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Options for Access to Plant Genetic Resources and the Equitable Sharing of Benefits Arising from their Use

The attached document was submitted by the International Plant Genetic Resources Institute, following a request by the Sixth Session of the Commission that IPGRI study the feasilbility of posible systems for the exchange of plant genetic resources for food and agriculture and the equitable sharing of benefits, with particular attention to their efficiency, practicality and cost-effectiveness.[1]

[1] The present document complements the paper made available at the time of the Commission's Second Session, which is again available at the current Session, under the title "Access to Genetic Resources and the Equitable Sharing of Benefits".

Options for Access to Plant Genetic Resources and the Equitable Sharing of Benefits Arising from their Use

Introduction

1. The 6th Session of the FAO Commission on Plant Genetic Resources requested that IPGRI[1] study the feasibility of possible systems for the exchange of plant genetic resources for food and agriculture (PGRFA) and the equitable sharing of benefits, with particular attention to their efficiency, practicality and cost-effectiveness. IPGRI assembled a small study team to undertake this task and based on their work, which involved consultations with all major stakeholder groups, a report was made available at the time of the 2nd Extraordinary Session of the Commission on Genetic Resources for Food and Agriculture in April 1996 *("Access to Genetic Resources and the Equitable Sharing of Benefits", IPGRI, 1996).*

2. Subsequently, IPGRI commissioned a study on the transaction costs likely to be incurred in the various system options presented in the original report *(Lesser, W. IPGRI, 1996. Unpublished).* These two studies, together with comments received on the former and new information brought to light by *The State of the World's Plant Genetic Resources for Food and Agriculture*[2], form the basis for this synthesis report. Its purpose is to contribute to the ongoing debate surrounding the question of access to genetic resources.

3. The synthesis report is divided into two sections. The first section describes, and in some cases expands on, the analysis presented in the original IPGRI study. The second section draws on information contained in the follow-up study on transaction costs. For a fuller account of many of the ideas and options discussed below, the reader is referred to the prior studies which are available from IPGRI.

Section One: Options for Exchange Systems

The Basis: Why is International Exchange of Genetic Resources Necessary?

4. Throughout history, crops have traveled beyond national borders, exchanged by farmers and rural communities, and carried around the world by ecological interactions, shifting populations and explorers. As a result, both developed and developing countries rely on crops that originated elsewhere for a large part of their production and consumption. In many countries, crops originating in other parts of the world have become a national dietary staple and a major export.[3]

5. There are many reasons why countries might wish to collaborate in the exchange and use of genetic resources: to increase their access to improved germplasm, technologies and information, for example. These and other benefits of international cooperation are detailed below. But perhaps the most compelling argument for collaboration lies in the fact that countries are interdependent with regard to genetic resources; this interdependence makes collaboration essential.

6. Many countries hold significant plant genetic diversity in genebanks, on farmers' fields and in the wild. Nevertheless, they continue to require access to the diversity available elsewhere for genes conferring useful traits for crop improvement and to guard against the risks of over-reliance on too narrow a genetic base. In addition, countries depend on access to improved varieties from around the world. A successful plant breeding effort is a long and step-wise process. It therefore relies extensively on the availability of materials developed by breeders in many countries and regions. For example, the VEERY wheat lines — grown on approximately

3 million hectares around the world — were developed through 3170 crosses using 51 individual parents (some used more than once) originating in 26 countries.[4]

Global Trends and Policy Shifts

7. Farmers and professional breeders have traditionally relied on open access to genetic resources, most often exchanging material on a casual basis, i.e. without the use of formal transfer agreements. Over the years, this has led to the development of numerous bilateral and multilateral alliances. Such alliances provide a framework for informal exchanges among institutions and countries with common interests in crops and/or ecogeographical regions. Recently, however, there has been a trend towards greater privatization of plant breeding and research, coupled with increasing pressures to enact stricter intellectual property legislation. At the same time, there is a growing recognition of the value of biodiversity to sustainable development.

8. With the entry into force of the Convention on Biological Diversity (CBD), the conservation imperative has received formal recognition, as have the sovereign rights of nations to control access to their biological diversity and to make it available under terms and conditions that are agreed mutually between providers and recipients. Among other things, these conditions support the right of providers of original material to negotiate a fair and equitable share of the benefits arising from its use by others.

9. A number of individuals interviewed in connection with the IPGRI studies expressed concern that the principles of sovereign rights and benefit-sharing might lead to greater restrictions on the exchange of genetic resources. Indeed, this appears to be the case already; in response to the Convention's recognition of national authority to determine access to genetic resources, a number of countries have already started to regulate germplasm transfers. For example, African nations have imposed a temporary ban on the transfer of any biological resources not covered by existing conventions and where prior informed consent is not in effect.[5] Other countries have introduced specific control mechanisms (e.g. the Philippines[6]) or have negotiated regional exchange arrangements that control the release of genetic material from member states to outsiders (e.g. the Andean Pact countries).

10. The informality that has characterized most exchanges of genetic resources to date has much to recommend it *(see "The Current Approach to International Exchange" below).* Nevertheless, it appears that, given global trends that limit the availability of genetic resources (e.g. through increased use of intellectual property protection in conformity with the GATT/TRIPS provisions) coupled with current political realities, such an approach is no longer broadly acceptable to many countries. In addition, a number of stakeholders[7] contacted in the course of the IPGRI studies have indicated that current exchanges of genetic resources tend to have narrower participation than might be desirable.

11. The Convention on Biological Diversity explicitly recognizes the important role of indigenous and local communities in the conservation and sustainable use of biological diversity[8]. Given the interdependence of countries with regard to genetic resources, there is little question that the world community, both South and North, can only gain from the greatest possible involvement of all genetic resources stakeholders in international exchanges. Thus both policy and practicality argue for the inclusion of groups — such as farmers and local organizations and institutions — that to date have played only a limited role in such exchanges.

12. Nevertheless, there is a perception by many that the current approach, while informal, is not as "open" as they would wish to see it, in the sense that there are no clear entry points for the uninitiated. Numerous comments received during the preparation of the IPGRI studies point to a widespread belief that participation in informal exchange alliances is restricted to

institutions that know and trust each other and that have a history of working together. Other groups that have not been involved in these alliances may not know how they function, how "non-traditional" partners might gain by participation, or even that such alliances exist.

13. Furthermore, a lack of agreement concerning the basis for access and benefit-sharing, the increased use of intellectual property protection, and the fact that the position on these issues is not codified in rules upon which stakeholders can rely, have led to a widespread concern that all stakeholders might not benefit equally from participation. According to a number of sources, this has created reluctance on the part of some stakeholders to become involved in exchange alliances so that, ironically, the very informality of the present approach may have led to a rather more closed and restricted exchange regime than many consider desirable.

14. The Global Plan of Action (GPA) — one of the chief outputs of the International Technical Conference on Plant Genetic Resources — will serve as a tool for implementing the CBD with regard to agricultural biodiversity. The GPA, which has the conservation and sustainable use of genetic resources as its chief aims, is expected to result in resources being targeted to global priorities and to increase the effectiveness of national and international conservation efforts. The successful implementation of the GPA will depend upon the continued availability of plant genetic resources for food and agriculture. This will in turn rest upon the accommodation of the principles of sovereign rights and benefit-sharing in any future approach to germplasm exchange. It will also require the development of mechanisms for ensuring the broadest possible participation by all stakeholder groups.

15. While the current approach to exchange has accomplished a great deal in the last three decades, recent global trends and policy shifts have tended to promote a slow but steady "drift" towards bilateralism. The advantages and disadvantages of individually negotiated bilateral exchanges will be explored further below. It appears, however, that an exchange model based entirely on individually tailored agreements between individual countries would likely impede the international flow of germplasm. If for no other reason than to avoid that scenario, it is critical that agreement be reached on an effective system or systems for the exchange of PGRFA.

