* approaches across the Member States in order to reinforce collaboration and integration between the communities involved. Complementary *in situ* and *ex situ* conservation strategies have advantages with respect to overall conservation objectives, as *ex situ*

materials are usually well described and readily available but necessarily only cover part of all agro-biodiversity, whereas on-farm approaches can maintain additional diversity and keep this in use for product development and adaptation to changing conditions, keeping associated knowledge alive. Opportunities to develop, establish and enhance collaboration between various actors in the value chain are offered by a recent call in the framework of the EU Horizon 2020 programme (SFS-4-2017).

Better coordination and optimal communication at national, regional and global levels is needed to strengthen linkages between *in situ* and *ex situ* conservation efforts. In the Second State of the World on Plant Genetic Resources (PGRs) (FAO, 2010) key gaps and needs were identified, including the need for better coordination and collaboration between different stakeholders and actors, and strengthening the linkages between institutions primarily concerned with conservation and those concerned primarily with its use. The Global Plan of Action on Forest Genetic Resources (FAO, 2014) emphasised the long-term goal to maintain genetic diversity and the evolutionary processes of forest species, by better implementing and harmonising measures to conserve Forest Genetic Resources (FGRs), both *in situ* and *ex situ*, including through regional cooperation and networking. Similarly, the Global Plan of Action for Animal Genetic Resources (FAO, 2007) also indicated that activities related to *in situ* conservation, to *ex situ* conservation, and to the use of animal genetic resources for food and agriculture, have been largely pursued without adequate linkages and coordination. For the national implementation of the sector specific GPAs a limited number of Member States have built a network of relevant stakeholders within the framework of a National Programme for GR, e.g. Germany. These National Programmes for GR include national actions for the conservation (*in situ*/on-farm, *ex situ*) and sustainable use of PGR, FGR and AnGR.

During the *in situ/ex situ* approaches workshop, concerns were expressed with regard to the need to improve communication between all stakeholders (particularly including genebanks) in order to allow and develop the dissemination of genetic material and information to farmers (supported by data on characterisation and evaluation accessible from databases also providing information on IPR). The lack of transdisciplinary exchange and networks to bridge the gap between on-farm management activities, food chain development and policy support; and the varying culture of the different stakeholders (formal versus informal approaches) was also highlighted by the workshop participants as a major challenge to deal with. The workshop participants raised the need to discuss progress across domains (plant vs. animals, vs. forest), bearing in mind that each of the three domains was highly specific in terms of overall structure, balance between *in situ* and *ex situ* efforts, balance between conservation and use, the number and type of stakeholders in the "GR Development Chain", the role of each stakeholder, and R&D technologies used. Several participants appreciated having a cross domain exchange which could lead to identifying "new ideas" for a given area. This aspect needs more attention in the future, particularly in terms of the technical aspects of genebanking and on-farm management efforts. Whereas the majority of the participants agreed that the interface between *in situ* and *ex situ* conservation had to be improved, it was also recognised that this is a complex issue which needs to be tackled best per domain.

3.1.4. Conclusions and recommendations for Theme 1

Member State authorities are not strongly involved in shaping and coordinating collaborative genetic resource management activities at the European level. Their involvement is largely confined to policy making, and lacks commitment and support to a coordinated implementation of such policies by national stakeholders through collaboration at the European level. The current financial situation in many Member States (recent budget cuts and staff reductions) has led to a very limited involvement in the functioning of the European networks, as well in little support for national and local activities, in particular with regard to European collaboration. This also holds true for the

EU Commission where coordination regarding the development and implementation of a policy on genetic resources for food and agriculture is missing.

At present, the formal structures at European level, the networks ECPGR, EUFORGEN, ERFIP and MIRRI do not have sufficient impact at European level to effectively promote the conservation and sustainable use of GR, due to a lack of funding and recognition from Member States, the EU Commission and stakeholder groups. Further strengthening of these networks is needed in order to further develop the coordination and harmonisation of efforts aiming at the conservation and sustainable use of genetic resources at EU level.

As a result, the European networks are not well connected to the EU policy framework as it is perceived by a majority of interviewees that these networks do not provide relevant information and data to support policy development and decision-making. There is a need to enhance the involvement of the European networks in policy development in the EU, through e.g. establishing a platform coordinated by an EU focal point for agrobiodiversity. The FAO National Focal Points on Genetic Resources for Food and Agriculture may play an instrumental role in such an initiative, indicated by the fact that in some Member States, they have already been involved in the national implementation of the FAO GPAs (PGR, FGR and AnGR) through activities of the National Programmes for the conservation and sustainable use of GR (e.g. in Germany).

In line with their current shortcomings, these networks are not properly equipped to deal with major future challenges, especially following from the implementation of the Nagoya Protocol in the European Union, the full implementation of the ITPGRFA and the development of coping strategies in light of climate change. The current networks have a strong technical orientation, but their impact is limited and their actions often lack policy focus and expertise. A better balance might enhance the role these networks could play at EU level.

For proper *in situ*/on-farm management of genetic resources, existing networks operating at the European level are few and poorly funded, their span and outreach can be regarded as unnecessarily limited. This type of collaboration should be further strengthened to safeguard a wider segment of genetic diversity, in particular Europe's bio-cultural heritage, and to increase the visibility of that heritage. The often local dimensions of such initiatives create strong limitations regarding knowledge exchange across MS (complicated by language issues). Therefore, one may consider that the approach of strong coordination centres is not the best structure to develop and improve communication between various *in situ* communities and a better integration between *in situ* and *ex situ* approaches. Instead of fully integrating *in situ* in *ex situ* coordination platforms, the alternative could be to develop specific tools to allow for more networking, such as well-accessible web-information in the form of interactive websites and international meetings dedicated to specific topics of interest to *in situ*/on-farm conservation, supporting a decentralised and voluntary collaboration at various geographic levels and in specialised sectors. Success stories on collaboration and knowledge exchange across MS and in different sectors should be publicised in order to trigger the interest of additional stakeholders as well as further and stronger collaboration.

Ex situ conservation and *in situ* management are often undertaken in different stakeholder communities, isolated from each other and with only limited interest from both sides in finding synergies and complementarities. *In situ* and *ex situ* conservation programmes need to collaborate more closely towards the common goal to protect genetic diversity in food and agriculture. Future programmes and networks further require additional efforts to measure developments in genetic diversity conservation and use occurring in all domains and should not be limited to indicator species of only some plants and animals.

In summary, as regards Theme 1 the following recommendations are made:

- Improve the funding options for network-coordinated European genetic resources management efforts, in addition to the current funding mechanism for research on genetic resources;
- Strengthen the role of the existing European networks in policy development and implementation at the European Union level;
- Support initiatives for more networking regarding *in situ* management activities at the European Union level;
- Increase opportunities for cross-sectorial projects involving *ex situ*, *in situ* and on-farm communities;
- Facilitate the further integration of *ex situ*, *in situ* and on-farm communities through cross-sectorial representation in routine sectorial meetings; and
- Promote the day-to-day communication and coordination between *in situ* and *ex situ* management structures and activities. More joint activities such as workshops related to the integration between *in situ* and *ex situ* should be organised in the future.

3.2 Theme 2: Enhancing networking among key stakeholders and end-users in view of exploring marketing (and other cooperation) opportunities, such as provided by quality schemes and short supply chains.

First, this theme intends to provide information on existing (multi-actors) networks dealing with genetic resources (in particular networks pursuing the opening of marketing opportunities for products derived from local/traditional/rare breed and varieties and neglected/underutilised crops). Additionally, this theme approaches the general issue of the valorisation of genetic resources and describes the levers and barriers for the set-up and development of valorisation schemes and projects.

3.2.1. Comprehension of Theme 2

This theme builds on the principle that the best way to conserve genetic resources for agriculture and food is to keep as many of its components as possible in the valorisation of genetic resources i.e. the production and the marketing opportunities for local/traditional/neglected species, rare varieties and rare breeds is of greatest importance.

Marketing products using these local genetic resources can often be carried out directly at the farm. To increase the market for these products, cooperation and collaboration between stakeholders is crucial. Networks may be established at local level and they can include a range of different stakeholders, including producers, processors, retailers, tourist agencies, restaurants, community institutions/organisations. They might focus on several genetic resources typical of a specific region. Networks can also focus on the marketing of a specific rare breed/variety.

It is crucial to know the different types of networks that are successful, the kind of stakeholders which are needed in networks, the challenges/bottlenecks they face in establishing a network, and the key drivers of success/failure.

Consumers have a crucial influence on the use of genetic resources in agriculture and food production by demanding specific products. Consumers are increasingly realising that their behaviour has an effect on the environment and on society. Thus, in their purchasing decisions consumers are giving further consideration to the issue of sustainability. There are labels that guarantee consumers a certain standard of a product (organic, quality or regional labels).

The products of region-specific varieties or breeds can be labelled with national or EU-labels such as "Protected Designation of Origin" (PDO) and "Protected Geographical Indication" (PGI). Success stories for the integration of agro biodiversity issues are for example the labels "Monteleone di Spoleto Emmer PDO" in Italy and "Schwaebisch-Haellische Qualitaetsschweinefleisch PGI" in Germany.

One may consider that there might also be a great potential, if "agrobiodiversity-friendly" products could be more strongly connected to other sustainability relevant topics, which are already known to consumers such as "organic food", "healthy food", "animal welfare", "safety food", "quality and tasty food", "local food".

All these different elements are considered under this theme.

3.2.2. Methodology and tools for Theme 2

While doing the mapping exercise (Task 1) the research team strived for a comprehensive overview of the existing (multi-stakeholder) networks pursuing marketing opportunities for products produced with local/traditional/rare breeds/varieties and neglected/underutilised crops in all 28 EU Member States. Starting from a pan-European approach, the research team applied a snowball approach to identify local initiatives at local level (NUTS 3 level as required in the tender specifications).

The preparation of the questionnaires (Task 3) allowed the consideration of questions that enable the collection of information about the activities and involvement of key stakeholders in existing networks, interactions between these key stakeholders, drivers and obstacles of the success of network activities, and the link between different types of products, market dynamics and marketing strategies. The literature review (Task 2) was also conducted in such a way, that fruitful information on challenges and particularly on solutions and innovations for such network activities were extracted and presented.

The range of interview partners (Task 4) was chosen to include a sufficient number of partners that are key stakeholders in existing local networks investigating marketing opportunities for products based on traditional/neglected genetic resources.

Some of the twenty projects selected for case studies (Task 6) include network initiatives that investigate marketing opportunities for genetic resources. Finally, a workshop (Task 7) was dedicated to issues related to the initiation and development of valorisation projects based on neglected/underutilised crops and rare breeds. In addition, a workshop on the implementation of FAO's Global Plans of Actions for GR in the EU gave relevant information about the issue valorisation of rare GR.

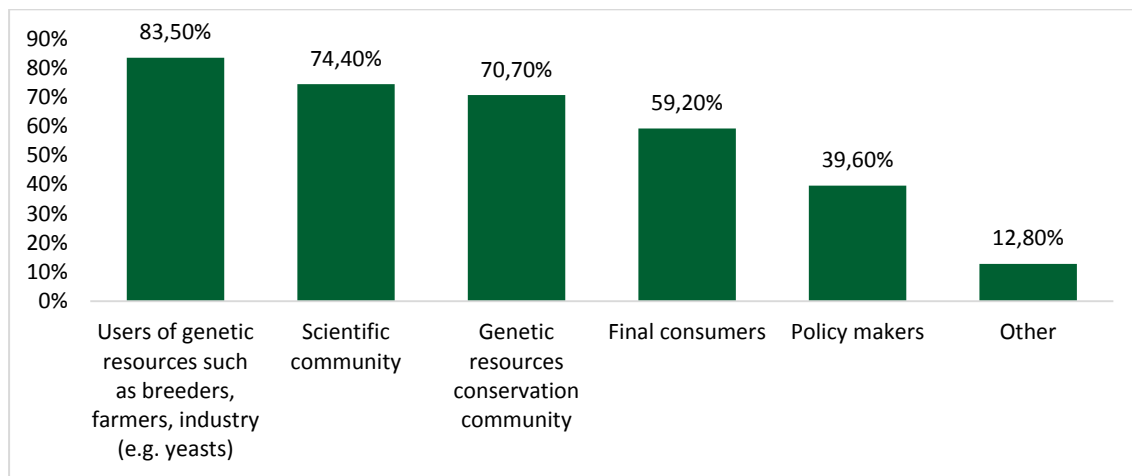
The information gathered during the tasks facilitated in-depth analyses, including the challenges that such networks encountered and the solutions found.

3.2.3. Analysis of Theme 2

Based on the **mapping results** from the weighted respondents' ranking, the promotion of the sustainable use of GR is one of the top five aims of initiatives for the conservation of GR. A further goal which is closely related to the use of rare GRFA is breeding and producing cultivars/breeds.

Even if the most surveyed activities are not directly focused on the use of GRFA, the view on the expected beneficiaries of these activities indicates that the sustainable use of GRFA is the overall goal of almost all of these projects/initiatives.

Our sample indicates that **GR users (e.g. breeders, farmers and industry) are the ones to benefit the most (84%). Benefits for the final consumers are also expected by a majority (59 %).**

Figure 6: Expected beneficiaries from valorisation projects/initiatives of GRs

Note: The sum of percentages exceeds 100% as this is a multiple choice question allowing for the selection of more than one option.

There are three projects currently funded under the Horizon 2020 Work Programme 2014 topic SFS 7A-2014, to support landraces/local breeds by means of developing value chains and valorising local/regional assets.

The project TRADITOM cares for the conservation and the sustainable use of traditional tomato varieties. It is a multi-actor approach that includes scientists, farmers, consumers and small seed companies and is coordinated in Spain.

The consumer demand for high quality and healthy pork meat and the utilisation of old regional pig breeds are themes of the project TREASURE. Actors from different sectors (academia, farmers, producers, end-users) should work together and benefit from the knowledge and experience that each of them have.

DIVERSIFOOD is also a multi-stakeholder approach to enrich the diversity and to improve the market potential of regional (cultural) food in regional food chains. One of the objectives is to show the socio-economic value of on-farm seed systems.

These three projects are still running and their results will be of key importance to understand good practices and under which conditions such valorisation projects can produce sustainable income for producers and the complete supply chain.

In the last decade, in the **scientific literature** the use and valorisation of GR has come more into focus in the PGR and AnGR domains. The use of FGR as part of sustainable forest management is getting more attention, especially in relation to the adaptation of forests and forest management to climate change. Molecular biology has created new options for use via marker assisted selection, gene editing (mainly PGR domain) and genomic selection (mainly AnGR), and diverse options for gene discovery and mapping in all four domains. The concept of conservation through use has been fundamental in AnGR. The concept of Payments for Ecosystem Services associated with market failures and the public good characteristics of agrobiodiversity conservation was introduced (Narloch et al., 2011). The Millennium Ecosystem Assessment distinguished four groups of ecosystem services: provisioning services, regulating and habitat services, supporting services and cultural services.

The **interviews** conducted within this theme had the intention of gathering information on how to enhance cooperation and networking activities in this context, as well as on existing initiatives, their results and impact. In particular, interesting initiatives were

identified in the AnGR and PGR domains. A few projects were considered interesting also within the FGR domain.

The interviews expressed a number of **key considerations and issues** which can be summarised as follows:

- In addition to food products, tourism activities were also highlighted as important means of use of GR;
- Marketing activities should include the dissemination of information, publications, and research results, as well as awareness raising and efforts to bring knowledge and information about GR to the general public;
- Obstacles that were mentioned include the lack of structure and coordination around existing activities. As a result, they often remain small scale “one man initiatives” without developing further. In Italy, the Monteleone die Spoleto Emmer case is a strong example of a multi-stakeholder approach that led to marketing of new products;
- Projects with a mix of organisations and stakeholders involved, including both public and private stakeholders, were mentioned as successful. Some interviewees suggested a 2-step approach:
 - A first step consisting in analysing and characterising products in order to market and label the products accordingly, raise awareness and show consumers the quality and characteristics of these products;
 - In a second step, a network or platform should be established for producers to sell their products, since the resources and knowledge required to set up a business are not always available. Such platform could also involve stakeholders with a more business oriented approach who could team up with producers;
- The lack of funding was reported to be a problem for various interviewees. It was noted that in most cases where funding is provided; it is limited to a specific project and time period. While such funding is helpful, it is also difficult for the organisation in question to maintain regular activities, and the potential of further developing the activities is hindered once the funding ceases. Another difficulty mentioned was the large number of small and medium businesses that are active in this field. Generally, small and micro businesses are the most present and their activities would benefit from further public funding. This is not only in relation to farming, but also to retail and processing; and
- It can be added that many **young people** are interested in rare breeds and crops but they do not inherit land. Thus they need other opportunities to engage for rare GR.

Some **case studies** provide strong examples of product development. In those cases, efforts were made to focus on one or several rare varieties of different crops/breeds in order to adapt and commercialise them for the market. The Monteleone di Spoleto Emmer (Farro di Monteleone di Spoleto) is a protected designation of origin. It is a variety which was revived due to the initiatives of farmers who rediscovered this historically and culturally important variety. In Italy, the Monteleone di Spoleto Emmer case is the result of a multi-stakeholder approach which led to marketing new products that are sold locally during events and fairs or directly to consumers. Product development is also one of the main objectives of the French seed company OBS. Another interesting example is the supply chain development in Switzerland where the private seed organisation ProSpecieRara teamed up with the retailer Coop to commercialise old varieties. Other examples include Slow Food and the SAVE foundation.

Finally, value chain creation includes initiatives where a supply chain was developed and

established. Again, the Swiss vegetable case is a successful example, as well as OBS and the heritage beer in the UK. Two cases which are somewhat specific in nature are categorised under value chain creation: Crop for the Shop and Nordic Food. In these two instances, a specific concept was developed which led to the creation of a value chain. In Denmark, the development of an important number of initiatives related to the use and commercialisation of GR through restaurants and food manufacturers followed the Nordic Food Manifesto. Regarding Crop for the Shop, the objective is to encourage short supply chains where the local community is involved.

As regard the tomato case studies in Spain and OBS in France, the projects were initiated by the producers and group of producers as they were facing a significant issue: In Spain, tomato varieties lacked resistance to fusarium and in France (OBS in Brittany) there were no homogenous varieties of cauliflower (only farm saved seed cultivars lacking quality and uniformity). In these cases, the development of a value chain fully answered a specific need of the end-users which contributed to the successful outcome of the projects. While these initiatives could be duplicated in other regions/countries with similar products, it is important to note that the economic valorisation of a neglected and/or under-utilised variety is a lengthy process that requires cooperation between different stakeholders.

In other projects, the action was initiated upstream, by researchers. In most of these cases, the research work led to significant results, however the “commercialisation” of the research work is not yet achieved. One important reason for this is the fact that no end-user has been identified and the research work may not recognise commercial added value (identification of new *Penicillium* strains for seasoning of salami in the Italian case study on ISPA). However, the main reason for not delivering “commercial” products is the lack of funding that is required to further develop the project. The lack of resources does not allow the development of a marketing plan and to set up a production. This is observed for example in the marketing plan of the Nature Park in Croatia that aims to develop traditional products from Turopolje pig breeds. In addition, all NGOs covered by the case studies have mentioned that they lack funding to continue the development of their activities.

One important example of a successful project which was initiated by researchers is the UK case study on beer brewed from a heritage barley variety. In this case, initial research regarding the traits of this barley variety resulted in both breeding activities to improve modern varieties, as well as the product development of a beer brewed from this variety. The successful outcome was enabled through the collaboration between researchers, farmers, breweries and maltsters.

Regarding the valorisation of rare breeds and crops, the case studies led to the same main conclusions as the interviews. Additionally, the following points complete the findings from the interviews:

- The successful development of a “genetic resource product” should also be analysed by considering other criteria such as the development of traditional products, the set-up of new commercial approaches such as short supply chains, the development of tourism, heritage, local culture and tradition;
- Product development is seen as an opportunity for many case studies. However, the bridging of platforms between stakeholders along the value chain is often missing. The analysis of the case studies shows that in most cases, projects in the field of genetic resources are initiated by researchers and/or scientists. When research activities led to significant outcomes, the dedicated platforms required for the valorisation of these research outputs was missing. However, this issue is not specific to genetic resources, as the link between researchers and users is considered to be weak in most business fields. On the other hand, in the field of

genetic resources, this situation is a key concern, as valorisation projects are not developed sufficiently and therefore projects are often not sustainable;

- Initiatives on the valorisation of genetic resources may suffer from a lack of critical mass. The critical mass is required to develop a sustainable commercial activity. However, research is often based on small activities. The multiplication of breeds or seeds is required to obtain a critical mass on which a marketing plan can be developed. If this critical mass is not available or can only be available on a short to medium term basis, business opportunities are reduced as the economic sustainability of the project is at risk. For instance, this was one of the main reasons why the ITEM-ISPA project did not succeed, even though there were commercial plans. On the other hand, the OBS case in France shows that ongoing support by producer organisations is a key success factor, demonstrating the need to fund post-research/pre-marketing activities; and
- Projects without a clear demonstration of added value for the end-users in the value chain (producers, farmers, consumers) are not viable. Several projects were initiated and developed by researchers while funding was available. Most of these projects led to concrete results and outcomes. However, in most cases no exploitation of these results was initiated. The main successful projects seem to come from initiatives which have been taken forward by the users and the end-users.

