Biotechnologies, Seeds & Semicommons

Enrico Bertacchini[1]

[1]CLEI - IEL Ph.D,
University of Turin and University of Gent,
enrico.bertacchini@unito.it

DRAFT - Not for Citation

Abstract

The paper applies the framework of semicommon property arrangement to analyze the effects of the expansion of property rights in the development, exchange and conservation of crop genetic resources.

Strong intellectual property rights have emerged to protect investments of private breeding sector in crop development while national sovereign rights over plant genetic resources have been established at the international level. The new international regime should provide effective incentives for the sustainable use and conservation of crop genetic resources, but it may be ill suited in a field where 1) crop development is a cumulative process based on a networked environment of innovators and 2) traditional farmers and public institutions are still relevant stakeholders in crop development sector.

The understanding of crop genetic resources management as a semicommons may help to unveil normative prescriptions in order to avoid the distort effects of the enclosure. New institutional devices, which guarantee access to germplasm among traditional farmers and the public agricultural research system, may limit the distortions caused by the expansion of exclusion rights.

The new FAO Treaty (signed in 2001), which sets up a multilateral system of facilitated germplasm exchange and affirms the concept of Farmers' Rights, may be considered an institutional mechanism that shares this policy vision.

1 INTRODUCTION

The aim of the paper is to explore the interaction between property rights and the management of crop genetic resources.

Crop genetic resources are part of plant genetic resources and consist in domesticated plants used for food and agriculture[1]. As seeds, they represent the main input for

[1]For the definition see FAO (Food and Agriculture Organization of the UN) [1998] "The State of the World's Plant Genetic Resources for Food and Agriculture" *FAO. Rome, Italy.*

agriculture production. At the same time, the genetic material embedded in seeds represents the main input for crop development, the human controlled process for producing improved crop varieties and developing new agricultural products.

A number of economic and technological changes occurred in the last decades of XXth century, with the expansion of commercial agriculture and the use of biotechnologies in plant breeding. These changes are imposing a new organization of both crop development strategies and agricultural production systems.

First, scientific advances and biotechnological applications have allowed a major manipulation of crop germplasm and the emergence of a specialized private breeding industry, with higher investment requirements in both human and physical capital. Second, the diffusion of commercial agriculture, which relies on more genetic uniform varieties is leading to the loss of genetic diversity relevant for agriculture.Because crop genetic resources are the raw material for plant breeding, genetic erosion reduces the possibility to develop new varieties adapted to the changing environmental conditions and resistant to the new pests and pathogens.

As a result, the threat of genetic erosion and the advances in genetic engineering have increased the value for using crop genetic resources. This enhanced value has created the conditions for the emergence of a new structure of more defined property rights that – in theory – should lead to a more productive allocation. Patents and new patent-like systems for plant variety protection have been adopted in many industrialized countries and diffused also to many developing countries that comply with TRIPS agreement. In addition, to address the problem of conservation of plant genetic resources and recognizing their unrealized economic value, the 1992 Convention on Biological Diversity (CBD) has provided a legal basis for the establishment of Sovereign Rights on Plant Genetic Resources - crop genetic resources as well - devising a bilateral contracting mechanism for the exchange and compensation for Plant Genetic Resources.

Looking at the expansion of property rights over seeds and focusing on the informational value of germplasm, many commentators argue that crop genetic resources are another Global Commons that is threatened to be enclosed [2].

Because the many similarities between the crop genetic resources and digital information[3], seeds have been easily introduced in the broader contemporary debate that challenge advocates and opponents to the second enclosure movement in information goods. The advocates of privatization stress the relevance of property rights to create incentives to innovators. On the contrary, the critics stress the cumulative production process of information goods and deem access to informational inputs as the vital requirement for information production.

[2]See for example HERDT, R.W. [1999] "Enclosing the Global Plant Genetic Commons The Rockefeller Foundation, New York, Occasional Paper; FOWLER C., FALCON W.P. [2002]"Carving up the Commons: the Emergence of a new Regime for Germplasm Development and Transfer Food Policy 27.

[3]Plant germplasm may be seen as a genetic software easy to reproduce and copy, while physical seed containing the genetic software has diskette-like features. See also REICHMAN J.H. [1989]"Computer Programs as Applied Scientific Know-How", 42 Vand. L. Rev. 639, 65669 where he explains that biogenetic engineering and computer software engineering industries are both posing, with more dramatic economic consequences, the same fundamental problems.

Although this debate has been highly elaborated and refined over the last years, it has not brought to a clear "verdict" on the costs and benefits of the different property regimes applied to information goods. For this reason, the paper wants to contribute to the debate focusing on a specific set of resources – seeds – and asserting they should be regarded, instead as Commons, under a Semicommons regime.

The concept of Semicommons applies when there is a dynamic interaction between the private and commons use of a resource. In the case of seeds, the semicommons emerges because seeds may be treated either as physical entities (plant varieties) or as genetic information for plant breeding. In the semicommons, agents are common users who have free access to genetic information for crop development. At the same time, as private users they capture the benefits of crop development through the improvement of plants varieties.

The article contends that the three main stakeholders – traditional farmers, states and the private breeding sector – have long managed crop genetic resources in a semicommons. Considering seeds suitable for a semicommons arrangement may help in devising institutional solutions that are more effective in dealing with the effects generated by the current privatization trend. Even if the technological and economic changes are leading to an increase in the value of crop genetic resources, this does not necessarily mean that an expansion of property rights is the right way to capture such value. If the actors can still capture the increased value through the semicommon arrangement, then a more complex set of governance rules should be superior to a pure system of property rights protected by exclusion rules.

2 SEMICOMMONS THEORY

The concept of Semicommon property regime is relatively new in the theory of property rights. Despite the definition, Semicommons is not simply a hybrid regime between common and private property rights. A Semicommons, instead, requires both common and private property regimes to interact.

Semicommon property is likely to arise when an attribute of the resource is privately owned and a second one commonly owned and there exists a dynamic relationship between the common and private use. The co-existence of two property regime achieves greater benefits from multiple use than would be achieved under a scheme of either primarily private or primarily common property[4].

Smith has first considered the Medieval English Open Field system as a Semicommons because peasants within a community (mainly village) owned the land in common during the period for grazing the cattle, but hold private property rights on parcels of land when they grew crops in the other periods of the year[5]. This enabled the community to take advantage of economies of scale in grazing and to appropriate the benefits

[4] It is clear that either a private property or common property scheme would allow only respectively the private use or common use of the resource.

[5] See SMITH H.E. [2000], "Semicommons Property Rights and Scattering the Open Field" Journal of Legal Studies 29

of crop growing (with no important scale economies). At the same time, the dynamic interaction between common and private use is also emphasized by the fact that common use of land for grazing brings to the private use for grain growing both positive (manure) and negative (trampling) externalities.

However, semicommon property also faces transaction costs because in such a regime there is a strategic incentive to distribute harms and benefits of the common use based on who owns attributes of the resource in the private use. Indeed, like in the tragedy of the commons, the members of the semicommons will attempt to overuse the commons to the extent they internalize just a fraction of the cost of their actions. In addition, they will attempt to both minimize the negative effects of common use on their own property and maximize the negative effects of their own private uses on the commons.

The type of strategic behaviors characterizing English open fields arises because the private user attempts to maximizing the benefits (manure) while minimizing the costs (trampling) from the commons use in her privately owned parcels of land.

Since it seems that strategic behavior in Semicommons is more likely to occur with even more disruptive effects, then the problem is to discover strategies that counter such behaviors. In the case of Open Field, scattering was such solution. Dividing the one's owned land in thin dispersed parcels, the borders of land for private use purpose are altered so as to make the costs of engaging in the strategic behaviors prohibitive. Scattering made it difficult, if not impossible, for the shepherd to identify whose land the flock was either grazing upon or enclosed in for the night.

Semicommon property may be established as an effective property regime if the benefits of the dynamic interaction of common and private use outweigh the costs imposed by individuals' strategic behavior and measures taken for its prevention. On the contrary, Semicommons is likely to disappear where economic and technological changes either dilute the benefits from operating at a multiple scale or favor methods for allocating rights that lower costs for other property rights structure.

