Coase, Pigou and the Potato: Whither Farmers' Rights?

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Abstract

This paper explores the realization of farmers' rights in order to reward farming communities for their contribution in conserving and developing crop genetic resources. Current proposals to realize farmers' rights follow both Coasean and Pigouvian approaches, which try to solve the public good dilemma generated by traditional farmers in supplying agrobiodiversity. However, both the solutions not only may be difficult to realize but also provide just incomplete incentives to traditional farmers in enhancing *in situ* genetic diversity. In analogy with emerging open source models in the digital information economy, I contend that traditional farming systems, with the customary practices of seed saving and exchange, must be regarded as a commons based peer organization for germplasm production and distribution. For this reason, new options for implementing farmers' rights should be devised in order to strengthen farmers' practices to use and exchange seeds within the traditional seed systems.

Keywords: Farmers' Rights, genetic resources, agrobiodiversity, conservation, benefit sharing

JEL codes: O34, P14, P48

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1 Introduction

What have Coase and Pigou to do with the potato? Both the economists proposed solutions to cope with the public good dilemma and the external effects caused by human actions (Coase 1960, Coase 1974, Pigou 1932). In the same vein, the conservation of the potato, that is the conservation of crop genetic diversity, is a public good. Because genetic diversity is the raw material for the future improvement of all crops, traditional farmers generate positive externalities through the conservation in their fields of agrobiodiversity (Brush 2002).

With the development of modern breeding and the creation of new improved varieties, farmers in traditional agriculture have incentives to adopt commercial agriculture and to replace their genetically diverse landraces with more productive and homogeneous varieties (Swanson, Pearce & Cervigni 1994). As a result, agrobiodiversity rich areas are substituted by homogeneous fields, lessening the stock of germplasm available for breeding purpose. While intellectual property rights – in the form of patents and plant breeders' rights – provide private plant breeders incentives to develop new crop varieties, no compensation exists to reward farmers for the conservation of existent genetic resources. In this way, the loss of genetic resources and agrobiodiversity as inputs for crop development may in the long term threaten breeding activities and have tremendous consequences for agriculture productivity.

In this perspective, farmers' rights, introduced after a long gestation in the 2001 International Treaty on Plant Genetic Resources (ITPGR), may represent a new instrument to redress the imbalance between farmers and commercial breeders and to set proper economic incentives for the *in situ* conservation and sustainable use of crop genetic resources. However, because farmers' rights in the ITPGR only recognize the long standing and future contribution of farmers in conserving and developing crop genetic resources, they have been regarded by many as a vague and abstract concept (Correa 2000).

Based on Coasean and Pigouvian approaches, different options have been proposed at the national and international level to realize farmers' rights. The Coasean mechanisms favor the definition of property rights as a way for traditional farmers to appropriate the benefits of conservation and uses of landraces. These solutions are grounded on the argument that a clearer definition of property rights will allow parties to bargain. This may reduce externalities and induce a socially optimal balance between private and social costs. A second solution to the market failure is to promote farmers' rights with the creation of national and international funds to directly sustain the farmers who conserve and sustainable utilize plant genetic resources. In this case, the familiar Pigouvian argument applies with the imposition of a levy on breeders profits to create a fund for conservation. As a result, subsidization of traditional farmers' activities is supposed to correct the distortions caused by externalities.

The two approaches have many limitations both in their practical applications and in enhancing *in situ* conservation activities. Arguably, both Coasean and Pigouvian options try to develop profit oriented incentives or compensation mechanisms for farmers' genetic resources, without addressing the traditional farming process that creates and preserves genetic diversity. This process, on the contrary, relies on customary practices of seed saving and exchange, which are based more on mechanisms of reciprocity and cooperation. Jointly with the network-like system of farmers' relations, this makes traditional farmers' breeding and conservation activities closer to a peer organization of production and distribution of germplasm. Based on this assumption, new policies for implementing farmers' rights should be devised in order to strengthen farmers' practices to use and exchange seeds within the traditional seed systems.

2 Externalities and the Public Good Nature of Agrobiodiversity

The social value of agrobiodiversity derives from its capacity to contribute to the agricultural system upon which human societies depend. Because plant breeding relies on the available germplasm to improve crop varieties, the preservation and supply of genetic diversity is crucial to sustain the future agriculture productivity. Indeed, although it is difficult to separate the contribution of breeding activity from the contribution of agrobiodiversity in crop development, the value of germplasm contribution to improved plant varieties seems to be very high (Evenson & Gollin 1997).

There are two broad forms of values which best describe the role of agrobiodiversity: *insurance* and *information* (Swanson & Goeschl 1999). Insurance refers to the value of genetic diversity in providing a broad base of independent genetic assets on which to build agriculture production. Investing in diversity generates a portfolio of different cultivated crop varieties which insures against complete crop failure. Information refers to the uncertainty that exists about the future, and what will be revealed or discovered with the passage of time. In this case, genetic diversity possesses both an option and exploration value. The former represents by the value of retaining the larger choice set of germplasm until environmental conditions change. The latter is the value of retaining the evolutionary processes of varieties for the opportunity to discover new traits and characteristics.

Traditional farming systems are the repository of the greatest amount of agrobiodiversity in the world and farmers have for long directly benefited from and captured the value of genetic diversity they maintained[1].

