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REVISION OF THE INTERNATIONAL UNDERTAKING

ANALYSIS OF SOME TECHNICAL, ECONOMIC AND LEGAL ASPECTS FOR CONSIDERATION IN STAGE II

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REVISION OF THE INTERNATIONAL UNDERTAKING: SUMMARY OF RELEVANT TECHNICAL, ECONOMIC AND LEGAL ISSUES

I. PURPOSE OF THIS DOCUMENT

1. Document CPGR-Ex1/94/5 provides information on the two issues for consideration in Stage II of the Revision of the International Undertaking, initiated by Resolution 7/93 of the FAO Conference, namely access to plant genetic resources, and Farmers' Rights".[1]

2. This document presents, on the basis of specific studies undertaken under the supervision of the Secretariat of the Commission, a number of concepts and elements that may be of service in analyzing the main issues. No attempt is made to suggest or propose solutions. This will be the task of the negotiations to revise the Undertaking.

3. The studies reported here are premised on the concept that plant genetic resources for food and agriculture differ substantially from other plant genetic resources, and therefore that specific solutions - which are not necessarily similar to those required for other kinds of biodiversity - may need to be found for their conservation and development, as well as for their availability, and the fair and equitable sharing of the benefits derived from their use. Among these differences are the following:

i They are essentially *man-made*, that is, biological diversity developed and consciously selected by farmers since the origins of agriculture, who have guided the evolution and development of these plants for over 10,000 years. In recent times, scientific plant breeders have built upon this rich inheritance. Much of the genetic diversity of cultivated plants can only survive through continued human conservation and maintenance.

ii They are not randomly distributed over the world, but rather concentrated in the so-called "centres of origin and diversity" of cultivated plants and their wild relatives, which are largely located in the tropical and sub-tropical areas (see table 1).

iii Because of the diffusion of agriculture all over the world, over the last 10,000 years, and because of the association of major crops with the spread of civilizations, many crop genes, genotypes and populations have spread, and continue to develop, all over the planet. Moreover, plant genetic resources for food and agriculture have been systematically and freely collected and exchanged for over two hundred years, and a large proportion have been incorporated in *ex situ* collections.[2]

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1 See, as well, document CPGR-Ex-1/94/3 "Mandate, Context, Background and Proposed Process."

2 These collections were made before the entry into force of, and hence outside the Convention on Biological Diversity, as Resolution 3 of the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity recognized.

iv There is much greater inter-dependence among countries for plant genetic resources for food and agriculture than for any other kind of biodiversity. At the regional level, and for major crops, the average inter-dependency has been estimated to be more than 70% (see Appendix 1, tables 1 and 2), and at a national level it may be estimated that every country depends for more than 90 % on genetic resources that originated in other countries for its major crops. Continued agricultural progress implies the need for continued access to the global stock of plant genetic resources for food and agriculture. No region can afford to be isolated, or isolate itself, from the germplasm of other parts of the world.

4. In order to facilitate the work of the Commission, a number of complex economic, technical and legal issues have been examined. The economic studies (Appendix 1) focus on two matters. They first describe the nature of the values of plant genetic resources for food and agriculture, and survey attempts to quantify these values. Secondly, they analyze, in economic theory, the failure to appropriate these values, which explains the economic basis of the erosion of plant biodiversity for food and agriculture. They also examine possible mechanisms by which the more effective appropriation, or compensation for, these values may promote the conservation of plant genetic resources for food and agriculture.

5. The technical studies (Appendix 2) examine to what extent, and by which technical means, the origin of specific genes and genotypes can be determined, and to what extent materials may be identified and, if necessary, traced to the country of origin, and to the farming communities that managed them. The answers to such questions may contribute to the discussion of the economic and legal mechanisms that could be established to share benefits, particularly with farmers' countries and their communities.

6. The legal studies (Appendix 3) deal with a number of matters that require understanding, in considering the feasibility and enforceability of various approaches. These include sovereign rights and various types of property right, particularly in relation to the appropriation of the intangible content of plant genetic resources for food and agriculture, and access to collected germplasm.

II. CONTENTS OF THE STUDIES

II.1 *Economic aspects*

7. Wild and weedy crop-relatives and landraces provide the foundation breeding materials for crop improvement and sustainable agriculture. They allow value to be added or provide a "value of use" in breeding and farming activities. This value is realized through the use of germplasm from *in situ* conditions, or of material in *ex situ* collections.

8. Besides the current use-value of plant genetic resources, Appendix 1 describes a variety of expected marginal values for plant genetic resources. The *portfolio value* is the value of retaining a relatively wide range of assets within biological production systems, to smooth yield fluctuations. The *option value* is the value of retaining a wide range of known agro-biodiversity across time, as a source of currently unknown potential usefulness. The *exploration value* is the value of retaining unexplored biodiversity, for the same reasons. Another way of grouping those values is to see them as *insurance values*, (diversity acts as an insurance against crop yield

fluctuations) and *information values*,[1] (specific information coded in the germplasm may later prove to be of concrete value).

9. Partial quantitative estimations exist of the importance of plant genetic resources for food and agriculture, that is, their current use-values, and how they add value in crop production. For example, a detailed study on the value of rice landraces for Indian agriculture showed that they contribute between US$ 100 and 200 million per annum to the value of rice production in South Asia. Appendix 1 further analyzes this and other issues.

10. It is clear that the conservation of plant genetic resources for food and agriculture generates a use-value. A further question is how an exchange-value may arise, that is, how is it possible to obtain a price, or other economic compensation, for the exchange of these resources? An understanding of this matter is necessary in attempting to identify effective incentives for the conservation and sustainable use of plant genetic resources for food and agriculture.

11. Traditional farmers, their communities and countries maintain agro-diversity *in situ*, and thereby conserve and further develop the diversity contained in their landraces and related material[2]. A problem arises, however, in that they often have an economic incentive to replace their variable landraces by homogeneous modern varieties, as these frequently offer higher yields and productivity, and thus, higher incomes. While this process of conversion (the replacement of landraces by modern varieties) may be a rational decision on the part of an individual farmer, in global terms, increasing conversion means a continuous and irreversible loss of diversity, which is not in the global interest.[3]

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1 Swanson *et al.* ("The Valuation and Appropriation of the Global Benefits of Plant Genetic Resources for Agriculture", Swanson T. M., Pearce D. W., and Cervigni R. (Centre for Social and Economic Research on the Global Environment, and University of Cambridge), 1994, unpublished, supplemented by personal communication with Swanson) consider that there are two parts to the information value of biodiversity: one part (*option value*) is unappropriable under all known mechanisms, while one part (*exploration value*) is approbiable under current conditions. They believe that the returns earned by plant breeders and seed companies, when they market a new variety over which they have any form of exclusive marketing right, includes this value.

2 The countries of the world have recognized this, and the need to reward and promote the continuation of this work, by adopting the concept of Farmers' Rights, as defined by FAO Conference Resolutions 3/91 and 5/89.

3 An example may be given of how fast the conversion process is. Tarwi (*Lupinus mutabilis*) is one of the Andean crops that have formed the staple diet of the area for thousands of years, as a protein-source. These landraces were selected by farmers over many generations for the quantity (as much as 40%) and quality of their proteins. Although of lesser interest to the farmer, tarwi also has a high fat content (as much as 26%). There is, however, a negative correlation between productivity and the oil content of tarwi seeds. In 1977, in a foreign assistance project to industrialize the crop, an experimental factory for the extraction of tarwi oil was established south of Lima. The commercial production of new varieties of this crop, which had been selected to offer better characteristics for oil extraction, was encouraged, and farmers replaced their very heterogeneous and protein-rich landraces with the new, uniform, oil-rich but protein-poor varieties. The experiment failed, and the factory was closed in 1979. Farmers found themselves without seeds of their old, more nutritious, landraces, the useful genes of which would have been lost for ever, had not some samples previously been collected and kept viable through storage. In situations like this, a few years of the substitution of landraces by modern varieties are often enough to cause the permanent loss of germplasm that has been selected in

12. The question of the realization of an exchange-value for plant genetic resources for food and agriculture is complex, because the farmers and communities developing and cultivating landraces, and other related genetic resources, in their farming systems, are, in fact, creating a global economic value, much of which they are unable to appropriate. In other words, they have no mechanism for obtaining a price, or other form of compensation, for the valuable germplasm they generate and conserve. It is the germplasm which they have developed within their farming systems that is the world's main source of plant genetic resources for food and agriculture (whether it is still maintained in the fields, or in *ex situ* collections). This germplasm is, however, mostly available at no cost.

13. Traditional farmers thereby generate externalities, as providers of a "public good" (that is, a good that cannot be appropriated by its producers, and which may be used by many without exhausting it, and without adding cost). To the extent that traditional farmers, their communities and countries, are not able to appropriate the values that they generate, they lack economic incentives to continue developing and conserving the diverse plant genetic resources for food and agriculture, on which agricultural development will continue to depend. That is, they lack economic incentives to maintain this biodiversity, rather than convert to improved varieties. The reasons why local communities and farmers, and their nation states, cannot appropriate much of the value of their diverse resources are further analyzed in Appendix 1.

14. In more general terms, where public goods are created, the investments for producing or preserving them necessarily tend to be sub-optimal, because their producers are unable to fully benefit from the rents such goods may generate. This is a typical market failure, and is also often found in areas such as the funding of basic science.

15. The public nature of the good generated by traditional farming does not mean, however, that other agents do not benefit from, and eventually appropriate these values, at a later point of the development and production process. Plant breeders and seed companies do, for example, capture at least part of the rents generated by the farmers' germplasm which they have incorporated in their varieties, especially when these are protected by plant breeders' rights, or other forms of intellectual property right. But this value is not appropriated at the correct point in the production cycle.

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traditional farming systems over thousands of years. (Esquinas-Alcázar, J.T., "Los Recursos fitogeneticos: un inversion segura para el futuro", INIA, Madrid, 1983, pp. 15-16.)

