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FARMERS' RIGHTS AND PROTECTION OF TRADITIONAL AGRICULTURAL KNOWLEDGE

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ABSTRACT

Although achieving *in situ* conservation is possible without changing farmers' customary management of crops as common pool resources, an alternative approach is to negotiate a bioprospecting contract with providers of the resource that involves direct payment and royalties. This bioprospecting mechanism implies a change in the customary treatment of crop genetic resources as common pool goods and is in line with national ownership mandated by the Convention on Biological Diversity (CBD). This paper questions the value of bioprospecting for protecting traditional agricultural knowledge and argues for a common pool approach. It examines the nature of crop genetic resources and farmers' knowledge about them, and it analyzes the nature of the 'common heritage' regime that was partly dismantled by the Convention on Biological Diversity. The paper reviews the implementation of access and benefit sharing schemes under the CBD and discusses programs to recognize Farmers' Rights that have arisen since the establishment of the CBD. It concludes with recommendations for meeting the Farmers' Rights mandate of the International Treaty on Plant Genetic Resources for Food and Agriculture.

Keywords: genetic resources; collective action; bioprospecting; conservation

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Farmers' Rights and Protection of Traditional Agricultural Knowledge[1, 2]

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1. INTRODUCTION

Crop genetic resources are the result of collective action over many generations of crops and farming people: shared knowledge, seed exchange, and the accumulation of valuable traits in crop populations. The collective action that has generated this knowledge and resource is informal, decentralized, permeable, and protean, and the resulting resources have conventionally been treated as common pool resources that are freely exchanged and not monopolized by any one person or group. Approaches to conserving genetic resources and farmer participation in continued crop evolution include increasing the demand for traditional crops by farmers and consumers (Smith et al. 2001), enhancing the seed supply of those crops (Bellon 2001), and mechanisms to negotiate a monetary value for genetic resources (Ferraro and Kiss 2002). While achieving *in situ* conservation is possible without changing farmers' collective action practices, an alternative approach is to negotiate a contract with providers of the resource that involves direct payment and royalties (Reid et al. 1993). This bioprospecting mechanism implies a change in the customary treatment of crop genetic resources as common pool goods and a shift toward establishing property for biological resources and traditional knowledge. The issues addressed here are the (1) efficacy of replacing collective action without local property with private ownership and (2) the conception of conservation mechanisms that retain a collective action framework for crop genetic resources.

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2. THE COMMON HERITAGE REGIME

Until the end of the last century, crop genetic resources were managed as public domain goods according to a set of practices loosely labeled as "common heritage." Common heritage refers to the treatment of genetic resources as belonging to the public domain and not owned or otherwise monopolized by a single group or interest. An obstacle to understanding and appreciating common heritage is its inherently implicit nature, but roots of the concept are visible in the free exchange of seed among farmers, the long history of diffusion through informal and formal mechanisms, established scientific practices, and the application of the term to other resources in the international arena (e.g., Cunningham 1981). The robust debate about common property (e.g., Kennedy and Michelman 1980) was likely to have triggered the use of the term by crop scientists. Reference to crop genetic resources as a common heritage appeared in the 1980s in association with the establishment of the Commission of Plant Genetic Resources at the Food and Agricultural Organization of the United Nations (hereafter FAO Commission) and the launching of the International Undertaking of Plant Genetic Resources (Pistorius 1997).

Common heritage for plant resources implies open access and non-exclusion to seeds and plants from farmers' fields. Seeds were collected in different ways by consular officers, travelers, missionaries, students, scientists and since the early 20th century by official collecting missions. The latter worked with host government permission and often in collaboration with local scientists, and collections were almost always done with consent of farmers and recognition of the importance of farmers' need for seed and undisturbed fields. Two aspect distinguish collective action for crop resources from other common property regimes described by anthropologists and other social scientists (McCay and Acheson 1987, Ostrom et al. 1994). First crop resources are highly moveable, replicable, and protean in contrast to common pastures and wood lots or to community managed irrigation systems. These characteristics lend themselves to looser and less explicit rules about access to and management of collective resources. Second, crop genetic resources are less encumbered by membership rules than other common property assets which are often "club goods" (Cornes and Sandler 1996) that are openly accessible only to members. Thus, in contrast to groups which are often portrayed in analyses of collective action (e.g., Ostrom et al. 1994), crop genetic resources are the product of *de facto* or quasi-groups, loose assemblages of actors who may or may not perceive themselves as a group. This lack of structure is logically related to the nature of crop resources and their evolution, but it confounds efforts to promote collective action by providing incentives to specific groups of farmers.

The logical foundation of common heritage is in the nature of crop genetic resources, the universal processes of diffusion and dispersal, and the historical practices of reciprocity. Crop genetic resources derive originally from the natural and amorphous processes or crop evolution: mutation, natural selection, exchange, and decentralized selection. Because no person or group controls crop evolution, it is inappropriate for anyone to claim authorship or ownership. Likewise, the tangled history of diffusion and dispersal not only obscure origin, but suggests that all farmers benefit from fluid movement of seed. Farmers who openly provide seed expect to receive it in the same manner, and the same is true for crop breeders.