Taking into consideration the key importance of the valorisation of neglected/underutilised crops and rare breeds, a **workshop “Genetic resources for value chain development”** was carried out to address Theme 2.

The presentations and the discussions led to the following main **conclusions**:

1) The use of rare GR should be facilitated by specific competence centres:

- There are two major aspects which have to be addressed to foster rare GR value chain development and thus enable GR producers to earn an adequate income: communication/visibility and logistics.
- To improve communication and value chain development for rare GR the establishment of GR ‘competence centres’ was suggested. There is a structure for communication between GR stakeholders at European level which works well (ECPGR/ERFP). Similarly, some countries have functioning networks under the umbrella of the National Programmes of GR that can be used for GR communication on a (sub-) national level. They should have a multi-stakeholder approach. Such diverse groups reflect different stakeholders’ interests and can use their combined competences to full capacity. Indeed, an EU-wide exchange between national GR competence centres under the umbrella of National Programmes for GR, ECPGR and ERFP can serve as the relevant platform. These coordination platforms should also be involved in EU policy setting regarding the conservation and sustainable use of GR.

2) Need for the development and dissemination of knowledge in the form of (practical) good practices and success stories:

- The valorisation of rare GR often leads to significant business opportunities. However, as expressed by a majority of participants, user guides and methodologies on how to approach these dedicated marketing development schemes are often missing. Marketing schemes are too often developed for large projects involving a large number of actors. The workshop participants asked for the drafting of a User Guide at EU level that could easily be adapted (and translated) nationally and locally by experts. Such type of guide would have the benefit of initiating the sharing of practices on which local stakeholders could build

their marketing and development plan.

- Similarly, success stories on the valorisation of rare GR and value chain developments should be compiled and distributed via the existing EU networks. These success stories should promote best practices.
- These User Guides and description of success stories could be distributed to national and local advisory services.

3) The sustainable use of genetic resources needs proportionate legal requirements for small producers:

- Despite the implementation of new instruments and tools of the new CAP which contribute directly or indirectly to the sustainable use of genetic resources in agriculture including the measures for extensification, multiple remarks have been made during the discussions as regard the suitability of the current EU legal framework for the sustainable use of GR. Most of these remarks were criticisms against the seed marketing directives for cultivated plants which, according to several participants, have negative effects in the context of the valorisation of rare PGR. This framework is too limiting for small and local producers. More freedom to operate is required to allow an easier exchange of germplasm between and across seed savers. Participants also highlighted that significant improvements were included in the proposal for the revision of the seed marketing directives for cultivated plants. However, these improvements have not been considered during the first reading at Parliament level.

4) Administrative burden limits the development of valorisation projects:

- A significant number of remarks have been made during the discussions as regard administrative burden which is linked to obtaining subsidies and other types of funding. For example, BESH was one of the 64 partners in the EU FP6 research and development project Q-PorkChains. BESH led two pilot chains in the context of the project. BESH's activities were EU funded at the level of 60%. The project was completed at the end of 2012, while the latest payment was made in 2015 when all the administrative work for the partners had been completed. These issues can ruin small organisations as they rely on stable sources of income for their activities.

5) How to secure critical-mass for rare GR:

- Valorisation projects could be at risk, especially during their inception phases, when only a few animals or seeds are available to initiate the supply chain. In these cases, it is important to consider a first stage of up-scaling, which is to guarantee that the number of available animals and seeds is significant enough for the supply chain under development and for the marketing objectives (volumes of production and sales).

6) The use of GR in organic production systems has potential for the economic growth of the organic farming sector:

- Organic farmers could be encouraged to use indigenous breeds to increase their credibility and attract additional consumers with a positive attitude towards rare and regional breeds and crops. The increasing interest in regional breeds could serve as a positive impulse for organic value chains.

7) Valorisation projects should preferably be initiated and developed in added value food supply chains:

- The speakers at the workshop clearly indicated that the valorisation of GR and the development of dedicated supply chains benefited from dedicated working

alliances among stakeholders in branches. The operational links in the branches between seed supply system, processing and distribution stakeholders should be strengthened. For example, developing marketing plans for dedicated supply chains such as direct selling and organic production creates value for producers.

- The regional scope of valorisation projects is also strength in the marketing of GR. The regional approach emphasises the fact that these are local products by local producers. There are a number of incentives to consume local products. These include health, environmental benefits, economic or community benefits and regional identification. The combination of local farming techniques and short travel distances makes the products consumed more likely to be produced organically and fresh, which is an added benefit.
- The use of local trade-marks and quality signs (e.g. the European geographical indications) is also seen as an important tool for valorisation purposes. These quality signs are part of a differentiation strategy, and the use of niche markets. They also participate to the development and recognition of dedicated brands.

8) The funding of valorisation projects is often an issue:

- Initiating valorisation projects and developing new supply chains are often limited by the fact that resources to fund the project are lacking. A large number of valorisation projects exist, however not many are fully developed as no resources are available to initiate the first steps. The Rural Development Plans often consist of funding such types of initiatives by providing premiums to producers. Funding should go to the group of stakeholders directly involved in the development of the project. In addition, these premiums are limited to a period of 2-3 years. This is not enough to secure the medium term development of the projects. Additionally, the EU farm promotional programmes could be a very important tool for GR, but they are currently not adapted to the needs of fostering valorisation projects. They have certain exceptions for PGI/PDO products – but in general they are focused on export, multi-national cooperation and big marketing campaigns. A solution to this could be the establishment of a “light version” for small initiatives dealing with genetic resources.
- For instance, Arche Noah indicated that 70% of the initial development phase was covered by innovation project funds. This funding contributed significantly to the success of the initiative.

In the workshop “Implementation of the Global Plans of Action (FAO): which role for the European Commission?” several issues related to the valorisation of rare GR were discussed. Conservation and sustainable use of genetic resources belong together. The workshop participants highlighted the importance of the exploration of value chains for the conservation and sustainable use of GR.

3.2.4. Conclusions and recommendations for Theme 2

Compiling the findings from all tasks with regard to Theme 2, the following conclusions can be expressed:

- According to the mapping exercise, the case studies, the workshops and the interviews; the sustainable use of GR is key for the conservation of the diversity of GR, and also for R&D activities.
- The use of GR is an increasingly addressed issue in scientific literature.
- The successful development of a “genetic resource product” often implements criteria e.g. the development of traditional products, the set-up of new commercial approaches such as short supply chains, and the development of tourism, heritage, local culture and tradition.

- For the majority of interviewees and based on results of the mapping exercise, valorisation projects are expected to profit farmers and the complete supply chain.
- Marketing activities should include the dissemination of information, publications, and research results, as well as awareness raising and efforts to inform the general public about GR. User guides and methodologies on how to approach these dedicated marketing developments are missing. Success stories on the valorisation of rare GR and value chain developments should be compiled and distributed via the existing networks.
- Projects with a mix of organisations and stakeholders involved, including both public and private stakeholders, were mentioned as successful. A 2-step approach is suggested:
 - The first step consisting in the analysis and characterisation of products in order to market and label them accordingly, raise awareness and show consumers the quality and characteristics of these products;
 - The second step is the establishment of a network or clusters for producers to sell their products, as the resources and knowledge required to set up a business are not always available. Such platform could also involve stakeholders with a more business oriented approach, who could team up with producers;
- The funding of valorisation projects is often not sufficient.
- Many young people are interested in rare breeds and crops but they do not inherit land. Thus they need other opportunities to engage in the conservation and use of rare GR.
- A sufficient critical mass is required to develop a sustainable commercial activity.
- The use of rare GR could be facilitated by the development of specific competence centres. With ECPGR, ERFP and EUFORGEN, there is a successful structure for the communication between GR stakeholders at European level. For an EU-wide exchange between national GR competence centres, ECPGR, ERFP and ECPGR can serve as the relevant platform. These coordination platforms could also be involved in EU policy setting regarding the conservation and sustainable use of GR.
- The sustainable use of genetic resources needs a favourable legal framework and proportional legal requirements for small producers.
- Administrative burden limits the development of valorisation projects.
- The use of rare GR in organic production systems has potential for the economic growth of the organic farming sector.
- Successful valorisation projects are often initiated and developed in added value food supply chains. The regional scope of valorisation projects is strength in the marketing of GR. The use of local trade-marks and quality signs such as the European geographical indications is also an important tool for the development of successful valorisation projects. These quality signs allow the implementation of a differentiation strategy on the market.

On the basis of these conclusions, the following recommendations addressing the valorisation and sustainable use of genetic resources can be proposed:

- The use of rare GR should be facilitated by specific competence centres under the umbrella of the already well-working European coordination platforms ECPGR, ERFP and EUFORGEN. These coordination platforms should also be involved in EU policy setting regarding the conservation and sustainable use of GR;

- Awareness rising on the conservation and sustainable use of GR is important. More and improved links between local producers and larger stakeholders in the value chain enhance marketing opportunities and should be facilitated by the competence centres and the EU;
- The sharing of success stories through appropriate tools and the set-up of User guidelines are recommended to facilitate the creation of valorisation initiatives.
- Set-up criteria for valorisation should not be limited to economic topics but also take into consideration social added values (touristic, cultural etc.). Ideally, these criteria could be built from the existing ones in the TEEB²⁰;
- Organic farmers should be encouraged to use indigenous breeds to increase their credibility and attract additional consumers with a positive attitude towards rare and regional breeds and crops.
- The use of the three EU product quality schemes known as PDO (protected designation of origin), PGI (protected geographical indication) and TSG (traditional speciality guaranteed), as well as other national labels, should be further associated to valorisation projects in order to promote and add value to commercial products.
- Marketing initiatives and projects, including the development of efficient short supply chains, with more direct links between producers and consumers, should focus on the regional level, so as to develop regional identity around the product.
- Project funding for the valorisation of GR should be extended in order to include the practical implementation of the research results in the value chain.
- CAP payments for rearing endangered local breeds or the preservation of plant genetic resources under threat of genetic erosion (second pillar, agri-environmental measures) should be extended by national/regional authorities, so as to facilitate the needed up-scaling of rare GR for successful valorisation projects.
- CAP funding (second pillar) should additionally address regional collaborative projects in order start new initiatives at local/regional level in a more flexible manner, in order to allow support for marketing programmes or product development.
- Seed marketing legislation has been mentioned as problematic for SME.
- Under CAP financing, the problem is the lack of funding for cooperative projects (including SMEs and farmers).

3.3 Theme 3: Improvement of the exchange of knowledge and research on genetic diversity in agriculture systems

The third theme addresses the improvement of the exchange of knowledge and research on genetic diversity in agriculture systems. Knowledge plays the same role in the conservation and sustainable use of genetic resources as it does in other sectors: it allows increase of efficiency and efficacy, thus leading to higher proficiency of the stakeholders.

²⁰ The Economics of Ecosystems and Biodiversity: Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation. See <http://doc.teebweb.org/>

3.3.1. Methodology and tools for Theme 3

The input for the study of the third theme was gathered from the various tasks of the Preparatory Action, most importantly the interviews (Task 4), some case studies (Task 6) and workshops (Task 6), and as a basis, the literature review (Task 2).

First, the literature review (Task 2) allowed to better understand and delineate the perimeter of knowledge as well as to identify the major research objectives in the field of conservation and sustainable use of genetic resources and the associated issues faced by the scientific community.

Then, the mapping exercise (Task 1) and the interviews (Task 4) helped identify the relevant information and knowledge, and revealed information and knowledge needs and gaps in the different stakeholder groups.

Additionally, a few case studies were dedicated to the detailed analysis of the relationship between researchers and (potential) users of genetic resources. These examples were found in the field of pre-breeding and the (phenotypic and genotypic) characterisation of genetic resource accessions; as well as in participative breeding projects.

3.3.2. Comprehension of Theme 3

Theme 3 of the Preparatory Action covers the research related to the conservation and sustainable use of genetic resources. In addition, it deals with the flow of knowledge between the research sector and the agricultural sector. The theme tackles the issue of the knowledge base in the decision-making process regarding GR conservation and sustainable use initiatives. Indeed, there can be a lack of knowledge, and an investment of research in generating the applicable knowledge. The dissemination of the findings may also be an issue, therefore better education schemes, knowledge exchange and communication activities may be required. Finally, social, economic and cultural factors might make stakeholders reluctant to use the findings, irrespective of whether they have access to the knowledge or not.

This mutual exchange of knowledge is the main factor allowing and driving cooperation, and it is a necessary condition for further capacity development. Stakeholders need to be aware of one another's resources and services, and they must have access to the knowledge necessary for an optimal use of these resources and services. This knowledge on genetic diversity in agricultural systems has to be (1) relevant, (2) available and (3) accessible. These three elements provide the basic structure to the theme.

Relevance can be defined as the ability of the information and knowledge to support cooperation with the aim of further capacity development in the conservation and use of genetic resources for agriculture and food production. Data collection revealed that there are needs for information and knowledge from stakeholders. The information gathered in the preparatory action allowed the identification of the type of knowledge and information currently available as well as the gaps hindering the use of genetic resources in agricultural systems in Europe.

The availability of such data raised the question as to whether the information and knowledge needed actually exists, and if so, in what form. Another issue to be addressed as part of the "*availability issue*" is the conditions for access, in particular if there are intellectual property issues.

The final element, looking at the accessibility of relevant and available information and knowledge, investigated the possibility of using these resources in practice. The (potential) user of the information and knowledge has to know that it exists, where it exists and how to access it. Many issues have been considered, such as the quality of the information sources, the availability of capacity building instruments, as well as the technical aspects of the information resources, allowing interaction with other

communities such as the genomics community.

These three elements have been analysed from the perspectives of all stakeholders, as the information and knowledge needs differ strongly between groups. For example, the (potential) users of genetic resources need to know about the potential of genetic resources for his/her activities, where they are maintained, what properties they possess, how they can be obtained, and how they can be used. On the other hand, maintainers of genetic resources require knowledge on other similar activities, other genebanks or *in situ* activities, and the possibilities for collaboration and task sharing, as well as needs and capabilities of (potential) users.

The analysis as part of this theme takes into account the three dimensions of the preparatory action, i.e., the range of stakeholders, the different domains (plant, animal, forest, microbial & invertebrates) and the EU-wide geographic range.

The stakeholder networks and the flow of information, current and optimal, within the network are included in the analysis. In addition, bottlenecks have been identified, allowing for the formulation of solutions and recommendations.

3.3.3. Analysis of Theme 3

"Knowledge on genetic diversity in agriculture systems" comprises of the following elements, as shown by the literature review:

- The origin of the diversity;
- The structure of diversity, and its distribution over gene pools and within genomes;
- Technical conservation methodology to preserve the gene pool and make it available to potential users (*in situ*, *ex situ*, on-farm methodologies);
- Organisation and coordination of GR conservation on international and national level; and
- Sustainable use of GR in breeding and other services.

The first two elements, origin and structure of diversity, can be considered as the basis of the knowledge on genetic diversity in agriculture systems, and in turn build on more fundamental issues related to the nature of diversity, the genetic aspects including the evolutionary origin, and the population's genetic and molecular properties.

As all of these topics are scientific in nature and without direct consequences on the efficiency and efficacy of operations, they are not considered in the discussion of this theme. Theme 3 focuses on the latter three "how"-elements, where the knowledge generated in the first two, and the underlying more fundamental science, also plays an important part.

Technical conservation methodology

The methodologies to conserve GR, and make it accessible to potential users, vary strongly between domains (PGR, AnGR, FGR and MiGR) and include *in situ*, *ex situ* and on-farm methodologies. This is also true for methodologies to support or to promote the sustainable use of GR. The optimal methodology should be effective, efficient and knowledge based, however this is not always the case. Regarding options for creating synergies between stakeholder groups, it appears from several interviews and case studies that the traditional methodology prevents the effective use of technology, in cases such as the *ex situ* back up of *in situ* crop wild relative material structure/organisation of breeding programmes, or access to *ex situ* conserved material for on-farm use. Ample examples of this lack of use of options also appeared during the workshop 'Better integration of *ex situ* and *in situ* approaches towards conservation and

sustainable use of GR'. For example, during this meeting observations were made such as 'Gap analysis [should be used] as a means of bringing together the *ex situ*, *in situ* and on-farm communities, and work together to implement systematic conservation and use', 'There is lack of knowledge of diversity in crop and agro-environment, how to collate knowledge of diversity and network farmers, which landraces to grow?', 'Significant diversity held by single farmers should be conserved *in / ex situ / on-farm*, or used as landrace (development added value), or reintroduced', 'Focus genomic work to benefit farmers, get material out of gene bank and back to farmers, make better links between breeders and farmers networks', etc.

Organisation and coordination of GR conservation on international and national levels.

Whereas the challenges are clear and many coordinating bodies exist in the various GR domains, the organisation and coordination of GR conservation and their sustainable use is generally sub-optimal. For example, hundreds of plant genebank are operational in Europe, but coordination regarding the composition of their collections has not occurred. As a result the duplication amongst genebank collections is abundant whereas gaps in the collections remain unaddressed. Indeed, the flow of knowledge regarding needs and options is not sufficient, and there is a lack of options allowing efficient organisation and coordination. This observation was made by the stakeholders themselves, e.g. ECPGR and EFRP.

Use of GR in breeding and for other services.

The use of GR comprises a very wide range of activities varying over GR domains with their value chains, levels of technology, types of products and services. Many aspects of this use were already covered in other themes. Therefore, under this theme, we only focused on the availability of the appropriate knowledge for efficiency and effectiveness.

Finally, the infrastructural components allowing the generation and sharing of knowledge (research infrastructure, the educational system and aspects of communication²¹) also have to be considered.

When analysing the results of the interviews, it is assumed that exchange of information is the main factor allowing and driving cooperation, and a necessary condition for further capacity development. Stakeholders need to be aware of one another's resources and services, and they need to have access to the necessary knowledge so as to use these resources and services optimally.

The knowledge about genetic diversity in agricultural systems has to be (1) relevant, (2) available and (3) accessible. These three elements were analysed during the interviews, and the information and knowledge needs differed strongly between stakeholder groups. These observations are described in the paragraphs below.

In the agro-food supply chain, farmers rely on research and advisory services to help improve their knowledge, efficiency, productivity, profitability, and contribution to the benefit of their livelihoods. In return, research and extension organisations such as technical institutes play a key role in disseminating technology and practices.

However, due to various reasons, the impact of knowledge generated by research and extension organisations at farmer and agro-food supply chain level is lower than expected.

²¹ Overlap with Theme 1 has been avoided as much as possible.

When there is no close working relationship between agricultural research and advisory services on one hand, and advisory services and farmers on the other hand, a subsequent lack of quality and dedicated information flow is observed. Agricultural researchers indicated that there was little collaboration with farmers and producers in their work.

Background information demonstrates that during the last 30 years there has been a decline of advisory services for farmers. In many countries, e.g. the UK and partially in France, these technical advisory services moved from being public to private, leading to a repositioning of these services. In the UK, the main agronomic advisory services (e.g. ADAS, NIAB, and SAC in Scotland) have become private companies that still provide technical support to farmers, it is no longer free (private agronomic consultancy services). In France, the privatisation of advisory services is less obvious regarding some crops.

Technical services are still financed by public authorities (e.g. FR-CTIFL for fruit and vegetables), while for other advisory services, such as FR-ARVALIS (cereals), the funding comes from private sources. In Germany and Austria, a similar situation is observed at *Landwirtschaftskammern*' level. In Italy, the majority of the research respondents mentioned that the technical liaison is currently missing, as advisory services have nearly disappeared in some of the 21 Italian regions. The quality and quantity of advisory services provided differ hugely from one region to another, due to historical political choices and different structural configurations.

In short supply chains, the connection between the market, research and the producers is not carried out via advisory services, it is much more direct. However, the role of research in these chains is more limited compared to the traditional agro-food supply chain.

The situation seems to be different regarding short supply chains, where several initiatives can be identified. The typology of short supply chains includes direct sale by producers (such as farm sales, farmers' markets, fairs, baskets, community sales point) and sales with at least one economic operator (such as Internet, retail sales, shops). Some initiatives to develop local markets and short food supply chains result from the support and promotion of farmers, distributors or consumers. Examples of such initiatives are as follows: the "Association pour le Maintien de l'Agriculture Paysanne" (AMAP) in France, the "Groupe d'Achat Solidaire de l'Agriculture Paysanne" (GASAP) in Belgium and the "Gruppi di Acquisto Solidaire" in Italy. Several researchers have indicated that they include local farmers in their work, particularly during the testing stages. This is especially the case in GR *in situ* networks and participatory plant breeding in crops, as well as the rare breed conservation and valorisation of farm animals. However, the scale of these activities is small and the involvement of the scientific community is limited.

For most of the interviewees in the agricultural sector, it is considered necessary that the representation of farmers in agricultural research structures at local and regional levels is further institutionalised in order to avoid the complete commercialisation of the technical institutes.

The presence of farmers in these structures could also lead to improved efficiency. Advisory services have started to expand their activities down the supply chain and now work with food processors. This is seen as an improvement according to most interviewees. When comparing animal and plants, it seems that the relationship between researchers and food chain actors is easier in AnGR than in PGR, as the number of sectors and species is lower for AnGR. Therefore, the relationship is facilitated by the specificities of the structure of the chains.

