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CHAPTER 6 : – ACCESS AND BENEFIT-SHARING LAWS AND PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE: THE INTERNATIONAL LEGAL REGIME

6.1. HISTORICAL BACKGROUND: FAO CONFERENCES IN 1961, 1967 AND 1973. DISCUSSIONS ON *EX SITU* AND *IN SITU* CONSERVATION OF PLANT GENETIC RESOURCES

Plant genetic resources are the basis for any agricultural system and of agrobiodiversity at all levels. Along with water and soil, they are essential for any agricultural model, and, therefore, for food security. The set of genes in a plant is fundamental for determination of characteristics such as resistance to diseases and insects, droughts or floods, color, flavor, nutritional value, etc. Hereditary characteristics are transmitted from one generation to the next via genes, and both farmers and professional breeders depend upon wide access to diversified genetic

materials in order to develop and/or improve agricultural varieties and to adapt them to new environmental and sociocultural conditions. Wild relatives of cultivated plants are also very important, since their capacity for survival in adverse situations is usually very high and this makes them especially valuable as sources of traits for developing the so-called "climate-ready" crops.

The concept of genetic resources – any genetic material with real or potential value – was developed in the 1960s and 1970s, to emphasize the strategic social and economic value of genetic information contained in them, which justifies them being treated as "resources". Genetic diversity should be protected in order to ensure food security for all humankind, both nowadays and in the future. Genetic resources were regarded, essentially, as the indispensible input for plant breeding. The concept of genetic resources – later adopted by many legal instruments[1] – emphasized the economic and utilitarian value of these resources, underestimating the cultural and identity value they have for farmers and local communities. Conservation of agrobiodiversity has far broader and more comprehensive implications than conservation of plant genetic resources. In this study, we shall focus on agrobiodiversity as biological and cultural heritage, and plant genetic resources as one of the components of such heritage, considering that policies and legal instruments must consider both the biological support of agricultural biodiversity and the knowledge and practices associated with it.

Loss of agricultural biodiversity and genetic erosion reached alarming levels in the 1960s and 1970s. Expansion of the green revolution provoked – and continues to provoke – widespread substitution of traditional and local varieties which are genetically heterogenous by modern cultivars, with high yields and narrow genetic bases. Countless agricultural species and varieties have been disappearing, along with agricultural

knowledge associated with agrobiodiversity. Not only have species domesticated by humans been disappearing, but also their wild relatives, due to the rapid devastation of natural ecosystems.

Concern with extinction of agricultural species and varieties motivated a series of conferences and technical meetings to discuss plant genetic resources and the most appropriate strategies for their conservation, held by FAO in 1961, 1967 and 1973. According to Robin Pistorius (1997), the three events laid the foundation for the scientific premises behind current international *ex situ* conservation. (out of their natural habitats, in germplasm banks) of plant genetic resources. During the 1967 Conference, it was decided that *ex situ* conservation was considered preferable to *in situ* conservation, and during the 1973 Conference the scientific criteria for *ex situ* conservation were established.

The decision to give priority to *ex situ* conservation generated diverging opinions in 1967 among scientists gathered at the FAO Conference. Since different conservation strategies, both *ex situ* and *in situ*, are still at the center of current debate, we will highlight below some of the main points of divergence between two renowned scientists, Otto Frankel (Australian) and Erna Bennett (Irish), who led the debates at the FAO. They were the ones who developed, in the 1960s, the expression "genetic resources", to emphasize the strategic importance of their conservation and the risks of genetic erosion for food security.

Otto Frankel and Erna Bennett[2] had fundamental roles in international discussions plant genetic resources conservation. In 1970, Otto Frankel and Erna Bennett (in association with R.Brock, A.Bunting, J. Harlan and E.Schreiner) published the book *Genetic resources in plants*: *their exploration and conservation*, which became a reference for debates regarding conservation and use of plant genetic resources in the 1970s

and 1980s. The book helped to convince participants of the U.N. Conference on the Human Environment, held in Stockholm, Sweden, in 1972, of the need to adopt a global plant genetic resource conservation program. In 1975, Otto Frankel and Jack Hawkes edited another reference book, *Crop genetic resources for today and tomorrow*, more action oriented, offering specific scientific, technical and organizational solutions to start programmes to collect and conserve threatened genepools. Both books resulted from FAO Conferences of 1967 and 1973 (Pistorius, 1997)

Otto Frankel argued mainly in favor of the advantages of *ex situ* conservation. In Frankel´s opinion, to make genetic material useful for breeding purposes, it had to be preserved under controllable conditions and should not be left in the field exposed to continuously changing agricultural practices. As a corn breeder, Frankel saw germplasm banks mainly as genetic material stocks for breeding purposes. Frankel believed that *ex situ* conservation created a safe niche for genetic resources, in which they would be protected against alterations provoked by external factors. Frankel did not rule out, nevertheless, *in situ* conservation, but considered it more complex, difficult and risky (Pistorius, 1997, p26).

Erna Bennett and other scientists agreed and held that there was an urgent need to adopt *ex situ* conservation, due to the alarming genetic erosion in the fields. They feared, however, that if *ex situ* conservation became dominant, local varieties would lose their capacity to adapt. Erna Bennett went as far as claiming that "static" conservation of seeds, through storage meant "adopting museum concepts". To Bennett: "The purpose of conservation is not to capture the present moment of evolutionary time, in which there is no special virtue, but to conserve material so that it will continue to evolve", and according to her, "such continued evolution could only be possible in in situ collections' (Pistorius, 1997, p27).

There were, however, other disagreements between Erna Bennett and Otto Frankel. Frankel thought that locally adapted variability would probably be of little use, since they only meet local demands, and that genetic materials used on a global scale should have priority (for conservation), since they "feed millions of people." Bennett thought, on the contrary, that the limited use of local varieties was not a problem, since these contribute to maintenance of genetic diversity in the field and feed the local population. At that time, the green revolution was at its peak, and the points of view of the two scientists regarding it were also divergent. Frankel was basically in line with major international agricultural research institutes, including FAO, oriented toward the development of high-yielding varieties. Bennett, however, was not convinced of the success of the green revolution, and rejected breeding for high-yielding varieties without adaptation to local environmental conditions. She also thought that the green revolution was not effectively eliminating hunger worldwide. Furthermore, with the expansion of intellectual property rights over plant varieties, Bennett began to worry about the control of multinationals over genetic materials conserved *ex situ*, holding, strongly, that these should be kept in public domain (Pistorius, 1997, p27).

Although *in situ* conservation was discussed, in the 1967 FAO Conference (and later in the 1973 Conference), the position which prevailed was that *ex situ* conservation should be given priority, and national and international policies became mainly aimed at this type of conservation. Thus, expeditions for germplasm collection[3] around the world increased in number drastically during the 1970s and 1980s. The idea that agricultural varieties should be collected and stored before they were lost forever prevailed, since their natural habitats were being devastated. A study performed by the International Board for Plant Genetic Resources (IBPGR[4]) in 1975 showed that until then, there were only eight long-term genetic resource conservation centers, mainly located in developed countries. Just seven years later, this total had gone up to 33

(Damania, 2008, p14). Historically, germplasm collections have been created for different purposes, which are not mutually exclusive. For example: ensuring the country's autonomy regarding these resources (e.g. the former Soviet Union), introducing new plants (in countries with many immigrants, such as the USA), and conserving genetic resources for plant breeding programs.

In 1971, the Consultative Group on International Agricultural Research (CGIAR[5]), was established with financial support of the Ford and Rockfeller Foundations, the United Nations Environment Programme (UNEP), FAO, the United Nations Development Programme (UNDP) and the World Bank. CGIAR gathered international agricultural research centers in a network and coordinated discussions regarding the priorities for international agricultural research and financial support. The CGIAR system is currently comprised of 15 international agricultural research centers, 11 of which have germplasm banks. CGIAR germplasm banks have approximately 650,000 samples[6] of crop, forage and agroforestry genetic resources in the public domain, which represent around 12% of the world's plant genetic resources kept *ex situ*. IBPGR (International Board for Plant Genetic Resources) was founded in 1974, and became IPGRI (International Plant Genetic Resources Institute) in 1991, and it is also part of the CGIAR network. In 2006, IPGRI and the INIBAP (International Network for the Improvement of Banana and Plantain) became only one organization: Bioversity International. Since 1994, these germplasm collections were put under the auspices and jurisdiction of FAO, and access to these materials became regulated by agreements between FAO and CGIAR centers (called "in trust" agreements), which forbid any claims of intellectual property rights over genetic resources held in their collections (Fowler, 2003). According to such agreements, ex situ collections held by the CGIAR centers were not the property of individual nations, nor were they the property of the centres themselves, but were held by the centres "in trust" for the international community (Moore and Frison, 2011). In 2006, the 11 international agricultural research

centres (IARCs) of the CGIAR which hold ex situ germplasm collections signed agreements with the governing body of the International Treaty on Plant Genetic Resources for Food and Agriculture, placing their collections under the treaty. Under these agreements, the centres recognize the authority of the governing body of the treaty to provide policy guidance relating to their ex situ collections[7].

In the 1980s and 1990s, however, the international *ex situ* conservation system came under heavy criticism from many civil society organizations, led mainly by the Rural Advancement Foundation International (RAFI, which later became the ETC Group[8]). After all, they argued, the system served mainly the interests of developed countries and of the international seed industry, and developing countries were losing control over their own genetic resources. In their view, the CGIAR system focused too much on research to develop genetically uniform high-yielding varieties of commercial crops, that are dependent on expensive inputs (chemical fertilizers and pesticides), to which poor farmers have no access. Locally important crops remained under-researched and little priority was given to locally important breeding goals. Besides, the introduction of new homogeneous varieties tended to undermine local varieties and biodiversity. E*x situ* conservation became increasingly associated with the green revolution, and farmers have always had limited access to plant genetic resources kept in ex situ germplasm banks.

Furthermore, in the 1980s, it was realized that genetic erosion was taking place in germplasm banks, due to the precariousness of many facilities, especially in poor countries. Lack of seed regeneration, and consequent loss of its viability, and the lack of resources for characterization and evaluation are some of the problems[9]. Additionally, when kept in germplasm banks, plants have their evolution frozen in time and space, which does not happen when they are left in their natural environments (*in situ*), where they evolve and adapt to environmental

and sociocultural changes. *In situ* conservation maintains not only plants, but also their agricultural ecosystems, conserving agrobiodiversity at all of its levels, and giving farmers control over their plant genetic resources.

Nevertheless, it was only in the 1980s and 1990s that *in situ* conservation became more recognized as a necessary and complementary strategy for genetic diversity conservation. The "Keystone International Dialogue Series on Plant Genetic Resources', chaired by Dr M.S. Swaminathan, played an important role in the recognition that genetic diversity should be maintained *in situ* and *on farm* (in local agricultural systems, with the participation of farmers) as well as in germplasm banks. The "Keystone Dialogues" took place in 1988, 1990 and 1991, in Keystone (USA), in Madras (India, now Chennai) and Oslo (Norway), and gathered 92 specialists from 30 different countries to discuss many topics related with conservation and sustainable use of plant genetic resources. Different stakeholders (private, public, ngos and academics) were involved in these informal meetings, and one of their agreed conclusions was that plant genetic resource conservation programs should include both *ex situ* and *in situ* strategies, which are complementary.

Plant genetic resources conservation strategies were central in the international agenda during the 1980 and 1990s. However, another important part of this agenda was dominated by diverging opinions and conflicting interests about access, control and ownership over plant genetic resources, which were regulated by successive international legal instruments, such as the International Undertaking on Plant Genetic Resources for Food and Agriculture (1983) and the International Treaty on Plant Genetic Resources for Food and Agriculture, which was approved in 2001 (and came into force on June 29th, 2004).

6.2. THE INTERNATIONAL UNDERTAKING ON PLANT GENETIC RESOURCES

The International Undertaking (IU) on Plant Genetic Resources was adopted at the 22nd Meeting of the FAO Conference, through Resolution 08/83[10]. It was the first comprehensive international agreement dealing with plant genetic resources for food and agriculture, but it was not legally binding. Adopted in 1983, the Undertaking was signed by 113 countries, and it was based on the "universally accepted principle that plant genetic resources are a heritage of humankind and consequently should be made available for use without restriction" (article 1). It was approved with the reservations of 8 countries (Canada, France, Germany, Japan, New Zealand, Switzerland, UK and US)

According to article 1 of the International Undertaking (IU), its objective is to "ensure that plant genetic resources of economic and/or social value, particularly in agriculture, are explored, preserved, evaluated and made available for plant breeding and scientific purposes". The International Undertaking established, in fact, two categories of genetic resources, subject to distinct legal regimes: 1) plant genetic resources under public domain, freely accessible to all (in reality, these are the genetic resources recognized by the IU as "common heritage of humankind"), and 2) plant genetic resources under private control. The International Undertaking is signed by states, not by private companies: plant genetic resources under private control are not affected by the free access principle. Private companies have no obligation to make their collections accessible to others. The International Undertaking (IU) attended mainly the interests of breeders from private institutions, interested

in guaranteeing access to public collections and in freely collecting genetic materials located in their centers of origin and diversity, located in tropical and sub-tropical countries (Hermitte and Kahn, 2004, p31). The IU makes no reference to farmers' rights, but applies both to varieties developed by farmers, called "obsolete" or "primitive", and to "elite" varieties.

During all negotiations of the International Undertaking, developing countries defended the principle of free and unrestricted access to plant genetic resources, which is more coherent with farmers´ traditional practices. The concept of "common heritage of humankind" was incorporated into the International Undertaking, but many developed countries (led mainly by the US), did not sign the IU because they considered it did not recognize and offer sufficient protection to breeders' rights. To increase the number of countries signatories of the International Undertaking, the FAO Commission on Plant Genetic Resources started to negotiate its controversial aspects with different countries, and this process resulted in the adoption of "agreed interpretations" of the IU, set out by Resolutions 04 and 05/89 and 03/91 of the FAO Conference.

Resolutions 04/89, 05/89 and 03/91 of the FAO Conference

The three resolutions approved by the FAO Conference (04 and 05/89 and 03/91), with "agreed interpretations" of the International Undertaking, meant so many concessions for developed countries that the International Undertaking lost its original purpose (to guarantee free

access to plant genetic resources), and became an empty and incoherent instrument, with very little practical applicability. In the words of Regine Andersen (2008), these three resolutions marked the "beginning of the end of the International Undertaking."

On November 29, 1989, the FAO Conference approved two resolutions which simultaneously recognize breeders' and farmers' rights, in an attempt to balance relations among industrialized countries (biotechnology-rich), and developing countries (agrobiodiversity-rich). These were the resolutions adopted (annexed to the International Undertaking):

1) Resolution 04/89 reaffirms that plant genetic resources are a "common heritage of humankind" and that they "must be freely accessible for use, in benefit of present and future generations." Furthermore, it recognized that plant breeders' rights, as provided for under the International Union for the Protection of New Varieties of Plants (UPOV), were not inconsistent with the Undertaking, and simultaneously recognized farmers' rights defined in Resolution 5/89. Resolution 04/89 also established that countries should only impose restrictions to free interchange of genetic materials which are strictly necessary for meeting national and international obligations.