Neither common property nor common heritage imply a lack of rules governing the use and management of common assets (Ostrom et al. 1994, Brush 1996), a fact that has been often misunderstood (Hardin 1968, Shiva 1997). One implicit rule in common heritage of crop genetic resources is the rule of reciprocity: those taking seeds are expected to provide similar access to crop resources. The flow of seed within farming villages illustrates this reciprocity, but it is also evident in the movement of seed beyond the village and into the international system of collecting and using genetic resources. Reciprocity by plant collectors and breeders is evident in three ways. First, plant collectors who gather material that is freely exchanged within farming communities continue this free exchange with crop breeders everywhere (Shands and Stoner 1997). Second, collectors and crop breeders have historically worked under the ethos of public sector research in which the free dissemination of improved crops and the availability of genetic resources from gene banks represents reciprocity to farmers and countries that provide genetic resources. The wide diffusion of modern crop varieties from international breeding programs is one indication of the extent of reciprocity under common heritage (Byerlee 1996). Third, plant variety protection, the most widely used form of Breeders' Rights, includes farmers' and research exemptions which allow farmers to replant and researchers to reuse certified seed without paying royalties to the certificate holder (Baenziger et al. 1993). The most recent international guidelines for plant variety protection (UPOV 1991) define the breeder's exemption as compulsory but make the farmer's exemption optional. However, even staunchly pro-intellectual property countries like the U.S. have retained the farmer's exemption in plant variety protection. Illustrating the reciprocity principle in practice, Shands and Stoner (1997), enumerate the multiple ways that the U.S. National Germplasm System (NGPS) honors its obligations in the global flow of crop resources. These include donor support to other countries' and international conservation and crop improvement programs, cooperative breeding programs, access to USDA collections, repatriation of germplasm, training, and scientific exchange. The history of exchange bears out the open accessibility of germplasm from the NPGS (Smale and Day-Rubenstein 2002)

The exchange of seed among farmers and the lack of explicit proprietary rules governing specific crop types, traits, or germplasm appear to be common to agriculture before the 20th century, and they remain characteristic of seed management for the large majority of farmers around the world. The occasional prohibitions on the export of seed or plant cuttings, such as the 19th century embargo by Peru and Bolivia on the export of *Chinchona* seedlings (Musgrave and Musgrave 2000) or Ethiopia's more recent embargo on coffee (Fowler and Mooney 1990), cannot be interpreted as negating the custom of treating genetic resources as public goods. The age-old and continuing diffusion of crops through informal and formal mechanisms, without restrictions on the use of progeny, also supports the argument that genetic resources have historically been defined as part of the public domain.

The crop scientists who articulated the idea of common heritage for crop resources had been acculturated in science as a social system without proprietary relations over its basic resources – theories, algorithms, or methodologies – that Merton (1973) described as the "communism of science" in which authorship did not imply exclusive rights. Accordingly, most crop scientists who helped establish the international framework for plant genetic resources worked in public breeding programs that released their products as public goods. Common heritage management of genetic material that is not claimed as intellectual property remains conspicuous at two extremes: (1) in farming communities and (2) in the international gene banks. The exchange of crop material among farmers within and between communities appears to be ubiquitous (Zeven 1999) and perhaps a necessary part of agriculture. Seed exchange is necessitated and promoted by many factors. Seeds have finite viability because of the constantly changing natural environment, especially pests and pathogens. Seed becomes infested with disease organisms, such as viruses. Human tastes are notoriously fickle, especially when reflected in markets. Households lose seed in bad years to rot and vermin. Commingling of genetic material within and among villages occurs on common threshing floors, in the exchange of gifts of seed, wage payment in kind to agricultural labor, through regional trade of commodities and seed, and farmer experimentation (Louette 1999, Perales et al. 2003). This commingling poses a high barrier to any other form of seed management than common heritage.

Common heritage is logical within farming communities where land and other natural resources are communally owned, seed is exchanged or shared, invention is collective, provenance is ambiguous, and natural and artificial selection are intertwined. Because of the transaction costs of proprietary management of seed, common heritage arguably is the best way to satisfy the frequent necessity to change or acquire seed in non-market economies. However, common heritage is also prevalent where ownership of land and other resources are established and where markets for land, labor, and commodities exist. Intellectual property for plants was a rather recent change (Fowler 1994) that lagged far behind the development of markets for land and labor. Plant patenting and other forms of intellectual property in plants has been willingly embraced in some countries but resisted in many others (Khor 1996) because of objections to the ownership of life forms and naturally occurring elements as well as the fear that plant patenting will concentrate ownership of seeds to the detriment of poor farmers. .

The flow of crop germplasm through international gene banks and crop breeding programs is also an open system. Very few countries or farming systems in the world today do not rely to some degree on the international system that moves crop germplasm, breeding lines, improved varieties, and commercial seed across international borders. Studies of breeding programs show that developing countries, including those within Vavilov Centers (centers of crop origins and diversity), are heavily dependent on international flows of germplasm and more dependent than developed countries (Smale and Day-Rubenstein 2002). Rejesus et al. (1996) examined wheat breeding and found that in West Asia, the Vavilov Center for wheat, wheat breeders' use of their own landraces and advanced lines accounted for 41.6% of the breeding material in their programs compared to 45.6% from international sources. For rice, Evenson and Gollin (1997) document the flow of germplasm in Asia and the dependence of Asian countries on germplasm obtained from the International Rice Research Institute (IRRI). Vavilov center countries (e.g., India, Burma, Bangladesh, Nepal, Vietnam) depended on IRRI for between 65.0% (India) and 98.1% (Vietnam) for the rice material in their breeding programs. This compared to 13.6% in U.S. rice breeding. Fowler et al. (2001) estimate that 89.8% of the rice distributed samples from IRRI go to developing countries. Like farmers' exchange seed of landraces, the international exchange of crop germplasm is described as an open system (Fowler et al. 2001).