Public private partnerships are seen by many of the interviewees as an appropriate instrument to bridge the gap between the (public) genebanks, researchers and the breeding industry (private sector). The traditional partnerships for plant research, where public research institutes did the pre-breeding and the industry used the results, no longer exists. Therefore, it is unclear who should be in charge of pre-breeding activities.

Regarding *ex situ* activities, researchers were traditionally in charge of the conservation of GR, while the users of GR stored in genebanks were mainly food chain stakeholders through breeding activities, often after a pre-breeding step performed by public breeding institutes. Interviewees mentioned a clear evolution with the development of modern breeding techniques, which led to the necessity of more extensive pre-breeding research and application.

Pre-breeding refers to all activities designed to identify desirable characteristics and/or genes from non-adapted materials that cannot be used directly in breeding populations, and to transfer these traits to an intermediate set of materials that breeders can use further in producing new varieties for farmers. It is a necessary first step in the use of diversity arising from wild relatives and/or other unimproved materials. These activities can be organised in collaboration between the germplasm curator (a public researcher) and the private plant breeders who need to work together to understand the scope and value of germplasm collections and how new traits from these collections can be bred into new varieties.

This collaboration leads to the need to implement public private partnerships (PPPs) to support pre-breeding activities. NordGen is a good example of this type of approach. Besides pre-breeding, public private partnerships offer ample opportunities for strategic pre-competitive research, developing methodologies and knowledge to improve conservation strategies and to support sustainable use and breeding in various domains.

The sharing of responsibilities in the *in situ* environment is rather different from *ex situ* cases as conservation and use are dynamic activities, which are not as differentiated as for *ex situ* (with a higher specialisation of actors).

Conservation and sustainable use go together in the majority of cases for *in situ* management activities in the field of AnGR, PGR and FGR. Conservation through sustainable use in the context of sustainable breeding programmes is the key strategy for AnGR. *Ex situ* conservation is an important complementary strategy for AnGR, while *ex situ* conservation is relatively more important for MiGR and PGR. This characteristic of *in situ* conservation certainly explains on one side the lower efficiency and reliability of conservation efforts from a genetic diversity point of view, compared to *ex situ* conservation. However, *in situ* PGR activities generally show higher levels of interaction between supply chain actors.

The **case studies** allowed for a more in depth analysis of theme 3. Although none of them specifically addressed the topic, most of them touched on relevant issues. Given the number and diverse nature of the case studies, it is not possible to draw general lessons, they rather provide important but anecdotal insights that will be presented in the following paragraphs (as far as they contained aspect relevant to theme 3).

The case study about the Greek network for Biodiversity and Ecology in Agriculture (AEGILOPS) showed the important role an NGO can play in bridging the gap between the formal sector institutions (research sector and national genebank) and the farmers. This is especially prominent in cases where the institutions in the formal sector lack funding to the extent that, in this case, the genebank was not able to regenerate and distribute its material to users.

The case related to the reintroduction of a heritage barley variety “Chevallier” for beer brewing showed how, based on public interest, the knowledge and expertise from a public research institute can be used to get an old variety back on the market. However, it also showed the hurdles that need to be overcome: reluctance of farmers to grow low yielding and difficult to manage heritage varieties, and the reluctance of scientists to out-scale their activities to commercial ventures.

The analysis of the case related to cherry variety garden and the reintroduction of traditional uses of the cherries in the municipality of Hagen, demonstrated the need to conserve not only the germplasm but also the knowledge about old varieties that had largely been lost in this case. Furthermore, it illustrated the difficulties of creating commercially viable *in situ* conservation programmes, even if it can be combined with a variety of products and tourism activities.

The example of the reintroduction of the Monteleone di Spoleto Emmer showed a multi-stakeholder initiative to revive the cultivation of this PDO (protected designation of origin) variety. The actors involved ranged from scientists from the university to local farmers. While the project is a success, the financial stability of the project is not guaranteed.

The case on the Breedwheat research project in France, combining genetics, genomics, and ecophysiology with high-throughput phenotyping and genotyping in wheat was an example of a high tech PPP project that aims at adding value to PGR maintained in genebanks. It successfully addresses the problem of bridging the gap between the genebank collections and the private breeding programmes, but also shows the practical problems associated with such long term and high cost projects.

The Dutch national network Eternal Kale, which aims to maintain and grow old agricultural varieties, is a good example of collaboration between the formal sector (the national genebank) and the informal sector (about 100 NGO’s and other initiatives). Knowledge from the formal sector is used effectively to support the activities in the informal sector.

The case study on SAVE, a European NGO network working to safeguard agricultural varieties and breeds, shows a network organisation supporting its members and participating in projects at international level. It is an example of a bridging organisation between the formal (research) sector and local GR initiatives. The difficulty to obtain EU funds due to the bureaucracy, and the lack of financial capacity to follow up on finished projects are flagged as issues limiting their positive impact.

The analysis of the Genebank for Crop Wild Relatives in Osnabrück, Germany, is an example of an initiative purely in the formal sector, where important resources were created, but the sustainability was not secured. Since it was collaboration between a governmental funding agency and a number of universities/botanic gardens, access to knowledge was not a major issue, although the lack of knowledge regarding the storage behaviour of CWR hindered the operation.

The case study on the Italian ITEM microbial collection gives an excellent example of a formal institute doing important work on GR, in this case microbial. It has access to all necessary scientific knowledge, and even develops new products. However, the conservation activities are underfunded and the link to the market is weak since scientists are not able (or willing) to fully exploit the possibilities.

The charity Future Trees Trust, that aims to improve the timber quality of broadleaved trees planted in the UK and Ireland, is a good example of how collaboration between sectors has an added value. To quote the fiche on this case study: “The sharing of

knowledge is key in improving genetic diversity, and the range of people working together contributes towards that, as well as the dissemination of results. The fact that foresters and geneticists are involved in FTT brings added value to the work in terms of knowledge. In addition, the fact that the involvement is voluntary shows that there is an interest and dedication in improving the quality of hardwood species and whilst ensuring genetic diversity remains as broad as possible." This example also observed a lack of data, but that was primarily the result of the long generation span, and not of failing infrastructure.

The NordGen case study provides a clear example of regional collaboration in the field of *ex situ* PGR and AnGR conservation. The flow of information and knowledge is no issue, since the activities occur in an academic environment with collaboration with the private breeding sector in PPP's. The major weaknesses have to do with the politics surrounding collaboration between countries, and the unstable funding situation.

The case study on New Nordic Food shows a very timely initiative to promote 'pure and healthy ingredients from land and sea in the Nordic region', which in many cases include rare breeds or landraces. The high-end end-products (restaurant food) allow for high prices of the agricultural products, and as a result cultivation does not have to be optimised to a level where other products need. Marketing is more important than research.

The case study on the Slow Food movements in Italy and the Netherlands is related to the previous one. The 'event organisations' promote 'small-scale produced quality products that belong to the cultures, history and traditions of the entire planet and represent an extraordinary heritage of fruits, vegetables, animal breeds, cheeses, breads, sweets and cured meats.' As for the New Nordic Food movement, the need for knowledge and research was not mentioned.

The case study looking at the Organisation Bretonne de Sélection, one of the very few EU plant breeding activities that have been created by farmers and producers, showed an example of an organisation that would need new knowledge to do other things. For organic breeding (and cultivation) to become more competitive and interesting to farmers and consumers, new breeding techniques are needed. The former collaboration with the national research organisation INRA solved only part of this problem when it related to specific breeding programmes.

The case study on a small research project regarding the on farm management of lentils in Germany shows an example of much needed but very rare professional research on GR conservation methodology. Especially where it concerns on-farm conservation, many of the claims are not scientifically established and questioned by the (formal sector) scientists leading to a troubling of the relationships between the science driven formal sector and the often "*holistic*" informal sector. This project contributes to the much needed scientific basis for decisions regarding management of GR.

The conservation project of the Turopolje pig in the Lonjsko Polje Nature Park shows how a scientific problem, i.e. inbreeding due to low population size, is addressed by an EU Horizon 2020 funded project. As a result, the knowledge of a university can be applied to solve a problem of a ground level GR initiative.

The **workshops** allowed deeper analysis of the topics discussed. The main findings read as follows.

During the first workshop²² the participants agreed that the interface between *in situ* and *ex situ* conservation had to be improved, and it was recognised that this is a complex issue that needs to be tackled per domain. A multi-disciplinary approach linking science, agriculture/forestry and policy is required. The audience widely discussed the need to assess the integration issue across domains. When it was recognised that each domain is highly specific in terms of e.g. overall structure, equilibrium between *in situ* and *ex situ*, equilibrium between conservation and use, number and type of actors in the "GR Chain", role of each actor, R&D technologies being used; several participants appreciated having a cross domain exchange, which led to identifying "new ideas" for a given area.

The overall EU policy context and its link with the international initiatives (e.g. FAO) shall encourage exchanges between actors in order to recognise mutual trust and benefits. There is a need for improved communication with all stakeholders all along the food chain to secure that genetic resources' issues are fully recognised as a basis for food production and sustainable forest use for production, environmental and societal functions. It also requires appropriate and balanced funding for *in situ* and *ex situ* activities, reflecting their respective contributions in the different domains. Transdisciplinary networks can bridge the gap between on-farm research, implementation, food chain and policies.

Even though improvements have been observed since the establishment of the EU coordination platforms (ECPGR, ERF, EUFORGEN, MIRRI), there is still significant improvements to be made as regards the current level of integration and exchange of knowledge and experience between *in situ* and *ex situ* conservation.

The second workshop of this Preparatory Action²³ concluded that collaboration between Forest GR actors through the EUFORGEN programme needed to be strengthened, to facilitate equal participation in this EUFORGEN and to implement strategies for dynamic conservation and appropriate use of FGR under climate change conditions, in cooperation with non EUFORGEN member countries. Clear knowledge gaps were identified, amongst others regarding the adaptation and adaptive capacity of forest populations. It is currently unknown whether the current genetic resources will be able to adapt to new climatic changes and further societal needs. There is also a deficit of knowledge in FGR and breeding programmes on the subject of ecological interaction and a need to develop rapid phenotyping methods for measuring complex traits. Furthermore, long-term monitoring is key to understanding the impacts of climate change on FGR and effective knowledge transfer is vital to create an unbroken chain from research to forest management, e.g. this could be mediated through internet portals for data sharing. Furthermore, the workshop emphasized the importance of cross-sectoral communication to better integrate FGR conservation objectives with biodiversity objectives, for instance, those from the IUCN. Assisted migration was recognized as an important part of FGR conservation strategies that/and needs further attention (i.e. research experiment, policy etc.) together with other *ex situ* activities. As far as it has been discussed the workshop recommends the EC to facilitate the establishment of adequate documentation of source material, to have this freely available for end users to make informed choices. The assessment of potential risks of assisted migration built on the results of past/current/future provenance and progeny trials should be facilitated.

During this third workshop dedicated to **microbial genetic resources**, like in the previous two, the need for better communication and information exchange between

²² Better integration of *ex situ* and *in situ* approaches towards conservation and sustainable use of GR.

²³ Forest Genetic Resources in Europe in a changing climate: challenges and needs for conservation

users, resource holders, industry and funders was expressed, to address the diverse key issues of the Genetic Resources for Food and Agriculture community. This should also be done through more structured multidisciplinary interactions. Mutually beneficial business models between companies and consortia of resource holders will make collaboration more attractive for bio-industry partners. Multi-disciplinary (environmental, plant, animal etc.) strategies for the conservation of endangered organism communities are needed as micro-organisms are involved in complex interactions in their natural surroundings. Therefore, partnerships between resource holders, the scientists and the farmers in the field should be strengthened and a mutual understanding is needed and can be achieved by involving expert advisors in the specific sectors that can connect the different partners. Also improvement of the collaboration amongst the different kinds of collections (mBRCs, private, research and restricted) would be beneficial. This collaboration and interaction would increase by improving the legal clarity on aspects of Biosecurity and ABS for all stakeholders, which now are still quite reluctant to collaborate with each other. Improvement on these aspects will also have a positive effect in the future for development and marketing of novel products, and working together in making a difference in the EU food and agriculture sector. In this light, success stories should be communicated through improved outreach from projects that involved genetic resources and led to the production of specific products; or collaborative platforms for example the collaboration of the microbial domain. It was observed that there is still a big gap between some of the EU member states in the amount of knowledge on novel techniques and the usage of state of the art technologies. It is important to look at ways to transfer new technology and knowledge to lesser resourced countries and include them in decision making strategies.

All in all, the conclusions made have highlighted numerous needs in all areas dedicated to the conservation and use of MiGR. There is a clear underpinning structure being put together but there are still significant improvements to be made with regards to the needs of the food and agriculture sector to encourage sustainable use of this genetic resource. Generating new knowledge and exchange of knowledge and experience between actors will be essential. One of the conclusions that was made is that MIRRI will be able to provide a good basis for dealing with many of the numerous needs that were highlighted during the workshop. Unfortunately, MIRRI still lacks the support it needs, as many countries have not yet put MIRRI on their national roadmaps.

Prediction of the impact of **climate change on the conservation and utilisation of crop wild relatives** clearly is purely knowledge based, and during this fourth workshop of the Preparatory Action it became apparent that the knowledge is weak if not lacking. The workshop participants highlighted the need for CWR diversity and gap analysis and niche modelling. Furthermore, the conservation tools available for producing eco-geographical land characterisation maps, climate change mitigation, and gap analysis via GIS techniques and genomic approaches need to be enhanced and made more widely available to conservationists.

Based on a common European strategy, the activities of *in situ* and *ex situ* actors should be integrated, assuring optimal interaction and synergy (as was concluded in the first workshop). An inventory of CWR in Europe should be completed, giving an overview of potential use, current occurrence and expected shifts due to climate change. Mechanisms for prioritization of CWR species should be completed on the basis of use potential, threat level and climate change modelling. Germplasm selection tools, such as those for predictive and genomic characterisation, and associated datasets need to be enhanced and made more widely available to germplasm users to help aid germplasm selection. Some priority species should be evaluated for user-defined traits, pre-bred (including the use of various omics techniques) and data and material should be made publically accessible in collaborative projects, thus developing mechanisms that could be scaled up

towards massive introgression efforts. Finally, the European CWR conservation and use activities should be put in a global context and linked to technology transfer activities.

In conclusion, this workshop observed the need to generate knowledge (modelling techniques, inventories, gap analyses, sequencing and phenotyping results), rather than to establish communication between actors, as was the conclusion relevant to Theme 3 of the previous workshops.

The fifth workshop discussed the **role of genetic resources in value chain development**. It was suggested that valorisation projects should be initiated and developed in added value food supply chains. In the past, projects often failed because of insufficient critical-mass, lack of funding and administrative burdens, this should be avoided in future projects. Furthermore, it was observed that sustainable use of genetic resources requires a friendly legal framework and proportional legal requirements for small producers; on this point many improvements can be made.

The workshop participants suggested that 'GRFA competence centres' should be established to improve communication and value chain development for rare GRFA. These centres could be based on a well-working structure for communication between GRFA stakeholders on European level (ECPGR/ERFP) and, depending on the country, various networks under National Programmes. In turn, for EU-wide exchange between national GRFA competence centres, ECPGR and ERFP can serve as the relevant platform. These coordination platforms should also be involved in EU policy setting regarding the conservation and sustainable use of GRFA.

All in all, numerous opportunities and needs for valorisation projects of GRs in both the animal and plant sector were identified. It also became clear that there are still a lot of options for improvements to encourage value chain developments based on genetic resources. Apart from the conclusion that there is a need for the development and dissemination of knowledge in the form of good practices and success stories, the suggestion to establish 'GRFA competence centres' was the major contribution to Theme 3 of this fifth workshop.

3.4 Theme 4: Adaptation of breeding methods and legislation to the need of conservation and sustainable use of genetic resources

Maintaining, enlarging and sustainably using agricultural genetic diversity requires a consistent organisational framework for breeding activities and an enabling legal basis. This includes the encouragement, adaptation and improvement of breeding schemes and methods to conserve and make full use of available agricultural genetic diversity. The fourth theme aims at investigating the respective needs of genetic resource conservation and sustainable use as well as analysing the legal framework impacting on these activities. Approaches and methods related to the valorisation (sustainable use) of genetic resources have been discussed under Theme 2.

3.4.1. Comprehension of Theme 4

Having physical access to the proper germplasm or breeding material alone is not sufficient for allowing the sustainable use thereof. Two major obstacles are formed by (1) the knowledge and technology, i.e. breeding methods available to develop sustainable breeding programmes and (2) the legislation that could stimulate but can also complicate the conservation of germplasm and its use in research and breeding programmes.

Breeding methods

The starting point of any breeding programme for plant, animal or any other organism is genetic diversity. Traditionally, breeding programmes concentrated on the use of well-adapted local breeds, varieties and germplasm as a source of genetic variation. New productive and specialised breeds and varieties have been developed along with intensification in agriculture. Advanced breeding methods are used by the commercial breeding industry, leaving local breeds or varieties behind. In order to sustainably use local and exotic genetic resources, there is a need to develop and implement proper breeding strategies, taking advantage of the specific features of local breeds and varieties and their exploitation. Breeding programmes either select individuals within breeding populations to genetically improve the next generations, or take advantage of genetic diversity between breeds or varieties. Crosses between commercially available elite varieties and the following selection process can create new elite varieties; structured cross-breeding programmes involving two or more breeds, varieties or breeding lines generate superior hybrid offspring. Forest populations can be selected for increased adaptation. Commercial breeding is turning towards 'genomic selection' and increasingly focusing on the identification of genes or alleles for relevant/new traits. At the same time, efficient selection programmes strive not to result in high inbreeding rates and a too narrow genetic base.

In the case of plants, new sources of genetic variation include not only older varieties and landraces but also wild related species, the so-called crop wild relatives (CWR). For example, the resistance of genes against the fungal disease *Bremia*, which affects lettuce, are broken because new pathotypes of *Bremia* develop through the selection of advantageous mutations for the disease, often only a few years after the introduction of varieties with such resistance genes on the market. Lettuce breeders regularly isolate one or more new pathotypes every year. The identification of new resistance genes is only possible by screening large numbers of wild lettuce accessions, initially from landraces, more recently also from crop-wild relatives. New technology offers opportunities to make more efficient use of exotic germplasm, such as CWR. For example, marker-assisted selection allows monitoring the presence of the desired trait in offspring lines without phenotyping them and minimising "linkage drag" from the wild parent. Genomics allows the identification of allelic variants of a known allele in different phenotypes within a crop or even the prediction of traits as identified in other crops or in wild relatives (comparative genomics). These technologies ("pre-breeding") are already changing breeding practice, marker assisted selection is now common place for many crops, and the concepts for developing allele collections are being developed.

Animal breeders improve livestock by selecting animals that have desirable traits (breeding goal) for different purposes (the production of milk, meat, eggs, or for companionship and other purposes). Animal breeding has evolved from selective breeding by individual farmers/breeders to modern breeding programmes dominated by cooperative/private breeding organisations making use of the latest, modern selection methods and reproductive technologies. Selection programmes for farm animals lead to incremental improvements and make use of breed variation. Animal breeding is based on a cumulative improvement of breeding populations with every new generation. Selection within breeding populations is the main method to achieve genetic progress and at the same time the management of breed genetic diversity is of key importance. Crossbreeding is also applied in animal breeding for upgrading, backcrossing or the creation of new synthetic lines or breeds. Structured cross-breeding approaches are used to produce hybrid end-products in commercial production, especially in meat or egg production.

The implementation of "genomic selection" is currently leading to major changes in the efficiency and organisation of breeding programmes in the livestock sector. In animal breeding, the possibility to genotype animals at a low cost using chip array-based

genotyping techniques made it possible to develop and apply genomic breeding techniques, that use the overall genomic make up of an animal to predict its breeding value for relevant breeding goal traits.

Compared to agricultural crops, genetic improvement of forest tree species only recently started in Europe (1950s). Most forest tree species in Europe are wild, managed in natural ecosystems, or at the early stage of selection, except for the introduction of exotic species and the hybridisation of transferred populations with local populations. Forest tree species are typically long-lived, highly heterozygous organisms with a late sexual maturity. Consequently, progress in breeding was delayed compared to crop and animal breeding. The use of recent genomics investigations, marker assisted breeding to increase the selection efficiency on complex traits or to better manage breeding populations only just started in European forest species.

Apart from marker-assisted breeding and other genomics-related methods, there are several newly developed methods to speed up breeding and further increase the value of genetic resources. An example is using cross-compatible wild relatives for efficiently introducing disease resistance genes into crops with complex genetics or long generation times in the cisgenesis approach. Some of the latest methods, in particular genome editing, can basically be used across all domains and generate specific mutations targeting desired traits directly in modern (elite) materials with far more precision than classical mutagenesis. Still, genotypic and phenotypic knowledge on traditional genetic resources remains important for identifying desirable genes/allele sequences and understanding or predicting the relation between genotype and phenotype, even if the tedious and time-consuming introgression of the trait into modern materials can be circumvented by genome editing and genetic modification. These methods involve regulatory issues that are discussed under legislation.

