Shifting Common Spaces of Plant Genetic Resources: an International Regulatory Appraisal

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Abstract

The appellative "common heritage of mankind" is often used as a description of the property domain that governed plant genetic resources (PGR) at an international level up until the end of the twentieth century. However, the concept is rarely elaborated on. In this paper, we explore the origins of common property in PGR and the shifting content and shape of the genetic commons over the past several decades.

Using the theoretical framework of diverse common property regimes developed by Peter Drahos, we chart the way in which the emergence and interaction of various international regulatory regimes related to PGR reshape common property spaces, rights and obligations.

We argue that these international agreements do not regulate a single property domain in isolation, but rather modify the content and boundaries of the complex set of property domains that apply to PGR: private, state, common and public. More than a theoretical conundrum, we show that any realistic appraisal of the implementation of the international regulatory regimes in relation to agricultural PGR in countries like Brazil, India and the Andean Pact countries must acknowledge the conflicting and complex dynamics of these interrelated property domains, as well as the way in which they are being put into place 'on the ground'.

We argue that a deeper understanding of the interactions among these international agreements and the dynamics of property at their interfaces is important for the construction of a governance framework that ensures the conservation and sustainable use of plant genetic resources for the wellbeing of society at large.

Keywords: *plant genetic resources, genetic commons, property domains, international regulatory regimes, biodiversity governance.*

Acronyms/Abbreviations: intellectual property (IP), genetic resources (GR), plant genetic resources (PGR), the International Undertaking on Plant Genetic Resources (International Undertaking or Undertaking), the International Convention for the Protection of New Plant Varieties (UPOV Convention), the Convention on Biological Diversity (CBD), the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), the International Treaty on Plant Genetic Resources for Food and Agriculture (International Plant Treaty).

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Introduction

Plants are integral components of the processes of human civilisation; growing crops enabled our sedentary lives to begin. Plant resources for food and agriculture have long been tied to food security, sustainable livelihoods and development (Tripp 1997). Although always present and used for centuries, the genetic component of plant resources began to take centre stage with the discovery of the informational molecule DNA[3] and the subsequent technologies developed for its characterisation and direct use (Herdt 1999). For centuries plant genetic resources (PGR) were regarded as resources to be shared by everyone and available for all to use. This form of access and use of PGR is often referred to as "common heritage of mankind" (Brush 2003, Kloppenburg Jr 2005, Safrin 2004; Raustiala and Victor 2004). However, the concept of common heritage and in particular its relation to common property regimes, is rarely elaborated on. What are the implications of governing a resource as a common heritage? And, in particular, is there still anything 'common' about the ownership of these resources at an international level?

In this paper we first analyse the informational dimension of genetic resources and its centrality to the notion of a genetic commons. We then discuss the concept of "common heritage of mankind" in relation to plant genetic resources and examine its connection to common property. Aware that the concept of commons is in need of more clarity, we subsequently use Drahos' typology of common property regimes (Drahos 2006) to identify four main categories of common property and to explore in more detail how the plant genetic commons has shifted and changed as a result of treaty or agreement-based international regulatory regimes.

The International Undertaking on Plant Genetic Resources, the International Convention for the Protection of New Plant Varieties (UPOV Convention), the Convention on Biological Diversity (CBD), the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the International Treaty on Plant Genetic Resources for Food and Agriculture (International Plant Treaty) pull the levers of regulation of plant genetic resources at an international level. We delve into this set of agreements to unveil the interdependent nature of the property domains that underline each of these international regulatory regimes and the way in which the interplay of these regimes reshapes the content and form of the common property spaces of PGR.

Considering briefly the adoption and implementation of these international regimes in some national settings, we show that the lack of acknowledgement and understanding of the dynamics of interaction of the regulatory regimes and how they reshape the various interconnected proprietary spaces –commons, private, state and public - renders efforts with the multiple aims of conservation, access, use and development of PGR futile. Finally, we argue that the recognition of the interplay of these international agreements and the dynamics of property at their interfaces is important for the construction of a governance framework able to balance the seemingly irreconcilable aims of PGR conservation, facilitated access and use for the benefit of the global society.

[3] DNA stands for desoxyribonucleic acid. The structural units of the double chain of DNA are four nucleotide bases: adenine (A), which is complementary to thymine (T), and cytosine (C), which is complementary to guanine (G). The order adopted by the four bases in a sequence formed by billions of bases in length in the double chain is what constitutes the informational template for a given organism (Voet 2004).

The informational dimension of plant genetic resources

Plant genetic resources relate to the world's plant biodiversity of actual or potential value for food, fibre, medicinal, industrial and cultural purposes. Our crop agricultural systems rely on plants growing in the wild, and on those transformed by people as part of domestication processes. Seeds of all of these diverse plants are the physical inputs that in conjunction with the intellect, skills and needs of peoples all over the world have allowed the development of agriculture and in the end the development of many of our current ways of life.

All this tangible plant biodiversity represents a pool of genetic information, whose actual and potential value, that is, its value as a resource depends on peoples' knowledge, needs and interests. The collection of genetic material or 'germplasm' has been a vital resource for farmers and breeders for a long time; it constitutes the basis of their ability to select for and enhance the transmission of hereditary traits between generations of crops (Herdt, 1999, p.4; Tripp 1997, p.19).

The term germplasm refers to the physical genetic material (the desoxyribonucleic acid molecule or DNA) that contains the information (or 'code') of the inherited traits of an organism. Although physically delimited, germplasm is primarily an informational resource. In a basic working model the transmission of information contained in the genetic code is as follows: DNA is converted (transcribed) into a strand of a messenger molecule called mRNA, which is then used to build the strings of amino acids that form the proteins, the most essential molecules in the metabolism of an organism, in a process called translation. This apparently straightforward model of informational flow (DNA $\wedge$ mRNA $\wedge$ protein) does not, however, reflect the diverse information patterns of the genetic code. There are many ways to 'read' the information contained in DNA during the transcription and translation processes. Furthermore, other molecules can alter DNA information.[4]

Since the discovery of the DNA and with the advances of biotechnology that have permitted the characterisation of the genetic material and diversified the ways in which the genetic information can be used, the informational component of the PGR has become the main object of global regulation of property relegating the tangible biological components to an unimportant second place (Safrin 2004, p.664). Additionally, the application of intellectual property regimes to genetic resources and the increased role of a knowledge-based economy in many parts of the world, have both played significant roles in the 'informational' way in which germplasm is today understood, used, valued and conserved (Parry 2004, Kay 1995 and Wright 1986).

Amenability of plant genetic resources to exclusion

In the global knowledge economy, PGR are inputs of primary importance for agricultural and pharmaceutical industries, which are the fastest growing bio-industries based on the development and innovation of informational products.

[4] Different phenomena contribute to the non-linearity of information in the genetic code. For example, non-coding regions interspersed in coding regions splice in alternative ways resulting in rearrangements of coding regions. There is also more than one starting point to read the information in the DNA template. In addition, proteins can be assembled from different mRNAs molecules transcribed from non-contiguous genes (units of genetic information and heredity). All of the former events generate many more and different molecules that the ones predicted by simply following the DNA sequence. Finally, recent discoveries have shown DNA of plants and mice rewritten based on RNA messages of past generations (Pearson 2006a; 2006b).

