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# COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

**Item 3 of the Provisional Agenda**

**AD HOC TECHNICAL WORKING GROUP ON ACCESS AND BENEFIT-SHARING FOR GENETIC RESOURCES FOR FOOD AND AGRICULTURE**

**First Session**

**Longyearbyen (Svalbard), Norway 11 - 13 September 2012**

# DISTINCTIVE FEATURES OF GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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# I. INTRODUCTION

1. Over recent years, a new international legal architecture on access and benefit-sharing (ABS) for genetic resources has emerged, which may have important implications for the use and exchange of genetic resources for food and agriculture (GRFA). The recently adopted *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* (Protocol) constitutes the newest element of this legal framework and adds new impetus to the discussion about how to best address ABS for GRFA.

2. The Commission on Genetic Resources for Food and Agriculture (Commission) has started work in this field as an early task within its Multi-Year Programme of Work, and decided at its Thirteenth Regular Session in July 2011, to establish this Working Group.[1] According to its terms of reference, the Working Group shall, *inter alia*, "identify relevant distinctive features of the different sectors and subsectors of GRFA requiring distinctive solutions".[2]

3. This document shall aim to assist the Working Group in identifying the relevant distinctive features of GRFA requiring distinctive ABS solutions.

# II. BACKGROUND

4. While the special nature of agricultural biodiversity and the distinctive features of GRFA have long been recognized, they have rarely been specified in more detail. However, the identification of the specific features and needs of GRFA is a condition for the development of ABS measures adapted to the food and agriculture sector.

5. One major effort to characterize the patterns and practices of use and exchange of genetic resources in the various subsectors of food and agriculture (including animal, aquatic, forest, plant, micro-organism and invertebrate GRFA) has been made in a series of background study papers prepared for the Commission in 2009.[3] The study papers demonstrate that GRFA are exchanged in many different ways, by a broad range of stakeholders, for various purposes, and under a wide variety of conditions. The patterns of use and exchange vary not only between the different sectors of food and agriculture, but also within the subsectors according to the type of use, the type of genetic material, the taxonomic group and the geographical region concerned. At the same time, the study papers demonstrate that, in all subsectors, the international exchange of GRFA plays a fundamental role for achieving food security and sustainable agricultural development.

6. GRFA have been moved around the world for millennia and no prosperous food system has ever been based on genetic resources of purely domestic origin. The most commonly used farm animal breeds, for example, are of mixed ancestry[4], and aquaculture species are farmed far beyond their natural distribution ranges. As a result, Asia is the number one producer of African tilapia; Chile is the world's second largest producer of farmed salmon originating from the northern hemisphere; and the oyster industries in North America and Europe rely on Japanese germplasm.[5]

7. Nowadays, large quantities of germplasm samples are exchanged across national borders and international cooperation on the conservation and utilization of GRFA is essential. A network of over 500 public culture collections for micro-organism genetic resources is organized in the World Federation of Culture Collections (WFCC). Together, they hold more than 1.4 million strains, and more than 0.5 million samples are distributed every year.[6] A similar situation can be observed for plant GRFA, where the CGIAR Centres alone distribute more than 0.5 million samples of Annex 1 material per year.[7]

[1] CGRFA-13/11/Report, paragraph 60.
[2] CGRFA/WG-ABS-1/12/Inf.2.
[3] Background Study Paper No. 43 - 47.
[4] Background Study Paper No. 43, p. 26.
[5] Background Study Paper No. 45, p. 18.
[6] Background Study Paper No. 46, p. 7.
[7] See document IT/GB-4/11/Inf.05 (http://www.planttreaty.org/sites/default/files/gb4i05e.pdf).

8. The cross-border exchange of genetic material and the introduction of exotic species are often the critical step in the development of a new agricultural technology. The development and use of a new biological control agent is, for instance, based on the introduction of a pest's natural enemy into an environment that it is not native to. To date, at least 119 countries have provided a biological control agent to another, and 145 countries have made use of biological control agents received from others.[8]

9. With the new challenges posed by climate change, it is likely that the importance of the international exchange of GRFA will even increase in future.[9]

## III. DISTINCTIVE FEATURES OF GRFA REQUIRING DISTINCTIVE SOLUTIONS FOR ABS

10. Building upon the analysis of use and exchange patterns in the different sectors and subsectors of food and agriculture, this chapter presents a list of 20 distinctive features of GRFA that might be relevant to the design of ABS measures suitable for GRFA. The list has been developed on the basis of the outcomes of wide stakeholder consultations that were carried out to develop the above mentioned background study papers, and during the course of a Multi-stakeholder Expert Dialogue on ABS for GRFA, that had been initiated by the Secretariat of the Commission in 2010 and reported to the last session of the Commission.[10]

11. The features are presented in seven clusters, each with a one-sentence summary and a brief explanation, providing the rationale and some more detailed information. The wording used to describe the features aims to reflect an equilibrium between all subsectors of food and agriculture and highlights those aspects that are considered to apply to all types of GRFA. Consequently, not every feature is necessarily applicable to each and every GRFA, but to many or even most of them.