2) Resolution 04/89 also states adhering to the Undertaking "recognize the enormous contribution that farmers of all regions have made to the conservation and development of plant genetic resources, which constitute the basis of plant production throughout the world, and which form the basis for the concept of farmers' rights". According to Resolution 04/89, they "consider that the best way to implement the concept of farmers' rights is to ensure the conservation, management and use of plant genetic resources, for the benefit of present and

future generations of farmers." According to Resolution 04/89, these objectives could be reached through the appropriate means, including, in particular, the International Fund for Plant Genetic Resources (*which is part of Resolution 03/91, discussed below*).

3) Resolution 05/89 recognized farmers' rights as "rights arising from the past, present and future contributions of farmers in conserving, improving, and making available plant genetic resources, particularly those in the centres of origin/diversity". These rights were "vested in the international Community, as trustee for present and future generations of farmers, for the purpose of ensuring full benefits to farmers, and supporting the continuation of their contributions, as well as the attainment of the overall purposes of the International Undertaking". It was the first international instrument to recognize farmers' rights, but it was not legally binding and had very little concrete efficacy (for more information on the history of farmers´rights, see chapter X of this book).

According to Regine Andersen (2008, p95), these two resolutions (04 and 05/89) were the results of tense negotiations. There had been fierce resistance to plant breeders´rights among developing countries, and the agreed interpretations providing for the acceptance of such rights could be adopted only with the simultaneous recognition of farmers´rights. Access to and control of plant genetic resources had become a highly political issue, dividing northern and southern countries.

3) Two years later, the FAO Conference adopted a new Resolution (03/91), which made access to plant genetic resources and its interactions with intellectual property rights even more ambiguous and confusing. Resolution 03/91 states that "the concept of common heritage of humankind, as set forth by the International Undertaking on Plant Genetic Resources, is subject to the sovereignty of countries over their

resources." In other words, access to plant genetic resources is no longer free, but subject to approval by their countries of origin. These countries may agree or not to allow access to their resources, just as they can establish conditions and/or restrictions in light of intellectual property rights. The Resolution itself recognizes that "conditions for access to plant genetic resources need further clarification." Resolution 03/91 also created an international fund for plant genetic resources, aimed at implementing farmers´rights, especially in developing countries. This fund received very few voluntary contributions, and never became a reality.

Therefore, while farmers' rights recognition did not go beyond formal statements, intellectual property rights over plant varieties became increasingly stronger in the 1980s and 1990s, which exacerbated developing countries´ fears of losing control over their own genetic resources. This situation contaminated, once and for all, north-south relations. The UPOV Convention, approved in 1961, was revised in 1972, 1978 and 1991, always with the purpose of granting more effective protection for plant breeders´rights, and with greater restrictions for farmers´ traditional practices. The legal space for traditional agricultural practices, such as seed saving and exchange among farmers, was increasingly reduced, making inequalities more marked in the international legal system. The question was: if the rights of holders of biotechnology were recognized in the form of breeder´s rights, patents, etc, why the rights of germplam holders were not? (Diaz-Silveira, 2011)

According to Marie Angèle Hermitte (2004, p29), intellectual property rights became a "political obstacle" to free access to genetic resources, leading developing countries to defend the principle of sovereignty over genetic resources located in their territories, which was later incorporated into the Convention on Biological Diversity. Ironically, access and benefit sharing laws, based on the Convention on Biological Diversity, have produced effects which are very similar to those of intellectual property rights: they further restrict access to genetic resources,

keeping a larger part of resources and knowledge out of the public domain. Access and benefit-sharing laws, on the other hand, have generated very few (if any) benefits for local communities, and contributed very little to biodiversity conservation.

6.3. THE CONVENTION ON BIOLOGICAL DIVERSITY AND AGRICULTURE

The International Undertaking adopted in 1983 was formally in force until the adoption of the International Treaty on Plant genetic Resources for Food and Agriculture, in 2001, but received very little attention after the Convention on Biological Diversity (CBD). CBD was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (UNCED, the "Earth Summit"), held in Rio de Janeiro. The CBD was the first international instrument to address biological diversity in a comprehensive way, and was signed by 157 countries during UNCED. Currently, 193 countries are parties of CBD[11]. The US signed, but did not ratify it. The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is a new international agreement, adopted under the auspices of the Convention on Biological Diversity (CBD), in Nagoya, Japan, on 29 October 2010, and it will enter into force 90 days after 50 countries have ratified it.

The Convention on Biological Diversity (CBD) represented a paradigm shift, and it broke with the concept that genetic resources are a "common heritage of humankind". It recognizes the sovereign rights of States over their natural resources and establishes that the authority to determine access to genetic resources rests with the national governments and is subject to national laws. It also sets forth that access must be

granted in 'mutually agreed upon terms", and is subject to prior informed consent from the country providing the resources, as well as to fair and equitable sharing of benefits deriving from their use (article 15).[12] The Convention on Biological Diversity (CBD) entered into force on 29 December 1993 (90 days after the 30th ratification), and it has three main objectives: conservation of biological diversity, sustainable use of the components of biological diversity and fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

In the Nairobi (Kenya) Conference which approved the agreed text of the Convention on Biological Diversity, on May 1992, Resolution 3 was also adopted, which deals with the interactions between biodiversity and promotion of sustainable agriculture. Resolution 3 of the Nairobi Final Act recognised the need to seek solutions to outstanding matters concerning plant genetic resources, in particular: a) access to *ex situ* collections not addressed by the Convention, and b) farmers' rights. Resolution 3 acknowledged the importance of CBD´s principles for plant genetic resources for food and agriculture, and the need for measures to promote complementary and cooperative relations between the Convention on Biological Diversity and the FAO Global System of Conservation and Use of Genetic Resources for Food and Agriculture (of which the International Undertaking on Plant genetic Resources was a key component). FAO became responsible for implementation of the CBD regarding plant genetic resources for food and agriculture.

In 1993[13], the FAO Conference approved a new Resolution (07/93), requesting FAO´s general director to start negotiations with member countries to adapting the International Undertaking on Plant Genetic Resources, in harmony with the Convention on Biological Diversity. This was the starting point for long negotiations which resulted in the adoption, in 2001, of the International Treaty on Plant genetic Resources for

Food and Agriculture (ITPGRFA). In 1995, the Second Conference of the Parties of CBD, held in Jakarta (Indonesia), also recognized the "special nature of agricultural biodiversity, its distinct features and problems, needing distinct solutions" (Decision II/15).

Adapting the International Undertaking on Plant Genetic Resources to CBD´s principles was not an easy task. These instruments have very different approaches: the International Undertaking was aimed mainly at promoting sustainable agriculture and food security, as well as facilitating access to plant genetic resources for food and agriculture. The International Undertaking was negotiated by specialists from the agricultural area, generally representatives of the ministries of agriculture, through FAO. The CBD was negotiated mainly by environmentalists and representatives of ministries of environment, primarily concerned with wild fauna and flora conservation, through the United Nations Environment Programme (UNEP), according to Regine Andersen (2008).

The CBD focuses mainly on conservation and sustainable use of wild biodiversity, and establishes a bilateral system of access benefit-sharing. According to CBD, member countries (called 'contracting parties') must "respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities". They must also encourage the wide application of such knowledge, innovations and practices (with the approval of their holders), as well as encourage equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices (article 8 j).

The CBD sets forth that conditions for access and sharing of benefits must be established between countries providing and using genetic resources and associated traditional knowledge, through bilateral contracts and on a case-by-case basis. Each contract is negotiated with the

country of origin and with local communities which hold traditional knowledge, including benefit sharing for each concrete case. This system is difficult to apply to plant genetic resources (used for food and agriculture) and agricultural knowledge and practices, since it was conceived to regulate access to genetic resources of wild fauna and flora species, used for chemical and pharmaceutical purposes.

According to the CBD, the country of origin of genetic resources means the country which possesses those genetic resources in in-situ conditions. "In-situ conditions" are defined as "conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species[14], in the surroundings where they have developed their distinctive properties". CBD does not have a definition of "centre of origin" or of "centre of crop diversity", but such concepts are defined by the FAO International Treaty on Plant Genetic Resources for Food and Agriculture, which is a specific agrobiodiversity treaty. [15] Therefore, CBD requires that, in the case of cultivated species, the 'surroundings where they have developed their distinctive properties' be identified.

Identification of the country of origin of many agricultural species and varieties can be a complex task, due to all the migrations and exchanges which have occurred throughout history. Identifying the 'surroundings where they have developed their distinctive properties' is even more complex. The country of origin is not always the same as the one in which the species developed its distinctive properties. The same crop species can develop new traits in geographical locations different from its place of origin. To make this point more clearer, we will present below the studies of some scientists who did research on the origin of crops:

In the famous 1859 book by Charles Darwin, "*The Origin of Species*", the origin of cultivated and domesticated plants was not the main object of study. However, in a later, less known book, "*The Variation of Animals and Plants Under Domestication*," published in 1868[16], Charles

Darwin came to some conclusions on crop domestication: there is a wild species in the origin of domesticated species; modifications among wild and cultivated species are so important that most cultivated species lose their ability to survive in nature, without assistance from humans; morphological diversity (in a broad sense) found in cultivated species is far larger than in wild species (David, 2008).

Alphonse de Candolle was a Swiss botanist who published, in 1882, the book "*Origin of Cultivated Plants*", re-published in English in 1959, in which he tried to identify the geographical regions of origin of cultivated plants through botanical, archeological, historical and linguistic criteria. He investigated the distribution of wild relatives of cultivated plants and the variation patterns. Alphonse de Candolle was one of the collaborators of *Flora Brasiliensis*, a classical study about Brazilian flora, produced in Germany between 1840 and 1860 by Carl Friedrich Philipp von Martius, August Wilhelm Eichler and Ignatz Urban[17].

Nikolai Vavilov was a Russian agronomist and geneticist who went on more than 100 expeditions to collect genetic materials worldwide, for plant breeding programs developed by the National Institute of Plant Industry[18], in the former Soviet Union. He visited over 50 countries, in Asia, the Americas, Africa and Europe, collecting approximately 50,000 plant samples, and is considered a pioneer in germplasm collection according to scientific and systematic bases. He defended the existence of eight "centers of origin" for the main plants cultivated around the world, which would be the geographical locations from which species originated. They are: 1) China; 2) India and Indo-Malaysia; 3) Central Asia; 4) Near East; 5) Mediterranean; 6) Ethiopia (Abyssinia); 7) South Mexico and Central America; 8) South America (Peru, Ecuador and Bolivia, the Chiloe Archipelago, in Southern Chile, and the Southern region of Brazil-Paraguay).

Vavilov became interested in the origins of cultivated plants because he was interested in genetic diversity, and believed they were associated. In 1926, Vavilov wrote the essay "*On the origin of cultivated plants*," dedicated to Alphonse de Candolle (who had a major influence on his work), in which he argued that the center of origin of a cultivated plant was located in the region with the greatest genetic diversity and, especially, where their wild relatives could be found (Harlan, 1975, p52-53). Later, further research showed that this does not always occur, and that center of diversity and center of origin are not necessarily the same. Plants migrated with humans, and were taken to places different from those where they originated, developing new traits in other geographic regions, which may also become centers of diversity. Many scientists pointed out gaps in Vavilov's studies, since he did not investigate, in greater depth, Sub-Saharan Africa and the lowlands of South America, where many important agricultural crops were domesticated[19].

However, many of the concepts and theories developed by Vavilov, are still widely accepted and used by geneticists[20]. Vavilov's studies were important to show that plant genetic resources are not uniformly distributed across the globe. They are concentrated, in large part, in centers of origin and diversity of cultivated plants and their wild relatives, located mainly in tropical and sub-tropical regions (Africa, Asia and the Americas).

In 1975, Jack Harlan, a U.S. American agronomist and geneticist wrote the classical book "*Crops and man*," based on the previous works of Alphonse de Candolle and Nikolai Vavilov. Harlan considered that many cultivated plants did not originate in the centers proposed by Vavilov, some plants do not have a center of diversity, and others may have more than one center of diversity. Harlan (1975, pp149-167) argued that centers of origin are not the same as centers of genetic diversity, and that cultivated plants have different patterns of variation and evolution

in time and space. He held, however, that centers of diversity do exist for many cultivated plants, and that this concept is useful to study genetic diversity.

Many scientists have contested, reformulated and added new elements to the theories of Candolle, Vavilov and Harlan[21], proposing other centers of origin and diversification, and such issues are beyond the scope of this book[22]. Our point is: it is not always easy to define a precise geographical location where a given agricultural species originated or diversified, in order to determine who is the legitimate party to authorize access to the plant genetic resource and receive benefits, as set forth in the bilateral CBD system.

Furthermore, from the standpoint of farmers, the bilateral CBD regime creates another problem: to whom do cultivated plants and agricultural knowledge belong? Who can authorized and is entitled to receive benefits which may be arise out of the use of plant genetic resources and associated knowledge? Ethnobotanist Laure Emperaire (2006) explains that, in local agricultural systems "there have been, and there continues to be, selection, genetic improvement, exchange of seeds, knowledge and experiences and wide plant circulation" And that this is a dynamic process: "Plants circulate among families, communities or ethnic groups; new varieties originating from other regions or locally produced are evaluated and incorporated into the farmer's stock of varieties; there is an interest in diversity for itself." Plant diversity is a value in itself, promoted by many traditional communities.

How can farmers, used to sharing and promoting exchange of genetic materials, knowledge and agricultural experiences via social networks and regulated by local norms, define who these resources belong to? If local/traditional farming communities are to determine who the

"owners" of these resources are, access and benefit sharing laws may encourage disputes and rivalries that can end up restricting circulation and exchange of genetic material, which is fundamental for conservation of agricultural biodiversity.

Although the CBD does not exactly establish an "owner" of genetic resources and associated traditional knowledge, its principles – prior informed consent and benefit sharing with countries of origin and local communities – are based on the assumption that there are "providers" and "recipients" (or users) of genetic resources, and that they must establish, contractually, the conditions for access and benefit- sharing. Genetic resources and traditional knowledge end up becoming commodities or merchandises, negotiated at "market prices", which goes against the collective logic of how these resources and knowledge are generated and shared by local communities. Besides, the mercantile approach adopted by the CBD does not take into consideration agricultural species of great local and regional importance for food security, which are not commodities, and, therefore, of little commercial interest.

The complexity of processes to obtain access authorizations (and ambiguities in national access-benefit sharing laws) has, in many countries, discouraged research on genetic resources and traditional knowledge[23], while, at the same time, brought very few concrete benefits for local communities and biodiversity. There is no word, until now, of a benefit sharing contract with local farming communities, resulting from implementation of access and benefit-sharing laws based in the CBD. Public domain becomes increasingly restricted – be it by means of private appropriation via intellectual property rights, or the principle of sovereignty of countries of origin over their genetic resources.

The CBD treats genetic resources as goods with an economic and utilitarian value, without considering the biological and sociocultural processes that lead to the construction of agrobiodiversity and associated knowledge. It ignores local perceptions and values associated with plant genetic resources, how local norms determine ownership over genetic resources, the intrinsic link between resource and knowledge, the circulation and exchange of plant genetic materials, its sharing by several communities etc. It does not take into consideration the complexity of social and cultural processes which enrich agrobiodiversity. It tends to undermine the free circulation of plant genetic material, encourage monopolies and restrict public domain, and potentially can have a negative impact on local agricultural systems (Emperaire and Santilli, 2006).

