

Plant Genetic Resources for Food and Agriculture: A Common Heritage of Mankind?¹

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Introduction

Plant genetic resources for food and agriculture that are exchanged and used in a successive and continuous release of improved varieties through plant breeding have brought great benefits to society. Since the origins of agriculture farmers have selected crop cultivars from the genetic diversity available to them. They have moulded genetic resources over centuries through phenotypic selection, allowing and even facilitating genetic exchange between cultivars and weedy relatives by transporting cultivars from one region of the globe to another. By incorporating and re-mixing genetic diversity in new varieties, modern plant breeding has created more variation in food crops than has ever been available to farmers and consumers.

Farmers and breeders have traditionally relied on “open” access to genetic resources. In recent years, however, decision makers at the national level have come under increasing pressure from a wide range of stakeholders to draft laws and policies affecting the exchange, use, conservation and ownership of plant genetic resources for food and agriculture. Of course, these issues aren’t being considered in a policy vacuum. At the international level, the International Treaty for Plant Genetic Resources for Food and Agriculture creates a framework for access, use and conservation based on international co-operation. The Convention on Biological Diversity (CBD) recognises the sovereign rights all countries have over their natural resources and their authority to determine access to genetic resources within their borders for which they are the countries of origin. The Bonn Guidelines adopted by the Parties to the CBD encourages bilateral regulatory mechanisms to negotiate the terms and conditions of access to their genetic resources. Under the obligations required by TRIPs, some countries have created *sui generis* forms of intellectual property rights for farmer varieties and related traditional knowledge. There are similar demands within the context of the meetings of WIPO’s Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore meetings.

Some countries have instituted national laws that establish bilateral systems of access to genetic resources and negotiate agreements on a case-by-case basis. More are in the process of doing so. Often these laws do not treat plant genetic resources for food and agriculture (PGRFA) differently from other forms of genetic resources. But is there a case for treating plant genetic resources for food and agriculture any differently?

Interdependency and Genetic Resources

Most of the food crops were developed over millennia in parts of the world that are today considered to be developing countries. The arrival of Columbus in the Americas in 1492 set in motion the so-called ‘Colombian exchange’ of domesticated crops and animals from different parts of the world. Wheat was introduced to the Americas from Europe over 500 years ago and on his return from the Americas Columbus introduced maize to Europe. Rice was introduced to the Americas from Asia 200 years ago. Secondary centres of diversity became widespread for a large number of crops and once foreign foods are now well integrated into national/regional diets.

In a study assessing the degree of a country’s dependence on non-indigenous crops

¹ This paper draws on a previous piece written by the author late in 2005.

(measured in terms of calorific contribution to nutrition contributed by crops whose centre of diversity is outside the country in question), Palacios (1998) showed all countries grow or import crops that come from distant lands (Table 1). Ghana is just as dependent on crops originating outside of Ghana (70-81%), as Italy is on crops originating outside of Italy (71-81%). No nation today is completely independent in terms of genetic resources for food and agriculture and both, developed and developing countries have come to rely on non-indigenous crops for their food supply.

Table 1 - Levels of dependency for some countries in the world

Country	Degree of dependence (%)	Main source of energy supply	Primary region of diversity of crops
China Japan Republic of Korea	46 – 55 43 – 61 30 – 54	Non-native – wheat, sugar, maize, potato Native – rice, soybean	East Asia - rice, onion, tea, soybean, orange, Brassica, millet
Indonesia Philippines Vietnam	29 – 33 28 – 38 13 – 19	Non-native – wheat, maize cassava, soybean, sweet potato Native – rice, sugarcane, banana, coconut	Southeast Asia – rice, yam, banana, sugarcane, coconut/copra and citrus
Bangladesh India Nepal	14 – 21 35 – 47 47 – 57	Non-native – wheat, maize Native – rice, sugarcane, millet	South Asia - rice, sugarcane, banana, sesame, millet, <i>Brassica rapa</i> , <i>B juncea</i>
Australia New Zealand Fiji	88 – 100 87 – 100 65 – 77	Non-native – wheat, rice, barley, potato, maize, soybean, sweet potato	Pacific - sugarcane and coconut/copra
Ethiopia Kenya Uganda South Africa Zimbabwe	28 – 56 89 – 98 76 – 88 90 – 98 89 – 95	Non-native – <i>Phaseolus</i> , maize, sweet potato, potato, cassava, banana, plantain, wheat, rice Native (for Ethiopia) – tef, <i>Avena Abyssinian</i> , <i>Brassica carinata</i>	East and Southern Africa - sorghum, millet, yam
Brazil <u>Andean Region</u> Argentina Colombia	81 – 94 89 – 95 84 – 94	Non-native – wheat, sugar, rice, maize, soybean, plantain, banana Native – potato, <i>Phaseolus</i> (for Andean Region); cassava (Brazil)	Andean region - potato, sweet potato, tomato, cocoa, <i>Phaseolus</i> , cassava, groundnut, pineapple
Western Europe (on average)	70 – 95	Non-native – wheat, soybean, barley, potato, maize, rice sugar,	Europe - apple (Mediterranean region - olive, grape)
United States Canada	77 – 100 84 – 99	Non-native – wheat, sugar, soybean, potato, maize, barley, rice, groundnut	North America - sunflower