### *Cluster A: The role of GRFA for food and security*

**A.1 GRFA are an integral part of agricultural and food production systems and play an essential role for achieving food security and the sustainable development of the food and agriculture sector.**

12. Alongside with soil and water, GRFA constitute the basis for any agricultural production and are one of the most important raw materials for farmers, breeders and scientists. The use of genetic diversity plays a fundamental role in adapting agricultural production systems to changing environmental conditions, new biotic and abiotic stressors, and evolving human needs and preferences. In order to be able to cope with the challenges of climate change and a growing global demand for food and agricultural products, the whole range of existing agricultural biodiversity needs to be at the disposal of researchers, breeders and producers beyond national borders.

**A.2 Plant, animal, invertebrate and micro-organism GRFA form an interdependent network of genetic diversity in agricultural ecosystems.**

13. Agricultural ecosystems and their productive capacity depend on complex interactions between cultivated and bred species (such as crops, domesticated animals, cultivated tree species or farmed aquatic organisms), and associated biodiversity (such as weeds, soil and water microorganisms, pollinators, pests, diseases and their natural enemies etc.) providing important ecosystem functions or posing a threat to production. The interactions between cultivated and associated biodiversity are increasingly subject to research and are often the starting point for product development. Consequently, research and development programmes, but also production itself, rely on the combined use of, and access to, various groups and subsectors of GRFA.

[8] Background Study Papers No. 47, p. 14.
[9] See also Background Study Paper No. 53-57 and 60.
[10] Background Study Paper No. 59.

### *Cluster B: The role of human management*

**B.1 The existence of most GRFA is closely linked to human activity and many GRFA can be regarded as human-modified forms of biodiversity.**

14. Humans have shaped the evolutionary processes by which GRFA have developed through the modification of living conditions in natural ecosystems and the provision of artificial habitats in agricultural production systems. Furthermore, GRFA are often the result of long and complex processes of domestication and selective breeding, that have considerably altered the genotypic and phenotypic characteristics of the originally wild species and populations, and adapted them to the changing needs of production and consumption. GRFA continue to evolve in a dynamic interaction between the environment, human management practices and the genetic diversity itself.

15. The way in which humans have influenced the evolution of GRFA may differ from one subsector to another and even between species. Domestication and systematic genetic improvement play a major role for animal and plant GRFA, and for an increasing number of species used in aquaculture and forestry. Other aquatic and forest GRFA, and nearly all micro-organism and invertebrate GRFA, have been shaped by humans in a less direct form, as their living conditions depend on agricultural practices and they often evolve in parallel with cultivated species.

**B.2 The maintenance and evolution of many GRFA depend on continued human intervention, and their sustainable utilization in research, development and production is an important instrument to ensure conservation.**

16. As GRFA have evolved as an integral part of agricultural and food production systems, they are adapted to, and dependent on, living conditions shaped by human management. Rather than being a threat to their survival, human use is consequently often a precondition to their persistence. One of the main reasons for the loss of agricultural biodiversity is that particular genetic resources drop out of utilization because of changing agricultural practices and production systems. Other important reasons are the degradation of habitats, the loss of ecosystems, overexploitation and the introduction of invasive species. The sustainable management of agro-ecosystems and the utilization and further development of GRFA in research, breeding and production are essential components of effective conservation strategies.

### *Cluster C: International exchange and interdependence*

**C.1 Historically, GRFA have been widely exchanged across communities, countries and regions over often long periods of time, and a relevant part of the genetic diversity used in food and agriculture today is of exotic origin.**

17. As GRFA are inherently linked to human livelihoods and food security, they have historically moved together with people throughout the world, spurred by migration, colonization and trade. Furthermore, it has been common practice in the food and agriculture sector to exchange genetic material among local communities, farmers and breeders, as part of customary improvement and production processes. Successful production systems and technologies, including the associated genetic diversity, have also frequently been transferred to other countries and regions. As a result, a significant part of the genetic diversity used in current agricultural and food production systems is of exotic origin.