Attempts to regulate access and use of the informational component of PGR have led to the escalated enclosure of these resources under the claims that private (intellectual) property is required for an efficient resource use and for obtaining incentives for increased innovation in these information intensive areas (Boyle 2003; Drahos 2004a).

However, as informational resources PGR pose serious challenges for the regulation of property, in particular for exclusionary property. In contrast to their physical instantiations, as informational resources PGR are fundamentally 'non-rival' and 'non-excludable'. Non-rivalrous consumption means that one person's use of the good does not interfere with another's ability to simultaneously make use of it. In addition, non-excludability means that it is impossible or at least very difficult or costly to allow some people to use informational resources while excluding others. In light of these two characteristics, the central dilemma posed by these goods is that the market alone is unlikely to provide adequately for their production because users can easily free ride on these resources without incurring any costs for their development. In response to this problem, intellectual property tries to create exclusionary spaces to allow profit making and private investment in these information intensive goods (Drahos 2004a, p.321-322).

Private property is, however, not the only way to regulate access and use of PGR to achieve innovation and production of, in particular, agricultural resources. In light of the non-rivalry and non-excludability of PGR it is clear that these resources are by their nature difficult to contain. PGR are resources that are, in important ways, 'open' to public use and sharing. While as physical objects seeds are a limited resource, susceptible to erosion and depletion that may result from environmental factors and/or human mismanagement, informational genetic resources grow through people's use and combined skill and effort. As Drahos has put it, "[r]epletion through use rather than depletion is what characterizes the intellectual commons" (2006, p. 3). Commons, as a property domain, is therefore another realistic regime for the provision, distribution and regulation of PGR.

The commons of plant genetic resources

A property regime can be defined as a set of rights derived by rules or norms regulating how people relate to each other in relation to a resource (Ostrom and Schlager 1996). In a common property domain members of a community set forth the norms or rules of access and use of a resource. There are numerous examples of physical resources such as pastures, livestock, fisheries, water and land that have been and often still are managed as commons by local communities around the world (Agrawal 2001, Dietz et al 2003; Ostrom 1999).

A stigma has, however, accompanied the seemingly unruly notion of common property since Garrett Hardin made it the subject of a 'tragedy' (Hardin 1968). Using grazing pastures as an example, Hardin argued that a rational user of a commons would seek to maximise their own gain by extracting as much of the resource as possible for their own benefit without regard for the costs imposed on other users. Pursuing this behaviour, every individual's actions would lead to resource overuse and eventual depletion (the 'tragedy'). The solution, according to Hardin, lies in the allocation of rights as private or public (state) property.

A growing volume of ground-based evidence and scholarly work has, however, shown that users of commons have often devised institutional arrangements and

governance regimes that are sustainable for long time periods, allocate resources equitably and minimise efficiency losses[5]. PGR in particular, by virtue of their non-excludability and non-rivalry, do not suffer from the tragic overuse that Hardin argued might occur in common property regimes. Hardin's tragedy relates to tangible resources with limited stock and units, a feature that makes these resources susceptible to depletion through overuse.[6] Conversely, the intangible (informational) components of PGR thrive with use.

'Common heritage' or global genetic commons

For a long time the genetic diversity of plant resources was considered "the estate" of humanity as a collective, or in other words, the 'common heritage of mankind' – owned by no one and accessible to everyone (Frankel 1974; Wilkes 1983; Kloppenburg Jr. 2005). Before any statutory or formally embodied legal principle, there was a general uniform and consistent practice of unencumbered access and use of plant resources as germplasm for food and agriculture across nations. This situation is deemed as a global commons (Safrin 2004).

When the International Undertaking on Plant Genetic Resources (hereinafter International Undertaking) came into being in 1983 the customary practice of availability without restrictions was expressed as 'heritage of mankind' and in subsequent resolutions of the International Undertaking the expression varied to 'common heritage of mankind' and finally to 'mankind's heritage'.[7] But while global commons is a widely accepted notion to describe the practice of sharing PGR, there are doubts as to whether there has ever really been a 'common heritage' system in the international legal sense (Baslar 1998).

Birnie and Boyle argue that 'common heritage' as an international legal governing regime requires, among other factors, the presence of a clearly appointed international governing authority and an obligation to share the benefits flowing from the use of the resources (Birnie and Boyle 2002) - both features absent in the governing regime of PGR heralded by the International Undertaking. None of the subsequent international agreements related to PGR adopted the term of 'common heritage' again. In fact, as we will see later on, the openly shared character of PGR has pretty much disappeared altogether; instead the right of access to biodiversity resources is subject to the sovereignty of nation states or alternatively subject to private intellectual property rights.

We, therefore, abandon the problematic legal concept of 'common heritage' and instead seek to analyse more precisely the patterns of use and ownership that have characterised the global commons of agricultural genetic resources.

The interlocking and disparate spaces of global PGR commons

[5] See for example Agrawal 2001, Dietz et al. 2003, and Ostrom 1999.

[6] It should also be noted that in most respects Hardin was wrong. He assumed that common spaces are 'open access' regimes and thus missed the complex social systems and prohibitions that structure access and use of common spaces in real communities. See Ostrom 1990.

[7] First Paragraph of Agreed Interpretation of the International Undertaking, Resolution 4/89 Twenty Fifth Session of the FAO Conference, Rome, 29 November 1989; First Paragraph (a) of Resolution on Farmers' Rights, Resolution 5/89 Twenty Fifth Session of the FAO Conference, Rome, 29 November 1989; and First Paragraph a), Resolution 3/91 Twenty Sixth Session of the FAO Conference, Rome, 25 November 1991.

Discussion of widespread patterns of germplasm sharing and a global PGR commons might give the impression of an homogenous space of universal, unrestricted and equal access. But this 'romantic' notion of the commons covers over important distributional inequities. In reality, as Chander and Sunder argue, "differing circumstances – including knowledge, gender relations, wealth, power, and ability – render some better able than others to exploit a commons" (Chander and Sunder, 2004). As such, it makes sense to understand this 'common space' as a *set of interlocking spaces*, each with its own system of governance and rights of access and alienation, some more equitable than others.

What combined these distinct spaces into a *global* commons, however, was the overriding consensus that seeds – at least in the quantities needed for research, breeding, and the distribution of valuable germplasm - should be freely shared. While it has clearly never been the case that PGR has been shared in a completely universal and free manner (Fowler 1993), until recently there existed no international (and few domestic) regulatory systems to restrict its movements, and the overwhelming tendency amongst both farmers and scientists was to make germplasm of plant varieties freely available to others (Brush 2003; Zeven 1999).

This situation, however, brings into focus another important concern in relation to plant genetic resources as common property. The rhetoric of the commons has often been deployed as part of an effort to invalidate the traditional claims of use and ownership of particular groups of people. As Chander and Sunder note, since these informational resources have become more valuable, an increasing number of powerful voices have begun to advocate a public domain or an unregulated space of open-access for these so called 'raw materials' – the wild plants, primitive cultivars and their associated knowledge mostly localised in native communities in developing countries (2004, p.1335). Very often, however, the same voices call for protected and exclusionary access to 'worked resources' (or improved plant materials through the application of Western scientific methods). On the other hand, mostly disempowered peoples from the "global South", who "once stood for the commons", now often "demand [strong] property rights" over PGR (Raustiala and Victor 2004; Chander and Saunder 2004).