With the introduction of modern crop development techniques and the rise of a specialized breeding sector, commercial breeders benefit from the available agrobiodiversity but their activity gives raise to a dangerous vicious circle. Plant breeders needs large stock of genetic diversity to create elite commercial varieties that have narrow genetic makeup. At the same time, traditional farmers have incentives to replace their landraces with improved and uniform varieties, reducing the global amount of genetic diversity.

From an economic viewpoint, an externality occurs. Farmers, which conserve genetic diversity in agriculture produce a positive externality, expressed by the insurance and information values of agrobiodiversity. However, commercial breeders do not fully take into account these values, as they are interested in the conversion of traditional farming systems to profitable markets for their uniform and improved crop varieties. Agrobiodiversity is therefore a public good and, as long as the social and private values diverge, underprovision will occur.

Private plant breeders could have the incentive to optimally invest in the supply and use of genetic diversity, but only to the extent that the information and insurance values are appropriable on a time scale relevant to these enterprises. In addition, even if commercial plant breeders could indirectly internalize part of these values through the protection and commercialization of improved crop varieties, no direct mechanism would automatically exist at the farmer level to capture the benefits from genetic diversity conserved in the field (Swanson & Goeschl 1999).

3 History and Rationale of Farmers' Rights

The concept of Farmers' Rights has not been originally conceived as a remedy to externalities, rather it has been first used in the political debate as a proposal to balance the emerging exclusive rights over crop genetic resources (Andersen 2005, Girsberger 1999). Nowadays, commercial breeders can protect their new and improved plant varieties with forms of intellectual property rights, especially plant breeders' rights and patents.

Intellectual property rights for new plant varieties are generally justified on the ground that they provide necessary and legitimate returns on investment in

[1] Traditional farmers are expected to maintain high level of genetic diversity as an insurance for their annual food subsistence and income. Planting crops with heterogeneous genetic makeup allows to secure yield stability because genetic diversity may buffer against environmental variation (climate, soil conditions, pests). In addition to this supply-side argument, there is also the demand-side impetus for retention of genetic diversity. The primary reasons why farmers would demand diverse resources would be attributable to locally-evolved preferences and/or micro-environments (Almekinder & Louwaars 1999, Cooper 1993).

breeding and biotechnological research. In any case, modern plant breeding today still relies on the availability of plant genetic resources that are the result of enormous efforts towards conservation, selection and improvement of domesticated plants over centuries by rural communities that go unrewarded. Thus, there is a fundamental asymmetry between rewards accruing to genetic resources that form the basis of development of new varieties and rewards accruing to new varieties that are the products of research (Esquinas Alcazar 1998).

During the debates held in FAO fora during the 1980's, developing countries argued that if industrialized countries demanded recognition of plant breeders' rights they should be prepared to recognize farmers' rights as well. In a compromise, farmers' rights were first enshrined in 1989 in two FAO resolutions on the interpretation of International Undertaking on Plant Genetic Resources (IUPGR), a non binding legal instrument whose primary intent was to promote the free exchange of plant genetic resources.

During the 90's, the rising concern for genetic erosion and the need for conservation strategies added a new layer to the political debate over plant genetic resources. Because modern plant breeding relies on the existent stock of germplasm as input, maintenance of agrobiodiversity and conservation of genetic resources is of huge value to sustain any future crop development and improvement[2].

The 1992 Convention on Biological Diversity (CBD) and the 1996 FAO "Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture are indicative of the global efforts to cope with the loss of biodiversity. In this context, farmers' rights, which remained till that time a loose concept in international law with no practical application, gained new life. Could farmers' rights be linked to the conservation strategies supported by the great international consensus, then they would have gained a greater recognition and a solid ground for practical realization. The conservation rationale behind farmers' rights lies in the fact that they can provide a framework within which traditional farmers can appropriate some of the global values of agrobiodiversity, thus creating a structural incentive for the retention of plant genetic resources (Srinivasan 2003, **?**).

Farmers' Rights were eventually introduced in the 2001 FAO International

[2]In the mid of XXth, the need for conservation was already addressed with the creation of national and international gene banks in which many landraces and wild relatives were stored. However, as commercial agriculture is spreading , the flow of useful germplasm from farmers' fields towards genebanks is decreasing (Pistorius & Van Wijk 1999). As a result, *ex situ* conservation nowadays is just a short-term solution to sustain future crop improvement. *In situ* and *on farm* conservation are increasingly regarded as a complementary and necessary option. Allowing germplasm to co-evolve with the changing ecological conditions contributes to sustain the long term development of new plant varieties and the dynamic resilience of the crops' system (Wood & Lennè 1997).

Treaty on Plant Genetic Resources (ITPGR), a binding international agreement, which also sets up a multilateral system of facilitated germplasm exchange among the contracting parties[3]. In the ITPGR, the notion of Farmers' Rights follows the unclear formulation adopted in previous FAO resolutions, as it simply recognizes the long standing and future contribution of farmers in conserving and developing crop genetic resources. The Treaty does not provide any substantive definition of farmers' rights insofar as the protection at the international level is concerned. It only makes explicit some measures that national governments should address in priority. These mainly includes the protection of traditional knowledge and the right to participate in benefit sharing arising from the utilization of genetic resources. Further, the controversial rights of farmers to save, use exchange and sell farm-saved seed are just protected to the extent that national law does not differ from the provisions of the Treaty.