16. If it is in the global interest to maintain landraces and other diverse plant genetic resources for food and agriculture, it is necessary that farmers and communities, who develop and conserve diversity, and their countries, either appropriate the values of diversity directly, or are compensated for the costs of conserving diversity, or for the potential benefits that they forego by not converting to modern varieties. For global values that are easy to estimate, but difficult to appropriate, a compensation strategy might be indicated. For global values that are very uncertain, appropriation mechanisms might be preferable. A major difficulty arises with agro-biodiversity, where values are both difficult to estimate and to appropriate. In fact, an essential part of these values, specifically those of global nature, cannot be appropriated.

17. Whichever approach prevails, economic analysis suggests that, for an agreement to be economically effective, it should be forward-looking and include structural incentives to favour and reward conservation in a clear, transparent manner. These incentives must be greater than the benefits foregone by renouncing conversion to specialized agriculture. If necessary, they could be linked to conservation for precise periods of time. The implementation of such incentives would require international arrangements, within the framework of an overarching multilateral agreement.

18. This analysis suggests that future losses of plant biodiversity, especially that developed and maintained in *in situ* conditions, could be avoided or minimized through an international agreement that provides for clear financial incentives to farmers, and their communities and host states, to compensate them for their conservation efforts, and the potential profits foregone in not converting to modern varieties, and thus, to allow them effectively to appropriate a greater part of the values of their rich and diverse resources. Such a system might, in principle, be based on market mechanisms (for example using intellectual property rights or contracts), on non-market mechanisms (such as an international fund), or on a mixture or combination of mechanisms (such as a system of payments from countries on the basis of the commercial benefits derived from the use of foreign plant genetic resources for food and agriculture to an international fund, and utilized to pay countries/farming communities maintaining diverse plant genetic resources for food and agriculture, for making specific commitments). These mechanisms in turn raise a number of technical and legal questions, which may condition their feasibility and enforceability. These three possible mechanisms - especially the latter two - provide ways in which Farmers' Rights could be implemented.

II.2 *Technical aspects*

19. For the design and implementation of mechanisms for the appropriation of, or compensation for, plant genetic resources for food and agriculture (or a combination of both), the identity and origin of material must be identifiable. Appendix 2 reviews the capabilities and limitations of genetic fingerprinting, and related modern techniques, in identifying plant genetic resources for food and agriculture, and establishing their geographical origin.

20. In this analysis, a distinction is made between an original accession, the population from which that accession was sampled, a single genotype from that accession, and a particular gene from an accession. While any individual organism appears as a phenotype[1], genetic fingerprinting

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1 The expression of a particular genotype in a particular environment.

and related techniques help to analyze the genotype, and the particular combination of genes and gene variants (that is, alleles) it contains, independently of the environment in which it may be expressed. Diverse populations can be described in terms of genotype and allele frequencies.

21. It must also be noted that there are important differences in the genetic structure, as well as the genetic variability contained in landraces, when compared with the modern varieties that are the subject of plant breeders' rights. Current plant breeders' rights legislation applies only to propagating materials that are distinct, uniform and stable, and can therefore easily be identified; that is, to modern varieties. These contain much less variation than is usually present in a landrace. A landrace is the product, at a particular moment of time, of continuous, changing evolutionary processes, that result in great variability in the genepool, but which also provide the capacity to adapt to changing human needs (expressed through selection by farmers) and environmental conditions (expressed through evolutionary pressure). It is these characteristics that give landraces their high value as sources of plant germplasm. However, these same dynamics mean that the identification of a landrace is much more difficult than the identification of a modern variety.

22. Genetically inherited traits, such as flower colour, growth habits, and disease resistance, can be used to identify plant genetic resources for food and agriculture. More precise identification can also be obtained at the level of biochemical and molecular composition, specially through proteins and DNA-sequences.

23. The examples given in Appendix 2 show that, in specific instances, a number of techniques have been used to distinguish varieties and accessions. However, it is unlikely that such techniques can be routinely used to prove the identity of specific genotypes, or gene-sequences, and even less the origin of unknown genetic material. There are several reasons for this:

(i) the high costs of some of the techniques, particularly sequencing and RFLPs;

(ii) the same, or similar, genetic material may exist, and be detected, in more than one place, especially in neighbouring countries;

(iii) different methods of analysis may give different genetic estimates for the same accessions, which may lead to disputes; and

(iv) the complex pedigrees of most improved varieties resulting from a plant breeding programme complicate attempts to trace specific genes, and to infer their possible relative values.

In addition, it must be borne in mind that, on the rare occasions when the ultimate geographical origin can be identified, it may not necessarily benefit the country or region of origin, since this might not be the provider of the accession, which, in line with the Convention on Biological Diversity, will usually be the subject of any rights[1].

II.3 *Legal aspects*

1 Article 2 of the Convention on Biological Diversity.

24. The discussion in Appendix 3 considers the distinction between sovereign rights and property rights, as well as between physical and intangible property. The recognition of sovereign rights over plant genetic resources for food and agriculture is not equivalent to the attribution, or existence, of property rights over such resources: it only means that the State may, within the limits imposed by the nature of such resources, determine what type and modalities of property rights, if any, are recognized.

25. The real value of plant genetic resources for food and agriculture lies in the genetic information contained in their germplasm. It is from this point of view that intellectual property rights become relevant. Intellectual property rights cover the intangible content of processes or goods: in the case of living forms, for instance, they may govern knowledge of the information contained in genes, or other sub-cellular components, in cells, propagating materials or plants. However, the existence of intellectual property rights over such information is not equivalent to property rights over the individual organism that carries such information, but is the right to exclude third parties from producing or selling such organisms without prior agreement. Intellectual property rights (in particular, patents and breeders' rights) cannot currently apply to crop landraces and farmers' varieties. It may be questioned whether it is technically sound, and legally feasible, to extend such rights, possibly in a modified, *sui generis*, form, to cover such heterogeneous populations, and whether this would create adequate incentives for the conservation of landraces.

26. A number of complex legal problems would need to be analyzed. These include the definition of the subject matter of such rights, requirements for protection, who may become title-holders, the territorial validity and administration of the system, and the actual enforceability of rights. A proposal to extend intellectual property rights to landraces, if feasible, would also have to consider the transaction costs involved in the establishment and operation of the system.

27. In certain cases, the value of plant genetic resources may also be appropriated by contractual arrangements, whereby the suppliers of germplasm are remunerated, or otherwise ensured an equitable sharing in the benefits of their exploitation. Most contracts concluded until now relate to genetic resources of specific pharmaceutical or industrial value, rather than plant genetic resources for food and agriculture.

28. Under either a multilateral or a bilateral approach, "material transfer agreements" (a form of contract) may be of value in regulating the transfer of material. Material transfer agreements typically regulate the use of the materials by the receiver, issues relating to intellectual property rights, and economic compensation to the supplying source.

29. Another important legal issue relates to the implementation of an international fund to share benefits with, or compensate, traditional farmers, their communities and countries, for the value of plant genetic resources for food and agriculture made available. Under the International Undertaking, the international fund is to be entrusted with the responsibility of implementing Farmers' Rights. This approach may overcome a number of difficulties that arise from the frequent lack of knowledge of the origin of specific germplasm contributions; the difficulty of attributing value; the fact that the same diversity may be found in *in situ* conditions in a number of countries; and the probably onerous transaction costs, and administrative complexities, that are likely to be involved in devising new systems of intellectual property.

30. A number of issues need definition or clarification with regard to the implementation of Farmers' Rights, notably the nature of these rights; the resources needed; and the basis for contributions and allocations. The above issues are developed in Appendix 3.

III. FINAL CONSIDERATIONS

31. This document, with its appendices,[1] provides information and analyses issues which the Commission may wish to consider in Stage II of the revision of the International Undertaking. The analysis is not exhaustive, since many issues still need to be explored and further researched and discussed. The elements contained therein may, however, provide a starting point for the future orientation, by the Commission, of the Secretariat's work on the subject.

32. It should also be noted that the studies presented in the appendixes do not represent any particular position or view of the Secretariat on the issues dealt with, but rather an attempt to provide an objective, theoretically supported basis for the resolution of the outstanding issues of conditions of access to plant genetic resources for food and agriculture and the implementation of Farmers' Rights.

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1 The appendices to this document have been prepared by the Secretariat, under its own responsibility, on the basis of a number of contributions, especially those of Swanson T.M., Pearce D.W., and Cervigni R. (Centre for Social and Economic Research on the Global Environment, and University of Cambridge); Evenson R.E. (Yale University); Hardon J.J., Vosman B. and van Hintum Th.J.L. (Centre for Plant Breeding and Reproduction Research); Correa C.M. (University of Buenos Aires); and Brush S.B. (University of California, Davis).

