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Global Justice and the Shift in Property Regime for Plant Genetic Resources

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Abstract: Although new technologies in plant breeding have the potential to reduce poverty and improve global food security, a shift in property regime for plant genetic resources (PGRs) prevents this potential from being realised. As the emergence of biotechnology has increased the value of PGRs, rent-seeking behaviour by the plant breeding industry spurred the emergence of intellectual property rights (IPRs) for improved plant varieties. Whereas this system is globally implemented through the TRIPS agreement, biodiversity-rich developing countries increasingly use the Convention on Biological Diversity (CBD) to protect their PGRs through state sovereignty. By using an economic perspective, this article aims to explain the appropriation of PGRs and the efficiency rationale that is used for its justification. However, as this perspective disregards the alarming consequences for smallholder farmers in developing countries, a global justice perspective is used to explore these effects. Focusing on distributional justice and the provision of the right to food, this article will demonstrate that the property regime shift for PGRs leads to decreased availability of, and access to, crops that are used by resource-poor farmers. The International Treaty on Plant Genetic Resources for Food Agriculture (ITPGRFA) and Consultative Group on International Agriculture Research (CGIAR) seem to be most promising in challenging the shift in property regime for PGRs and the global justice concerns this shift entails.

Key words: Plant genetic resources (PGRs); intellectual property rights (IPRs); Convention on Biological Diversity; ITPGRFA; CGIAR; global justice

1. Introduction

The extent to which we will be able to reduce poverty and ensure food security will for a large part be determined by the evolution of the agricultural sector. This is especially true knowing that an estimated 75 per cent of the world's poor and hungry live in rural areas and depend

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directly or indirectly on agriculture for their livelihoods (Kiers *et al.* 2008). Moreover, with the world population expected to reach 8.3 billion by 2030, of whom 90 per cent will live in developing countries, about 1.3 billion extra people will have to be nourished (Esquinas-Alcázar 2005). In the effort to meet the growing demand for food and to ensure that farmers will be able to cope with a changing climate, much will depend on the technological advancements made available in agriculture. As such, developing improved plant varieties through plant breeding has proven to be decisive in increasing agricultural production. Growth rates in yields achieved by traditional plant breeding are declining, but the emergence of biotechnology in plant breeding is now seen as a promising instrument to meet the growing demand for food. Focusing on its contribution to poverty reduction, the potential of biotechnology becomes even clearer when it is seen as a tool that can be tailored to developing countries' needs and circumstances (Korthals 2005).

Yet, the impacts of biotechnology have been very unbalanced so far; although we seem to be capable of producing more and more food, the highly unequal distribution of this basic good is among the most pressing ethical issues of today. While biotechnology-based research has led to improved crops that have increased yields and productivity in places where they have been adopted, these crops are hardly planted in the least developed countries (Zilberman *et al.* 2007). The main reason for this is that little or no biotechnology research has been conducted on crops that are planted by resource-poor farmers, such as cassava, sorghum, beans and white maize (Pray and Nazeem 2007). Instead, biotechnology is mainly used in research that focuses on crops that are used as animal foodstuffs and on crops that have the highest commercial value.

As biotechnology has vastly increased the scope of the genetic diversity that can be included in the activity of plant breeding, the plant genetic resources (PGRs) that can be found around the world have become more valuable as potential input material for new products and inventions (De Jonge 2009). As a result, policy and institutional arrangements have also seen many changes over the last decades. Driven by the attempt to capture the increased value in PGRs, various interest groups are seeking to shape an institutional environment that allows them to appropriate these resources. The struggle over the control and ownership have gradually shifted the "property regime", as it is called by Roa-Rodríguez and Van Dooren (2008), from a common heritage system to a system that allows for different kinds of claims to this natural material.

Thus, intellectual property rights (IPRs) have entered the contemporary arena, providing plant breeders the exclusive but time-limited right to commercially exploit their improved plant varieties. This advent has, in its turn, caused political debate about who owns the material that is used to develop these protected inventions or products. While the improved plant varieties are largely generated in developed countries, which also have the capacities for biotechnology research, it is chiefly the biodiversity-rich developing countries that provide the plant generic resources (PGRs) on which these improved plant varieties are ultimately based. This has led many such countries to seek ways to protect the PGRs within their borders and to find ways to be compensated for its use by others.

The increased appropriation of the world's extremely valuable PGRs mainly comes at the expense of smallholder farmers in developing countries. It has not only resulted in reduced access to seeds because of intellectual property protection, it has also indirectly influenced private and public research agendas in the plant-breeding sector. As the increasing value of PGRs plays such an important role in these developments, this article aims to explain the property regime shift by using an economic perspective. By fundamentally unpacking the term PGRs and the different values it holds, it will become clear that the appropriation of this material is not merely the result of interest groups seeking to obtain a share in the increased value. This article will also show that PGRs in their worked form – the improved plant varieties – have much in common with public goods and that this leads to an undersupply, which is, of course, inefficient and undesirable. However, apart from the objective to explain the shift in property regime for PGRs and the efficiency trade-offs it entails, this article also aims to show that this economic perspective is incomplete. Instead of solely being used to explain the relationship of economic phenomena, efficiency arguments are increasingly seen as a justification for the private appropriation of natural material, based on the premise that when markets cannot deliver efficient outcomes on their own, the government needs to implement public policies or institutions that support this aim. The article argues that the perfectly efficient allocation of resources, even when providing the greatest good for the greatest number, is not necessarily satisfying. Instead, a so-called "global justice" point of view is used to evaluate the shift in property regime for PGRs, focussing particularly on distributional justice and the human right to food. This way, this article also aims to look forward and to identify those international institutions that can play a role in challenging the current property regime for PGRs in such a way that technological advances in agriculture are actually used to the benefit of those who are most in need.

2. The Enclosure of the PGR Commons

In order to understand the changing rules and institutions that regulate the ownership, creation and exploitation of PGRs, it is necessary to first explore and define the term itself. By doing this, it will become clear that the way PGRs are understood is closely related to the value that is attached to them. Yet, economists have encountered difficulties in determining the value of PGRs, as different sorts of value can be distinguished. Making it even more complex, although their value increases rapidly, PGRs appear to have certain characteristics that make it difficult to capture this increasing value and this is exactly what spurred the shift in its property regime.

2.1 Unpacking the Term PGRs

Because of its broad scope and prominence, PGRs are often described as the "building blocks of life". They are the basis of our food products, as well as of a wide variety of products that derive from plants, such as medicines, pesticides and cosmetics. Because of these many uses and applications, there is a continuous search for PGRs that can be incorporated in the production systems to meet new demands and needs that result from new conditions such as population growth, climate change and the emergence of new diseases (De Jonge 2009). Although the uses of PGRs cover a wide field, the focus of this article will be on PGRs that are used for food and agriculture. In this sense, PGRs refer to the genetic material that can be found in wild plants, farmers' varieties (landraces), and modern varieties (cultivars).