As with common heritage at the farm and village level, a common heritage approach for international exchange is sensible because it lowers transaction costs that are inherent in defining and defending property over genetic resources (Visser et al. 2000). These costs include negotiation costs, pre-distribution tracking costs, and post-distribution tracking costs (Visser et al. 2000) as well as the conventional transaction costs, e.g., exclusion, information, and communication (Arrow 1969). An example of information costs associated with crop genetic resources is how to ascertain the true "source" of collections. Germplasm collecting existed for many decades before it was more formally organized in the 1970s with the creation of world collections and the International Board for Plant Genetic Resources. The United States received germplasm from many sources, including missionaries, diplomats, and plant explorers. The original collections that established the U.S. National Seed Storage Laboratory included material that had only the country of origin (A. Damania, personal communication). These U.S. collections were duplicated and distributed to other national and international gene banks, such as the Italian National Gene Bank at Bari and the International Center for Agricultural Research in Dry Areas (ICARDA), thus multiplying the material without detailed provenience in gene banks around the world (A. Damania, personal communication). A 1984 review of the status and use of gene banks by Peeters and Williams reports that passport data was wholly lacking for 65% of the samples in the active international network of gene banks. This percentage has probably decreased as more systematic collection has added to inventories, but the FAO (1998) reports that only 37% of the material in national collections has passport data. Plant explorers often cover large territories and reduce collection times by collecting in markets and other central places such as schools. Assigning a territorial designation may also be problematic because of the frequency of migration and the transitory nature of political boundaries. Even if collections come directly from farmers, the seed may be a recent acquisition from another farmer or village. Assuring that source information adheres to collections also incurs cost.

3. TRADITIONAL AGRICULTURAL KNOWLEDGE

Interplay between biological variation and selection make crop and natural evolution similar to one another, but the two differ by virtue of the role of "conscious" selection by humans in crop evolution. Conscious selection implies knowledge systems about the crop and its environment, which are subsets of the more general traditional knowledge and indigenous knowledge (e.g., Ellen et al. 2000). While "traditional knowledge" and "indigenous knowledge" are not synonymous, they share many attributes, such as being unwritten, customary, pragmatic, experiential, and holistic. The terms are frequently used in the same context to distinguish the knowledge of traditional and indigenous communities from other types of knowledge, such as the knowledge of scientific and industrial communities (Ellen et al. 2000). Indeed, the primary distinction between traditional and indigenous knowledge pertains to the holders rather than the knowledge *per se*. Traditional knowledge is a broader category that includes indigenous knowledge as a type of traditional knowledge held by indigenous communities (Mugabe 1999). While traditional knowledge has emerged in international discourse on new legal mechanisms (Wendland 2002), indigenous knowledge is a term long in use by anthropologists and other investigators of non-industrialized societies (Ellen et al. 2000), and because of this history, indigenous knowledge enjoys a more elaborated discussion and definition than the more inclusive term. While Kongolo (2001, 357) observes that “(t)raditional knowledge is rarely defined within the national, regional, and international frameworks,” indigenous knowledge has been extensively analyzed by ethnobotanists and others (e.g., Berlin 1992), so it behooves us to utilize the analysis of indigenous knowledge to grapple with traditional knowledge.

Traditional knowledge is associated with folk nomenclatures and taxonomies of plants (Berlin 1992) and the environment (Ellen et al. 2000) and in practical domains such as disease etiology (Berlin and Berlin 1996), and agricultural practices (Brush 1992). Distinguishing between indigenous knowledge and other knowledge systems has proven to be problematic (Agrawal 1995), but anthropologists and others have argued that a number of criteria can be used to differentiate the two forms. Indigenous knowledge’s characteristics include (1) localness, (2) oral transmission, (3) origin in practical experience, (4) emphasis on the empirical rather than theoretical, (5) repetitiveness, (6) changeability, (7) being widely shared, (8) fragmentary distribution, (9) orientation to practical performance, and (10) holism (Ellen and Harris 2000). These same characteristics apply to traditional knowledge.

The primary development of crops and cropping systems occurred with traditional knowledge before the relatively recent discoveries of agricultural chemistry and crop biology, and most of the world’s farmers still rely on traditional knowledge. The current hyperbolic growth of agricultural production may rely on formal science, but it is built on foundations developed by traditional farmers. While the accomplishments of traditional knowledge are unquestioned, its characteristics pose severe obstacles for its valuation and protection by indigenous people and outside interests such as conservationists, indigenous rights activists, and rural development agencies. Indeed, outside efforts to value, promote, and protect traditional knowledge appear inevitably to distort it and its social context (Dove 1996).