Other than the Semicommons in the English Open Field, there is a growing literature which extends the use of this new concept in other domains, especially in intellectual resources such as information and knowledge.

Because information is difficult to subject to exclusive rights and because multiple uses may derive from the non rivalrous resource, intellectual property is argued to establish a semicommon property regime in information goods. In this case, Intellectual Property law devises a dynamic interaction between the common use and the protection of private production of intellectual resources. Although it is true that Intellectual property rights partly enclose the information commons (public domain), it is equally true that they feed in many ways the information commons. This may occur, for instance, when IP rights expire or in cases of Research exemption in Patents and Fair Use doctrine in Copyright Law. Likewise, the information commons partly enclosed by the intellectual property rights provides information inputs for the private creation of new intellectual resources[6].

[6]See FRISCHMANN B. and LEMLEY M.[2006], "Spillovers", *100 Columbia Law Review*; FRISCHMANN M.B. "Evaluating the Demsetzian Trend in Copyright Law" 3 Review of Law and

Strategic behaviors arise also in the information semicommons and can be of two types[7]. The illegal reproduction and distribution of privately owned information may be deemed as an improper expansion of common use that strategically distributes harms to the owners of the protected information. To the same extent, the strengthening of exclusive rights that blocks the access to the common components of information may be seen as an expansion in protection of private use that restricts the use of the information in public domain.

3 SEMICOMMONS IN SEEDS

3.1 Traditional farmers' Semicommons

In traditional agricultural systems farmers act as both users and breeders of crop genetic resources[8]. Every season farmers save seeds as inputs for the next sowing and use traditional knowledge to select seeds that will express the desired physical traits of crop plants. As a result, the system is characterized by a high degree of decentralization and crop varieties are the result of a collective and cumulated effort.

In addition, the decentralized system of selection of crop varieties is sustained by widespread practices of free and reciprocal exchange of seeds among farmers[9], which eventually create a huge diversity of locally adapted landraces.

The management of crop genetic resources by farmers in traditional agricultural systems seems to fit the Semicommons system: farmers leave in common use the germplasm as information inputs for the development of new crop varieties, but privately use crop varieties as physical entities for agricultural production. The dynamic interaction between the private and common use arises because, even if the value of genetic information is hard to be captured, its use is ostensibly worth to affect the value of crop physical traits, that are easy to capture by farmers. Moreover, within the common use of genetic information, farmers have also incentives to exchange seeds. To explain these incentives it is necessary to look at the farmers' system as a network.

In this context, when property rights are undefined (because net benefits of defining them are negative) and there is a networked environment of users, the most effective organizational structure for the production of information goods could be the common based peer-production[10]. There are four attributes that make peer-production economic viable: first the production system relies on information goods as output and input;

Economics (forthcoming 2006). .

[7]See HEVERLY R.A. [2003] supra note 6.

[8]See BRUSH S.B. [2004] "Farmers' Bounty" *Yale University Press*

[9]According to Brush, farmers have long sought to increase returns to land and labor through experimentation and exchange of knowledge and seeds. Seed exchange between farming communities is also necessitated by the loss of seed and by seed degeneration. Seed-exchange networks and/or markets quickly diffuse local varieties found to possess valuable characteristics such as disease resistance, drought tolerance, or special culinary qualities

[10]BENKLER J. [2002] "Coase's Penguin, or Linux and The Nature of the Firm", *112 YALE L.J. 369*

second the costs of information production have to be low; third the human capital inputs must be highly variable across the network; fourth the exchange of information across space and time must be cheap enough.

Even if Benkler's work applies to digital networked environments, where individuals using interconnected PCs share and produce information, it is not hard to find analogies with the seeds. First, the exchange of seeds by farmers represents a production system whose primary inputs are the existing genetic information embodied in seeds and the final output is new information in the form of recombined genetic material. Second, the cost of production of new genotype seems to be low as farmers use a basic breeding technique which strongly relies on natural processes. Third, the environmental conditions where crops are adapted are very variable and the farmers knowledge used to select the desired physical traits expressed by the genotypes is decentralized across the network. Fourth, since crop resources are highly moveable and replicable, the cost of exchanging information embodied in seeds is low.

Essentially, the semicommons system for the management of crop genetic resources, with seed exchange as common based peer production, allows traditional farmers to appropriate part of the value of germplasm through the common use genetic information with beneficial effects on the value of the crops physical traits. Even in the absence of property rights on the germplasm, the Semicommons sets the incentives for the production and exchange of crop genetic resources.

3.2 Public intervention: the Global Semicommons

The rediscovery of Mendelian laws and their application to crop genetics redesigned crop development strategies and bore changes in agricultural production systems. Modern plant breeding becomes a more effective system for the manipulation of genetic material, but it requires higher R&D investments. At the same time, these new techniques allow to develop improved and uniform crop varieties to support the emergent industrial agriculture sector.

Moreover, the growing possibilities of using germplasm for new agro-industrial needs imply also a change in conservation strategies. First, with modern plant breeding techniques the number of plants that are potentially useful is expanded and *ex situ* germplasm collections become relevant to sustain immediate breeding efforts[11]. Second, the emergence of commercial agriculture reduces the availability of germplasm because modern varieties rapidly replace traditional landraces[12].

It is not surprising that, as the new system of plant breeding requires higher investments to develop new genetic information, the first way to avoid the public good dilemma[13] in crop development has historically been the public sector intervention. With

[11]Today, more than 6 millions of accessions are stored in 1320 genebanks all around the world. FAO (1998) supra note 1

[12]Such concern was expressed by HARLAN J., MARTINI M.L. [1936] "Problems and results in barley breeding". in: *Yearbook of Agriculture 1936.* USGPO.

[13]The classical dilemma in information production is that, being non excludable and non rival, the potential supplier of such good hardly captures the investment made in production, then no one will

the same vein, *ex situ* conservation strategies, which entail high initial investments and maintenance costs, were publicly funded.

By the early of the XXth century, but especially after WWII, the principal concern of governments has been to increase productivity of their national agricultural system through crop development policies. National breeding programs were set up either to distribute seeds of improved crop varieties directly to farmers or to support the emerging but still weak private breeding sector. In this second case, private plant breeders rely on parental lines developed by public institutions and use them to generate follow-on crop varieties. In addition, since national agriculture sectors also relies on the cultivation of crop species originated in other regions, the collection of genetic material of the new relevant crop species becomes crucial to sustain breeding programs for the development of well adapted crop varieties.

Many developed countries created national germplasm collections[14] and heavily invested in public agriculture research programs[15]. Even today, public sector agriculture research still plays a relevant role in many developing countries[16].

In the 1971, a network of internationally public funded agricultural research centers (IARCs) and genebanks were also implemented under the label of Consultative Group on International Agricultural Research (CGIAR). These non-governmental centers were mainly established in developing countries. Their aim was to support the crop development activity of developing countries, but at the same they served the developed countries to collect germplasm in areas of traditional agriculture where genetic diversity is high. The CGIAR centers may be considered as an international collective action, which highlights the need for modern plant breeding to have access to germplasm collection for crop development purpose. Indeed, the CGIAR collections mainly consist of landraces which are the main source of germplasm for modern plant breeding.

In order to appreciate why a semicommons arrangement exists in this context it is necessary to consider that 1) public intervention makes the access to germplasm free and 2) countries, like traditional farmers, always had incentives to exchange and obtain crop genetic resources to capture the value of the improved crop varieties in national agriculture production.

Except few attempts by some countries to control their genetic resources, germplasm has flown freely at the international level[17]and today National agriculture research centers (NARCs), IARCs and national and CGIAR genebanks form indeed a thick network

supply the good at the social desired level and consequently undersupply of the public good will occur.

[14]Today, 83% of the total accessions are stored in national genebanks. A remaining 11% is stored in international genebanks. FAO (1998) supra note 1.

[15]U.S. have the first to implement a public crop development policy and afterwards were followed by european countries. For an historical analysis of public R&D expenditures see ALSON J., PARDEY P., SMITH V. [1998] "Financing agricultural R&D in rich countries: what's happening and why" *The Australian Journal of Agricultural and Resource Economics Vol 42(1).*

[16]The public agricultural R&D investments in 1995 accounted for 94,5% of the total investments in developing countries. In developed countries the share is 48,5%. See PARDEY P. and BEINTEMA N. [2001] "Slow Magic: Agricultural R&D a Century After Mendel" *IFPRI*

[17]For instance, US have obtained in the first decades of XXth century over 4000 soybean varieties from Japan, Korea and China for the introduction of this crop in their agriculture system.

of publicly funded institutions which yearly exchange germplasm and improved material (breeding lines) for agricultural R&D purpose[18].