Multilateral versus bilateral systems of exchange of germplasm

As policy makers debate options in regulating the exchange, use and ownership of, and benefits from PGRFA, data on the magnitude and direction of germplasm flows might shed some light on whose interests would be served by placing restrictions on access to PGRFA.

The Consultative Group on International Agricultural Research (CGIAR), often called the international public sector, was the first formal system in place that provided plant breeders access to germplasm available beyond their borders. The CGIAR collections comprise over

half a million samples of crop, forage and tree germplasm of major importance for food and agriculture. Data from the System-wide Information Network for Genetic Resources (SINGER) (<http://singer.cgiar.org>), an information exchange network of the CGIAR and associated partners, provides some insight into flows of genetic resources around the world. Table 2a indicates the number of samples of accessions originally collected from a region that were distributed to another over the years 1973 – 2003. For instance, 12,584 samples of accessions originally collected in the Asia Pacific region were distributed to recipients located in Europe.

Table 2a - Flows of genetic resources within and between regions

To Region	Samples of accessions collected originally from						Total
	Asia Pacific	Europe	N America	S America	S S Africa	WANA	
Asia Pacific	209,095	11,074	30,547	30,665	133,908	46,039	461,328
Europe	12,584	6,952	3,499	10,406	17,633	27,469	78,543
N America	13,458	2,332	3,410	11,729	18,745	9,313	58,987
S America	10,677	4,635	4,881	60,246	11,140	4,776	96,355
Sub Saharan Africa	21,658	3,593	6,959	19,213	61,228	8,374	121,025
West & N Africa	13,796	5,435	3,089	2,450	10,138	44,533	79,441
Total	281,268	34,021	52,385	134,709	252,792	140,504	895,679

Note: The data reflects samples of single accession that have been provided

A further analysis of the data in Table 2b demonstrates the benefits that all regions obtained from an 'open access' system. If requests for a sample are indicative of a need for germplasm for crop research and development, the table below is illustrative of interdependency between regions and furthermore, the benefits from a co-operative and multilateral system of access to genetic resources.

Table 2b – Dependency between regions on genetic resources

Region	Accessions originally collected from region	Samples distributed to region	Gain (%)	Flows to region from within (%)	Material 'borrowed' (%)
Asia Pacific	158,153	461,328	292	74	55
Europe	35,560	78,543	221	20	91
N America	16,557	58,987	356	7	94
S America	105,680	96,355	91	45	37
Sub Saharan Africa	116,695	121,025	104	24	49
West & N Africa	86,447	79,441	92	32	44
	519,092	895,679			

Using genebank data from the CGIAR and other sources, M Halewood et al. (unpublished) focussed on exchanges of PGRFA in and out of Kenya and Uganda. Over the course of twenty years (approximately 1974 – 2001) Kenya and Uganda together received (from all of the 11 CGIAR genebanks) a total of 12,000 unique accessions that were collected from other countries. During the same period of time, the genebanks distributed 4,000 accessions originally collected in Kenya and Uganda to other countries of the world. Kenya and Uganda therefore gained access to 300% more accessions than they distributed.