Table 1 Cultivated plants and their regions of diversity.[1]

1. Chinese-Japanese Region

   - Prosomillet, Fox tail millet, Naked oat
   - Soybean, Adzuki bean
   - Leafy mustard
   - Orange/*Citrus*, Peach, Apricot, Litchi
   - Bamboo, Ramie, Tung oil tree, Tea

2. Indochinese-Indonesian Region

   - Rice
   - Rice bean, Winged bean
   - Cucurbits/Ash gourd
   - Mango, Banana, Rambutan, Durian, Bread fruit, *Citrus*/Lime, Grapefruit
   - Bamboos, Nutmeg, Clove, Sago-palm, Ginger, Taros and Yams, Betel nut, Coconut

3. Australian Region

   - *Eucalyptus, Acacia, Macadamia* nut

4. Hindustani Region

   - Rice, Little millet
   - Black gram, Green gram, Moth bean, Rice bean, *Dolichos* bean, Pigeonpea, Cowpea, Chickpea, Horse gram, Jute
   - Eggplant, Okra, Cucumber, Leafy mustard, Rat's tail radish, Taros and Yams
   - *Citrus*, Banana, Mango, Sunnhemp, Tree cotton
   - Sesame, Ginger, Turmeric, Cardamom, Arecanut, Sugarcane, Black pepper, Indigo

5. Central Asian Region

   - Wheat (Bread/Club/Shot), Rye
   - *Allium*/Onion, Garlic, Spinach, Peas, Beetroot, Faba bean
   - Lentil, Chickpea
   - Apricot, Plum, Pear, Apple, Walnut, Almond, Pistachio, Melon, Grape, Carrot, Radish
   - Hemp/*Cannabis*, Sesame, Flax, Safflower

6. Near Eastern Region

   - Wheat (Einkorn, Durum, Poulard, Bread), Barley, Rye/*Secale*
   - Faba bean, chickpea, French bean, Lentil, Pea
   - *Brassica oleracea, Allium*, Melon, Grape, Plum, Pear, Apple, Apricot, Pistachio, Fig, Pomegranate, Almond
   - Safflower, Sesame, Flax
   - Lupins, Medics

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1 Esquinas-Alcázar, J.T., "Plant genetic resources", in Hayward, M.D., Bosemark, N.O., and Romagosa, I., *eds*, "Plant breeding: principles and prospects", Chapman and Hall, London, 1993, pp. 38-9. Based on Zeven and Zhukovsky (1975) and Zeven and de Wet (1982).

7. Mediterranean Region

- Wheat (Durum, Turgidum), Oats
- *Brassica oleracea*, Lettuce, Beetroot, Colza
- Faba bean, Radish
- Olive, *Trifolium*/Berseem, Lupins, *Crocus*, Grape, Fennel, Cumin, Celery, Linseed

8. African Region

- Wheat, (Durum, Emmer, Poulard, Bread)
- African rice, Sorghum, Pearl millet, Finger millet, Teff
- Cowpea, Bottle gourd, Okra, Yams, Cucumber
- Castor bean, Sesame, Niger, Oil palm, Safflower, Flax
- Cotton, Kenaf, Coffee
- Kola, Bambara groundnut, Date palm, Ensete, Melons

9. European-Siberian Region

- Peach, Pear, Plum, Apricot, Apple, Almond, Walnut, Pistachio, Cherry
- Cannabis, Mustard (black), Chicory, Hops, Lettuce

10. South American Region

- Potato, Sweet potato, *Xanthosoma*
- Lima bean, Amaranth, *Chenopodium, Cucurbita*, Tomato, Tobacco, Lupin
- Papaya, Pineapple
- Groundnut, Sea island cotton
- Cassava, Cacao, Rubber tree, Passion fruit

11. Central American and Mexican Region

- Maize, French bean, Potato, *Cucurbita*, Pepper/Chilli, Amaranth, *Chenopodium,* Tobacco, Sisal hemp, Upland cotton

12. North American Region

- Jerusalem artichoke, Sunflower, Plum, Raspberry, Strawberry.

THE IDENTIFICATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE AND THE TRACING OF THEIR GEOGRAPHICAL ORIGINS, BY MODERN GENETIC ANALYTICAL TECHNIQUES

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Appendix 2
Technical Aspects

THE IDENTIFICATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE AND THE TRACING OF THEIR GEOGRAPHICAL ORIGINS, BY MODERN GENETIC ANALYTICAL TECHNIQUES

A2.I INTRODUCTION

1. For the design and implementation of mechanisms for the appropriation of, or compensation for, plant genetic resources for food and agriculture, the identity and origin of material must be establishable. Because a number of powerful, modern genetic "fingerprinting" techniques exist, and have been successfully applied in, for example, forensic analysis[1], it is often assumed that they can be applied to identifying plant germplasm, and tracing it back to its geographical origin. Such questions have become important with the adoption of the Convention on Biological Diversity.

2. This appendix explores how feasible and likely it is that these techniques can be of value for the systematic identification and tracing of plant genetic resources for food and agriculture. The questions addressed are:

- i What are the capabilities and limitations of genetic fingerprinting, and related techniques, for identifying plant genetic resources for food and agriculture and their geographical origin;
- ii Can these be used to identify a legal owner; and
- iii What are the implications of these techniques for the enforcement of sovereign rights over germplasm?

A2.II SOME BASIC GENETIC CONCEPTS

3. Any individual organism is a *phenotype*, that is the expression of a particular *genotype* in a given *environment*. Before the advent of molecular biology, genetic analysis was mainly concerned with drawing inferences about the genotype behind the phenotypic expression. It is through the genotype, and the particular combination of genes it contains, that *genes* and gene variants *(alleles)* are transmitted. Every genotype is unique (except under special circumstances: identical twins, clones or highly inbred lines), but ephemeral, while genes remain, and their frequency is determinant

1 For example, in law-suits about disputed paternity, and murder cases.

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A2.I INTRODUCTION

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1 For example, in law-suits about disputed paternity, and murder cases.

for the structure of present and future populations. These facts have important consequences for our discussion.

4. Any descriptors capable of identifying plant genetic resources for food and agriculture must be concerned with genotypes and genes. Their expression - as far as possible - must be *independent of the environment*.

5. *Plant Breeders' Rights*, which support the commercialization of modern varieties, are underwritten by a set of clearly defined principles and conditions, that enable the identification of the variety protected. To be eligible for protection, varieties must be:

- i *distinct* from existing, commonly known varieties;
- ii sufficiently *uniform* and *homogeneous*;
- iii *stable* under multiplication; and
- iv new, in the sense that they have not been commercialized prior to certain dates established by reference to the date of the application for protection.

6. Such rules may easily be applied to individual modern varieties, which are usually characterized by homogeneity and stability, but not to landraces, and their wild relatives. These, on the contrary, are characterized by heterogeneity, and a consequent instability: these characteristics, in fact, are the basis for their value as diverse genetic resources for agriculture. This is the reason why this appendix will frequently return to the application of tracing techniques to material from such populations.

7. Upon transmission of the genes from one generation to the next, new combinations (genotypes) may arise. This is a source of *instability* in the context of identification, and the reason why Plant Breeder's Rights legislation demands a strict control of this factor. Other natural evolutionary processes also lead to changes in plants and plant populations, such as competition and selection, migration, mutation and genetic drift: these are the very phenomena that confer variability in many traits on landraces and their wild and weedy relatives, and this variability is the basis of their value for food and agriculture.

8. At any one point in its evolution, a plant population may be described by its gene and genotype *frequencies*, which reflect its evolutionary history. *Centres of crop diversity* are regions that are particularly rich in variability, in numbers of alleles and genotypes. The genetic composition of these populations represents different adaptations to environmental and social demands: because of this specificity, their greatest economic value probably lies in their local use. Not infrequently, however, they also have value - most often through the genes they contain - as plant genetic resources for food and agriculture in other parts of the world. The globalization of the major crops shows this. It must be borne in mind, in the analysis that follows, that the unit with which we are most often dealing is an *accession*, that is, a single sample from a population, whose constituents and their frequencies vary with time.

9. These dynamics mean that the identification of a landrace is much more difficult than the identification of a modern variety. It is important to distinguish between identifying an original accession[1], the population from which it was sampled, a single genotype from that accession, or a

1 Usually the difficulty of identifying an accession is directly proportional to the amount of diversity it contains.

particular gene which has been introduced from such an accession into a plant breeding programme.

A2.III METHODOLOGIES FOR THE IDENTIFICATION OF PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

10. The transition from genotype to phenotype is a result of *gene expression*. The DNA[1] is expressed as RNA and proteins, and further into growth and differentiation, metabolic pathways and visual characteristics. This continuum is a spectrum of more or less distinguishable traits. To be useful for identification purposes, traits need

i to be independent of environment, and
ii to display clear-cut variation (show *polymorphism*).

11. Traits governed by single genes are usually preferred, because of their genetic simplicity. In this context, these traits are often not of interest in themselves, but as *markers*, or "tags", for identification purposes. The more independent marker genes that are identifiable, and the larger the number of different alleles that exist for each (that is, the more polymorphism there is), the more different combinations (genotypes) will be identifiable, and the greater will be the discriminatory potential. Traits based on external morphology, including flower colour and growth habit, and monogenic disease resistance, are examples of markers that are easy to observe and cheap, but they are usually too few and not sufficiently variable to allow high discrimination. This, of course, does not reduce the utility of any polymorphism present. Disease-resistance genes are frequently used in the Plant Breeders' Rights context. If the gene or genes transferred express themselves in unique and easily recognizable ways, their identity with, and descent from, a certain source could probably be claimed. Examples here are important disease-resistance genes in barley originating in Ethiopia[2]. This kind of certainty is, however, very unusual.

12. If we proceed "inwards" from the external phenotype, the *variation in chemical composition* may be used to characterize genotypes. With techniques like gas or high pressure liquid chromatography, genotypic differences may be discerned. Such differences tend, however, to be quantitative, and with an unclear genetic basis, and they are not frequently used in population analyses.

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1 DNA is Desoxyribonucleic Acid, a molecule assembled by a very large number of repetitions of four basic components ("base pairs"), the combination and order of which codes genetic information, in the same way that the combination and order of the letters of the alphabet codes written information. RNA is Ribonucleic Acid, a molecule with a similar structure and function, which is usually necessary in the decodification process of the genetic information.

2 Barley yellow dwarf virus resistance (Qualset, C.O. (1975) in Frankel and Hawkes (eds.) IBP2, pp. 81-96), and the barley powdery mildew resistance gene, ml-o (Jörgensen (1992), Euphytica 63:141-153). In the first case, this is the only gene known in barley to confer resistance against the yellow dwarf virus. In the second case, at least ten other equivalent alleles have been produced by induced mutation.