As in traditional agricultural systems, this exchange is peculiar for a common based peer production of crop genetic resources performed by the of public research and conservation centers. In this case, a "Global Semicommons" arises from the dynamic interaction of the common use of genetic information in a networked environment and the private appropriation by every single state of crop value in agricultural production.

However, whereas the main result of the semicommons system at the farmer level is the maintenance of genetic diversity in traditional agricultural system, the "Global Semicommons" has favored the spread of crop resources from their centers of origin to other areas. Today the agriculture of virtually all countries is heavily dependent on a supply of crop genetic resources from other parts of the world[19]. This, of course, makes the access to crop genetic resources even more valuable for countries which rely for their food security and agriculture production in non indigenous crops[20].

3.3 Semicommons with Plant Breeders Rights

The public intervention in the emerging plant breeding sector is just one – and the first adopted – of the strategies for crop genetic resources management after the mendelian revolution and the application of modern breeding techniques. Indeed, the same technological and economic changes, that increased the implicit value of genetic information, also carried the germs for the emergence of property rights.

Except for hybrid crops – that represent an island of exclusive property rights enforced by technological barriers embedded in seeds[21] – the more comprehensive solution to the private breeders' dilemma in crop development has come out from the implementation of a *sui generis* system of protection for innovation in crop genetic resources, defined as Plant Breeders' Rights. This *sui generis* system was required as the traditional patents seemed inadequate for the protection of innovation in plant varieties[22]. Like any other form of intellectual property, Plant Breeders' Rights grant protection to new crop varieties (both sexually and asexually reproduced) and they establish an exclu-

[18]For example, 887879 seed samples have been distributed by CGIAR genebanks to countries for the period 1974-1997. SINGER Database at http://www.singer.cgiar.org/.

[19]See FAO (1998) supra note 1 for the data on world interdependence in crop genetic resources.

[20]Indeed, since the genetic basis of non indigenous crops is more limited than the one in the centers of origin, if these countries lack large *ex situ* collections of germplasm the risk of genetic vulnerability is high.

[21]Seed of hybridized crops is produced by crossing parent varieties. This seed exhibits the selected physical attributes of the two parents when planted. However, these attributes deteriorate markedly in second-generation seed harvested from the first generation. Thus, if farmers save and replant seed from a hybridized variety, the agronomic performance will typically be considerably lower in the second round. Or in other words, the income stream derivable from that seed will be much less.

[22]The requirements for patentability are: novelty, non obviousness, utility and adequate disclosure. A first objection to plants patentability is that breeders' products are not inventions, but rather product of nature and discoveries. In addition breeders' products seem to not satisfy the disclosure requirement as plant varieties and their breeding processes are not suited for the statutory requirements of written description.

sive right of no less than 15 years[23] for new varieties that comply with the requirements of Distinctiveness, Uniformity and Stability (DUS)[24].

Even if PBRs are exclusive property rights, they have two limitations to the scope of protection that greatly highlights which are the incentives private plant breeders are interested in within this regime. The concern to capture the value of investments made on the innovation seems not so very relevant in this case. UPOV Convention assumed a farmers' exemption, whereby farmers can use the first generation of propagating material they had lawfully acquired also for replanting in their own field.

In addition, private plant breeder sector still benefited from public agriculture research for the major improvements in crop plants. Public research centers used to spread freely to the seed companies these innovated products and plant breeders could then slightly improve and commercialize new protected varieties[25].

On the contrary, the issue of the distribution of information seems to be more relevant in a context where innovation is a cumulative and collective process. The concern to guarantee a relatively high degree of free access to protected varieties as informational inputs for further crop improvements is addressed with a strong the research/breeders' exemption in UPOV provisions[26].

The balance between exclusion and access of genetic information embedded in protected varieties makes Plant Breeders Rights resemble to a copyright like form of protection with strong semicommons features. On one hand, the exclusive rights components of plant breeders rights is apt to internalize part of the value of the innovative recombination of germplasm (in the form of a new plant variety) to the extent the breeders make enough return to cover their investment. On the other hand, the breeder exemption is designed to promote the spread of spillovers by leaving free the access to the genetic information contained in protected varieties . More precisely, Plant Breeders' Rights devise an exclusive right respect to farmers for the private appropriation of return made on innovation, but the "breeders' exemption" allows a common use of genetic information.

3.4 A global view of crop genetic semicommons

Traditional farmers, public agricultural research centers/genebanks and private plant breeders used to treat crop genetic resources as a semicommons. The common denominator of the semicommons in all the three cases is the free access to genetic information

[23]According to the amended UPOV text in 1978.

[24]Art. 6, UPOV 78. *Distinctiveness* means new varieties should be clearly distinguishable from existing varieties. *Uniformity* means the first propagated material must conserve a certain degree of homogeneity. *Stability* requires the plant remains true to type after repeated cycles of propagation.

[25]Empirical evidence suggests indeed that plant breeders' rights do not have greatly stimulated the innovative effort or R&D expenditures for the effective crop varieties improvements (such as yield), but rather they serve as a marketing tool to allow plant breeders differentiate in the seed market their protected crop varieties, often with few cosmetic modifications. See ALSTON J.M., VENNER R.J. [2000] "The Effects Of The U.S. Plant Variety Protection Act On Wheat Genetic Improvement" *IFPRI-EPTD Discussion Paper No.62.*

[26]The exemption is for the utilisation of the variety as an initial source of variation for the purpose of creating other varieties or for the marketing of such varieties. Art .5(3), UPOV 78

contained in seeds, while incentives for private appropriation of benefits derive from the use of such genetic information. This seems an effective system to the extent that the development of crop genetic resources is characterized by a cumulative and collective process of information production where agents are thickly networked.

The three clusters of actors also interact with each other devising a global semicommon regime of crop genetic resources.

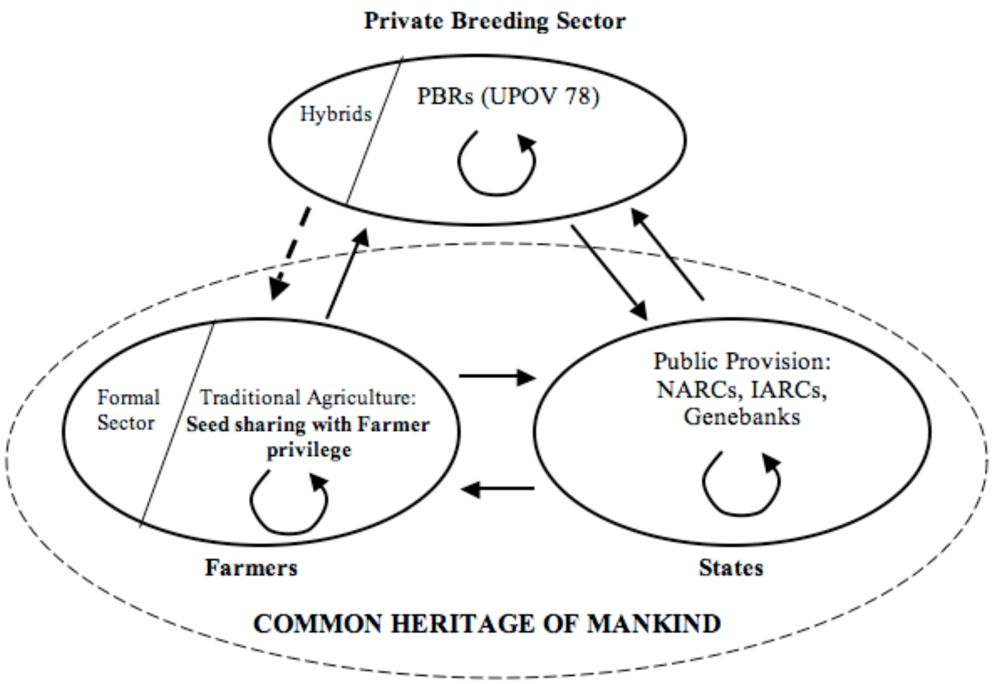

Figure 1: A global perspective of Crop Genetic Semicommons

Figure 1 presents in more details this global perspective. The three spheres represent the actors involved and the organization strategies adopted to use crop genetic resources. The arrows describe the exchange relationships that occur within and between each group. The full arrows stand for free access mechanism, while the shaded lines depict the access mechanism based on property rules and market exchange.