The Criteria: What is Required for an Effective and Acceptable System of Exchange?

16. Plant genetic resources for food and agriculture lie at the heart of sustainable development. They provide the means to ensure food security and to enhance the role of agriculture as an engine for economic development. Any system for the exchange of genetic resources must support the continuing efforts of farmers, breeders and policy-makers to achieve these goals.

17. To be acceptable, such a system must conform to both the letter and the spirit of the CBD. The exchange of genetic resources should thus support conservation, promote use and ensure an equitable sharing of any benefits arising from the use of exchanged material. The system should aim to minimize transaction costs while maximizing efficiency and effectiveness.

The Benefits of Exchange

18. There have been few attempts to quantify the benefits currently flowing to both providers and users of germplasm as a result of its international exchange. However, the qualitative benefits of international cooperation are generally well known. Any international exchange system should, at a minimum, provide the same range of benefits as are currently available. These include:

- access to greater amounts of germplasm than are available in any one country;

- access to improved materials;
- increased opportunities for developing joint strategies for the conservation and use of genetic resources and for sharing responsibilities and costs regionally and / or globally;
- the facilitation of research partnerships and the pooling of resources needed to exploit particular genepools effectively;
- access to relevant technologies developed by partner countries;
- access by providers to information, e.g. special traits or multiplication testing data, on material that they have supplied as well as on material supplied by partners;
- more cost-effective means of exchanging information, e.g. through shared databases and information systems;
- access to training at a range of specialized institutions.

The Current Approach to International Exchange

19. International cooperation in the conservation, use and exchange of plant genetic resources can occur on either a bilateral or a multilateral basis. Both approaches are consistent with the CBD.

20. Bilateral arrangements refer to partnerships negotiated between two parties for their mutual benefit and are generally formalized through a contract or memorandum of understanding. They can range from highly specific (e.g. to cover a single transfer between two institutions) to fairly broad (e.g. general exchange agreements between two governments or to cover all transfers of a range of germplasm).

21. Multilateral arrangements involve several parties sharing the costs and benefits of collaboration and making decisions collectively as to the basis for that collaboration. These arrangements can also be broad in scope (even global, e.g. exchanges conducted within the context of the CGIAR[9]) or limited to a region (e.g. networks such as that which includes the SADC[10] countries or the ECP / GR[11] programme) or to a genepool (e.g. crop genetic resources networks).

22. The current approach to exchange cannot be characterized as either strictly bilateral or as purely multilateral; it includes elements of both models. The approach comprises a multiplicity of formal and informal, simple and complex relationships between partners. These relationships have resulted in the development of a web of alliances between and among individual national programmes, within regions, with and between NGOs, CGIAR Centres and the private sector. The exchange of material within alliances may be governed by legally complex bilateral agreements or, as has more often been the case, by purely informal arrangements among two or more parties. This approach is flexible, dynamic and supremely adaptable. It has been responsible for much of the food crop germplasm collected and exchanged internationally over the past two decades.

23. The CGIAR is a multilateral system that operates within the context of this web of exchange alliances. The germplasm collections housed by the CGIAR Centres — collectively the world's largest international holdings of basic food crops — fall under the auspices of the FAO Commission on Genetic Resources for Food and Agriculture. CGIAR policy, as confirmed by Agreements signed in 1994 with FAO, is that the collections are not Centre property but are held in trust for the world community. As such, the broad basis for exchange and benefit-sharing with regard to the CGIAR collections is set by that intergovernmental body.

24. Responsibility for the day-to-day management and distribution of the collections rests with the CGIAR Centres, which operate under the authority of their individual multinational Boards of Trustees. The overall policy and operational context of the system is set by the CGIAR members, which currently include 54 countries (of which 30% are from the South), and by the co-sponsors, themselves intergovernmental organizations (FAO, UNDP, UNEP and the World Bank). The collective decision-making that characterizes the CGIAR system has resulted in the formulation of standard rules and procedures that govern the germplasm exchanges between the centres and their partners, for example the standard agreements that accompany the release of materials from CGIAR genebanks.[12]

25. As noted above, most international exchanges of germplasm between breeders and researchers have hitherto been carried out on an informal basis. Until recently, governments have, for the most part, exercised little or no control over the exchange of genetic resources, particularly for major food crops. Countries have generally permitted collecting missions on the condition that their own scientists participate and that duplicate samples of collected material (and related information) are provided for storage at a local facility. Despite growing restrictions, the practice of free exchange is still observed by many national genebanks in industrialized and developing countries. The CGIAR Centres have also followed a policy of allowing unrestricted access to the plant genetic resources in the in-trust collections.

26. Bilateral arrangements have long been common in industry, typically through the use of formal contracts such as material transfer agreements (MTAs) which govern the exchange of genetic resources. There are also bilateral exchange agreements between governments, for example the agreement between Brazil and Malaysia to exchange rubber.[13] Nonetheless, the use of MTAs in public sector exchanges is a recent phenomenon and still relatively rare. They are usually signed when genetic material is exchanged as part of a collaborative research programme.

Characteristics of Multilateral and Bilateral Approaches

27. The international exchange of genetic resources is inherently beneficial, whether it be carried out on a bilateral basis or within the context of a multilateral effort. The bilateral approach has characteristics that make it preferable in particular situations but less suitable in others where a multilateral approach might be more appropriate. The particularities of these two broad approaches to exchange are described below with examples of the circumstances where they might be more or less appropriate.

Bilateral approaches

28. The limited focus of bilateral arrangements may allow partners to reach agreement and deliver results more quickly than is possible within the context of a larger partnership. A comparatively rapid turnaround might be suitable in situations where, for example, the speed of product development confers a competitive advantage.

29. Bilateral arrangements often have the advantage of flexibility; their structures, rules and goals can be modified easily and quickly to respond to changing needs.

30. A bilateral agreement can be tailored to the needs and circumstances of the parties and can deliver targeted and highly focused results. Partners collaborate because of their shared objectives and are able to exploit their respective comparative advantages without risk of diluting their efforts through the need to collaborate with partners that have less in common.

31. Bilateral partnerships can be created for specific purposes and then dissolved, without the need for permanent institutional structures. Thus bilateral arrangements may have lower overhead costs than multilateral approaches to exchange.

32. As they are limited to two partners, bilateral arrangements offer far greater confidentiality than is generally possible with multilateral arrangements. They are thus well suited to maintaining the secrecy that may surround the development of certain products, or when proprietary information or technologies are shared.

33. Bilateral arrangements offer opportunities for developing specific research partnerships and training activities.

34. Bilateral arrangements can be used to ensure safe conservation, when, for example, one genebank arranges with another to hold a duplicate set of material.

35. In cases where the characteristics of a sample are known in advance (e.g. as a result of local or indigenous knowledge, or an earlier screening), direct bilateral negotiations between the holder of the germplasm and the recipient may be the most efficient and appropriate means of allowing access on mutually agreed terms.

36. In the search for naturally occurring chemicals for pharmaceutical use, access to species and genetic diversity might best be gained through bilateral agreements with species-rich countries.

37. In general, the more specific the bilateral exchange arrangement, the higher will be the transaction costs per sample exchanged.

Multilateral approaches

38. Multilateral approaches offer opportunities for developing common and cost-effective conservation strategies, and for coordination and mutual support among partners.

39. A multilateral approach offers participants access to a far greater range of germplasm than is generally possible in bilateral arrangements. Thus multilateral arrangements are preferable for crops with wide geographical distribution. This advantage is even greater if one considers multilateral agreements covering a range of crop species.

40. Multilateral approaches are likely to provide greater opportunities for exchanging and screening genetic resources than bilateral arrangements. The evaluation of data from a large number of environments leads to a better understanding of the properties of the exchanged material, adding significantly to its value and increasing the chances that it will be used.