Our goal is not to further contribute to this undermining of indigenous people's claims, but rather to introduce some clarity and specificity into discussions of 'the genetic commons'. We hope that through our analysis it becomes clear why many groups of people are no longer advocating common property in genetic resources. An anticipated answer is that 'the commons' has, in recent decades, been transformed from a space in which resources were, by and large, open to all and could not be enclosed by any individual, to a space in which resources are readily available for appropriation by commercial interests in a way that limits the rights of other users. Before exploring the series of events that has led to this situation, we first introduce Drahos' typology of common property to help us understand the emergence and interaction of various international regimes regulating property in PGR.

A typology of commons

In an attempt to bring more clarity to the discussion about the diversity of commons Peter Drahos distinguishes four basic commons configurations (2006; 1996). For the rest of this paper we adopt Drahos' terminology and classificatory system,

supplementing it with the work of Elinor Ostrom (1999). Drahos proposes four types of common property regimes based around two key distinctions: between the positive and the negative, and between inclusiveness and exclusiveness (2006).

A negative commons is where resources are owned by no one, and therefore appropriable by anyone, whereas in a positive commons resources are owned by everyone, and therefore cannot be alienated by any individual without the consent of all others. Adding Ostrom's operational rights in common property {insert Ostrom 1999} to this characterisation, one could rightly assume that the 'management', 'exclusion' and 'alienation' rights, as opposed to the primary 'access' and 'withdrawal' rights, would be the critical rights in the case of the governance of informational resources. That is, in both a positive and a negative commons commoners could access and withdraw resources, but in a positive commons any one commoner would need the consent of all (or most) commoners to exclude and alienate others from the use of resources.

The right of exclusion is the pivotal right in Drahos' classificatory schema between inclusive and exclusive commons. In the first commons all individuals, regardless of "geography, race or culture" would be included - a situation that Drahos acknowledges is rare for tangible goods, but less so for intangibles because of their non-rivalry in consumption (2006). An exclusive commons, on the other hand, is one in which only a particular group of people are included. In Ostrom's terminology, this latter situation corresponds to genuine 'common property', while an inclusive commons is more akin to an 'open access' regime (1999). The four general common property regimes proposed by Drahos emerge from the combination of these two pairs of distinctions, resulting in Negative Inclusive, Negative Exclusive, Positive Inclusive and Positive Exclusive commons.

The public domain

In light of our discussion on the interdependence of property domains that underpin the international regimes of PGR, it is necessary first to make a distinction between public domain and commons. The public domain is regarded as an "undifferentiated" space of "different sizes" and contents that vary with times and countries (Samuelson 2003). The amorphous nature of this domain is due to its being a residual domain of intellectual property regimes (Drahos 2006); in other words, it is formed by resources that are not protected at all by a form of intellectual property law, as well as materials whose protection term has expired (Litman 1990). In addition, everyone can make use of resources in this domain and appropriate them without consent because they are completely unmanaged (Benkler, 1999; Boyle 2003).

While the borders between the public domain and common property regimes are often blurry and unclear, we maintain a general distinction between these two domains on the basis that common property regimes are in some sense 'active' social projects that are *managed and 'built' by diverse peoples in diverse places*, where use rights over resources are in some sense overseen.

A clear contrast between public domain and commons is exemplified by active, positive commons such as the Open Source movement in software. Instead of simply releasing information into the public domain without any safeguards against monopoly, the Open Source software movement makes available information under a license that allows users to copy, modify and redistribute the information on the

condition that they extend the same rights to subsequent users (Boyle 2003; Moglen 2003). This condition known as a "grant-forward" requirement (Hope 2008) is considered essential for both protecting the information commons against misappropriation and for maintaining the openness of information to all those who commit to the communal project (Free Software Foundation 2007).

Commons and public domain are, therefore, overlapping spheres. Commons projects draw on and give back to the public domain, often networking together diverse resources. The borders between these two 'domains' (as well as those with private properties) are fuzzy and complex, full of leaks, movements back and forth, and myriad interdependencies that must be analysed on a case-by-case basis (Samuelson 2003).

The shifting commons spaces under international regulatory regimes

Access to plant genetic resources in general and PGR for food and agriculture in particular is regulated by a range of international regimes including the International Convention for the Protection of New Plant Varieties (UPOV Convention), the International Undertaking on Plant Genetic Resources (International Undertaking), the Convention on Biological Diversity (CBD), the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the International Treaty on Plant Genetic Resources for Food and Agriculture (International Plant Treaty). The discussion that follows focuses on (i) the various property spheres advanced by these agreements and (ii) the paradoxical interdependency and conflict among the property domains at play.

The International Convention for the Protection of New Plant Varieties (UPOV Convention)

The UPOV Convention came into being in 1961[8] amidst the presence of two identifiable concomitant property domains. On one hand, there were the spaces where all types of plant germplasm, either domesticated or non-domesticated, were part of a global genetic commons used by farmers and mostly public breeders around the world. These 'positive inclusive commons', available to everyone and alienable by no one, were, and still are, the domains where public plant breeding enterprises and their products emerged and prospered.

On the other hand, breeding as a commercial industry was growing since the late 1920's in the USA and Europe and the producers were demanding legal protection for the marketing of their plant varieties as a way to counteract free riding on their investment. The U.S. *Plant Patent Act* of 1930 was the result of successful lobby of the USA government by influential thriving agriculturalists. Although the Act is limited in its protection scope[9] and confined to the USA, it represents an important historical development in terms of the emergence of plant variety protection through intellectual property as a means for agricultural economic growth and development (Le Buanec 2004; Joerdens 2005).

The UPOV Convention, primarily the product of European breeders' effort (Le Buanec 2004), was produced to provide breeders exclusive intellectual property

[8] International Convention for the Protection of New Plant Varieties (Act of 1961), 2 December 1961.
[9] The U.S. Patent Act of 1930 provides intellectual property protection for vegetatively propagated crops (excluding tubers) such as fruit trees, ornamentals, and other plants propagated through cuttings. The jurisdiction of the Act is limited to the USA and its territories.

rights over commercial plant varieties[10] deemed to be new, distinguishable, uniform and stable. All UPOV Acts (1961, 1978, and 1991) confer exclusive rights upon breeders called Plant Breeders' Rights (PBR) to demand their authorisation to commercially produce, offer to sale and market the protected plant variety.[11] The latest Act has extended the breeders' rights to include more than the original protected plant variety conferring protection to harvested products and plant materials essentially derived from the originally protected variety (protection of "essentially derived varieties").[12]

UPOV is a highly significant agreement in the historical evolution of common property in PGR. With the passing of UPOV and later an equivalent U.S. Act –the *Plant Variety Protection Act* of 1970- a means of enclosing germplasm and excluding others from its use emerged. These plant variety protection systems impinged on the dynamics of exchange-flow of cultivars, effectively transforming plant genetic resources from 'positive' to 'negative' common resources. In other words, while germplasm remained open to all to use, it could now be removed from the common space and made private through IP protections.