The only shaded arrow is the one between private plant breeders and farmers, since in commercial agriculture and seed formal sector farmers acquire the entitlement use protected varieties paying royalties. However, as we have seen before, the "farmer privilege" set by Plant Breeders Rights grants a certain degree of free access to the protected variety, after the first time that has been legally acquired. In all the other cases the access to crop genetic resources by traditional farmers, public institutions and private plant breeders is open either because no exclusive rights are set on the genetic resources or because the *breeders' exemption* permits access to genetic information.

In this way, public agricultural research centers and private plant breeders can freely collect seed samples from farmers' fields. Private plant breeders have free access to genetic material and breeding lines stored and developed by public institutions. Traditional farmers can receive without cost the improved varieties developed by national agricultural programs.

This situation expresses the "Common Heritage of Mankind "regime under which crop genetic resources were managed[27]. The term "Common Heritage" has been applied to crop genetic resources the 1983 FAO International Undertaking on Plant Genetic Resources (IUPGR)[28].

According to Article 5 of IUPGR, this regime implies that governments should not claim any exclusive right to their genetic resources and should allow international and foreign national research organization or private companies to collect genetic resources on their territory for breeding purpose and to conserve them in open access. As a consequence, the Common Heritage regime not only allows for a free flow of crop genetic resources between farmers and across the states borders, but it also allows private plant breeders to freely access crop genetic resources held on farm and in public research centers or genebanks.

4 THE ENCLOSURE OF THE SEMICOMMONS

4.1 Biotechnologies and the blooming of property rights

In the last decades of the XXth the biotechnology revolution has drastically amplified the effects that the rediscovery of Mendelian laws had in plant breeding. In classical plant breeding, crossing and mass-selection were effective techniques for the improvement of crop physical traits, but they allow an indirect manipulation of genetic material. The plant's DNA remains a black box and breeders simply know that a set of genes responsible for crop improvement has been successfully introduced to the new cultivars. On the contrary, biotechnologies offer new molecular breeding methodologies which operate at the level of DNA sequences to manipulate directly the plant's genotype.

At the same time, because genetic engineering relies on more sophisticated technological devices and scientific knowledge, it requires much more investments in R&D and time to develop improved varieties than the classical plant breeding techniques[29].

Genetic engineering has favored also the arrival of new economic actors in the private plant breeding sector and an overall reorganization of agro-industry system. Whilst the governments used to be the main organizers of crop development, there is a tendency for private industry to replace the national government in that role.

[27]The expression "Common Heritage of Mankind" and its content are to be attributed to the Maltese Ambassador, Arvid Pardo who presented it on 1 November 1967 at the First Commission of the United Nations Assembly discussing the future of legal regime of the seabed and its subsoil. For a discussion of the concept of Common Heritage see BASLAR K. [1998] "The Concept of Common Heritage of Mankind", *Kluwer Law International.*

[28]This is a non binding international agreement introduced as Annex to the resolution 8/83 of the 22nd session of the FAO Conference, 1983

[29]Ten Kate and Laird (1999) supra note 33.

It seems clear that the new opportunities set by this technological change, the greater involvement of private sector and the high cost for using biotechnologies have spurred the establishment of a new structure of property rights to capture the value created by breeders with such applications. The new emerging property rights are utility patents and patent-like forms of plant variety protection.

Since the landmark case *Diamond v. Chakrabarty* in US, property rights on improved crop genetic resources have bloomed in the form of patent protection on biotechnology innovations applied to crop germplasm[30] and have been adopted by all industrialized countries[31].

The introduction of a new regime of exclusive rights has also led to a revision of the copyright-like system of Plant Breeders' Rights. Because Plant Breeders' Rights on plant varieties and patents on genetically modified plants may be overlapping regimes[32], patents have gained a competitive advantage because of the broader protection this system offers. At the same time, because developments in biotechnology are making reverse engineering of protected varieties possible as well as generally speeding up the breeding process, breeders are loosing their lead time with respect to competitors and ask for a greater protection for their plant varieties. As a result, both biotechnologies and the competition with patent protection have pushed the Plant Breeders' Rights system to adapt to the new technological and institutional conditions and have become a more a patent-like regime.

The 1991 UPOV revision, with the restriction of the farmer's and breeders' exemption highlights this trend. First, the scope of protection has been extended to imports and exports of protected varieties and it includes not only the vegetative propagating material but also the harvested material, where the harvest has been obtained through an unauthorized use of the propagating material[33]. Second, the farmer's privilege to save and sow seed has become optional, according to national laws[34]. Third, the breeders' exemption has been maintained but in practice limited, as the scope of protection of UPOV 1991 has been expanded to essentially derived varieties[35].

[30] Falcon and Fowler (2002), supra note 1, count that in the US the patent applications containing the terms "rice", "wheat" and "corn" plus "gene" has passed from 257 in the period 1981-85 to 11475 in the period 1996-2001

[31] Apparently, in Europe, plant varieties are not eligible for patent protection according to Art. 53(b) of the EPC and Art. 4(1) EU Biotech Directive N 98/44. However, Art. 4(2) provides that "Inventions which concern plant or animals shall be patentable if the technical feasibility of the invention is not confined to a particular plant or variety". Indeed, in *Transgenic Plant/Novartis II*, the Enlarged Board of Appeals of the EPO permitted the issue of patents on engineered plants provided that the claims were not directed to a specific variety or varieties.

[32] Breeders can protect the plant variety with a PBR and the biotechnology invention inserted in or applied to the plant with a patent.

[33] Art. 14 UPOV 1991

[34] Art. 15(2) UPOV 1991

[35] See to Art. 14(5) UPOV 1991. This provision aims to prevent a subsequent breeder who simply made a "cosmetic" improvement – selecting a mutant or a minor variant from an existing variety or just inserts an additional gene into it by back-crossing or some other procedure– to protect the resulting variety without rewarding the original breeder for his contribution to the final result. See GREENGRASS B. [1991] "The 1991 Act of the UPOV Convention" *E.I.P.R. Vol. 13(12).*

In addition, because the continuos advances in biotechnology applications in plant breeding there are now proposals (advanced by some big agribusiness companies) to restrict once again the breeders exemption by introducing a waiting period during which time other breeding companies are not permitted to use a protected variety in their own breeding research[36].

The global expansion of property rights is also occurring at the international level through the Trade Related Aspects of Intellectual Property Rights (TRIPs) agreement under the World Trade Organization. In order to comply with TRIPs many developing countries are being required to enact laws that, at a minimum, provide for protection of plant varieties[37].

4.2 Planting property rights against the threat of genetic erosion

Since genetic engineers can tap from a much larger pool of genetic information than "classical" breeders, new concerns have emerged at the global level with regard to the genetic erosion and loss of biodiversity occurring in wild genetic resources as well as in crop genetic resources.

For crop genetic resources, the genetic erosion comes from the process of homegenization of crop varieties as inputs in agriculture production. The introduction of commercial agriculture and the replacement of landraces and wild relatives in many developing countries, rich of crop genetic diversity, have made many crop varieties disappear from farmers' field[38].

As was previously noted, the concern for genetic erosion was already addressed in the mid of the XXth century and part of the conservation efforts already occurred with the creation of national and CGIAR gene banks. Because the threat of genetic erosion in farmers' fields was in its early stages, *ex situ* collections represented a first solution to guarantee a wide enough stock of diversity to modern plant breeders. But, as commercial agriculture is spreading , the flow of useful raw genetic resources towards genebanks is decreasing, requiring new conservation strategies.