13. The ability to separate proteins, or DNA-fragments, through *electrophoresis* is the basis of much more precise and versatile techniques. The principle is explained in Figure 1. The dotted bands visualize molecules (enzymes or DNA-fragments) separated on a gel, due to their different mobilities, when placed in an electric field. Genotypes **A** and **B** have no common alleles in the two genes, and are easily distinguished. Genotype **C**, however, has bands in common with both. At gene 1, **C** is distinguishable as a heterozygote. Looking at gene 2, however, **C** is *indistinguishable* from **A**, but they are not *identical*, however, since **C** is known to be a heterozygote which shows dominance. Such dominance is a handicap in some of the techniques listed below: unless the inheritance is known, however, **A** and **C** will be scored the same.

Figure 1

	GENOTYPE A (homozygote)	GENOTYPE B (homozygote)	GENOTYPE C (heterozygote)
GENE 1	----------- -----------	----------- -----------	----------- ----------- ----------- -----------
GENE 2	----------- -----------	-----------	----------- -----------

14. With protein techniques (enzymes, seed storage proteins), up to a few dozen genes with usually less than 5 variants at each locus may be detected. DNA techniques are more versatile, and use dozens, or even hundreds of genes, each with several alleles. There are a rapidly increasing number of methods, which are usually known by their acronyms. Figure 2 lists some of them and what they can identify, the sample size economically justifiable, their discriminatory power (in terms of polymorphism that the techniques can identify - the greater the polymorphism the better) and their estimated precision.

Figure 2

METHOD[1]	WHAT IS IDENTIFIED	SAMPLE SIZE ECONOMICALLY JUSTIFIABLE	ABILITY TO IDENTIFY POLY-MORPHISM	PRECISION
PROTEIN MARKERS	SINGLE GENE POLY-MORPHISMS	LARGE	LIMITED TO HIGH	VARIABLE TO HIGH
DNA-SEQUENCE	STRUCTURE OF GENES AND OTHER DNA	VERY SMALL	VERY HIGH	VERY HIGH
RFLP (SINGLE COPY DNA)	POLYMORPHISM AT, OR CLOSE TO, GENE LOCI	LIMITED	LIMITED TO HIGH	HIGH
SPECIFIC SEQUENCE PCR	PRESENCE OF SINGLE GENES	LARGE	LIMITED TO HIGH	HIGH
RFLP (MULTIPLE COPY DNA)	"FINGERPRINT" PATTERN	LIMITED	HIGH	HIGH (MAY BE DOMINANT)
RANDOM SEQUENCE PCR	"FINGERPRINT" PATTERN	LARGE	HIGH	VARIABLE TO HIGH (MAY BE DOMINANT; SPECIES SPECIFIC)

15. The costs of these methods vary greatly. Sequencing and RFLPs require expensive laboratory facilities, with high running costs. Polymerase chain reaction-based methods require partly similar equipment, but running costs are much lower, and sometimes approach the costs of protein techniques. Still, it must be noted that even the costs of protein techniques are prohibitive for their wide use in many plant breeding programmes. In this context, it must be noted that the value of an individual genotype is far less in plant breeding, than in animal breeding: more expensive techniques can therefore be afforded for animals, and, of course, for forensic purposes.

Protein Marker Techniques

16. Protein techniques have been used for over 25 years. They are relatively cheap and reliable. In the context of Plant Breeders' Rights, they have not been much used, because of a lack of polymorphism in the highly bred germplasm of some species (such as wheat). Moreover, once "exotic" genotypes from landraces have been crossed into a breeding programme, the protein markers are so few, that no traces of ancestry may be identifiable. If a protein marker is found at, or closely linked to the gene locus, this may be used to corroborate a claim that a variety has incorporated a specific

1 RFLP = Restriction fragment length polymorphisms; PCR = Polymerase chain reaction. See paragraphs 17 to 19.

material. An example is the complete association between a disease-resistance gene and a certain enzyme allele transferred from the wild species *Aegilops ventricosa* into wheat[1]. As in the case of yellow dwarf virus-resistance from Ethiopia, this is, however, very exceptional. Less exceptionally, biological origin can be traced back only to particular agro-ecological regions, rather than back to specific countries, and even less to specific farming communities within those countries. Proteins are also useful in determining the degree of relatedness (*genetic distance*).

DNA-Based Techniques

17. These conclusions largely also hold true for DNA-based techniques, though their discriminatory power far exceeds that of protein techniques. The DNA-sequence, the unit of which is the *base-pair*, is the ultimate, environment-independent description of a genotype. Most such descriptions concern only a single gene, which is usually composed of up to a few thousand base-pairs in length. In a few species (including the annual plant, *Arabidopsis*[2], and human beings) efforts are underway to sequence the entire genome, that is, all the DNA in a genotype. In human beings this involves 2.9×10^9 base-pairs, which is of the same order as barley, ($4\text{-}5 \times 10^9$). Clearly, these tasks and the cost are enormous, with a very limited possibility of sampling variants. Simply to seek out and sequence a single gene is very costly: for this reason, these techniques are more usable at the level of individual genes, not the genotype.

18. In the case of plant genetic resources, the actual sequence of an important gene would, in theory, be a very strong indicator of identity, because even though a mutation at a certain gene locus, which produces a similar phenotype, may occur elsewhere, it is exceedingly improbable that the identical sequence has arisen. In principle, however, the gene sequence could be modified by genetic engineering, with the aim of blurring its identity. Mutations also occur during storage (including in genebanks). In practice, however, few gene sequences are known for important crops. The cowpea trypsin inhibitor gene, which was found in the genebank of the International Institute Tropical Agriculture in Nigeria, and sequenced in Europe, is an exception. To date, not a single plant gene for resistance against any fungal disease has been isolated and sequenced. If, in future, such information becomes available, these genes could, in principle, be traced. The sequence-specific polymerase chain reaction (PCR) could be used as an economically acceptable detection method.

19. Other methods are all based on the more-or-less random variation in the DNA-sequence between different genotypes. The RFLP method is based on cutting the DNA with enzymes that recognize certain specific short

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1 McMillin *et al.* (1986) Theoretical Applied Genetics 72:743-747.

2 This plant is usually chosen for genetic research because of the simplicity of its genetic structure.

sequences: if genotypes differ at these sequences, molecules of different sizes will be produced, and a polymorphism may be detected. Single-copy DNA RFLP and multiple-copy RFLP differ only in whether this polymorphism is associated with a certain gene or chromosomal location, or with many: the former is genetically more informative, since dominance is less frequent. The latter, like the random sequence polymerase chain reaction (PCR), generates a "stack" of bands on a gel: dominance occurs, and makes distinct genotypes indistinguishable, as Figure 1 showed. With many bands, however, a "fingerprint" analysis is, in principle, possible. Other fingerprint methods, using so-called *mini-* or *microsatellites*[1], are very specific, but have been little studied in plants, because of their high cost.

20. An increasing number of studies are now being published which utilize such techniques to determine the genetic origin of plant genetic resources for food and agriculture. RFLP bands have been shown to be uniquely associated with distinct resistance alleles in wild barley from Israel[2]. Since, however, the barley progenitor is not constrained by national boundaries, it is highly probable that these genes occur elsewhere in the region, and, with lesser likelihood, in other regions. Other alleles at this gene locus, also originating from known sources, could not be unequivocally distinguished in this way. In another successful study of *Arabica* coffee accessions, by random-sequence PCR, it was possible to distinguish Ethiopian accessions. The Asian or South-American accessions were much less distinguishable, due to their co-ancestry, and the transfer of germplasm between continents.[3] It should be noted that this picture largely coincides with what was already known from classical botany.

A2.IV THE POTENTIAL AND LIMITATIONS OF MOLECULAR TECHNIQUES IN DETERMINING THE IDENTITY AND ORIGIN OF VARIETIES, LANDRACES, GENOTYPES AND GENES

21. Important resources are at present expended on the use of molecular techniques in the context of Plant Breeders' Rights, because of the commercial interests involved and the desire to protect profitable varieties. By refining such techniques, it will theoretically be possible to improve the resolution, and to distinguish even between closely related cultivars. Certain companies already routinely run RFLP gene profiles on more than 100 loci for their maize inbreds, for instance, to back up possible legal claims if other varieties are "too similar".

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1 A recent study (Saghai-Maroof *et al.* (1994), PNAS 91:5466-5470) shows an extraordinary degree of polymorphism in such genes in barley, using microsatellites.

2 Schuler *et al.* (1992) Theoretical Applied Genetics 84:330-338.

3 Orozco-Castillo *et al.* (1994) Theoretical Applied Genetics 87:934-940.

22. Modern techniques may, under certain conditions, prove to be a useful instrument in determining the identity and origin of landraces, genotypes and genes. However, the practical difficulties, and the high costs, make it unlikely that this can be of routine and practical use, in the context of agreements for access to plant genetic resources for food and agriculture. Among the major reasons that would make their use in such a context difficult are the following:

i. Great variability is inherent in most landraces and populations. For identification purposes, this variability becomes an obstacle, complicated by the fact that very few individuals can usually be sampled in identification studies, because of the costs implied (particularly in sequencing and RFLPs).

ii. Genes do not respect national borders: the same kind of genotypes, or the same gene, may be detected in a number of countries, especially if they are neighbours. Even if a probable origin of a genotype can be suggested, this would still be different from proving legal identity. And even where biological origin can be proved (which is exceptional), it may not necessarily serve the country or region of origin, since these may not be the *providers of the accession*, to which the Convention on Biological Diversity confers specific rights.

iii. Methodological imprecision means that different technologies may give different conclusions regarding the identity and possible origin of the same genetic material, and hence give rise to disputes[1]. Moreover, genetic engineering could be used deliberately to modify the gene-sequence, and blur its identity.

iv. Tracing genetic material may be even more problematic when it has been introduced into the complex pedigrees of a plant breeding programme. Even though modern techniques may reveal some "residual" donor DNA, the results will inevitably be equivocal: the presence of genes from nine landraces and one wild species in the rice cultivar, IR36[2], (see Figure 3) illustrates the potential problem of tracing the origin of genes from a particular genotype in its pedigree, let alone of attempting to assign a marginal value to its contribution to a commercial variety.