CBD raised unreal expectations in many biodiversity-rich countries that resources from benefit-sharing contracts signed between providers and users of genetic resources would be large and sufficient to finance biodiversity conservation, which did not happen in the vast majority of cases. Neither did the CBD solve political imbalances among countries which are biodiversity-rich (southern developing countries) and biotechnology-rich (northern developed countries). The principle of sovereignty of countries of origin over their own genetic resources, set forth by the CBD, was an attempt to balance out historical inequalities in North-South relations, related with the appropriation of these resources by northern countries through intellectual property rights. However, CBD did not provide a solution to the negative impacts of intellectual property rights on biodiversity, and, at the same time, legitimized them (indirectly). Access to genetic resources and associated knowledge became more restricted, and the special nature of plant genetic resources for food and agriculture led to the adoption of the FAO International Treaty on Plant genetic Resources for Food and Agriculture, which will be

6.4. THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Introduction

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was adopted (by consensus, with only two abstentions: Japan and the U.S.) during the 31st meeting of the FAO Conference, held in Rome on November 3, 2001, and came into effect on June 29, 2004[24]. It is the first legally-binding international instrument to deal exclusively with plant genetic resources for food and agriculture. The objectives of the International Treaty are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The preamble of the Treaty is important to understand its main premises, and therefore it is analyzed below.

According to the preamble of the Treaty, contracting parties are "convinced of the special nature of plant genetic resources for food and agriculture, their distinctive features and problems needing distinctive solutions". The "special" nature of plant genetic resources (for food and agriculture) is pointed out by many studies (Frison, López and Esquinas-Alcázar, 2011; Halewood and Nnadozie, 2008; Moore and Tymowski, 2005; Stannard, 2004, Cooper, 2002, among others) to justify a differentiated legal regime for these resources, distinct from the legal regime established for genetic resources in general. Some of the distinctive features of plant genetic resources are:

- Human intervention had (and still has) a fundamental role in the domestication of crop species and conservation of agrobiodiversity. Throughout history, farmers have been domesticating wild plants, and through selection and improvement, adapting them to agriculture and to human needs. Useful traits, such as resistance to diseases and extreme weather conditions, and more nutritious grains, rapid germination and uniform maturation were bred in by farmers, while others, such as seed dormancy, bitter-tasting grains or toxic components, were bred out by farmers. Any cultivated plant variety is the result of selection and improvement activities developed by many generations of farmers. Agrobiodiversity is the result of complex and dynamic management carried out by farmers. Conservation and sustainable use of agrobiodiversity are intrinsically related, and cannot be dealt with separately.

This difference between wild and cultivated biodiversity is, however, relative, since biodiversity cannot, under any circumstances, be reduced to a mere natural phenomenon; it is also a cultural phenomenon (Santilli, 2005; Diegues, Andrello and Márcia, 2001; Balick and Cox, 1996). Nevertheless, cultivated plants depend more heavily on humans, since many domesticated species loose their capacity to survive in wild environments.

- Exchanges among different countries and farmers led to the development of varieties whose composition is based on genetic materials from various geographical origins, which makes it difficult, in many situations, to attribute a single geographical origin to genetic materials used in the development and/or breeding of the variety. Several varieties are generally used in selection and breeding processes, both by farmers and professional breeders. Local agricultural systems are neither closed nor static, and farmers constantly incorporate new varieties, brought by other farmers or by agricultural research institutions.

Plant varieties developed by professional breeders also have a complex pedigree, which may make it difficult to identify all varieties which contributed to the development of the new variety, which is the end product of plant breeding. Evaluating the importance of each variety used in the breeding process, giving it a specific value, is a complex task. After a long process of selection, breeding and cross-breeding of several varieties, it is not simple to establish which genetic component determined that specific trait, present in the end variety. The amount of resources and time spent in doing such an identification would likely surpass the resulting economic benefits. Besides, many genetic resource collections are located outside their regions of origin, in locations very distant from where they were collected.

The spring bread wheat variety known as Veery was developed by the International Maize and Wheat Improvement Center (CIMMYT) was the product of 3170 different crosses involving some 51 parental varieties, from at least 26 different countries. The IR 36 rice variety has 15 landraces and one wild species in its heritage (Moore and Tymowski, 2005, p24). The Orofen wheat variety is included in the pedigree of 245 released varieties in China (Louwaars, 2007, p82). Estimates indicate that for development of each new variety of wheat, the average number of varieties used increased from 12 to 64, in 1992 (Visser, 2008).

The International Treaty´s preamble also sets forth that contracting parties recognize that "plant genetic resources for food and agriculture are a common concern of all countries, in that all countries depend very largely on plant genetic resources for food and agriculture that originated elsewhere". All countries are dependent, to a greater or lesser extent, on plant genetic resources originating from other parts of the world. Currently, there is no self-sufficient country in terms of plant genetic resources, all are inter-dependent, on an average of 50% (Palacios, 1997). This inter-dependence among countries is greater in regard to plant genetic resources (for food and agriculture) than regarding other genetic

resources. Therefore, countries frequently need to access and use plant genetic resources originating from other countries, for scientific research and breeding, as well as for direct use in their agricultural and food systems. Maintaining the flow and exchange of plant genetic resources is essential to breeders, farmers and consumers. Besides, climate change will have a great impact on countries´ interdependence on genetic resources for food and agriculture, according to a more recent study, prepared at the request of the Commission on Genetic Resources for Food and Agriculture (Fujisaka et al, 2009). According to the study, "germplasm interdependence will be the greatest for crops, augmenting the already high (and well-documented) international movement of plant genetic resources for food and agriculture (PGRFA) that has been taking place for a long time. Interdependence on PGRFA will likely increase in association with adaptive crop improvement achieved through both conventional plant breeding and biotechnological methods. Interdependence will also increase as climate change creates the need to adopt new crops in particularly stressed areas – millets and sorghum in the place of maize, for example" (Fujisaka et al, 2009). The International Treaty addresses adaptation to climate change through facilitated access to plant genetic resources (via multilateral system) and through its Benefit-Sharing Fund, that supports on-farm conservation of plant genetic resources in developing countries, as well as adaptation to climate change. During the 4th session of the governing body, the International Treaty´s Benefit-Sharing Fund was officially recognized as an international adaptation-funding mechanism under the Adaptation Fund of the UN Framework Convention on Climate Change (UNFCCC). The interfaces between agricultural biodiversity and climate change, and the need to promote closer collaboration between the International Treaty and the UNFCC have been highlighted in several international fora: The Cordoba Declaration on Agricultural Biodiversity in Addressing Hunger and Climate Change, adopted in September 2010[25] has encouraged the adoption, by UNFCCC, of a programme of work on agriculture and the

development of synergies between UNFCCC mechanisms and agricultural biodiversity fora. The Ministerial Conference on Biodiversity, Food Security and Climate Change, held on 11 March 2011, in Bali, Indonesia, has also adopted the Bali Ministerial Declaration on the Role of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) on Biodiversity, Climate Change and Food Security[26]. During its 4th session, the governing body of the International Treaty requested its secretary to explore possible areas of cooperation with the UNFCC, given the connection between climate change and adaptation in agriculture and genetic resources, such as the participation of the Treaty as a partner in the initiative on reducing emissions from deforestation and forest degradation in developing countries (REDD). In relation to mitigation of climate change, the International Treaty has the following limitation: its multilateral system only applies to Annex I crops used for food and feed purposes, and not for greenhouse gas emission reduction and CO2 fixation nor for bioenergy production (Grugel, 2009)

The treaty preamble also sets forth that contracting parties "acknowledge that that the conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture are essential in meeting the goals of the Rome Declaration on World Food Security and the World Food Summit Plan of Action and for sustainable agricultural development for this and future generations".

The Rome Declaration was adopted in 1996, during the World Food Summit, and countries committed to "achieving food security for all and to an ongoing effort to eradicate hunger in all countries, with an immediate view to reducing the number of undernourished people to half their present level no later than 2015". In order to meet these objectives, the World Food Summit Plan of Action sets forth that governments, in

collaboration with civil society, must "promote access, by farmers and farming communities, to genetic resources for food and agriculture". According to the Plan of Action, countries must also "promote an integrated approach to conservation and sustainable utilization of plant genetic resources for food and agriculture, through *inter alia* appropriate *in situ* and *ex situ* approaches, systematic surveying and inventorying, approaches to plant breeding which broaden the genetic base of crops, and fair and equitable sharing of benefits arising from the use of such resources[27]".

The Treaty recognizes the close relationship between conservation of plant genetic resources, and, when referring to the Rome Declaration on World Food Security, contributes to create awareness that hunger and undernourishment can only be eradicated if access to plant genetic resources is ensured for farming communities, free of restrictions, and that genetic diversity is conserved not only *ex situ*, in collections, but also *in situ* and on farm, in the agroecosystems, with the participation of local farmers.

Another part of the treaty´s preamble says that contracting parties "recognize that, in the exercise of their sovereign rights over their plant genetic resources for food and agriculture, states may mutually benefit from the creation of an effective multilateral system for facilitated access to a negotiated selection of these resources and for the fair and equitable sharing of the benefits arising from their use".

The Treaty recognizes sovereign rights of States over their plant genetic resources, and that authority to determine access to these resources rests with national governments and is subject to national laws. However, in the exercise of their sovereign rights over their plant genetic resources, the Treaty's contracting parties agree to establish a multilateral system of access and benefit sharing, both to facilitate access to

plant genetic resources for food and agriculture, and to share, in a fair and equitable way, the benefits arising from the utilization of these resources. Such multilateral system is restricted, nonetheless, to 35 food crops and 29 forages (legumes, grasses and other) that are listed in Annex I of the Treaty (see, at the end of this chapter, the list of crops covered under the multilateral system) and that are under the management and control of the contracting parties and in the public domain. Forages were included because they are mainly destined for animal feed, which are then consumed by humans.

Access to the plant genetic resources included in Annex I of the Treaty, through the multilateral system, is provided solely for the purpose of utilization and conservation for research, breeding and training for food and agriculture, and as long as it does not include chemical, pharmaceutical and/or other non-food/feed industrial uses. Maize (corn) genetic resources, for instance, can only be accessed through multilateral system for food and agriculture purposes, not for production of agrofuels, for example. If access is aimed at non-food/feed industrial uses, the multilateral system is not applicable, and the interested party must follow CBD´s bilateral regime of access and benefit sharing, which depends on "mutually agreed terms" between providers and users of genetic resources[28].

Inclusion of agricultural crops in Annex I of the Treaty met, in theory, the criteria of interdependence and food security, but political criteria were also decisive. The choice of crops to be included in the multilateral system led to many controversies during treaty negotiations[29]. The extensive list of crops originally presented ended up substantially reduced, and important crops were excluded, such as soybean (removed by China, after a conflict over the occupation of China airspace by an U.S. aircraft), peanuts, tomatoes, sugarcane, many wild relatives of cultivated plants, onions, garlic, cucumber, pumpkins and squashes, pepper, tropical forages, tea, coffee and cacao, among others. On the other hand, minor

crops, with questionable importance for food security, were included, such as strawberries and asparagus. Crops of great local or regional importance were excluded, such as wild relatives of manioc (needed for genetic improvement of the species, and a staple food in Sub-Saharan Africa and many Latin American countries), many species of millet used in human and animal diets in Mid-Asia and the Near East, and tropical forages which are widely used by pastoralist communities. The 64 agricultural crops included in Annex I account for approximately 80% of the world's supply of food, but represents the main commercial crops. Inclusion of a new crop in Annex I depends on consensus between all treaty contracting parties[30].

Many developing countries tried to limit the scope of the multilateral system because they believe the CBD bilateral regime would be more advantageous[31], since access and benefit sharing are negotiated directly with the provider country, and benefits go to that country, not to the multilateral system. (See Table 6.1. for the main differences between the CBD bilateral regime and the FAO Treaty´s multilateral system) Developed countries, on the other hand, strongly resisted any restriction to intellectual property rights over plant genetic resources, and this made developing countries even less willing to make concessions, and to allow the inclusion of further crops in the multilateral system. Retaliation among countries also took place. Brazil and Bolivia excluded peanuts, Andean countries excluded tomato and African countries excluded tropical forages.

Table 6.1. – Main differences between the CBD bilateral regime and the multilateral system (FAO Treaty). Source: CBD, articles 1, 8,9 and 15 (www.cbd.int/convention/text/, accessed 10 March 2011) and FAO Treaty, articles 1, 5,6, 10, 11, 12 and 13 (/www.planttreaty.org/texts_en.htm)

	CBD	**FAO TREATY (MULTILATERAL SYSTEM)**
Scope	All forms of biodiversity, including both wild and domesticated species.	The Treaty covers all plant genetic resources for food and agriculture, but the multilateral system includes only those that are listed in Annex I, and which are under management and control of the contracting parties and in public domain.
Objectives	Conservation of biological diversity, sustainable use of the components of biological diversity and fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Conservation and sustainable use of plant genetic resources *for food and agriculture* and the fair and equitable sharing of the benefits arising out of their use, in harmony with CBD, *for sustainable agriculture and food security*.
Access purposes	Conservation and sustainable use for any purposes, in principle, but CBD was conceived mainly for chemical, pharmaceutical, and/or other non-food/feed uses.	Utilization and conservation for research, breeding and training for *food and agriculture*, and as long as it does *not* include chemical, pharmaceutical and/or other non-food/feed industrial uses.
Access and benefit-sharing	CBD recognizes sovereign rights of states over their natural resources, and the authority to determine access to genetic resources rests with national governments and is subject to national access and benefit-sharing laws. Access depends on 'mutually agreed upon terms", established through bilateral contracts between providers and users, on a case by case basis. Access is subject to prior informed consent of the country of origin of resources, and to fair and equitable sharing	Contracting parties (of the FAO Treaty) agree to establish a multilateral system of access and benefit sharing (which applies only to 35 food crops and 29 forages listed in Annex I of the Treaty, under the management and control of the contracting parties and in the public domain). A Standard Material Transfer Agreement (SMTA) establishes access and benefit-sharing conditions, and access is facilitated and expeditious. Benefit-sharing is mandatory only when commercialized products (that incorporate

	of benefits deriving from their use. Access to associated traditional knowledge depends also on prior informed consent of Indigenous peoples and local communities.	material accessed from the multilateral system) are *not* available without restriction to others for further research and breeding (ex: patented genetic materials) The equitable share corresponds to 1.1% of gross product sales minus 30%, which represents 0.77%/ or 0.5% of all product sales resulting from the same crop. Other benefit-sharing mechanisms are: exchange of information, access to and transfer of technology and capacity-building.
Forms of conservation	*Ex situ* conservation is considered as complementary to *in situ* conservation, and must preferably take place in the country of origin of genetic resources.	Articles 5 and 6 of the FAO treaty establishes principles and guidelines for in situ, on farm and ex situ conservation of *all* plant genetic resources for food and agriculture. The multilateral system of access and benefit-sharing (articles 12 and 13) apply only to plant genetic resources listed in Annex I and under management and control of the contracting parties and in public domain. Access to plant genetic resources for food and agriculture found in *in situ* conditions must be provided according to national laws.