41. A multilateral system can provide greater opportunities for pooling efforts on characterization and evaluation.

42. Multilateral approaches provide access to a wider range of information than is available bilaterally and offer opportunities to use information cost-effectively, avoiding duplication and unnecessary expense by sharing databases, for example.

43. Multilateral arrangements have proven to be highly effective in fostering a supportive climate for innovation, as well as in promoting collaborative research and providing training opportunities at a wide range of specialized institutions. In the case of multilateral arrangements, these benefits are less likely to be directly linked to the provision of access to specified germplasm.

The Scenarios: Tailoring the Approach to Fit the Exchange Situation

44. Bilateral approaches may be most appropriate when a small number of countries have, or need access to, the genetic diversity of a particular species or group of species, and/or when highly expensive and specialized research gives a strong competitive advantage to a single or limited number of institutions. Such conditions may prevail in the case of some industrial crops, for example rubber, and in certain sectors, for example pharmaceuticals.

45. Exclusively bilateral arrangements are likely to be extremely complicated in the case of staple food crops, given the large number of potential actors (and hence individual agreements) involved, the complex pedigrees of crop lines (and hence the difficulty of assessing and apportioning benefits) and the limited capacity of many partners to be able to negotiate favourable terms. Such arrangements at any rate are not likely to yield significant financial rewards given the difficulty — or impossibility — of capturing such benefits in situations where the material is in the public domain and seed is largely produced on-farm and disseminated among farmers, as in the case of most staple food crops in developing countries (an exception being hybrid varieties)[14].

46. Multilateral approaches may be most appropriate in situations where individual countries harbour only part of the genetic variability (i.e. the total genepool) of interest, and/or when farmers and professional breeders in many countries need access to a wide range of genetic resources. They may also be preferable when there is a high social stake in successful crop improvement and when the pooled efforts of many are likely to be more effective in promoting improvement than the efforts of a few. These conditions prevail for the majority of staple food crops.

47. The release of materials from genebanks is easier and more cost-effective if standard conditions can be applied to their acquisition and distribution. While it would be possible for genebanks to negotiate the terms of acquisition and release bilaterally, they might be forced to turn down materials if it were not possible to reach agreement on terms that they might apply and enforce relatively easily. A better approach, from the perspective of most national and international genebank staff interviewed in the preparation of the IPGRI studies, would allow the negotiation of multilateral agreements concerning standard terms and conditions covering the exchange of materials held in partner genebanks.

The Options

48. This report considers three broad models for genetic resources exchange systems: bilateral, network-based and global.

49. As noted above, recent global trends and policy shifts are tending to promote a slow drift towards bilateralism as more and more countries seek to assert their sovereign rights over indigenous germplasm. In absence of broader agreements governing the terms of exchange, it is possible to imagine a "system" within which arrangements for exchange and cooperation only take place bilaterally. However, given the complexity and probable high costs of individual transactions *(see Section Two on transaction costs, below)*, it is unlikely that an exchange option based purely on bilateral agreements would prevail for long, as countries came to recognize the benefits of forging wider partnerships based on shared interests.

50. The probable result would be the evolution of a limited multilateral approach involving a number of countries or institutes in networks based on regional or crop-based interests. Indeed, strong regional alliances are already beginning to emerge. Within these networks,

members might agree to exchange material on terms and conditions agreed amongst themselves. The qualitative benefits of multilateral exchange, such as access to a wider range of germplasm than is available in any one country and access to improved material, technologies and information, would be limited to those available within member countries. Costs of collecting, conservation, training and technology development might be shared by network members, reducing the burden on any one country. Exchanges with non-members might take place according to bilateral agreements only, or on some other agreed basis.

51. The third option would be to establish a global system for multilateral exchange. This is the so-called MUSE option, treated at length in the IPGRI study, "*Access to Genetic Resources and the Equitable Sharing of Benefits*"[15]. Such a system would retain the strengths of the current informal alliance-based approach to exchange. It would, however, be adapted to recent policy trends and developments and would avoid the problematic aspects of the current approach, described above, by formalizing the rights and obligations of all members. In this regard, the global exchange system would inevitably require the establishment of certain mutually agreed principles to determine – among other things — the scope of the system and the basis for exchange of material contained within that scope. The exchange principles would set the framework for the global system.

52. While it appears that a basic framework is fundamental to the establishment and effective function of a global exchange system *per se*, the specific characteristics of the system would wholly depend on the definition of its scope and exchange principles *(See Annex for an analysis of scope options)*. In fact, there are a number of approaches to composing a global system, any of which might be accommodated within the basic framework. For example, the agreed exchange principles might apply equally to all materials in the system, or they might vary according to the category of crop. The latter case could allow for the existence of bilateral arrangements within the system to cover particular categories of crops (e.g. pharmaceuticals) or under certain circumstances (typically when there are prospects for commercialization).

53. Consideration might also be given to including a fund within the global exchange system as a mechanism for financial compensation in return for access and in recognition of Farmers' Rights. Compensation through the fund might be linked to one or more categories of crops contained within the scope of the system.

54. As noted above, the establishment of a global exchange system, whatever its composition, would require agreement on exchange principles and scope. In addition, it would likely require rules and procedures governing participation in the system. This might involve countries becoming party to an intergovernmental agreement governing conditions of membership, terms of access to genetic resources, mechanisms for sharing benefits among participants, and relationships with non-members.

55. Given the important role of all genetic resources stakeholders in conservation and use – as emphasized by the CBD — the framework for the global exchange system would ideally be flexible enough to allow the participation of non-government members such as private institutions, NGOs, farming and indigenous communities, etc. Conditions for such membership would need to be set by the host country of the participating institute or organization whose responsibility it would be to determine how to implement and enforce these conditions at the national level.[16]

Bilateral Benefit-sharing within the Context of a Global Exchange System

56. If it were decided to accommodate bilateral arrangements within a global exchange system, an original provider of germplasm would enter into negotiations with a recipient for an appropriate share of benefits. This might take the form of access to a commercialized product

derived from the germplasm, or to technologies, royalty-free or on special terms, access to facilities, training or other services, or an appropriate share of royalties or profits arising from the product.

57. Negotiations between a germplasm provider and recipient on benefit-sharing — including whether or not to share benefits – might arise at various points as a product is developed from the material. The timing of the negotiations would require careful consideration as the value of the provided germplasm may be assessed differently at the various stages of product development.

58. Bilateral benefit-sharing arrangements would in any case be subject to practical difficulties and some costs *(see below)*. Negotiating an appropriate share of financial benefits, for example, would require evaluating the contribution of the provided germplasm to the market value of the new product. This is a tremendously difficult and complex process and may, in some cases, require protracted and costly arbitration.

59. The concept of 'commercialization' would itself need careful definition in the context of negotiations on benefit-sharing. Should it refer to all sales or just the sale of seeds? Would it only cover those sales intended to bring profit? What about sales made on a concessional basis in a highly subsidized seed production and marketing situation, as is often the case with government-bred varieties in developing countries? What about situations where a new product is not sold but bartered for goods and services?

60. Another significant issue needing resolution is the extent to which benefit-sharing obligations would be transferred through a chain of varieties. Would the obligation stop with the first release? Would it thereafter be transferred to the breeder of a new variety bred from the first, thus transferring the obligation to share benefits through successive varieties, with the actual share of benefits decreasing as the original germplasm came to constitute an ever-decreasing proportion of the ancestry of the new varieties produced?

61. According to UPOV rules, released varieties can be used as parents of new varieties bred by others without authorization from the original breeder, providing the new variety differs sufficiently from the original (the so-called Breeders' Exemption). The principle of carry-over obligations, if accepted within the context of a global exchange system, would thus introduce a principle that is not required under UPOV rules.