UPOV has created or left alone, depending on the point of view, some spaces for public use (or public domain) where farmers can still reuse protected seeds in further plantings in their own plots and breeders can use protected cultivars for further breeding.[13] Despite these spaces of open access and use, UPOV has ultimately shifted PGR into a negative commons where wild plants, farmers' cultivars and their associated native knowledge -the so called 'raw' materials- can now be alienated through being 'worked'. As transformed plant materials that are deemed to be new, distinguishable, uniform and stable, they are no longer open to all to use but have become private property.

The International Undertaking on Plant Genetic Resources

It was the perceived inequity of having wild and farmers' plant germplasm as everyone's resource and improved commercial plant germplasm as 'protected' private material that gave rise to the International Undertaking in 1983.[14] In an attempt to avert the contraction of the global genetic commons, the United Nations Food and Agriculture Organization (FAO) and the participant countries convened the International Undertaking to provide unfettered access to any type of PGR for food and agriculture ('raw' or 'worked'),[15] including those under private plant variety

[10] Art. 2 and 6 of UPOV Convention Act of 1961 provide for the forms of protection available to plant varieties, the meaning of 'plant variety' and the conditions required for protection.
[11] The 1991 Act of UPOV extends protection of plant varieties to harvested material and plants essentially derived from the initial protected variety (Art. 14). There are 63 countries members to either of the two in force UPOV Acts (1978 or 1991) (see www.upov.int).
[12] Article 14(5) of UPOV Act of 1991.
[13] Art. 5 of UPOV Acts of 1961 and1978; Art. 15 of UPOV Act of 1991;and Art. 113(4) of U.S. Plant Variety Protection Act of 1970.
[14] International Undertaking on Plant Genetic Resources, adopted at the end of the Twenty-Second Session of the Food and Agriculture Organization (FAO) Conference (Resolution 8/83), Rome, 5-23 November 1983. The title of the Undertaking was amended to International Undertaking on Plant Genetic Resources for Food and Agriculture to reflect the true scope of the agreement.
[15] Types of PGRFA covered by the IU (Art. 2) refer to the types of plant materials used as resources in crop breeding are cultivated varieties (cultivars) in current use and newly developed varieties, obsolete cultivars, primitive cultivars (land races), wild and weed species, near relatives of cultivated varieties, and special genetic stocks (including elite and current breeders' line and mutants).

protection regimes.[16] In other words, the International Undertaking attempted to make a move back to an inclusive positive commons, in which germplasm could not be made private.

Despite the fact that the Undertaking never became legally binding, 113 countries, international agricultural research centres and national research centres adhered to its principles of unencumbered access to germplasm for the conservation, research and development and public breeding of PGR for food and agriculture.[17] However, the attempt to reclaim a positive inclusive commons for all PGR for food and agriculture was short-lived.

Three subsequent annexes reshaped the commons the International Undertaking of 1983 tried to define. In 1989, an agreed interpretation made clear that UPOV-type protection for 'worked' materials was compatible with the Undertaking; the negative character of the PGR commons was again asserted.[18] In the same year, a second Resolution put farmers' rights into the picture, in an attempt to redress the imbalance created by the plant variety protection systems (Brush 2005; Correa 2005).[19] Despite this second resolution, the divide between 'raw' plant resources (deemed part of global commons) and 'worked' plant materials (legitimately enclosed by plant variety protection systems), was by then well entrenched.

A significant blow to the prospect of a positive inclusive commons came with the 1991 Resolution of the International Undertaking. In it "the concept of mankind's heritage", in relation to PGR for food and agriculture, was subjected "to the sovereignty of the states over their plant genetic resources".[20] Thus, by 1991, the global genetic commons for plant resources had been severely undermined by both private plant variety protection claims over 'worked' plant materials and state-sovereignty claims over national germplasm (Roa-Rodríguez and van Dooren 2008).

The Convention on Biological Diversity (CBD)

In the following year (1992), these state sovereignty claims over genetic resources were expanded through the coming into force of the Convention on Biological Diversity (CBD). Although presented as the major international agreement on the conservation and sustainable use of biological resources (McGraw 2002), the chief objective of developing nations in the negotiation of the CBD was to control physical access to biological resources in order to regulate the genetic component, and to be able to capture benefits from the use of genetic resources (Glowka 1998). Under the terms of the CBD, natural and biological resources are under state sovereignty[21] and states determine access to their genetic resources,[22] including those for food and agriculture.

[16] Art. 1, 2 and 5 of the International Undertaking of 1983.
[17] Art. 5 of the International Undertaking of 1983.
[18] Art. 1 of Resolution 4/89 of the International Undertaking on Plant Genetic Resources for Food and Agriculture.
[19] Resolution 5/89 of the International Undertaking on Plant Genetic Resources for Food and Agriculture.
[20] Preamble, Resolution 3/91 of the International Undertaking on Plant Genetic Resources for Food and Agriculture.
[21] Preamble, 5th paragraph and Art. 3 of the CBD.
[22] Art. 15(1) CBD. Natural, biological and genetic resources are intimately related but not equivalent. Natural resources are the largest category and encompass the other two types of resources. Biological resources in turn encompass genetic resources and materials. Thus, genetic resources are only a type of biological and natural resources.

The legally binding nature of the CBD made the recognition of state sovereignty over PGR for food and agriculture in the 1991 Annex to the International Undertaking more significant. At an international level, the CBD establishes a new property domain in genetic resources -a domain limited and ruled by the sovereignty of the states. Post-CBD, people wishing to gain access to genetic resources must negotiate with the source country/community of the genetic resource to ensure an equitable return of benefits arising from use of the resource.

Some scholars have understood the CBD to create a sphere of collective ownership (Paavola 2007), a sort of biodiversity commons to counterbalance the private IP domain (Strauss 2000; Linarelli 2004). Other principles enshrined in the CBD such as 'prior informed consent', 'mutually agreed terms' and 'fair and equitable benefit sharing', may also lead people to view the CBD as having created a 'biodiversity commons'. Furthermore, these additional principles support the view of the CBD as a regulatory framework that recognises providers' and users' needs, allows participation, and is concerned with the legitimate distribution of control over genetic resources. However, these potentially positive and inclusive features have tended to operate differently in reality.

The common spaces that the CBD has created are 'exclusive positive commons' in Drahos' terms. They are *exclusive* spaces because the CBD allocates property in common resources to the citizens within the boundaries of nation states. Additionally, they are *positive* spaces because the CBD requires that users obtain the consent of the common-owners. 'Prior informed consent' and 'mutually agreed terms' requirements have made the private enclosure of the PGR located in the CBD's exclusive commons more difficult - at least for those that respect these requirements.

The sovereignty exerted by the states has, however, heightened the exclusive character of the nation-size common property spaces created by the CBD. One of the consequences of this exclusivity is that in nations where commoners are poorly represented by the state the common character of PGR has been undermined by the implementation of very strict sovereignty-based regimes constraining use rights of commoners. We will discuss this situation further below when considering the implementation of the CBD in some biodiversity-rich nations.

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)

The TRIPS Agreement, adopted in 1994,[23] paved the way for the globalisation of the intellectual property domain through its introduction of minimum IP-protection standards, alongside the connection between IP and trade and the creation of trade enforcement tools through the World Trade Organization (Drahos and Braithwaite 2002; Drahos 2004b). In the 14 years since the birth of TRIPS the intellectual property sphere has grown to encompass genetic resource-based products mainly under patents and *sui generis* forms of plant variety protection.[24] Any modified plant or plant part, plant variety as well as the related knowledge are now eligible for intellectual property protection in countries belonging to the World Trade Organization (CIPR 2002; Koo, Nottenburg et al. 2004).