The realization of farmers' rights rests with national governments, which are encouraged to promote them, as and where appropriate[4]. This flexibility for contracting parties is necessary to manage the complex and practical issues concerning farmers' rights, but it also sheds light both on the lack of consensus for a definition of such rights at the international level and on the confusion surrounding the possible options for the implementation(Blakeney 2002).

As I contend next, all the proposed options may be classified in either Coasean or Pigouvian approaches to reward farmers in order to solve the public good dilemma which characterizes the conservation of agrobiodiversity in traditional agriculture. Indeed, so far farmers' rights have been mainly conceived as a tool for implementing benefit sharing mechanisms (Biber-Klemm, Cullet & Kummer Peiry 2006).

4 Coasean Approaches

Coasean approaches try to correct the inefficiencies caused by the externalities with a better definition of property rights within a decentralized system of interactions. Establishing property rights on farmers' varieties should allow local communites to capture part of the agrobiodiversity value by devising incentives for the conservation of precious genepools. Two main mechanisms have been suggested: 1) *sui generis* intellectual property rights systems for the protection of farmers' va-

[3]For a detailed overview of the Treaty see (Moore & Tymowsky 2005).

[4]At the moment, the main national legislations which provide a comprehensive implementation of Farmers' Rights are India's Act N. 53 for "The Protection of Plant Varieties and Farmer' Rights" (2001) and the Organization of African Unity's "African Model Legislation for Protection of Local Communities, Farmers and Breeders and for the Regulation of Access to Genetic Resources" (2000)

rieties and 2) farmers' rights as "access rights", which enable the development of contracts for biological prospecting between local communities and commercial breeders.

4.1 Farmers' Rights as Sui Generis Intellectual Property

Granting intellectual property rights is a familiar method for internalizing positive externalities. Innovators invest in the research and development of new products which benefit the society as a whole. If one assumes low transaction costs, intellectual property rights make innovators internalize part of the positive spillovers by using the protected innovation for commercial purpose or by licensing those rights, whenever it is economically efficient to do so.

Defining crop genetic resources within farmers' varieties as a form of intellectual property has a certain appeal (Swaminathan 1996). Farmers may be regarded as innovative breeders, who not only maintain landraces and wild relatives in their fields, but also are able to select and experiment new crop varieties through traditional breeding techniques[5]. Farmers' rights as intellectual property are normally introduced in national Plant Variety Protection (PVP) legislation, jointly with plant breeders' rights[6]. This form of protection is provided in the expectation that the beneficiary communities will be able to derive royalties from the protection of their varieties in the same way as commercial plant breeders derive royalties from protected varieties.

However, within the existing intellectual property system several factors weaken this proposal. The main concerns refer to the identification of right holders and the definition of requirements for the protection of varieties.

The attempt to confer IPRs on varieties clashes with the feasibility of identifying specific communities or individual farmers to whom the development of individual varieties can be attributed. In order to be effective, IPRs need to be assigned to clearly defined legal entities that can coherently exercise these rights. However, traditional varieties may be spread over large and dispersed areas, used by several communities located even in different countries (Biber-Klemm 2006).

With regard to requirements, conventional PVP systems protect "new" varieties that are "Distinct, Uniform and Stable" (DUS). If farmers' varieties are to be protected under a *sui generis* system, then looser requirements need to be defined (Srinivasan 2003). This is necessary because farmers' varieties tend not to be homogeneous and loses over time the very characteristics that identify them.

[5](Louwaars, Salazar & Visser 2007), for example, present several cases of farmers' bred varieties that have been broadly adopted and cultivated in different regions

[6]The minimum *sui generis* regime required by Art. 27(3)(b) TRIPs for the protection of plant varieties provides indeed room for introducing farmers' rights in PVP and Sui generis legislation, allowing developing countries to comply with the WTO agreement.

For instance, some proposals have suggested to replace the DUS requirements with the Distinctiveness and Identifiability (DI) requirements (Leskien & Flitner 1997). Even if this approach leaves considerable flexibility, it leads to broader property claims than under classical PVP legislation. Such expanded claim should in turn be balanced with a lower standard of protection. As a consequence, because the cost for claiming the rights may well outweigh the benefits derived from a weaker protection, the new *sui generis* regime risks to be unattractive or worthless for the potential right holders.

It is also doubtful whether farming communities can actually derive any rent from the protected varieties if they are not able to enforce the rights granted by the *sui generis* system. On the contrary, the incentive to share seeds among farmers would be influenced by the ability to claim ownership rights over farmers varieties. When it becomes possible for farmers to register their varieties they would have greater incentive to charge for use of the variety rather than giving it away freely to other farmers. Because the transaction costs in this context seem high in comparison with the value of crop varieties, the flow of germplasm exchange will be negatively affected (Ramanna 2003).

4.2 Farmers' Rights as Access Rights

A second mechanism that could be adopted for the realization of farmers' rights is to grant farmers the control over the access and use of the genetic resources found in their fields (Brush 1998). This solution entails a defensive legal protection for genetic resources as compared with the positive protection entailed by an intellectual property regime (Dutfield 2004). In this case, farmers' rights would be linked to the national legislations implemented in accordance with the CBD to regulate the access and sharing of benefits deriving from *in situ* genetic resources. The main justification for this approach is to prevent the misappropriation of germplasm by commercial breeders and to stimulate the development of bioprospecting contracts[7].