A severe obstacle to valuation and protection is the disarticulation of different types of knowledge when that information is local, orally transmitted, practical, and fragmentary in distribution. Agricultural knowledge is comprised of numerous substantive domains - soil types, pests, pathogens, environmental conditions such as rainfall and temperature patterns, and crop genotypes – as well as management domains – irrigation techniques, soil amendments, planting patterns, pest control, weed control, and, crop selection to name a few. Brookfield (2001) adds organization as a third domain that includes tenure arrangements, resource allocation, and dependency on alternative production spheres. These domains are demarcated by distinct lexicons and nomenclatures such as crop variety names or terminology for management practices. Traditional knowledge is rife with “covert categories” (Berlin 1992) and unlabeled, intermediate domains (Brush 1992) that may link substantive and management domains but require intensive research to understand.

The fact that traditional knowledge is orally transmitted and changeable creates problems in identifying truly local and autochthonous knowledge (Dove 2000). The fact that traditional knowledge is local, empirical, and holistic suggests that indigenous people don’t have to worry about consistency over wider areas, as plant collectors and geneticists must. Since variety names are orally transmitted, repetitive, widely shared, and fragmentary, name lists cannot be used directly to estimate genetic diversity or population structure above the farm level (Quiros et al. 1990). Capturing the knowledge in a single domain by collecting its nomenclature, such as crop variety names, is relatively easy but of limited use. Linking nomenclatures of substantive domains to one another and to management domains is complicated by the inherent qualities of localness, oral transmission, and fragmented distribution. The best studies showing linkage between different domains (e.g., crop diversity and local ecological conditions) are executed in single communities or micro-regions (e.g., Bellon and Taylor 1993). Linking multiple domains, such as crop type, soils, and plant diseases, or showing how domains are linked across regions is daunting and generally not attempted in research on traditional agricultural systems.

4. CLOSING THE GENETIC COMMONS

Following the successful initiatives of the 1970s, which organized an international framework for conserving and exchanging crop genetic resources, the common heritage approach for managing access came under increasing, erosive pressure. Factors that combined to threaten the common heritage approach include the increasing value of genetic resources, the expansion of Breeders' Rights in industrial countries, liberal policy formulation for agricultural development, North/South political discourse, and the rise of the environmental movement These strands converged in the early 1990s to produce the Convention on Biological Diversity (CBD). The nearly simultaneous emergence of the CBD and the Global Agreement on Trade and Tariffs (GATT) hinted at the demise of common heritage by stipulating national ownership of biological resources and pushing countries to adopt intellectual property for plant materials.

The potential coup de grâce to the common heritage regime was delivered in the CBD's sovereignty clause that defined genetic resources as belonging to nation states. The initialing of the CBD at the 1992 U.N. Conference on the Environment and Development (UNCED) in Rio de Janeiro marks a watershed in the management of crop genetic resources. UNCED sought to forge a new framework for confronting environmental problems (Roddick 1997). This new framework was intended to defuse increasing North/South polarization of the pre-UNCED era with a cooperative approach involving unbinding ("soft law") agreements such as Agenda 21, community based forms of action, inclusion of non-governmental organizations (NGOs), and voluntary reporting (Posey and Dutfield 1996, Roddick 1997). UNCED also followed a period of heightened awareness of the trans-national nature of environmental problems and somewhat fitful attempts to negotiate individual, legally binding conventions, such as the UN Convention on the Law of the Sea (UN 1983).

The post-UNCED system for managing crop genetic resources was characterized by (1) national ownership of crop resources overlying customary and professional practices inherited from the pre-UNCED (common heritage) period and (2) the creation of management tools that would be appropriate to the UNCED principles of sovereign ownership and equitable sharing of benefits from the use of biological resources. Two contradictory pressures are, however, evident in the spirit of UNCED. The emphasis on sovereign ownership suggested a move to regulate access to national resources and to develop access and benefit sharing regimes which generally emphasized bilateral contracting mechanisms that became know as bioprospecting agreements (Reid et al. 1993, ten Kate and Laird 1999). The second pressure in UNCED was to eschew legally binding international conventions (Girsberger 1999) in favor of more cooperative, "soft law" approach (Roddick 1997), based on voluntary mechanisms. These pressures have had different effects in reshaping access to genetic resources depending whether pharmaceutical and natural product resources or crop resources are involved. Access to resources for pharmaceutical development tended toward regulation by bilateral contracts while access to resources for crop development has tended toward open, multilateral mechanisms. Three differences between these two genetic resources explain this outcome. First, pharmaceutical resources tend to involve relatively discrete traits and perhaps single genes while crop resources involve quantitative traits that are controlled by multiple genes. Second, crop resources are dependent on human stewardship and have resulted from collective management and selection. Third, pharmaceutical resources lacked the international infrastructure of collection, conservation, public breeding, and exchange that was developed for crop resources. The Merck/InBio contract (Reid et al. 1993) epitomized bioprospecting contracts for pharmaceutical and natural product development. No comparable agreements were negotiated for crop genetic resources. Rather, "soft law" mechanisms, such as Material Transfer Agreements (Barton and Siebeck 1994), were developed for crop resources.. For instance, the instruments developed by the international gene banks of the CGIAR system informs the recipient of germplasm that it is for research and breeding purposes only and inveighs him/her to forgo future claims of intellectual property. These mechanisms retain common heritage aspects of the pre-UNCED era and avoid moving to more rigid contractual agreements that specify benefit flows that are found in bioprospecting agreements for pharmaceutical and other natural products (Reid et al.1993, ten Kate and Laird 1999). As nations weigh mechanisms to manage access to their crop genetic resources, it behooves us to examine the experience regulating access to other biological resources through contracts.