In an attempt to tackle the complexity of PGRs and the property issues that these entail, some authors have distinguished *raw* PGRs from *worked* PGRs (Raustiala and Victor 2004; Helfer 2004; Rubenstein *et al.* 2005; Roa-Rodríguez and Van Dooren 2008). According to this classification, worked PGRs should be understood of as improved plant varieties that result from the process of plant breeding. Raw PGRs refer to the genetic resources that can be found in their natural state. Thus, raw PGRs would be those found in the wild, such as a grass in a rain forest that has a not-yet-discovered gene that can be used to breed higher yielding grains. Worked PGRs would be the products derived from that grass, such as an improved grain variety. Distinguishing between raw and worked PGRs will be very helpful in exemplifying current debates on the changing property regime for PGRs and both classes have shifted out of the common domain: worked PGRs through IPRs and raw PGRs through state sovereignty. The boundary between what we should call raw PGRs and worked PGRs can be very blurred and controversial. For the sake of explaining the current property regime, this article will view wild plants and farmers' varieties as raw PGRs, while modern varieties are viewed as worked PGRs. Seeds and other PGRs held in national and international gene banks can be raw or worked since these collections generally contain all three classifications (Raustiala and Victor 2004).

The plant breeding industry depends upon the use of both raw and worked PGRs. Both are subject to a continuous search for traits that help to maintain a system that keeps away the always-evolving pests and predators of our food crops, as well as to unceasing attempts to improve these crops in terms of yield and nutritional value (Swanson and Göschl 2000). Although plant breeders will generally develop new plant varieties by using their own breeding populations, raw PGRs are used more frequently because of the new possibilities that arise with scientific advances. Especially the use of pre-breeding, which refers to all activities designed to transfer genes and gene combinations from raw PGRs into more usable breeding material, highly increases the possibilities to use raw PGRs in breeding improved plant varieties (Hausmann *et al.* 2004).

2.2 The Increasing Value of PGRs

PGRs are tangible, but their value depends very much on people's knowledge and interests. It is, therefore, increasingly recognised that there is an important informational component in PGRs. The role of this informational component, as well as its increasing importance, is best illustrated by the evolution of agricultural intensification and commercialisation over time. Primitive hunters-gatherer societies started the domestication of wild plant species, creating the basis for permanent agricultural systems. These early farmers selected and replanted the best seeds and so improved crops in terms of suitability for human cultivation. Crop improvement evolved over thousands of years into the development of landraces – farmers' varieties that are adapted to local growing conditions and consumption preferences. It was only some 100 years ago that crop improvement changed tremendously when conventional breeding of modern varieties was introduced, using genetic principles based on the phenotype or physical characteristics of an organism. During this phase, the first high-yielding hybrid maize varieties were produced as well as the semi-dwarf wheat and rice varieties that led to the Green Revolution some 60 years ago. The modern varieties that were developed in this period have been widely adopted and shaped the intensive agricultural production systems. The current phase of crop improvement research is based on molecular science, which also permits the introduction of genetic materials from sexually incompatible organisms. These new biotechnology tools greatly expanded the range of genetic variations that can be used in plant breeding (Raney and Pingali 2005).

The agricultural intensification clearly illustrates how people's knowledge and interests have changed the way new plant varieties are developed. Today's new insights in molecular science, which can be used in both conventional breeding and genetic engineering, not only expanded the range of plant varieties that can be bred, it also highly accelerated the breeding process. Plant breeding has now become a specialised task that is no longer vertically integrated in farm operations and breeders are more and more perceiving PGRs as a "pool of genetic information" (Eaton 2013). This information, found in genes or other subcellular components, reveals the particular characteristics and use of the tangible material. As Roa-Rodríguez and Van Dooren (2008: 3) put it: "Since the discovery of the DNA and with the advances of biotechnology that have permitted the characterisation of genetic material and diversified the ways in which the genetic information can be used, the informational component of the PGRs has become the main object of global regulation of property, relegating the tangible biological components to an unimportant second place".

2.3 IPRs for Improved Plant Varieties

In plant breeding, it is mainly the informational component of PGRs that determines the current and future values of these resources. These values are increasing rapidly as technological advancements greatly enlarge people's insights in the use of both raw and worked PGRs. However, the growing importance of the informational component in PGRs has paradoxically created difficulties in capturing this increased value. The reason for this is that information, and hence to a great extent improved plant varieties, have the characteristics of so-called *public goods*.

In economics, the term public goods refer to those goods that are non-excludable and non-rival in consumption. In simple terms, it means that it is not possible to prevent individuals from enjoying such goods once available and that the use of such goods by one individual does not compete with their use by others. These characteristics of public goods are generally seen as problematic since these allow third parties to free ride on its provision, leading to a permanent and inefficient undersupply of such goods. In order to solve this market failure, IPRs are put in place. IPRs provide the right to exclude others from commercialising an invention or product of a creative mind. Its legal framework currently protects creative products such as trademarks, technical inventions, databases, literary works, musical compositions, and plant varieties (Lévêque and Ménière 2004). As different sectors call for different rights regimes, IPRs should be seen as an umbrella term. Depending on the type of innovation, copyrights, patents, industrial designs, trademarks or trade secrets, are granted to the creator or inventor (Apte 2006). The economic justification of IPRs is that they solve market failures related to public goods. By offering an exclusive right for a limited period, intellectual property law addresses the problems of non-excludability and non-rivalry and it is generally claimed that this is realised by striking the balance between incentive and access: On the one hand, IPRs provide incentives for innovation and disclosure, while on the other hand they create a temporary and inefficient monopoly (Eckert and Langinier 2011). As a result of this mechanism, research and development (R&D) enterprises are made viable as they can market their products exclusively and recoup the invested costs of human and material capital during the monopoly period. After this period, the innovators lose their ability to obtain royalties (through licensing) and the innovation passes into the public domain, resulting in knowledge externalities that benefit society (De Jonge and Korthals 2006).

The characteristics of public goods largely apply to improved plant varieties – or more accurately the seeds – which are the physical embodiment of the invention of the plant breeder. This invention is based on the idea of crossing certain varieties in one way or another by using the insights into the possible results of this process (Eaton 2013). These ideas and insights (about traits, progeny, methods and tools) epitomise the informational component and are practically impossible to keep as a so-called trade secret. With modern techniques, it is becoming much easier for other breeders to read the genetic code of the improved plant variety and thus reap the benefits of the breeders work. Although one could theoretically prevent the seed from being used by others, this would not only make it impossible to commercialise the seed, it would also be a troublesome task because of the biological fact that plants are self-reproducing. If someone else acquired the seed, whether legally or not, it would be impossible for the breeders to prove that the genetic information used was exclusively theirs (Straus 2005). In line with the general justification, IPRs for improved plant varieties are put in place to address the inefficiency problem of public goods. Intellectual property protection for plant-related innovations reduces free riding and enables breeders to recoup their costs of investment. The exclusive protection through IPRs will not only benefit plant breeders in the form of royalties they can charge for their products, it will also benefit the consumers who use the invented superior products. Society as a whole would benefit because of the development of seeds and plants with new and favourable traits, together with the reduced requisite for governments to fund or subsidise such activities (Helfer and Austin 2011).