23. In addition, in the studies discussed in the previous section, geographical origins were generally known beforehand. It will be even less straightforward to *prove* the identity and origin of unknown genetic material.

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1 Dos Santos *et al*. (1994) Theoretical Applied Genetics 87:909-915.

2 Plucknett *et al* (1987), "Genebanks and the world's food".

A2.V CONCLUSIONS

24. Modern methods of genetical analysis are continually improving our ability to describe genotypes. In certain cases, it is possible to claim that there is genetical identity between genotypes, and to point to the genetic similarity or distance between germplasm with the same or different geographical origins. On this basis, it may be possible to assign to particular accession a probable geographical origin: this, however, will rarely mean a country, much less a farming community. It will usually be impossible to prove that the genotype or gene does not occur elsewhere, particularly in neighbouring countries, and, in many cases, the country of origin may not be the provider of the accession. Moreover, the material may already exist elsewhere through previous exchange of germplasm.

25. Once the genotype has been included in a breeding programme, only unique genes it contained could occasionally be traced, through actual DNA-sequences, or tightly linked markers. However, it is, at present, unfeasible to consider establishing the DNA-sequence of genes of value to plant breeding; using markers is simpler, but both methods demand very substantial and expensive research investments.

26. Even though similar methods may theoretically be used to distinguish varieties protected by Plant Breeders' Rights, and accessions from landraces and associated wild and weedy species, high variability, segregation over time, and adaptability are characteristics of the latter, and expressly bred out of the former. This is an essential distinction, which makes it unlikely that they can be successfully used to define and enforce rights over traditional varieties, and related wild material collected from agricultural ecosystems created and maintained by traditional farmers.

Figure 3: The Ancestry of IR36[1]

1 "Genebanks and the World's Food". Edited by Plucknett D. L., Smith N. J. H., Williams J. T. and Anishetty N. M., 1987. Princeton University Press, Princeton, New Jersey.

SOVEREIGN RIGHTS, PROPERTY RIGHTS AND THE IMPLEMENTATION OF INTERNATIONAL AGREEMENTS

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Appendix 3
Legal Aspects

SOVEREIGN RIGHTS, PROPERTY RIGHTS AND THE IMPLEMENTATION OF INTERNATIONAL AGREEMENTS

A3.I INTRODUCTION

1. The revision of the International Undertaking raises a number of legal issues related to access to, and ways of appropriating, plant genetic resources, as well as the basis for sharing the benefits with farmers, their communities, and their countries. This appendix briefly discusses the concept and implications of sovereign rights; ownership of plant genetic resources for food and agriculture under *in situ* conditions, and in *ex situ* collections; and intellectual property protection. The appendix reviews a number of aspects of tangible and intangible property rights regimes, which may assist countries negotiating the revision of the Undertaking to consider Farmers' Rights in the appropriate context, and from a more inclusive perspective.

A3.II SOVEREIGN RIGHTS

2. The fact that a Nation has sovereign rights over its territory, including its natural resources, is a well established principle in international law.[1] A State has the power and jurisdiction to establish how such resources and assets, tangible and intangible, are distributed, used, and, if it wishes, made subject to property rights.

3. The first international instrument to make specific reference to the sovereign rights of States over plant genetic resources was the FAO International Undertaking on Plant Genetic Resources, in Conference Resolution 3/91, adopting what is now Annex 3 to the Undertaking. The Convention on Biological Diversity also reaffirmed, in article 3, this principle, by stating that "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies..." (see also article 15 of the Convention). The Code of Conduct for Plant Germplasm Collecting and Transfer (1993), for its part, recognizes that nations have sovereign rights over the plant genetic resources in their territories.

4. Two considerations regarding the implications of sovereign rights are relevant. First, the recognition of sovereign rights over plant genetic resources for food and agriculture is not equivalent to the attribution, or existence, of property rights over individual resources. As discussed below, it means only that the State may - within the limits imposed by the nature of such resources - determine what type and modalities of property rights, if any, are recognized.

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1 Resolution 1803 of the UN General Assembly stated, in 1962, that due care should be taken "to ensure that there is no impairment, for any reason, of the State's sovereignty over its natural wealth and resources". See also Principle 21 of the 1972 UN Conference on the Human Environment, Stockholm, which was reproduced by article 3 of the Convention on Biological Diversity, that "states have the sovereign right to exploit their own resources pursuant to their own environmental policies".

5. Second, the exercise of sovereign rights over plant genetic resources for food and agriculture is subject to obligations emerging from international agreements. Thus, the Convention on Biological Diversity stipulates, in article 3, "the responsibility [of States] to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction". In addition, the Convention provides for a right of access by other Contracting parties, subject, however, to the prior consent of the country concerned, and the requirement that access must be on "mutually agreed terms". The Code of Conduct for Plant Germplasm Collecting and Transfer stipulates that, in the exercise of sovereign rights, governments should designate the authority competent for issuing permits to collectors (article 6).

A3.III PROPERTY RIGHTS

6. In considering the issue of property rights in connection with plant genetic resources, a distinction should be made between rights over a physical entity, as such, (physical property) and over the genetic information[1] contained in these resources (intangible property). The real value of the resources lies in the latter, and it is here that the legal questions that arise are particularly complex.

7. With respect to physical property, plant genetic resources may be subject to private or public property rights. Property may be derived from the ownership of the land where plants are located, as a consequence of the application of the traditional law principle, in accordance with which everything adhering to the land belongs to the landowner. Once separated from the land, the plants (or parts thereof) become subject to ownership regime covering moveable property, including when they are transported off the original land, or to a different country.

8. With respect to the intangible content of plant genetic resources (information contained in their DNA, genes and genotype), except as otherwise established by law, such information is usually considered to be in the "public domain", irrespective of the property rights that may be exercised over the physical samples in which the information is contained. This results from the very nature of knowledge as a "public good", which may be simultaneously used by many, without added costs, and without reducing its availability to others.[2]

9. "Public domain" means, in this context, that a particular piece of knowledge may be used by anyone, without restriction. In other words, it does not mean that a particular piece of knowledge is the "public" property of a particular State, but that it is freely available.[3]

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1 Genetic material is composed of combinations of genes (genotypes), which determine the physical and functional characteristics of plants, varieties and populations, in a given environment. The knowledge of the information related to such a material, and to its expression (phenotype), is the relevant subject matter, in terms of intellectual property rights.

2 A public good has an economic value, but since there is not a market for it, this value is not expressed as a price.

3 When a patent or a breeder's right is cancelled, or expires, the respective protected subject matter also enters the public domain. Similarly, as such rights are of a territorial nature, in countries where they are not registered, the subject matter also pertains to the public domain.

10. The principle of "public domain" can be derogated by specific laws, such as by the introduction of intellectual property rights as a mechanism for creating private rights. The establishment - or non-establishment - of intellectual property rights is a manifestation of sovereign rights, subject, however - as discussed below - to considerations of feasibility and enforceability, and to international conventions entered into on the matter.

11. A further point of relevance to the operation of intangible property rights over plant genetic resources, is the distinction between wild and domesticated plants.[1] The legal treatment of wild plant genetic resources may vary greatly. In accordance with the sovereign rights of a State, its laws may, for instance, establish that newly discovered plant genetic resources are declared as public property. They may also be made the subject of private property rights, such as those of landowners. The law may also provide that wild resources may be appropriated by those who discover them, or be regulated in a way similar to the case of the harvest of wild animals, which may include user fees in favour of local communities and land owners.

12. There are thus numerous legal alternatives through which the sovereign power of a State may determine the legal treatment of its plant genetic resources. However, the establishment of property, or other rights in relation to plant genetic resources - as is the case with other goods - is limited by the nature of the tangible or intangible goods in question. To be feasible, a system of protection must appropriately define its subject matter, and the kind of rights to be granted.[2] It should also be enforceable, that is, there must be means to properly identify ownership, and to make effective the rights granted.[3] Finally, the benefits of the system should outweigh the costs, in terms of the restriction of certain activities, or direct costs.

13. The freedom to legislate is also subject to the obligations that States have contracted internationally. The main relevant conventions include the Paris Convention for the Protection of Industrial Property, and the Berne Convention for the Protection of Literary and Artistic works. Both establish certain minimum standards to be complied with. With the adoption of the TRIPs Agreement (see also section A3.V below), such standards become mandatory, even for countries that have not signed those conventions, but which are members of the World Trade Organization (after its establishment in 1995).

14. An issue of particular importance relates to the legal status of *ex situ* collections of germplasm. A FAO study,[4] in 1987, found that:

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1 As will be discussed below, in the case of domesticated plants, a further differentiation is required between landraces or "folkseeds" (usually heterogeneous and variable), on the one hand, and "modern varieties" (usually homogeneous and stable), which are the result of formal breeding processes, on the other.

2 This is, as discussed below, one of the major problems to be faced in any attempt to extend intellectual property rights to knowledge or materials held by traditional farmers.

3 The enforcement - and not merely the existence - of rights has been one of the central issues in recent international negotiations on intellectual property rights, as illustrated by the TRIPs Agreement, adopted as an outcome of the Uruguay Round.

4 "Legal status of base and active collections of plant genetic resources", CPGR/87/5, Rome.

> "The position with regard to the ownership of plant genetic resources in genebanks may be summarized as follows. The material held in Government genebanks or in those of public institutions belongs (subject to any specific exceptions) to the State or to the individual public institution. In either situation, in practical terms, ownership and control are vested in the State. Only in a few instances is the precise question of legal title unclear. The situation with regard to the IARCs is more unclear still. In this context may be viewed those genebanks which consider themselves the custodians or depositories of the germplasm held there. There are also, of course, *ex situ* collections of plant genetic resources held by private corporations, but little information about them is available. Since they are not under Government control, they fall outside the scope of this study".