18. The extent of the historical exchange of germplasm and the proportion of exotic diversity used differ between subsectors and species. While animal and plant GRFA have extensively been exchanged over the last 10 000 years, and livestock and crop production in most regions of the world today utilizes genetic resources that originated or were developed elsewhere, the situation in the forestry and aquaculture sectors, which are at much earlier stages of development, is mixed. Some of the commercially most relevant species have been moved extensively throughout the world and are cultivated now far beyond their natural distribution ranges. Several other species are just starting to be farmed in aquaculture, or are only used within their natural habitat in native forests, and their exchange has been limited so far. Micro-organism and invertebrate GRFA have often been exchanged

unintentionally, spreading together with the farmed species and production systems they were associated to.

**C.2 Countries are interdependent with regard to GRFA and act both as providers of some genetic resources and as recipients of others.**

19. The fact that an important part of agricultural and food production relies on the use of species of exotic origin, means that countries are usually not self-sufficient with regard to GRFA. Most countries need to access some genetic resources from elsewhere to sustain their agricultural production and food security, and can consequently be regarded as interdependent. Moreover, it is very difficult to draw a clear line between provider and recipient countries, as most countries may, at least potentially, be providers of some types of genetic diversity and recipients of others. Another reason for the interdependence of countries regarding GRFA lies in the increasing specialization and division of labour among actors across national borders.

20. In general, interdependency plays a role in all subsectors of GRFA. However, it may be more or less pronounced in different branches of production and different geographical regions. While, for example, the management of native forests relies only on genetic diversity that can be found locally, the production of fast-growing plantation tree species often depends on foreign reproductive material. Also, the reasons for interdependence may vary. The utilization of micro-organism GRFA is, for example, highly dependent on international cooperation due to the need to specialize and distribute an overwhelming amount of organisms to be researched and managed[11]. In classical biological control, the interdependence arises instead from the fact that the methodology itself is based on the introduction of exotic species.

**C.3 The international exchange of GRFA is essential to the functioning of the sector, and its importance is likely to increase in future.**

21. To the same extent that agriculture and food production have become a globally interlinked activity, the international exchange of GRFA fulfils an indispensable function in this system. As a consequence of the historical movement of germplasm around the world, most countries make use of genetic diversity that originated or was developed elsewhere. This trend is likely to increase in the future, as the shift of agro-ecological zones provoked by climate change will need to be matched with adapted genetic material. In addition, the complexity and magnitude of the global task to conserve and use GRFA in a sustainable manner, requires international division of labour and specialization among different actors across national borders. This relies on the cross-border transfer of genetic material at different stages in the value chain.

22. The international exchange of genetic resources fulfils a crucial role in all subsectors of food and agriculture in the sense that its inhibition would have severe consequences. Nevertheless, the actual volume and direction of the flow of genetic material varies considerably among different subsectors, species, countries and over time.

### *Cluster D: The nature of the innovation process*

**D.1 The innovation process for GRFA is usually of incremental nature and based on contributions made by many different people in different places at different points in time.**

23. GRFA are often used in a process of incremental innovation, in the sense that the genetic material is being improved continuously over multiple successive generations and the gains are cumulative. One innovative step is added to another and products are not the final result, but rather an intermediate step in an ongoing chain of improvement, as they can themselves be used as an input to further innovation. In the course of this continuous improvement process, genetic material is frequently exchanged and mixed with other genetic resources. Consequently, many GRFA have been developed over long periods of time, based on material originating from different parts of the world and thanks to the contributions made by many different people.

[11] Background Study Paper No. 46, p. 7.

24. The degree to which contributions to the development of GRFA are dispersed, depends on the intensity and length of the improvement processes to which they have been subject. For most animal and plant GRFA, the history of improvement goes back to several thousand years, and many people in places that are sometimes geographically very distant from each other contributed to such improvement. In the aquaculture and forestry sectors, domestication and genetic improvement activities are often so recent that only a moderate number of innovative steps have accrued so far, and contributions to the development of a specific genetic resource can more easily be attributed to individual people, communities or countries.[12] However, it can be expected that, as the improvement process progresses, contributions will increasingly be dispersed.

**D.2 Most products are not developed out of an individual genetic resource, but with the contributions of several genetic resources at different stages in the innovation process.**

25. Product development based on GRFA usually implies the use of a broad range of genetic diversity. Often, large numbers of samples of genetic material are accessed at different stages in the research and innovation process, and many GRFA contribute in one way or another to the creation of a specific genepool and the products developed from it. Therefore, products are often developed with the contributions of several GRFA from different providers and being added to the development process at different points of time. In many cases, it is quite complicated, if not impossible, to assess the value of each individual genetic resource in the development of a specific product.