The expansive exclusive intellectual property domain advanced by TRIPS impinges

[23] Trade-Related Aspects of Intellectual Property Rights, Annex IC of the Marrakech Agreement Establishing the World Trade Organization (WTO), Marrakech, Morocco, 15 April 1994.
[24] Art. 27(3)(b) TRIPS Agreement.

on both the commons and the public domain of PGR. By not incorporating prior informed consent and mutually agreed terms when it comes to access and use of biodiversity-related resources in protected products, TRIPS fails to acknowledge the *positive* character of the exclusive commons defined by the CBD. Effectively, the TRIPS Agreement treats genetic resources *negatively*, as resources open to appropriation by anyone. From the perspective of TRIPS genetic resources occupy one of two spaces. Either an unmanaged and residual space –a public domain- from which anyone can take resources without the need for permission from other users, or a private property space.

There are, therefore, two pathways to privately appropriate PGR from the genetic commons. In the first pathway PGR are deemed a positive resource and they move out to a private sphere through the sovereign gatekeepers established by the CBD. In the second pathway, the sovereignty requirements are ignored and PGR can be privately appropriated without any consent from the relevant internationally recognised 'common' property owners.

Through these two pathways, the expanding private intellectual property domain has been able to draw resources from the commons to the extent that the latter is now significantly shrinking in size and content. Contradictorily, the growth of intellectual property relies in great part on the existence of these open access and common spaces. If the current trend continues we may be witnessing the depletion of genetic resources because of restrictive access and use regimes, which might lead to an under-use of plant genetic resources and affect PGR-based innovation and product development (Roa-Rodríguez and van Dooren 2008). This situation has been called a "tragedy of the anticommons" (Buchanan and Yoon 2000; Heller and Eisenberg 1998; Hope 2004, 2008).

The International Treaty on Plant Genetic Resources for Food and Agriculture (International Plant Treaty)

In an attempt to counteract the access and use restrictions on PGR for food and agriculture erected by both state sovereignty and intellectual property domains, another international treaty was convened by the UN Food and Agriculture Organization (FAO) in 2001. The International Plant Treaty[25] created a multilateral system of access and benefit-sharing for a selected group of crops located under *in-situ* and *ex-situ* conditions under the control of contracting parties and in the public domain.[26] This multilateral system also encompasses the exchange of knowledge and the access and transfer of technologies related to PGR for food and agriculture.[27]

The International Plant Treaty aims to restore access to a broad genetic base of crop germplasm by forging a 'protected' commons. For a selected group of crop genetic

[25] International Treaty on Plant Genetic Resources for Food and Agriculture ('International Plant Treaty') adopted through Resolution 3/2001, Thirty-first Session FAO Conference, 3 November 2001.
[26] As of March 2008, 116 countries and 11 international agricultural research centres belonging to the Consultative Group for International Agricultural Research (CGIAR) are members of the Treaty, which entered into force on 29 June 2004 with the fortieth country member of the Treaty. See Members of the International Treaty at http://www.fao.org/Legal/treaties/033s-e.htm; and Statement of the CGIAR Centres Regarding Implementation of the Agreements Between the Centres and the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture, 16 October 2006, at http://ipgri-pa.grinfo.net/media/1/CGIAR%20Alliance%20statement.doc.
[27] Art. 1, 3, 11 and 13 of the International Plant Treaty.

resources[28] -otherwise under state sovereignty- the Treaty establishes a more *inclusive* space in which a larger group of users (international agricultural research institutes and legal persons of member nations) have facilitated access through the multilateral system. Through this agreement the shrinking PGR commons for food and agriculture has increased in size, for the possible benefit of those working in public research and development of agriculture and agricultural production. Outside of this more inclusive commons are institutions or people located in non-members states and all other non-selected PGR for food and agriculture.[29] For these outsider crops and entities either the rules of the CBD or other national access and use rules apply. Consequently, applying Drahos' typology, the commons created by the International Plant Treaty is still an exclusive commons.

With respect to the positive or negative character of this crop genetic commons, the International Plant Treaty does not allow individuals to claim private intellectual property over resources "in the form received" from the multilateral system.[30] Therefore, the Treaty creates a 'positive exclusive commons' where members of the commons access and use the resources without appropriating or alienating them. This *de jure* commons, however, has the potential to be a different commons in practice. According to the text of the Treaty and the Standard Material Transfer Agreement that regulates the transfer of germplasm, it seems possible to claim intellectual property protection over PGR for food and agriculture (including any of their parts) deemed to be out of the 'form received' (e.g., modified; isolated) through the multilateral system (Helfer 2005; Fowler et al. 2003).[31] If such intellectual property protection were to impede access and use of the plant materials and genes in their acquired form, the goal of the International Plant Treaty would be threatened (Correa 2006). If this situation took place the 'positive exclusive commons' of crop genetic resources would turn into a negative exclusive commons where the resources would be appropriable by anyone.

Interplay and interdependency of domains

The boundaries of the international regimes on PGR are difficult to demarcate. A background of rules and aligned interests has conditioned the emergence of the regimes[32] and continues to shape the dynamic interplay between them in part due to the interconnected property domains they advance (Roa-Rodriguez and van Dooren 2008). The nature of the relationships among property domains is such that whatever is done to one domain invariably affects another one in one way or another (Samuelson 2003; Chander and Sunder 2004). Although each international regulatory regime advances a particular property domain (the domain in the 'foreground'), the interplay between the different property spaces means that each of the regimes also redraws the shape and content of the property domains remaining in the background (Roa-Rodriguez and van Dooren 2008).

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[28] Annex I, List of crops covered under the Multilateral System, International Plant Treaty. See at ftp://ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf

[29] It refers to all PGR for food and agriculture not included in Annex I (e.g., beverage crops such as coffee, cocoa, tea; fibre crops such as cotton; soybean; groundnuts; and most fruit and vegetable crops).

[30] Art. 12.3(h) of the ITPGRFA. IP claims are barred for any PGRFA "in the form received from the multilateral system".

[31] The prohibition of IP claims on PGRFA "in the form received from the multilateral system" does not extend to post-acquisition modifications of resources "in the form received".

[32] Raustiala and Victor 2004, p.296-298.

Overall, the expansive intellectual property-based enclosures advanced by UPOV and TRIPS, and the sovereignty-based enclosures forged by the CBD have effectively reduced the global PGR commons. Both types of domains are expanding at the expense of positive inclusive commons and open spaces, but ironically both the IP and sovereignty-based domains rely on the existence of and supply of resources from public and commons spaces (Roa-Rodriguez and van Dooren 2008). The modus operandi of private intellectual property and sovereignty-based domains differs. However, both domains appear to be driven by the possibility of obtaining and accruing benefits from the use of plant genetic resources. The private domains of TRIPS and UPOV extract 'raw' plant materials from those more open and positive-inclusive spaces to allegedly add 'value' resulting in 'worked' products that are the object of exclusive property. Similarly, the CBD's sovereign domain claims property over genetic resources that could be in public and common spaces as it seeks to obtain benefits resulting from the use of accessed resources.