Bioprospecting is based on a Coasean bargaining that should internalize the external effects caused by farmers' maintenance of agrobiodiversity, whenever transaction costs are sufficiently small. It establishes a contracting mechanism to transfer some of the social value of agrobiodiversity into private benefits through contracts between germplasm providers and plant collectors.

As there are many factors limiting the realization of farmers' rights through

[7]Bioprospecting was suggested as a recommendation to fulfill the 1992 CBD by the *Global Biodiversity Strategy* (WRI, IUCN & UNEP 1992). As farmers' rights were introduced in the ITPGR possible synergies have been proposed between farmers' rights and the CBD Art. 8(j), related to the protection of traditional knowledge of indigenous and local communities. See documents UNEP/CBD/COP/6/WG.II/CRP.9/Rev.1 and UNEP/CBD/COP/VII /Inf. 18.

protection of farmers' varieties, with the same vein, there exist limitations to adopt farmers' rights as a tool for promoting bioprospecting agreements.

The relevance of transaction costs and incomplete or asymmetric information in bioprospecting agreements are likely to yield to a suboptimal provision of bio-contracts. On one hand, transaction costs may be relevant because genetic resources can be considered as experience goods, for that the germplasm value can seldom be determined a priori but only observed a posteriori (Trommetter 2005). Difficulties in the measurement of the resource value, conservation costs and benefits from germplasm access are reasons for the failure of signing bilateral contracts (Dedeurwaerdere 2005). On the other hand, asymmetric information between provider of genetic resources and user may lead to reciprocal moral hazard (Richerzhagen & Virchow 2002).

Another set of criticisms focus on the supply and demand side of farmers' genetic resources. On the supply side, if each local community was entitled the control over its genetic resources, farmers' rights would exist in a "monopsony" environment (Mendelsohn 2000). Indeed, farmers' varieties are normally spread among many local communities and also across national boundaries, while seed companies interested in germplasm collection are more limited in number. This makes farmers with genetic resources face an extremely limited set of potential "buyers" for their resources, leading to a market failure.

Looking at the demand side of genetic resources, local communities are not likely to receive great financial rents for their conservation effort. The total value of agrobiodiversity conserved in farmers' field may be high as a source of leads in the development of new crop varieties. However, bioprospecting plant breeders will only consider the value of the marginal variety with respect to its potential use for breeding. In this case, the value is likely to be low (Simpson & Sedjo 1998). If there is a wide number of potential germplasm sources from farmers' varieties, with approximately the same prospect of success and the same testing cost, all the genetic resources in farmers' fields are expected to be close substitutes. When numerous substitutes exist, the marginal value and the corresponding price of each will be low. Moreover, the demand for farmers' varieties may be even more reduced because at the moment seed companies either have a strong preference for well known "elite" germplasm or they can access landraces and wild relatives held in public genebanks. Biotechnology applications also enable alternative sources of germplasm and thus undercut the demand for crop specific germplasm (Brush 2004).

Finally, bio-contracts may not be considered as a proper conservation mechanism. From a seed company viewpoint, the need for *in situ* conservation expires once the resource is incorporated in the new crop variety. As a result, the limited duration of contracts is not likely to sustain long-term conservation incentives

(Barrett & Lybbert 2000). If in turn bioprospecting agreements involve continued access for a certain period, the period of the contract will reflect the time horizon of the parties (especially of the bioprospecting plant breeder), which is likely to be shorter than the social time horizon related to the need for agrobiodiversity conservation (Swanson & Goeschl 1999).

5 Pigouvian Solution

The Pigouvian solution calls for regulatory intervention with forms of taxation and subsidization apt to correct the externalities of human activities. Unlike Coasean approaches, this solution conceives intervention by a central authority as an appropriate tool to solve the market failure. The realization of farmers' rights in this case involves setting up centralized funds to reward farmers for the *in situ* and *on farm* conservation activity. In turn, such funds are mainly collected through a levy on the profits made by private plant breeders through the commercialization of their protected plant varieties. This system will be mainly implemented at the national level, but it is expected that also at the international level a similar fund will be realized under the FAO ITPGR[8].

The Pigouvian approach has a certain appeal because it supposedly reduces the transaction costs that highly affect the Coasean mechanisms in building a market for farmers' genetic resources. The realization of farmers' rights in such a way would lead to significant economies because of the centralized administration of the system. Farmers' rights would be managed by an authority which would set up the level of royalties and the distribution of the benefits among local communities financing conservation programs. Transaction costs would then be reduced because no decentralized bargaining over genetic resources occurs and the monitoring and enforcing costs would be handled by the central authority. Likewise, the subsidies distributed through the central fund would reward farming communities for the conservation of agrobiodiversity, so sustaining the supply of genetic resources.

Also in this case, several obstacles may pose operational problems to this approach. A first concern refers to the amount of funds that can be generated through the taxation system. Royalties assessed as a percentage of profits from seed sales of protected plant varieties constitute a narrow base for resource generation (Falcon & Fowler 2002). In addition, while fees collected to generate the conservation fund are expected to be low, on the other hand, the administrative costs of implement-

[8]Indeed, the new treaty envisages an international fund, used to support farmers who conserve and sustainably utilize crop genetic resources. The fund will be financed with the royalties accrued by the profits from the commercialization of plant varieties which incorporate material from the multilateral system. In the first meeting of the Governing Body in 2006 the share of compensation from the commercialization of products was set at 1,1% of the selling price

ing such a levy system would probably be high, as it would involve monitoring variety-wise sales/profits at the national and international level for all protected varieties over their lifetime. It appears, therefore, that conservation funds will have to rely on other sources, like on budgetary appropriations from governments or international donors. Nevertheless, relying only on governments' willingness to invest in agrobiodiversity may be a bad solution as well. Collective action problems for coordination among countries will undermine the supply of the optimal global level of agrobiodiversity. Governments will eventually underinvest in *on farm* conservation programs because this generates global positive externalities to the remainder of the world (Swanson et al. 1994).