Legislation

The adoption of the Convention on Biological Diversity (CBD) in the early nineties changed the view on genetic resources. Although this convention was not aimed at reducing access to genetic resources for food and agriculture, in practice it had that effect to quite some extent. It is now very demanding to exchange germplasm between countries (or in some cases even within countries) because prior informed consent (PIC) on the basis of mutual agreed terms (MAT) has to be achieved with the proper national competent authorities (NCA) before material can be moved or used. These conditions for access and benefit sharing (ABS) were further negotiated and elaborated in the Nagoya Protocol (2010), which has recently been implemented in European legislation. This protocol provides an international legal framework for the effective implementation of the CBD objective related to fair and equitable sharing of benefits arising from the use of genetic resources. It obliges signatories to take measures to ensure that only legally acquired genetic resources and associated traditional knowledge are used within their jurisdiction.

For the domain of plant genetic resources, the FAO tried to enhance access and benefit sharing, to avoid a negative effect of the CBD on the breeding of especially food crops. For this purpose, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, 1994) was created, which allows the free exchange of material that is included in the so-called Multi-Lateral System (MLS).

Another impact of legislation on genetic resources conservation and use arises from the instruments to protect Intellectual Property (IP), both in the form of varieties (UPOV treaty for plants) and of inventions and discoveries (patent law). Under the UPOV treaty, new crop varieties can be granted breeder's rights in countries with plant variety protection (PVP) laws. In the EU, an application must be sent to national offices or to the Community Plant Variety Office (CPVO) in Angers, France. Each new variety has to be

Distinct, Uniform, and Stable (evaluated in DUS testing). PVP does not hamper the use of genetic resources, because breeders have a breeders' exemption meaning that they use existing varieties in their breeding programme. In European patent law, plant varieties are not eligible for patenting and neither are "essentially biological processes" of conventional crossing and selection. However, plants with new traits can be patented provided that they fulfil the normal patent requirements of novelty, inventiveness and applicability, as recently confirmed by a decision of the Enlarged Board of Appeal of the European Patent Office²⁴. The protection offered by a patent on a plant with a specific trait means that it can only be used for the breeding of new commercial plant material containing that trait with a license of the patent holder.

The Seed Marketing Directives²⁵ allow for certain derogations for the acceptance for registration and seed marketing of traditional varieties. Farmer's varieties, old varieties, conservation and amateur varieties, and landraces are often genetically heterogeneous and for that reason many not pass DUS criteria. The newly proposed EU Regulation on marketing of plant productive material, which aimed to replace twelve directives²⁶, offered the possibility to opt for breeding, trading and using non-certified seed material. However, various stakeholders expressed concerns that this will be insufficient to facilitate the use and to stimulate the commercial exploitation of such varieties and landraces. Moreover, the rejection of the Commission proposal in 2014 and the decision by the Commission (DG SANTE) not to resubmit a new proposal means that these perceived improvements will not be implemented.

Animal genetic resources used for breeding are mainly under private control and ownership and their exchange is mainly regulated by the transfer of private ownership.

At EU level, the breeding, trade, movement and transport of animal genetic resources are regulated and sometimes hindered by the following legal frameworks:

- Veterinary and sanitary OIE and EU regulations (to protect human and animal health);
- Regulations on animal identification and registration (to ensure traceability of animals in case of disease outbreaks and to provide basis for breeding work);
- Zootechnical regulations, within the framework of EU legislation (framework for intracommunity trade of breeding animals, sustainable breeding programmes and breed conservation); and
- Animal welfare regulations (to ensure animal welfare on farm, during transportation and at slaughter).

The EU's zootechnical legislation²⁷ in the animal genetic resource domain aims at the promotion of free trade in breeding animals and their genetic material considering the

²⁴ Enlarged Board of Appeal of the European Patent Office decision about "broccoli" and "tomato" cases, G 2/12 and G 2/13, respectively

²⁵ Conservation varieties EU legislative framework:

- Directive 2010/60/EU: Derogations for marketing fodder plant seed mixtures for use in preservation of the environment
- Directive 2009/145/EC: Derogations for accepting vegetable landraces and varieties traditionally grown in certain regions, threatened by genetic erosion and varieties with no intrinsic value for commercial production but developed growing under particular conditions; marketing of their seed.
- Directive 2008/62/EC: Derogations for agricultural landraces and varieties naturally adapted to local conditions, threatened by genetic erosion; marketing their seed and seed potatoes

²⁶ See ec.europa.eu/food/plant/plant_propagation_material/legislation/review_eu_rules/index_en.htm

²⁷ http://ec.europa.eu/food/animals/zootechnics/legislation/index_en.htm

sustainability of breeding programs and preservation of genetic resources. The basic aim of 1) free trade in breeding animals and their genetic material, and 2) the legal right of entering a herd-book of the same breed is reached by harmonised - recognition of breeding associations, - entering herdbooks, - pedigree certificates, - performance testing and genetic evaluation, and - acceptance of breeding.

In forest tree breeding, the legal protection of forest tree varieties is obtained through Intellectual Property Rights. However, this applies only to clonal material (cultivars) and it is thus restricted to a small number of species such as poplars, willows, wild cherry, chestnut, or walnut in Europe.

Several of the newly developed methods to speed up breeding produce plants that either will fall under the legal framework regulating genetically modified (GM) food and feed in the EU, or it is unclear whether or not they will do so (JRC report EUR 24760 EN, 2011). This uncertainty may hinder the implementation of these so-called "new plant breeding techniques", and thus their use in valorisation of genetic resources in breeding within the EU.

The CAP legislation (including RD legislation) is discussed under Theme 5.

3.4.2. Methodology and tools for Theme 4

Input for the study of the fourth theme was gathered during most tasks of the Preparatory Action. The literature review (Task 2) identified developments in breeding methods with relevance to the use and conservation of genetic resources. The interviews (Task 4) have helped identify views on the relevance of breeding methods and the legal framework. A few case studies (Task 6) were partly dedicated to Theme 4, in particular case study 9 (BreedWheat) with regard to breeding methods, and several other case studies contained views on legal issues. Additionally, Workshop 5 (in Task 6) 'Genetic resources for value chain development' and Workshop 7 'Implementation of the Global Plans of Action (FAO): which role for the EC?' addressed many issues relevant to the theme.

3.4.3. Analysis of Theme 4

Maintaining, enlarging and sustainably using agricultural genetic diversity needs a consistent organisational framework for breeding activities and an enabling legal basis. This includes the encouragement, adaptation and improvement of breeding schemes and methods to conserve and make full use of available agricultural genetic diversity.

Breeding methods

Technological developments offer opportunities for breeding such as marker assisted selection, genomic selection, genome-wide association studies and genomics/bioinformatics. These technologies have already changed breeding practices. For instance, in plants, marker-assisted selection (MAS) significantly improved the introgression of traits from exotic germplasm. Using exotic germplasm and wild relatives implies a number of challenges. First, the germplasm needs to be accessed. CWR are relatively rare in gene banks, but exist in some countries (e.g. the Genebank for CWR in Germany). Collecting CWR from the wild is technically but also legally difficult. Secondly, identifying the desirable traits in exotic germplasm is easy when it concerns a qualitative trait, such as an absolute disease resistance gene; however it can be very difficult if it concerns a quantitative trait, such as drought tolerance or taste, as it is obscured by all the other interfering properties of the exotic germplasm. Thirdly, the actual cross between the exotic germplasm and the adapted parent can be difficult or even impossible without additional and sophisticated technical means. Finally, the cross will result in half-adapted but still half-wild offspring. The wild background can only be removed by many generations of backcrosses, and even then the desired trait is often accompanied by

severe “linkage drag” (i.e. unfavourable characteristics that are linked to the gene of interest). All of this is a severe obstacle to the successful use of CWR.

In the field of animal breeding selection within breeding populations is the main method to achieve genetic progress and at the same time the management of breed genetic diversity is of key importance. Crossbreeding is also applied in animal breeding for upgrading, backcrossing or creation of new synthetic lines or breeds. Structured cross-breeding approaches are used to produce hybrid end-products in commercial production, especially in meat or egg production. In addition, for farm animals a trend towards marker assisted breeding can be observed, and genomic selection was first developed in this domain. Compared to agricultural crops, the genetic improvement of forest tree species only recently started in Europe (1950s). Therefore, most forest tree species in Europe are wild, managed in natural ecosystems, or at the early stage of selection, except for some introduction of exotic species and the hybridisation of transferred populations with local populations. The use of recent genomics investigations, marker assisted breeding to increase the selection efficiency on complex traits or to better manage breeding populations only just started for European forest species.

When introducing this theme during the interviews, the study team observed that the **issue of breeding methods was not considered as important as the issue regarding legislation**. However, the following remarks can be made.

“Breeding methods” is a term that has several definitions. In the EU policy area, “new plant breeding techniques” is a term that has been used in the field of biotechnology and GMOs, more specifically for a list of methods where the status of the final plant products with regard to being GMO or not is under debate. This will be further discussed under Legislation. Several interviewees mentioned that the term “new plant breeding techniques” should not be limited to this closed list as breeding programmes have benefitted from other new techniques of breeding, among which the aforementioned marker-assisted selection and genomics, that are outside of the GMO regulatory oversight. For example, in winter oil seed rape, a dedicated process of testing unrestored hybrids allows to field test material before restoring it. This leads to high cost savings as the number of material that can be tested is higher and that only unrestored hybrids that show high commercial potential are entering the restoration scheme. Many examples of breeding improvements could be further reported here. Giving the impression that “new plant breeding techniques” are only limited to the eight methods indicated under regulatory scrutiny²⁸ leads to a rather limited impression on how breeding methods evolved.

Interviewees in the context of the case studies mentioned an evolution in modern breeding techniques which led to the further development of so-called pre-breeding techniques. Pre-breeding refers to all activities designed to identify desirable characteristics and/or genes from non-adapted material that cannot be used directly in breeding populations. Pre-breeding also encompasses the transfer of these traits to an intermediate set of material which breeders can use to produce new varieties for farmers. It is a first step, often necessary to be able to use the diversity arising from wild relatives and/or other unimproved material. This leads to the need to implement public private partnerships (PPPs) to support pre-breeding activities. NordGen is a good example of this type of approach, as it has set up and coordinates a number of PPPs involving stakeholders from different countries. Another good example is BreedWheat, which aims

²⁸ See list at http://ec.europa.eu/food/plant/gmo/new/legislation/plant_breeding/index_en.htm

at increasing the value of the INRA wheat genetic resource collection. This is done by state of the art characterisation, both genotypic and phenotypic, and the development of pre-breeding material which private companies can subsequently breed into elite varieties, thus improving the sustainability and competitiveness of French agriculture.

Furthermore, breeding programmes need to reap the benefits of advanced technology. For instance, the nine-year BreedWheat research project in France (2011 to 2019) aims at increasing the value of the French wheat genetic resource collection by state-of-the-art characterisation. However, as the project unfolds, phenotyping remains a limiting factor in genetic studies, as currently the amount of sequencing and marker data generated for genotyping is far greater than the number of plants that can be characterised phenotypically, even with state-of-the-art high-throughput platforms. Technology is currently changing breeding practices. The seed sector (ESA) confirmed a need to re-inforce capacities to the phenotypic and genotypic characterisations of accessions in Workshop 5 Value chain development. These efforts could ideally be done via a long-term public/private partnership approach such as BreedWheat in France.

The interviews carried out for the case studies substantiated that the introduction of advanced breeding techniques are not without any risks:

- Advanced breeding techniques are based on technologies that are rather expensive and therefore not all breeders and not all crops can afford to use these technologies. With the fast developments and cost reductions in sequencing and genotyping technology, marker-assisted selection is becoming less costly and it now is easier to introduce it in small crops for which no prior DNA sequence information exists. Nevertheless, crops with high return and top commercial values are the ones that benefit from the use of these technologies first, and this is harder for minor/orphan crops;
- Crops affected by specific local diseases cannot benefit from these technologies, as they are too expensive, since the organisations tackling these issues are often local and work at a small scale. This is illustrated in the French case study on the Organisation Bretonne de Sélection (OBS) and their vegetable breeding activities, as they encounter difficulties in finding funds for e.g. molecular breeding, since OBS is a small organisation compared to competitors in the field.

Moreover, organic breeding in European countries is often linked to the use of local agricultural genetic resources, often resistant to diseases. In order to conserve and sustainably use local genetic resources, one must develop and implement proper breeding strategies, taking advantage of the specific features of local breeds and varieties, such as pest or disease resistance. For instance, the RAF tomato in Spain is resistant to Fusarium, explaining its popularity, and is organically bred. In addition, due to the increasing demand for products ranging from environmentally friendly agricultural systems, breeding organisations are developing participatory plant breeding (PPB), where farmers and sometimes end-users participate in the selection process. Indeed, AEGILOPS, a Greek network for Biodiversity and Ecology in Agriculture establishes a network between the Greek Gene Bank and farmers so as to prioritise participatory breeding, and therefore evaluate and select adapted local varieties in agricultural systems.

Another example of the ability to adapt to local circumstances is provided by the improvement work carried out by Future Trees Trust in the UK through the governmental Living Ash project, aiming at selecting tree families resistant to the ash dieback disease, currently devastating broadleaved ash populations in the UK. It shows that tree species can also be selected to increase adaptation to the local environment as well as disease resistance, properties that might become even more relevant with the changing climate.

Legislation

The legislative perimeter to be covered under Theme 4 was left open. Therefore, each interviewee was asked to list legislation frameworks considered important to report. This approach has led to an inventory of regulatory frameworks that are considered as levers and/or barriers for the development of activities related to the conservation and use of genetic resources.

Interviewees mentioned the following legislative frameworks to be considered under scrutiny:

- Nagoya Protocol and its implementation in the EU (Regulation 511/2014);
- Implementation of the ITPGRFA;
- The seed marketing directives;
- The EU zootechnical legislation;
- The CAP and mainly the Rural Development policy.

As there is a specific theme dedicated to rural development policy, major preliminary findings regarding this dedicated regulatory framework are presented under Theme 5 and therefore not discussed under this theme.

The EU's zootechnical legislation²⁹ (as part of the EU animal health legislation) in the animal genetic resources domain aims at the promotion of free trade in breeding animals and their genetic material considering the sustainability of breeding programs and preservation of genetic resources. The basic aim of free trade in breeding animals and their genetic material, and the legal right of entering a herd-book of the same breed is reached by harmonised recognition of breeding associations, entering herd-books, pedigree certificates, performance testing and genetic evaluation, as well as acceptance of breeding. This legislation is aiming at ensuring level playing fields for commercial actors and free trade within the EU.

Several interviewees mentioned that the Veterinary legislation is also an important regulation for animal-genetic resources under the following aspects:

- Measurements, exceptions in case of epidemics (important also: precaution measurements);
- Conditions for long-term storage of semen and embryos;
- Identification and registration of livestock animals; and
- Breeding for resistance (e.g. scrapie).

For example, measures to be applied in case of an outbreak of a given animal disease (e.g. foot-and-mouth) in the vicinity or within certain specific premises may lead to eradication of valuable breeding populations, breeds or lines. Member States can determine special conditions or derogations for the conservation of valuable animal genetic resources, and at the same time ensure that all appropriate bio-security measures are taken to protect animals from infection. In an example from the Case Studies, this leads to measures where pigs need to be fenced when pasturing outdoors. However, this legislation restricts the popularity of the Turopolje pig in Croatia which is typically bred in semi-wild conditions (i.e. in the forests).

²⁹ http://ec.europa.eu/food/animals/zootechnics/legislation/index_en.htm

Several issues concerned the implementation of the Nagoya Protocol (2010), which is to be implemented through the Regulation (EC) No 511/2014³⁰. This protocol provides an international legal framework for the effective implementation of the Convention on Biological Diversity (CBD) objective related to fair and equitable sharing of benefits arising from utilisation of genetic resources. It obliges signatories to take measures to ensure that only legally acquired genetic resources and associated traditional knowledge are utilised within their jurisdiction. Most interviewees that are involved in exchange of materials across EU MS have indicated that the current status of implementation (most of the MS currently defining their approaches) leads to uncertainty regarding which GR exchanges will be possible and which not. For example, EU botanical gardens exchange annually more than 22,000 samples within the EU. Actors from botanical gardens currently do not know the consequences of the implementation of the Nagoya Protocol on these transactions.

A second issue is related to the compilation of information required to complete the Material Transfer Agreements (MTAs) and the transaction. Some managers of *ex situ* collections mentioned that they are looking for the required information in their archives as it is not immediately available. If not all the required information is found, not all accessions can be kept available for distribution due to administrative and legal reasons. The same interviewees also clearly indicated that the implementation of the Nagoya Protocol will lead to a large increase of administrative burden. Interviewees from botanical gardens reported that there is a need to have one FTE per garden to manage burden due to the implementation of the Nagoya Protocol. The interviewees in the case studies corroborated this. The Protocol will thus lead to an important amount of added administrative burden, especially for genebanks, but also for seed saver organisations, such as ProSpecieRara (CH). This is a key issue which needs to be given specific attention in the coming years by all stakeholders and authorities in the field of PGR.

For plant genetic resources, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, 1994) was created by FAO, allowing the free exchange of material that is included in the so-called Multi-Lateral System (MLS). The implementation of ITPGRFA also created some uncertainties e.g. regarding the requirements. For instance, genebanks may be able to address these issues with an SMTA (standard material transfer agreement) for handing out seeds, but this is practically impossible for seed saver organisations, as a large number of people order from the catalogue, and these people in turn may pass on seeds to third parties. Interviewees also clearly mentioned that the joint implementation of both the Nagoya Protocol and the ITPGRFA should be kept in mind by all stakeholders and that collaboration by relevant authorities should be intensified.

The seed marketing directives were also highlighted by several interviewees (especially from the *in situ* community) as a major issue for the development of commercially viable activities and supply chains based on non-uniform material. Farmer's varieties, old varieties, conservation and amateur varieties, and landraces are often genetically heterogeneous and therefore many do not pass the DUS criteria required for the registration of new varieties.

For the majority of interviewees, the proposed EU Regulation on marketing of plant productive material, which aimed to replace the 12 previous Directives, offered new possibilities to facilitate the placing on the market and to stimulate the commercial

³⁰ Regulation (EU) No 511/2014 of the European Parliament and of the Council of 16 April 2014 on compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union.

exploitation of such varieties and landraces. However, the rejection of the Commission proposal in 2014 and the decision by the Commission (DG SANTE) not to resubmit a new proposal led to the fact that these perceived improvements will not be implemented. The current legislation and more particularly the legislation on conservation varieties³¹ is not seen by the interviewees as a robust tool for exploring and exploiting these new markets with e.g. old varieties and landraces. Multiple remarks made during the discussions in Workshop 5 indicated that this framework is too limiting for small and local producers. Participants also highlighted that significant improvements were included in the proposal for the revision of the seed marketing directives that have not been considered during the first reading at Parliament level. In addition, the case studies revealed that the seed directives were seen as a barrier for the development of *in situ* activities, as the distribution of seeds is limited to registered varieties. Indeed, the case study on AEGILOPS in Greece raised this issue as the directives limit the development and use of landraces in the country. The conservation variety directives and derogations to EU seed laws may however facilitate the exchange of non-listed varieties. In addition, costs could be prohibitive as indicated by the on-farm management case studies in Switzerland and Germany. The yearly fees required to maintain the registration of a variety could act as an incentive to withdraw from activities once a variety becomes obsolete and could be too much of a burden for conservation organisations with large numbers of varieties. Another barrier may come from legislation addressing final products. For example, wine producers are not allowed to produce wine from old varieties, as there is currently no legal base for the use of traditional grape landraces to produce wine. There is thus a need for a legal basis for grape conservation varieties and laws for the classification of traditional wines deriving from conservation varieties.

Overall, few interviewees reported an impact on the conservation and use of genetic resources arising from the instruments to protect Intellectual Property (IPR), both in the form of varieties (UPOV treaty for plants) and inventions and discoveries (patent law). However, in the case studies, the issue related to the patenting of native genes was noted as a threat for local breeding programmes, on-farm development of varieties and participatory breeding, as local breeders will no longer have access to genetic variability. Indeed, these will be patented and then restricted to companies that will be able to afford to pay for the access to these proprietary traits. This barrier was mentioned in the case studies on lentil on-farm development in Germany and Organisation Bretonne de Sélection (OBS). Genebanks address such issues by distributing material under a Material Transfer Agreement containing an article about patenting and facilitated access to the plant material (see e.g. CGN³²). In addition, the availability and intellectual property of the data generated can be problematic when there is collaboration between the research and agricultural sectors. Indeed, for instance, the tree trials conducted by Future Trees Trust in the UK for applied research purposes are on foresters' land. Foresters therefore retain the intellectual property of the improved broadleaf tree species developed, which causes a problem when the aim is to market the seeds. Another issue regarding the '*in situ* community' (illustrated by on-farm management case studies in Switzerland and Germany) is the use of GM crop varieties in Europe as it is not authorised in organic farming.

³¹ Conservation varieties EU legislative framework:

- Directive 2010/60/EU: Derogations for marketing fodder plant seed mixtures for use in preservation of the environment
- Directive 2009/145/EC: Derogations for accepting vegetable landraces and varieties traditionally grown in certain regions, threatened by genetic erosion and varieties with no intrinsic value for commercial production but developed growing under particular conditions; marketing of their seed.
- Directive 2008/62/EC: Derogations for agricultural landraces and varieties naturally adapted to local conditions, threatened by genetic erosion; marketing their seed and seed potatoes

³² <http://www.wageningenur.nl/en/article/Patents-on-native-traits.htm>

Finally, an inventory of the “new plant breeding techniques” to speed up breeding processes has been established by the JRC-IPTS in 2011³³. A working group was set-up by the EC to discuss potential regulation of eight of these key technologies. The EU compares the “new plant breeding techniques” with the methods already assessed in the context of current regulations (2001/18/EC) in order to make a decision on whether or not to classify the new methods as a genetically modifying method in scientific and legal terms, and if these are associated with any additional food safety and environmental risks when compared to products of conventional plant breeding. This discussion has been ongoing for more than five years. The accompanying regulatory uncertainty is hampering their implementation, and thus their use in breeding within the EU.