The intellectual property domain and the state sovereign domain seem to have entered a vicious cycle of escalating ownership or 'hyper-ownership' as noted by Safrin (2004). In an attempt to counterbalance the IP domain, the sovereign domain of the CBD has become increasingly restrictive itself. The dynamics unleashed by IP and sovereign regimes are transforming the varied common spaces, with their multiple modalities of access, use and alienation of resources, into a de facto homogeneous commons space where the negative and exclusive characteristics are predominant. Predominance of spaces with these latter characteristics has the potential to interrupt or alter negatively the flow of informational biodiversity–related resources.

Interplay of common spaces on the ground

The analysis of the interdependency of property domains at the level of international regulatory agreements represents one side of the coin only. When nations adopt or adhere to international regimes and implement them the empirical side of the coin is revealed. Some biodiversity-rich developing nations such as India, Brazil and the Andean Community countries[33] have adopted the spirit of the international agreements with respect to their principles and mechanisms of regulating access and intellectual property as well as their core concepts of property (sovereignty-based in the case of the CBD; private intellectual property-based in the case of TRIPS and UPOV). However, distortions with respect to global regulatory regimes may emerge when local context, needs and interests are thrown into the mix of enacting and implementing international regimes at national level.

In this section we offer some examples of the configuration of the commons on the ground, in national settings. Here commons managed by civil actors, which seem to have disappeared from the international scene, interact with the predominant exclusive property forms based on sovereignty and private intellectual property advanced by the CBD and TRIPS and UPOV, respectively.

PGR under state sovereignty

[33] The Andean Community of Nations is a regional body born in 1969 with the signature of the Cartagena Accord or Agreement. The aim of this regional institution is to further the economic and social development of its countries members. As of March 2008 Bolivia, Colombia Ecuador and Peru are members of this organisation.

The biodiversity commons proclaimed by the CBD, where the state regulates access to genetic resources, operates differently through the legal instruments that govern access to genetic resources in countries such as Brazil, India and the Andean Pact countries. In these countries, PGR stakeholder groups such as researchers have their rights of access and use of national PGR curtailed by overstrict regulations that affect the scientific networks vital for biodiversity research and development.

Either provisional legislation –Brazil's case[34]- or enacted law – as in India[35] and the Andean Community[36]- regulate access to genetic resources in these biodiverse countries. In Brazil and the Andean Community the concept of access is overarching. It comprises any act of isolation and selection –and in the Brazilian case processing- of non-human genetic resources and their derivatives for use in any non-commercial or commercial activities. Access to agricultural resources and associated knowledge is also ruled by these access regimes.[37] In the Andean countries common or individual private property owners or administrators of biodiversity no longer have control over access to genetic resources (including knowledge and derivatives) as the access regime equally applies to resources located on state or private land or in natural conditions or *ex-situ* collection centres (Roa-Rodríguez 2007).

State entities are the authority on access to genetic resources in all circumstances, but the set of rules and institutions regulating access may differ for foreigners and nationals. For instance, in India, sub-national biodiversity boards with apparently less restrictive rules regulate access by Indian citizens,[38] while a central regulatory authority (the National Biodiversity Authority) strictly regulates bio-collections and bio-prospecting activities by foreigners.[39] Interestingly, in the case of access applications by foreigners the national regulatory authority appears to disregard the rights of consent and 'mutually agreed terms' of Indians citizens, as these requirements are not demanded for collecting and obtaining biological resources. Furthermore, while benefit sharing is demanded from the foreign applicants, the Indian national authority is under no obligation to share monetary benefits with individuals, groups or organisations, whose biological resources or knowledge have been accessed.[40]

Access contracts set out the conditions of access and benefit sharing of genetic resources. In Brazil, the state is the provider party of genetic resources while

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[34] Provisional Act 2.186-16 of 23 August 2001, see at http://www.wipo.int/export/sites/www/tk/en/laws/pdf/brazil_heritage.pdf and Brazilian Draft Bill on Law Covering the Collection of Biological Material, Remittance and Transport of Biological Material, Access to and Protection of the Associated Traditional Knowledge and Rights or Farmers and the Sharing of Benefits, open for public comments until 28 February 2008, see at http://www.planalto.gov.br/ccivil_03/consulta_publica/consulta_biologica.htm (in Portuguese).

[35] Biological Diversity Act 2002, No. 18 of 2003 (5 February), see at http://envfor.nic.in/divisions/biodiv/act/bio_div_act.htm.

[36] Andean Decision 391 Common Regime on Access to Genetic Resources, see at http://www.comunidadandina.org/ingles/normativa/d391e.htm.

[37] Art. 7(I-III) of Brazilian Draft Bill and Art. 1 of Andean Decision 391.

[38] Art. 22-24 of Biological Diversity Act 2002.

[39] Art. 4, 6, 19, 20 and 21 of Biological Diversity Act 2002. Some of the conditions applying to foreign applicants include: due report of any research and development results; no transfer of resources and information obtained during the course of research to third parties without previous authorisation; no right to claim IP over resources or research products in any part of the world without the authority's consent. See also Safrin 2004, p. 651.

[40] Art. 21 of Biological Diversity Act 2002.

communities are the provider and contracting parties where traditional knowledge is accessed.[41] The proposed Brazilian law also allows for many different indigenous peoples and farmers to have rights to the same traditional knowledge.[42] How these multiple entitlements to traditional knowledge are going to be recognised and how this recognition will translate into the informed consent necessary for accessing traditional knowledge is still unclear. However, one thing is certain: the 'legitimate consent' needed to reach an access contract under the proposed Brazilian laws hinges upon an unambiguous recognition and definition of the property rights of these groups over traditional knowledge related to biodiversity.

The Andean Community of Nations has a system of multi-tiered contracts to regulate access to genetic resources. A single act of access is likely to require at least three different contracts –an Accessory, an Annex and an Access contract – depending on the object of access –biological (physical) resource, knowledge (information) resource, and genetic (information molecules) resource, respectively – and different parties -the owner/holder of the resources for the first two contracts and the state in the case of the latter contract (ten Kate 1997; Grajal 1999; Correa 2003; Ruiz Mueller 2003; Roa-Rodríguez 2007).[43] The validity of the first two contracts depend on the existence and enforcement of the Access contract - if the Access contract were terminated, nullified or modified, the others would also be (Roa-Rodríguez 2007).[44]

The cumbersome nature of the contractual approach of the Andean countries and the excessive control exerted by the state authorities in all these countries have delivered similarly disheartening outcomes for researchers: low instances of access through official access regimes;[45] reduction of biocollections (even for educational purposes);[46] and the absence of sought after monetary benefits (Dávalos et al. 2003; Roa-Rodríguez 2007). Farmers and indigenous communities, on the other hand, are confined to a mere provider role with symbolic participation in access and benefit sharing agreements; the state makes decisions about their resources and will be the main beneficiary (if benefits ever materialise). Ease of access and streamlined regulation may justify state control over biological and genetic resources. The problem is, however, that access to resources is not facilitated and regulation is rather cumbersome. Furthermore, in the exercise of this control, the state fails to acknowledge the needs, interests and rights of local communities and the social norms and networks that underpin the work of researchers and biological industries.