When focusing on the evolution of IPRs for improved plant varieties specifically, it will appear that political-economic pressure from various interest groups has also played a determining role. Because of this, these IPRs should not only be seen as attributions of inventiveness, but also as a commercial tool and a source of power, both heavily influenced by technological change (Rajan 2006). IPRs steer innovation, but conversely, technological change steers the development of the IPR systems as they continuously present new challenges and disrupt the formation of various interest groups. The increased value of PGRs that this involves, has led to a process of institutional change driven by an interaction of various actors that seek to influence the adjustments to their advantage (Eaton 2013). This was also recognised by Raustiala and Victor (2004: 7), as they explain that "when the private value of a good rises, potential owners will agitate governments to change property rules to allow capture of the added value. An increase in the value of the resource because of an exogenous circumstance, such as a technological development or the discovery of a new application, may create a sufficient incentive for the development of property rights". Over time, countries have implemented IPRs systems for improved plant varieties in various forms, differing in, *inter alia*, their protection, duration, and the exemptions that are offered to use the material for further research. A comparison of the principal differences among IPRs for improved plant varieties is provided in Table 1.

Table 1: Comparison of Principal Differences among IPR Systems for Plant Varieties

	UPOV 1978	UPOV 1991	Plant patents (US)	Utility patents over plant varieties (US)
Protection	Varieties of species listed by country	Varieties of all genera and species	Varieties of asexually reproduced plants, except uncultivated and tuber propagated plants	Varieties of sexually reproduced plants
Duration of Protection	15-20 years, depending on crop	20-25 years, depending on crop	20 years	20 years
Requirements	Novelty, Distinctness, Uniformity, and Stability	Novelty, Distinctness, Uniformity, and Stability	Novelty, Distinctness, and Stability	Novelty, Utility, Non-obviousness, and Industrial application
Exclusive Rights	Multiplication of variety for commercial purpose	Multiplication of variety for commercial purpose	Reproduction or sale of patented plant	Multiplication of variety for commercial purpose

Table 1 Continued...

Table 1 Continued...

Exemptions	(i) For further breeding (ii) For private and non-commercial use	(i) For further breeding, restricted in case of EDV (ii) For private and non-commercial use (iii) Farmers' Rights permitted, taking into account the legitimate interest of the breeder		(i) Research exemption (ii) Sexual reproduction of the claimed variety (iii) Products derived from the variety

Source: Adapted from Helfer and Austin (2011) and Louwaars *et al.* (2005).

2.4 The International Landscape of IPRs

IPRs have entered the plant-breeding sector as a result of efforts to stimulate innovation and economic growth, as well as due to political-economic pressure from various interest groups. As IPRs systems may vary, national legislators implementing an adequate system need to balance the moral dimension of rights and the role of IPRs in increasing welfare in their country (Louwaars 2007). The simple reasoning that these legislators, therefore, need to implement the level of protection that best suits their countries' characteristics and needs would ignore the fact that countries are part of a highly interdependent world economy. It is for this reason that the international landscape of IPRs has become a much-debated issue.

IPRs are national in character, meaning that a patent – or any other type of intellectual property protection – is only valid in the country where it is assigned. If a patent is granted at the US patent office, for example, this patent is only valid in the US, unless the patent holder applies for, and secures, protection in additional countries. This implies that all countries in which the inventor wants to secure the exclusive rights over a certain product need to have in place at the least an adequate legal system of protection. Still, many developing countries lack such a legal system, especially when the protection of improved plant varieties or biological materials is concerned (Falcon and Fowler 2002). As the inventions that are protected by IPRs are generally non-rival and non-excludable in nature, the most beneficial option for countries that want to use foreign technologies is to simply not provide intellectual property protection at all. This way, these countries would be able to free ride on the provision of foreign inventions (Louwaars 2007). Indeed, developing countries have been able to use inventions that were protected elsewhere, but this situation is changing rapidly. International treaties and conventions increasingly govern various aspects of the implementation of intellectual property protection on a global scale. The World Intellectual Property Organisation (WIPO) has a lead role in coordinating and collecting information on the existing IPRs and offers an important service in assisting developing countries to implement the legal requirements for an IPRs system (Wright and Pardey 2006). Yet, the most influential legal instrument that now regulates IPRs globally, the TRIPS agreement, has been negotiated outside of the international treaties and conventions that were traditionally associated with intellectual property protection. During the 1986-1994 Uruguay Round of the General Agreement on Tariffs and Trade (GATT), which is now the World Trade Organisation (WTO), the multilateral agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) was negotiated.

The TRIPS agreement contains minimum standards for the protection of intellectual property, which need to be implemented by all member countries of the WTO. When countries fail to do so, they may be subjected to a dispute settlement procedure within the WTO and receive trade sanctions in any possible area (Correa 1995). The development of the TRIPS agreement was highly influenced and monitored by international industries, especially from the US, in the areas of pharmaceuticals, chemicals, trademarks and copyrights (Wright and Pardey 2006). Although many spectators reckon the globalisation of IPRs to be in favour of technology providers, others argue that there is a correlation between the strength of IPRs in developing countries and the level of foreign direct investments (Lesser 2005; Kanwar and Evenson 2003; Maskus 2000). Certainly, the relationship between intellectual property protection and international trade has become highly contested in recent years. It has led to many international negotiations and disputes about international trade in general, but particularly about the implications for developing countries, which are concerned with their decreased ability to use already existing technologies. The objectives of the TRIPS agreement are described in Article 7, specifying that: “The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations.” Yet, many developing countries perceive the TRIPS agreement as an impediment to the use of technological knowledge to promote public interest goals such as health, nutrition and environmental conservation (Juma 1999).