62. One way to simplify matters might be for system participants to agree to consider bilateral benefit-sharing only when a commercialized variety, or a single gene or gene-construct derived from the introduced material, comes under intellectual property protection. However, if such an agreement were to include Plant Breeders' Rights as well as patents it still would not resolve the problem of the Breeders' Exemption addressed above. The simplest way around this would be to allow bilateral benefit-sharing only in the event that a user were to take out a patent on the product developed from the material. In this case, it might be possible to introduce regulations requiring that all applicants filing for a patent identify the provider of genetic material from which a patent was derived or a variety developed, thereby providing a simple tracking mechanism. At the same time, since other forms of intellectual property rights (notably Plant Breeders' Rights and Trade Secrets) are commonly used by the seed industry, this approach would considerably limit opportunities for the bilateral sharing of benefits.

63. The difficulties involved in evaluating benefits fairly late in product development raise another potential problem. Companies might not support a requirement to negotiate benefit-sharing late in the research and development process (e.g. after a patent application has been submitted) if this would offer providers the chance to withhold their ultimate consent to commercialization, thus jeopardizing the investments already made. One option would be to

determine a range of minimum and maximum levels of benefits — binding on all members — that would apply if provider and user were unable to reach an alternative agreement.

Section Two: Transaction Costs Relating to the International Exchange of Genetic Resources

64. There are a number of basic elements of exchange that will be common to all three of the broad system models considered in this report — bilateral, network-based and global. These relate to fundamental operations such as collecting and conservation which are prerequisite to exchange. The relative costs of these operations are unlikely to vary significantly according to system model. However, the question of who pays for them might well differ among models. In addition, a network-based or global exchange system might include certain elements that would not be necessary or appropriate in bilateral transactions and *vice versa.*

65. This section will identify a number of these elements and attempt to assign costs to them. In general, the more parties that are involved in an endeavour — be it germplasm conservation, exchange or breeding — the more widely the costs can be shared, thus reducing the burden on individual parties. Likewise, in the case of regional networks and global exchange arrangements, the broader the scope of the systems, i.e. the wider the range of material they cover, the lower will be the transaction costs to individual members.

66. The elements that might be included in a system (or systems) for access and exchange — subject to agreement by participants — cover a wide range of operations. These include:
    - collecting
    - conservation
    - regeneration
    - multiplication
    - distribution
    - global information network
    - negotiating exchange agreements
    - tracking and monitoring use
    - enforcing agreements, including litigation costs
    - establishing a secretariat office
    - establishing criteria and managing a compensation fund
    - negotiating terms of international and national agreements.

67. Individual element costs are detailed below. It should be noted that, given the variable and uncertain nature of many costs, the figures presented herein are best used comparatively for approximating the costs of alternative exchange models.

68. The letters H, M and L (High, Medium and Low) refer to a subjective assessment of the precision of the cost estimates provided. All figures are presented in $ US.

Collecting

69. Collecting is estimated to cost between $ 10 and 30 per accession (M).[17] These costs relate to a relatively straightforward mission where seed is collected in a fairly accessible area. Vegetatively propagated crops, such as roots and tubers, are likely to be more expensive to collect. Likewise, targeted missions undertaken in remote areas might yield fewer accessions at greater expense, thus increasing the relative cost per accession.

70. Global food security largely depends on a very few crop species, with three crops — wheat, rice and maize — providing more than half of the world's plant-derived energy intake. Other major crops — such as sorghum, cassava, millet and potatoes — are essential to food security

at regional and subregional levels, particularly for resource-poor people. For example, cassava supplies over 50% of plant-derived energy in Central Africa, although at the global level the figure is only 1.6%.[18] Given the importance of a relatively small number of crops for global food security, it is particularly important that the diversity within major crops is conserved effectively and available for use.

71. While the genetic diversity of the major food crops has generally been well collected, not all of these are equally well represented in genebanks. More than 40% of all accessions in genebanks are cereals, for example, not surprising as these are relatively easy and inexpensive to collect as seed. Wheat alone accounts for 14% of total *ex situ* holdings (over 500 000 accessions)[19] and it has been estimated that 95% of wheat landraces and 60% of wild species have been collected.[20] Even so, there remain gaps in global holdings of wheat and other cereals.

72. The collecting of other major crops has lagged far behind that of the cereals, particularly for those which present collecting difficulties. For example, just 35% of cassava landraces and 5% of wild species are represented in collections globally.[21] Only 28 000 cassava accessions are found in genebanks, amounting to 5% of global holdings. Cassava is a vegetatively propagated plant whose bulky size precludes collecting in any great quantity at any one time or requires the use of alternative approaches such as *in vitro* collecting methods.

73. In addition, a larger group of “minor staples” are important from a local, national or regional perspective. These include various species of yam, fonio, bambara groundnut, etc. The State of the World’s Plant Genetic Resources reports that minor crops are at present very underrepresented in collections and identifies the need for further collecting, with a focus on indigenous landraces, minor crops and other underutilized species, especially crop wild relatives.[22]

74. The Global Plan of Action identifies collecting as a priority activity. It notes that past collecting missions conducted with inadequate methods may not have successfully sampled diversity. Conditions in genebanks also may have led to the loss of materials, leading to a need for re-collecting. In some cases, collecting is needed to rescue materials under imminent threat. In others, clear utilitarian needs – for disease or pest resistance or other adaptive characteristics – make further collecting warranted.[23]

75. No information exists on the total global investment on collecting over the years, let alone the proportionate cost that has been borne by individual countries or shared between two or more partners. Yet it appears that a large part of the collecting that has occurred to date – especially of major food crops —has been funded multilaterally, for example through the CGIAR system or through collaborative missions undertaken — and supported — within the context of crop and / or regional networks. With the sole exception of maize, the world’s largest collections of major crops (wheat, rice, potato, cassava, banana / plantain, sorghum, yam, sweet potato, chickpea, lentil and *Phaseolus*) are held by the Centres. While at least 50% of these collections consist of donations from countries, the system has spent an estimated $9 million on collecting since 1974.

76. Both a global exchange system and a network-based approach could enable collecting costs to be shared on a multilateral basis. For major food crops, grown in many countries around the world, and others whose diversity stretches across regions, such an approach might be the only means of capturing the total range of diversity. The fact that gaps in current collections appear to relate particularly to those which are relatively more expensive to collect might serve as an additional incentive for countries to collaborate multilaterally on collecting.

77. In the case of a system based entirely on bilateral relationships, collecting costs would presumably be borne by the country concerned or bilaterally. Safety-duplication of collected material, another activity that has often been supported multilaterally, would, in all likelihood, become the responsibility of the source country and / or of its bilateral partner. A lack of data

precludes a comprehensive assessment of the degree to which collections have been duplicated for safety although the Report on the State of the World's Plant Genetic Resources does provide an indication. About half of the countries submitting country reports, it notes, provided information on the safety-duplication of their collections and of these, only 15% reported that their collections (436 000 accessions in all) had been duplicated.[24]

Conservation

78. Conservation costs reported below refer to orthodox species, i.e. seeds that can tolerate drying and storage at low temperatures. Included are the costs of seed preparation, testing (viability and health), packaging and operating costs of the storage facility (e.g. staff, electricity). Non-cold tolerant and vegetatively propagated materials are many times more costly to maintain and, perhaps because of this, are only a small percent of total holdings and so have a limited effect on the numerical average.

79. Annual variable costs are estimated to be in the range of $0.52 per accession (L) for storage expenses, primarily electricity[25]. Facility costs (overhead and equipment) vary widely according to the location of the genebank, its age and other factors and so are not included here. Using the base figure of 6.1 million accessions stored in *ex situ* collections, global conservation costs amount to $3 172 000 per year.

80. While there is a large — and growing — number of genebanks financed by the host national government, significant existing collections, including those housed in the genebanks of the CGIAR, have traditionally been supported by bilateral or multilateral funding. A number of national genebanks have been established and supported with multilateral funding and important regional genebanks, such as that which serves the Nordic countries, have been funded by a number of countries collectively and, in some cases, have substituted for national facilities.