In the workshops 3 and 5 several points related to legislation were raised. Overall, a more legalised framework could stabilise the efforts for the conservation and sustainable use of genetic resources. Appropriate means could be regulations, guidelines or strategies. Having a legalised framework would enhance the value of the different activities. An obstacle for the EU legislation setting for GR is that GR are affected by different DGs of the European Commission. For example, some aspects are covered by DG AGRI others are under the responsibility of DG SANCO or DG ENVI. For a better coordination, information and knowledge exchange, it would be very useful if there were a single entry point for matters relating to genetic resources. An EU Focal Point responsible for GR could be established.

3.4.4. Conclusions and recommendations for Theme 4

Breeding methods

Technological developments offer opportunities for breeding, such as marker assisted selection, and the use of genomics. These technologies have already significantly changed breeding practices. Modern highly efficient genotyping methods increase the value of genebank collections and are helpful in creating new pre-breeding material, though the efficiency of phenotyping is lagging behind regarding the characterisation of material and breeding populations.

Most breeding methods are aimed at or result in uniformity. Especially in organic and low external input agriculture and in the efforts of seed savers, breeding for diversity (and thus resilience) is seen as priority, preferably in a participatory approach. In order to conserve and sustainably use local genetic resources, one must develop and implement proper breeding strategies, taking advantage of the specific features of local breeds and varieties, such as pest or disease resistance. Furthermore, marker-assisted selection will be helpful in improving the efficiency of breeding and the characterisation of plant material. However, not all breeders, and not all crops can afford to use these advanced technologies. With the fast developments in sequencing technology, marker-assisted selection is becoming less costly. Nevertheless, crops with high return and top commercial values are the ones that benefit from the use of these technologies first, and benefits are harder to achieve for small crops. Therefore, a need to re-inforce capacities for the phenotypic and genotypic characterisations of accessions was indicated by stakeholders. These efforts would need support from public funding or in the case of high-value crops, could ideally be done via a public/private partnership approach.

³³ Lusser and al.; 2011; “*New Plant Breeding Techniques: State-of-the-Art and Prospects for Commercial Development*”. Available at: <http://ftp.jrc.es/EURdoc/JRC63971.pdf>. Consulted on May 12, 2015.

Recommendations:

- The implementation of advanced technologies such as marker-assisted selection and genomics, for breeding activities in the public sector for genetic resources conservation and use should be supported, as the costs may be prohibitive for SMEs and NGOs;
- Capacity building activities, demonstration projects and the involvement of technology users in technology development projects are necessary to effectively link collections to breeding and use; and
- Public/private partnerships to organise these activities should be stimulated and supported. In this regard, particularly long-term engagements are called for, as long-term funding is an important issue for the on-farm development of genetic resources and participatory breeding efforts. Breeding processes often take over ten years to be completed.

Legislation

Legislation is focused on mainstream, export-oriented agriculture. Examples include seed legislation, as well as phytosanitary and veterinary legislation³⁴. For small/medium (organic) companies and NGOs (seed savers) this legislation may be difficult to address due to a lack of resources. The following legislations were put forward as highly relevant.

ABS regulations may limit access to genetic resources. There are several issues around the implementation of the Nagoya Protocol (2010), which provides an international legal framework for the effective implementation of the Convention on Biological Diversity (CBD) objective related to the fair and equitable sharing of benefits arising from the use of genetic resources. Most interviewees have indicated that the current status of implementation leads to uncertainty regarding which GR exchanges will be possible. A second issue is linked to the compilation of information required to complete the Material Transfer Agreements (MTAs) and the transaction. This leads to a large increase of administrative burden. Interviewees also clearly mentioned that joint implementation of both the Nagoya Protocol and the ITPGRFA should be kept in mind by all stakeholders and that collaboration by relevant authorities should be intensified.

The seed marketing directives also form a major issue for the development of commercially viable activities and supply chains based on non-uniform material. Farmer's varieties, old varieties, conservation and amateur varieties, as well as landraces are often genetically heterogeneous and therefore many do not pass the DUS criteria required for the registration of new varieties. The current legislation and more particularly the legislation on conservation varieties is seen as too limiting and costly for small and local producers. The newly proposed EU Regulation on the marketing of plant productive material aims to improve the situation, though various stakeholders expressed concerns that this will be insufficient to facilitate the use and to stimulate the commercial exploitation of such varieties and landraces. The rejection of the Commission proposal in 2014 meant that measures perceived by many stakeholders as improvements will not be implemented.

With regard to intellectual property, the issue related to the patenting of native traits is seen as a threat for local breeding programmes, the on-farm development of varieties and participatory breeding, as the outcome of their breeding activity may not be freely marketable. Breeding for such traits may become restricted to companies that will be

³⁴ EU phytosanitary and veterinary legislations are integrating international agreements of the WTO and therefore are defined based on technical specifications defined by technical international agencies (the International Plant Protection Convention for plant health and the World Organisation for Animal Health)

able to afford to pay to access these proprietary traits. To some extent, genebanks can address this issue with the standard MTA.

Generally, a more legalised framework could stabilise the efforts for the conservation and sustainable use of genetic resources. An obstacle for the EU legislation setting for GR is that GR are affected by different DGs of the European Commission. For a better coordination, information and knowledge exchange, a single entry point for issues relating to genetic resources is needed. An EU Focal Point responsible for GR could be established.

Recommendations:

- During the implementation of the Nagoya Protocol for ABS, it is extremely important to streamline and limit accompanying administrative burdens and costs, to avoid severely limiting the exchange of genetic material;
- A revision of the seed marketing directives for cultivated plants is needed. The current legislation on conservation varieties is not seen by the *in situ* community as a robust tool for exploiting new markets with traditional varieties. This legislation should better address the conditions for small and local producers and an easier exchange of germplasm between seed savers. Continued attention should be paid to optimising derogations for conservation varieties;
- The debate about the impact of intellectual property rights on the use of genetic resources in breeding needs to be stimulated and supported. Notably, the impact of native trait patenting on the use of genetic resources should be addressed;
- The current EU legislation for animal genetic resources should be reviewed in the context of supporting the conservation and sustainable use of local and transboundary breeds, to ensure sustainability, limits on requirements and avoid unnecessary burdens for breeders;
- The legislations on GR should be merged to a common GR legislation to stabilise the efforts for their conservation and sustainable use. Therefore, a responsible unit for this GR legislation within the COM is needed.

3.5 Theme 5: Contribution to the successful implementation of rural development measures concerning genetic diversity in agriculture

The new rural development policy 2014-2020 continues to promote measures fostering activities which focus on genetic resources (e.g. to preserve, restore and promote sustainable use of agricultural genetic diversity *in situ* and *ex situ*, to raise awareness and improve exchange of information through various tools in order to facilitate uptake).

The objective of Theme 5 was to evaluate the current practices and use of these rural development measures in the regional/national rural development programmes that have been recently adopted at regional and national levels.

3.5.1. Comprehension of Theme 5

Agricultural genetic diversity, with its plethora of crop plants, forest species, animal breeds, microorganisms and invertebrates, is linked to traditional practices and knowledge. It also contributes to sustaining local agricultural economies in changing economic scenarios, and thus to rural development.

An important financial support mechanism for the conservation of crop/animal biodiversity within the EU is based on the rural development policy. Council Regulation

(EC) No 2078/1992³⁵ enabled EU Member States to support rural development and mentioned the protection of genetic diversity in agriculture as one of the overall goals of the legislation. Amongst other measures, the regulation allowed payments to farmers who entered voluntary agri-environment schemes (AEM) including the support of endangered local farming breeds. These measures have been kept in the subsequent regulations on rural development policy. The current legislative foundation for funding the agricultural activities is Regulation (EC) No. 1305/2013³⁶ on support for rural development by the European Agricultural Fund for Rural Development (EAFRD Regulation). AEMs have been renamed AECMs (agri-environmental-climate measures).

This theme of the preparatory action focused on the contribution to the successful implementation of rural development measures regarding genetic diversity in agriculture as set out in the detailed provisions of Article 7 and Article 8 of Commission Implementing Regulation (EU) No 807/2014³⁷ for the implementation of Council Regulation (EC) No 1305/2013. These rural development measures foster activities focusing on genetic resources as lists under Article 8(2) of Regulation 807/2014 (e.g. a) targeted actions: actions promoting the *in situ* and *ex situ* conservation, characterisation, collection and utilisation of genetic resources in agriculture and in forestry, including web-based inventories of genetic resources currently conserved *in situ*, including on-farm or on-forest holding conservation, and of *ex situ* collections and databases; (b) concerted actions: actions promoting the exchange of information for the conservation, characterisation, collection and utilisation of genetic resources in Union agriculture or forestry, among competent organisations in the Member States; (c) accompanying actions: information, dissemination and advisory actions involving non-governmental organisations and other relevant stakeholders, training courses and preparation of technical reports).

The framework conditions set-up for sustainable agriculture through the Common Agriculture Policy of the EU (CAP) have significantly improved in recent years. With the CAP's so-called "*health check*" in November 2008, the EU Council of Agriculture Ministers adopted a resolution to give stronger support to agriculture in mastering the new challenges, including climate change as well as biodiversity issues, and to further develop the resolutions adopted in the agricultural reform in 2003. The agri-environmental measures are an essential instrument in helping to attain these CAP goals.

The preparatory action analysed past and newly introduced rural development measures. In particular, it gathered information on the implementation of agro-environment measures in rural development programmes dedicated to the conservation of endangered local farming breeds and of plant genetic resources under threat of genetic erosion, as well as the conservation of genetic diversity in agriculture in broad terms at national or regional levels. Academic, economic and social parameters that can have positive effects on the implementation of rural development measures have been identified.

Theme 5 emphasises that the preservation and management of genetic resources are closely linked to the needs of the agricultural sector and that they contribute to the rural economy. Rural development can be fuelled by the use of local animal breeds and crop

³⁵ Council Regulation (EEC) No 2078/92 of 30 June 1992 on agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside

³⁶ Regulation (EU) No 1305/2013 of the European Parliament and of the Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005

³⁷ Commission Delegated Regulation (EU) No 807/2014 of 11 March 2014 supplementing Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and introducing transitional provisions

varieties. The preparatory action, however, also recognises that local breeds and varieties that require conserving are often not the most productive ones. On the other hand, their products may be differentiated from mass quantity to top quality, potentially yielding high economic margins and sustainable benefits. In addition, these breeds and varieties are sometimes hardier, better adapted and more resistant than their commercial, highly productive counterparts, and they are preferred in low input systems such as organic agriculture.

Information on the achievements of successful implementation of rural development measures concerning genetic diversity in agriculture served as a basis for further reflections on future actions. These include a particular emphasis on encouraging the participation of end-users, including breeders, farmers, NGOs and consumers. Therefore, Theme 5 paid particular attention to fully understanding and catering to key stakeholder needs.

3.5.2. Methodology and tools for Theme 5

The methodology for Theme 5 mainly drew information from interviews and workshops. The objective of the interviews was to obtain further details regarding rural development measures concerning genetic resource initiatives, and to gather material for the analysis of the theme. Interviewees were selected from the list of stakeholders identified in the mapping exercise taking into account the expertise and experience of the interviewee, the geographical coverage of EU Member States, the coverage of the four GR domains of the preparatory action (PGR, AnGR, FGR, MIGR), and the relevance of the activity/interviewee for theme 5. Interview questionnaires were developed in consultation with the Commission.

After each interview, a report was prepared to summarise the most important aspects of the interview and to provide key findings of the interview. Upon completion, the reports were sent to the interviewees by email for validation. Workshops were organised during the second part of the preparatory action. The workshops allowed stakeholders to discuss specific issues detected or proposed during the interviews, case studies, or directly by the study team or the Commission on their own initiatives.

3.5.3. Analysis of Theme 5

Agricultural genetic diversity is linked to traditional practices and knowledge and it contributes to sustaining local agricultural economies in changing economic scenarios and, ultimately, to rural development.

An important financial support mechanism for the conservation of crop/animal biodiversity within the EU is based on the rural development policy. Council Regulation (EC) No 1305/2013 enables EU Member States to support rural development using funding from the European Agricultural Fund for Rural Development (EAFRD). Agri-environment-climate measures (AECMs) are the main tool for genetic resources protection in rural development:

"AECM payments should further encourage farmers and other land managers to serve society by introducing or continuing to apply agricultural practices that contribute to [...] genetic diversity. In that context the conservation of genetic resources in agriculture [...] should be given specific attention".

"Forest-environmental and climate services and forest conservation measure: [...] a specific attention should be paid to the conservation and promotion of forest genetic resources".

Article 28 of Regulation (EU) No 1305/2013 on agri-environment-climate measures specifies specific support for the conservation or for the sustainable use and development

of genetic resources in agriculture (paragraph 9) (for forest genetic resources the relevant provisions are laid down in Art.34(4)). In addition, Article 35 on cooperation could support activities related to conservation and sustainable use of GR, in particular via the European Innovative Partnership (AGRI-EIP).

Commission Delegated Regulation (EU) No 807/2014 supplementing Regulation (EU) No 1305/2013 and Commission Implementing Regulation (EU) No 808/2014 laying down rules for the application of Reg. 1305/2013 list eligible farm animals and conditions which must be met to enable granting support for the conservation and use of genetic resources. While support for endangered resources is limited to farmers and "similar" actors only as eligible beneficiaries, the support for the general genetic resources (not limited to endangered breeds and varieties) is open to a larger scope of beneficiaries including e.g. research institutes.

Following the establishment of the new legal framework for rural development policy for the period 2014-2020, Member States at the national or regional level were finalising their rural development programmes in 2015, which are subject to the assessment and approval of the Commission. Therefore, an effective implementation of the new provisions is only beginning in those Member States and regions, which have seen their programmes approved. Thus, it is too early to draw any conclusions. This leads to the fact that all remarks made during the interviews mainly refer to the previous legal framework³⁸ rather than recent developments in this area.

Several publications present statistics as regard the use of RDP funding for the conservation and use of genetic resources as part of a set of measures, mainly measure 214.

In particular, Mellozzi presents some statistics³⁹ regarding the use of measure 214 (the so-called "agri-environmental payments") in RDPs during the 2007-2013 programming period and the allocation of resources to this measure by Member States with a particular focus on the situation in Italy. Quotes from Mellozzi publication are as follows:

"Observing the financial apportionment for measure 214 compared to the total content of each RDP at EU level, it emerges that the countries that invested more in it are Sweden, United Kingdom, Ireland, Austria and Denmark in percentages of their total budgets of between 40% and 55%. Italy invested only 22%. The bottom of the scale is mainly occupied by Europe's southernmost members with a scanty 10% (Malta and Portugal) and the recent newcomers to the European Union (e.g. Romania). The reasons for this gap, naturally, are many and are to be viewed considering the differences in farming methods in EU countries. That said, some states have manifestly invested more heavily in infrastructure (axis 1) whereas others, whose structural and infrastructural capital is greater, oriented their choice towards market reorganisation, placing more emphasis on quality production (such as, for example, organic crops) and on functions for reviewing the landscape and natural eco-systems, promoting sustainable local/territorial development and environment integration. More in detail, not every Member State put the specific initiative for safeguarding the plant or animal biodiversity into practice. 24 countries out of a total of 27 added at least one of the initiatives to their RDP and 19 provided for measures to support both plant variety and animal breeds. Only Romania, Czech Republic and the Netherlands did nothing in this sense".

³⁸ Council Regulation (EC) N° 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development and Commission Regulation (EC) No 1974/2006 laying down detailed rules for the application of Council Regulation (EC) No 1698/2005.

³⁹ L. Mellozzi. 2009. Incentives for agrobiodiversity within the European Union: the role of Rural Development Plans. *Journal of Agriculture and Environment for International Development* 2009, 103 (1/2): 11-30

Table 3: Measures in support of plant varieties and/or animal breeds

Country	Specific measures for the conservation of genetic biodiversity resources	Measures to support plant varieties and/or animal breeds	
		Plant varieties	Animal breeds
AT, BE, EE, FI, FR, DE, EL, IT, LV, LU, MT, PL, PT, UK, SK, SI, ES, SW, HU	Yes	Yes	Yes
CY, DK	Yes	Yes	No
BU, IE, LT	Yes	No	Yes
NL, CZ, RO	No	No	No

Source: L. Melozzi. 2009. Incentives for agrobiodiversity within the European Union: the role of Rural Development Plans. *Journal of Agriculture and Environment for International Development* 2009, 103 (1/2): 11-30

However, this publication does not clearly present the breakdown of funding per sub-measure as included in measure 214. Therefore, it is very difficult to understand, in reality, how much funding has been dedicated to conservation of genetic resources. There are no clear statistics as regards this sub-measure. This leads to the conflicting situation where several policy makers mentioned during the interviews that significant resources have been allocated to the conservation of genetic resources when others have indicated that in reality, RDP funding was rarely dedicated to this purpose.

Therefore, a majority of interviewees have reported that rural development (RD) measures have not yet proven to be sufficient for the conservation and use of GR. Other reasons for this are as follows:

- The available RD measures are subject to selection by national and regional Managing Authorities as part of a global pool of measures. Often, the measure supporting GR and/or biodiversity is not seen as a priority, consequently limited funding has been dedicated to GR conservation and use;
- When budgets are allocated to specific measures aiming at the conservation and use of GR, several interviewees reported that they are under the impression that the funding goes to projects which are not directly linked to "agricultural commercial activities" but rather addressing solely biodiversity issues;
- When budget is allocated, the amount provided is limited, and it is given only over a short period of time;
- Premiums are paid per unit (e.g. animal heads). This approach does not encourage collective approaches as they privilege individual ones even though in the new legal framework collective approach is possible within agri-environment-climate measure. Therefore, these measures should be extended for the set-up and development of a collaborative approach. Several interviews have clearly mentioned this issue. For collaborative approaches, other type of funding should be favoured. For example, the newly established European Innovation Partnership "Agricultural Productivity and Sustainability" (EIP-AGRI) allows the establishment of operational groups at local level that would perfectly serve the need of the conservation of genetic resources *in situ* and on-farm; and could also be considered as interesting platforms to initiate a valorisation project for

neglected/underutilised crops or rare breeds. Additionally, it may be considered that these platforms could recognise the importance of farmers as drivers to attain economic, social or environmental goals and maintain genetic resources on-farm⁴⁰.

Several concrete examples of funding programmes fully dedicated to the conservation of genetic resources via e.g. the previous agri-environmental support (AEM measures) and co-operation measures were reported:

- In Emilia-Romagna region in Italy, a project aims at genetic and ecosystem biodiversity. The objective is at conserving and restoring natural spaces and agricultural landscape and to create an environment favourable to the survival and reproduction of wild flora and fauna on land withdrawn from production. The scheme was launched in 1994/95 and is still managed with an expected end date of 2022/23. It is a key element of the Emilia-Romagna regional agri-environmental programme;
- In Germany several funding programmes for rare breeds haven been implemented. Since 2006, there have been substantial improvements for 13 rare breeds with the support of AEM;
- In Greece, farmers and competent bodies have received about 20,000 EUR to preserve endangered and threatened local breeds of animals and to preserve traditional breeding systems;
- In Poland, three measures for the protection of specific breeds of endemic cattle, horses and sheep are proposed in the rural development policy. Several other breeds are subject to breeding programmes according to the Polish National Programme for the Protection of Animal Genetic Resources and farmers can be supported for rearing these animals.

The FP6 MEACAP⁴¹ project performed an analysis regarding the use of AEM funding for conservation of genetic resources. One of the main conclusions of the project was “*AEMs for the conservation of plant genetic resources are rare*”. Other considerations that were identified to be important for the conservation of endangered livestock breeds and plant varieties were:

- A need for the registration, documentation and evaluation of genetic diversity of breeds and crop varieties and a need for improved coordination between regions and countries;
- A need for the international exchange of information and coordination of conservation activities;
- For MiGR, a need for microbial genetic variability to be retained so as to have diversified food products in terms of taste, texture and even to improve the nutritional value of end products;
- A need for an identification of specific administrative, structural and normative restraints and possibly an adaptation of legal conditions in order to remove obstacles for the use and distribution of genetic resources; and
- A need for more support of *in situ* conservation and a stronger link between *in situ* and *ex situ* conservation programmes.

⁴⁰ EIP-AGRI focus group. 2015. Genetic resources cooperation models. Available at: https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-agri_fg_genetic_resources_final_report_2015_en.pdf

⁴¹ Specific Targeted Research Project n°SSPE-CT-2004-503604.

MEACAP flagged that AEMs are to address the on-farm conservation of selected species (e.g. keeping of rare local breeds of farm animals and the cultivation of rare plant varieties). The intended impact is on genetic diversity. Some measures have suffered from low uptake due to low premiums for farmers (e.g. in Finland, Italy and the Netherlands). AEMs supporting the on-farm management of plant and livestock genetic resources should be further developed and their financing ensured. Non-full-time farmers who keep rare breeds/varieties should also be taken into consideration, e.g. hobby breeders could be included.