Indeed, *ex situ* conservation is only one strategy for conserving crop genetic resources. Putting seeds in the fridge may allow conserve germplasm which contains the right genetic response to the evolving ecological conditions. However, sometimes this strategy does not provide the right solutions to the ecological problems, especially in the case of suddenly emerging pests and pathogens. This occurs because the set of genetic information stored in genebanks does not have the required characteristics or because, being crop genetic resources conserved *ex situ*, they have not evolved to challenge the new

[36] See EATON D. and TONGEREN F. [2005] "Should Europe further strengthen IP for plant breeders? An Analysis of seed industry proposals", *Paper presented at the XI International Congress of the EEAE.*

[37] Art. 27(b) of TRIPs agreement requires the patentability of biotechnology innovation and the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof.

[38] For instance, in India cultivated rice varieties have passed from 30000 to less than 10 or in China where nearly 10000 wheat varieties were in use in 1949, in the 1970's only 1000 were still cultivated. See WCMC (World Conservation Monitoring Centre) [1992] "Global Biodiversity" *Chapman & Hall: London*

ecological conditions[39]. *In situ* and *on farm* conservation, that is the conservation made on the farmers' fields, especially in traditional agriculture, may represent a second solution to override the static limits of *ex situ* conservation and guarantee a sufficient source of agro-biodiversity. Indeed, the continued cultivation of a wide range of landraces and wild relatives within a natural environment would allow natural selection to signal which of these varieties has the resistance to new ecological conditions.

However, the fact that the patents and plant breeders rights reward only breeders for the innovation in new plant varieties, at the opposite extreme of the crop development chain farmers do not have incentives for conserving *in situ* crop genetic resources. Smaller and poorer states, in particular, see few incentives in conserving a high level of diversity in farmers' fields, because they appropriate only a small proportion of the benefit. Their farmers are encouraged to switch to high-yielding varieties, rather than maintain diversity. The same argument applies also to wild genetic resources where the cost of conservation for biodiversity rich countries outweighs the direct benefits for preserving such resources.

Forms of intellectual property rights in improved plant varieties and pharmaceutical products, that allow to capture only indirectly the value of such existent information inputs, do not set the "efficient" incentives for the conservation. On the contrary, incentives for the conservation have to be addressed at the first stage of the production chain, that is at the farmers' and natural habitat level[40].

The value of these unprotected genetic resources is high due to potential biotechnology applications, therefore property rights may be a solution to set incentives for the conservation and sustainable use of genetic resources. Indeed, the increased value of the genetic resources may lead the emergence of property rights and facilitate a "Coasean" bargaining to internalize the negative external effects of genetic erosion. In other words, this solution establishes property rights on existent resources at the "conservation" level, that have to be used at the "access" level for exchanging them with the most interested parties[41].

This approach seems to have been followed by the states which signed the Convention on Biological Diversity (CBD) in the 1992 at the UN Rio Summit[42]. In recognition of the ecological importance of plant genetic resources as well as their unrealized economic value, the CBD provides a legal basis for the establishment of Sovereign Rights on plant genetic resources. It covers both wild and crop genetic resources found *in situ* and the resources collected *ex situ* after the entry into force of the convention[43].

[39] Other concerns about the limits of *ex situ* conservation come from the lack of funds for seeds regeneration and seeds characterization. In such cases, a genebank may loose its accession or cannot find it even if stored. FAO (1998) supra note 24.

[40] See SWANSON T. AND GOESCHL T. [1998] "The Management of Genetic Resource for Agriculture: Ecology and Information, Externalities and Policies" *CSERGE WP 98-12*

[41] See Sedjo (1992) supra note 27

[42] For an explanation of how developing countries used CBD to counterbalance the expansion of intellectual property by developed countries see HELFER L.R. [2004] "Regime Shifting: The TRIPs Agreement and New Dynamics of International Intellectual Property Lawmaking" *The Yale Journal Of International Law Vol. 29: 1.*

[43] However, the CBD does not explicitly address the legal status of CGIAR centers and how germplasm

In the CBD there is no mention of the phrase "common heritage", but the Preamble recognizes biodiversity conservation as the common concern of humankind. Art. 15 CBD, entitled "Access to Genetic Resources", recognizes that genetic resources are within the Sovereign Rights of the States and are subject to national legislation[44]. It obligates parties to facilitate access to genetic resources for environmentally sound uses. Article 15 also stipulates that access to genetic resources shall be subject to prior informed consent of the contracting party and calls for fair and equitable sharing of the benefits arising from utilization of resources.

Just like intellectual property rights, wherein an exclusion right on the genetic resource is assigned to the innovator, the CBD is another legal instrument which grants property rights on the potential conservators (biodiversity rich states). It seems clear that the underlying objective of this convention is to devise a bilateral contracting system for the exchange and compensation (sharing of benefits) of Plant genetic resources. The conceptual touchstone for this new regime in favor of property rules is the notion of "bio-propspecting". Firms can prospect for valuable genetic resources just as miners for gold. A famous 1991 deal, in which a US pharmaceutical giant (Merck) contracted with Costa Rican conservation Institute (INBIO) for bioprospecting rights in the Costa Rican rainforest, has become a symbol for the multi-million dollar revenues that every "tropical" government could reap[45].

4.3 Strategic behaviors in Semicommons

With the emergence of the Intellectual property-Sovereignty rights regime (TRIPs and CBD), the expansion of property rights on seeds is leading towards the enclosure of the crop genetic semicommons.

The biotechnologies revolution and the threat of genetic resources have induced 1) private breeders and agribusiness companies to claim for stronger protection of their investments against competitors and farmers and 2) biodiversity rich countries to regulate access to their genetic resources in order to capture the increased value.

In the past, any actor had incentives to leave in common use the genetic information and to privately appropriate the beneficial spill overs arising from such common use. Today some of these actors are more interested in enforcing strong exclusion rights to capture the value of genetic information, with the consequence to close the tap trough which spillovers spread.

The strengthening of property rights is bearing also a "domino" effect on public institutions that used to operate in agricultural research and conservation without any property rights claim. First, shortage of public funds and a push towards more privatization policies, have led some National Agricultural Research Centers in developing countries to use plant breeders rights in order to protect their improved plant varieties[46].

collections in these gene banks are to be managed.

[44]Art. 15(3) CBD.

[45]RAUSTIALA K., VICTOR G. [2004] "The Regime Complex for Plant Genetic Resources" *58 International Organization 277*

[46]See LOUWAARS N.P., TRIPP R., EATON D., HENSON-APOLLONIO V., HU R., MENDOZA M.,

Second, as the private sector takes advantage of the new property rights system, international agriculture research centers (IARCs) are also pushed by the competitive environment to adopt IPR policies in order to selectively protect their inventions as a defensive strategy and to facilitate partnership with industry[47].