5. IMPLEMENTATION OF ACCESS AND BENEFIT SHARING MECHANISMS

The CBD and GATT set off efforts in many nations to organize national systems for regulating access to genetic resources and sharing the benefits from their use (ten Kate and Laird 1999). A group of researchers at the University of California recently completed a study of national access and benefit sharing programs among nations around the Pacific Rim (Carrizosa et al. 2004). The study combined detailed country studies in 8 nations with a broad survey of 32 other nations. While many national programs have not yet been implemented, comparison of those that have implemented access and benefit sharing programs illustrates the conditions that predict whether an agreement will be concluded and put into practice. Comparison of the experiences of Colombia, Mexico, and Costa Rica illustrates the range of experience in negotiating agreements between providers and users of genetic resources, from lack of agreement to success. The incidence of success is limited to a small number of developing countries, notably Costa Rica (Cabrera M. 2004) and Samoa (Cox 2001).

COLOMBIA

Colombia's difficulties in negotiating access and benefit sharing agreements are detailed in Ferreira Miani (2004). In 1997, the government of Colombia approved the National Biodiversity Policy (NBP). Colombia's policy includes a National Biodiversity Strategy and Action Plan, creation of a Ministry of the Environment, Decision 391 of the Community of Andean Nations establishing a Common Regime on Access to Genetic Resources, and national legislation and executive decrees to implement Decision 391. Decision 391, the "Cartagena Agreement of Andean Countries" is the key to Colombia's regime. It was formulated in 1996 to regulate access to genetic resources and their derivative products and to provide for sharing of the benefits derived from access. Colombia named the Ministry of the Environment as the national authority to regulate access but it also recognizes an indirect role for autonomous regional authorities. A significant and troublesome aspect of Decision 391 is its distinction between genetic and biological resources. The latter defined as specimens that are not accessed to obtain genetic resources, for instance specimens for taxonomic research. Nevertheless the regulating authority may decide that any biological resource is potentially also a genetic resource. Likewise, Decision 391 is ambiguous whether botanical extracts for industry are to be treated as genetic resources. Therefore, collection of any biological material, whether it is for pharmaceutical research, natural product extraction, or agriculture, may be included under the access regime.

The permitting process involves negotiating agreements between the owner of the land where collection is planned, the relevant conservation program, the owner of the biological resource, the state as owner of the resource, and the pertinent national supporting institution. The Ministry of Environment, as the national competent authority is given broad powers decide on applications for collection, negotiate terms of access and benefit sharing, and protect the rights of the providers of the resource and the state, but Decision 391 does not set any specific standards for evaluating applications, the level of benefits, or their distribution. Moreover, the Ministry of the Environment is directed to coordinate its review and decision with three other ministries, other entities related to the environment, and private and public universities.

Since the Cartagena Agreement in 1996 that established Decision 391, not a single access contract has been signed in Colombia. Ferreira Miani (2004) evaluates nine access proposals presented to Colombia's Ministry of the Environment and finds that three were withdrawn, one denied, and five are pending with requests for further information. Ferreira Miani (2004) sites numerous reasons for the failure to conclude an access and benefit sharing agreement, including confusion and lack of information over the terms of agreement, excessive economic expectations, and lack of interest by applicants to become involved in the complicated, expensive and uncertain procedure.

MEXICO

The Mexican experience in implementing their access and benefit sharing regime is analyzed by Larson-Guerra et al. (2004). Mexico represents a case of partial success in achieving access and benefit sharing agreements. These agreements have been reached, but a lack of subsequent fruition is common. Unlike Colombia, Mexico is not bound by an international framework that determines its access and benefit sharing regime. Moreover, the Mexican approach is to rely on ecological and wildlife legislation and intellectual property legislation to achieve the goals of the CBD. Collection under this framework requires prior informed consent by the landowner with the implication of benefit sharing, but access permits are not centralized into a single ministry or other government agency.

A number of bioprospecting projects have been negotiated and initiated in Mexico, and Larson-Guerra et al. (2004) examine three projects in depth. The UNAM-Diversa project involved collaboration between the National Autonomous University and a U.S. pharmaceutical company to prospect on federal public land. This agreement was brokered and facilitated by several government agencies including the Secretariat of Environment and National Resources (SEMARNAT) and the National Commission for the Knowledge and Use of Biodiversity. The UZACHI-Sandoz agreement established collaboration between a consortium of six Zapotec and Chinantec communities in the state of Oaxaca in southern Mexico and the Swiss pharmaceutical company to evaluate soil microorganisms. Benefit sharing involved short-term benefits, ownership of the project’s infrastructure, and a fixed royalty. The third agreement involved the

Maya International Cooperative Biodiversity Group (Maya ICBG) that brought together a U.S. university, a national university in Chiapas Mexico (ECOSUR), a small biotechnology company in the U.K., and indigenous communities in the southern state of Chiapas. This agreement was financed by a U.S. government program administered through its National Institutes of Health.