With regard to PGRs, Article 27.3 of the TRIPS agreement states that “plants (…) and essentially biological processes for the production of plants (…)” may be excluded from patentability. However, the same Article proceeds with prescribing that “members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof.” The possibility to implement such a *sui generis* system has led to different legal systems in countries to protect their worked PGRs. While some WTO members have not used the TRIPS provision to exclude patent protection for worked PGRs, other countries have used this room for exemption and excluded plants, and in some cases all genetic material, from patent law. Even though other models could be included as well, most countries that exempt improved plant varieties from patent protection have implemented the UPOV 1991 Act as their *sui generis* system (Van Overwalle 2005). Surprisingly, there are very few countries that fully make use of the flexibilities under the TRIPS agreement in protecting worked PGRs, especially when developing countries are considered. Among the reasons for this is that many developing countries have given up the alternatives available under TRIPS in negotiations with their more powerful trading partners. Where the TRIPS agreement already forces developing countries to implement minimum standards in intellectual property law, there is also an increasing presence of bilateral trade agreements between these countries and their industrialised trading partners on IPRs provisions that go beyond the minimum TRIPS standards. These so-called TRIPS-plus agreements are usually negotiated bilaterally, requiring developing countries not only to become a member of UPOV, but also to introduce the more restrictive patent protection on plant varieties or genes (Louwaars 2007).

2.5 The Demise of the Common Heritage System

IPRs have dramatically privatised worked PGRs, allowing for the protection of improved plant varieties as well as for smaller products or methods that are used in plant breeding. With the TRIPS agreement, this privatisation is further extended as it is gradually being implemented in the entire global trade system. Unlike worked PGRs, raw PGRs are not eligible for intellectual property protection since wild plants are not manipulated by man and landraces do not meet the uniformity and stability criteria (Aoki and Luvai 2007). Although the line between what should be considered raw and worked PGRs is often subject to debate, raw PGRs hence stayed out of the intellectual property regime and plant breeders and seed companies have long continued to gather raw PGRs from around the world in the belief that this material was genetic information that could not be owned (Raustiala and Victor 2004). But all this changed when biodiversity-rich countries insisted on the implementation of a global system that would regulate the appropriation of raw PGRs.

Traditionally, people have viewed PGRs as part of a global commons. This view was eminently reflected in the International Undertaking on Plant Genetic Resources (IUPGR), which was adopted by approximately 100 countries in 1983. The undertaking formed a nonbinding agreement that was negotiated under the FAO and stated: “The undertaking is based on the universally accepted principle that plant genetic resources are a heritage of mankind and consequently should be available without restriction” (FAO 1983). Although the FAO Undertaking attempted to counter the ownership not only of raw, but also of worked PGRs, many industrialised countries refused to allow for open access to the latter. For raw PGRs, on the other hand, the FAO Undertaking meant that they were a freely accessible good, like information in the public domain, and without the exclusive preserve of any single user or nation. It practically meant that, during these times, researchers were allowed to freely collect samples of genetic material, without the obligation to obtain national government approval for these sampling activities (Safrin 2004). Nevertheless, this approach towards raw PGRs changed entirely with the Resolution of the International Undertaking on Plant Genetic Resources for Food and Agriculture in 1991 (Roa-Rodríguez and Van Dooren 2008). In this resolution, the common heritage concept was subjected to the sovereignty of states over their PGRs. From this moment onwards, the common heritage concept for PGRs was not only undermined by IPRs for worked PGRs, but also by state-sovereignty claims over raw PGRs.

The state sovereignty claims over raw PGRs were expanded when the Convention on Biological Diversity (CBD) came into force in 1992. The CBD is a multilateral agreement that resulted from environmental concerns. It originated from the idea that economic incentives were necessary in order for developing countries to conserve their biodiversity instead of seeking rapid gains through the destruction of nature (Aoki and Luvai 2007). In terms of ownership, the CBD clearly turns away from the common heritage idea as it holds that the conservation of biological diversity is a common concern of humankind but that states have sovereign rights over their biological resources (De Jonge 2009). The CBD did not just spring from environmental concerns. As a result of the emerging possibilities in biotechnology and the establishment of different systems for IPRs, the potential and use value of raw PGRs increased rapidly. Especially the poor but biodiversity-rich countries hoped that the CBD would give them the possibility to control the physical access to their raw PGRs, and through this, be able to capture the benefits from the use of these resources (Roa-Rodríguez and Van Dooren 2008). It was for this reason that mainly developing countries favoured the protection of their genetic material, as these are the nations that harbour the greatest amount of the world's genetic diversity (Safrin 2004). The CBD was also supported by the international environmental movement, which had a major share in the outcome of the negotiations and considered the sovereign rights over raw PGRs as an adequate incentive for poor countries to stimulate nature conservation. The prospect was that these countries would take measures to safeguard their potentially valuable raw PGRs as they were now recognised to be theirs. Designated as the "grand bargain", the CBD had to provide access to genetic resources for the emerging bio-industries in the North, in exchange for a fair share in the benefits of these resources for the South (De Jonge 2009).

As from the entry into force of the CBD, access to raw PGRs need to take place based on prior informed consent and mutually agreed terms negotiated with the country of origin (Falcon and Fowler 2002). All of this would be done through a so-called "access and benefit sharing" framework that was set up with the Nagoya Protocol of the CBD and successive Bonn

Guidelines. The access and benefit sharing mechanism was generally seen as a tool for developing countries to redress an inherent imbalance of power with industrialised countries that have historically obtained raw PGRs free of charge. It addresses the seemingly unjust system in which raw PGRs flowed freely from developing countries to industrialised countries, while the flow of worked PGRs was protected through IPRs and sold for higher prices. However, these potentially positive regulations have tended to operate differently in reality. One major criticism of the CBD is that virtually all countries see themselves as providers and hence sellers of their raw PGRs. This, in combination with the fact that no country seems to be a buyer, has led to a decreased international transfer of raw PGRs. In many developing countries, legislation is now highly focused on access restriction, designed to prevent abuse instead of capturing a share in the benefits (Falcon and Fowler 2002). In addition, there is often a lack of clarity by user-countries as to which institutions have the authority to grant access, while on the part of the provider-countries there is often a lack of willingness to take responsibility to make such decisions (Louwaars *et al.* 2006). Another problem with effectively protecting the raw PGRs through the CBD is that it is practically impossible to control all transfers. This, again, has to do with the fact that PGRs carry information, which is naturally transferring among organisms, ecosystems and countries. Also, researchers only need small quantities for R&D. As a consequence of the above, it becomes a very difficult task to prevent anyone from smuggling biological material out of a country (Koopman 2005).

3. A Global Justice Perspective and Recovering the PGR Commons

Many scholars have studied the shift in property regime for PGRs, particularly the extension of IPRs through the TRIPS agreement, which is a much-debated issue in the current Doha Development Round of the WTO. However, in examining the effects of this property regime shift, scholars generally use a perspective that is limited to the effects it has on efficiency and economic growth. Using this narrowed focus, it is rather easy to explain the changes undergone in this sector. Justifications based on these explanations fit the so-called “market-failure paradigm”, holding that when markets cannot deliver efficient outcomes on their own, the government needs to implement public policies or institutions that support this aim

(Paavola 2009). From the same perspective, also the CBD can be seen as an attempt to solve comparable efficiency concerns, but in this case for raw PGRs. Apart from efforts having to do with access and benefit sharing, the CBD aims to establish a more efficient framework for the conservation and utilisation of the world's genetic resources. By granting sovereign ownership over countries' resources, the argument goes, the countries would make better decisions in the management of these resources because the option value would also be internalised in these decisions.