Crop resources and the commons of the International Plant Treaty

The International Plant Treaty attempts to reduce the hurdles and complex access rules for these resources and in this way it appears to be more sensitive to the networking nature of the PGR for food and agriculture systems. The Treaty releases

[41] Art. 72 of the Brazilian Draft Bill.
[42] Art. 38-44 (on indigenous communities) and Art. 55-57 (on farmers) of the Brazilian Draft Bill.
[43] Art. 32 of Decision 391. None of the three contracts provides for sublicense rights, third-party transfer of accessed resources, non-disclosed activities with the accessed materials and IP over products derived from accessed materials without the express consent of the national authority on access according to the Model of Access Application provided by Resolution 414 of 22 July 1996.
[44] Articles 42-44 of Decision 391.
[45] For data on access contracts in the Andean pact countries see Consorcio GTZ/FUNDECO/IE, 2001.
[46] For the situation of basic research and biocollections in India see Bawa (2006); for Brazil see e.g. (Ramalho, 2007).

access to crop resources from the burden of case-by-case contractual agreements and the several parties involved by providing a Standard Material Transfer Agreement. This Agreement, defined in June 2006,[47] acts as a sole regulatory tool for the formal access and benefit sharing of the selected PGR for food and agriculture covered by the Multilateral System of the International Plant Treaty.

The regulatory terms of both the International Plant Treaty and the Standard Material Transfer Agreement appear to be more responsive to the interconnectedness of stakeholders and the use of PGR of multiple types and origins in the research and development of crops. However, some issues remain controversial, in particular the one related to the possibility of intellectual property claims over materials derived from those acquired from the Multilateral System.[48] As previously noted, patenting of isolated and modified plant materials (including genetic information) provided through the Multilateral System might reduce the freely useable contents of the PGR commons created through the Treaty (Roa-Rodríguez and van Dooren 2008).

It is still too soon to say whether the 'protected' commons of the International Plant Treaty will deliver on the grounds of restoring the flow of exchange of PGR that has been undermined by strict state sovereignty following the CBD's principles. Also, it is too soon to say if the private IP domains that have already fragmented the active spaces of common exchange of PGR will find in this protected commons a new (and facilitated) source of 'raw' resources (Roa-Rodríguez and van Dooren 2008). For the sake of a more fluid exchange and use of resources for the purposes of research and development and global food security, it would certainly be helpful if the International Plant Treaty and related national legal and policy frameworks managed to achieve a 'protected commons' of plant genetic resources.

Intellectual property growth

Sprawling intellectual property regimes are now occurring in both international and national contexts. The TRIPS Agreement unleashed this growth with the standardisation of a set of minimum requirements for intellectual property protection applicable to all areas of technological endeavour and a trade-linked intellectual property enforcement regime that operates in all countries belonging to the World Trade Organization (Braithwaite and Drahos 2000). But the growth of intellectual property protection in terms of scope and time and its global harmonisation is slow when the TRIPS multilateral route is followed. Large corporate enterprises in the pharmaceutical, information technology and agro-biotechnology industries wanting to locate production anywhere in the world are particularly impatient with the slow progress. By lobbying their governments these industries have sought to speed up the implementation of TRIPS standards in developing nations and at the same time to strengthen intellectual property protection as a way to maximise income capital and stave off free-riding on their products (Drahos 2004b).

A subsequent flurry of mostly bilateral trade or investment agreements has been the outcome of this effort to 'ratchet up' intellectual property protection standards at an international level (Drahos 2004b; Maskus 2004; Musungu and Dutfield 2003). The Andean Community countries, for instance, have not escaped this broadening trend.

[47] Resolution 2/2006, Adoption of the Standard Material Transfer Agreement (contained in Appendix G), 16 June 2006, First Session of the Governing Body of the ITPGRFA, IT/GB-1/06/Report, ftp://ftp.fao.org/ag/cgrfa/gb1/gb1repe.pdf).

[48] Art. 6.2 of the Standard Material Transfer Agreement.

Peru and Colombia, two of the Andean community countries, have recently signed bilateral trade agreements with the U.S that include substantial modifications to the current Andean intellectual property regime in these countries.[49] Among the changes are the provision for patent protection for plants and for plant and animal varieties,[50] and the provision of pharmaceutical and agricultural chemical data protection -5 years and 10 years, respectively[51] –both requirements imply a departure from the current Andean Decision 486 on a Common Regime on Industrial Property, which mirrors the TRIPS agreement.

The TRIPS Agreement requires member countries to choose between a *sui generis* system for the protection of new plant varieties, patents for the protection of new cultivars, or alternatively, to have both systems in place.[52] The UPOV Convention has become the *sui generis* protection system per excellence. Membership of the UPOV Convention has grown since the implementation of TRIPS at national level and as a result of intellectual property obligations acquired through bilateral or regional trade agreements (GRAIN 2004; Le Buanec 2004).

The Andean Community countries (with the exception of Peru) and Brazil are members of the UPOV Convention Act of 1978.[53] The plant variety protection laws that operate in these countries are, however, more in line with the most recent Act of the UPOV Convention; the 1991 Act.[54] In these countries, the protection of the original plant variety extends to its harvested material and any variety essentially derived from the original protected variety –a feature present in the 1991 Act but absent from the 1978 version. This is an example of extended proprietary rights on plant materials.

In the Andean countries, however, the broader IP rights in cultivars are partially matched by the provision of farmers' and breeders' rights. In this context, rights are granted for research and further breeding using protected varieties, as well as for farmers to save and re-use seed from protected cultivars. These sorts of public niches carved within the private property domain defined by plant breeders' rights are essential for the sustainability and furtherance of farmer seed systems and the public breeding enterprise, both of which are currently predominant in these

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[49] The Colombia-USA Trade Promotion Agreement, signed on 22 November 2006 (yet to be approved by the Congress of both countries) and the Peru-USA Trade Promotion Agreement, signed on 12 April 2006 and to enter into force in January 2009, contain a chapter (No.16) on intellectual property providing for extended scope of IP protection particularly on patents, copyrights and plant breeders' rights. See full text of the Colombian agreement at http://www.ustr.gov/Trade_Agreements/Bilateral/Colombia_FTA/Final_Text/Section_Index.html and the Peruvian agreement at http://www.ustr.gov/Trade_Agreements/Bilateral/Peru_TPA/Final_Texts/Section_Index.html

[50] Art. 16.10 of both the Colombia-USA Bilateral Trade Agreement and the Peru-USA Bilateral Trade Agreement.

[51] Art. 16.9.2 of both the Colombia-USA Bilateral Trade Agreement and the Peru-USA Bilateral Trade Agreement.

[52] Art. 27.3(b) of the TRIPS Agreement.

[53] See Membership of the UPOV Convention at http://www.upov.int/export/sites/upov/en/about/members/pdf/pub423.pdf (accessed on April 2008).

[54] The Andean Common Decision 345 on the Protection of Plant Breeders Rights of 1994 operates for all countries of the Andean Community irrespective of their membership of UPOV. In Brazil the law governing protection of plant varieties is the Plant Variety Act, Law No. 9.456/1997. Although none of these countries is a member of the 1991 Act of UPOV, all of them grant protection to plant materials (e.g., harvest materials, new varieties) essentially derived from the plant variety originally protected, a feature that is characteristic of the latest UPOV Act and is absent in the 1978 Act.

developing countries.