In reality, the treaty establishes a double legal regime for plant genetic resources that are under the management and control of the contracting parties and in the

plant genetic resources for food and agriculture. It is the first time that a legally-binding international treaty acknowledges the role of local farmers and communities in the conservation of agrobiodiversity, obliging countries to adopt actions, policies and programs to support on-farm conservation, although the Treaty recognizes that it is up to the countries to decide which specific actions to take. On-farm conservation plays several important functions besides conservation, such as empowerment of local communities, strengthening of traditional and local agricultural systems and keeping farmers farming.

Some authors see on-farm conservation as a type of *in situ* conservation, and the expression "on-farm *in situ* conservation" is very commonly used. Others believe the term *in situ* refers mainly to conservation of wild species in their natural habitats, and that, when domesticated species are managed by farmers, in local agroecosystems, it is more appropriate to use the expression "on farm conservation". Walter de Boef prefers to use the expression "community biodiversity management", pointing out that the term "management" is more appropriate than "conservation," because it better translates the dynamic nature of human and ecological processes, which cannot be controlled or "conserved." "Conservation" is a concept developed by conservationists, rather than a goal of farmers (Boef, 2000)

In situ conservation is in Article 5.1. "d" of the treaty, which establishes the obligation of contracting parties to promote *in situ* conservation of wild crop relatives and wild plants for food production, including in protected areas, by supporting, *inter alia*, the efforts of indigenous and local communities. *In situ* conservation of cultivated plants may take place both in protected areas and beyond their borders, in the environments where they developed their distinctive properties. When conserved *in situ*, cultivated plants maintain their capacity to evolve and adapt. Furthermore, *in situ*

conservation maintains not only the plant but the whole agricultural ecosystem, and it does not isolate the plant from the social and cultural contexts in which they evolved.

- *Ex situ* conservation is in Article 5.1. "e", which sets forth that countries must cooperate to promote the development of an efficient and sustainable system of *ex situ* conservation, giving due attention to the need for adequate documentation, characterization, regeneration and evaluation of genetic resources. "Documentation" refers to the totality of the documentation that should be available for genebank accessions, including that related to the characterization, regeneration and evaluation of individual accessions. "Characterization" refers to the categorization of data on highly heritable characteristics of genebank accessions, such as colour of flowers, that are constant in any environment. "Regeneration" refers to the need to grow out stored seeds periodically to ensure that they remain viable. "Evaluation", on the other hand, relates to the assessment of the agronomic characteristics of the material, including disease or drought resistance, including my molecular techniques (Moore and Tymowski, 2005, p47). To a large extent, the accessibility of germplasm, and its usefulness for farmers and breeders, will depend on the adequacy of the documentation, characterization, regeneration and evaluation of that germplasm, as Moore and Tymowski point out (2005). Hawtin and Fowler (2011) point out that "conserving genetic diversity e*x situ* is vital if plant breeders are to have ready access to the traits and genes they need to do their work. It would be impossibly complicated and expensive if new materials had to be freshly collected from the wild or from farmers' fields, often in far away countries, every time a plant breeder needed new genetic diversity". Besides, "e*x situ* collections provide a "safety net" – a last resort – that enables locally adapted varieties and/or unique traits to be reintroduced back into farming systems after they have been lost due to natural or human-induced disasters, changing production systems, or as a result of

their replacement by new varieties", Hawtin and Fowler point (2011) out. Two significant developments (aimed at ex situ conservation) have been the creation of the Global Crop Diversity Trust, in 2004, (as an endowment fund to support ex situ conservation of plant genetic resources and an essential element of the funding strategy of the International Treaty) and the opening, in 2008, of the Svalbard Global Seed Vault, in (see the chapter of this book on climate change for more information on this vault, whose primary operational costs are covered by the trust).

It is very difficult, and perhaps impossible, to determine how representative *ex situ* collections are of the total agricultural diversity found *in situ/on farm*. All over the world, about 7.4 million plant accessions are currently conserved in germplasm banks, i.e. in *ex situ* collections, and there are more than 1750 genebanks worldwide, about 130 of which hold more than 10,000 accessions each. Of the 7.4 million accessions worldwide, national government genebanks conserve about 6.6 million, 45 per cent of which held in only seven countries. These accessions represent a limited number of major crops, and about 45 percent of all the accessions in the world´s genebanks are cereals. Food legumes are the next largest group, accounting for about 15 per cent of all accessions, while vegetables, fruits and forage crops each account for 6-9 percent of the total number of accessions maintained ex situ. Roots and tubers, as well as oil and fibre crops each account for 2-3 percent of the total (according to the Second Report on the State of the World´s Plant Genetic Resources for Food and Agriculture). Landraces and local varieties, as well as underutilized and neglected plant species and crop wild relatives are underrepresented in *ex situ* collections. According to Laure Emperaire (2008, p420), the genetic diversity of manioc (cassava) found in a traditional agroecosystem in the Negro river basin (in the Brazilian Amazon) is wider than the genetic diversity found in manioc ex situ collections of the International Center for

Tropical Agriculture (CIAT), in Cali (Colombia). Besides, various analyses suggest that between 25 and 30 percent of the total holdings (or 1.9-2.2 million accessions) are distinct, with the remainder being duplicates held either in the same or, more frequently, in a different collection. Much of this duplication is unintended and the situation is most serious for vegetatively propagated species and species with recalcitrant seeds (according to the Second Report). It is widely recognized that there is a need for greater rationalization within and among collections.

Article 6 of the treaty establishes that the Contracting Parties must develop and maintain appropriate policy and legal measures that promote the sustainable use[34] of plant genetic resources for food and agriculture, such as:

a) pursuing fair agricultural policies that promote the development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources;

b) strengthening research which enhances and conserves biological diversity by maximizing intra and inter-specific variation for the benefit of farmers, especially those who generate and use their own varieties and apply ecological principles in maintaining soil fertility and in combating diseases, weeds and pests;

c) promoting plant breeding efforts which, with the participation of farmers, particularly in developing countries, strengthen the capacity to develop varieties particularly adapted to social, economic and ecological conditions, including in marginal areas;

d) broadening the genetic base of crops and increasing the range of genetic diversity available to farmers;

e) promoting the expanded use of local and locally adapted crops, varieties and underutilized species;

f) supporting the wider use of diversity of varieties and species in on-farm management, conservation and sustainable use of crops and creating strong links to plant breeding and agricultural developmentTj8.3946
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its agriculture and rural development programs and policies, activities aimed at conservation and sustainable use of plant genetic resources (set forth in articles 5 and 6, mentioned above), and cooperate with other countries, directly or through FAO, and with other international organizations.

The multilateral system of access and benefit sharing

Facilitated access

Next, we will present the main rules of the multilateral system of access and benefit sharing. We shall start with the rules related with facilitated access:

- The multilateral system applies only to plant genetic resources in Annex I of the Treaty that are under the management and control of the contracting parties and in public domain, and facilitated access is provided to natural or legal persons in the jurisdiction of any treaty contracting party (or member country).

The multilateral system is a global common pool of PGRFA (plant genetic resources for food and agriculture) for a specific group of crop species (listed in Annex I of the treaty- (See Table 6.2 for the list of food crops, and Table 6.3. for the list of forages, included in Annex I).), to which access will be facilitated for research and breeding for food and agriculture. It is a geographically-distributed "virtual" gene bank, and materials in the multilateral system are distributed over a large number of individual collections located in different countries (Chiarolla and Jungcurt, 2011). In the multilateral system, sovereignty of countries of origin over their plant genetic resources is not meant to establish, on a case-by-case basis, the conditions for access, but rather to

create a system which provides access to all contracting parties, under standard conditions, to all 64 plant genetic resources included in the multilateral system (and listed in Annex I of the treaty). Regardless of how many plant genetic resources each country made available to the multilateral system, all contracting parties have facilitated access to all 64 plant genetic resources included in the multilateral system. According to the treaty (article 10.2), contracting parties agree to "establish a multilateral system, which is efficient, effective, and transparent, both to facilitate access to plant genetic resources, and to share, in a fair and equitable way, the benefits arising from the utilization of these resources, on a complementary and mutually reinforcing basis".

Under article 12. 2 of the treaty, contracting parties have agreed to provided facilitated access to plant genetic resources for food and agriculture (within the multilateral system) *to other contracting parties and to legal and natural persons under the jurisdiction of any contracting party* (emphasis added). A literal interpretation would lead to the conclusion that only researchers and institutions from contracting parties can access resources included in the multilateral system. However, this interpretation is not correct: individual researchers and research institutions located in countries which did not ratify the treaty can also access plant genetic resources through the multilateral system, as long as they sign the standard material transfer agreement (SMTA). Such SMTA will be binding on its parties, which are the provider and recipient institutions, and not the countries themselves (these are contracting parties to the treaty, not to the SMTA). A SMTA is a bilateral contract, and a legally enforceable agreement. A SMTA can be enforced within the jurisdictions of the countries where providers and recipients are based, independently of the ratification or not of the treaty by their country. This is especially true in relation to materials held in trust by CGIAR centers worldwide, that must continue to make material available to

recipients from non-contracting parties. In 2006, when CGIAR centers signed agreements with the governing body of the International Treaty, they clarified their understanding that while the agreements talked only in terms of making samples of plant genetic resources available to contracting parties, this would not prevent the centres from also making germplasm available to non-contracting parties, using the SMTA, as well as to farmers for direct cultivation and use (Moore and Frison, 2011). Restricting access to genetic resources would go against the spirit of the treaty, which intends to facilitate access.

On one hand, everyone (including private companies and scientific research institutions, either public or private) has facilitated access to plant genetic resources made available through the multilateral system. On the other hand, there is no obligation for private companies to make their own *ex situ* collections available to the multilateral system. In another words, private companies benefit from facilitated access to resources kept by the multilateral system without having to commit themselves to share their own germplasm collections. For this reason, civil society organizations claim that, in its original conception, the objective of the Treaty was to strengthen farmers' rights, but it ended up becoming an instrument which "grants new privileges to industry." In reality, there is a serious inequality in the system: access to resources maintained by public and international agricultural research institutions, is provided to private institutions through the multilateral system and in a facilitated way, but there is no obligation for them to make their own germplasm collections available to public and international institutions. Despite this, many organizations recognize that it is a viable alternative to the bilateral CBD regime, which restricts access and circulation of genetic resources by imposing complex and costly bilateral negotiations which are incompatible with the nature of plant genetic resources (ETC Group 2001).

The treaty sets forth that all natural and legal persons holding plant genetic resources listed in Annex I are "invited" to include their resources in the multilateral system, and that contracting parties must take appropriate measures to "encourage" them to do so (art. 11.2)[36]. It also establishes that within two years of the entry into force of the treaty (which occurred on June 29th, 2004), the governing body must assess the progress that such natural and legal persons have made in the inclusion of their own resources in the multilateral system. The governing body must then decide whether access will continue to be facilitated to those natural and legal persons that have not included their resources in the multilateral system (article 11.4). According to a recent study (Chiarolla and Jungcurt, 2011), no natural and legal persons that are not part of national PGRFA systems, such as private plant breeding companies, have decided, until March 2011, to voluntarily place their collections of Annex I materials directly in the multilateral system. Two natural and legal persons are listed on the treaty website – Association pour l'Etude et l'Amélioration du Maïs (Pro-Maïs), and Association Française des Semences de Céréales à Paille et Autres Espèces Autogames (AFSA)- however these are both part of the French National Institute for Agricultural Research (INRA) and thus have to be considered to be part of the materials under the management and control of a party. This means that to date (March 2011), no collections of truly separate natural and legal persons (i.e. collections from the private sector) have been included in the multilateral system, and thus there are currently no natural and legal persons outside of national PGRFA systems that have included their collections in the MLS, according to the study (Chiarolla and Jungcurt, 2011). At its second session, in Rome (2007), the governing body of the treaty decided to postpone the assessment of progress in the inclusion of PGRFA in the multilateral system until its third session. At its third session in Tunis (2009), the governing body conducted an

assessment of progress of inclusion of materials, but decided to postpone the assessment of whether facilitated access should continue to be granted to legal and natural persons who have not included their PGRFA in the multilateral system until its fourth session in March 14th-18th 2011, in Bali (Indonesia**),** when, once again, this decision was postponed until its fifth session, expected to be held in 2013. Since such a decision has not yet been made, there is currently no legal basis to refuse access to natural and legal persons from contracting parties who have not made their collections available to the multilateral system. The above-mentioned study (Chiarolla and Jungcurt, 2011) recommends that the governing body of the treaty consider options for restricting access to natural and legal persons (from contracting and non-contracting parties) that have not made their genetic materials available to the multilateral system. It considers two options: the first one would be to simply follow the principle that only those entities that share their own materials are entitled to benefit from facilitated access through the multilateral system, but, according to the study, such option must be considered with caution, since a direct restriction could lead to adverse effects and deter private sector participation and undermine the multilateral system in the long run. The second option discussed by the study would be to devise a payment scheme for access for those natural and legal persons who have decided not to make their materials available. The scheme would make access subject to additional contributions to the benefit-sharing fund for those entities that benefit from facilitated access under the multilateral system but refuse to grant the same access to their own materials by not putting their collections in the system. There would be two options for such entities: 1) *Option 1 - Pay per accession:* at the time of accession, the recipient would pay a fixed fee per accession to the benefit-sharing fund. Benefit-sharing payments would be made once a product incorporating that material is commercialized, that is, based on a percentage of the sales of the

individual product; 2) *Option 2 – Pay per crop*: recipients that opt to make payments based on a percentage of all sales of a given Annex I crop – would have to contribute a higher percentage of the sales of products of that crop as long as their own collections are not available to the multilateral system. If they make their materials available, the payment is reduced to the normal rate. (Chiarolla and Jungcurt, 2011)

- Access to plant genetic resource must be provided "expeditiously", without the need to track individual accessions and free of charge, or, when a fee is charged, it must not exceed the minimal cost involved (that´s why it is called facilitated access);

- Facilitated access to plant genetic resource must be provided along with all available passport data and other associated available non-confidential descriptive information;

According to a recent study (Chiarolla and Jungcurt, 2011), seven years after the treaty's coming into force, progress in the implementation of the multilateral system has been slow: less than one-sixth of the contracting parties have notified which collections they are placing in the multilateral system and provided the documentation necessary to facilitate access. According to the study (Chiarolla and Jungcurt, 2011, while all materials under the management and control of contracting parties are legally part of the multilateral system, their effective inclusion requires that parties identify which collections are under their management and control, and inform the treaty secretariat where information on how to access these materials is publicly available. As of January 2011, the total number of accessions for which such complete information is available was estimated at around one million. Roughly two-thirds are accessions made by the international agricultural research centers (IARCs) of the CGIAR and one-third by parties and institutions of the European region. Accessions by other regions make up approximately 2.6 percent, with African countries contributing 2.1 percent, those from

the Near East 0.3 percent and those from Latin America and the Caribbean 0.2 percent. Only 22 of the 127 contracting parties have provided notification of their collections and access to the relevant information. Of these, 13 have made all necessary information directly available to the secretariat, and six parties have made partial information available, but information about their collections can be accessed through the Eurisco[37] catalog or the website of Icarta (International Center for Agricultural Research in Dry Areas).

- Facilitated access to plant genetic resource must be provided pursuant to a standard material transfer agreement (SMTA), which was adopted by the treaty´s governing body during its first session, held between June 12 and 16, 2006, in Madrid. The treaty's governing body adopted the SMTA[38] through Resolution 01, of October 16, 2006.