It is undeniably helpful to evaluate the shift in property regime for PGRs from an economic perspective that focuses on efficiency and overall growth. Yet, this perspective falls short in fully explaining the reasons for the emergence of the institutions that have privatised PGRs, let alone the consequences that this entails. First of all, the efficiency justification disregards the fact that both IPRs and the CBD were heavily shaped by political-economic motives, intended to take advantage of the opportunities that arose with the emergence of biotechnology in the plant breeding sector. More important, the institutions that have enclosed the PGR commons are often criticised because they do not sufficiently meet – or even obstruct – other ethical standards than the efficiency criterion, namely that of distributional justice and the provision of human rights.

3.1 Beyond the Market Failure Paradigm

From the distributional justice and human rights perspectives, which can be grouped under the term "global justice", the perfectly efficient allocation of resources is not essentially the most desirable ethical standard. The global justice perspective arises from the idea that the world is largely unjust. It is often used to refer to the global requirements of justice, conceived as a special class of reasons for action that apply primarily to the institutional structure of political and economic life (Beitz 2005). Although more specific views on global justice diverge, common grounds are the high level of attention that is given to inequality and the importance of providing basic human rights. The prominent philosopher Peter Singer, for example, pleads for uniform standards and rules that can create equality between human beings, as well as between and within states. According to his view, this should be achieved through international institutions and agencies that can restrain the egotism of richer states in defending their interest against poorer states. Another philosopher in this field, Thomas Pogge, also emphasises the need for institutional reform and political relationships, but more from the reasoning that rich peoples have the obligation to improve the situation of the poor (Pogge *et al.* 2010). But it is not in the scope of this article to thoroughly discuss the concept of global justice or the differences in its precise perceptions. Instead, the global justice concept will be used in its broader sense, based on the principles of equality and universality. This way, using the perspective of global justice to evaluate the institutions responsible for the changing property regime for PGRs, will lead to interesting insights that would not be obtained by simply using the market failure paradigm.

3.2 Distributional Justice

Examining IPRs for improved plant varieties shows that there are various alarming distributional consequences and they can be categorised, as was also done by DeCamp (2007), according to the means by which they influence the distribution of objects: a) the type of objects that will be developed: availability; b) the differences in access that people have to these objects: access; and c) the distribution of the IPRs themselves among various actors: concentration.

3.2.1 Availability

Since commercial plant breeders and seed companies have the motive to make profit, their research is generally focused on innovations that are likely to generate high sales. Crops that are grown by small-scale farmers, especially those in developing countries, are, therefore, generally under-researched. As such, very little research has been directed towards crops such as sorghum, millet and cassava (De Schutter 2009). This is because these so-called orphan crops would only be used by the capital-poor, making it an unprofitable target for research in the private sector (Falcon and Fowler 2002). According to a calculation by Beintema and Stads (2008) only 6 per cent of privately funded agricultural research is focused on developing country agriculture.

The evolution of IPRs in plant breeding has not only created a system in which there is merely an incentive to invent or produce products that are targeted towards the capital-rich; it has also allowed for the privatisation of this industry. As improved plant varieties were previously considered to be a public good, the provision of such goods greatly depended on public research institutes and public funding. This gradually began to change since the 1930s, as since then there has been a steady increase in the level of private investment in plant breeding research. Yet, it was only from the 1990s onwards that the share of these private investments increased dramatically when a small number of agribusiness giants began to direct large amounts of money into biotechnology. Although public breeding programmes continued to operate in many countries, there has been a general withdrawal from seed production activities by public organisations (Morris *et al.* 2006; Thirtle *et al.* 2001). Moreover, the National Agricultural Research Institutes (NARIs) that do continue their plant breeding activities are often confronted with a dilemma as IPRs have changed the institutional environment. To be more precise, researchers working at NARIs and universities have been increasingly stimulated by research administrators to protect their created knowledge because they see the possibility to create additional income by licensing the invented and protected plant varieties (De Jonge 2009). However, the ability to actually receive such incomes very much depends on the farmers' demand for these varieties. As it is clearly stated by Louwaars *et al.* (2005: 4): "There is a danger that this heterogeneity may be translated into inequitable and questionable public research resource allocations, further reducing research on orphan crops and a smallholder focus in favour of breeding objectives and methodologies directed at large-scale commercial production". Public policymakers and research managers, therefore, need to carefully consider the extent to which IPRs are used in public plant breeding. If NARIs are forced to redirect their breeding strategies simply to remain financially viable, governments should provide the necessary funds for research.

As commercial seeds are increasingly directed to the capital-rich, many of the seeds that are currently found on the market create specific implementation problems for smallholder farmers in developing countries. Although these seed varieties often have the potential to improve yields, sufficient additional inputs such as water and fertilisers are needed to achieve this end. Because of insufficient income, poor farmers are often not able to acquire such additional inputs. Moreover, these commercial seeds are generally directed to agro-ecological environments that are suitable for large-scale mono cropping. As poor farmers are generally situated in areas with specific environmental challenges (such as height or drought), landraces are often more appropriate (De Schutter 2009).

3.2.2 Access

Access to improved plant varieties protected by IPRs is restricted in the sense that farmers, only to a limited extent, are allowed to save, exchange and sell the harvested seed of the protected plant variety. Especially for smallholder farmers in developing countries, who traditionally rely on these practices, such restrictions could have detrimental consequences. It is for these reasons that the national implementation of "Farmers' Rights" can make a huge difference in accessing protected varieties (De Schutter 2009). Farmers' Rights allow farmers who purchase seed of a (through IPRs) protected variety to save from those crops and to replant without additional payments (Aoki and Luvai 2007). These rights, which vary heavily among countries and among the different UPOV Acts, emerged from the imbalance in the options for protection of raw PGRs and worked PGRs. While improved plant varieties are eligible for intellectual property protection, local farmers' varieties or landraces are considered raw PGRs that cannot be owned. However, there is something significantly controversial about this distinction, as farmers have grown, selected and replanted their PGRs for thousands of years. The landraces that resulted from these practices do not qualify for legal protection, yet many of these landraces are used by plant breeders to develop improved plant varieties, which are then protected, and in some cases, sold to these same farmers. The introduction of Farmers' Rights is an attempt to restructure this imbalance and to recognise farmers as the historic, present, and future stewards and innovators of PGRs (De Jonge and Korthals 2006). Deplorably, the UPOV 1991 Act dramatically limited Farmers' Rights. The seed industry greatly lobbied their governments, resulting not only in the entire prohibition to sell some of the harvested seeds, but also in the inclusion of Article 15.2 that made Farmers' Rights optional and allowed each UPOV member to decide whether or not to introduce these rights in their national laws (Helfer and Austin 2011).