That these public spaces, or more inclusive protected commons, will remain in the long term is, however, doubtful. The seed industry is seeking to further limit the breeder's exemption in developed countries through the introduction of delayed periods of access to newly developed varieties, alleging lack of incentives to innovate and invest in breeding activities (Le Buanec 2004; Donnenwirth et al. 2004). Farmers' rights to save and re-use protected seed are also being further limited at the behest of private proprietary interests. This is the case in Colombia, for example, where the foreign flower breeding industry, (which is the largest user of the plant variety protection system in this country), and the national rice industry, have successfully lobbied the national regulatory authorities to ban rice and flower growers from reusing seed derived from protected cultivars.[55] In addition to this restriction, severe criminal penalties are now imposed on anyone who infringes upon the rights of breeders.[56]

The overall intellectual property landscape is, therefore, becoming increasingly restrictive. The exemptions or freedoms for non-private owners of plant materials, - that is, the spaces where it is possible for other groups to access and use either public or more inclusive positive common resources- are being drastically reduced. In addition to their internal strengthening, plant variety property regimes in countries like the USA now seem to be being abandoned by intellectual property owners in favour of utility patents (Janis and Smith 2006).

Regulating PGR commons globally

With the aim of "steering the flow of events, [resources] and behaviours" (Braithwaite, Conglianese and Levi-Faur 2007) treaty-based international regulatory regimes based on different property notions have influenced the principles, norms and procedures that govern the interaction of actors in the area of plant genetic resources. The level of influence of these international instruments on the collectives (nations and individuals) to achieve particular outcomes is however compromised by the interacting and interdependent nature of the property spaces underlying the regimes. Far from regulating a single property domain (private, commons or state sovereignty-based) in isolation, the analysed international PGR regimes shape and change the resource contents and the use rights of other property spaces.

Through the control of a domain ruled by sovereign ownership, the CBD reshapes and transforms the global genetic commons (the backgrounded domain). Likewise, the UPOV Convention and the TRIPS Agreement regulate the private IP domain directly, but in so doing reshape and modify the public and commons domains. The International Plant Treaty, in the meantime, tries to build a 'protected' commons for selected PGR for food and agriculture amidst intellectual property and sovereignty enclosures and a shrinking public domain. As we have seen the ultimate outcome of the interplay of the complex rules and procedures of the international PGR regimes has been the contraction of the global genetic commons and its fragmentation into spaces with less positive and inclusive characters.

The international cacophony of intertwined property domains extends to nation states (Roa-Rodríguez 2007). The adoption, adaption and implementation of the

[55] Resolution 2046 of 2003 and Resolution 148 of 18 January 2005 of the Colombian Agrarian Institute (ICA, Spanish acronym). ICA is the Colombian regulatory authority of plant variety protection.
[56] Law 1032 of 2006, Modification of Art. 306 of the Colombian Criminal Code.

international PGR regimes in the national context is mired by the lack of understanding of the dynamics of the property spaces at the interfaces of these regulatory instruments. Developing nations, in particular, are poorly equipped in terms of financial, infrastructural, technical and human resources to deliver, monitor and enforce property rights (Fitzpatrick 2006). This situation tends to breed conflict and contestation among concomitant and competing interests of diverse groups (state, farmers, bio-industries, researchers) in relation to access and use of plant genetic resources.

Explicit acknowledgement of the existence of concomitant property domains and better understanding of the interdependencies among these domains is necessary for the design of interacting regulatory frameworks that do not cancel out each other and for an overall governance framework that effectively provides, distributes (and regulates) resources. The conflicting goals of conservation, access, use, appropriation and benefit sharing of PGR are all part of the set of international regulatory regimes and derived national regimes on PGR. As Paalova suggests institutions for the governance of environmental resources characterised by conflict should be based in social justice rather than efficiency (2007, p. 96). That is, values, interests and motivations of diverse actors need to be taken into account in the design and implementation of governance regimes on natural resources.

Plant genetic resources are complex natural resources because of their informational (intangible) dimension. PGR for food and agriculture, in particular, are characterised by a plurality of values: cultural, environmental, economic and political. The regulation of these information and knowledge-based resources requires the incorporation of both learning mechanisms and processes and the logic of actions and norms of diverse social actors (Dedeurwaerdere 2005). In addition, meaningful participation (influence) of the diverse actors on plant genetic resources at local, national and international levels is likely to increase the legitimacy of the seemingly contradictory goals pursued by the regulatory and governance regimes on plant genetic resources.

If conservation and sustainable use of plant genetic resources for the general wellbeing of society is a genuine concern and goal of the international regulatory regimes then they will need to actively recognise the dual nature of PGR; the multiple differing actors involved in the conservation, research, development and production of PGR; the diversity of values attached to PGR; and the overlapping property relations that actors hold in relation to these resources.

Conclusions

The shape and contents of the PGR commons have changed dramatically in the last three decades. For centuries PGR as germplasm, as informational resources, were regarded as resources to be shared by everyone and available for all to use. The international regulatory regimes related to PGR that started with the UPOV Convention in 1961 and include the successive UPOV Convention Acts, the International Undertaking of 1983 and successive amendments, the CBD of 1992, the TRIPS Agreement of 1994 and the International Plant Treaty of 2004 have altered fundamental characteristics of the plant genetic commons. From positive and inclusive resources available to everyone and appropriable by no one, PGR are now increasingly being treated as exclusive resources within predominantly negative common spaces that are appropriable by anyone with the means to do so.

Although a trend towards a negative and exclusive commons prevails today, the property domain applicable to PGR is far from being completely homogenous. The international regulatory regimes are based upon concomitant and conflicting, yet interacting property domains. The private intellectual property domain is the basis of the UPOV Convention and the TRIPS Agreement. Fostering its growth is the central outcome of the implementation of these regimes. However, the growth of the private intellectual property domains relies on the existence of public domain and common domain PGR; the first domain feeds on the latter two. At the same time, the state sovereign domain of the CBD covers genetic resources that could be in public and common domains as it seeks to control access to these resources and obtain benefits resulting from their use.

Squeezed in the middle a protected commons of PGR for food and agriculture established by the International Plant Treaty is trying to maintain a selected group of PGR free of the restrictions imposed by both sovereignty and intellectual property claims. Further reduction of PGR in public and common domains is likely to have a negative impact in the most exclusionary domains. Yet the most worrisome consequences lie in the likelihood of further decline in the exchange-flow and use of informational PGR for the purposes of global food production and development for the wellbeing of society.

Rather than simply being a property debate confined to the international arena, the shrinkage of the more inclusive and positive commons in biodiversity-rich countries that have implemented sovereignty and intellectual property-based regimes highlights the need to take into account the multiple values attached to PGR resources and the social norms operating among diverse PGR stakeholders. Access and use of PGR for food and agriculture by researchers and farmers have been adversely affected amidst the misunderstood and conflicting deployment of property rights in countries such as Brazil, India and the Andean Pact countries.

The design of interacting and effective regulatory frameworks for plant genetic resources requires the explicit acknowledgement of the existence of concomitant but different property domains and better understanding of the interdependencies among these domains. In addition, the regulation of these information and knowledge-based resources requires the incorporation of both learning mechanisms and processes and the logic of actions and norms of diverse social actors. All these elements are required if the governance regimes on plant genetic resources are to achieve their diverse goals of conservation, access, use, and benefit sharing of PGR for the well being of the society at large.

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