A second and more general concern refers to the measurement both of the external effects to be corrected and of the public good value of agrobiodiversity. How much commercial breeders should be taxed in order to compensate farmers' contribution of useful genetic material? While with Coasean mechanisms the value at stake emerges through market transactions, the Pigouvian approach relies on a collective choice mechanism to estimate the level of the compensation. However, it is quite optimistic to assume that a central authority is able to gather all the necessary information and assess in monetary value the contribution of farmers varieties to breeding and the cost for the optimal conservation level.

Further, even if measurement and administrative costs may be sustained, new obstacles are likely to arise with the distribution and management of the funds to initiate conservation programs With scarce resources and several local communities or agrobiodiversity rich areas to subsidize, rent seeking behavior is likely to emerge. Farmers movements and NGOs may be willing to mobilize to capture such funds. This is likely to lead to rent dissipation and to reduce the allocation efficiency for investments in conservation programs, as far as stakeholders may capture the central authority (Buchanan, Tollison & Tullock 1980, Stigler 1971).

6 A Stewardship Approach to Farmers' Rights

The analysis of the options proposed to implement farmers' rights has shown several limitations of both Coasean and Pigouvian approaches to reward traditional farmers and to provide incentives for their *in situ* conservation activity. This part provides the theoretical ground for a more effective proposal to realize farmers' rights and to create incentive for the sustainable use and conservation of genetic resources. Traditional farming systems – with practices of seed saving and exchange based more on reciprocity and cooperation – should be seen as a form of social sharing for germplasm production and distribution, which in turn enhances crop genetic diversity. Because neither market approaches nor Pigouvian solutions are wholly appropriate to support this system, I explore the option and the economic implications to realize farmers' rights through a "stewardship approach" which fosters the traditional farmers' organization of germplasm production and distribution.

6.1 Traditional Farmers and Seed Social Sharing

Many agro-ecological studies have acknowledged the role of traditional farming systems in maintaining and fostering *on farm* crop genetic diversity (Almekinder & Louwaars 1999). Local and informal seed systems, in opposition to the formal model of seed production and distribution by public institutions or private seed companies, are characterized by customary practices of seed management which have long sustained agrobiodiversity.

Traditional farmers do not usually obtain their seed requirements from external sources, but they save seeds. Some estimates account that in developing countries the use of traditional varieties ranges from 20% to 50% according to the type of crop and in many parts of Africa and Asia it is estimated that over 80% of farmers' seed requirements are met from outside the formal sector (Byerlee 1996, Ten Kate & Laird 1999).

In addition, farmers can conduct their own varietal selection and testing in order to experiment and adapt crop varieties to the local ecological conditions. At the community level, farmers' breeding is often a collective effort. Farmers who experiment new varieties provide material to their communities, and often need the involvement of their fellow farmers since they do not possess sufficient land and time to manage the trials on their own land. Once distributed, materials are monitored and inspected and interesting breeding lines might be redistributed for follow-up experimentation (Louwaars et al. 2007).

Farmers' collective breeding is sustained by the exchange of seeds, which does not occur as a bilateral impersonal market transaction following a profit oriented scheme. On the contrary, it is grounded on mechanism of reciprocity and cooperation[9]. Indeed, traditional seed systems are mostly based on social and family relations, cast in the context of mutual interdependence and trust, often forming dynamic networks with a high degree of complexity. Saving and freely exchanging seeds in a community are therefore key elements to introduce and adapt plant varieties to local conditions and to preserve the vitality of the crops across their different generations (Louette 1999). This is true both for landraces and for commercial improved varieties. Indeed, farmers expose improved varieties to the ecological conditions of their fields, continually select seed of these varieties for

[9]Although in some case studies on farming communities it has been highlighted that seed exchange is based on the sale and purchase of seed, interviews confirm that this is not done for profit but out of a sense of social obligation (Badstue, Bellon, Berthaud, Ramirez, Flores & Juarez 2007).

replanting and, in some cases, promote their hybridization with landraces. This activity eventually produces "creolized" varieties, which have a more heterogeneous genetic makeup as compared to the parental lines, and contributes to the vigor of improved varieties (Bellon, Adato, Becerril & Mindek 2006).

In this context, seed saving and exchange among farmers tends to operate in a decentralized and non-market system, that can be defined as a form of "social sharing" of seeds (Benkler 2004). Jointly with the network of farmers relations, seed social sharing makes farmers' breeding close to a commons based peer production and distribution of germplasm. According to (Benkler 2002), commons based peer production relies indeed on sharing resources and outputs among widely distributed, loosely connected individuals who cooperate with each other withinin a decentralized, collaborative and non-proprietary framework.

Because commons based peer-to-peer organization is an emerging model of production in the digital information economy, the same arguments used to prove peer production viability in the digital environment may be adapted to traditional farming systems (Srinivas 2006). Genetic material embedded in seeds may be considered an information product. Farmers who breed and adapt new varieties may therefore be seen as germplasm producers who share their outputs with the other connected farmers in the local community networks. The "common" feature of farmers' peer organization comes indeed from the fact that the seed exchange is basically free, without any restriction on access and distribution.