3.2.3 Concentration

The emergence of IPRs in plant breeding has led to a significant increase in concentration in the seeds business. Especially the entrance of agrochemical companies in the commercial seed sector has resulted in the unprecedented convergence between the key segments of the agricultural market. In 2008, the top 10 seed companies already represented 67 per cent of the global protected seed market, with Monsanto, DuPont and Syngenta, the top three of this market, accounting for 47 per cent of this share (De Schutter 2009). This increasing concentration is even more apparent in the agricultural biotechnology sector, in which six companies controlled 98 per cent of the market for protected biotech crops in 2003 (Tansey and Rajotte 2008). These few companies now control many key patents that are needed in the industry, thereby increasing the barriers for new firms to enter the sector. In order to gain control over their protected material, as well as to be able to retain freedom to operate, larger companies often acquire smaller companies. DuPont, for example, paid 9.4 billion dollar for the company Pioneer, simply to strengthen its seed operation in maize (Falcon and Fowler 2002).

3.3 The Right to Food

Even though there are divergent views on global justice, the most important views share the recognition of basic human rights (Timmermann and Van den Belt 2013). When evaluating the consequences of IPRs for worked PGRs, there is one human right that is of specific concern: Many scholars and politicians have raised the question whether there should be a human right to food. Such a human rights framework could help countries not only to oblige themselves to make agricultural policies that maximise yields, but also to make policies that primarily influence who will benefit from those yield increases. It would require countries to place at the centre of their efforts the needs of the most disregarded groups (De Schutter 2009). At the World Food Summit in 1996 and the Millennium Summit in 2000, for example, the government representatives declared that each person has a right to adequate food that is safe and culturally appropriate (Pinstrup-Anderson and Watson II 2011). Even more binding is the formulation of the human right to food in the International Covenant on Economic, Social and Cultural Rights (ICESCR), a multilateral treaty of the United Nations. Article 11 of the ICESCR imposes three primary obligations on governments in the realisation of the right to food. First, countries have to *respect access to adequate food*, meaning that they should not take any measures that would prevent this access. Intellectual property protection without adequate recognition of Farmers' Rights could be seen as such a measure, since this obstructs the informal seed systems of farmers and hence their access to food. Second, countries have the obligation to *protect the right to food*. In

India, this has resulted in the recommendation to provide state subsidies that enable farmers' access to re-usable generic seeds and so to eliminate their increasing dependency on multinational seed enterprises. Third, states have the obligation to *fulfil the right to food*. With regard to worked PGRs, this could mean that governments have to promote agricultural research that is directed at orphan crops, with the result that everyone will have access to adequate food (De Schutter 2009).

Interestingly, the right to food seems to be counterbalanced by Article 15 of the same ICESCR, which states that everyone has the right to protection of the moral and material interest resulting from any scientific, literary or artistic production of which he is the author. However, the Committee on Economic, Social and Cultural Rights seems to clarify this jeopardised balance by concluding that intellectual property is a social product and has a social function. It further notes that member parties have a duty to prevent unreasonably high costs for access to plant seeds or other means of food production (De Schutter 2009).

3.4 How the CBD Fails to Bring Global Justice

Where the appropriation of worked PGRs through IPRs can be seriously criticised from a global justice perspective, this appears to be different for the appropriation of raw PGRs as the CBD was partly set up to address global justice concerns. These concerns are reflected in the avowed objective of the CBD, which explicitly states that there should be a "fair and equitable sharing of the benefits arising out of the utilisation of genetic resources". Clearly, this benefit sharing aims at significant distributive effects as it is predicated on a bilateral model of exchange and compensation based on the sovereign rights that states have over their PGRs. This way, poor countries are to be compensated for their contribution to the production of improved plant varieties by offering their raw PGRs (De Jonge 2009).

Despite affirmations in the CBD that states must provide "facilitated access" to the PGRs on which they have sovereign rights, it has failed to generate a significant flow in these resources. In fact, as it appears so far, the CBD has been a major obstacle to the access to PGRs by both researchers and the bio-industry (De Schutter 2009). Hence, instead of creating a global justice institution that protects the interest of poorer states against the egotism of richer states (as is advocated by Peter Singer), the sovereign ownership of raw PGRs is obstructing the flow of germplasm on which the agricultural sector historically depends (De Jonge and Korthals 2006). As a matter of fact, a continuing flow of the world's genetic resources is considered to be essential for global food security in the long run (De Jonge 2009). That PGRs have been distributed around the world for millennia can be easily illustrated. For example, it is estimated that Bangladeshi rice contains four varieties from its own landraces and 229 "borrowed landraces" coming from other countries. Rice from the US comprises 219 native landraces and 106 borrowed landraces. Several studies suggest that similar interdependence applies to all major food crops (Blakeney 2009). Hence, even though the CBD has been an attempt to address global justice concerns about the unfair distribution of resources itself, it has indirectly caused the emergence of another global justice concern, namely that of food security and accordingly a possible violation of the right to food.

Instead of pursuing the right to food and the more equitable distribution of PGRs through steering the highly unequal direction in plant breeding towards the benefit of smallholder farmers in developing countries, many efforts are now being made to claim ownership of raw PGRs and to prevent its misappropriation. Based on the CBD, the national access regimes are adopted in a context of fears of biopiracy and a lack of compensation for the benefits that commercial exploitation of PGRs could generate. Even though the emergence of the regimes have created awareness about the importance and potential value of PGRs, the main consequence is that these regimes have been essentially protective, aimed at preventing rather than promoting the use of PGRs for research. Of course, biopiracy should be condemned and mechanisms to share in the benefits of the worlds PGRs should be sought. But such efforts so far have mainly increased what Safrin (2004) has called the "hyperownership" of PGRs in which an interactive spiral of increased IPRs-enclosure leads to increased sovereign-based enclosure, resulting in the sub-optimal utilisation and improvement of these resources. Box 1 shows the example of Peru, a biodiversity-rich country, where both the Peruvian government and Andean farming and indigenous communities heavily protect their PGRs in their fight against potential misappropriation.

Box 1: Peru's Fight Against Biopiracy

Peru is one of the 10 mega-diverse countries in the world. With three large and different regions (coastal plains, the Andes and the Amazon jungle), it has almost all scientifically recognised life zones. Perhaps the most spectacular example of Peru's biodiversity is the potato, which is an easily grown plant, producing more food on less land faster than any other crop. Being the third most important food crop in the world, after rice and wheat, the potato has become a major carbohydrate in the diet of hundreds of millions of people in developing countries (CIP 2008). The cultivated potato traces its origins to Andean and Chilean landraces that were developed by pre-Colombian cultivators. Although disputed, the precise location of its origin is argued to be Peru (Spooner *et al.* 2005), where potato farming goes back to 5,800 BC and which is home to between 2,000 and 2,500 native potato varieties (Scott 2011).