A breakdown by crop is presented in Table 3. This data on germplasm transfers indicates that Kenya and Uganda have gained access to a wide range of material from both, the region and the rest of the world. Halewood et al. point out that even when Kenya and Uganda are actually the centre of diversity of the crop in question, their proportionate gain in access to material of that crop far outstrips the region's or the rest of the world's gain. They

highlight this is so because of Kenya's and Uganda's participation in a relatively open system of facilitated access the CGIAR operates for its *ex situ* collections.

Table 3 - Germplasm accessed by Kenya and Uganda (K+U), 1974 - 2001

Crop	Centre of diversity	Material collected from (%)		
		K+U	SSA*	Rest of the world
Groundnut	South America	18	47	35
Finger millet	East Africa	20		80
Beans	South America (secondary centre South Africa)	4	17	79
Pigeonpea	East Africa	15	40	45
Sorghum	East Africa	3	74	23
Tropical forages CIAT		20	33	47
Forages ILRI		2		98

* Sub Saharan Africa

Kenya and Uganda are not alone in their need for genetic resources from around the world. In 1994, the International Fund for Agricultural Research (IFAR) produced a series of case studies based on fifteen countries (Chile, Colombia, India, Indonesia, Kenya, Madagascar, Pakistan, Peru, Philippines, Rwanda, Saudi Arabia, Syria, Tanzania, Uruguay and Zimbabwe) that showed that together they received 47,502 vegetable and 16,928 forage samples from international agricultural research centres. Their own contribution to the collections were 2,712 and 7,381 samples of vegetables and forages, respectively. In other words, the number of germplasm they received from the collections was many more times than that they contributed.

Legislation that poses restrictions on a multilateral and open system of access may alter these patterns of germplasm flows. Had the fifteen countries studied by IFAR obtained the needed germplasm through a bilateral system, they would have had to negotiate with the 125 and more countries that had made material available to the centres (Fowler et al., 2001). Simple transaction costs associated with bilaterally accessing material would be substantial for any country. If the ratio of inflow to outflow of genetic resources remains as it is, but access were subject to restrictions and became monetary-based, all developing countries stand to lose. Access would be particularly severe for poorer countries with small markets and weak institutions.

The Convention on Biological Diversity

Article 15 of the CBD affirms the sovereign rights of all countries over their natural resources and their authority to determine access to genetic resources based on "prior informed consent" and "mutually agreed terms". Under the CBD, countries may provide access to genetic resources for which they are "countries of origin", countries possessing the material in *in-situ* conditions. *In-situ* is defined as:

...conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

This framework, while useful, does not provide an explanation or advice on what a "distinctive property" is. Neither does it clarify what "property" is: is it a gene, a trait, a particular combination of otherwise common alleles? Centres of crop diversity have not always occupied a limited area and moreover, secondary centres of diversity exist in areas with a long history of continuous cultivation. If a crop is oligo-centric or non-centric in its origin, how can one know where a particular "distinctive property" first arose? What happens

when a single seed contains numerous distinctive properties, each with a potentially different country of origin?

The historic wide spread use of PGRFA is evident in the ancestry of individual crop varieties. Numerous publications cite examples of the complex parentage of crop varieties used widely in breeding programmes all over the world. VEERY, a wheat variety widely released in the 1980s, and still used in breeding programmes around the world, was developed through 3170 crosses involving 51 parents from 26 different countries. A study of 1709 rice varieties released in 15 countries, showed that only 145 varieties (8.5%) were developed entirely from own-country parents, grandparents and other ancestors. Thirteen of these 15 countries were more than 80% dependent on foreign progenitors for their rice-breeding programme. Table 4 presents a summary of international flows of rice ancestors in selected countries.

Table 4 - International flows of rice ancestors

Country	Landrace progenitors in released varieties (no.)	Own landraces (%)	Borrowed landraces (%)
Bangladesh	233	2	98
Brazil	460	17	83
Burma	442	7	93
China	888	18	82
India	3917	40	60
Indonesia	463	9	91
Nepal	142	1	99
Nigeria	195	8	92
Pakistan	195		100
Philippines	518	7	93
Sri Lanka	386	17	83
Taiwan	20	15	85
Thailand	154	18	82
United States	325	67	33
Vietnam	517	4	96

Source: IPGRI (2005)

Sorting out which country has the right to negotiate the terms of access to genetic resources for food and agriculture led delegates to the CBD to recognise that there was a need “to seek solutions to outstanding matters concerning plant genetic resources” and led to negotiations that concluded in the International Treaty on Plant Genetic Resources for Food and Agriculture.