The Standard Material Transfer Agreement (SMTA) is a contract between the provider and the recipient of a plant genetic resource, which establishes the terms and conditions for the genetic material transfer. The contracting parties of the treaty are the (member) countries, but the parties in the SMTA are natural or legal persons providing (the "provider") and receiving (the "recipient") plant genetic resources through the multilateral system[39]. Once a country ratifies the Treaty, the adoption of the SMTA becomes mandatory for crops listed in Annex I. Other MTA models can only be used for plant genetic resources not included in the multilateral system.

The Standard Material Transfer Agreement (SMTA) contains a clause (pursuant to article 12.4 of the treaty) stating that the recipient of plant genetic resources must require that the conditions of the SMTA be applied to all subsequent transfers of plant genetic resources. According to article 6.4 of the SMTA, when the recipient transfers

the genetic material supplied (through the multilateral system) to another person or entity ("the subsequent recipient"), the recipient must do so under the terms and conditions of the SMTA, through a new material transfer agreement, and notify the governing body[40]. However, the recipient has no further obligations regarding the actions of any subsequent recipient.

The recipient must also make available to the multilateral system all non-confidential information resulting from research and development performed on the material received. It is not clear, however, who decides what information is confidential and what information is not: the recipient or the Treaty's steering committee? The objective of this clause is to force those who access resources included in the multilateral system to provide information about them, in order to share with other users of the system. Nevertheless, criteria for definition of what is and what is not confidential information are not established. This could create space for users to simply withhold information about accessed resources, under the pretext of "confidentiality".

- The multilateral system also includes plant genetic resources listed in Annex I and held in ex situ collections of International Agricultural Research Centres (IARCs) of the Consultative Group on International Agricultural Research (CGIAR), and access to such resources will be provided according to the same rules of the multilateral system, and through the Standard Material Transfer Agreement (SMTA).

The IARCs started using the SMTA for genetic materials of Annex I crops on January 1st, 2007 (See Table 6.2 for the list of food crops, and Table 6.3. for the list of forages, which are included in Annex I). At the second session of the treaty's governing body, held from October 29 to November 2, 2007, in Rome, contracting

parties decided that plant genetic resources *not* listed in Annex I, held by IARCs, should also be provided according to the SMTA. The governing body agreed to the addition of an explanatory footnote to the SMTA clarifying its application to Annex I as well as non-Annex I materials. Therefore, the SMTA is used for all material collected prior to the entry into force, in 2004, of the International Treaty (Annex I and non Annex I materials), and for Annex I material collected after the entry into force of the International Treaty (which are held in trust by IARCs). However, non-Annex I material received and conserved by IARCs after the coming into force of the International Treaty, will be available for access on terms consistent with those mutually agreed between the IARCs that receive the material and the country of origin of such resources (or the country that has acquired those resources in accordance with CBD or other applicable law), as article 15.3 of the treaty sets out. That is, non-Annex I material collected after the entry into force of the treaty fall outside the scope of the multilateral system in the IARCs, and are subject to CBD and to the Nagoya Protocol. On the other hand, the contracting parties in whose territory the plant genetic resources for food and agriculture were collected from *in situ* conditions (and are conserved in ex situ collections of IARCs) will be provided with samples of such plant genetic resources on demand, *without any MTA* (art.15.1.b ii of the treaty). The international legal personality of the IARCs holding *ex situ* collections is recognized and forms the basis of the agreements signed by the centres with the governing body of the treaty.

According to Chiarolla and Jungcurt´s study (2011), in the time period until 31 December 2009, a total of 1.15 million samples of Annex I crops have been distributed using the SMTA, of which approximately 84% were sent to recipients in developing countries or countries with economies in transition, 9.5% to developed countries and 6.5% to other CGIAR centers. According to the Second Report on the State of the

World´s Plant Genetic Resources for Food and Agriculture, germplasm of crops listed under Annex 1 of the International Treaty is conserved in more than 1,240 genebanks worldwide and adds up to a total of about 4.6 million samples. Of these, 13 per cent is stored in the collections of the CGIAR centres and about 51 percent is conserved in more than 800 genebanks of the contracting parties of the International Treaty.

However, a study conducted by Edward Hammond, and released on March 2011, indicates that approximately half of sorghum genebank collections maintained by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT[41]) is being distributed outside of the multilateral system, through the U.S. Department of Agriculture (USDA) genebanks. USDA and ICRISAT hold some sorghum germplasm collections in commom, and according to the study, corporate and commercially oriented breeders are avoiding the benefit sharing requirements under the multilateral system by accessing the USDA sorghum genebanks instead of ICRISAT´s collections. The U.S. has not ratified the International Treaty, and the USDA distributes their sorghum collections freely, while ICRISAT´s collections are under the multilateral system, and access can only be granted through a SMTA, which has mandatory benefit sharing requirements, according to the treaty´s system. Therefore, recipients of large USDA distribution of sorghum are not obligated to share benefits and do not have to comply with the restrictions of the SMTA on patenting parts of the genetic material received (Hammond, 2011).

- Access to plant genetic resources under development, including materials being developed by farmers, is at the discretion of their developer, during the period of their development.

That is, there is no obligation to provide access to materials under development, and if the developer opts to grant access, he may establish additional conditions (apart

from the conditions established by the SMTA). According to the SMTA, plant genetic resources "under development" means "material derived from the genetic material, and hence distinct from it, that is not yet ready for commercialization and which the developer intends to further develop or to transfer to another person or entity for further development. The period of development is deemed to have ceased when those resources are commercialized as a product" (article 2 of the SMTA).

-. According to the treaty (article 12.3.d), "recipients shall not claim any intellectual property or other rights that limit the facilitated access to the plant genetic resources for food and agriculture, *or their genetic parts or components, in the form received from the multilateral System*" (emphasis added).

Natural or legal persons who receive plant genetic resources through the multilateral system cannot prevent third parties from receiving the same resources through the system, through intellectual property rights over them. This is one of the most controversial issues of the treaty, and this norm resulted from tense negotiations between developed countries, which opposed to any restriction or limitation on intellectual property rights established by the treaty, and developing countries, which intended to expressly prevent intellectual property rights from being granted over genetic materials provided through the multilateral system, which would limit access to them.

Most developed countries understand that intellectual property rights can be requested regarding plant genetic resources or their parts or components if some innovation or modification has taken place, i.e. as long as the material is no longer in "the form received from the multilateral system." When the European Union joined the Treaty, on March 31, 2004, it declared that it interprets Article 12.3.d (above-

mentioned) of the treaty as recognising that plant genetic resources for food and agriculture or their genetic parts or components which have undergone innovation may be the subject of intellectual property rights provided that the criteria relating to such rights are met. Austria, Belgium, Denmark, Finland, Germany, Greece, Ireland, Italy, Luxembourg, Sweden, Poland, Spain, Sweden and United Kingdom made similar declarations[42]. In another words, any innovation would be enough to allow intellectual property rights´claims. It is controversial, however, if the mere isolation of genes (contained in genetic material accessed through the multilateral system) would be enough to allow patenting, because if an unaltered gene (simply isolated from a plant in the multilateral system) can be patented, access to these materials would be restricted, which goes against the spirit of the treaty, which seeks to facilitate access to plant genetic resources. According to Visser and Borring (2011), it remains a matter of legal interpretation and jurisprudence "what really constitutes a "product" in biotechnological use, and in particular whether the mere isolation and independent multiplication and use of a DNA sequence in its original form but in a different genetic environment is sufficient to define that as a "product". However, on the view of the seed industry (represented mainly by the International Seed Federation –ISF), cells, organelles (specialized subunits within cells that have specific functions), genes or molecular constructs isolated from the material may be protected by the recipient through patents, if the criteria for patentability are met (Den Hurk, 2011).

- Access to plant genetic resources found in *in situ* conditions must be provided according to national legislation or, in the absence of such legislation, in accordance with standards set by the governing body of the treaty (article 12.3.h.)

For countries who ratified CBD and approved national access and benefit-sharing laws (based on CBD principles), access to *in situ* plant genetic resources

(including both wild relatives of crop species and local/traditional varieties and landraces) is subject to prior informed consent and equitable benefit-sharing with the countries of origin and local communities (CBD, article 8j). Not all countries that have ratified CBD already have national access and benefit-sharing laws, which creates operational difficulties for the implementation of CBD principles. Article 12.3 h. of the treaty establishes that, in the absence of such (national legislation), contracting parties may adopt standards set by the governing body of the treaty. However, such (international) standards have not been adopted yet by the governing body, and national laws must regulate access to plant genetic resources in *in situ* conditions (for a more detailed discussion on national laws on access to *in situ* and *on farm* plant genetic resources, see the next chapter of this book).

- In emergency disaster situations, contracting parties agree to provide facilitated access to plant genetic resources for food and agriculture in the multilateral system for the purpose of contributing to the re-establishment of agricultural systems, in cooperation with disaster relief co-ordinators (article 12.6.)

Restoring agriculture and food security is an essential step in helping any community or nation recover from natural disasters or conflicts[43]. Germplasm banks can be useful for recomposition of areas devastated by wars or natural catastrophes, which has already occurred on several occasions. When a tsunami killed thousands and devastated 12 Asian countries in 2004, local agricultural systems were also affected. In Sri Lanka and Malaysia, one of the effects of advancing sea waves over the sand was excessive salt contents on coastal regions, and the germplasm bank in the Philippines sent six varieties of salt-tolerant rice to the affected regions in order to rebuild their farming systems. Something similar happened in Rwanda, which, in 1994, was

devastated by genocide, war and hunger. Approximately 800 thousand people died in a few months and 3 million more became refugees in neighboring countries. An emergency program was established by the International Tropical Agriculture Center, with support from other international centers, agricultural institutions on neighboring countries and non-governmental organizations, in order to ensure that farmers received seeds and technical assistance to restore their agricultural systems, and restart planting of local varieties. Seeds kept in germplasm banks were used, as well as bean and corn seeds stored by farmers themselves[44]. There are also examples of threats facing genebanks when political instability and civil unrest happens: in Egypt, recent political unrest led to the looting of the Egyptian Desert Gene Bank at Sheikh Zowaid Station in North Sinai. At the Desert Gene Bank, home to a prized collection of fruit and medicinal plants, equipment was stole, the facility's cooling system was destroyed, and data that represented more than a decade worth of research were ruined (in February 2011). The Egyptian bank is specialized in desert plants[45].

Access and benefit sharing

We will now present the main rules related with benefit-sharing in the multilateral system regarding benefit sharing:

- According to article 13.1 of the treaty, the contracting parties recognize that facilitated access to plant genetic resources for food and agriculture constitutes itself a major benefit of the multilateral system.
- The following benefit-sharing mechanisms are established: 1) exchange of information: contracting parties agree to make available information which, *inter alia*, encompass catalogues and inventories, information on technologies, results of technical, scientific and socio-economic research, including characterization,

> evaluation and utilization, regarding those plant genetic resources for food and agriculture under the multilateral system. Such information shall be made available, when non-confidential, through the information system[46] ; 2) access and transfer of technology for the conservation, characterization, evaluation and use of plant genetic resources for food and agriculture which are under the multilateral system; 3) capacity-building[47]; and 4) sharing of monetary and other benefits of commercialization, taking into account the priority activity areas in the rolling Global Plan of Action for Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture, and under the guidance of the governing body of the treaty.

There are two different benefit-sharing frameworks: the first one (which includes exchange of information, access and transfer of technology and capacity-building) is not connected with any specific genetic material access or transfer, since it comprehends general mechanisms, which are independent of specific transactions. The second benefit sharing framework (sharing of monetary and other benefits of commercialization) is associated with a specific access or transfer, and depends on further commercialization of resources and other conditions (article 16.d.ii and article 6.7 of the SMTA). According to the treaty, a recipient (of plant genetic resources) who commercializes a product that is a plant genetic resource for food and agriculture and that incorporates material accessed from the multilateral system, must pay to the treaty´s Benefit Sharing Fund, an equitable share of the benefits arising from the commercialization of that product, except whenever such a product is *available without restriction to others for further research and breeding*, in which case the recipient who commercializes will be "encouraged" to make such payment (that is, the payment is not mandatory, but voluntary). In another words, if recipients (who accessed the resources

maintained by the multilateral system) commercializes an end product (which is also a plant genetic resource [48]) and do not allow others to use this product for research or breeding, they are obliged to pay a fixed percentage of the sales of the commercialized product to the benefit sharing fund of the treaty, aimed at its implementation. If the developed product is available for further research and breeding, benefit-sharing is voluntary.

When monetary benefit-sharing is mandatory, the recipient may choose one of following forms of payment: 1) a fixed percentage (1.1%) of the sales of each commercialized[49] product (that incorporates material received from the multilateral system), less 30%, which represents 0.77%, *or* 2) a discounted rate of five percent (0.5 %) on the sales of each product, made from the same crop (that is, the payment is made per crop, and not per accession nor per product). This second option is valid for a period of 10 years, and is renewed for additional periods of five years unless the recipients notifies his intention to opt out, and the choice must be communicated to the governing body[50]. In the second option, the payment obligation is applicable not only to the sales of the product (that incorporated material received from the multilateral system), but to *any* products that are plant genetic resources for food and agriculture belonging to the same crop to which the material received from the Multilateral System belongs. This means that, by selecting this option, the recipient would pay a royalty on all products of a certain crop regardless of whether they incorporate the material received from the multilateral system or whether the further use of the material by third parties for research and breeding is limited. A clear advantage of this option from the perspective of contracting parties is that the payment obligation is triggered as soon as the recipient sells any product of the respective crop. Another feature of this option is that, once the choice is made, it becomes the mandatory form of payment applicable to the recipient.

This means the recipient is free to choose but, after selecting his preferred option, he is bound by the respective terms and conditions of the SMTA, as Carlos Correa explains (2011).

In any case, no payment will be mandatory if the product: - is available without restriction to others for further research and breeding; - has been purchased or otherwise obtained from another person or entity who either has already made pa

using it in the manner specified in the treaty. Currently, when recipients claim breeders´rights over plant genetic resources (that incorporate material accessed from the multilateral system), and independently of adopting the 1978 or 1991 UPOV system, they are not obliged to share benefits, since breeders´ rights protect the so-called "breeder´s privilege"[51], that is, the possibility of using protected resources as a source of genetic variation in research and breeding. If, however, new products are protected through patents, benefit-sharing is mandatory. However, since some patent laws permit use of patented materials for research purposes (called "research exemption"), some companies claim that, under these circumstances, patent protection should not trigger compulsory benefit sharing either (Meienberg, 2007). However, the only countries that allow patenting of plant varieties are the U.S., Japan, Australia and New Zealand. The U.S. signed but did not ratify the Treaty. Japan and New Zealand neither signed nor ratified the Treaty. Only Australia signed and ratified the treaty[52] (as of March 2011), which shows how limited this benefit-sharing mechanism really is.

Another controversy is if benefit sharing is also mandatory when hybrids are developed (using genetic material accessed from the multilateral system). In hybrids, parental lineages are kept secret, and new generations lose the so-called "hybrid vigor", which discourages farmers from re-sowing saved seeds due to loss of yield and productivity in the plant´s next generations. Third parties are not legally prevented from using hybrids, but they are discouraged to do so because of the "biological protection" that hybrids have. The development and commercialization of hybrids (that incorporate genetic material accessed through the multilateral system) should trigger compulsory benefit-sharing, because they represent a serious restriction on the availability of these resources to other parties. Other situations of compulsory benefit sharing are Genetic

Use Restriction Technologies (GURTs) and restrictions imposed by contracts and licenses.