26. The various subsectors may differ as to the way in which genetic diversity is used for product development. In some subsectors, like micro-organism and invertebrate GRFA, a wide array of GRFA is used in the early stages of product development and contributes to the screening of the existing diversity and the identification of the most suitable genetic material. In other subsectors, such as plant and animal GRFA, GRFA can be incorporated in different phases of the genetic improvement process and directly contribute their parts and components to the genetic set-up of the resulting products.

**D.3 Most products developed with the use of GRFA can in turn be used as genetic resources for further research and development, which makes it difficult to draw a clear line between providers and recipients of GRFA.**

27. Most of the products derived from the use of GRFA comprise genetic material containing functional units of heredity and are, at least theoretically, ready to be reproduced and used for further research and development based on their genetic set-up. Furthermore, it is common practice in agricultural research and development to make use of products as an input to further innovation processes. Consequently, it is very difficult to make a clear distinction between providers and recipients of genetic resources, as every recipient of genetic material could also become a provider if her or his products are used by others.

28. Examples of this feature can be found in all subsectors of food and agriculture. For instance in the aquaculture sector, fish fingerlings might be sold by hatcheries for commercial grow-out in production ponds. Instead of being exclusively used for grow-out and consumption, some of them could be used to reproduce and build up new brood stock.

**D.4 Many agricultural products reach the market place in a form in which they may be used both as biological resources and as genetic resources.**

29. Many agricultural products, including commodities, are sold in a form that potentially allows their use as a genetic resource, for instance in multiplication and breeding activities. Whether they are going to be used only as a biological resource (i.e. for production and consumption) or also as a genetic resource (i.e. for reproduction and further development) is often unclear and unpredictable at the time of the market transaction. Consequently, it is often difficult to distinguish between exchanges of biological resources and exchanges of genetic resources. Therefore, targeting ABS measures exclusively at the use and exchange of genetic resources and not at the exchange of biological resources, in order not to interfere with ordinary market transactions of agricultural commodities, becomes a complex exercise.

[12] Background Study Paper No. 59, p.15.

30. While this is in principle true for all subsectors, the degree to which the purpose of use is predictable depends on the level of differentiation and specialization in breeding/reproduction on the one hand, and production on the other. If reproduction and breeding have been centralized in the hands of specialized actors and separated from production and grow-out, this often also implies that genetic material with different characteristics is developed for the different purposes, and it usually becomes easier to determine which genetic material is going to be used for which purpose.

### *Cluster E: Holders and users of GRFA*

**E.1 GRFA are held and used by a broad range of very diverse stakeholders.**

31. In the food and agriculture sector, many different stakeholders are involved in the management of genetic resources, including, *inter alia*, subsistence farmers and local communities, the market-oriented farming sector, public and private genebanks and collections, research institutions at national and international levels, and small- and large-scale companies. The different holders and users of GRFA operate in very diverse realities, with different financial, technical and legal capacities. Those differences are to be taken into account in the design of regulatory measures for the exchange of GRFA. On the one side, regulatory measures hold the potential to balance existing inequalities between different stakeholders. On the other, they also bear the risk of excluding less-well equipped stakeholders from the exchange of GRFA due to their lack of capacities to comply with those measures.

32. While all subsectors are characterised by the large diversity of stakeholders managing genetic resources, the number of involved actors may differ. For instance, compared to the farm animal and crop sectors, the user community in the biological control sector is rather small.

**E.2 The different stakeholders managing and using GRFA are interdependent.**

33. The conservation, management and utilization of GRFA is a major endeavour that requires extensive resources and capacities as well as highly specialized skills and knowledge. The work is divided among a broad range of actors holding and using GRFA and fulfilling different functions along the value chain. Consequently, GRFA are frequently exchanged and many stakeholders act both as providers and recipients of genetic material. No single actor or stakeholder group may perform all the required tasks and the activities are intertwined in a complex web of interdependencies. Cooperation among stakeholders becomes the cornerstone of effective conservation and sustainable use, for food security and agricultural development, and the regulatory environment should be enabling in that respect.

**E.3 A significant amount of GRFA is privately held.**

34. As an integral part of agricultural and food production systems, GRFA are often held and exchanged privately by farmers and producers, breeding companies and other suppliers of agricultural inputs, the food processing industry and commercial traders. Genetic resources may be owned in many different forms, such as live animals, commercial seed, brood stock, seedlings, genetic material in private collections, and breeding pools of private companies. This situation deserves special consideration regarding the potential scope of ABS measures, as extending the scope to privately held genetic material would greatly increase the number of regulated transactions, and the range of providers and recipients called to comply with ABS regulation.