15. Though there are differences between common-law and continental-law countries with respect to the concept of property rights, in principle such rights can be established only by law. Property rights in general can neither be created nor diminished by private parties, and their definition and enforcement is one of the major attributes of sovereignty within the territory of each State. Therefore, as in the case of materials available *in situ*, the legal status of materials held in *ex situ* collections will depend primarily upon the principles of law, and the specific legislation, of the State in which the collection is located.

16. The same principles will apply with respect to collections maintained in internationally supported centres, except if the materials were acquired under specific rules, for instance, within the framework of an international agreement which included provisions regarding their legal status. The current understanding, as expressed in the draft agreement between FAO and the CGIAR Centres, whereby the Centres will bring their collections within the International Network of *Ex Situ* Collections under the auspices of FAO, is that the Centres hold the collected germplasm as trustees, for the benefit of the international community, without claiming any legal ownership over it. The Centres would not, in addition, seek intellectual property protection over collected germplasm, or related information.

17. A point that may, however, need further consideration is the legitimacy of a State's claims to property rights with respect to materials held in *ex situ* collections on its territory, when the materials they contain were obtained from other countries under the principle of free exchange, or when their origin cannot be determined. Though the physical property over the samples may be well established, this would not extend to its intangible contents, which would belong in the public domain, except if protected by intellectual property rights, or similar types of rights. Any restriction imposed on access to, and the use of the samples would amount to a restriction of access to their intangible content, and would be therefore of questionable legitimacy.

A3.IV SOME BASIC ISSUES REGARDING LEGAL MECHANISM FOR SHARING BENEFITS AND PROVIDING INCENTIVES FOR CONSERVATION

18. A number of basic issues need to be considered in order to explore possible mechanisms for the legal appropriation of plant genetic resources for food and agriculture. One of the most important is the subject matter to which rights may refer, in terms of genes and gene variants (alleles), genotypes, populations, varieties, *etc*. (see, in this regard, Appendix 2). In the context of the revision of the International Undertaking, and the realization of Farmers' Rights, the examination of possible forms of protection for traditional varieties is of particular importance.

19. Other relevant basic issues relate to the grounds on which a given method of appropriation is established, and to the nature of the rights conferred. It is generally accepted that patent-like protection aims at rewarding, and thereby promoting, innovative activities. Thus, it provides, through a monopoly right, a return on investments in human capital, even when the protected subject matter is a natural substance. (Patents on genes, for example, would compensate for the human effort in sequencing, isolating, or otherwise identifying them and their functions). A *sui generis* regime on landraces might, by the same logic, reward the human effort by farmers and communities, in selecting and improving genetic materials.

20. It has also been suggested that a specific type of rights (which might be called "informational property rights") might be introduced to reward and promote investment in genetic resources conservation *per se*, that is, in natural capital. These rights might be vested in States or in private parties, including farmers and communities.[1] The precise nature, scope, enforceability and effects of such rights would require further examination.

21. The contribution made by generations of farmers to the conservation of germplasm and the improvement of species has been recognized by the international community, particularly under the International Undertaking on Plant Genetic Resources, through the concept of Farmers' Rights, as well as by the Convention on Biological Diversity (article 8.j). There is also a growing recognition of the contribution made by indigenous and local communities to the state of knowledge on plant uses, particularly for therapeutical purposes.

22. The development of methods to compensate the contributions of indigenous and local communities requires, as a fundamental condition, the identification of the categories of knowledge or materials, of actual or potential value, which may be the subject matter of the rights conferred. These categories may include specific materials, as well as certain kinds of knowledge, such as information:

- on the use of plants;
- on the preparation, processing, and storage of useful species;
- on formulas and recipes, using plants for various purposes;
- on individual species (such as, for example, planting methods, cultural practices and selection criteria); and
- on ecosystem conservation.

23. It should be noted that while traditional knowledge does not necessarily mean frozen, immutable, knowledge, it includes usages that have adapted and evolved over time. If the scope of patentability (or appropriation through similar title) is extended, knowledge that today is in the public domain would become subject to exclusive rights.

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1 See Sedjo, R.A., "Property rights and the protection of plant genetic resources", in J. Kloppenburg, Jr., Ed., Seeds and Sovereignty: the Use and Control of Plant Genetic Resources, Duke University Press, 1998. (Note however, that this author refers to "newly discovered natural genetic resources", p. 308); and "The Valuation and Appropriation of the Global Benefits of Plant Genetic Resources for Agriculture", Swanson T. M., Pearce D. W., and Cervigni R. (Centre for Social and Economic Research on the Global Environment, and University of Cambridge), 1994, unpublished.

24. Before entering into a discussion of specific ways of protecting plant genetic resources for food and agriculture, and the sharing of benefits, including compensation, in the context of Farmers' Rights, it may be useful to look at certain present protection and compensation regimes, that were developed to overcome certain difficulties similar to some of those that may arise with plant genetic resources for food and agriculture, and the implementation of Farmers' Rights. From these, some elements of value to the present discussion may be extrapolated.

A3.V INTELLECTUAL PROPERTY RIGHTS

25. Intellectual property rights relate to the intangible content of processes or goods. In the case of living forms, for instance, they may relate to the information contained in genes, or other sub-cellular components, in cells, propagating materials or plants. Intellectual property rights are not equivalent to property rights over the physical objects containing such information, but are rights to exclude third parties from producing or selling the objects in question, without prior agreement. The "exclusive" rights of the title holder are exercised indirectly over the materials containing the protected information, and in this way the production, storage, circulation and trade of such materials is affected.

26. Intellectual property rights can only be exercised in countries where the respective title has been granted. In accordance with the principle of "territoriality", no protection exists in countries where no registration has taken place (regardless of whether this innovation has been registered elsewhere), and the innovations there belong to the "public domain". In addition, unlike physical property, where rights are in perpetuity, intellectual property rights are temporary, and last, in general, for up to twenty years from the date of application, in the case of patents, and twenty-five years, in the case of Plant Breeders' Rights.

27. The main areas of intellectual property relevant to plant genetic resources for food and agriculture are patents and Plant Breeders' Rights.[1] There are still considerable differences among national laws regarding the patentability of inventions relating to plants. There is, however, a trend - at least in industrialized countries - towards accepting the patentability of genes, cells and microbiological processes, including, in certain cases, naturally occurring materials.

28. More substantial differences arise with respect to the patentability of plant varieties. This is generally not permitted in European countries. The same applies to essentially biological processes for the production of plants.[2] Plant varieties are, however, patentable in other countries, including the United States.

29. Relevant international conventions in force, with respect to patent rights in this field, are the Paris Convention for the Protection of Industrial Property,[3] and the Budapest Treaty on the

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1 Trade secret protection is also relevant, particularly in connection with hybrid seeds.

2 Patent law relating to biotechnology is being substantially harmonized in the States of the European Union, under a Directive on biotechnological inventions.

3 This Convention deals with national treatment, priority rights, compulsory licensing and other matters, but has no specific rules on patentability.

International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedures.[1]

30. The Budapest Treaty establishes a system aimed at facilitating the deposit of microorganisms, as a means of complying with the disclosure requirements of patent laws. A deposit made with one "international depositary authority" (IDA) suffices, for the purpose of patent procedures before the national patent offices of all Contracting States. The Treaty leaves to national legislation the issue of conditions of access to the deposited samples. It is thus a matter for national law to determine when, and under which circumstances, samples may be obtained.

31. Legal systems vary considerably in this regard. Under some laws, samples can only be obtained after the granting of the patent. Under other laws, samples may be obtained after publication of the application, and before the patent has been granted, but through an independent expert, and for experimental purposes only.

32. By the end of 1990, IDAs had received a total of 15,265 deposits, 51% of which were with IDAs established in the United States.[2] By the same date, only 256 samples (1,7% of total deposits) had been furnished to third parties, under Rule 11.3 of the Regulations of the Budapest Treaty.[3] Of 26 IDAs existing, as of January 1994, only one had been established in a developing country: South Korea. The Treaty has 29 members, including four developing countries.[4]

33. Plant Breeders' Rights, established under the UPOV Convention, protect, in principle, the propagating materials of plant varieties, and are generally applied to both sexually and asexually reproducing plants.[5] The protection of discovered varieties is possible under this system. National legislation on Plant Breeders' Rights has characteristically recognized two exceptions to the exclusive rights of the breeder. The so-called "farmer's privilege" allows farmers to re-use, on their own holdings, seeds obtained by the cultivation of protected varieties. The "breeder's exemption" under certain conditions, allows the use of a protected variety as the basis for further varietal development by third parties. These exemptions are often considered to be one of the main differences between the system of Plant Breeders' Rights and the patent system.[6] In the 1991 revision of the Convention, however, the farmers' privilege was changed from a general rule to an exception.[7]

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1 Mention should also be made to the Patent Cooperation Treaty (Washington, 1970), which simplifies the obtaining of protection, when this is sought in several countries.

2 They are the American Type Culture Collection, and the Agricultural Research Service Culture Collection.

3 Data based on Industrial Property Statistics 1990, WIPO, Geneva, 1992.

4 Cuba, Trinidad and Tobago, South Korea and the Philippines.

5 With the exception of the laws of the United States and South Korea.

6 These are not, however, the only important differences. There are also significant differences with regard to the subject matter of, and the requirements for, protection.

7 The 1991 revised UPOV Convention transforms the way in which the rights of farmers to re-use farm-saved seeds on their own land are expressed. These rights previously depended on a generally accepted interpretation of the term, "production for purposes of commercial marketing", which

34. The UPOV Convention established minimum standards for the protection of Plant Breeders' Rights. Its 1991 revision also eliminated the obligation (present in the 1978 Act of the Convention) not to accumulate patent and Breeders' Rights protection for plant varieties. As of April 1993, there were 31 countries that protected plant varieties by a special system, and three countries (Mexico, Rumania, and the Republic of Korea) that protected plant varieties through hybrid systems, with features of both the utility patent system and of a special system. Of the 31 countries protecting plant varieties by a special system, 24 were members of UPOV, and had adhered to the UPOV Convention[1]; the remaining seven had laws that conformed to, or were substantially modelled on, the UPOV Convention.

35. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), adopted as a part of the outcome of the Uruguay Round, has introduced new international rules that are of relevance. Under article 27.3.b) of the Agreement, Members may exclude from patentability:

> "plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this sub-paragraph will be reviewed four years after the entry into force of the WTO Agreement".

36. Various elements of article 27.3.b) need to be considered.

i Unlike European law and other national legislation that followed the same approach, the article refers to "plants and animals", and not to classifications thereof ("varieties", "races" or "species").[2] In the absence of any distinction, and in the light of the second sentence of the same article, the exclusion may be interpreted, in broad terms, to be inclusive of animal and plants as such, animal races, and animal and plant species.

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excluded from the scope of the Convention the re-use of farm-saved seed of protected varieties, by farmers, on their own lands. The expression, "production for purposes of commercial marketing", has now been widened to read "production or reproduction", but an optional clause allows individual Contracting Parties to restrict Plant Breeders' Rights in order to permit farmers to use, for propagating purposes, on their own holdings, the product of the harvest which they have obtained by planting the protected variety on their own holdings. Thus, in practical effect, the farmers' privilege is changed from a principle to an exception. Another important change was the introduction of the concept of "essentially derived varieties", which excludes the protection of "cosmetic" varieties, and varieties that only represent a minor change, with respect to the protected variety used as a source of variation.

1 In September 1993, following the accession of Norway.

2 The distinction is important. In European countries, the prohibition to patent a "variety" does not prevent patenting a plant, as such. The acceptance by the European Patent Office of a patent application on the "Harvard mouse", was, similarly, based on the judgment that it was not a "race", but a specifically altered animal, that is patented.

ii The exclusion of "essentially biological processes" does not affect the patentability of "non-biological and microbiological" processes. The aim is to limit the exclusion of patentability to traditional breeding methods, while preserving the possibility of obtaining protection, for instance, on developments based on cell-manipulation, or the transfer of genes. Under the text quoted above, processes employing microorganisms (such as fermentation) are also patentable, in accordance with current practice in most countries.

iii As stipulated in the article, Members must provide protection for "plant varieties", either by patents, or by "an effective *sui generis* system or by a combination of both". The reference to a *sui generis* system suggests the Plant Breeder's Rights regime, but the possibility is open of combining the patent system with the Plant Breeders' Rights regime, or to develop new *sui generis* forms of protection. Hence, countries which presently do not protect plant varieties (especially developing countries) have considerable room in which to develop their systems of protection, in a way that would meet their specific needs and concerns.

iv Article 27.3.b) is the only provision in the TRIPs Agreement that is specifically made subject to an early revision: four years after the entry into force of the World Trade Organization (WTO) Agreement. This period is even shorter than the transitional period contemplated for developing countries (article 65).[1] This indicates how difficult a compromise on the biotechnology-related issues has been, and suggests the need for a deeper examination of the matter.

The possible extension of intellectual property over heterogeneous agro-biodiversity: perspectives and limitations

37. Various forms of intellectual property rights already cover distinct sectors of homogeneous plant genetic resources for food and agriculture, namely the modern commercial crop varieties (essentially through Plant Breeders' Rights) and other products of the new biotechnologies (generally under patents). These regimes, which were discussed above, require the easy recognition and, in cases of the infringement of the rights, the tracing of the subject of protection. The accent has therefore been on homogeneity, and stability of protected material over generations.

38. There have recently been a number of attempts to analyze the possibilities of extending intellectual property rights regimes to cover also other forms of agro-biodiversity, including landraces, and the wild and weedy relatives of crops. Great difficulties have, however, been encountered, since the value of these resources lies precisely in their variability (lack of homogeneity) and their continuing evolution (lack of stability over generations), which makes recognition and tracing aleatory. For specific genetic traits, it is easier to define the subject, but more difficult to identify the area of origin: they may occur *in situ* in more than one country, and be found in *ex situ* collections in or outside the country. In the specific cases where these problems can be resolved, various legal issues remain to be considered.

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1 The transitional period allows developing countries up to five years to implement TRIPs provisions at the national level; this term is extended to 11 years for least developed countries.

39. One such question is the level and nature of human intervention, as well as the *innovation required*, if any, for a given material to be protectable. Deciding who should be the *title holder* is likely to be a delicate problem, not because of the collective nature of innovations (which may be dealt with as in the UNESCO model law on folklore), but because the genetic information contained in landraces generally has no single origin, and is the result of the interaction of many landraces over time. Patents and Plant Breeders' rights are *territorial rights*, in the sense that they are only valid in the countries where registration has been obtained.[1] There would be a need, therefore, for an internationally respected system of rights. In addition, the *attribution of rights* to particular communities and countries could become a source of serious conflict, and imply considerable enforcement and litigation costs. Issues such as the examination of requests for protection, and registration, would need to be analyzed, as well as the likely transaction costs involved in the operation of the system.

40. Another key issue is the extent to which such a system would actually operate in favour of its intended *beneficiaries*, rather than in favour of those who are better positioned to take advantage of it. The acquisition, and, particularly, the *enforcement of rights*, may only be possible for those with strong financial capabilities, and adequate technical and legal support[2]. The availability of rights is useless, if they cannot actually be enforced. Enforcement depends on how easy it is to prove *infringement*,[3] on the existence of preventive measures and remedies against infringement, and, above all, on the capacity to monitor possible infringement of the rights, and bear the costs of administrative and judicial procedures. A further issue to be determined is the *duration* of protection for an intrinsically evolving (changing) material, for which, in addition, the date of "creation" cannot be established.

41. In cases where new legal regimes of this nature can be developed, they are more likely to be applied when the objective is to identify chemical substances of potentially high commercial value, particularly medicinal substances. The applicability of this type of agreement to plant genetic resources for food and agriculture is subject to two main constraints. First, unlike medicinal or other chemical substances, the value of plant varieties is usually dependent upon a large number of genes, frequently originating from many different sources; it would be very difficult to isolate the value attributable to specific genes found in a specific area.[4] Second, in

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1 This is a major point of difference from copyright, which does not require registration, and has an almost universal validity, by virtue of the application of international conventions.

2 In fact, this is one of the major handicaps facing innovators in developing countries, who wish to obtain patents abroad, because they are often unable to bear the costs of the acquisition, maintenance and defense of the rights.

3 With respect to the effectiveness of available techniques, see Appendix 2.

4 *Biological prospecting contracts* provide a framework for determining rights and obligations, and, in particular, attributing property rights, and regulating the sharing of benefits, in the case of the discovery of plants with new commercial applications. Benefits to donors of germplasm generally take the form of payments, beforehand, for the right to explore, or royalty payments deriving from the use of material discovered, for a given period, or both. Contractors get, in exchange, the right to patent, or otherwise exclusively exploit, materials discovered. This type of contract has so far been applied to wild plants for medicinal or industrial purposes, but not yet to the collection of plant genetic resources for food and agriculture. The Inbio-Merck agreement, in Costa Rica, is the best

most cases, the same genes might well be found in other places, including in existing *ex situ* collections.

known example of a bio-prospecting contract. A further example is the agreement among Bristol Myers Squibb, Conservation International, and the Tiriò People of Surinam.

A3.VI OTHER POSSIBLE FORMS OF PROTECTION AND REMUNERATION OF RELEVANCE TO PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Trade Secrets

42. Some valuable knowledge may be preserved by being kept secret, particularly in the case of the application of plants for therapeutical purposes. Holders of such knowledge may well be protected under the concept of unfair competition rules, which does not require previous registration or other formalities.

43. Trade secrets protection, unlike patents, does not confer an exclusive right, but the right to prevent the acquisition, and use by third parties, of the protected information in a manner contrary to honest commercial practices.

44. Any secret information of commercial value may be protected under the law relating to trade secrets.

Appellations of origin

45. This title regulates the use, in describing a product, of a geographical identifier relating to a specific place, region or country, when the typical features, or special characteristics, of a product are closely related to the geographical area or region from which it comes. This modality of protection might be applied to centres of diversity of certain crops, in a way similar to the use of appellations of origin for wines and spirits.

46. The protection conferred under such titles may be exercised through associations representing the producers of the region or area concerned. It should be noted, however, that an appellation of origin does not protect a specific technology, or knowledge as such, but only prevents the false use of the geographical identifier.[1]

Protection of Expressions of Folklore

47. The UNESCO/WIPO Model Provisions for National Laws for the Protection of Expressions of Folklore against Illicit Exploitation and other Prejudicial Actions, have often been mentioned as a possible framework for the protection of traditional knowledge. The Model Provisions attribute rights not only to individuals, but also to communities, and allow the protection of ongoing or evolutionary creations.[2]

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1 In this sense, this form of protection is closer to the trademarks regime, than to patents.

2 Only Bolivia and Morocco are reported to have implemented rules within the framework of the Model Provisions.

48. This type of protection belongs in the area of copyright, where only the expression of a work, and not the underlying ideas, is protectable.[1] This certainly limits its usefulness, as a means of protecting and compensating methods or knowledge of a functional character.

Remuneration rights

49. Another form of protection might be provided by a system in which a right to remuneration, not associated with the exercise of an exclusive right, is ensured, in order to compensate contributions made by communities. Some situations involving intellectual property have been addressed by systems of this type. One example is the public lending right, that is, the right of authors to a remuneration (that is directly paid by the State, in certain countries), for the lending of their books by public libraries. The remuneration is distributed among authors in accordance with certain criteria, such as the number of books in the libraries' stocks.