Moreover, (Benkler 2002) highlights some basic conditions which are emerged to make peer-production economic viable: first the production system relies on information goods as output and input; 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 such conditions apply to digital networked environments, where individuals using interconnected PCs share and produce information, it is not hard to find analogies with the information goods represented by genetic resources embodied in seeds.

First, the breeding activity by farmers represents a production system whose primary input is the existing germplasm embodied in seeds (or plants) and the final output is new information in the form of genetic material embodied in plants. Second, the cost of production of new germplasm seems to be low as farmers simply select the genetic resources whose phenotypic expression fit the desired traits that come out from the natural genetic variation. Third, the environmental conditions in which 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, because seeds are highly moveable and replicable, the cost of exchanging germplasm embodied in seeds is low. Moreover, Farmers' contribution to the development of new varieties seems also to be very modular[10] and granular[11]. The cumulative breeding process in local communities is well spread among different farmers' fields and the seed exchange allows to integrate the various breeding efforts as new genetic material obtained by experimentation is redistributed among farmers.

Crucially, it is noted that also the incentives for participating to commons based peer production may diverge from the standard economic benefits of producing information. In this context, a set of indirect benefits and social rewards have been highlighted as the main factors for motivation. Indirect benefits, like hedonic gains or peer-reputation may improve rather than reduce people performance (Lerner & Tirole 2002). With regard to social incentives, psychological and anthropological literature stresses that the weight a society put on social and economic rewards is a function of the cultural values associated with the actions (Hann 1998, Fehr & Falk 2002, e.g.). Economic factors are not the unique forces to determine benefits and costs of actions. On the contrary, social norms contribute in shaping different costs and benefits for individuals transactions. As a result, organization of activities in different cultural contexts may not follow the same economic and social set of incentives.

In the case of traditional collective breeding, farmers mainly obtain indirect economic benefits in agriculture from growing the varieties they have developed and adapted. Because traditional farmers often directly use the product of their breeding experiments, they have incentives in finding specific solutions to develop varieties which fit the ecological conditions of their fields. At the same time, peer social recognition within farmers' community in seed management may equally represent an incentive mechanism (Badstue et al. 2007). Traditional farming systems are also likely to express an institutional and cultural context where socio-psychological rewards matter more than economic rewards. In this case, sharing or other forms of non-market cooperation among community members is widespread and social institutions and attitudes are more readily available to support a system of seed sharing (Dennis, Ilyasov, Van Dusen, Treshkin, Lee & Eyzaguirre 2007) .

6.2 Coase, Pigou and the Social Sharing Mismatch

Analyzing traditional farming systems and comparing them to a form of seed social sharing provides a useful point of departure to discuss new options for the realization of farmers' rights. Both the approaches focus on the public good dilemma

[10]Modularity is a property of a project referring to the extent to which it can be broken down into smaller components, or modules, that can be independently and asynchronously produced before they are assembled into a whole.

[11]Granularity refers to the size of the modules, in terms of the time and effort that an agent must invest in producing them.

	Market	Non Market
Decentralized	**Price**	**Social Sharing**
Centralized	**Firm**	**Taxation**

Table 1: The Social Sharing Box

of agrobiodiversity erosion and implicitly assume that the supply of genetic diversity from farmers' fields serves the needs of a specific crop development paradigm. This paradigm relies on a specialized breeding sector which develops and delivers new varieties. The main proposals thus follow a "reward approach" where farmers are expected to be compensated or subsidized for the genetic resources conserved in their fields. As a consequence, the risk is to misconceive agrobiodiversity rich systems and see them just as passive "mining areas" to be conserved for future exploitation by modern plant breeders.

On the contrary, considering informal seed systems as a form of social sharing highlights the dynamic function of traditional farmers in enhancing agrobiodiversity. The proposals based on Coasean and Pigouvian arguments are therefore limited to the extent they consider the dynamic maintenance of agrobiodiversity by farmers as a non rewarded externality. Arguably, they fail to consider agrobiodiversity enhancement as a product of farmers' practices and do not address farmers' incentives in saving and exchanging seeds.

Table 3.1 elaborates this point, presenting how production and exchange activities are organized. Leaving aside the Firm case, which follows a centralized and hierarchical model of production supported by market exchange, all the other boxes are relevant for our analysis.

Coasean approaches bet on markets, on the decentralized price mechanism for exchanging farmers' genetic resources and compensate farmers for their conservation activity. Pigouvian solution, in turn, is based on a centralized and non market mechanism whereby *on farm* conservation is subsidized through a taxation system. It is clear that the two approaches do not cover a third box of interactions, which has been suggested to characterize farmers' seed system. This box is where social sharing occurs as a decentralized, peer-organized production mode, which in turn relies on cooperative and reciprocal mechanisms for exchanging and producing resources.

In addition, considering that these approaches are more oriented to monetary incentives for the conservation of agrobiodiversity, there is the risk that these reward oriented mechanisms may erode or crowd-out the social-psychological incentives that traditional farmers express in the seed social sharing system. The risk is relevant to the extent social and economic incentives are negatively correlated (Dedeurwaerdere 2005, Frey & Oberholze-Gee 1997).