A general problem connected with AEMs according to MEACAP, especially for the cultivation of specific crops, is that the long term commitment of farmers is not guaranteed and that bureaucratic effort is comparably high, when supporting single species or plant variety on different farms. Contract area per rare variety, or number of rare breeds supported through AEMs will remain rather limited, therefore the administrative burden relative to the number of grants is high. High administrative burden will also result from administration and control standards which do not fully fit with the conditions of *in situ* conservation. There is a certain reluctance of Member States to implement AEMs especially in the field of rare crop varieties, which can partially be explained by high administrative burden and lack of specific know-how to run such programmes.

The implementation of rural development measures has not been the focus of any of the case studies conducted and it has rarely been mentioned. While funding has been discussed in all case studies, rural development and available funding was mentioned only by SAVE Foundation. However, they highlighted that the administrative burden related to EU funding is sometimes difficult for a small organisation like SAVE, and mentioned that they did not receive any funding under these measures. Moreover, the Turopolje pig breed in Croatia and the Nature Park, which is working to conserve this breed, seems to have received funding in the context of EU rural development measures. In the case study on emmer in Monteleone di Spoleto, interviewees mentioned the fact that it is sometimes unclear who is eligible for funding under the rural development measures.

While it is not explicit from the case studies, there seems to be a lack of awareness in regards to the existence of the rural development measures. Again, this relates to the lack of knowledge among smaller stakeholders on the available support mechanisms at both national and EU level.

Regarding new CAP 2014-2020, the use of financial supports from the European Agricultural Fund for Rural Development (EAFRD) programme within the Common Agricultural Policy (CAP) (2nd Pillar, Regulation (EU) No 807/2014) seems, also, to be rather low. Very few examples have been collected during the study.

For instance, regarding poultry species, the Hungarian government funded conservation programmes and there are local initiatives launched in Italy and Belgium. Additionally, it was reported that in some countries, the rural development measures are limited to AnGR. The French approach is specific as a new strategy has been elaborated, which will enter into force in 2016. The objectives of this strategy are to preserve the existing biodiversity within poultry species within the framework of FAO objectives. A request for an allowance to submit and activate delegate acts within the regulation (Regulation (EU) No 807/2014), which had been accepted in 2015, had been addressed to the European Commission by the French Ministry in charge of Agriculture in 2014. Afterwards, a national guideline document defining the content of two measures applicable within the delegate acts were submitted and accepted by the European Commission. The measures aimed at providing the collective organisations of stakeholders fixed financial support. These measures respectively address the breeds that result in niche production and for

which pedigrees are known (measure 1: Advance stage) or not (measure 2: Relaunching stage). In the meantime, a list of local poultry breeds eligible to these measures, which corresponded to a list of 61 French local poultry breeds launched by a French competent scientific authority, was associated to the national guideline document.

3.5.4. Conclusions and recommendations for Theme 5

It is challenging to draw conclusions on the success of the newly implemented rural development measures concerning genetic diversity in agriculture, since the most recent reforms of these measures in Commission Delegated Regulation (EU) No 807/2014 supplementing Regulation (EU) No 1305/2013 and Commission Implementing Regulation (EU) No 808/2014 laying down rules for the application of Regulation (EU) No 1305/2013 were only made two years ago and hardly implemented in Member States. Serious monitoring and evaluation of these measures has thus not been done yet.

However, measures to support conservation and sustainable use of genetic resources were already present in previous rural development legislations.

On one hand, the analysis shows that there is not much evidence as yet about the use of the latest RDPs but on the other hand, it presents concrete examples from 2007-2013 period. Therefore, the lack of information from the new period should not be either obstacle or excuse to propose recommendations/conclusions.

This analysis covers both periods back to 2007. Conclusions and recommendations might be formulated as follows:

- The legal basis for payments for agri-environmental measures (including payments for grassland and rare breeds or traditional/ conservation varieties), organic farming (closely related to agrobiodiversity) and Natura 2000 (established to protect biodiversity) are in place. However, in some countries, e.g. the Netherlands, rural development measures hardly address genetic diversity objectives. The current set-up of the rural development framework at EU level offering flexibility and freedom to Member States with regard to the application of various measures leaves room for this;
- Limited awareness of agri-environmental measures to support genetic diversity preservation among stakeholders, relatively low levels of financial support proposed by Member States and high levels of administrative burden seem to be the main factors for the limited success of current and previously implemented rural development measures concerning genetic diversity in agriculture;
- The ECPGR Documentation and Information Network and the ECPGR *in situ* and on-farm Conservation Network could jointly develop and present draft national inventories of landraces maintained on-farm. These are defined by the respective national focal points as plant genetic resources naturally adapted to the local and regional conditions, and under threat of genetic erosion;
- Assistance in the development of national inventories of on-farm cultivated landraces and in the development of effective national monitoring schemes as well as project proposals could be done by the respective ECPGR Networks and National Focal Points to the national authorities responsible for the EAFRD implementation plans;
- The newly established European Innovation Partnership "Agricultural Productivity and Sustainability" (EIP-AGRI) and Co-operation measure allow the establishment of operational groups at local level which would serve the need of the conservation of genetic resources *in situ* and on-farm; and could also be considered as interesting platforms to initiate a valorisation project of neglected/underutilised crops or rare breeds. Additionally, these platforms could

allow the recognition of the importance of farmers as drivers to attain economic, social or environmental goals and maintain genetic resources on-farm.

Most importantly, the main recommendation would be to set up a detailed monitoring and evaluation programme of the current rural development measures regarding genetic diversity in agriculture in Commission Delegated Regulation (EU) No 807/2014 supplementing Regulation (EU) No 1305/2013 and Commission Implementing Regulation (EU) No 808/2014, laying down rules for the application of Regulation (EU) No 1305/2013 to allow for an experiential evidence-based new reform of these measures. Grants for these measures need to be increased to become more effective. Legislation allows this as apart from endangered breeds the legal framework does not provide for maximum level of support.

3.6 Theme 6: Explore bottlenecks and enabling conditions for the sustainable use of genetic resources in agriculture

This theme aims to present bottlenecks and enabling conditions in addition to the ones already presented under the previous themes; and in particular regarding the “sustainable use” of genetic resources.

3.6.1. Comprehension of Theme 6

The focus of this theme is to evaluate to which extent information obtained under themes 1 to 5 appears congruent, and to which extent information under one theme reconfirms and reinforces information under the other themes. Vice versa, the theme also evaluates apparent disagreement between the results obtained under different themes and seeks to understand, explain and, where possible, reconcile different outcomes. Upon this, additional issues and levers are identified regarding the sustainable use of GR.

Work under this preparatory action theme takes into account the aspect of sustainability. In this context, sustainability can be assessed as a number of themes grouped under the main themes of People, Planet, and Profit. A large number of themes have been proposed in the past, and sustainability can also be seen as a moving target with changing priorities and standards over time and space.

Here we include e.g. the sustainability of current agricultural practices and sustainability of the outcomes of recommended actions (Planet), return on investments (Profit) as well as the organisation of the user chain (People) e.g. can farmers afford to adopt a wider genetic diversity in their farming system, will collection holders survive institutional challenges, and can hobbyists organize themselves in such a way that their joint efforts become sustainable over time?

As a second step, this exercise draws conclusions at an aggregated level and recommends actions to be addressed in a strategy for the sustainable use of genetic diversity in agriculture. In doing so, it pays due attention to the capacity, expertise and roles of different stakeholders, take account of differences across the plant, animal, forest and microbial/invertebrate domains, and carefully address the differences between countries across the continent. These actions will be developed and presented in such a way that they can easily be incorporated, if appropriate, in a coherent and balanced strategy for the use of genetic diversity in agriculture.

Finally, work under this theme carefully takes into account broader conditions and trends, including i.e. technological advance, user sector development, e.g. concentration in the industry, climate change, demographic changes within European Union and in relation to other global regions, political conditions, e.g., public-private partitioning or valuing of biodiversity.

While the Tender Specifications clearly indicate that this theme should concentrate on sustainable use (and not on conservation), the study team is of the opinion that the segmentation between sustainable use and conservation is not an obvious cut. Therefore, findings, conclusions and recommendations presented here mainly concerns sustainable use, but may cover, in certain cases, conservation activities.

3.6.2. Methodology and tools for Theme 6

This preparatory action theme has required an appropriate methodology and a well-conceived process. Its methodology is based on the three dimensions outlined above (stakeholder identity, domain, geography), providing for a network analysis and reporting, distinguishing these dimensions.

The stakeholder identity (Task 2) dimension ensures due attention to the position of stakeholders on another axis: upstream or downstream on the product development line. Only a horizontal network and vertical chain analysis appreciative of the differences along these dimensions have been able to function as a thorough basis for recommendations for actions.

The methodology and resulting analysis assumes that conservation and use should be considered as two sides of the same coin: conservation is undertaken for the purpose of use, and only through use do resources acquire their value, thus ensuring conservation. The two go together in a majority of cases, as already highlighted above.

Activities under this theme involved all actors involved in the other themes (consortium partners and major stakeholders). Exchange and comparisons of experiences and results were conducted to address anomalies between themes and to develop conclusions at a higher level of aggregation.

The process included options to reach out once more to respondents approached under the other themes, to trigger their response to early conclusions and suggestions for recommended actions at a higher level of aggregation. Furthermore, the workshop on the implementation of FAO's Global Plans of Actions for GR in the EU which was organised in April, 2016, gave relevant information about bottlenecks and enabling conditions.

As this theme may be considered as an overarching theme summarising several major issues addressed under themes 1 to 5, the findings presented below can be considered as conclusions/recommendations. Therefore, this section does not include specific sub-chapter for conclusions.

3.6.3. Analysis of Theme 6

Theme 1 to 5 already addressed issues and levers as regards the sustainable use of genetic resources in two fields: communication and networking between actors and EU regulatory frameworks (both policies and funding opportunities). Themes 1, 2 and 3 consider relationships, communication and networking between the main group of actors in the field of genetic resources being public authorities under Theme 1, private actors and stakeholders under Theme 2 and then the research community(ies) with relevant stakeholders under Theme 3. Policies and funding opportunities are being discussed under Theme 4 with a particular focus on Rural Development policy under the CAP under Theme 5.

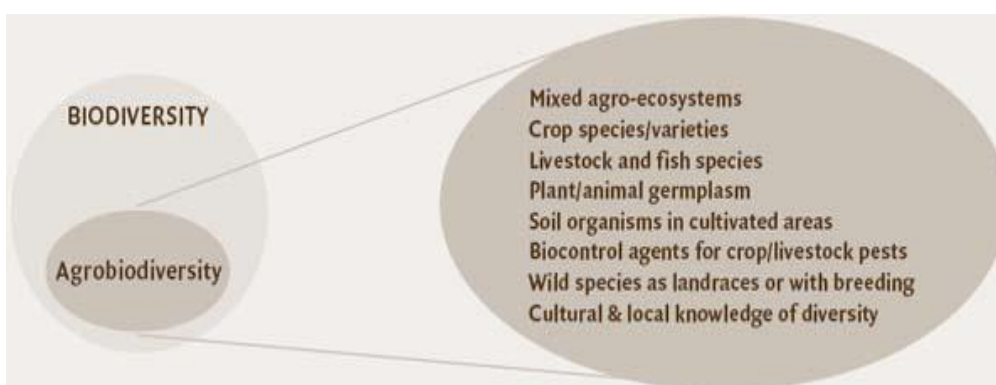
The analysis of all data collected under the methodology as discussed above leads to the analysis of additional complementary bottlenecks that can be reported as follows:

- A general bottleneck that immediately appeared during the study is the lack of correct understanding of the subject matter. Too often genetic resources are considered as purely biodiversity issues by the general public and by consumers. The comprehension is limited to old varieties, rare breeds, and neglected crops

when genetic resources should be understood as large groups that include old cultivars and modern varieties, improved as well as non-improved ones. In fact, the relation and interactions between biodiversity and agro-biodiversity is not sufficiently understood by the actors along the supply chain.

- FAO defines agrobiodiversity as being “the result of natural selection processes and the careful selection and inventive developments of farmers, herders and fishers over millennia. Agrobiodiversity is a vital sub-set of biodiversity. Many people’s food and livelihood security depend on the sustained management of various biological resources that are important for food and agriculture. Agricultural biodiversity, also known as agrobiodiversity or the genetic resources for food and agriculture, includes 1)harvested crop varieties, livestock breeds, fish species and non-domesticated (wild) resources within field, forest, rangeland including tree products, wild animals hunted for food and in aquatic ecosystems (e.g. wild fish); 2)non-harvested species in production ecosystems that support food provision, including soil micro-biota, pollinators and other insects such as bees, butterflies, earthworms, greenflies; and 3)non-harvested species in the wider environment that support food production ecosystems (agricultural, pastoral, forest and aquatic ecosystems)”⁴².

Figure 7: Agrobiodiversity is central to overall biodiversity



Source: FAO. Available at: <http://www.fao.org/docrep/007/y5609e/y5609e01.htm>

The consequence of this correct understanding and segmentation of biodiversity versus agrobiodiversity leads to the risk that focus in terms of EU policy and funding is only being put on upstream issues of losses of variability and cultivated biodiversity for old varieties and rare breeds rather than putting focus on all genetic resources as defined in the CBD Convention. Concrete explanations of what agro-biodiversity or cultivated biodiversity imply, are needed outside of the traditional boundaries of the different research and scientific communities involved in conservation and sustainable use of GRs.

One can observe that this lack of clear understanding of biodiversity vs. agrobiodiversity and the relationship between the two, lead to consequences regarding governance of EU policies in this field. While it can be observed that several DGs are active in several activities directly or indirectly related to GRs (e.g. ABS regulation on Nagoya Protocol by DG ENV, acquis communautaire on seed, GENRES funding programmes, etc.), it is more difficult to understand the overall governance and the interactions searching for completeness and complementarity, avoiding overlaps and absence of coherence across DGs.

⁴² FAO, 1999a; available at www.fao.org/docrep/007/y5609e/y5609e01.htm

- In addition, sustainable use of genetic resources would benefit from increased awareness and education activities at all levels. Initiatives related to awareness raising, education, and other activities aiming to bring knowledge about GR to the general public were mentioned as enabling conditions. Currently, the field of GR conservation is often limited to researchers and experts.
- Genetic resources of all domains play an important role along the formal agro-food value chains and an even greater role in new supply chains (e.g. short supply chains). Therefore, when developing R&D and valorisation programmes on potential applications of GRs, it is important to have a clear view of all associated value chain actors. Farming plays a critical role in this supply chain as it is the primary production and the start of the chain. Indeed, valorisation and sustainable use of GRs start at farming level for most of the PGRs and AnGRs. At this primary production stage, there is a clear bottleneck for genetic variability, and therefore for the potential of developing new products. A clear reduction of the cultivated biodiversity can be observed, as well as of the variability on biological production factors to better control the production field.
- At processing level, genetic resources and mainly microbial genetic resources (e.g. fermenting microorganisms; or biotechnological derivatives of genetic resources such as enzymes, protein extracts or nano-proteins, etc.) play an important role, particularly for food processing industries. Also here, the reduction of variability or a change in the desired phenotype in the conservation units may restrict the potential to develop new innovative food products.
- In smaller countries, the limited knowledge base may be problematic. Consulted stakeholders mentioned that some fields are neglected as there are no departments, nor any qualified experts working on particular issues. As a consequence, it is sometimes difficult to keep up with international or European activities where they exist.
- Consulted stakeholders indicated that FGR receives less attention than the other two main domains – PGR and AnGR. The economic potential in the use of FGR is currently underestimated and the existing practices are lagging behind other domains.

Several additional bottlenecks can be presented regarding the set-up and management of valorisation projects, as already partially mentioned under Theme 2:

- A multi-stakeholder approach seems to be crucial to secure positive outcomes and developments of a project, in particular in regards to product development in the food supply chain;
- Product development is seen as an opportunity and potential development of the activities in many of the case studies conducted in the context of the preparatory action. However, the connections with actors along the value chain as well as financial investments are often missing;
- Projects which are not demonstrating added value for the final actors /end users in the value chain are hardly viable. However, the importance of seeing further than the economic factors of these activities has been mentioned previously in this report;
- Where a product has been developed and there is an interest and demand from end users, a critical mass is required upon which a marketing plan can be developed. In some cases, the time needed to generate and obtain this minimal volume of commercial material is too long and costly. As a consequence, business opportunities are reduced as the economic sustainability of the project is at risk; and

- The lack of funding and in particular lack of long-term and consistent funding implies a threat to the continuity of most activities. A variety of interesting projects are initiated through project funding, but encounters difficulties once the funding period ends.

As for bottlenecks; the first 5 themes already discuss enabling conditions as regards interdisciplinary approaches, cooperation models and communication channels which are required between both public and private stakeholders. Therefore, these elements are not further discussed here.

The following enabling conditions are additional to the ones already listed previously:

- The presence of a clear leadership and governance is a key success factor for the development and sustainability of a project;
- A common European Programme and European Focal Point responsibility for matters related to GR could facilitate the actions of the Member States. ECPGR, ERFP and EUFORGEN stand ready to assist this European Focal Point and should be used. While they have offered their assistance often in the past, this has not really been noticed by the EC and no further action has been taken. This focal point could act as a coordinator across MS and could also act as a project manager for projects involving several MS and several organisations. It would play a pivot;
- The development of public/private partnerships is seen as an interesting tool to close the issues related to the lack of characterisation at *ex situ* collection level. Public scientists and breeders can ideally work on the first characterisation phases (phenotyping and morphological characterisation) and distribute the knowledge to all private actors which are part of the PPP project. For example, NordGen and Breedwheat are clear good practices in this field. This approach may partly solve the issue of lack of resources at the individual *ex situ* level to develop a significant characterisation program. In this type of organisation, the private sector can bring resources and funding to initiate the first characterisation tasks which have a value for all breeders. For example, one could say that the PPPs will develop gene pools for a desired trait that will then be distributed to the commercial sector. This approach benefits all actors;
- The development of alternative products marketed via e.g. alternative supply chains benefits from the existence of networks of farmers at local levels. There is a need to further develop these networks at EU level to further disseminate good practices on valorisation of GRs. The operational group approach of the European Innovation Partnership (EIP) also offers expertise, capacities and funding for the development of local initiatives and communication channels for their extensions and for dissemination of good practices. In these EIPs, links can be created between different actors who may benefit from working together but who are not always aware of the others existence. For example, improved links between local producers and larger parties (e.g. supermarket chains and/or their local branches) would further enhance marketing opportunities;
- The current data management systems that have been created by the coordination bodies (ECPGR, ERFP, MIRRI, and EUFORGEN) offer robust bases to further develop a pan European data management and data sharing systems across *ex situ* collections. The issues of data harmonisation and inter-operability of data management systems are today limiting data exchanges and data dissemination across countries and communities, and between *in situ* conservation experts themselves;

- Sustainable use of underutilized, local genetic resources should be maintained at local levels. Financial support targeting family farmers would certainly benefit the conservation as their knowledge helps to preserve the genetic diversity and adds to the culture of the region; and
- Agro-tourism and gastro-tourism are extremely important in sustainable use of GR. Tourism companies are the immediate partners and without local and regional gastronomy and charm, farmers would not be able to offer and market their products. Touristic activities were said to provide a means of supporting the conservation of GR.

3.7 Theme 7: Reduction of the unnecessary administrative burden so as to provide better access to actions

This theme aims to provide the European Commission with practical recommendations to reduce administrative burdens and administrative requirements to ensure the right balance between simplification and sound financial management.

3.7.1. Comprehension of Theme 7

EU Regulation is generally defined as “the diverse set of legal instruments by which the European Union sets requirements for stakeholders and public authorities” that is put in place in order to support public policies. Stakeholders and authorities spend time and resources in order to comply with these regulations. The costs incurred during this compliance process are often referred to as “administrative burden”. In addition to the direct cost of administrative regulations, it is also recognised that administrative regulations can impede innovation and create unnecessary barriers to investment and economic efficiency. This might be the case when the administrative regulations become excessive in number and complexity. Administrative burden can affect the overall cost efficiency of stakeholders and authorities; and hence there could be a significant impact at a macro level on the competitiveness of an economy internationally.

Reducing administrative and regulatory burden is a main priority of the European Commission. Cutting red tape is more important than ever in difficult economic times, when EU businesses and administrations have less resources due to national budget reductions. In 2006, the Commission proposed an ambitious programme to reduce the administrative burden of existing regulation and associated actions in the EU. It was suggested that the Commission, together with the Member States, should measure administrative burdens related to existing European legislation and the national transposition, and draw up appropriate reduction proposals. At the same time, Member States should measure and reduce the administrative burden of purely national and regional legislation. The EU Standard Cost Model Methodology was developed for the purpose of measuring the administrative burden. The programme reached its target of cutting 25% of the administrative burden stemming from the EU legislation (estimated at EUR 124 billion). The measures adopted at EU level until December 2012 are worth EUR 30.8 billion in annual savings for businesses⁴³.

In general terms, there are several ways of limiting burdens for stakeholders (e.g. users, administrations, supervising authorities). For example, the implementation of recognised best practices reduces the risk of non-compliance and compliance checks as best practices lead to harmonisation and therefore to improved communication channels between different actors. Best practices are recognised by the Commission and trusted collections are recognised by the Member States.