While the Mexican experience shows success in negotiating access and benefit sharing agreements, the execution of these projects has been troublesome in all three cases and impossible in two out of three. The UNAM-Diversa and the Maya ICBG both ended without either providing access or sharing benefits, and activities under the UZACHI-Sandoz agreement are suspended and pending the development of a specific legal framework of genetic resources. The UNAM-Diversa program was stalled by a public denunciation to the Federal Attorney for the Protection of the Environment (PROFEPA), an independent agency that was not involved in negotiating the agreement. Although PROFEPA eventually decided that it did not have authority to void the agreement, the agreement had expired. The Maya ICBG project also came under public attack, including criticism from and the international NGO ETC (previously RAFI) and Maya communities that were not part of the project. Despite attempts by SEMARNAT to resolve a heated conflict in Chiapas, the project terminated when the local Mexican institution, ECOSUR, withdrew.

The UZACHI-Sandoz agreement remains as the only bioprospecting project of the three with possible fulfillment. Nevertheless, this agreement was criticized for possible imbalance in providing benefits to the different indigenous communities and for excluding indigenous communities. The project is stalled by the lack of long-term contracts, a lack that is in turn triggered by the absence of a specific legal framework in Mexico.

COSTA RICA

Costa Rica and the U.S. are the only countries among those studied by Carrizosa et al. (2004) that have both negotiated and fully implemented bioprospecting agreements. Costa Rica's experiment with bioprospecting is well known and documented (Reid et al. 1993). Costa Rica initiated bioprosecting before the CBD and before a legal framework governing biodiversity (the 1998 Law of Biodiversity No. 7788). The initial agreement that triggered subsequent ones is the Merck-INBio agreement reached in 1991 (Reid et al. 1993).

INBio grew out of Costa Rica's unique environmental, social, scientific, and political context, but scientific leadership in Costa Rica and networks outside of the country also were instrumental in developing this model bioprospecting framework. INBio was established in 1989 with the support of the Ministry of Natural Resources, Energy, and Mines (MIRENEM) as part of Costa Rica's efforts to improve environmental protection for its notable biological diversity (Gámez et al. 1993). It was created as a private, not-for-profit, public interest association dedicated to carrying out research and conservation activities for the protection of biological diversity in Costa Rica. A key element in INBio's approach was the opportunity under the regulatory framework of the 1992 Law No. 7317 for Wildlife Conservation (LWC) that permitted the Ministry of Environment and Energy (MINAE) to allocate biodiversity prospecting concessions in national conservation areas (Gámez et al. 1993).

The INBio contract with Merck provided access to genetic resources in national parks in return for financial support for INBio's national biodiversity inventory and the National Parks Fund of MINAE (Sittenfeld and Gámez 1993). In addition to the Merck agreement, which was renewed three times before expiring in 1999, INBio negotiated 12 agreements with international research institutions and private firms for prospecting activities that include chemicals from insects, fragrances and aromas, nematicides, and extremophilic organisms, in addition to bioassays of plants (Cabrera M. 2004). Eight of these agreements are with private firms, one is with a multilateral organization, and three are with universities in the United Kingdom, USA, and Canada (Cabrera M. 2004).

The success in implementing bioprospecting projects in this framework owes to the special position of INBio as a non-governmental institution with high scientific and administrative capacity and the agreement by MINAE to allow INBio to broker contracts for access to resources on certain public lands. By working in designated conservation areas, such as the Guanacaste National Park, INBio is alleviated from the need to negotiate with landholders and local communities. This condition sets the INBio case apart from other bioprospecting programs where community participation is an objective. Likewise, the sharing of benefits was facilitated by INBio's scientific and educational role and by its special relation to the National Park system and MINAE. These factors help INBio and its international partners to minimize transaction costs in negotiating for access and distribution of benefits. By acting as a singular and nongovernmental authority in negotiating access and benefits, INBio reduced the complexity of negotiating with private firms and universities. Finally, its focus on national parks and designated conservation areas directly connected benefits to accepted conservation activities.

However, and despite the apparent success of this model, Costa Rica has now moved beyond the framework of the LWC by enacting the Law of Biodiversity in 1998 (Cabrera M. 2004). The new law is in part a response to the mandate of the CBD to incorporate access and benefit sharing principles into national legislation. The new law replaces the non-governmental approach utilized by INBio with a centralized process of issuing access permits through the Comisión Nacional para la Gestión de la Biodiversidad (NGB – National Commission for the Management of Biodiversity). INBio is not a member of the NGB (Cabrera M. 2004).

INBio's record suggests that agreement and implementation is best achieved in a decentralized system with flexible norms of negotiating benefits, a direct system whereby the entity empowered to grant access negotiates directly with the organization seeking access, and where the number of parties in the negotiation and permitting process is minimized. The process envisioned in the Law of Biodiversity appears to move Costa Rica away from these norms. Although the implementation of the new law is not yet fully developed or tested, it faces potential obstacles (Cabrera M. 2004). These include uncertainty about the role of key elements in the new access and benefit sharing provisions, ambiguity about the earlier framework established under the LWC, and complexity in the application procedures. The general atmosphere of negotiating access and benefits under the Law of Biodiversity is to be more restrictive and controlling. Furthermore, the constitutional challenge requested by MINAE in 1998 has raised political uncertainty about the role of the NGB. The brief record of receiving applications under the new law appears to validate these concerns since none of the three applications submitted to date have been finalized (Cabrera M. 2004).