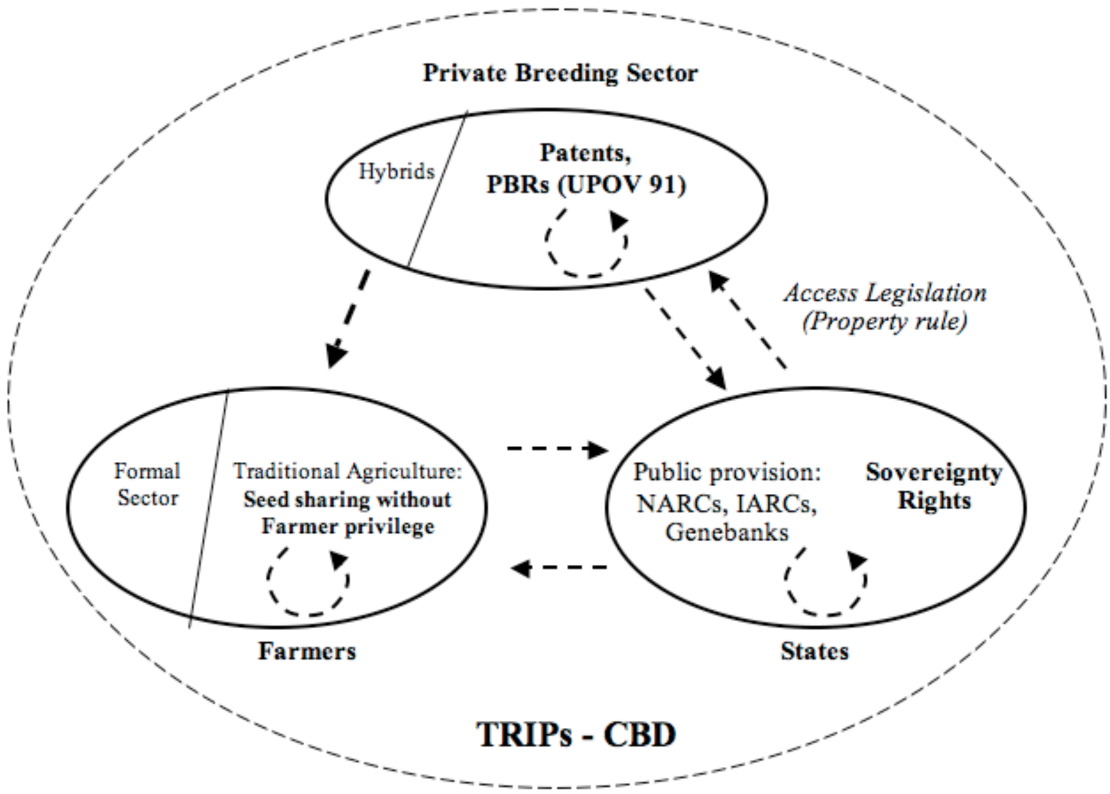

Figure 2: The Enclosure of Crop Genetic Semicommons

Figure 2 presents the emerging property rights regime governing crop genetic resources[48]. As illustrated, many of the mechanisms for free access (full arrows) are being substituted by exclusive rights sustained by property rules in the access (shaded arrows). The circular arrows within the Farmers and States bubbles are now shaded because of the restriction on Farmer exemption under the UPOV 1991 or because of the restriction

MUHHUKU F., PAL S., WEKUNDAH J. [2004] "Impacts of Strengthened Intellectual Property Rights Regimes on the Plant Breeding Industry in Developing Countries" *Report Commissioned by World Bank*.

[47]See DALTON R. [2000] "Cereal gene bank accepts need for patents..."*Nature*, Vol 404, p. 534; SGRP [2003] " Booklet of CGIAR Centre Policy Instruments, Guidelines and Statements on Genetic Resources, Biotechnology and Intellectual Property Rights".

[48]This is more an ideal representation because even if there is evidence on the creation on a new structure of more defined property rights, not all the steps to fully implement such regime have been undergone or there is still strong resistance to perfectly comply with this scheme.

on access under the CBD. The exchange interaction between states and private breeding sector is also characterized by a shaded arrow to the extent Access and Benefit Sharing legislations are implemented.

It is evident that the TRIPS-CBD framework is intended to favor a decentralized market oriented system. A clear assignment of property rights will provide the correct set of market incentives for the allocation of the resources and the distribution of the benefits generated by their use and exchange[49]. The new scenario is, of course, totally different from the free exchange and sharing practice of germplasm, flowing in the networked system of private plant breeders, public institutions and farmers.

As the enclosure of the semicommons is only at the beginning, there is a natural tension between the existent semicommons and the emerging property regime, which is producing an increase of strategic behavior among the users of the semicommons. Regarding crop genetic resources, three different kinds of strategic behaviors may be considered, according to the type of the actors who strategically behave and the type of actors who suffer the costs.

Strategic behaviors within private breeding sector

A first type of strategic behavior comes from the adoption of strong exclusion rights, in particular patents, that could restrict the common use of genetic information by other private plant breeders. This situation creates a patent thicket[50].

The "patent thicket" problem has led to a series of litigations on patent infringement[51] which show how the enforcement of strong exclusive rights may lead to tragic outcomes in the innovation process[52].

At a first glance, the costs of strategic behavior within the private breeding sector may be burdensome and eventually risk to block the whole sector. However, in the long term such strategic behavior may be overcome because actors could learn to contract around property rules and lower transaction costs and hold-up. Indeed, cross-licences and patent pooling are becoming quite diffused practices. In addition, concentration of the sector through mergers and acquisitions is occurring, leading to the concentration of patents and plant breeders' rights in the hands of few agribusiness companies[53]. These

[49] For the relationships between TRIPs and CBD see DUTFIELD G. [1999] "Intellectual Property Rights, Trade And Biodiversity: The Case Of Seeds And Plant Varieties" Background Paper for the IUCN Project on the Convention on Biological Diversity and the International Trade Regime

[50] A patent thicket is the IP portfolios of several companies that form a dense web of overlapping intellectual property rights that a company must hack its way through in order to actually commercialize new technology. See SHAPIRO, C. [2001] *Navigating the Patent thicket: Cross Licenses, Patent Pools and Standard Setting* in "Innovation Policy and the Economy, Volume 1", Jaffe, A., J. Lerner and S. Stern (eds.), *NBER.*

[51] Indeed, the IP portfolios of companies have become so substantial that every firm is likely to infringe patents held by their competitors. See KRATTIGER, A.F. [1997] "Insect Resistance in Crops: A Case Study of Bacillus Thuringeinsis (Bt) and its Transfer to Developing Countries" ISAAA Brief No. 2

[52] See HELLER, M. AND EISENBERG, R. [1998], "Can Patents Deter Innovation? The Anticommons in Biomedical Research" *Science, 28.*

[53] See UNCTAD (United Nations Conference on Trade and Development) [2006] "Tracking The Trend Towards Market Concentration:The case of Agricultural Input Industry" *UNCTAD/DITC/COM/2005/16*

may be considered as institutional solutions that partly solve the problem of accessing genetic resources and avoid the transaction costs and hold up problems caused by the fragmentation of property rights in genetic information[54].

However, as will be discussed below, even concentration of exclusive rights may have economic negative implications in contractual relationships between the new oligopoly of agribusiness companies and actors out of the private sector (for example public institutions in developing countries)[55].

Strategic behaviors between farmers and plant breeders

A second kind of strategic behavior challenges farmers and private plant breeders because of the self replicating nature of crop genetic resources. Farmers may easily copy and replicate seeds covered by property rights, with an improper expansion of the common use that bears cost to the privately owned assets of plant breeders. The private breeding sector, that for decades has striven to increase the legal protection of its products, is now reluctant to see its efforts vanish because of farmers' free riding. Indeed, even if it is hard and costly to monitor if farmers use protected varieties without infringing, in the last years commercial breeding companies are pursuing an aggressive strategy to enforce their exclusive rights respect to farmers.

One can see the increasing number of litigations involving agribusiness companies and farmers who are sued because found to save and sow patented GM seeds[56] or the international "diplomatic" war between Monsanto and Argentina where farmers cultivate GM soybeans that are not protected under the Argentina IP law[57]. As these cases involve farmers' infringement within a commercial agriculture context, it seems appropriate that private plant breeders act against farmers' strategic behavior.

However, the aggressive strategy pursued by private plant breeders may have harmful effects if adopted in developing countries, where seed saving and exchanging is a common practice. In many developing countries, farmers in traditional agriculture system produce a great share of national seed requirement[58]. For this reason, traditional farmers represent a big new market for seed companies, but at the same time they are also worth for their contribution to preserve genetic diversity and to adapt new plant

[54]See MERGES, R. P. [1995] "Intellectual Property And The Costs Of Commercial Exchange: A Review Essay" *93 Mich. L. Rev. 1570*

[55]See SRINIVASAN C.S. [2003] "Concentration in ownership of plant variety rights: some implications for developing countries" Food Policy 28

[56]See Monsanto Co. v. McFarling, 363 F.3d 1336 (2004), at 1341-43 and Monsanto Canada Inc v. Schmeiser, decision of the Federal Court Trial Division [2001 FCT 256]; decision of the Federal court of Appeal [2002 FCA 309]; decision of the Supreme Court of Canada [2004 SCC 34]

[57]It is interesting to note that Monsanto is supported in this war by U.S. farmers producing soybean, because they are threaten in the international market by the royalty free, and so less expensive argentine soya. See NELLEN-STUCKY R. and MEIENBERG F. [2006] "Harvesting Royalties for Sowing Dissent? Monsanto's Campaign against Argentina's Patent Policy". *Berne Declaration* at http://www.evb.ch/en/p11321.html.