It is essential, therefore, that the governing body of the treaty clarifies all these issues involving mandatory monetary benefit-sharing, and more specifically, the exact meaning of the expression "available without restriction", and who has to pay mandatory benefit-sharing and who is exempt, considering the needs not only of professional breeders, but also of farmers-breeders and on-farm breeding. An excellent study conducted by Chiarolla and Jungcurt (2011) points out the main issues that need clarification, and makes the following recommendations:

- 1) Patents that cover PGRFA products under current intellectual property laws must be presumed to restrict access for research and breeding and to fulfil the mandatory benefit-sharing requirement (independently of eventual research exemptions in national patent laws);
- 2) 1991 UPOV-type plant variety protection impedes informal exchange and sale of seeds, and it reduces opportunities for on-farm breeding, varietal improvement and selection by farmers. By doing so, UPOV 1991 also imposes restrictions on research and breeding, which takes place outside the formal seed system, and it must be considered to fulfil the mandatory benefit-sharing requirement;
- 3) There are already technical means in widespread use that are restricting access to PGRFA for research and breeding (such as cytoplasmic male sterile varieties and hybrids), and they must be considered to fulfil the mandatory benefit-sharing requirement. Chiarolla and Jungcurt (2011) explain that conventional hybrids are generally deemed not to restrict access for research and breeding, because, in theory, their genetic composition is freely available. However, if a breeder does not have access to the parental lines, it is very complicated to use hybrids as the basis for further development. Thus, hybrids limit on-farm breeding and effectively prevent farmers from using the material for selection and breeding and also – to a large extent – from replanting farm-saved seeds. In crops where this is not feasible (e.g. sunflower, cabbage, etc.) other expedients may be needed, such as cytoplasmic male sterility (CMS) breeding or incompatibility. While cytoplasmic male sterility may naturally occur in some species (e.g. radish), proprietary techniques have been used to transfer CMS to species where it does not occur naturally and that cannot be hybridized through conventional techniques. Cytoplasmic male sterile varieties prevents the female parent from being selfed because it is male sterile (i.e. it does not produce functioning pollen). Varieties that incorporate genetic

use restriction technologies (already covered under the current SMTA) must also be considered to fulfil the mandatory benefit-sharing requirement;

Chiarolla and Jungcurt (2011 recommend, therefore, a broader interpretation of what may constitute an «access restriction», to build a more economically viable, equitable and ethically-sound product base for the calculation of benefit-sharing under the treaty, and we totally agree with their wise recommendations. After all, the implementation of a funding strategy for the treaty aims to enhance availability, transparency, efficiency and effectiveness of financial resources to implement activities under the treaty. The financial strategy must cover all objectives and activities contained in the treaty, not only the multilateral system, and give priority to implementation of agreed plans and programs for farmers in developing countries who conserve and sustainably utilize plant genetic resources for food and agriculture (article 18.5). During its first session, held in Madrid (2006), the governing Body adopted the funding strategy for the implementation of the International Treaty (through Resolution 1/2006, Appendix F), and decided that benefits arising from the use of plant genetic resources for food and agriculture that are shared under the multilateral system should be used in accordance with priority activity areas of the rolling Global Plan of Action[53]. Such benefits include both monetary benefits arising from the commercialization of plant genetic resources for food and agriculture (explained above), as well as donations and voluntary contributions from countries, international organizations, private companies, non-governmental organizations etc. According to the secretariat of the treaty, on the first call for proposals for funding (under the Benefit-Sharing Fund of the treaty), for the cycle 2009-2011, US$ 550,000 were granted for eleven projects (submitted by public and private institutions from developing countries from Africa, Asia, Latin America and the Caribbean and the Near East that are contracting parties to the treaty[54]) These funds

derived entirely from voluntary contributions, and so far (as of March 2011), the secretariat of the treaty has not received any mandatory monetary payment (arising from the commercialization of plant genetic resources). The governing body also agreed on a strategic plan for the implementation of the treaty´s benefit-sharing fund, and established a target for benefit sharing over five years (US$ 116 million between July 2009 and December 2014, in accordance with Resolution 3/2009). So far (as of March 2011), US$ 14.37 million have been committed to the second call for proposals (2010-2014) under the Benefit-Sharing Fund, mainly from Spain, Italy, Australia, Switzerland, UNDP, and Norway (0.1% of seed sales in perpetuity[55]). The projects to be funded under the second project cycle are expected to be announced on June 2011[56]. During the 4th session of the governing body, in March 2011, Indonesia (the second richest country in biodiversity, after Brazil) announced that it will be the first developing country to make a financial contribution to the benefit-sharing fund of the International Treaty[57]. The governing body also approved (during its 4th session) a resolution stating that voluntary contributions to the core administrative budget of the treaty will be based on an indicative scale of contributions, aimed at serving as guidance regarding the possible level of contributions from contracting parties[58]. It clearly appears that mandatory benefit-sharing payments are expected to play a very marginal role in achieving the US$ 116 million target for benefit-sharing under the funding strategy[59]. According to Visser and Borring (2011), if the breeding cycle is taken as a reference, substantial income can only be expected 7 – 15 years after distribution of germplasm for breeding has taken place.

Despite the limited scope of mandatory benefit-sharing under the treaty, some European seed industries have criticized it. When the treaty´s benefit-sharing mechanisms were being discussed, some of their representatives argued that benefit

sharing should only take place when a great part of the genetic resources could be

materials accessed through the multilateral system, regardless of whether these products are protected by intellectual property rights or not, or whether they are available (or not) without restriction for further research and breeding. After all, it would be fair that all users/recipients of the multilateral system channel part of their profits obtained from sales of their products to the conservation of plant genetic resources, and this would contribute to a more solid and sustainable funding strategy on the long term. It would also be important that countries create national benefit-sharing funds, to be used for in situ and on farm conservation of plant genetic resources for food and agriculture (see next chapter of this book for a more detailed discussion on national benefit-sharing funds). If this option is not made, the governing body should, at least, clarify all questions concerning the exact meaning of the expression "available without restriction", so that it becomes perfectly clear that all commercialized products that are patented (independently of research exemptions), protected through 1991 UPOV, or have their access restricted for breeding (such as hybrids and cytoplasmic male sterile varieties and hybrids), must fulfil the mandatory benefit-sharing requirement (See Table 6.2 for the list of food crops, and Table 6.3. for the list of forages, which are covered under the multilateral system)

Table 6.2. – List of crops covered under the multilateral system (Annex I of the Treaty): food crops

Crop	**Genus**	**Observations**
Breadfruit	*Artocarpus*	Breadfruit only.
Asparagus	*Asparagus*	
Oat	Avena	
Beet	*Beta*	
Brassica complex	*Brassica* et al.	Genera included are: *Brassica*, *Armoracia*, *Barbarea*, *Camelina*, *Crambe*, *Diplotaxis*, *Eruca*, *Isatis*, *Lepidium*, *Raphanobrassica*, *Raphanus*, *Rorippa*, and *Sinapis*. This comprises oilseed and vegetable crops such as cabbage, rapeseed, mustard, cress, rocket, radish, and turnip. The species *Lepidium meyenii* (maca) is excluded

Pigeon Pea	*Cajanus*	
Chickpea	*Cicer*	
Citrus	*Citrus*	Genera *Poncirus* and *Fortunella* are included as root stock
Coconut	*Cocos*	
Major aroids	*Colocasia, Xanthosoma*	Major aroids include taro, cocoyam, dasheen and tannia
Carrot	*Daucus*	
Yams	*Dioscorea*	
Finger Millet	*Eleusine*	
Strawberry	*Fragaria*	
Sunflower	*Helianthus*	
Barley	*Hordeum*	
Sweet Potato	*Ipomoea*	
Grass peã	*Lathyrus*	
Lentil	*Lens*	
Apple	*Malus*	
Cassava	*Manihot*	*Manihot esculenta* only
Banana/Plantain	*Musa*	Except *Musa textilis*.
Rice	*Oryza*	
Pearl Millet	*Pennisetum*	
Beans	*Phaseolus*	Except *Phaseolus polyanthus*.
Pea	*Pisum*	
Rye	*Secale*	
Potato	*Solanum*	Section tuberose included, except *Solanum phureja*
Eggplant	*Solanum*	Section melongena included
Sorghum	*Sorghum*	
Triticale	*Triticosecale*	
Wheat	*Triticum* et al.	Including *Agropyron, Elymus* and *Secale*.
Fava Bean/Vetch	*Vicia*	
Cowpea et al.	*Vigna*	
Maize	*Zea*	Except *Zea perennis, Zea diploperennis* and *Zea luxurians*.

Table 6.3. – List of crops covered under the multilateral system (Annex I of the Treaty): forages

Genera	**Species**
LEGUME FORAGES	
Astragalus	*chinensis, cicer, arenarius*
Canavalia	*Ensiformis*
Coronilla	*Varia*
Hedysarum	*Coronarium*
Lathyrus	*cicera, ciliolatus, hirsutus, ochrus, odoratus, sativus*
Lespedeza	*cuneata, striata, stipulacea*
Lotus	*corniculatus, subbiflorus, uliginosus*
Lupinus	*albus, angustifolius, luteus*
Medicago	*arborea, falcata, sativa, scutellata, rigidula, truncatula*
Melilotus	*albus, officinalis*
Onobrychis	*Viciifolia*
Ornithopus	*Sativus*
Prosopis	*affinis, alba, chilensis, nigra, pallid*
Pueraria	*Phaseoloides*
Trifolium	*alexandrinum, alpestre, ambiguum, angustifolium, arvense, agrocicerum, hybridum, incarnatum, pratense, repens, resupinatum, rueppellianum, semipilosum, subterraneum, vesiculosum*
GRASS FORAGES	
Andropogon	*Gayanus*
Agropyron	*cristatum, desertorum*
Agrostis	*stolonifera, tenuis*
Alopecurus	*Pratensis*
Arrhenatherum	*Elatius*
Dactylis	*Glomerata*
Festuca	*arundinacea, gigantea, heterophylla, ovina, pratensis, rubra*
Lolium	*hybridum, multiflorum, perenne, rigidum, temulentum*
Phalaris	*aquatica, arundinacea*
Phleum	*Pratense*
Poa	*alpina, annua, pratensis*
Tripsacum	*Laxum*
OTHER FORAGES	
Atriplex	*halimus, nummularia*
Salsola	*Vermiculata*

6.5. THE NAGOYA PROTOCOL AND ITS INTERFACES WITH FAO´S INTERNATIONAL TREATY AND OTHER SPECIALIZED ACCESS AND BENEFIT-SHARING AGREEMENTS

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is a new international agreement,

adopted by the Conference of the Parties to the Convention on Biological Diversity (CBD) at its 10th meeting, on 29 October 2010, in Nagoya (Japan)[60]. The Nagoya Protocol will enter into force 90 days after the deposit of the 50th instrument of ratification, acceptance, approval or accession[61]. It supports the further implementation of one of the three objectives of the Convention on Biological Diversity: the fair and equitable sharing of benefits arising from the utilization of genetic resources and traditional knowledge.

Since the Nagoya Protocol is an instrument for the implementation of access and benefit-sharing provisions of CBD, it only applies to genetic resources and traditional knowledge (associated to genetic resources) that are covered by CBD. It does not apply to such resources when they are covered by other specialized international access and benefit-sharing instruments. So far, the International Treaty on Plant Genetic Resources for Food and Agriculture is the only international agreement to establish a specialized (multilateral) access and benefit-sharing provisions.

The Nagoya Protocol aims to establish clearer conditions for access and benefit-sharing and to create greater transparency in relationships between providers and users of genetic resources and traditional knowledge. However, the full implementation of the Nagoya Protocol depends on national access and benefit-sharing laws. The core elements of the Nagoya Protocol are:

1) *Access to genetic resources* (articles 6 and 8):

a) In the exercise of sovereign rights over natural resources, and subject to national laws, access to genetic resources is subject to the prior informed consent of the provider party (country of origin or that has acquired the genetic resources in accordance with CBD);

b) Contracting parties must take measures to ensure that the prior informed consent or approval and involvement of Indigenous and local communities is obtained for access to genetic resources, where they have the established right to grant access to such resources (in accordance with national laws);

c) Contracting parties have the obligation to establish legislative, administrative or policy measures regarding access and benefit-sharing, that: - create legal certainty, clarity and transparency; - provide fair and non-arbitrary rules and procedures; - establish clear rules and procedures for prior informed consent and mutually agreed terms; - provide for issuance of a permit or equivalent when access is granted;

d) In the development and implementation of their national ABS laws, contracting parties must: - create conditions to promote and encourage research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries, including through simplified measures on access for non-commercial research purposes; - pay due regard to cases of present or imminent emergencies that threaten or damage human, animal or plant health, considering the need for expeditious access and benefit-sharing; and consider the importance of genetic resources for food and agriculture and their special role for food security.

2) *Access to traditional knowledge associated with genetic resources*: (articles 7 and 12):

a) In accordance with its national law, each contracting party must take measures to ensure that traditional knowledge associated with genetic resources that is held by Indigenous and local communities is accessed with the prior and informed consent or approval and involvement of these Indigenous and local communities, and that mutually agreed terms are established;

b) Due consideration must be given to Indigenous and local communities' customary laws, community protocols and procedures, with respect to traditional knowledge associated with genetic resources;

c) Contracting parties must support the development, by Indigenous and local communities, of community protocols, minimum requirements for mutually agreed terms and model contractual clauses;

d) Contracting parties must not restrict the customary use and exchange of genetic resources and associated traditional knowledge within and amongst Indigenous and local communities.

3) *Fair and equitable benefit-sharing (arising from the utilization of genetic resources and associated traditional knowledge)* (articles 5, 9 and 10):

a) Benefits arising from the utilization of genetic resources, as well as subsequent applications and commercialization, must be shared in a fair and equitable way with the provider party (country of origin or that has acquired the genetic resources in accordance with CBD), based on mutually agreed terms;

b) In accordance with national laws regarding the rights of Indigenous and local communities over genetic resources, contracting parties must take legislative, administrative or policy measures to ensure that benefits arising from the utilization of genetic resources that are held by indigenous and local communities are shared in a fair and equitable way with the communities concerned;

c) Benefits may include monetary[62] and non-monetary benefits[63], including but not limited to those listed in the Annex of the Protocol;

d) Contracting parties must take legislative, administrative or policy measures to ensure that benefits arising from the utilization of traditional knowledge associated with

genetic resources are shared in a fair and equitable way with Indigenous and local communities holding such knowledge;

e) Contracting parties must encourage users and providers to direct benefits arising from the utilization of genetic resources towards the conservation of biological diversity and the sustainable use of its components;

f) Contracting parties must consider the need for a global multilateral benefit-sharing mechanism to address the fair and equitable sharing of benefits derived from the utilization of genetic resources and traditional knowledge associated with genetic resources that occur in transboundary situations or for which it is not possible to grant or obtain prior informed consent;

g) The benefits shared by users of genetic resources and traditional knowledge associated with genetic resources through this mechanism must be used to support the conservation of biological diversity and the sustainable use of its components globally.