81. A global exchange system would facilitate the sharing of conservation costs and responsibilities among members, thus easing the burden on individual countries. It would allow a rational approach to conservation based on collaboration, and would promote full use of appropriate existing national, regional and international facilities, one of the objectives of the Global Plan of Action.[26] This would be of particular benefit to poorer countries which, while they might be in a position to contribute relatively larger amounts of germplasm to the system than many of the wealthier nations, may not be able to carry the burden of conservation alone. Such a system would also provide members with access to an enormous range of germplasm (including improved materials) – far more than they contribute individually and more than they could hope to gain from simple bilateral or network-based exchanges. This in turn would probably lead to the increased likelihood of germplasm being used, as it would be more thoroughly evaluated and readily available to a wider range of potential users.

82. A regional or crop-based network approach to exchange could reduce conservation costs to individual members by allowing the establishment of genebanks serving the conservation needs of a region or by housing particular crops on behalf of others. Scientific institutes have long cooperated on this basis. Rules of procedure guide the activities of participants within many such networks but they are not standardized across networks and may differ greatly with regard to their requirements in terms of access and benefit-sharing.

83. The establishment of common guidelines and principles within the context of a global exchange system would not necessarily eliminate the need for network-specific rules to cover many of the operations within networks. However, it is likely that it would promote and facilitate greater cooperation between networks with interests in similar crops, eco-regions,

conservation methodologies, etc. Indeed, if common rules were developed, applying to all members of the global system, it is possible to envisage collaboration among almost any groupings of institutions.

84. An exchange system based solely on bilateral relationships would place the burden of conservation costs on the nation concerned. Donor agencies might continue to be willing to contribute to meeting these costs. It is likely that many countries would not be in a position to meet their conservation needs themselves without significant financial investment. In some, perhaps many, cases, countries would not only have to bear the costs of storage and curation, but would find it necessary to invest heavily in infrastructure and equipment as well.

85. According to the Report on the State of the World's Plant Genetic Resources, most countries do not currently have facilities for the long-term *ex situ* conservation of plant genetic resources. A large number of national genebanks were built in the 1970s and 1980s, apparently without sufficient provision for ongoing financial support. Some of these genebanks have now closed and others are in a state of deterioration. The Report notes that "there are many...(genebanks)...that are perhaps incapable at present of performing the basic conservation role of a genebank".[27] It is fairly clear that ensuring a nation's capacity to meet its obligations under the Convention on Biological Diversity and the Global Plan of Action will be a costly business and the recovery of costs through bilateral mechanisms is unlikely to be sufficient to eliminate the burden on poorer countries.[28]

Regeneration

86. Regeneration costs for maintaining seed viability may range from $50 to 350 (M) per accession; the regeneration of other forms of propagating materials could cost many times more. The actual cost per accession depends on the handling required and whether there is a need for specialized facilities like screenhouses for isolation and pollination, greenhouses, heating/cooling, etc.[29] The location of the genebank would obviously be a factor as well since regeneration costs are affected by the costs of labour and equipment and these vary greatly from country to country.

87. The regeneration of germplasm is critical for the safe and effective management of *ex situ* collections. If one assumes the regeneration cycle to be 25 years or more on average, routine annual regeneration needs would amount to 4% or less of the collection. (Strictly speaking, regeneration for conservation is only needed every 50-100 years; however, it will be required far more frequently if there is significant demand for distribution). But inadequate facilities and a lack of financial and human resources have limited the regeneration of stored material with the result that some 95% of the countries submitting information on regeneration during the process leading up to the International Technical Conference reported a far higher level of need, in some cases reaching 100%. According to the Report on the State of the World's Plant Genetic Resources, this is due to a number of factors, including poor storage conditions, lack of funds or facilities for regeneration, poor management or a combination of these factors. Furthermore, most countries report that they have difficulty regenerating their material, pointing to a need for support and capacity-building. FAO estimates that as many as one million accessions may be in need of regeneration.[30]

88. A global exchange system would provide a formal structure for addressing the development of world-wide regeneration strategies, targeting accessions and identifying locations for regeneration, completing agreements needed to formalize cooperation, improving capacities and infrastructure and initiating action to regenerate targeted accessions. One of the key objectives of the Global Plan of Action is to complete the first world-wide regeneration of accessions in *ex situ* storage. The Global Plan notes that such an activity will require cooperation among governments, the private sector, institutions and NGOs.[31]

89. In the case of an exchange system based on bilateral arrangements, responsibility for regeneration would most likely fall solely to the country housing the material. It is impossible to predict the costs of such an operation owing to the variable costs of regeneration but, given the level of need, particularly in developing countries, it is likely that the greatest cost burden would fall on those countries which are least able to afford it.

Multiplication

90. Regeneration is a conservation function while multiplication is carried out to ensure sufficient stocks for distribution. While conceptually distinct, these activities are often carried out simultaneously with the result that it is difficult to provide reliable separate cost estimates. Nevertheless, it appears that average multiplication costs run to approximately $2.00 per accession (L), although the costs are highly variable by crop. The costs of multiplying vegetatively propagated species, for example, are considerably higher.[32]

Distribution of Samples

91. The figures presented below are basic "order filling" costs only and would be greater if additional services such as identifying supply sources were included. They do not include costs associated with quarantine procedures. Costs are calculated from aggregate cost figures, divided by number of accessions. Many costs are unit charges per shipment and thus depend on the number of accessions per shipment. *In vitro* materials must generally be sent by courier, making them significantly more costly to distribute.

92. Distribution costs are broken down as follows:
postage: $0.25 / accession
phytosanitary permits: $0.50 / accession
total: $0.75 / accession (M)[33]

93. Approximately 800 000 accessions of food crops are distributed each year: 650 000 by the CGIAR system (of which 500 00 are genetically enhanced lines and 150 000 are drawn from the in-trust collections) and an additional 50 000 by national programmes. Currently, the costs of multiplication and distribution are typically paid by the germplasm supplier. At the present time, these costs — amounting to some $1 600 000 per year for multiplication and $600 000 for distribution – are largely shared multilaterally because a significant proportion of genetic resources for food and agriculture are currently sourced from the CGIAR Centres. In an approach to exchange governed by bilateral relationships, either the supplier country, the recipient, or both would bear the costs of the two activities. These costs would probably not be particularly burdensome: on average, any one country today receives only several thousand accessions annually and this amount could well be reduced, as the complexity of bilateral arrangements would tend to limit exchanges. In a network-based or global multilateral system, distribution costs could either be paid by suppliers or recipients or shared among members.

Global Information Network

94. According to the Report on the State of the World's Plant Genetic Resources, much of the plant genetic resources held in *ex situ* collections are insufficiently and / or poorly documented. Some countries have fully computerized documentation systems and reasonably complete data on the accessions held in their national collections. Many countries report partial or ongoing efforts to computerize their documentation systems. A large number of the country

reports prepared in connection with the International Conference and Programme on Plant Genetic Resources note the need for improved documentation systems that are integrated and compatible, thus allowing for easy exchange of information.[34]

95. A global exchange system would promote the establishment of linkages and broad partnerships among system members. This would provide a foundation for the development of a global information network which could provide members with current data on the availability (with characterization and evaluation information) of germplasm on a world-wide basis, as well as on requirements for access. Additional information of value to members would become available as a result of activities such as screening trials conducted by germplasm recipients, and jointly conducted multilocational trials and this could be shared through the network as well. Such a network could provide the basis for responding to the needs expressed by many countries and highlighted in the Report on the State of the World's Plant Genetic Resources. It also might provide a mechanism for implementing one of the priority activities of the Global Plan of Action which involves constructing comprehensive information systems for plant genetic resources for food and agriculture.[35]

96. In the case of international and national programmes with current and complete data on their germplasm holdings, costs would be associated largely with data clean-up and ensuring the compatibility of information systems. In other cases, it might be necessary to develop or improve national information capacities and systems and to gather the data required to ensure that these are comprehensive. Many countries simply lack information on the accessions in their own collections.[36] The costs of such an exercise are difficult to estimate but are likely to be substantial. However, were these costs to be shared within the context of a global exchange system, the burden on individual countries could be substantially reduced.