Like many other mega-diverse countries, Peru is primarily concerned with the control and protection of its PGRs. In this light, Peru and her neighbouring countries Bolivia, Colombia and Ecuador (together they form the Andean Community), adopted Decision 391, a legal framework that regulates a Common Regime on Access to Genetic Resources. As can be read in Article 5, Decision 391 aligns with the CBD as it states: "The Member Countries exercise sovereignty over their genetic resources and consequently determine the conditions for access to them, pursuant to the provisions of this Decision" (Coloma 2010: 80). With this Decision, these countries hoped that such a form of protectionism would result in well-negotiated contracts with user countries or companies, and so to gain from their rich biodiversity (Correa 2005). This was not inconceivable as these countries already found that biotechnology firms in industrialised countries had been using their biodiversity. As there was no or limited compensation for this use, some of these practices had been portrayed in the media as cases of biopiracy (Ruiz 2012). In 2002, for instance, the National Institute for the Defense of Competition and Intellectual Property (INDECOPI) found that an invention based on a Peruvian plant, Maca, had been granted to Pure World Botanicals. In order to determine whether biopiracy indeed applied, a working group was set up to look into the case. When this working group discovered that there were numerous other patents related to Maca, as well as hundreds of patents related to other plants of Peruvian origin, it was transformed into a longer-term body that would look into biopiracy cases since 2001: The National

Box 1 Continued...

Box 1 Continued...

Commission for the Prevention of Biopiracy. Since then, the Commission has identified, analysed, and taken action against many cases of biopiracy (Ruiz 2012). With the Supreme Decree 003-2009-MINAM, which is Peru's national implementation of Decision 391, Peru hopes to make access and benefit sharing a reality. The idea of this regulation is not to forbid companies from using their genetic resources, but to be fairly awarded for their use. However, there has not been any successful case of access and benefit sharing so far.

The Peruvian government is not the only stakeholder that is highly concerned with the protection of its PGRs. Over the past decades, Andean farming and indigenous communities have increasingly become aware of the vast interest in their PGRs, especially the diverse potato varieties they cultivate. Although their argumentations partly overlap with those of the Peruvian State, the Andean farming and indigenous communities fight against biopiracy from different moral positions, based on their own worldviews and traditions. In the fear of misappropriation of their PGRs and associated traditional knowledge, these farmers often consider both the State and national and international research centers as intruding forces that come to take their genetic resources without giving anything in return (De Jonge 2009).

Source: Author's compilation.

3.5 Challenging the Shift in Property Regime for PGRs

Examining the consequences of the shift in property regime for PGRs shows that current institutions do not seem to work to the benefit of smallholder farmers in developing countries. Although the potential of biotechnology in plant breeding is enormous, it appears to be mainly the powerful seed businesses that actually make use of it. Quite apart from the fact that these resources are directed to capital-rich farmers in developed countries, IPRs restrictions hamper such varieties to be taken up in developing countries' seed systems. Yet, challenging the shift in property regime for PGRs should not be sought through further enclosing the PGR commons. Instead, PGRs should be shared and national and international research institutes should increase their focus on breeding plant varieties that will benefit those that are neglected by the private sector. It is in this light that two specific institutions that have so far been left out of this analysis, seem to be very promising: the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Consultative Group on International Agricultural Research (CGIAR).

The ITPGRFA can be understood as an attempt to counteract the access and use restrictions of PGRs erected by state sovereignty and IPRs, and so as to create an institutional framework that better suits the agricultural sector. The Treaty was established by the FAO in 2001 and is currently ratified by over 120 countries. Central to the ITPGRFA is its Multilateral System, through which 64 key crops and forages can be accessed freely by the member countries. These key crops, which are estimated to provide about 80 per cent of humanity's food of plant origin, can be seen as a recovered commons since contracting parties of the ITPGRFA are obliged to provide facilitated access to these PGRs as if they are in the public domain (Louwaars *et al.* 2006).

The ITPGRFA is primarily concerned with countries' shared interest in food security. Knowing that no country is self-sufficient in its PGRs for food and agriculture, it is obvious that the facilitated access of these resources can be of great advantage for food production across the world. Although it is still difficult to measure the impact of the ITPGRFA, it is very likely to be a crucial step in making available PGRs for research and development objectives. Interestingly, the ITPGRFA also clearly expresses a distributional intention of the Multilateral System, asserting that the accruing benefits "should flow primarily, directly and indirectly, to farmers in all countries, especially in developing countries, and countries with economies in transition, who conserve and sustainably utilise plant genetic resources for food and agriculture" (FAO 2009: 22). Hence, the ITPGRFA can be easily linked to distributional justice and human rights objectives and this connection becomes even more evident when the inclusion of the international genebanks of the CGIAR centres are taken into consideration.

The CGIAR is an international organisation that funds and coordinates research into agricultural crop breeding with the goal of reducing rural poverty, increasing food security, improving human health and nutrition and ensuring a more sustainable management of natural resources. Its establishment can also be seen as an effort to preserve historically productive practices of sharing and free exchange of agricultural material, and so to actively respond to the increasing availability of proprietary protection. Over four decades, the number of research centres that are supported by the CGIAR grew from 4 to 15, which are currently coordinated by the CGIAR Consortium. Although guided by policies and research directions set by the Consortium Board, all 15 research centres are independent non-profit research organisations, innovating on behalf of the poor. These research centres are located all over the world and each research centre has its own expertise. The CGIAR currently houses more than 600,000 unique accessions of plant germplasm. Many of these accessions are derived from locally essential food staples. It can be seen as the most important international collection of PGRs, at least in terms of the diversity and quantity of accessions. These PGRs are freely supplied on the request of farmers, scientists and breeders (Marden and Godfrey 2012).

Although originally the focus of the CGIAR has been on increasing food production to avoid mass starvation, the focus has shifted over the years, concentrating increasingly on making available both raw and worked PGRs for research and plant improvement that is specifically targeted to address food security and productivity of the poor in developing countries (Gotor *et al.* 2010). Comparable to concerns about the restricted access to PGRs that have led to the ITPGRFA, the CGIAR had concerns regarding the accessibility of its collections and the extent to which this would be hampered with the rise of IPRs and the foundation of the CBD (Marden and Godfrey 2012). Attempts within the international community to secure the open access of PGRs resulted in the so-called In-Trust Agreement (ITA), which is an agreement between the CGIAR and the FAO. The ITA formalised the legal status of the CGIAR germplasm as freely available and was thus included in the Multilateral System of the ITPGRFA for the benefit of humanity (Gotor *et al.* 2010).