6.3 Implementing the Stewardship Approach

Identifying seed social sharing in traditional agricultural systems calls for a reconsideration of the measures to implement farmers' rights. In this perspective, a "stewardship approach" to realize farmers' rights would enable farmers to continue as stewards of agrobiodiversity within traditional agriculture systems. The idea is that the legal space required to continue this role must be upheld with measures that enable the practices of seed saving and exchange. This does not necessarily mean that a mix of strategies that include neo-proprietary and taxation-subsidization options is to be discharged. On the contrary, the mechanisms devised by such options could provide where appropriate economic benefits to farmers which otherwise would replace landraces for commercial varieties.

However, it is also worth to note that in many developing countries commercial and traditional seed systems coexist. As a consequence, the expanding legal framework adopted to foster the activity of commercial seed companies may hinder the social sharing of seeds by traditional farmers.

First, seed regulations, with the aim to foster seed quality and varietal identity of the seeds, tend to favor the formal seed sectors in the production and distribution of seeds (Jaffee & Srivastava 1992). Certification of seeds and registration of new released varieties are granted subject to requirements that usually only improved or commercial varieties could comply with[12]. As a result, formal regulations are often inappropriate for farmers' varieties, which have been developed locally and hardly fit the criteria for registration and certification. In this case, not only could seed regulations restrict informal seed systems, in some cases farmers initiatives could be declared illegal. Indeed, farmers may be deemed liable for exchanging seeds of local varieties that are not certified (Louwaars 2000).

Second, intellectual property rights over crop varieties may restrict the social sharing of new improved varieties in farmers' networks. When traditional farmers access the formal seed sector, they may satisfy a demand for experimentation. This may be especially true in Participatory Plant Breeding (PPB,) which is an

[12] Such laws require the certification of seeds for quality control and the registration of the new released plant varieties. The registration is granted if the plant variety complies with DUS criteria (the same of Plant Variety Protection legislations) and demonstrates "value in cultivation and use" (VCU). For a detailed discussion of this topic see (Tripp & Louwaars 1997).

emerging practice involving farmers and specialized breeders (Almekinder 2000). Once a new variety is introduced in this system, it is likely to be the source of new locally derived varieties which may represent a treasure of genetic information for future breeding. On the contrary, commercial breeders are more interested in the private and present benefits of making farmers regular purchasers of their seed bags. In this context, seed saving and exchange are just as free riding, because farmers can easily copy and distribute seeds of protected plant varieties.

Because seed regulations and IPRs may strongly restrict farmers' practices in the informal seed systems, measures should be adopted to uphold customary rights of farmers to save, share and use seeds within a non commercial, non profit context. This is particularly relevant in areas where genetic diversity is high and farmers find profitable to use local varieties through customary practices of seed saving and exchange. In this way, the recognition of farmers' practices would support the farming communities that are the "least cost" candidates for conserving agrobiodiversity (Smale, Bellon, Jarvis & Sthapit 2004).

A first set of measures should address a relaxation in seed laws to take into account local communities' needs to exchange traditional and farmers' varieties. This issue has been tackled by way of some national initiatives like in Switzerland and Brazil[13] where seed laws allow for traditional varieties and landraces to be marketed or exchanged without being registered or certified in the conventional way as long as they satisfy regular quality controls or bear a special label. Nevertheless, in some cases clearance is necessary from the government and the quantities of seeds distributed can be restricted[14].

It is interesting to note how this option creates a parallel system of seed production and distribution out of the formal seed system of improved and certified varieties. Indeed, it seems to address the social sharing box of farmers' system rather than the market box in which formal seed sector operates. For instance, unlike commercial breeders, users of traditional varieties do not enjoy any form of exclusive rights over the variety. Further, while there can be restrictions to users of traditional varieties for the marketing of their seeds, access and "exchange over the fence" of seeds would be permitted for the benefit of other farmers engaged in the same sort of activity. This can be regarded as a way to legalize farmers' practices where reciprocal and cooperative exchange is more relevant than the profit oriented scheme of seed marketing.

The relaxation of seed laws seems to be suited for traditional varieties and

[13]For Switzerland, see RS 916.151.1 "Ordonnance du DFE sur les semences et les plants des espces de grandes cultures et de plantes fourragres". For Brazil see "Lei no 10.711" – Dispoe sobre o Sistema Nacional de Sementes e Mudas.

[14]With a similar vein, EU Directives n 98/95 and 98/96 provide to expand the EU Common Catalogue for registered varieties in order to encompass landraces that will be defined as "conservation varieties".

landraces, but it does not cover the case wherein traditional farmers use modern protected varieties for experimental purpose. As a result, a second measure to realize farmers' rights should guarantee a legal space for the seed social sharing of modern and protected varieties. The goal would be to achieve long term benefits by sustaining agrobiodiversity through local adaptation and diversification of modern cultivars. The "farmer privilege", which was originally used in many PVP legislations to define the rights to save, exchange and use farm-saved seeds of protected varieties, may serve this goal. UPOV[15] 1978 model for PVP legislations, for example, only addressed commercial seed sale and did not include restrictions on seed saving or (non-commercial) seed exchange among farmers.