97. In the first instance, it might be advisable to begin the development of a global information network by creating linkages between the information systems in those countries and institutions that have fully computerized documentation systems and reasonably complete accession data. According to information gathered by the CGIAR's SINGER project, approximately 50 countries fall into this category. SINGER provides an indication of the costs that would be involved in establishing the basis for the network. The project has to date invested approximately $1 800 000 to clean up the data files at the CGIAR genebanks and to provide hardware and other infrastructure. Carrying out this process for 50 genebanks could take up to 10 years and cost on average $50,000 per institution. Costs might be reduced by having major centres serve as data file hosts for some national depositories. High-speed Internet access for some countries will be very expensive to establish and maintain; these costs are not included in the estimates.[37]

98. The development of regional or crop-based information systems could take place within the context of an approach to exchange based on networks. Indeed, many such systems already exist. The costs associated with establishing regional or crop information systems would vary depending on how many countries were involved and the type of information they would contain.

Negotiating Exchange Agreements

99. There are a number of options for agreements that might be used to govern exchanges within any of the system models described in this report. For example, an agreement between two countries or institutions might cover a single shipment or exchange of germplasm. Likewise, a bilateral agreement might be used to govern all germplasm transfers of a single species or a group of species, or to establish the legal basis for subsequent transfers of all species between the two parties to the agreement. A multilateral agreement amongst a limited number of parties, for example within the context of a network, could specify the terms of exchange for a

single species (this would normally be the case within a single crop species network) or a number of species (as would occur within a network working with, for example, cereals or forages). A limited multilateral agreement could also cover all germplasm transfers among signatories, for example, members of a particular regional network. Finally, a “global” exchange agreement might cover one or a group of species or all germplasm transfers amongst the parties.

100. In general, the more complex the exchange agreements, the higher the negotiating costs and the broader the agreement, the lower the overall costs will be, as there will be a need to negotiate fewer agreements. It is calculated that negotiating costs would range from $100 for a simple agreement to $1000 for a complex agreement involving, for example, several species or countries.[38] Standard use agreements, such as those presently used by the CGIAR, would involve no costs associated with individual exchanges, once the initial agreement has been established.

101. In an exchange system governed by strictly bilateral agreements, it is likely that these agreements would most often take the form of either customized versions of standard agreements or more complex material transfer agreements. Assuming the same level of annual exchange as occurs presently, global negotiating costs could range from $8 to $80 million per year. The cost to an individual country would, of course, depend on the number of countries with which it wishes to negotiate agreements, the amount of material it wishes to access and the complexity of the agreement it decides to use.

102. While it would be quite possible for countries or institutes to draft standard agreements governing their exchange with bilateral partners (as in the case of the Brazil-Malaysia agreement covering the exchange of rubber)[39], these would – at least to some extent — have to be standardized per partner and, most likely, per species. If a country wished to have access to species with a wide distribution of genetic diversity, as is the case with most major food crop species, this might involve the negotiation of a large number of agreements with numerous countries. For example, the world's largest and most complete collection of rice – located at the International Rice Research Institute (IRRI) in the Philippines – comprises more than 80 000 samples from 111 countries. The collection includes, among others, 8454 samples from Indonesia, 799 samples from Sierra Leone and 849 samples from Brazil. For any one country to have access to the same range of rice diversity through bilateral arrangements, it would be necessary to conclude agreements with 110 countries.

103. In multilateral exchange systems, the transfer among members of material within the scope of the system would be according to the terms of a standard intergovernmental agreement (or agreements if different categories of materials requiring different treatment are included) and so would not entail cost beyond that of negotiating the overall multilateral agreement or agreements. An MTA would probably be required for exchanges of material not covered by the scope of the system (s).

104. Transfers by members to non-members would presumably be permitted; these might require the non-member recipient to sign a standard MTA and to abide by its terms. Multiple transfers of the provided material could thus result in a ‘chain’ of MTAs with identical terms and linking every subsequent user with the original provider and thus provide a system for monitoring use[40]. New material would presumably only enter the system if the provider is willing and able to make it available under the standard terms contained in the intergovernmental agreement.

Tracking and Monitoring Use

105. In many situations and perhaps particularly in the case of germplasm exchanges governed by bilateral agreements, providers will need to monitor the use of their genetic resources as a means to identify infringements and thus to enforce the terms of release. While monitoring use is not an easy task, and may ultimately be impossible in many situations, there are ways in which it can be facilitated. Some possible tools – and their costs — are described below.

106. Identical genes may be found in more than one source and, given the small size of individual germplasm samples needed, it is difficult, if not impossible, to monitor the origin and use of the full range of material used in crop improvement programmes. For these reasons, any system for monitoring the use of genetic resources will inevitably have to rely to a large degree upon the methodical records and honesty of breeders.

Limited tracking

107. The costs for limited tracking and monitoring of materials are uncertain. Such an effort might involve tracking use through commercial channels (perhaps aided by other contract users who do not want the commercial disadvantage of competing with a firm which may not be paying agreed royalties). Experienced professionals indicate that costs vary according to the kind of material in question; greater efforts can be justified for more valuable than for less valuable materials. The simplest form of tracking (e.g. visiting nurseries of contracted firms) would apply only to materials observable by phenotypic characteristics, or variety name. Anything incorporated in a breeding programme would likely need a more sophisticated tracking system.

108. The costs of a limited-scale effort to track material as above can be calculated at about $1800 (L) per agreement. The cost is based on an assumed 2% time commitment per agreement for a professional compensated at a level of $90,000 per year.[41]

Systematic tracking

109. Another tool for monitoring use involves the application of molecular and chemical techniques such as genetic fingerprinting. These techniques would facilitate the comparison of genetic materials and could allow providers to determine with a reasonably high degree of probability whether suspected products were derived from material originating from them. However, these techniques need further development before they can be used routinely and, at least at present, they are inordinately costly to use on a routine basis.

110. For simple techniques in medium-income developing countries, variable chemical and personnel costs are estimated at $170/accession (L). If it were necessary to build a molecular biology laboratory, capital expenditures would add $300 000 - 500 000. More sophisticated techniques would cost $500/accession (estimated in the USA). For heterogenous samples (like many landraces and non-domesticated relatives), multiple individuals must be tagged, raising costs 10-to 20-fold[42]. These figures do not include the costs of tracking once the materials have been tagged; these would presumably in the order of the $1800 figure cited above for preliminary identification of possible infringements. Added to this must be the cost of the molecular analysis of the suspected samples.

111. These preliminary estimates, as limited as they may be, do indicate that universal fingerprinting of plant genetic resources for bilateral benefit-sharing requires an enormous investment, even if technical feasibility problems could be overcome. Total investment to mark just the materials presently held in the CGIAR in-trust collections would run from $102 million (using simple techniques) to $300 million (using more sophisticated techniques). As above, tagging heterogenous samples would increase costs considerably. In effect, the costs

of marking and tracking the provided materials would exceed the market value of all but a handful of plant genetic resources. This situation could change in the future with technological breakthroughs.

112. As the above figures indicate, the costs of tracking and monitoring the use of germplasm are formidable. In an exchange approach based on strictly bilateral arrangements, these costs and those associated with the development of complex MTAs and litigation (see below) could induce countries to limit their exchange of genetic resources with the consequent negative impact on development.

113. A multilateral system of exchange, whether network-based or global, would have lower costs associated with monitoring, assuming that the majority of exchanges are carried out on the basis of standardized agreements which would not require use monitoring or if a tracking system were adopted linked, for example, to the award of patents *(see above)*.