The ITPGRFA and CGIAR do not only show similarities with the distributional justice and human rights objectives that are associated with global justice, the goals of these institutions also strongly contrast with the shift in property regime for PGRs that is currently hampering these objectives from being realised. Yet, the changing institutional environment has caused many challenges for these international institutions. In the last 15 years, there has been a significant decline in the CGIAR centres' ability to acquire and conserve additional PGRs. According to a recent study of Halewood *et al.* (2012: 100) in which the genebank managers of the CGIAR centres were surveyed in 2006 and 2011, these declines mainly have to do with the "highly politicised nature of access and benefit sharing issues at the international, national and local levels, combined with low levels of legal certainty". Knowing that Peru is among the countries that most actively try to put in place the needed legislation to protect its PGRs as well as to reap the benefits from its use, it is not surprising that the International Potato Centre (CIP), which is one of the CGIAR research centres and situated in Peru, is regularly confronted with the above-described struggles. Yet, as it is shown in Box 2, analysing the strategies that are used by CIP demonstrates the ability of these institutions to reverse the shift in property regime for PGRs in order to make sure that the newly emerging possibilities in plant breeding are actually used to benefit the world's poorest.

Box 2: The Challenge of Sharing PGRs in a Protectionist Country

With Peru being the centre of origin of the potato, as well as the many different potato varieties that are used by farmers in the Andes, the location of the International Potato Centre (Centro Internacional de la Papa, CIP) in Peru is by no means unplanned. Being located in a country with such a huge diversity in potato varieties, CIP greatly benefits from its environment. The different potato varieties that are found in the Andean region are an important source for their current and future breeding activities. These varieties are, therefore, carefully conserved through storage in the CIP genebank, but also on small plots of land through cultivation. CIP attempts to use these PGRs to develop improved potato varieties for potato farmers in the Peruvian Andes, as well as for farmers in other parts of the world. Focusing on developing countries, potatoes and sweet potatoes are not only cultivated in South America, they are also cultivated in large parts of Africa and Southeast Asia. This ensures that Peru, or even South America, is not necessarily the primary target area for CIP. In fact, because of the highly diversified Andean potato systems, impacts of improved potato varieties are often potentially higher in Africa or Asia from a development perspective. Nevertheless, CIP also devotes meaningful attention to the production of potatoes in the Andean region, which can easily be illustrated by the large number of programmes to alleviate hunger and poverty among farmers in the High Andes (Vroom 2009).

Box 2 Continued...

Box 2 Continued...

Resulting from the changing political and legal environment embodied in Decision 391, as well as the opposition by Andean farming and indigenous communities, a political impasse on the management of PGRs has arisen in Peru. For CIP, this means that it is confronted with new challenges in achieving its objective to produce international public goods through releasing breeding material that is directed towards the alleviation of hunger and poverty (CIP 2006). As CIP has seen severe obstructions to add new acquisitions to its genebank, it heavily relies on the ITPGRFA (ratified by Peru in 2003), which is now by far the most important way to share its PGRs. Meanwhile, CIP has increasingly used a so-called multi-stakeholder approach. From the starting point of respecting the proprietary interests of the private sector, the Peruvian government and the Andean farming and indigenous communities, CIP aims to regain trust and to reshape opposition into partnerships that could contribute to its global justice perspectives. Thus, in acknowledging Peru's worries of biopiracy, CIP collects and conserves their PGRs in a completely transparent way. Although a major breakthrough still seems far away, there is consultation with the government of Peru on how to overcome the impasse on a regular basis. In recent years, CIP has also increased the involvement of Andean farming and indigenous communities, which easily becomes evident by exploring some specific collaboration activities. As such, CIP developed a catalogue of the native potato varieties that are cultivated by various farming communities in the Huancavelica region in Peru. By showing portraits of the families that grow these potatoes and specific information about the genetic make-up of these varieties, this catalogue is not only a tool for these communities to hold onto this knowledge, but also to protect the intellectual property by means of publication (De Jonge 2009). By doing this, CIP acknowledges the great contribution of these communities in creating these potato varieties and associated traditional knowledge. Another example is the so-called repatriation agreement between CIP and the Potato Park in which CIP scientists committed to repatriate potato varieties from the genebank to local farmers and to conserve them in the Potato Park. This agreement, signed in 2006, was established to protect both the genetic diversity of the region's potato varieties and the rights of the farming communities to control access to these resources. While this repatriation ensures that the genetic material does not become subject to IPRs, the agreement does not hamper collaborative research between CIP and scientists elsewhere, provided that this would not be used for exploitative or commercial purposes (Dias and Da Costa 2008).

Source: Author's compilation.

4. Conclusion

The emergence of biotechnology has created new insights into the possible uses of PGRs. Focusing on agriculture, this technological advancement has greatly expanded and accelerated the use of these resources in the development of improved plant varieties. Driven by the attempt to capture the increased value in PGRs, various interest groups are seeking to create an institutional environment that allows them to appropriate these resources. As a result, intellectual property protection for improved plant varieties is gradually implemented by governments around the world. In its turn, the emergence of IPRs for improved plant varieties have caused political debate about who owns the material that is used to create these protected inventions and products. While worked PGRs were increasingly subject to legal protection, raw PGRs have long continued to be gathered by plant breeders and seed companies in the perception that these belonged the "common heritage of mankind". However, when the CBD came into force and countries started to claim sovereignty over their raw PGRs, the property regime for PGRs had almost entirely shifted from a system in which these resources were available to everyone and appropriable by no one, to a system in which these resources can be protected by means of sovereignty-based rights and IPRs.

Although the economic perspective has proven to be useful in explaining the shift in property regime for PGRs, this perspective is incomplete in the sense that it disregards the alarming consequences for farmers in developing countries. IPRs for improved plant varieties only seem to address the undesired undersupply of those crops that are mainly used by capital-rich farmers in developed countries. Also, with the weak implementation of Farmers' Rights, access to protected plant varieties is restricted in the sense that farmers are scarcely allowed to save, exchange and sell the harvested seed of these varieties. As a response to the increasing value of PGRs and its appropriation through IPRs, many developing countries are adopting protective national access regimes. However, instead of creating effective access and benefit sharing practices, these regulations have further degraded the common heritage system. Moreover, the sovereign ownership of raw PGRs threatens the world's food security because it obstructs the flow of germplasm on which the agricultural sector depends. The hyperownership of PGRs results in the sub-optimal utilisation and improvement of these resources. Instead of further enclosing the PGR commons, PGRs should, therefore, be shared and public research institutes should increase their focus on those plant varieties that can be used by the world's poorest. The ITPGRFA and CGIAR seem to be the institutions in best position to seriously challenge the shift in property regime for PGRs and the global justice concerns that this shift entails.

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