However, there are today signals which indicate the willingness to restrict the "farmer privilege" especially in developing countries, as national governments are increasingly adopting the new UPOV 1991 model , where "farmer privilege" has become optional or only related to seed saving. In addition, recent discussions in the International Seed Federation (ISF) suggest that in the next revision of UPOV Convention the use of farm-saved seed will be totally dismissed (GRAIN 2007). As a consequence, the "farmer privilege" should be revitalized and framed to fulfill the agrobiodiversity conservation goal. Farmers' rights should entail a more comprehensive immunization from patents and plant breeders' rights infringement actions on behalf of non commercial, non profit and cooperative seed exchange.

Of course, the main problem is to define the boundaries between virtuous seed social sharing within farmers' networks and the mere practices of unauthorized seed sales, that would be an infringement. In analogy to copyright law doctrines, there should be a fair use defense from infringement claims, insofar the seed saving and 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. However, the extent to which it is possible to define seed exchange as "traditional" and to consider the use of seeds of protected varieties "in competition" with the holder of the rights may be very questionable and requires some further specification.

According to the economic analysis of copyright law, fair use should be awarded in a copyright infringement under three conditions: (1) when the potential infringer could not appropriately purchase the desired use through the market; (2) the use serves the public interest and social welfare and (3) the right holder's incentives would not be substantially impaired from the use (Gordon 1982).

The first two points are straightforward in applying the fair use defense in the farmers' rights context. Once obtained material from protected varieties, farmers

[15] Union for the Protection of New Varieties of Plants (UPOV) was established in 1961, and most industrialized countries, and a growing number of developing countries, are members of an UPOV Convention

need to save and exchange seeds in order to develop new varieties that cannot be acquired directly in the market. Furthermore, this form of use addresses the public interest for agrobiodiversity conservation through adaptation and genetic diversification of modern varieties. The third point is the most tricky to solve because of the necessity to balance commercial breeders' interests with traditional farmers' activities.

Seed saving and exchange activities made for experimentation should be differentiated from these occurring in order to achieve significant cost savings in agricultural production[16]. Given that it may be difficult to monitor and define the farmers' practices as experimental use of seeds, some proxies may be used. These proxies could entail a maximum threshold of seed saving and exchange, a threshold for farm size or income level to identify traditional farmers or a mix of both. [17]. Alternatively, governments may differentiate between crops that are distributed through commercial channels and crops that are mainly used by small scale farmers.

7 Conclusion

The article has focused on the different options to realize farmers' rights. The main rationale of farmers' rights is to generate incentives to conserve genetic diversity *on farm* and to balance the emergent exclusive rights over crop genetic resources which benefit the private breeding sector. Current proposals follow both Coasean and Pigouvian approaches, which try to solve the public good dilemma generated by traditional farmers in supplying agrobiodiversity. However both these approaches do not address the very nature of traditional farming systems as stewards of agrobiodiversity.

Indeed, traditional farmers are likely to act in a social sharing system where they save and share seeds following reciprocal and cooperative mechanisms. As a system of peer production and distribution of germplasm, seed social sharing may be regarded as an alternative way to develop crop varieties and dynamically sustain crop genetic diversity. The straight implication of this reasoning is that a different approach to farmers' rights should be considered. Governments must

[16]The private breeding sector recently complained that for just 18 countries surveyed, seed saving and exchange represent an average loss of about 7 billion US dollars annually. See (Le Buanec 2005). If the figures are correct this may imply the reduction of private sector incentives for plant variety development. In any case, such figures may be overestimated. Indeed, there are economic arguments to sustain that seed companies will indirectly capture all economic rents charging higher prices on the seeds, which reflect the future losses due to farmer seed saving. See (Le Roy & Knudson 1996).

[17]In some PVP legislations the "farmer privilege" is framed in this way. However, in many cases, only seed saving is permitted and not the exchange. See (GRAIN 2003).

undertake actions in order to sustain the social sharing of traditional farming systems. These measures should strengthen farmers' practices of seeds saving and sharing through a relaxation of seed regulations and an immunization from patents and plant breeders' rights infringement actions on behalf of non commercial, non profit and cooperative seed exchange.

Because farmers' rights are at stake for many developing countries, some concerns may be highlighted regarding the barriers to implement such rights in the proposed form. A first concern refers to the lack of awareness that even traditional farmers may feel regarding their rights over the seeds. Indeed, farmers are likely to not perceive the changing institutional conditions that in the long term may restrict their customary practices. As a result, investment in human capital oriented toward the appreciation and preservation of agrobiodiversity may be necessary to foster the conservation and utilization of genetic resources managed by farming communities (Brush 1998). In addition, the prevalent lack of monitoring and implementation capacity of conservation-related policies in many developing countries represents a second issue. Monitoring is necessary for both lawmakers and farmers in order to evaluate how incentives devised by legislations contribute in enhancing genetic diversity. Capacity building in turn is needed to implement the administrative infrastructure and a funding structure to support such activities is a necessary instrument for this purpose. Moreover, politicians in these countries may be unwilling to implement policies promoting farmers' local seed systems, especially if commercial seed companies and agribusiness industry have substantial influence over politics.

A final concern refers to the national boundaries for the realization of farmers' rights as a measure to sustain genetic diversity. Agricultural biodiversity is a global public good but it is unevenly distributed among the countries of the world and the centers of diversity of major food crops are in developing countries. In turn, almost all the countries are interdependent in their demand of plant genetic resources to sustain their agricultural sectors. As a result, developing countries with rich agrobiodiversity areas for specific crops should be considered as sensible targets for genetic erosion and therefore supported at the international level to realize and enforce farmers' rights.

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