Enforcing Agreements, Including Litigation Costs

114. Conflicts will arise periodically when the terms of exchange agreements have not been honoured or when there is disagreement about whether payment is required for genetic resources and how much. Two basic approaches exist for settling such conflicts: litigation and arbitration. Cost estimates vary according to where the proceedings are held, the type of arbitration proceedings (size of panel; whether the proceedings are conducted in person or by correspondence)[43] as well as the complexity of the issue. There is also often a direct association between the amount of the claim and the amount of money that the parties are willing to spend.

115. In the case of litigation, typically costs amount to $150 000 to prepare a case, $300 000 to go to court (in the USA), plus staff time, but can they can rise to and beyond $1 000 000[44]. Most patent (98-99%) and Plant Breeders' Rights (>99%) cases are settled before trial.

116. Arbitration costs are variable owing to the range of choices in structure, organization and location. In the USA, proceedings typically cost $2000 - 5000. Published cost components indicate that the possible range of costs of international cases (based on an award of $100 000 - 250 000) are in the order of:

Filing Fee	1 000
Arbitrators Fee	12 000
Arbitrators Expenses	4 500
Administration Exp.	4 000
TOTAL	21 500[45]

In the case of a network-based or global approach to exchange, the members could administer their own arbitration system or hire an established body, such as the International Chamber of Commerce, the American Arbitration Association, or the World Intellectual Property Organization. The UN system has its own arbitration system for contract disputes which follows the provisions of the UN Commission on International Trade Law.

Establishing a Secretariat Office

117. A small secretariat would likely be required to ensure the effective management of a global exchange system. An information service could also be established to serve the needs of members by, for example, providing centralized access to information and producing and/or distributing other materials such as newsletters, journals and abstract bulletins. The secretariat and information service could either be attached to an existing organization or could operate through a dispersed system by which individual institutions would agree to provide specific services, perhaps in return for certain concessions, such as a reduction of membership fees if it were decided to levy such fees.

118. If a secretariat were to be housed in an existing organization, such as FAO, annual costs would be in the order of $250 000 (M) per year (this includes the costs of two professional and one support staff). This is likely to be the minimum required to effectively manage a global exchange system.

Establishing Dispersion Criteria and Managing Distribution of a Compensation Fund

119.The establishment of a fund within the context of a global exchange system would require decisions on such matters as its establishment, governance, replenishment and disbursement. Special consideration would need to be given to developing mechanisms and guidelines for allocating the funds and, in particular, for ensuring that farmers and local communities receive adequate compensation. These issues are currently under discussion in other fora and therefore are not covered at length here except with regard to the potential costs of administering (but not assembling) a fund.

120.The establishment of a fund would require a transparent process for the equitable distribution of monies. Administering the fund is likely to require high-level meetings to decide on its allocation, as well as mechanisms for the actual administration of disbursements. Several alternatives are possible; for example, transfers might be made to national governments based on a quantitative standard or there might be a more complex disbursement programme, possibly including the transmittal of funds directly to local communities. The second approach would be more expensive to administer.

121.The costs of actually administering the fund would depend on the size of the secretariat so tasked. Assuming a secretariat consisting of two professional and one support staff, the costs would amount to $250 000 annually as above. Were it desirable to establish a board to consider policy or technical issues, costs might amount to $100 000 per meeting (assuming 25 members)[46]. It might be necessary for such a board to meet more than once a year.

Negotiating Terms of Intergovernmental and National Agreements

122.The policy basis for a global exchange system would be set by general principles established in the CBD. The system could operate according to standard rules set out in an intergovernmental agreement. These rules would provide formal clarification – and protection – of the rights and obligations associated with the exchange of plant genetic resources under the terms of the CBD and the revised International Undertaking.

123.In accepting the terms of such an agreement, members would agree to collaborate and to operate according to standard rules governing conditions of membership, terms of access to genetic resources, mechanisms for sharing benefits among participants, and relationships with non-members. The subsequent governance and monitoring of the system, including responsibility for revising the rules to meet changing needs, would rest with government members

124.Major international meetings – such as might be needed to negotiate an intergovernmental agreement — cost about $500 000 (H) for consultations, documents, translation, etc., including costs for assisted country delegates. Not included are the costs of delegates covering their own expenses, and staff time. If a session were to be held in conjunction with, for example a meeting of the FAO Commission, then costs would decline by about one-third ($330 000) (M).[47]

125.The agreement would also have to consider issues relating to membership or participation in the system by both governments and non-government institutions, including the private sector. It would seem most appropriate that conditions for non-government membership be set by the host country of the participating institute or organization, whose responsibility it would be to determine how to implement and enforce these conditions at the national level in accordance with national policies and legislation. Governments might, for example, allow interested parties to join the system by entering into an agreement at the national level or with the system as a whole. The latter option might apply for institutes and organizations located in non-member countries or for international organizations such as the CGIAR.

126.The costs of determining national policy regarding non-government membership and of developing a mechanism for implementing such policy are not estimated here.

Conclusions

127.Three broad system models are considered in this synthesis report: a system based on strictly bilateral approaches to exchange, a limited multilateral or network-based approach and a global system for multilateral exchange. Any one of these models could provide a basis for the exchange of plant genetic resources and the equitable sharing of benefits. Each has particular characteristics which may make it suitable in some circumstances and less so in others. For example, it appears that a strictly bilateral approach to the exchange of major food crops might require the establishment of a large number of more or less complex relationships which could impede the flow of germplasm overall. On the other hand, allowing unrestricted access by all countries to certain categories of crops with potential high value could jeopardize the ability of source countries to claim a fair and equal share of the benefits arising from the use of these materials. In terms of efficiency and equity, it seems that the logical approach would be broad enough to accommodate the best characteristics of all three models.

128.The report considers a number of elements which might be included in some or all of the system models and analyzes them on the basis of likely transaction costs. In general, it appears that the more complex and narrow the exchange arrangement, the higher the transaction costs will be. Using cost-effectiveness as a criterion, it would seem appropriate to develop a very flexible exchange framework which allows complex arrangements when appropriate but is not led by them.

129.The future of sustainable agriculture requires the development of a system or systems to facilitate efficient conservation, promote access and use and ensure an equitable sharing of the benefits arising from the use of plant genetic resources for food and agriculture. Such a system or systems should conform to both the letter and the spirit of the CBD and should aim to minimize transaction costs while maximizing efficiency and effectiveness. It is hoped that the options considered in this report will prove a useful contribution to the ongoing debate.

Annex: Scope

1. The implementation of any formal exchange system requires the definition of the range of biological materials ("the scope") to be covered by the agreement and, if relevant, the appropriate subcategories. Some of the options with regard to scope are discussed below.

Scope Defined by Taxon or Genepool

2. Species might be categorized according to a list or lists of taxa, based on such criteria as relevance for food security, social and economic importance, geographic distribution and/or the risk of genetic erosion. Given the disparity of the distribution of genetic diversity among countries and their different needs for and uses of genetic material, the determination of an internationally acceptable, taxonomically based scope would require careful negotiation, as would the taxonomic basis for the list(s), whether genepool, genus, species or other taxonomic class.

3. Genepool-based lists can be difficult to define. For many crops, reliable information about the natural flow of genes among species is limited and the distinction between taxa is often difficult to draw, making the definition of many genepools somewhat arbitrary. A list of genera, rather than a list of species, may be more appropriate in some circumstances, for example when genes from related species have the potential to contribute significantly to the improvement of the crop species in question. Another option would be to combine both species and genera in defining the scope of the system.

4. An approach might be to agree on specific commodities to be included and to rely on expert working groups to define the species that would be included in the genepool of each commodity in question.

5. Species might be considered on an inclusive basis (i.e. a list would specify materials included in the scope) or on an exclusive basis (i.e. a list would specify what is not included). In either case, the list would need to be regularly reviewed.