Two factors distinguish the successful INBio agreements in Costa Rica from the failed or less than successful efforts in Colombia and Mexico. First, the land and resources covered in the INBio agreements are owned by the Government of Costa Rica and do not directly involve management or participation by other persons or communities. Thus, a single entity, INBio with MINAE's permission, could negotiate the access and benefit sharing agreement. While Colombia designates the Ministry of the Environment as the competent national authority to review access and benefit sharing proposals, these proposals involve numerous parties – local communities, regional authorities, universities, and other government agencies. In two of the three Mexican cases, bioprospecting agreements required multiple communities and/or other parties and were challenged by outside communities. In the UNAM-Diversa case, it was not clear where authority rested to make a final judgment on the legality of the agreement. Second, the decentralized approach that characterized the establishment of INBio agreements helped create an atmosphere where an access and benefit sharing agreement could be negotiated and implemented, while the legal framework now in place in Costa Rica may retard similar negotiations. Colombia's approach to centralize review of bioprospecting agreements in accordance with Decision 391 of the Andean Pact seems to have established the conditions to frustrate the successful negotiation of agreements. The process is both complex and encumbered by many different interests vying in the same arena. Mexico's ambiguity whether a single authority has the right to oversee and decide on the legality of bioprospecting agreements was a factor in the failure of the UNAM-Diversa and the Maya ICBG projects.

The experience of access and benefit sharing agreements in Colombia, Mexico, and Costa Rica has concerned resources for pharmaceutical and natural product development, but it has important implications for policy regarding crop resources and traditional agricultural knowledge. While crop resources differ in critical aspects from pharmaceutical and natural product resources, these are often linked into a common category of biological resources that are found in less developed countries, managed by traditional communities, and collected and used by scientific organizations from industrial nations. The CBD, for instance, does not distinguish the resources of domesticated species as belonging to a category that is different from other biological resources. Nevertheless, important differences separate crop resources from the other types for designing appropriate access and benefit sharing regimes. Three important qualities set the genetic resources of agriculture apart from those of pharmaceuticals and natural products: (1) involvement of numerous farmers and farming communities in creating and maintaining genetic resources, (2) genetic complexity of crop traits, and (3) a long history of exchange and publicly supported conservation of crop genes within and outside of their places of origin. These qualities of crop resources increase the number of persons who have legitimate roles in access to and benefit sharing from crop resources. Following an ad hoc approach to formulating agreements between individuals or individual communities and firms that use agricultural resources will lead to challenges because it appears arbitrary in the face of the circulation of crop genetic resources among individuals and communities. The experience of attempting to meet the CBD goal of negotiated access and benefit sharing agreements suggests that we approach crop resources in a fundamentally different way. The logical approach for crop resources is to revisit the ex ante common heritage regime, albeit in the international framework of the CBD. As discussed below, the culmination of nearly two decades of negotiations over an international framework for exchange and use of crop genetic resources indicates that common heritage has, indeed, re-emerged as a principle for managing these resources.

6. THE INTERNATIONAL TREATY FOR PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

After long negotiations under the auspies of the FAO's International Undertaking on Plant Genetic Resources for Food and Agriculture, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) was completed (FAO 2001) and has now been signed by 79 countries, including the U.S. (FAO 2003). The ITPGRFA takes a multilateral approach that reaffirms a common heritage approach for the crop genera that are included in list of crops covered by the pact. This treaty was negotiated by parties to the CBD and with the endorsement of the CBD. States retain sovereign rights over their genetic resources, including the right to allow intellectual property over genetic material and whole plants according to national laws that stipulate criteria such as novelty, non-obviousness, utility, stability, and uniformity. The treaty implies that genetic resources in gene banks do not meet these criteria. The core provisions of the ITPGRFA (Articles 10-12) place the resources of 36 genera of crops and 29 genera of forages in the public domain and guarantee access to these resources for breeding and research. Germplasm from the multilateral system will be available with a Material Transfer Agreement (MTA) that may include provisions for benefit sharing in the event of commercialization. Implicit in this multilateral approach and reminiscent of common heritage is the idea that open accessibility of crop resources has the potential to return benefits, such as improved crop varieties and scientific collaboration, that are more widely distributed and valuable than financial rewards of a contractual, bilateral approach.

Article 13 of the ITPGRFA lays out a financial procedure for benefit sharing by stipulating that commercialization of a new plant variety will trigger a financial contribution to the multilateral system. Again, the approach is multilateral rather than contractual between the genetic resource provider and the person who commercialized a product using that resource. This approach reflects the intention of the ITPGRFA to eschew individual or community based property for crop genetic resources or traditional knowledge. The level, form, and conditions of payment (for instance whether small farmers are exempt) is not resolved in the treaty and will be subject to further negotiations within the Governing Body of the International Undertaking. The benefit sharing mechanism of the ITPGRFA faces serious logistical difficulty because of the long lag time between access to genetic resources and commercialization. Moreover, identifying the contribution of a specific resource within the complex pedigree of an improved crop variety poses a major obstacle to negotiating benefit sharing. Nevertheless, the treaty provides a mechanism for negotiating these obstacles while access to crop resources remains open.