The International Treaty on Plant Genetic Resources for Food and Agriculture

After seven years in negotiation, the International Treaty (the “Treaty”) on Plant Genetic Resources for Food and Agriculture was adopted in November 2001 and came into force in June 2004. It is the first treaty that provides a legal framework that not only recognizes the need for conservation and sustainable use of plant genetic resources for food and agriculture but also delineates a regime for access and benefit sharing, and in this process provides direct and indirect links to intellectual property right instruments.

How will the Treaty work?

A Reaffirmation of the Common-Heritage Approach to Genetic Resources

The main institutional innovation of the International Treaty is found in the novel scheme devised to regulate access and benefit sharing of PGRFA. For the most important food crops the Treaty establishes a Multilateral System of facilitated access that tempers the concept of national sovereignty with the recognition that all countries depend largely on PGRFA originating in other countries, thereby implicitly affirming the scientific and historical soundness of the “common heritage” approach.

The Treaty also provides facilitated access to all material that are listed in Annex 1 held in trust under the auspices of the FAO by Centers of the CGIAR. “In trust” refers to material collected before 1994 when the CGIAR entered into an agreement with FAO bringing its gene bank material under the auspices of FAO. Non-Annex 1 material held by the CGIAR gene banks in trust collections will be distributed by a Material Transfer Agreement that is substantially similar to the one adopted for Annex 1 material.

In response to calls for benefits flowing from the use of biological diversity to be shared with the country of origin of the material, discussions have tended to focus solely on monetary benefits often as a precondition to access. This approach, although well intentioned, has led to a disregard of the significant non-monetary benefits that result from the use of genetic resources. The Treaty reiterates that facilitated access under a multilateral system is probably the largest single benefit also to the providers of the material.

The tool for translating the language of the Treaty into contractual obligations for materials from the multilateral system is a Standard Material Transfer Agreement.

Intellectual Property Rights

In addressing the thorny issues of ownership of genetic resources and benefits resulting from their use, the Treaty acknowledges that they are inextricably linked with the more practical questions of not only access to, but also development and use of these resources. And in so doing the Treaty recognises intellectual property rights. This is of significance as modern varieties, those important building blocks for the plant breeding industry, are often protected either according to the UPOV system known as Plant Breeder’s Right (PBR) or by patents, and in certain circumstances they are protected by PBR and contain patented elements. The Treaty’s respect for intellectual property rights is also evident in its restriction of the multilateral system to genetic resources “under the management and control of the Contracting Parties (States) and in the public domain”.

The benefit-sharing regime of the Treaty constitutes another part of the process that seeks to make PGRFA a common concern of humankind. Providers are granted the right to receive some forms of benefits for facilitating access. Recipients of PGRFA who commercialise a product that incorporates material from the multilateral system will pay a share of the benefits arising from the commercialisation of the product into a financial mechanism set up by the Governing Body of the Treaty. Mandatory benefit sharing will not apply in cases where the product is available without restriction to others for further research and breeding.

Mandatory Benefit Sharing

Mandatory benefit sharing will not apply to cultivars that have incorporated material from the multilateral system and subsequently been protected by plant variety protection certificates under the UPOV or other *sui generis* systems with a breeders exception. It will apply to products protected by utility patents for instance or other systems where access is restricted, unless the holder of the rights voluntarily waives some of the rights that such laws typically provide. Intellectual property rights are, however, cannot be applied for anything “in the form received.” The question is whether this will be experienced as a limitation.

The International Seed Federation (ISF) interprets this article as follows: It is possible to claim intellectual property or other rights that limit access to the genetic parts or components isolated or inherited from the material received, provided that the criteria for patentability (in particular the utility patent on plants) are fulfilled. A genetic sequence without proven industrial activity as such should not be patentable. Nevertheless, the rights granted should in no case limit access to the initial genetic material. If so, then the recipient of the material will pay, according to the prescribed norms, into the funding mechanism set up by the Treaty.