6. It may be difficult to compile an exclusive list since taxonomic information about many species is inadequate and in many countries good inventories of native species are lacking. New species are frequently being discovered and taxonomic classifications are continuously being revised. In addition, negotiators may see such an approach as too open-ended. An inclusive list may be easier to compile, although the danger exists that species might be overlooked.

Scope Defined by Category of Germplasm

7. The scope of the system could be based on different classes or categories of germplasm based on the degree of "improvement" (i.e. the relative degree of human intervention) involved in their development, the actual or potential legal ownership status and/or potential strategic or commercial value. Categories might distinguish, for example: wild species, non-domesticated relatives of crop species, landraces, farmers' varieties, obsolete varieties, modern varieties, breeding lines and experimental populations, and lines with specific genetic characteristics.

8. The availability of certain categories might be restricted. For example, the International Undertaking states that the availability of breeding material is left to the discretion of the plant breeder concerned. The same principle might be applied in the case of material held by farmers or farming communities. Genetic stocks are not usually deposited in genebanks since

they typically form part of research collections. One option would be to limit the scope of the system to materials whose exchange is not already restricted in some way.

Scope Defined by Date of Collection (pre- or post-CBD)

9. Material collected or obtained prior to the entry into force of the Convention on Biological Diversity (29 December 1993) is not covered by its provisions on access and benefit-sharing. Thus this date could serve as a point of reference for determining scope. For example, any system might include only pre-CBD materials as a means to resolve the outstanding question of access to *ex situ* collections not acquired in accordance with the Convention. Alternatively, it might include only post-CBD materials, so that the system would be in full conformity with the Convention. This would leave pre-CBD materials outside the scope of the system (including the bulk of collections currently held *ex situ*) and open to unregulated exchange as at present.

10. From a practical standpoint, the distinction between pre- and post-CBD materials poses some difficulties, especially for *ex situ* genebanks. Added costs would be incurred in monitoring origins and in dispatching samples under different terms and conditions based on the time of acquisition. In addition, the same genes and gene combinations often occur in materials obtained both before and after the coming into force of the Convention.

Scope Defined by Conservation Method (*ex situ* or *in situ)*

11. This option would distinguish between genetic resources held *ex situ* and *in situ* as a means to determine the scope of the system. Most of the genetic resources held in genebanks obtained their characteristic properties while growing *in situ*, frequently as a result of human intervention on farmers' fields. The fact that these materials have been conserved *ex situ* at some time would therefore not appear to be a useful distinction. Indeed, genetic resources do not generally proceed directly from *in situ* regimes into the hands of end-users but first pass through an *ex situ* genebank and/or plant breeding programme. In addition it would be difficult, and in many cases impossible, to prove that a gene had come from an *in situ* or *ex situ* source.

12. In practice it is likely that most participants in a multilateral system, whether governments or institutions, would have control over *ex situ* rather than *in situ* resources. While local communities and indigenous groups controlling *in situ* resources might be eligible to participate in the system, depending on the agreed terms of membership, they may choose not to do so. Thus “ownership” rather than conservation method *per se* might be a better discriminating factor.

Scope Defined by Ownership

13. Countries differ in their recognition of ownership rights over genetic resources by the individuals, groups or institutions that are the actual holders, guardians or custodians of the material. The scope of the system could take into account the type of body that holds the material. Institutes generally fall into two very broad categories: public (under the direct control of government) and private (e.g. a company, NGO, community group, individual, or other entity beyond the direct control of government).

14. Assuming national legislation is not to the contrary, any government institution holding collections of genetic resources should be able to make them available to the system for

exchange. If so agreed, this might also include *in situ* resources under governmental control, for example in national parks.

15. A significant proportion of the genetic diversity currently used in breeding activities is in private hands, and governments may choose to regard this as the property of the holding institute. Likewise, governments may recognize ownership or other rights of farmers and indigenous communities over the materials on their lands or territories. A nation's membership in any multilateral system might thus not guarantee that all material within the scope of the system and held in the country will be placed at the disposal of the system. Similarly, member countries might not be willing or able to enact legislation requiring require private entities to share benefits arising from the use of material already in their collections.

Scope Defined by Intended Use

16. Genetic resources frequently have multiple uses. For example, certain food crops, or the products of specific genes they contain, can also be used in industry or for medicinal purposes. Genetic resources might be included in a multilateral system when they are used for certain specified purposes only, for example for human food. The permissible uses of the material could be specified in the terms and conditions of a multilateral agreement or agreements. Any other use, for example for pharmaceutical purposes, might require separate negotiations.

Scope Defined by Mixed Options

17. Combinations of the above options could be used in determining the scope of the system. For example, the scope might be defined not just by taxon, but also by intended use and / or nature of ownership. However, combining options will reduce the overall scope of the system and might require more complex monitoring systems.

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[1] The International Plant Genetic Resources Institute, one of the 16 international agricultural research centres of the CGIAR.

[2] This background document was prepared as part of the preparatory process for the International Technical Conference on Plant Genetic Resources, Leipzig 1996. It represents a work in progress and is not a formal publication of FAO. The document provided the basis for the development of *The Report on the State of the World's Plant Genetic Resources.*

[3] Cooper, D., Engels, J., and Frison, E. 1994. *A Multilateral System for Plant Genetic Resources: Imperatives, Achievements and Challenges. Issues in Plant Genetic Resources* No. 2. May 1994. International Plant Genetic Resources Institute, Italy.

[4] *Access to Plant Genetic Resources and the Equitable Sharing of Benefits. Issues in Plant Genetic Resources* No. 4. June 1996. International Plant Genetic Resources Institute, Italy. p. 24

[5] IPGRI 1996, fn. 23

[6] IPGRI 1996, fn. 24

[7] Genetic resources stakeholders include farmers and farming communities, the private seed industry, public and private research institutions and governmental and non-governmental organizations.

[8] Preamble, The Convention on Biological Diversity

[9] The Consultative Group on International Agricultural Research is an association of countries, international and regional organizations, and private foundations dedicated to supporting a system of agricultural research centres around the world. Sixteen centres are currently supported by the CGIAR.

[10] The South African Development Community

[11] The European Cooperative Programme for Crop Genetic Resources Networks

[12] IPGRI, 1996. fn. 50

[13] IPGRI, 1996. p. 29

[14] IPGRI, 1996. pp. 82-84.

[15] IPGRI, 1996.
[16] For a more detailed discussion of options for institutional arrangements, see IPGRI, 1996. Chapter III.
[17] *Lesser W. IPGRI, 1996. Unpublished*
[18] *The State of the World's Plant Genetic Resources for Food and Agriculture*. 336 pp. FAO-A, 1996. p. 8
[19] *Report on The State of the World's Plant Genetic Resources for Food and Agriculture*. 75 pp. FAO-B, 1996. p. 60
[20] FAO-A. p. 276
[21] FAO-A. p. 284
[22] FAO-A. p. 57
[23] *The Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture*. FAO 1996. para. 117
[24] FAO-B. p. 24
[25] Lesser, 1996
[26] *The Global Plan of Action*. para. 83
[27] FAO-B. p. 24
[28] See IPGRI, 1996 p. 52, fn 54 for a discussion on the extent of financial benefits likely to accrue through the sharing of benefits on seed trade profits.
[29] Lesser, 1996
[30] FAO-B. p. 26
[31] *The Global Plan of Action*. para. 103
[32] Lesser, 1996
[33] Lesser, 1996
[34] FAO-B. p. 26
[35] *The Global Plan of Action*. paras. 258-278
[36] FAO-B. p. 26
[37] Lesser, 1996
[38] Lesser, 1996
[39] IPGRI, 1996. p. 29
[40] IPGRI, 1996, Annex IV
[41] Lesser, 1996
[42] Lesser, 1996
[43] Lesser, 1996
[44] Lesser, 1996
[45] Lesser, 1996
[46] Lesser, 1996
[47] Lesser, 1996