[58]In India, for example, farmers produce two-thirds of India's annual seed requirement, and the National and State Seed Corporations only one-third. See VERMA S.K. [1995] "TRIPs and Plant Variety Protection in Developing Countries", *E.I.P.R. Vol 17(6), 281-289.*

varieties to different ecological conditions.

The core of the problem is that if traditional farmers access the formal seed sector, they satisfy a demand for experimentation or replacement of seeds. Once a new variety is introduced in this system, it is likely to be the source of new locally derived varieties and this in the mid and long term, may represent a treasure of genetic information for future breeding. On the contrary, private breeders see farmers' seed saving and exchange just as free riding. They are are more interested in the private and present benefits of making farmers regular purchasers of their seed bags.

In this case, the risk is that the stretching of exclusion rights and their enforcement in developing countries may inhibit the contribution of traditional farmers in adapting crop varieties (even those protected) to the natural habitats and hence in carrying out useful forms of *on farm* conservation[59].

Strategic behaviors by states

Strategic Behaviors are emerging also in the context of implementation of the CBD, where the establishment of sovereignty rights and bioprospecting is restricting the common use of crop genetic resources. What is emerging after the entry into force of the CBD is that bioprospecting may not be an effective mechanism to sustain conservation and sustainable use of crop genetic resources. In turn it is generating more harms than benefits.

Indeed, crop genetic resources are not localized in specific habitats belonging to a unique country, but rather they are spread in many countries and grown by several farmers' communities at the same time. If a private company is interested in the genepool of landraces and wild relatives of a crop species it may find different contracting parties in competition among each other. As a result, bioprospecting agreements for landraces and their wild relatives is hard to generates big potential rents to states or local communities. Bioprospecting contract may also not be so useful for farmers, since commercial seed companies mostly rely on elite and already improved breeding lines from public and private breeding programs rather than relying directly on farmers' landraces[60].

As for the drawbacks, the new system devised by the CBD (exclusion rights supported by property rules) is generating concern regarding possible hold-up problems[61] and increase in transaction costs for exchanging crop germplasm.

Many national legislations adopted to comply with the CBD would require the negotiation of benefit-sharing arrangements often with local communities and various govern-

[59]Such risk may even be amplified by the adoption of genetic use restriction technologies (GURTs; also referred as "terminator technology"). which make genetically modified plants unable to reproduce seeds. GURTs have the same effect of hybrid technology, but they are more powerful as they could be applied to every crop species. SeeSWANSON T. and GOESCHL T. [2003] " The development impact of genetic use restriction technologies: a forecast based on the hybrid crop experience", *Environment and Development Economics Vol. 8(1).*

[60]See BRUSH S. [1998] "Bio-cooperation and the benefits of crop genetic resources: the case of Mexican maize" *World Development 26* for a detailed explanation of this point.

[61]ANDERSEN R. [2006] "Governing Agrobiodiversity: The Emerging Tragedy of the Anticommons in the South" *47th annual Convention of the International Affairs Association, San Diego*

ment agencies prior to access of genetic materials[62]. At the same time, the international flow of crop germplasm may be reduced by the overwhelming transaction costs, as the number of exchanges involving crop genetic resources for agricultural research is very high[63].

The effects of such hold up problems and transaction costs have become evident. The US Department of Agriculture reports that after countries implemented ABS legislations, instances of refusal or inability of foreign governments to process USDA requests for *in situ* germplasm access increased[64]. Likewise, CGIAR centers whose genebanks averaged 9782 acquisitions annually for the five calendar years before the CBD, but in 1997 the number of new accessions was only 563.

5 REOPENING CROP GENETIC SEMICOMMONS: A NORMATIVE PERSPECTIVE

The enclosure movement is leading to an increased restriction on the access for crop genetic resources within a networked system that includes farmers, private breeding sector and public institutions.

The adoption of more exclusive rights favors the interests of the private sector. However this emerging regime may be ill suited in a system where different stakeholder – with different interests in the use of crop genetic resources – still have an equal weight. Indeed, at the global level, commercial seed industry accounts for approximately a third of the global market and it is valued at US$ 30 billions. The remaining two thirds are divided equally between the public sector and a locally farmer-seed systems[65]. Of course, the implication of the expansion of property rights are especially critical for developing countries whose agriculture systems still rely on traditional farmers and public sector agricultural research for crop development.

If there exists a common concern for the sustainable use and conservation of crop genetic resources at the global level, the main point is to find institutional solutions that support this goal and make the different interests of users coexists,.

The main concerns to be addressed are: 1) facilitating access to germplasm and breeding material for national and international agricultural research centers to the advantage of states agricultural system and 2) providing incentives to traditional farmers in developing countries for their breeding and conservation activities.

---

[62]See for example Philippines Executive Order No. 247 and Administrative Order No. 96-20 (1996), the Cartagena Agreement of the Andean Pact Decision on a Common System on Access to Genetic Resources and the Declaration and Draft Model Law by the Organization of African Unity.

[63]VISSER B., EATON D., LOUWAARS N. AND ENGELS J. [2001] "Transaction Costs Of Germplasm Exchange Under Bilateral Agreements" *CGRFA Background Study Paper No. 14* estimate that under a fully bilateral system the transaction costs would range from 22 to 78 millions US$. With free access to germplasm the total amount of TCs would be around 2 millions US$

[64]See WILLIAMS K. [2005] "An Overview of the U.S. National Plant Germplasm Systems Exploration Program " *Hortscience Vol. 40(2).*

[65]See RANGNEKAR D. [2000] "Access to Genetic Resources, Gene-based inventions and Agriculture" *Study Paper for the Commission on Intellectual Property Rights.*

Because the enclosure movement is grounded on exclusive rights with more absolute property rules to germplasm access, a way to reestablish the crop genetic semicommons would be to substitute such property rules with liability rules. As the common denominator of crop genetic semicommons has been the free access to genetic information contained in seeds, liability rules would help to unrestrict access to genetic information.

At the global level, this would necessitate to abandon the bilateral exchange system envisaged by the CBD and to opt for a compensatory liability regime tailored on the thick network of connections that characterizes the global system of crop genetic resources management.Since with the CBD each state holds sovereign rights to genetic resources, parties should use liability rules to free access for genetic information and enable the exchange among national and international agriculture research systems.

Of course, the main problem to set up a voluntary liability regime is represented by the incentives parties have to join it. However, if all the parties recognize the relevance of germplasm exchange, a compensation scheme would be mutually beneficial and should be tailored to reflect the value of access and sharing crop genetic resources as the most important benefit rather than any other form of market compensation. This new system would not apply to the intellectual property regime emerged in the private sector, but would leave states to appropriate directly on their agriculture research systems the benefits arising from the common use genetic resources. In turn the private breeding sector would still benefit for its breeding purpose from accessing under a liability regime the crop genetic resources held in common use.

At the farmer level, maybe it is harder to see a linkage between liability rules and incentives for *in situ* conservation. Indeed, *in situ* conservation is mainly a matter of economic incentives to prevent farmers from replacing their landraces with new commercial varieties. However, it is also acknowledged that farmers' practices of seed saving and exchange "over the fence" are essential to preserve the vitality of the crops across their different generations and contribute to genetic diversity[66]. This means that farmers' practices are an essential ingredient of *in situ* conservation strategies. As a result, the legal framework could affect indirectly conservation because defines what seeds farmers can use and to what extent farmers are allowed to save and exchange seeds.

In this context, a form of liability rule, existent in copyright laws, like fair use defense from infringement claims, would help traditional farmers to carry out their breeding and conservation activity even with protected crop varieties. This rule would apply insofar the exchange is kept within the boundaries of traditional practices and does not entail manufacture and sale of propagating material in competition to the holders of the right. In this way, the incentives to private plant breeders set by exclusive rights are preserved but also the semicommon arrangement existing among traditional farmers would be reopened.

The suggestion to use liability rules at the global and farmer level seems indeed the main objective of the FAO International Treaty on Plant Genetic Resources for Food

[66]See BRUSH S. [1994] Providing Farmers Rights Through In Situ Conservation Of Crop Genetic Resources *CPGR Background Study Paper No. 3*; Melinda Smale, Istvn Mr and Devra I. Jarvis [2002] "The economics of conserving agricultural biodiversity on-farm" IPGRI

and Agriculture (ITPGRFA) signed in 2001. This treaty grew out of nearly two decades of negotiations at the FAO concerning an international system for managing crop genetic resources.