50. Another example is the royalty on blank audio and video tapes that has been established in many countries, specifically for tapes suited for private use. This royalty is intended to compensate the title-holders of works published on audio and video tapes for the copying of these works without their consent, and is premised on the practical impossibility of actually controlling private copying.

51. In many other areas of copyright, and similar rights, difficulties in exercising exclusive rights have led to the establishment of remuneration schemes, with collective administration organizations. These organizations collect the license fees, and other remuneration, and distribute them among the authors concerned.

A3.VII TOWARDS AN INTERNATIONAL *SUI GENERIS* SYSTEM FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE, AND THE FAIR AND EQUITABLE SHARING OF THE BENEFITS

52. Under the International Undertaking, an international fund is to be established and entrusted with the responsibility of compensating, and providing incentives to, farmers, their communities and countries, for their continuous work on the development and conservation of plant genetic resources for food and agriculture. The operation of this fund would permit the realization of Farmers' Rights.

53. Such an approach has a number of intrinsic advantages, in view of:

- i the difficulties of determining the origin of specific germplasm contributions and their value;
- ii the essentially evolving nature of landraces, and the difficulty of adequately defining the protected subject matter;
- iii the fact that crop diversity spreads across borders;

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1 In accordance with the so-called idea-expression dichotomy, protection is conferred to the form in which a work is expressed, and not to the concepts, ideas, methods, *et cetera,* that underlie its expression. By this principle, for instance, the reverse engineering of integrated circuits and computer programmes has (under certain conditions) been allowed by national legislation.

iv the substantial transaction costs that are likely to be involved in the establishment and administration of a new intellectual property system; and

v the problems related to the enforceability of individual rights, and whether they would, in fact, work in favour of the intended beneficiaries.

54. As in the case of other mechanisms considered above, a number of issues, would, however, require consideration and clarification, with regard to the realization of Farmers' Rights.

Nature of the rights

55. The concept of a right to remuneration, discussed in the previous section, as applied in certain circumstances, in the area of copyright, may be implemented so as to ensure that any party can use the protected subject matter, provided that the title holder is remunerated (generally through levies collected by governments or other entities[1]).

Basis of the rights: past contributions, or incentives for future contributions

56. Since the development, by the Commission, of the concept of Farmers' Rights, many discussions of the issue have tended to oversimplify the question, by assuming that the purpose of Farmers' Right was just to compensate farmers, their communities and countries for their past contributions. However, the FAO Resolution on Farmers' Rights also refers to the future, and to the need to ensure the continuation of farmers' contributions[2]. Plant genetic resources for food and agriculture can be regarded as an accumulated capital, essentially derived from farmers' work. Recognizing the value of this capital, and attributing rights to its developers, will, in itself, provide an incentive for the continuation of farmers' contributions, and the conservation of germplasm. Seen in this light, the distinction between "compensation for past contributions" and "incentives for future contributions" appears to be more academic than real.

Funds needed

57. An important issue on which to focus discussion is the volume of the total funds that would be needed each year, for farmers and their countries and communities to implement Farmers' Rights. This is, of course, dependent on the methodologies used to measure the value of such contributions. One such methodology could be the calculation of the incentives that would need to be provided, in order to effectively conserve and continue developing the existing sources of plant biodiversity, on a global level.[3]

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1 See paragraphs 49 to 51 above.

2 Annex 2 of the International Undertaking, (Resolution 5/89 on Farmers' Rights), while considering that Farmers' Rights "arise from the past, present and future contributions of farmers", states their purpose to be "ensuring full benefits to farmers, and supporting the continuation of their contributions".

3 For such incentives to be successful, they would need to be more than the opportunity cost of foregoing conversion to modern varieties: see Appendix 1.

58. In addition to the direct costs of *in situ*, (including on-farm) and *ex situ* conservation, a fair and equitable sharing of benefits should include the resources required for research, training and public education, in order to enhance and promote the sustainable and efficient utilization of the resources.

Entitlement to benefits

59. Farmers and their communities may be the principal final beneficiaries, but institutional mechanisms may need to be established to represent their interests. These could be done, for instance, through their governments, or collective associations of farmers, or other entities, recognized by governments.

60. How to determine which farmers, their communities and countries would be beneficiaries is a technical, but not a minor problem. If a criterion were for countries to be located in a main region of crop diversity, at least 40 countries would satisfy it. On other criteria all countries, or all developing countries, could be eligible. In all cases, funds should be allocated according to mutually agreed modalities.

Funding obligations

61. It is envisaged that Farmers' Rights be exercised through an international fund. Governments might contribute to the fund on a mandatory basis, in order to achieve the effective implementation of Farmers' Rights, within a reasonable period.

62. The level of contributions to be made could be determined in accordance with various criteria, such as, among others, the sales of improved varieties, the seed trade, the value of crop production, value added in agriculture, gross domestic agricultural product, or simply gross domestic product. A fair distribution of charges might also be derived from the scale of country contributions to FAO or the UN. An analysis comparing these and other possibilities might be useful.

Use of funds by the beneficiaries

63. Two solutions may be envisaged. The intellectual property system, though theoretically grounded on ensuring the recovery and further financing of research and development costs, does not require the title-holder to apply the amounts received to research, or any other particular end. However, experience has shown that such systems have effectively promoted innovation and research. The same treatment could be applied to Farmers' Rights, where the expectation of future earnings from germplasm properly maintained and developed could be a sufficient incentive.

64. Another approach would be to link such payments to actual commitment, or, even activities related to the conservation and development of landraces. This could be achieved by financing programs evaluated, approved and monitored by the fund. This will imply certain transaction costs, which could, however, be offset by the advantages of a well managed administration of resources.

Allocation of the funds

65. Criteria for fund allocation would need to be defined. They might take into account, for instance, the amount and kind of plant genetic resources for food and agriculture in question, risks of extinction, levels of income, priority crops[1] and the ability to conserve.[2]

Possible supporting mechanisms

66. A number of contractual instruments may also be of importance in ensuring the effective and proper functioning of this *sui generis* system. The first is the *material transfer agreement*, an instrument which is increasingly used by industry and public sector laboratories in some countries, as well as in international germplasm exchanges. These agreements are conceived so as to permit access to certain samples of germplasm, generally under the condition of use for research purposes only, without simultaneously transferring title over their intangible content. They contain, as a rule, an obligation on the recipient not to seek patents over the material transferred, or over its derivatives, or, in cases where it is stipulated that such rights can be obtained, to share them, or the royalties deriving from their exploitation. In general, the recipient of germplasm undertakes to negotiate with the provider the distribution of any profits that may result, in other words, negotiation is left until after it has been demonstrated that there are profits about which to negotiate.[3]

67. The use of material transfer agreements could be useful both bilaterally and multilaterally. At the multilateral level, one example of a situation where such agreements could, if necessary, be of service, would be to cover releases from *ex situ* collections maintained in International Centres, for which the country of origin is unknown, and which were collected prior to the entry into force of the Convention on Biological Diversity.

68. A further contractual instrument that could be of value is the *international franchise agreements* proposed by Swanson *et al.*[4] This could take the form, for instance, of a tripartite agreement (between a State, the international community, through a special fund, and the franchisee) under which the compensation would be established and paid in exchange for the actual conservation of germplasm. It would be, in this sense, a *services agreement*, for maintaining an international public good.

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1 The Global Plan of Action being elaborated through the preparatory process for the Fourth International Technical Conference on Plant Genetic Resources is relevant in this context.

2 Such ability might be periodically verified on the basis of performance.

3 As a representative of IPGRI informed the Ninth Session of the Commission's Working Group (11 - 12 May 1994), a proposal for the use of this type of agreement by the CGIAR Centres is currently under consideration. (Barto. J., and Siebeck, W., "Material transfer agreements in genetic resource exchange. The case of the International Agricultural Research Centres"; Issues in Genetic Resources, No.1; IPGRI, Rome, May 1994). The model agreement includes obligations on the recipient to notify the transfer of the material to a third party; to acknowledge the source country of the germplasm in publications and variety descriptions; to communicate to the Centres pre-breeding evaluation results; to provide a reasonable share to the country of origin of the net profits eventually obtained; not to seek intellectual property rights over the materials; and not to assert rights on derivatives against nationals of the source country, other developing countries or the CGIAR.

4 Swanson T. M., Pearce D. W., and Cervigni R., *op. cit.*

69. The adequacy of the modalities considered above, their advantages and disadvantages, and their likely effectiveness in providing a global and long-standing solution, whereby to compensate traditional farmers, their communities and their States for conserving valuable germplasm, need to be further explored. Contractual arrangements might be simply bilateral, or be articulated and executed within a multilaterally agreed framework. A multilateral system may be necessary to ensure a certain uniformity in the conditions for access to, and use of germplasm, and in order to avoid prices being excessively driven down by competition among supplying countries. Furthermore, a multilaterally-based system would be essential to provide a global agreed basis for the conservation of agro-biodiversity, and a balance in the sharing of benefits and costs among all States and parties concerned.

A3.VIII FINAL CONSIDERATIONS

70. Discussions in this Appendix suggests that sovereign rights over plant genetic resources for food and agriculture may take a variety of forms, and that sovereignty should be distinguished from property rights, which may, in turn, refer to physical or to intangible property. Property rights are created by law: goods that are not subject to such rights belong in the public domain. This is the situation of the intangible content of landraces, and other materials that do not qualify for protection under existing regimes, including patents and Plant Breeders' Rights.

71. The document also reviewed the main trends with respect to the legal protection of plant-related innovations, and discussed various possible alternative forms of protection for traditional varieties. It also identified issues that would need to be considered, if the development of a new regime of intellectual property for plant genetic resources for food and agriculture were envisaged.

72. Similarly, a number of issues that would need to be addressed in order to develop institutional mechanisms at the international level were raised. The airing of this range of issues may serve to orient further analysis and discussion: it is in no way an exhaustive examination of the subject.