⁴³ Source: http://ec.europa.eu/smart-regulation/index_en.htm

Under this theme; the work was initially dedicated to identifying sources of administrative burden in the various policy frameworks related to conservation and use of genetic resources. Upon this, the work focused on identifying practical recommendations that were proposed under the six previous themes against their administrative burden.

3.7.2. Methodology and tools for Theme 7

This theme of the study focuses on the reduction of unnecessary administrative burden in order to provide better access to actions. Interviews, case studies and the workshops have been the main data collection tools used for collecting evidences regarding administrative burden in the conservation and sustainable use of genetic resources. Theme 7 was included in the interview questionnaires targeting Group 1 (NCAs), Group 2 (Rural Development Managing Authorities), and Group 10 (national focal points), i.e. a limited amount of questionnaires compared to other themes. However, many comments have been collected outside these three groups of stakeholders during the interviews and the case studies. In addition, several workshops have discussed the issue of administrative burden, and in particular the workshop related to the valorisation of genetic resources in the food supply chain. During this workshop, participants indicated that administrative burden to get EU funding is high as the applications involve too much paper work.

As it is widely recognised that the administrative burden can have a disproportionate effect on small and medium size companies (SMEs) compared to larger companies, a dedicated effort has been made to identify administrative burden for this type of enterprises. In general, SMEs have less capacity to handle all the regulations compared to larger companies and thus the situation could be even more difficult for small companies. An additional focus implied looking at potential administrative burden for researchers and public scientific bodies involved in the conservation of genetic resources. The approach applied was purely qualitative as no attempt to apply the Standard Cost Model on certain legislative framework was foreseen.

3.7.3. Analysis of Theme 7

The study reveals several areas where administrative burden is being seen as an obstacle to conservation and sustainable use of genetic resources. The three main issues are related to:

- The implementation of the obligations related to the Nagoya Protocol and user-compliance measures included in Regulation (EU) No 511/2014;
- The administrative and reporting work related to EU research projects; and
- Administrative work related to applications in the context of the funding mechanisms of the Agro Environmental Measures of the EU Rural Development Policy.

The main concerns as regards administrative burden for the conservation and sustainable use of genetic resources, expressed by a significant number of interviewees, lies in the obligations of users of genetic resources in the context of the Access and Benefit Sharing (ABS) regulatory framework. The EU Regulation on ABS⁴⁴ focuses primarily on user-compliance measures. The main provision of the Regulation is the “obligations for users” (Article 4) which requires users to perform “due-diligence” with the objective of ensuring that genetic resources⁴⁵ have been assessed and are being used in accordance with

⁴⁴ Regulation (EU) No 511/2014 of the European Parliament and of the Council on compliance measures for users from the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in the Union

⁴⁵ And its associated traditional knowledge

regulatory requirements and mutually agreed terms. In this context, due-diligence means that users have been seeking, keeping and transferring the “international recognised certificate of compliance” to subsequent users. The international certificate is an access permit delivered by the provider country, providing evidence that genetic resources have been accessed through the prior informed consent and that mutually agreed terms have been established for the utilisation. With regard to monitoring of user compliance, the EU Regulation establishes two checkpoints that users have to respect. The first checkpoint is the reception of research funding and the second checkpoint is the stage of final development within the supply chain of a product just before its placing to the market. Users are required to provide a declaration stating that they have respected their obligations and contacted the competent authorities to collect these declarations. The competent authorities referred to here are not the research funding authorities or the market approval authorities but rather the national competent authorities on ABS under the Protocol, which have still to be nominated in a majority of EU MS. Providers are to establish clear rules and procedures for prior informed consent and mutually agreed terms. In addition, they will have to establish national focal points that serve as contact points for ABS information and for granting access. User countries are to take measures to secure compliance regarding the conditions and procedures required by the providing party, e.g. by taking measures to monitor the utilization of the genetic resources.

In an article from 2015, Godt indicates this is a missed opportunity to adopt an integrated approach to ABS⁴⁶, whereby ABS measures are included in existing procedures and legal frameworks along the development chain. He adds that not only this approach lowers the administrative burden of both users and national competent authorities, but it would also strongly improve transparency of the flow of genetic resources and/or traditional knowledge in the development of a product. Moreover, such an integrative approach would also help to avoid a scenario where due diligence is only monitored at a very advanced stage of the development chain. Putting the burden of the proof at the end of the development chain does not encourage early users, whose products never make it to the commercialisation stage, to acquire genetic resources legally, while it increases legal uncertainty for end users.⁴⁷

The approach adopted by the EU Regulation generates different interpretations and implementation approaches in Europe that makes the administrative workload very hard to estimate in details. Additionally, the volume of “transactions” that needs to be covered by the EU Regulation obligations is difficult to estimate at this stage. There is a current lack of consistent and reliable data regarding the number of transactions of genetic resources by different organisations, and it is difficult to assess the economic value of genetic resources in a final product, and this to estimate the benefits).

The volume of use of genetic resources and associated traditional knowledge in agribusiness and horticulture varies considerably, from only a few transactions per year in some small organisations, to approximately 90,000 in the largest organisation.⁴⁸ Some interviewees from botanic gardens, which are considered of having a high experience with ABS, have clearly mentioned that implementation of ABS obligations will lead to severe administrative burden. For them, each of the EU botanic garden which is part of the European Botanic Garden Consortium will need to hire one more staff just to comply with administrative work related to ABS obligations in the context of material exchange

⁴⁶ Godt et al (2015) Implementing the Nagoya Protocol. Brill/Martinus Nijhoff

⁴⁷ IEPP, Ecologic and GHK, Study to Analyze Legal and Economic Aspects of Implementing the Nagoya Protocol on ABS in the European Union, (Brussels/London, 2012).

⁴⁸ IEPP, Ecologic and GHK, Study to Analyze Legal and Economic Aspects of Implementing the Nagoya Protocol on ABS in the European Union, (Brussels/London, 2012).

between botanic gardens in Europe. Additionally, genebanks, botanical gardens and other bodies organising conservation of genetic resources need to develop legal expertise which is now required to prepare Material Transfer Agreements (MTAs) and associated documents for ABS. The amount of paper work is seen as critical by several interviewees.

The second major concern related to excessive administrative burden is related to the dossiers that need to be developed when requesting dedicated funding in the context of agro-environmental measures (EAMs) of the Rural Development plan. There is a long-standing critic of rural development policies regarding the bureaucratic nature and high transaction costs. Several research teams have already highlighted this problem concluding that the bureaucratic burden is not reducible to just one factor. It is a complex and heterogeneous factor that is present at all levels of implementation of the Rural Development Policy. The first factors are linked to the large number of “enabling acts”, defined by the Commission. Next, comes the “*translation*” of the Regulation into National or Regional Rural Development Plans, and the selection of a corresponding set of measures. Thirdly, the elements that compose this National or Regional Plan may need to be integrated within already existing national, or regional, schemes. In such cases, European Funds are basically used to finance existing policy schemes. Fourthly, once specific projects have been accepted, the funding has to follow the European rules for accountability. This specific set of rules has its own rationale and its own administrative requirements, which might further complicate (and/or delay) the implementation of rural development policy measures, including support to conservation and use of genetic resources.

Several interviewees from small organisations, NGOs and SMEs have indicated that there is nearly no interest/value for them to invest time in looking for funding capacities from these schemes as the time that would be required to build a request for funding is too high and exceeds the level of potential subsidies. For them, applicants need to spend too much time gathering documents to justify the planned expenditure in their proposals. A general problem related to the AEMs, especially for the cultivation of certain crops, is that the long term commitment of farmers is not guaranteed and that the bureaucratic effort is comparably high, when supporting single species or plant varieties on different farms. The contract area per rare variety, or number of rare breeds supported through the AEMs will always remain rather limited, and thus the administrative burden is too high when compared to the total amount of the grant.

Furthermore, high administrative burden results from administration and control standards which do not fully fit with the conditions of in-situ conservation. Several interviewees have mentioned that there is a certain reluctance of Member States to implement AEMs especially in the field of neglected and underutilised crop varieties and rare breeds. This can partially be explained by high administrative burden and lack of specific know-how about to run such programmes. Additionally, the reporting obligations have also been described as discouraging by the same interviewees. Administrative burden at the institutional level was also identified. One example of this is the case study on emmer in Monteleone di Spoleto, where the municipality had to pay upfront several actions and tasks to prepare the projects/events that had been funded (including the set-up of the website), anticipating the money and accounting. This type of issues further limits incentives of public organisations to participate in these programmes. Overall, several consulted stakeholders indicated that the expected administrative requirements compared to the potential demand were the reasons why the initial plan of introducing genetic diversity measures within rural development programme was not realised everywhere. It was said that the burden outweighed financial incentives and advantages.

The administrative process related to the European research programme is also seen as significant burden by several stakeholders. SMEs in particular voiced their concerns about the administrative burden of managing research projects funded by the EU's Framework

Programme. When it comes to preparing and submitting research proposals for example, the Commission has begun to introduce new processes that aim to facilitate the application (e.g. the use of two-stage proposal submissions in H2020). While these new procedures do cut down on the total administrative burden in terms of time and workload required, there is a need to further expand these efforts.

Several interviewees have mentioned that the main issue is related to the final financial reporting and auditing once the project and all related tasks have been completed. The time period required to finalise the project and to have the reporting and auditing approved by the Commission is too long. As a consequence, the final funding sometimes arrives several months after the tasks are completed. Time periods of up to three years have been mentioned in the consultation of stakeholders. This is a key issue for small companies and micro-enterprises and implies an important obstacle for further participation in EU research projects. Despite the fact that administrative burden has been recognised as a key issue of the EU framework programmes, and the fact that Horizon 2020 includes 42 specific measures to reduce the administrative burden (a single set of rules for everyone, fewer audits, fewer reports to write, faster processing, and more); several interviewees indicated that too little efforts have been devoted to reduce burden for micro-enterprises that are working on conservation of genetic resources (mainly *in situ* activities) and on valorisation projects. This situation puts the participation of small actors in H2020 projects at risk.

Due to changes made in the EU financing procedures of the RDP 2014-2020 and in H2020, many interviewees indicated that it was time consuming to familiarise with the new procedures. This was mentioned as an obstacle for the implementation of particular activities, mainly in the short term, in both the RDP and in the new H2020 research programme. Another administrative burden issue has been reported by seed savers. The registration and certification of seeds have been mentioned as implying administrative burden in the context of e.g. the EU Directive on the marketing of vegetable seeds, and the International Treaty for PGRFA. This is the case for example for seed savers organisations since people ordering from the catalogues might in turn pass the seeds onto third parties.

3.7.4. Conclusions and recommendations for Theme 7

The final aim of the theme is to provide practical recommendations on how to reduce administrative burden and requirements to ensure a correct balance between simplification and sound financial management.

Many stakeholders generally agreed that administrative burdens exist. In particular, the implementation of the Nagoya Protocol, the application process for receiving subsidies from the EARFD; and the administration of the EU research projects were raised as the main issues. The level of burden is at times considered cumbersome and as an obstacle in accessing some of the actions. The administrative burden associated with access to EU actions is considered as too high, especially for smaller organizations, including NGOs and SMEs. As a consequence, organisations choose not to make the efforts to get access, and abandon opportunities to participate in these actions.

Stakeholders interviewed and encountered during the preparatory action made a number of practical recommendations to reduce burden on projects related to the conservation and sustainable use of genetic resources. These recommendations are summarised below:

- Unclear terminology was indicated as a reason creating additional administrative burden. In some countries there is no legal definition of genetic resources and stakeholders have to consult various legal documents which is cumbersome and time consuming. Interviewees agreed that the introduction of one universal

definition of genetic resources would certainly reduce the current level of administrative burden;

- Improving legal clarity on aspects of bio piracy and ABS for all stakeholders would help reducing workload for genebanks and users of genetic resources in the EU. Additionally, this may open possibilities for more and stronger collaboration and interaction between the different sectors, which are currently quite reluctant to collaborate with each other. An improvement on these aspects may also have a positive effect in the future for development and marketing of novel products, as well as on collaboration aiming for a difference in the EU food and agriculture sector;
- The European Agricultural Fund for Rural Development (EARFD) would benefit from a revision regarding the reduction of unnecessary administrative burden. Financial planning discussions should be moved to rural level authorities, with more opportunities for programme development at a lower level. Currently, this is not a practice in all MS;
- Small and local activities related to the conservation and use of underutilised crops are performed by small or micro businesses, and thus the application process as well as reporting in regards to funding (mainly RDP and H2020) were mentioned by interviewees as a burden taking too much time from the actual work. Furthermore, regular or on-going activities expressed concerns about having to re-apply for funding on a regular basis even though the initiative remains the same. A solution to this would be to have in place a simplified procedure for actors who are already beneficiaries;
- Establishing EIP groups as potential beneficiaries for the implementation of rural development AEMs measures could lead to a stronger role for groups, networks and partnerships at local and micro levels. Groups might be better placed to contract the expertise needed to deal with the administrative complexity. Furthermore, the organisation through groups could reduce transaction costs importantly;
- A ceiling could be introduced in the funding procedures (RDP and H2020). In this way, applications for small amounts of funding by micro-enterprises could be managed in a "light" way. As a result, many potential beneficiaries that are currently not applying for the funding due to the fear of lengthy and complex administrative procedures would be offered more practical ways of participating. An additional possible effect is that more people might be assisted;
- Stakeholders are in some cases not aware of the different support mechanisms available, even at national level. The understanding and gathering of information about funding mechanisms might be cumbersome in itself. More accessible and targeted information about available funding opportunities could potentially improve the situation;
- Several interviewees indicated that the level of administrative burden could be reduced if inter-institutional cooperation, nationally and at EU level, could be strengthened, especially between environmental and agriculture sectors.

PART 4: GENERAL CONCLUSIONS

This section first presents the conclusions per theme, and then the overall conclusions of the study.

Theme 1: Improvement of the communication between Member States concerning best practices and the harmonisation of efforts in the conservation and sustainable use of genetic resources

Past and current efforts at MS and EU levels as regards the conservation and sustainable use of genetic resources are recognised by a large majority of stakeholders met and interviewed during the Preparatory Action. However, the same stakeholders consider that Member State authorities are not strongly committed and coordinating genetic resource activities at European level. The current financial situation of Member State authorities (budget cuts and staff reductions) leads to a very limited involvement in the functioning of the European networks. This is also true for the European Commission where various services deal with genetic resources and agro-biodiversity. Interviewees have acknowledged that the importance of genetic resources for food and agriculture is not sufficiently recognised and reflected in the wider biodiversity supporting policies of most Member States and the European Commission.

At present, the formal structures at European level, including the networks ECPGR, EUFORGEN, ERFP, and MIRRI, do not have sufficient influence to promote the conservation and sustainable use of GR at European level. This is mainly due to a lack of funding and recognition from the part of the Member States, the European Commission and stakeholder groups. Furthermore, the expertise and capacities of these networks seem to be underexploited by the Member States and the Commission.

A related issue is the fact that the European networks are not well linked to the current EU policy frameworks (see Theme 4 and 5). The European Union would benefit from an intensified involvement of the European networks in the policy setting of the EU, through e.g. establishing a platform coordinated by an EU focal point for agrobiodiversity. The FAO National Focal Points on Genetic Resources for Food and Agriculture should also play an instrumental role in such initiative. Due to their financial shortcomings, these networks are currently not properly equipped to deal with future challenges, especially following the implementation of the Nagoya protocol in the EU. The current networks have a strong technical orientation and expertise; however, their impact in practice is limited and often lacks policy focus. An improved balance might enhance the role these networks could play at EU level, which would benefit the Member States and the European Commission.

For proper *in situ* management, most stakeholders consider that existing networks are few and poorly funded, and their span and outreach can be regarded as unnecessarily limited by bureaucratic burden. This type of collaboration should be further strengthened to safeguard Europe's bio-cultural heritage and increase its visibility and attractiveness.

The often local dimensions of such initiatives create issues regarding knowledge exchange across MS (including language barriers). In this context, it is possible that the current communication channels between *in situ* communities and with *ex situ* oriented programmes fostering the integration between *in situ* and *ex situ* approaches are insufficient. Instead of fully integrating *in situ* in *ex situ* coordination platforms, the alternative could be to develop specific tools to intensify networking. Such exchanges often hinge on personal contacts. Success stories on collaboration and knowledge exchange across MS and in different sectors should be publicised in order to trigger the interest of additional sectors and to promote further and stronger collaboration across the EU Member States. In addition, *ex situ* conservation and *in situ* management are often undertaken in different stakeholder communities, isolated from each other and with only limited interest in finding synergies and complementarities. The level of integration

depends on the specific features of the GR sector (more integrated in e.g. FGR) as well as on the country.

In situ and *ex situ* conservation programmes must collaborate more closely towards the common goal to protect endangered genetic diversity. The European Commission has responded to this need in its H2020 work programmes⁴⁹. These programmes also require tools to measure the impact on microbial populations in specific areas and habitats, and should not be limited to plants and animals.

Theme 2: Enhancing networking among key stakeholders and end-users in view of exploring marketing (and other cooperation) opportunities, such as provided by quality schemes and short supply chains.

According to the mapping exercise conducted in the context of the Preparatory Action, the sustainable use of GR seems to be key for the conservation of the diversity of GR but also for R&D activities. Indeed, the use of GR is an increasingly addressed issue in scientific literature. The sustainable use of genetic resources needs a user-friendly legal framework and proportional levels of legal requirements for small producers. The seed marketing directives have negative effects in the context of the valorisation of rare PGR and limit small and local producers. The influence of seed marketing directives is more a matter of their implementation at national level. In some MS, it is already easier to register on the national catalogue conservation and amateur varieties.

More freedom to operate is required to allow for an easier exchange of germplasm between and across seed savers.

A sufficient critical mass is required to develop a sustainable commercial activity. It is important to consider a first stage of up-scaling to guarantee that the number of available animals and seeds is significant enough for the supply chain under development and for the marketing objectives. Successful valorisation projects are often initiated and developed in added value food supply chains. The use of rare GR in organic production system has potential to trigger economic growth for the organic farming sector.

The successful development of a “genetic resource product” often implements criteria such as the development of traditional products, the set-up of new commercial approaches such as short supply chains, and the development of tourism, with a focus on heritage, local culture and tradition. The regional scope of valorisation projects has a positive impact on the marketing of GR. The use of local trademarks and quality signs such as the European geographical indications is also seen as an important tool to be used during valorisation projects. These quality signs allow a differentiation at market level and at consumer level. Marketing activities should include the dissemination of information, publications and research results, as well as awareness raising and efforts to bring knowledge and information about GR to the general public. Particular importance should be given to green public procurement that could sustain GR produce, e.g. through schools or university canteens.

User guides and methodologies on how to approach these dedicated marketing developments are currently missing and would provide added value. Success stories on the valorisation of rare GR and value chain developments should be compiled and distributed via the existing networks. Projects involving a mix of organisations and stakeholders, including both public and private stakeholders, were identified as successful in the context of the Preparatory Action. A two-step approach is suggested:

A first step consisting in analysing and characterising products in order to market and

⁴⁹ See Horizon 2020 Work Programme, topic SFS-4-2017 on page 23: http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-food_en.pdf

label them accordingly, raise awareness and show consumers the quality and characteristics of these products; and

In a second step, a network or platform should be reinforced for producers to sell their products, since the resources and knowledge required to set up a business are not always available. There are already SME promotion programmes (including in the agricultural domain) and support related to the Enterprise Europe Network. Such platforms could also involve stakeholders with a more business oriented approach, who could team up with producers.

It has been reported by various stakeholders that funding made available for valorisation projects is in many cases insufficient, and the development of new supply chains is often limited due to the lack of available resources. A large number of valorisation projects exist but their development does not take-off because there are no resources to initiate the first steps. Additionally, the EU farm promotional programmes could be a very important tool for GR. However, today they do not correspond to the needs of the GR stakeholders. While there are certain exceptions for PGI/PDO products, in general they are focused on export, multi-national cooperation and on big marketing campaigns. The establishment of a "light version" for small initiatives with genetic resources would be a positive contribution. Furthermore, the administrative burden overall limits the development of valorisation projects.

The use of rare GRFA could be facilitated by specific local/regional competence and training centres. These competence centres could take the form of e.g. Operational Groups from the European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability'. These coordination groups should include key and complementary stakeholders, and should not be limited to traditional economic actors of the agro-food supply chain. One could consider that local/regional stakeholders acting on tourism, territorial development should also be included in these groups. They would need to act at local level to be able to secure the engagement of local stakeholders.

Theme 3: Improvement of the exchange of knowledge and research on genetic diversity in agricultural systems.

Three different aspects of knowledge were considered in this discussion:

- Technical conservation methodologies to preserve the gene pools and make these available to potential users (including through *in situ*, *ex situ*, and on-farm approaches);
- Coherent organisation and coordination of GR conservation and sustainable use at the international and national level; and
- Use of GR for breeding and other services.

The lack of knowledge coupled with the systematic lack of funding to create and disseminate that knowledge, is a major obstacle for the stakeholders of the formal sector. In the informal sector, the difficulty is related to accessing the existing knowledge and lessons learnt from other stakeholders involved in similar initiatives elsewhere.