This interpretation is logical in the context of Article 13 of the Treaty, which through its use of the word “incorporate”, presumes that material received will be used in the development of new products which would in turn be protected by intellectual property rights. Some forms of property rights may limit the use of new products. In exchange for this privilege, benefit sharing is mandatory.

Fowler (2005) wrote, “Patents cannot typically be acquired for something that is pre-existing, known and described. Different countries, however, may interpret “in the form received” differently. In the U.S., for example, patents are available for “the isolated and purified form of the DNA molecule.” The U.S. authorities might argue that this isolated and purified form was not the form in which it was received from the Multilateral System. Others might argue that this is an irrelevant distinction. It would appear, however, that since the Treaty explicitly respects intellectual property rights and since such rights are national in character, it will be difficult for the Treaty to be interpreted in a manner that does not allow “parts and components” to be patented in the U.S., if the application meets U.S. requirements. Denial of this right would be counter to other provisions of the Treaty”.

Multilaterism and Development

Access to plant genetic resources is indispensable for research and development of improved crops. Exclusion of a crop from a multilateral system such as the Treaty could condemn it to an “orphan” status, as according to the provisions of the CBD - under whose purview such material falls - access to genetic resources would be purely on terms mutually agreed between those wishing access and the ‘owners’. New breeding programmes would probably not be initiated and existing programmes may be confined to using the germplasm countries already had.

A list of 35 crops and crop complexes (e.g. Brassicas) and 29 forage species is included in the Treaty’s multilateral system for access and benefit sharing, bringing an anticipated stability and predictability to their access and transfers. However, numerous crops including many that are important to the poor are not included in the multilateral system. Even as countries agreed to include those crops most important for food security and for which there was interdependency, the list of crops was the subject of intense negotiation. Politically motivated caution on the part of many ‘gene-rich’ countries won the day.

Rice, maize, wheat and potatoes are there. Soybean, tomato and groundnut are absent while asparagus, strawberry and grass pea are on the list. Most vegetables, fruits and tropical forages, as well as crops that also have industrial uses, are excluded and thus outside the scope of the agreement. Crops such as African leafy vegetables not globally widespread but important to the nutritional well being of many people in developing countries are also not listed.

Minor food crops with limited exchange and less complex negotiations may be amenable to bilateral arrangements but a multilateral approach as proposed by the Treaty offers opportunities for developing common and cost-effective conservation strategies, and for coordination and mutual support among partners. It offers participants access to a far greater range of germplasm than is generally possible in bilateral arrangements such as those provided under the CBD. Additionally, it provides access to a wider range of

information than is available bilaterally and offers opportunities to use information cost-effectively, avoiding duplication of efforts and unnecessary expense by sharing databases. It is preferable for crops with a wide geographical distribution. The advantage is even greater if one considers a multilateral agreement covering a range of crop species.

The ability to exploit genetic resources worldwide coupled with the creation of a system of national and international research centres in the 1960s revolutionised the supply of improved cereal varieties to developing country farmers. However, the financial and political environment of the last decade has seen significant reductions to the development of agricultural research capacity in many developing countries.

Traxler and Pingali (1999) subdivided 31 developing country national agricultural research systems (NARS) with wheat breeding programmes by the output of their research activities. They concluded that 25 did not have effective breeding capacities and were only able to release useful varieties by testing imported varieties and releasing those best suited to their environment. Such a situation creates an even stronger economic incentive for cooperation among countries and to free ride on research spillovers.

Summing up

The use of biological diversity is perhaps the most important prerequisite for the long-term conservation and sustainable use of PGRFA. Better use of plant genetic resources is critical to meeting the challenges of increasing food production and of alleviating poverty. All countries depend on plant genetic resources originating beyond their borders. Interdependence demands co-operation. International agreements are also necessary to guarantee the conservation of genetic resources. These were the views that the international community took while developing the legally binding multilateral system for access and benefit sharing in the framework of the International Treaty. Although far from perfect, the design of the Treaty reflects the nature of plant genetic resources for food and agriculture and the uses to which they are put.

Facilitated access to a wide range of crops for food and agriculture under a multilateral system, as promised by the Treaty, is essential to farmers and plant breeders.

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