As for the global level, the treaty, recognizing the economic value of crop genetic resources, creates an international regime for germplasm development and transfer. Consistent with the legal framework created by the CBD, the contracting parties mutually recognize their sovereignty rights[67] over their respective genetic resources , but use those sovereignty rights to create a multilateral access system for existent crop genetic resources, that are included in a list of fundamental crops and forages[68]. In addition the legal status of CGIAR centers and genebanks is solved including the international centers within the multilateral system[69].

A part to devise the multilateral system, the ITPGRFA introduces the concept of Farmers Rights as a way of balancing the traditional IPRs on crop genetic resources and addressing the problem of *in situ* conservation. However, the implementation of Farmers' Rights rests with national government of each contracting party[70]. Even if there are still rare examples of national legislations extensively implementing farmers rights, two different designs of such rights may be distinguished[71].

The former is based on an ownership approach, which refers to the right of farmers to be rewarded for the genetic material obtained from their fields. Access and benefit-sharing legislation and farmers intellectual property rights are suggested as central instruments. The latter is based on a stewardship approach, which refers to the rights that farmers must be granted in order to enable them to continue as stewards of agrobiodiversity.

It is clear that the ownership approach resembles the establishment of exclusive rights on the conserved resources that may have the same effects on access restriction created the CBD[72]. On the contrary, the stewardship approach is close to the use a Fair Use doctrine for traditional farmers in order to freely exchange seeds for non commercial purpose. Thus, it seems more related to the objective of reopening the semicommons at the farmers' level.

The new regime devised by the FAO ITPGRFA is presented in Figure 3. As it is clear, the new system has similarities with the Common Heritage regime depicted in Figure 1.

[67] See Preamble of ITPGRFA.

[68] The multilateral system principally covers the genetic resources held in *ex situ* collections. For crop genetic resources found *in situ* they will be provided under the system only if access legislation are absent. Art. 12.3(h) ITPGRFA.

[69] Art. 11(5) and Art. 15 ITPGRFA.

[70] Art. 9 ITPGRFA.

[71] See ANDERSEN R. [2005] "Results From an International Stakeholder Survey on Farmers Rights" *The Farmers Rights Project Background Study N.2.*

[72] For example, the Indian Protection of Plant Varieties and Farmers' Rights Act of 2001, which allows the protection of farmers' varieties, risks to pose problems of overlapping claims and resultS in complicated bargaining requirements for utilization of varieties. See RAMANNA A. [2003] Indias Plant Variety And Farmers Rights Legislation: Potential Impact On Stakeholder Access To Genetic Resources *IFPRI-EPTD Discussion Paper No.96.*

For the resources covered by the FAO treaty, the access would be again free, both for traditional farmers given Farmers' Rights and for the Contracting Parties because of the multilateral system of zero compensation liability rules (full arrows in farmers and states bubbles). The exchange interaction from the multilateral system to the private plant breeding sector (dotted arrow) would be characterized by a liability rule which grant free access but requires a monetary compensation if new crop varieties are developed. The sale of protected varieties to farmers in the formal sector (full arrow) continues to follow the market system based on property rules.

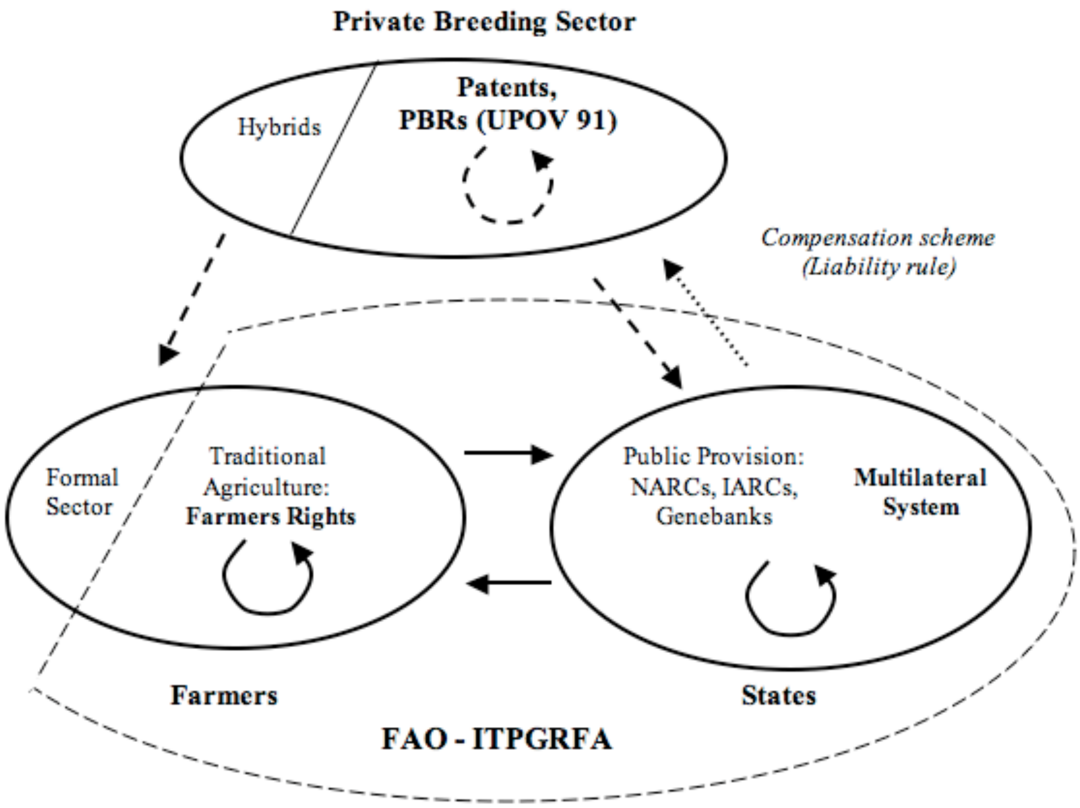

Figure 3: Reopening the Crop Genetic Semicommons

6 CONCLUSION

The expansion of property rights in information resources is often presented as the second enclosure movement of an information commons. The rhetoric of this debate makes the dichotomy "Property-Commons" a very charming and powerful image that scholars have extended to offer normative prescriptions in many fields where the resources can be perceived as information goods.

While the causes and implications of movements towards privatization are broadly discussed, less attention is devoted to the features of the "commons" from which the enclosure movement has originated. Of course, understanding such features may help to assess in static terms the implications of the emerging property rights structure respect to the previous regime and, dynamically, the tensions occurring in the gradual shift from one regime to the other

In this context, I have analyzed crop genetic resources which, embodying genetic information, represent a perfect example where the "Property - Commons" debate has been applied, as the privatization of genetic information is taking place. However, the main argument is that crop genetic resources were not exactly managed in the past like a Commons, but instead in a semicommon arrangement.

The semicommons, applied to a networked system of cumulative information production better than the commons may explain the different interests of heterogeneous users of the resource and why they so willing to share germplasm or leave the access free.

The new enclosure movement in crop genetic resources comes from the development of bioengineering applications and the perception by states to be able to capture the value of their genetic resources as genetic erosion is reducing the supply of valuable genetic raw material. However, the strong intellectual property rights supported by national sovereignty on genetic resources seem to mainly reward the private breeding sector in a global system where traditional farmers and public institutions still play a relevant role. In turn, this movement does not favor a sustainable use and conservation of crop genetic resources and is increasing the costs of the whole system for the germplasm exchange.

The understanding of crop genetic resources management as a semicommons may then help to find out normative prescriptions that avoid such distort effects of the enclosure. Reopening the semicommons under changed conditions does not mean to reestablish the Common Heritage regime or permeable forms of exclusive rights for the development of new crop varieties. This would be unfeasible as the interests of private breeding sector are too strong. On the contrary, institutional solutions which guarantee access to crop genetic resources among traditional farmers and the public agricultural research system seem to be a possible way to limit the distortions caused by the expansion of property rules. The FAO Treaty, which relies on liability rules rather than property rules for the germplasm exchange seems to share this policy vision as it devise a multilateral system of facilitated germplasm access and address the recognition of Farmers' Rights.