The main conclusion of the analysis can be formulated as follows: increased knowledge with regard to conservation and management methodologies will enhance efficiency and efficacy. Most stakeholders involved in conserving GR have to act on a narrow scientific basis.

This is mainly due to two factors:

- The necessary knowledge is not existent due to a lack of dedicated research. This is true where it concerns typical *ex situ* methodologies (e.g. tools for optimal characterisation of GR material or optimisation of cryo-preservation techniques), *in situ* methodologies (e.g. the effects of climate change on CWR reserves and effects of in-breeding in animal populations,) and on-farm (e.g. the ability of crops to adapt to a changing environment, and the so called “continued evolution” tools to manage community seed banks); and
- The knowledge does not sufficiently reach the stakeholders who need it, or is insufficiently adopted. The knowledge generally resides amongst the academia, in the public sector, and in private companies. Farmers and producers are often reluctant to take advice from the research sector, as the relationship between the two stakeholder groups is not sufficiently developed.

The available knowledge is not fully accessible in the form of tools and capacity building material adapted to the various stakeholder groups, in the different languages. Lessons can be learnt from on-going and past projects in the GR sector that will increase the impact of new GR use initiatives. Due to the lack of coordination and of research capacity, the options for the non-commercial use of GR in breeding or for other services (e.g. landscape management) are very limited. As many case studies showed, most of the activities were “re-inventing wheels”, not building on prior experience or available dedicated research. This concerned most aspects of this use: (alternative) breeding, processing, marketing but also communication and creating sustainability⁵⁰. The strengthening of the documentation aspect of characterisation and evaluation (C&E) data for plant breeders and universities (e.g. C&E-data in national inventories) to monitor the implementation of the FAO’s Second global plan for action (GPA) for PGR, EURISCO or a global information system (Art. 17 of the ITPGRFA), should be addressed and recommended.

Theme 4: Adaptation of breeding methods and legislation to the need of conservation and sustainable use of genetic resources.

Breeding methods: Technological developments increasingly offer opportunities for breeding with the help of marker assisted selection, and the use of other molecular tools. These technologies have already significantly changed breeding practices. Modern, highly efficient genotyping methods increase the volume of DNA sequence data and hence the value of genebank collections. These methods are helpful in creating new pre-breeding material, though the efficiency of phenotyping is lagging behind in terms of the characterisation of material and breeding populations.

In PGR, most breeding methods are aimed at, or result in, uniformity. However, in organic and low-external-input agriculture, and in the efforts of seed savers, breeding for diversity (and thus increased resilience) is seen as a priority, preferably through participatory approaches (participatory plant breeding). In order to conserve and sustainably use local genetic resources, breeding strategies must be developed and implemented, taking advantage of the specific features of local breeds and varieties, such as pest or disease resistance and higher tolerance to sub-optimal conditions (animal breeds and new tolerant plant varieties). Again, marker-assisted and sequence-based selection will be helpful in improving the efficiency of the breeding and characterisation of plant materials and in the maintenance of traditional animal breeds. However, not all

⁵⁰ See case study reports.

breeders, and not all crops, can afford to use these advanced technologies. With the rapid development in sequencing technology, marker-assisted selection is becoming less costly. Nevertheless, crops in farming systems with high return and top commercial values are the ones that benefit from the use of these technologies first, and benefits are harder to achieve for varieties adapted to alternative systems. Therefore, a need to reinforce capacities for the phenotypic and genotypic characterisation of accessions was highlighted by stakeholders.

These efforts would need support from public funding or in the case of high-value crops; this could ideally be done in the form of public/private partnership approaches.

Legislation: Legislation is focused on mainstream agriculture. This includes in particular seed legislation, and phytosanitary and veterinary legislation. For small/medium (organic) companies and NGOs (seed networks and savers) this legislation may be difficult to comply with because of different objectives and a lack of resources. The following legislations were put forward as highly relevant.

ABS regulation may limit access to genetic resources. There are several issues surrounding the implementation of the Nagoya Protocol (2010) in the EU, which provides an international legal framework for the effective implementation of the Convention on Biological Diversity (CBD) related to the fair and equitable sharing of benefits arising from the use of genetic resources. Most interviewees have indicated that the current status of implementation leads to uncertainty regarding which GR exchanges will be possible. The second issue observed is related to the compilation of information required to complete the legal requirements on the documentation of the transactions, in particular in the form of the agreed Material Transfer Agreements (MTAs). These requirements lead to an increased administrative burden. Interviewees also clearly mentioned that complementary implementation of both the Nagoya Protocol and the ITPGRFA should be kept in mind by all stakeholders, and that collaboration through the relevant authorities should be intensified.

The seed marketing directives may form a major obstacle for the development of commercially viable activities and supply chains based on non-uniform material. Farmer's varieties, old varieties, conservation and amateur varieties, and landraces are often genetically heterogeneous and for that reason many of them do not pass DUS criteria required for the registration of new varieties. The current legislation, and particularly the legislation on conservation varieties, is seen as restricting and costly for small and local seed companies. The influence of seed marketing directives depends on their implementation at national level. In some MS it is already easier to register on the national catalogue conservation and amateur varieties. The newly proposed and rejected EU Regulation on the marketing of plant productive material intended to improve the situation, though various stakeholders expressed concerns that this will be insufficient to facilitate the use and to stimulate the commercial exploitation of such varieties and landraces. The rejection of the Commission's proposal in 2014 implied that measures perceived by many stakeholders as improvements will not be implemented.

With regard to **intellectual property**, the issue related to the patenting of plants and native traits is seen as a threat for local breeding programmes, the on-farm development of varieties, and participatory breeding, as the outcome of the breeding activity may not be freely marketable. Breeding for such traits can become limited to companies which will be able to afford to pay to access these proprietary traits. To some extent, genebanks can address this issue with the standard MTA. However, genebanks are also increasingly confronted with a privatisation of traits in their publicly available collections.

The current EU legislation relevant for animal genetic resources should be reviewed in order to better support the conservation and sustainable use of local and cross-border breeds, to ensure sustainability, and to limit the negative impacts of essential rules and avoid unnecessary burdens for breeders (e.g. obligations for genetic evaluation for bulls).

Theme 5: Contribution to the successful implementation of rural development measures concerning genetic diversity in agriculture.

Agri-environment (AEM) and agri-environment-climate measure (AECM), forming part of the Rural Development Program, offer Member States the opportunity to target the level of practical farming to perform on-farm conservation of genetic resources⁵¹. Agri-environment and climatic measures include the possibility to compensate farmers for additional costs and income foregone resulting from conservation activities aiming to preserve endangered breeds and crops under threat of genetic erosion. The support in the framework of the ongoing programming period was made available only two years ago. As a consequence, it is difficult to draw any conclusions on the success of the implementation of these measures. However, such support has already existed in the previous programming period. Therefore, preliminary conclusions might be formulated.

The legal basis for payments for agri-environment-climate measure (including payments for the maintenance of traditional grasslands and rare breeds or traditional/ conservation varieties), organic farming (closely related to agrobiodiversity) and Natura 2000 (established to protect biodiversity) are in place. However, in several Member States, rural development measures hardly address genetic diversity objectives as conserving and promoting the use of genetic resources are not a clear priority of these MS or regions

The current set-up of the rural development framework at the EU level offering certain scope of flexibility leaves room for this. The main factors explaining the limited success of current and previously implemented rural development measures concerning genetic diversity in agriculture include limited awareness of agri-environmental and climatic measures to support genetic diversity conservation among stakeholders, relatively low levels of financial support, and high levels of administrative burden. Maximum grants for these measures need to be increased to become more effective.

The newly established European Innovation Partnership "*Agricultural Productivity and Sustainability*" (EIP-AGRI) allows for the establishment of operational groups at the local level that would perfectly serve the need of conservation of genetic resources *in situ* and on-farm; and could also create creative clusters to initiate a valorisation project of neglected/underutilised crops or rare breeds. Additionally, it may be considered that these clusters could recognise the importance of farmers as drivers for attaining economic, social and environmental goals, and for the purpose of maintaining genetic resources on-farm⁵².

National/regional RDPs 2014-2020 give also possibilities to build co-operative projects enhancing the preservation and valorisation of GR in many flexible ways. This is possible through local/regional/national or trans-national projects until the end of the programming period. The financing of the RDP may be subject to a training, advisory, product development, supply chain development, and even investment concerning GR under the Priority 4 of the programme. Examples of the actions and projects can be found by the managing authorities of the programme.

Theme 6: Explore bottlenecks and enabling conditions for the sustainable use of genetic resources in agriculture.

A widely felt bottleneck that immediately surfaced during the study is the lack of a correct understanding and appreciation of the subject matter by various target groups.

⁵¹ Commission Delegated Regulation (EU) No 807/2014 supplementing Regulation (EU) No 1305/2013 and Commission Implementing Regulation (EU) No 808/2014 laying down rules for the application of Regulation (EU) No 1305/2013

⁵² See example:

http://www.eip-agraar-sh.de/fileadmin/user_upload/Downloads/OG_Tiergenetische_Ressourcen_engl._ueberarb.pdf

Genetic resources are often considered by the general public as simply biodiversity issues. In that context, the issue of genetic resources is only associated with traditional varieties, rare breeds, crop wild relatives, and neglected crops, while genetic resources are not understood in a wider sense, including not only old cultivars but also modern varieties and breeds. Moreover, the distinction between biodiversity at large and the special role of agro-biodiversity is not well understood along the supply chain and by its various stakeholders.

The consequence of this limited understanding and separation between biodiversity and agrobiodiversity leads to the risk that the focus of EU policy and funding is on all genetic resources as defined in the CBD Convention rather than on the specific characteristics of agro-genetic resources. Concrete communication on the relevance of agro-biodiversity and cultivated biodiversity is needed to address its specific features in relation to biodiversity in general.

In addition, the sustainable use of genetic resources for food and agriculture would benefit from increased awareness regarding its relevance. Currently, the field of genetic resource conservation is often limited to researchers and experts. Initiatives related to awareness raising, education, training, and other activities aiming to bring information about genetic resources for food and agriculture to the general public were mentioned as enabling conditions for their sustained management.

The genetic resources of all domains play an important role in the formal agro-food value chains, in particular in local supply chains. Therefore, when developing R&D and valorisation programmes addressing potential applications for genetic resources, it is central to have a clear overview of all associated stakeholders in the chain. Farming plays a critical role in this supply chain as it represents the primary production phase, and the start of the chain. The valorisation and sustainable use of GR begin at farming level for most PGR and AnGR. At this primary production stage, there is a clear bottleneck regarding the increase of genetic variability, and thus also for the potential to develop new products, whereas one can observe a reduction of cultivated biodiversity and life-support functions at field level. Whereas several research projects are already in place, stakeholders consider that these types of initiatives should be further enhanced (see Theme 3)⁵³.

In food processing, genetic resources and in particular microbial genetic resources (e.g. fermenting microorganisms; or biotechnological derivatives of genetic resources such as enzymes, protein extracts or nano-proteins) play an important role. The reduction of variability in the genetic resources available may restrict the potential to develop new innovative and high-value food products.

The sustainable use of underutilised, local genetic resources at local level should be promoted. Financial support targeting family farmers undertaking such efforts would benefit conservation as their local knowledge helps preserve the genetic diversity and adds to the cultural identity of the region. Furthermore, agro-tourism and gastro-tourism are key in the sustainable use of GR. Tourism companies are the immediate partners and local and regional gastronomy enable farmers to offer and market their traditional and regional products. Touristic activities provide a mean of supporting the conservation of GR.

Projects which do not demonstrate added value for the final stakeholders / end users in the value chain appear to not be sustainable. Once a product has been developed and interest and demand from end users is demonstrated, a critical mass and expertise are required to develop a marketing plan. In a number of cases, these conditions are not

⁵³ See for example projects DIVERSIFOOD, TRADITOM and TREASURE funded under topic SFS-7-2014 of Horizon 2020 Work Programme 2014/2015 (see page 15)

fulfilled. Consequently, business opportunities are reduced and the economic sustainability of the project is at risk. Finally, the lack of proper funding implies a threat to the continuity of most activities. A variety of interesting projects are initiated through project funding, but encounter difficulties once the funding period ends.

The main enabling conditions identified under Theme 6 can be summarised as follows:

Public private partnerships (PPPs) are seen as an interesting tool to solve the lack of characterisation of *ex situ* collections, even if they may raise IP issues. Public sector scientists and breeders should be encouraged to invest in characterisation (phenotyping and genotyping) and to share the acquired knowledge with all stakeholders which are part of the PPP project. The collaboration undertaken by both NordGen and Breedwheat are considered as best practices in this context.

The development of alternative products marketed via alternative supply chains benefits from the existence of networks of farmers at local level. There is a need to further develop these alternative supply chains at EU level and to further disseminate best practices on the valorisation of GR. The operational group approach of the European Innovation Partnership (EIP) potentially offers expertise, capacities and funding for the development of local initiatives, communication channels for their target groups, and for the dissemination of best practices. In these EIPs, links can be created between different stakeholders who need to work together but often are not aware of each other's activities.

The current data management systems created by the European networks (ECPGR, ERFP, MIRRI, and EUFORGEN) offer a robust basis to further develop pan-European data management and data sharing between *ex situ* collections and with user communities. The limited data harmonisation and inter-operability of data management systems still hinder exchange and dissemination across countries and communities, and between *in situ* conservation experts themselves.

Theme 7: Reduction of the unnecessary administrative burden so as to provide better access to actions.

Many stakeholders consulted in the context of the Preparatory Action agreed that a substantial administrative burden is related to the undertaking of efforts to conserve and use genetic resources. The implementation of the Nagoya Protocol, the application process for getting subsidies from the EARFD, and, to a less extent, the administration of the past EU research projects were highlighted as main issues. For smaller organisations, such as NGOs, SMEs and farmers, this is an even more critical issue as the capacity and resources available to deal with the administrative burden are limited. Consequently, such organisations often choose not to access certain measures and thus abandon opportunities to participate in actions on the conservation and sustainable use of genetic resources.

PART 5: OVERALL RECOMMENDATIONS (THE VISION)

The general conclusions allow the formulation of preliminary recommendations which are built on practical and detailed suggestions formulated by stakeholders and public authorities during the Preparatory Action.

The major recommendations which have emerged from the discussions per theme have been grouped to allow a clear identification of problematic areas.

The order in which these recommendations are placed does not necessarily reflect their relative priority. The targeted level of each recommendation is presented into brackets in italic.

1. Re-inforce EU governance and optimise links with international and national activities and bodies (*Europe*)

- Assign formal responsibilities and create transparency on the distribution of competence and responsibilities between regional, national and EU stakeholders and institutions, as well as between these and international bodies and organisations. Biodiversity requires a multi-disciplinary approach, and involves multi-level decision making and implementation. It requires pluralist and modern governance models. Agrobiodiversity currently lacks a clear competent authority, a substantial budget line, and a functional strategy.

2. Set up an EU platform of all interested parties (stakeholders and competent authorities) to secure an optimal coordination between the different bodies and to tackle new challenges (e.g. legal, funding capacities)(*Europe*), the role of which will be to:

- Enhance dialogue and coordination across the different EC DGs dealing with genetic resources;
- Liaise with FAO as a further mean to secure the coordination of actions at international, EU, and Member State level. Use and actively promote synergies emerging from strengthened cooperation at national, transnational and international levels;
- Improve the involvement of farmers' organisations in policy development and activities related to plant genetic resources for food and agriculture (PGRFAs) as stated in Article 9 of the International Treaty that calls on governments to create a stronger involvement of farmers in policy development related to PGRFA;
- Foster information exchange in order to promote the EU-wide adoption of best practices and harmonisation of efforts, involving the established European-wide networks ECPGR, ERFP, EUGENA, MIRRI, EUFORGEN, and the NGO network Let's Liberate Diversity; and
- Communicate on new challenges such as the implementation of ABS Regulation.

3. Support partnerships and cooperation between stakeholders at all levels in the supply chain (*Europe*):

- Complement the existing European networks on genetic resources by supporting the creation of a network addressing MIGR (and possibly AnGR);

- Actively support EU user networks (farmer networks, seed savers, community seed banks, and others NGOs) in the exchange of knowledge and best practices in the field of on-farm and *in situ* conservation (including the conservation of crop wild relatives and cultivated genetic resources such as landraces) and use, in order to promote the development of regional and local supply chains as well as traditional and local products; and
 - Promote integrated approaches between *in situ*/on farm and *ex situ* activities also fostering the development of community seed banks (managed by the coordination platform).
- 4. Further develop R&D programmes for the dynamic conservation and management of GR, and promote European, national and regional R&D programmes exploring the sustainable use of wild and cultivated genetic resources for better food and nutrition and ecosystem services(*Europe and national*).** These programmes will help decrease the negative environmental impact of livestock production and aid towards adaptation to climate change. R&D programmes often exist but there are not sufficiently known at local level. Further dissemination and awareness rising regarding these programmes and support possibilities are required.
 - 5. Develop an appropriate infrastructure for pre-breeding activities in plants (*Europe, macro regional, national*),** addressing inter alia the characterisation on a genetic level to build up knowledge about the genetic diversity, and evaluation on a phenotypic level to receive information about priority genetic and agronomic traits of GR in *ex situ* collections through the adoption of new approaches and the establishment of interdisciplinary teams. The infrastructure would preferably be through a public and private partnership (PPP) in high value crops only. Improve the accessibility of public *ex situ* collections for end-users. Develop appropriate access policies taking into account IPRs issues and adapted MTAs.
 - 6. Strengthen the role of advisory services as a robust link between research and production (between scientists and farmers/producers) (*national, regional*).** Traditional advisory services (e.g. technical institutes) should ideally act as knowledge brokers/facilitators to: 1) secure the correct transfer of information from research to production for valorisation, and 2) to re-orient stakeholders in the product chain to better understand what users want and how to respond to these needs in a sustainable way.
 - 7. Promote the establishment of European Innovation Partnerships (EIP) operational groups to develop and reinforce GR valorisation projects for neglected and underutilised crops, crop wild relatives, landraces as well as rare and local breeds (*regional, producers*).** Use EIP to develop new business models adapted to GR. NGOs, universities, producers, and entrepreneurs all play a role in fostering such valorisation. RDP can provide a framework (and funding) for such cooperation. EIP-AGRI has a strong connection with H2020 project activities and results dedicated to the exploitation of genetic resources (e.g. as in the 2014-2015 topics SFS-7).
 - 8. Improve value chain cooperation for rare breeds and underutilised/neglected crops by facilitating the up-scaling of the number of breeding animals and seeds, promoting the added value (biodiversity, tourism, cultural heritage) and the use of the three systems for promoting and protecting the names of quality agricultural products and food in the EU (PGIs, PDOs, and TSGs) for**

rare and local GR and offering funding for such cooperation (under RDP). Secure valorisation in both food and non-food sectors. (*national, regional, producers*).

9. Promote the effective take-up of funding opportunities via the agri-environmental and climate measures (AECMs) (*national, regional*) on the maintenance and sustainable use of genetic diversity in agriculture (through e.g. adding collective financial support for collective programmes) while maintaining current measures for farmers/holders of endangered local GRFA).

10. Review and secure the coherence of existing legislation to facilitate and promote the conservation and sustainable use of genetic resources for food and agriculture⁵⁴ (*Europe*). This legislation includes inter alia zootechnical, veterinary, phytosanitary, seed marketing, invasive species, novel food, and ABS legislation as well as different additional EU regulatory frameworks and national legislation (e.g. State aid rules to support the livestock sector, EU regulation on quality schemes and EU support measures for the promotion of agricultural products, as well as research policy).

11. Reduce administrative burden, especially for SMEs and farmers (*Europe, national, regional*) given their pivotal role in exploring the use of genetic resources for food and agriculture, in particular in the context of the implementation of the Nagoya Protocol and in relation to AEMs in the Rural Development policy. Any actions linked to the Nagoya Protocol should be in support of implementation, especially by smaller stakeholders involved mostly in conservation activities.

12. Secure long term political commitment for agro-biodiversity supported by appropriate funding (*Europe, national, regional*).

Particular attention should be given to the following options:

- Identify synergies within technical institutes in charge of variety registration in each MS to fund *ex situ* collections; and
- Review options for the EC to participate in funding towards the existing scientific and NGO networks. These may serve as platforms to enhance science-policy-practice dialogues, to increase cooperation and coordination between Member States, to assess and communicate relevant scientific and tacit knowledge, and to coordinate the development of common strategies. A permanent source of funding from the Commission will ensure the long-term commitments needed to coordinate the conservation and sustainable use of genetic resources for food and agriculture in the EU.

Overall, it is recommended that the EU develops **an EU agro-biodiversity strategy that considers the conservation and valorisation of agricultural and forestry genetic resources in line with the EU Biodiversity Strategy (Target 3)⁵⁵**. This strategy should encompass different domains and different Directorate Generals (DGs) of the European Commission (EC).

⁵⁴ As stated in Article 6 of the Treaty and in the Global Plan of Action of FAO.

⁵⁵ http://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm

This strategy has to be considered as complementing and strengthening the current Biodiversity strategy developed by DG Environment, by securing the full coverage of "*cultivated biodiversity issues*".

The EU coordination platform mentioned in Recommendation 2 should be the central body for implementing this strategy. Opportunities of using existing tools of H2020 as Thematic Network as well as under national/regional RDP such as co-operation measure and the EIP Operational Groups should be fully explored in order to develop valorisation projects at local/regional level.