35. The proportion of GRFA that are under private ownership varies considerably between subsectors. While privately owned material accounts for the majority of genetic resources held and exchanged in the farm animal sector, the situation in the micro-organism, plant and aquatic sectors is much more balanced between privately and publicly held material.

**E.4 An important part of GRFA is held and can be accessed *ex situ*.**

36. Many genetic resources of special value for food and agriculture have been collected from their *in situ* environments and are stored and made available by *ex situ* facilities. *Ex situ* collections may fulfil different purposes, including: conservation and regeneration of genetic diversity; characterisation and authentication of genetic material; and working collection for research or

breeding programmes. Depending on its characteristics, the genetic material is stored in different forms and under different conditions, ranging from *in vivo* to *in vitro* and seed and deep-freezing storage systems. *Ex situ* facilities are often, but not always, maintained by public institutions at national, regional and international levels. They mostly act as intermediaries in the value chain, in the sense that they are neither the original providers of the genetic resource nor the end users in terms of product development and commercialisation. However, they perform an indispensable function in the overall operation of the sector and constitute an important part of GRFA exchanges.

### *Cluster F: GRFA exchange practices*

**F.1 The exchange of GRFA takes place in the context of customary practices and existing user communities.**

37. The exchange of genetic material is a long-standing practice among various stakeholder groups and user communities. Genetic resources are often exchanged in the context of wider collaborative efforts towards research and development, and the different actors are bound to each other by recurrent interactions. Over time, many user communities have established their own practices and modalities of exchange, which may be formalized to varying degrees. It would therefore be desirable to involve stakeholders in the development of ABS measures for GRFA, and to build upon existing practices and capacities of user communities related to the exchange of genetic resources.

**F.2 An extensive transfer of genetic material between different stakeholders along the value chain occurs in research and development**.

38. GRFA are exchanged in often large numbers of samples of genetic material at different stages in the research and innovation process. At the beginning of the product development process, large numbers of germplasm samples may be accessed to screen the existing genetic diversity for interesting traits and identify the most suitable genetic material for the desired purpose. At later stages, there may be a recurring demand for access to germplasm in order to add new genetic variation to the research and development cycle. Furthermore, as different stakeholders fulfil different functions in the value chain, GRFA are frequently passed on from one person to the other before reaching the stage of commercialization. Some of the stakeholders act more as a type of intermediaries in the process providing certain services like characterisation, authentication or multiplication. All these factors lead to a high number of exchange events and imply that the transfer of genetic resources is normally not a one-shot event at the beginning of the research and product development process, but needs to be repeated many times during its course.

### *Cluster G: Benefits generated with the use of GRFA*

**G.1 The expected benefits from the use of an individual germplasm sample are often uncertain and on average relatively low at the time of the transaction.**

39. The level of monetary and non-monetary benefits that a potential recipient of GRFA can expect from the exchange and utilization of an individual sample of germplasm, is often unknown at the moment of exchange, and, on average, is estimated as rather low. For instance, this is the case when large numbers of genetic resources are exchanged for screening purposes, but only a very small fraction of the exchanged samples is eventually included in product development. It is also the case when genetic resources are exchanged in the course of incremental innovation and incorporated as one of many genetic components of potential products, contributing only to a tiny part of their genetic set-up. However, the expected benefits from the use of an individual genetic resource usually augment proportionally with characterization and generation of information about the material.

**G.2 The use of GRFA generates important non-monetary benefits.**

40. The utilization of GRFA in research and development frequently generates non-monetary benefits that may in some cases be even more relevant than the profits. Non-monetary benefits may also arise if the product does not reach the market place. At the same time, the potential for non-monetary benefit-sharing, such as technology transfer, capacity building and information sharing, is

increased by the fact that many countries make use of the same species, establish similar production systems and face the same biotic and abiotic stressors. ABS measures may offer an opportunity to realize this potential.

**G.3 The use of GRFA leads to external effects going far beyond the individual provider and recipient, and some benefits can only be generated at the collective level.**

41. Activities involving the use of GRFA, including product development and release, often generate external effects that go far beyond the individual provider and recipient of the respective genetic material. These external effects may work in favour of international public policy objectives such as rural development and poverty alleviation, environmental protection, food security and cultural diversity. Some of the potential benefits of using GRFA can only be realized at the collective level. Information and knowledge generated through use activities, for example, can unfold their full potential only by being compiled and made available to a broader public.

## IV. GUIDANCE SOUGHT

42. In identifying the relevant distinctive features of the different sectors and subsectors of genetic resources for food and agriculture requiring distinctive solutions, the Working Group may wish to review the list of features contained in this document.