4) Compliance with national ABS legislation: (articles 15, 16, 17, 18 and 19):

a) Contracting parties must take appropriate, effective and proportionate legislative, administrative or policy measures to ensure that genetic resources utilized within its jurisdiction have been accessed in accordance with prior informed consent and that mutually agreed terms have been established, as required by domestic access and benefit-sharing legislation. Such measures must also ensure that traditional knowledge associated with genetic resources was accessed in accordance with prior informed consent or approval and involvement of Indigenous and local communities;

b) Contracting parties must take appropriate, effective and proportionate measures to address situations of non-compliance;

c) Contracting parties must cooperate in cases of alleged violation of domestic access and benefit-sharing legislation;

d) In order to support compliance, contracting parties must designate one or more checkpoints, encourage users and providers of genetic resources to include provisions, in mutually agreed terms, to share information on the implementation of such terms, including through reporting requirements, and encourage the use of cost-effective communication tools and systems;

e) Contracting parties must encourage providers and users of genetic resources and/or traditional knowledge associated with genetic resources to include provisions in mutually agreed terms to cover dispute resolution, including the jurisdiction to which they will subject any dispute resolution processes, the applicable law; and/or options for alternative dispute resolution, such as mediation or arbitration. They must also ensure that an opportunity to seek recourse is available under their legal systems;

f) Contracting parties must encourage the development, update and use of sectoral and cross-sectoral model contractual clauses for mutually agreed terms, voluntary codes of conduct, guidelines and best practices and/or standards in relation to access and benefit-sharing;

g) An internationally recognized certificate of compliance will serve as evidence that the genetic resource which it covers has been accessed in accordance with prior informed consent and that mutually agreed terms have been established, as required by national ABS legislations (of the provider party). Such certificate of compliance must be made available to the Access and Benefit-Sharing Clearing-House, a mechanism established in article 14 of the Nagoya Protocol as a means for sharing of information related to ABS.

The Nagoya Protocol sets out that its provisions do not "affect the rights and obligations of any party deriving from any existing international agreement", and do not

"prevent parties from developing and implementing other international agreements, including other specialized access and benefit-sharing agreements", if "they are supportive of and do not run counter to the objectives of CBD and the Nagoya Protocol" (article 4). It makes several explicit mentions to agricultural biodiversity in its preamble, and it recognizes:

- "the special nature of agricultural biodiversity, its distinctive features and problems needing distinctive solutions";
- " the interdependence of all countries with regard to genetic resources for food and agriculture as well as their importance for achieving food security worldwide and for sustainable development of agriculture in the context of poverty alleviation and climate change";
- "the fundamental role of the International Treaty on Plant Genetic Resources for Food and Agriculture a

food/feed industrial purposes. This means that plant genetic resources that are not included in Annex I (of the treaty), or that are used for any chemical, pharmaceutical and/or other non-food/feed purposes, fall under the scope of CBD, and of the Nagoya Protocol, since they are not subject to the multilateral system of the International Treaty. Besides, only genetic materials that are in the public domain and under the management and control of contracting parties are excluded from the scope of CBD and the Nagoya Protocol, which means that genetic materials held by private companies, non-governmental organizations and farmers (on their fields) are not part of the multilateral system (unless they decide to put their collections on the multilateral system, but this is voluntary and not mandatory), and therefore, such genetic materials are not excluded from the scope of the Nagoya Protocol. While they remain outside the multilateral system, they are subject to the rules of CBD and of the Nagoya Protocol.

It must also be taken into account that the International Treaty explicitly mentions that contracting parties may widen the scope of the multilateral system, to include other crops and forages, as long as such decision is taken by consensus of contracting parties to the treaty (articles 23 and 24). Therefore, if contracting parties of the treaty decide to widen the scope of the multilateral system, other crops and forages that are included in the multilateral system will also be left out of the CBD and Nagoya Protocol bilateral system of ABS. The Nagoya Protocol does not "prevent parties from developing and implementing other international agreements, including other specialized access and benefit-sharing agreements" (art. 4.3). This means that contracting parties to the treaty may decide to expand the scope of an already existing specialized ABS multilateral system, such as the one established by the International Treaty for Plant Genetic Resources for Food and Agriculture.

Regine Andersen et al (2010) raises some interesting questions regarding the exclusion, from the scope of the Nagoya Protocol, of the multilateral system established by the International Treaty for Plant Genetic Resources for Food and Agriculture. She calls attention to the fact that the International Agricultural Research Centres of the CGIAR have not only included genetic materials that are listed in the Annex I of the International Treaty in the multilateral system, but they are also using the Standard Material Transfer Agreement (SMTA) for transfers of plant genetic resources for food and agriculture of non-Annex I materials, collected prior to the entry into force of the International Treaty, and that some countries are also doing so, to avoid different systems for different genetic resources within gene banks. However, Andersen (2010) points out that it is still uncertain whether non-Annex I materials, transferred with a SMTA, can also be regarded as included in the multilateral system, and out of the scope of the Nagoya Protocol. Therefore, she suggests that not only Annex I material be excluded from the scope of the Nagoya Protocol, but all "material in the multilateral system and covered by the SMTA" (Andersen et al, 2010). The Nagoya Protocol is not so specific in relation to the exclusion of non-Annex I crops that are transferred with a SMTA, but since the Nagoya Protocol recognizes "the special nature of agricultural biodiversity, its distinctive features and problems needing distinctive solutions"; as well as "the fundamental role of the International Treaty on Plant Genetic Resources for Food and Agriculture and the FAO Commission on Genetic Resources for Food and Agriculture" and the multilateral system of access and benefit-sharing established under the International Treaty, all countries (including non contracting parties to the International Treaty[64]) can use the SMTA also for the transfer of non-Annex I materials collected prior to the entry into force of the International Treaty, held in their ex situ collections (and as long as they are used for research, breeding and training for *food and*

agriculture). This is not explicit in the Nagoya Protocol, but it is a viable interpretation. However, non-Annex I crops collected after the entry into force of the International Treaty fall outside the scope of the multilateral system, and are subject to CBD and to the Nagoya Protocol (for countries that are parties to CBD and the Nagoya Protocol). Nevertheless, the International Treaty, in its article 15.3, opens the possibility that International Agricultural Research Centers (IARCs), of CGIAR, use the SMTA for transfers of non-Annex I crops, received and conserved by IARCs after the coming into force of the International Treaty, as long as the provider country agrees. It is important, however, to take into consideration that such provision of the Treaty deals specifically with transfers of genetic resources, and not with access to *in situ* material, which is subject to national legislation, according to article 12.3.h of the treaty (which will be discussed in the next chapter of this book)

It is also worth mentioning that the International Agriculture Research Centres (IARCs) of CGIARs have proposed that the SMTA functions as a certificate of source, with the source or origin of the PGRFA being the multilateral system itself (SGRP, 2007). The SMTA would be a certificate of compliance with the International Treaty on Plant Genetic Resources for Food and Agriculture. As mentioned above, the Nagoya Protocol sets out that an internationally recognized certificate of compliance will serve as evidence that the genetic resource which it covers has been accessed in accordance with prior informed consent and that mutually agreed terms have been established. Contracting parties to the Nagoya Protocol must establish checkpoints and decide on what type of information to be requested at such checkpoints. Chiarolla and Jungcurt (2011) propose that a possible way to enhance transparency and the mutual supportiveness between the Nagoya Protocol and the International Treaty would be to amend the SMTA in order to request recipients to disclose, at plant variety protection

and patent offices, that the materials for which protection is sought have been obtained from the multilateral system and to inform the governing body (of the Treaty) accordingly. According to them, contracting parties, who endeavor to implement the Treaty and the Nagoya Protocol in a mutually-supportive manner, may envisage using the SMTA as an internationally-recognized certificate of compliance to be presented by resource users at all relevant checkpoints. During the 4th session of the governing body, held in Bali (Indonesia), on March 14th-18th 2011, the European region suggested that the governing body request the Conference of Parties of CBD to formally recognize the use of the SMTA as being in harmony with the ABS Protocol and an equivalent to the international certificate of compliance (under the Nagoya Protocol), and a resolution was adopted on the relationship of the SMTA with CBD[65].

As mentioned above, the Nagoya Protocol to CBD leaves room for the development and implementation of specialized access and benefit-sharing agreements (article 4), other than the International Treaty on Plant Genetic Resources for Food and Agriculture. There are ongoing discussions about the potential usefulness of the development of specialized international access and benefit-sharing regimes for animal genetic resources (see chapter X of this book) agricultural microbial genetic resources (SGRP- System-wide Genetic Resources Programme, 2010), human pathogens (for public health preparedness and response purposes), and for specific regions and sub-regions, which could establish multilateral system of access and benefit-sharing for non-Annex I crops that are particularly important for the regions concerned (SGRP, 2006)

[1] The International Treaty on Plant Genetic Resources for Food and Agriculture defines plant genetic resources for food and agriculture as "any genetic material of plant origin of actual or potential value for food and agriculture." Genetic material is defined as "any material of plant origin, including reproductive and vegetative propagating material, containing functional units of heredity."

[2] Erna Bennett directed the FAO Genetic Resource and Plant Ecology Unit in the 1960s and 1970s. She was responsible for several expeditions for collection of genetic materials and genetic resource conservation programs.

[3]Historically, expeditions for collection of genetic resources, whether systematic or not, have always taken place. Perhaps the most ancient record of an expedition organized for collection of plants is from 1495 B.C., when queen Hatshepsut, of Egypt, sent ships to Eastern Africa (currently Somalia, Ertitreia, Ethiopia and Djibouti) to collect plants. Her interest was mainly the incense tree, which she intended to place in her mortuary temple, and myrrh seeds (also used as incense in funerals and cremations). There are also records of an Egyptian pharaoh, Sankhkara, sending ships to the Gulf of Aden (in Yemen) to collect cinnamon and cassia, plants used for embalming the dead. Source: Damania, 2008.

To learn more about the history of germplasm collection around the world, and about scientific expeditions for collection of botanical material in Brazil, see: Walter, Cavalcanti and Valls (2005b). These authors report famous expeditions of the Royal Botanic Gardens, Kew (England), Alexander Von Humboldt (German, 1769-1859), Alphonse de Candolle (Swiss, 1808-1893), Nikolai Vavilov (Russian, 1916 until the 1930s), and many other plant collectors.

[4] For more information: www.bioversityinternational.org

[5] This group became internationally known by its acronym: CGIAR. Its centers are: Africa Rice Center (former West Africa Rice Development Association), in Benin, International Center for Tropical Agriculture (CIAT), in Colombia, International Maize and Wheat Improvement Center (CIMMYT), in Mexico, the International Potato Center, in Peru, International Center for Agricultural Research in the Dry Areas (ICARDA), in Syria, International Rice Research Institute (IRRI), in the Philippines, International Institute of Tropical Agriculture (IITA), in Nigeria, Center for International Forestry Research (CIFOR), in Indonesia, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in India, - International Livestock Research Institute (ILRI), in Kenya, International Water Management Institute (IWMI), in Sri Lanka, World Agroforestry Centre, in Kenya, WorldFish Center, in Malaysia, International Food Policy Research Institute (IFPRI), in Washington (U.S.) and Bioversity International, in Rome (Italy). For more information: www.cgiar.org

[6] Source: http://www.cgiar.org/impact/genebanksdatabases.html, accessed 24 January 2011.

[7] Source: http://www.cgiar.org/pdf/model_agreement_centers_2007.pdf, accessed 24 January 2011.

[8] The Action Group on Erosion, Technology and Concentration or ETC Group. See: <http://www.etcgroup.org/en/>. The International Coalition for Development Action (ICDA, which later became GRAIN – Genetic Resources Action International), also played an important role in the latter part of the 1980s. Two reference books were published during this period: *Seeds of the Earth: a Private or Public Resource*, by Pat Mooney, of RAFI, published in 1979, and *New Hope or False Promise: Biotechnology and Third World Agriculture*, by Henk Hobbelink, of ICDA/Grain, published in 1987.

[9] Other limitations of *ex situ* collections include the fact that some seeds cannot withstand very low humidity and/or are not resistant to temperatures below zero degrees, and therefore cannot be stored in cold chambers (called recalcitrant seeds). Vegetative propagation species (such as potatoes, yams, manioc, etc.) must also be conserved in field or *in vitro* collections, making *ex situ* conservation more expensive, complex and difficult to implement in poor countries.

Walter de Boef (2007,p46) points out that "passport data" (information about genetic resources) seldom include the characteristics described by farmers. Plant collectors generally spend no more than a few minutes with each plant sample. There is not enough time to talk with farmers and record their knowledge, which undermines the connection between farmers and their biological material.

[10] The inter-governmental Commission on Plant Genetic Resources was also established during the 22nd meeting of the FAO Conference, through Resolution 09/83. In 1995, the commission broadened its mandate to include all components of biodiversity for food and agriculture (not only plant but also livestock, forests,fishes etc), and became Commission on Genetic Resources for Food and Agriculture. The commission is responsible for the implementation of all FAO agreements on such issues, and is part

of the FAO Global System for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture.

[11] As of March 10th, 2011. Source: http://www.cbd.int/convention/parties/list/

[12] In this study, CBD aspects which are more related with agrobiodiversity and plant genetic resources for food and agriculture will be more specifically discussed. For more information about the CBD, see its website: <http:www.cbd. int>, and IUCN guidebook: Glowka et al, 2004.

[1313] In 1993, the FAO Conference also adopted the International Code of Conduct for Plant Germplasm Collection and Transfer. It is a voluntary code, which establishes general principles for the collection, conservation, exchange and use of plant germplasm. Source: http://www.fao.org/docrep/x5586E/x5586e0k.htm#xiv. appendix e international code of conduct for plant germplasm collecting a, accessed 10 March 2011.

[14] The CBD uses the terms "domesticated" and "cultivated" species as synonyms. A "domesticated or cultivated" species is defined as "species in which the evolutionary process has been influenced by humans to meet their needs". However, domesticating a plant is not the same as cultivating. For the diference between domesticated and cultivated plants, please see the chapter on this book on "Agrobiodiversity: a concept in construction", where these concepts are explored.

[15] According to FAO International Treaty on Plant Genetic Resources for Food and Agriculture, "centre of origin" means a geographical area where a plant species, either domesticated or wild, first developed its distinctive properties. "Centre of crop diversity" means a geographic area containing a high level of genetic diversity for crop species in *in situ* conditions.

[16] The second edition of this book, which is better known, was published in 1883

[17] *Flora Brasiliensis* was organized with the participation of 65 specialists from different countries. It contains taxonomical characterizations of 22,767 species of the Brazilian flora, gathered in 15 volumes and divided into 40 parts, with a total of 10,367 pages. See: <http://florabrasiliensis.cria.org.br, accessed 11 March, 2011.

[18] Since 1965, it has been called Vavilov Research Institute of Plant Industry, and is located in Saint Petersburg, in Russia. For more information, see: Loskutov (1997) and www.vir.nw.ru/

[19] More recent research in South America have showed that the Amazon may also be recognized as an independent crop domestication centre, along with Meso-America and the Andes. The Upper Madeira Basin and its tributaries (currently the state of Rondonia, in Brazil) are supposedly domestication centres for two of the most important plants cultivated in the Amazon: manioc and peach palm (*pupunha*). For more information, see the sub-chapter on this book on "GIAHS, Amazonian dark earths and agrobiodiversity»

[20] Vavilov died in 1943, in the Saratov prison, in Russia, victim of the persecution of the Stalinist regime, because he did not agree with theories developed by Trofim Lysenko, who was the head of the Institute of Genetics in the former Soviet Union. Lysenko did not accept the laws of heredity developed by Gregor Mendel, on which all modern genetics are based.

[21] Zeven and De Wet, for example, propose three birthplaces for agriculture – Eastern Asia (China and Myanmar), Near East (Fertile Crescent) and Central America, as well as 12 other centers of diversity. See Zeven and De Wet, 1982.

[22] For further information, see: Walter et al (2005a)

[23] See also: Clement (2007)

[24] For more information on the negotiations for the Treaty, see: Coupe and Lewins (2007)
To learn more about the Treaty and its member countries, see: <http://www.planttreaty.org>. The USA signed the Treaty on November 1, 2002, but did not ratify it (as of March 11, 2011). To ratify the Treaty, the state must be recognized by the United Nations, but it does not need to be a member of FAO or of its Committee of Genetic Resources for Food and Agriculture.

[25] http://www.itpgrfa.net/International/sites/default/files/cordoba_declaration_en.pdf, accessed 10 March 2011.

[26] http://biodiversity-l.iisd.org/news/ministers-adopt-bali-declaration-on-the-itpgr/, accessed 10 March 2011.

[27] Source: www.fao.org/docrep/003/w3613p/w3613p00.htm, accessed 10 March 2011.

[28] According to article 12.3.(b), in the case of multiple-use crops (food and non-food), their importance for food security must be the determinant for their inclusion in the multilateral system and availability for facilitated access.

[29] For a more detailed description of the negotiations of crops to be included in the multilateral system, see: Engsiand and Halewood (2008) and Visser and Borring (2011)

[30] All governing body decisions are made by consensus, except if consensually agreed otherwise. The Treaty's amendments, however, must necessarily be approved by consensus, including amendments to the Annexes. Institutional provisions in the Treaty are in Articles 19 to 35, and they cover compliance, settlement of disputes, amendments of the treaty, ratification, acceptance or approval etc.

[31] Lightbourne (2009) makes an interesting analysis of two cash crops, soybean and coffee, that were maintained outside the scope of the multilateral system, and whether they can be traded under profitable terms by their countries of origin (China and Ethiopia), in the framework of bilateral agreements complying with CBD.

[32] All components of the Treaty (farmers' rights, supporting components, financial and institutional provisions), apply to *all* plant genetic resources for food and agriculture, except the multilateral system of access and benefit sharing, which is restricted to Annex I crops. Annex II contains arbitration and conciliation rules.

[33] Ex *situ* collections of plant genetic resources held by the international agricultural research centres of the Consultative Group on International Agricultural Research (CGIAR), international plant genetic resources networks and the Global Plant Genetic Resource Information System are also supporting components of the Treaty.

[34] During its fourth session (held in Bali), the governing body approved a resolution that establishes an *Ad Hoc* Technical Committee on Sustainable Use of PGRFA, subject to availability of financial resources, and requests the secretary to: further explore development of a toolbox (to assist countries in designing appropriate measures for sustainable use), develop steps for implementation of the Global Plan of Action, organize stakeholders' consultations and invite submissions from parties and others on sustainable use, and work with regional networks and partners to promote locally adapted and under-utilized crops. Source: *Earth Negotiations Bulletin*, vol. 9, no. 550, March 12, 2011, http://www.iisd.ca/vol09/enb09550e.html, accessed March 25, 2011.

[35]Source: http://www.cbd.int/decision/cop/?id=7107, accessed 20 February 2011.

[36] Evidently, public and private institutions can include plant genetic resources that are not in Annex I list on the multilateral system, but it is a voluntary initiative.

[37] EURISCO is a web-based catalogue that provides information about *ex situ* plant collections maintained in Europe (http://eurisco.ecpgr.org/static/about_eurisco.html., accessed 10 March 2011).

[38] The SMTA can be consulted on ftp://ftp.fao.org/ag/agp/planttreaty/agreements/smta/SMTAe.pdf, accessed 11 March 2011.

[39] A "shrink-wrap" Standard Material Transfer Agreement (SMTA) is where a copy of the SMTA is included in the packaging of the material, and the recipient's acceptance of the material constitutes acceptance of the terms and conditions of the SMTA. A "click-wrap" SMTA is where the agreement is concluded on the internet and the recipient accepts the terms and conditions of the SMTA by clicking on the appropriate icon on the website or in the electronic version of the STMA, as appropriate.

[40] According to article 5e of the SMTA, the provider of genetic resources must periodically inform the governing body about the material transfer agreements entered into, and this information must be made available by the governing body to the third party beneficiary (FAO, who is in charge of monitoring compliance with the SMTA).

[41] ICRISAT is an international agricultural research center supported by CGIAR, headquartered in India, with two regional hubs and four country offices in sub-Saharan Africa.

[42] Source: http://www.fao.org/Legal/treaties/033s-e.htm, accessed March 10th, 2011.

[43] See the report "The healing wounds: how the International Agricultural Research Centers of the CGIAR help rebuild agriculture in countries affected by conflicts and natural disasters", published by CGIAR (2005) at http://www.cgiar.org/pdf/healingwounds.pdf , accessed March 10th, 2011

[44] Source: IRRI (2005) "Restore agriculture, aid can help developing countries recover faster from natural disasters", http://irri.org/news-events/media-releases/restore-agriculture-aid-can-help-developing-countries-recover-faster-from-natural-disasters, accessed March 10th, 2011.

[45] Source: "Egyptian gene bank looted", February 01, 2011, http://agro.biodiver.se/2011/02/egyptian-genebank-looted/, accessed March 10th, 2011.

[46] According to article 17, contracting parties must cooperate to develop and strengthen a global information system to facilitate the exchange of information on scientific, technical and environmental matters related to plant genetic resources for food and agriculture (called the Global Information System on Plant Genetic Resources for Food and Agriculture).

[47] According to article 13, b, c, contracting parties agree to give priority to (i) establishing and/or strengthening programmes for scientific and technical education and training in conservation and sustainable use of plant genetic resources for food and agriculture, (ii) developing and strengthening facilities for conservation and sustainable use of plant genetic resources for food and agriculture, in particular in developing countries, and countries with economies in transition, and (iii) carrying out scientific research preferably, and where possible, in developing countries and countries with economies in transition, in cooperation with institutions of such countries, and developing capacity for such research in fields where they are needed.

[48] According to the Standard Material Transfer Agreement (SMTA, article 2), a "product" means plant genetic resources for food and agriculture that incorporate (for example, by pedigree or gene insertion) the material or any of its genetic parts or components that are ready for commercialization, excluding commodities and other products used for food, feed and processing.

[49] According to the SMTA (article 2), "sales" means the gross income resulting from the commercialization of a product or products, by the recipient, its affiliates, contractors, licensees and lessees. "To commercialize" means to sell a product or products for monetary consideration on the open market, and "commercialization" has a corresponding meaning. Commercialization does not include any form of transfer of plant genetic resources under development.

[51] For more detailed information on the "breeder´s privilege", see the chapter of this book on the UPOV system.

[52] Source: http://www.fao.org/Legal/treaties/033s-e.htm, accessed March 11, 2011.

[53] The governing body established the following initial priorities, included in the Global Plan of Action, upon indication by the *ad hoc* Advisory Committee on the Funding Strategy: exchange of information, transfer of technology and capacity-building; management and conservation of on-farm plant genetic resources and sustainable use of plant genetic resources.

[54] The following projects were funded under the Benefit-Sharing Fund, within the first project cycle (2009-2011): 1) Kenya: characterization, genetic enhancement and revitalization of finger millet in Western Kenya (Maseno University); 2) Morocco: on-farm conservation and mining of local durum and bread wheat landraces of Morocco for biotic stresses and incorporating UG99 resistance (National Agricultural Research Institute); 3) Senegal: conservation of local cultivars of millet, maize and sorghum, promote major use of local varieties adapted to agro-climatic conditions and increase the diversity of the germplasm of these crops available to farmers; 4) Tanzania: strengthening on-farm conservation and use of local varieties of sorghum, finger millet, lablab beans and yams for food security and adaptation to climate change (National Plant Genetic Resources Centre); 5) India: conservation, dissemination and popularization of location specific farmer-developed varieties by establishing village level enterprises (Peermade Development Society); 6) Costa Rica: identification of useful potato germplasm adapted to biotic and abiotic stresses caused by global climate change (Universidad de Costa Rica, Centro de Investigaciones Agronómicas, CIA); 7) Cuba: contribution of traditional methods for in situ conservation and management of maize and bean for food security of farming communities in Cuba (Fundamental Research Institute on Tropical Agriculture); 8) Nicaragua: rescue, conservation and sustainable management of teocintle in Nicaragua, in (Apacunca Genetic Reserve), Universidad Nacional Agraria; 9) Peru: conservation and sustainable use of native potato diversity in the Potato Park, Cusco (Association for Nature and Sustainable Development (ANDES); 10) Uruguay: broadening of potato genetic basis through introgression of local wild species (Instituto Nacional de Investigaciones Agropecuarias); 11) Egypt: on-farm conservation and in vitro preservation of citrus local varieties and sustainable utilization in Egypt (National Gene Bank and Genetic Resources). Source:

ftp://ftp.fao.org/ag/agp/planttreaty/funding/pro_list09_01_en.pdf, accessed March 11, 2011. As of March 20, the projects to be funded within the second project cycle have not been announced by the treaty´s secretariat.

[55] Norway decided to make a permanent annual contribution to the benefit-sharing fund of the Treaty that amounts to 0.1% of the value of all seeds that are sold in the country.62 «The value of this contribution was $101,368 and was received on 15 June 2010. The reference to 0.1% of seed sales refers only to the method that is used to calculate the amount of donations to the Benefit-Sharing Fund, while such contribution is paid with government funds and not directly by the private seed sector.

[56] According to the requirements established by the governing body of the International Treaty, all plant genetic resources for food and agriculture listed in Annex 1 of the International Treaty resulting from projects funded by the Benefit-sharing Fund must be made available according to the terms and conditions of the multilateral system. Besides, information generated by projects funded through the Benefit-sharing Fund must be made publicly available within 1 year of the completion of the project.
Grant conditions of the Global Crop Diversity Trust also request that germplasm regenerated or characterized with support from the Trust will be available under the conditions of the Standard Material Transfer Agreement. The Trust currently supports the regeneration and characterization of both international collections of the CGIAR and national collections in a large number of countries.

[57]Source: http://www.itpgrfa.net/International/content/indonesia-first-developing-country-contribute-crop-benefit-sharing-fund, accessed March 14, 2011.

[58] This voluntary indicative scale of contributions must be based on the scale of contributions adopted from time to time by the UN, and adjusted so as to ensure that no party contributes less than 0.01% of the total, that no contribution exceeds 22% of the total, and that no contribution from a least developed country party exceeds 0.01% of the total. The scale shall be maintained and updated by the secretariat, in accordance with the work programme and budget for each biennium, as approved by the GB. Source: *Earth Negotiations Bulletin*, vol. 9, no. 550, March 12, 2011, http://www.iisd.ca/vol09/enb09550e.html, accessed March 25, 2011.

[59] Since monetary benefits are not destined to countries and/or institutions of origin of the plant genetic resources, and to address the gap in enforcement incentives, the Standard Material Transfer Agreement (SMTA, article 8.2) establishes that an "entity designated by the governing body" has the right, as a "third party beneficiary", to initiate dispute settlement procedures regarding rights and obligations of the provider and recipient of resources. FAO was designed as the "third party beneficiary", and therefore, is responsible for monitoring compliance with the conditions set by the standard ma l transfer agree nt and the treaty. As a "third party beneficiary", FAO acts on behalf of the gov f the t ty and its multila l system.

The SMTA establishes, in article 8, a dispute settlement procedure, for cases of non-compliance. A dispute settlement may be initiated by the provid e recipient o

common but differentiated responsibilities applies to compliance. Consensus was only made possible on the last day after an all-night session, using compromise text based on the Basel Convention Compliance Mechanism.

[60] During the 10th meeting of the Conference of the Parties to CBD, it was also adopted a revised and updated Strategic Plan for Biodiversity, for the 2011-2020 period, which can be accessed on http://www.cbd.int/decision/cop/?id=12268 (last accessed March 26, 2011).

[61] As of March 23, 2011, the following countries had signed the Nagoya Protocol: Algeria, Brazil, Colombia, Mexico, Rwanda and Yemen. Indonesia, the world´**s** second largest mega biodiversity after Brazil, also announced, on March 17, 2011, that it would ratify the Nagoya Protocol. The 11th meeting of the Conference of the Parties to the CBD will take place in India, on October 8-19, 2012, and it is expected to convene the first meeting of the parties to the Nagoya Protocol. For this target to be met, the Nagoya Protocol must enter into force no later than 8 October 2012, with the fiftieth instrument of ratification deposited no later than 10 July 2012. Source: http://www.cbd.int/abs/nagoya-protocol/signatories/ and http://embassyofindonesia.it/indonesia-to-ratify-nagoya-protocol-on-access-to-genetic-resources, accessed 23 March 2011.

[62] The Annex of the Nagoya Protocol lists the following monetary benefits: access fees/fee per sample collected or otherwise acquired, up-front payments, milestone payments, payment of royalties, licence fees in case of commercialization, special fees to be paid to trust funds supporting conservation and sustainable use of biodiversity, salaries and preferential terms, research funding, joint ventures and joint ownership of intellectual property rights.

[63] The Annex of the Nagoya Protocol lists the following non-monetary benefits: sharing of research and development results, collaboration, cooperation and contribution in scientific research and development programmes, particularly biotechnological research activities, where possible in the party providing genetic resources, participation in product development, collaboration, cooperation and contribution in education and training, admittance to *ex situ* facilities of genetic resources and to databases, transfer to the provider of the genetic resources of knowledge and technology under fair and most favourable terms, including on concessional and preferential terms, in particular, knowledge and technology that make use of genetic resources, including biotechnology, or that are relevant to the conservation and sustainable utilization of biological diversity; strengthening capacities for technology transfer, institutional capacity-building, human and material resources to strengthen the capacities for the administration and enforcement of access regulations, training related to genetic resources with the full participation of countries providing genetic resources, and where possible, in such countries, access to scientific information relevant to conservation and sustainable use of biological diversity, including biological inventories and taxonomic studies, contributions to the local economy, research directed towards priority needs, such as health and food security, taking into account domestic uses of genetic resources in the party providing genetic resources, institutional and professional relationships that can arise from an access and benefit-sharing agreement and subsequent collaborative activities, food and livelihood security benefits, social recognition and joint ownership of intellectual property rights.

[64] All countries that are parties to the International Treaty on Plant Genetic Resources for Food and Agriculture are also parties to CBD. However, not all countries that are parties to CBD are also parties to the International Treaty. As of March 24th, 2011, 127 countries are parties to the International Treaty, and 193 countries are parties to CBD, of which 66 countries are not parties of the International Treaty.

[65] Source: *Earth Negotiations Bulletin*, vol. 9, no. 550, March 12, 2011, http://www.iisd.ca/vol09/enb09550e.html, accessed March 25, 2011.

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