While the CBD sovereignty clause invited the rise of bilateral agreements, five factors pushed ITPGRFA toward a multilateral framework. First, replacing the open system with one defined by bilateral contracts would entail steep transaction costs that might exceed the value of the resources. Second, the process of creating a new access regime based on bilateral contracts posed the threat of interrupting germplasm exchange because of an anti-commons (Heller and Eisenberg 1998) resulting from the claims of different parties to control access (Correa 2000). Third, increasing evidence suggested heavy dependence by poor countries on outside germplasm resources (Fowler et al. 2001), contradicting the earlier conclusion (Kloppenburg and Kleinman 1987) that industrial countries were more dependent on germplasm than developing countries. Fourth, accessions from large and valuable collections of the CGIAR network and industrial countries, such as the National Seed Storage Laboratory of the U.S., remained openly available to crop breeders. Finally, non-governmental organizations, such as the Genetic Resources Action Network (GRAIN) played an important role in promoting a multilateral approach and in informing developing countries of this option (GRAIN 2000)

Uncertainty over whether a new international order for crop genetic resources should reconfirm or eliminate common heritage, as plant breeders understood it, had bogged down negotiations about the International Undertaking at the FAO (Fowler and Mooney 1990). The ITPGRFA overcame the conflict by shifting emphasis toward open-access to crop resources and away from the issue of compensation. Avoiding the long-term disputes about patenting life forms and gene sequences also aided the agreement on the status of international collections, although highly contentious issues, such the patentability of individual genes which are accessed from the multilateral system but transposed into a different species, are still to be resolved by the parties of the treaty. Finally, by separating the issue of gene bank access from Farmers' Rights and accepting the co-existence of Breeders' Rights and common-pool rights, the ITPGRFA avoided any specific national opposition.

7. FARMERS' RIGHTS AND INTERNATIONAL PROTECTION OF TRADITIONAL AGRICULTURAL KNOWLEDGE

The FAO's International Undertaking on Plant Genetic Resources provided a forum to discuss equity interests of farmers in developing nations and gave rise to the movement to create a program of Farmers' Rights. FAO Resolution 8/83, which established the International Undertaking on Plant Genetic Resources in 1983, had stressed the common heritage principle that plant genetic resources should be available without restriction and provided a sweeping definition of genetic resources as incorporating not only wild and weedy crop relatives and farmers' varieties but also newly developed "varieties" and "special genetic stocks (including elite and current breeders' lines and mutants)" (FAO 1987). Non-governmental organizations that presented the idea of Farmers' Rights to the FAO Commission in 1985 were antagonistic to Breeders' Rights (Mooney 1996) and perhaps believed that international acceptance of Farmers' Rights would undermine individual rights (Fowler 1994).

The gambit to undermine Breeders' Rights through a binding international resolution endorsing unrestricted access to all genetic material failed because of the opposition of states that provide for Breeders' Rights and the availability of large stocks of genetic resources in open collections that are linked to international agricultural development. FAO Resolution 5/89 resolved that the two types of rights were not incompatible and defined Farmers' Rights as:

> "...rights arising from the past, present and future contributions of farmers in conserving, improving, and making available plant genetic resources, particularly those in centres of origin/diversity. These rights are vested in the International Community, as trustee for present

and future generations of farmers, for the purpose of ensuring full benefits to farmers, and supporting the continuation of their contributions...” (FAO 1998, 278)

Farmers’ Rights differed from Breeders’ Rights in that they were to be vested in the “International Community” rather with individuals. However, by not specifying what genetic materials were covered or who could claim ownership, the FAO definition created a problematic category. Farmers’ Rights have remained an elusive goal. Their early association with the anti-Breeders’ Rights agenda, and their ambiguities regarding materials and holders of the rights thwarted its acceptance as an international principle or program. Following the ITPGRFA negotiation, the fate of Farmers’ Rights will be determined at the national level.

The nature of the rights conferred by Farmers’ Rights hinges on the economic benefit provided in the past, but no estimate of value or widely accepted method to estimate value of crop genetic resources are available. Estimating the historic contribution of farmers’ varieties ideally requires one to separate the economic contribution of germplasm from other factors such as the development of physical infrastructure and human capital. Likewise, estimating the cost of Farmers’ Rights is hampered by the lack of a program for how the stream of benefits to farmers might be used to achieve conservation goals.

Bipoprospecting contracts potentially offer a mechanism to provide equity and stimulate conservation by increasing the value of biological resources, but this mechanism is likely to be ineffective for addressing equity and conservation issues relating to crop germplasm. Because collecting genetic resources tends to be “single shot” (Barrett and Lybbert 2000), collecting fees are unlikely to have a long-term conservation effect. Contracts are likely to arbitrarily favor single communities or regions who have no special claim to crop germplasm, and Barrett and Lybbert (2000) argue that bioprospecting windfalls may be exclusionary or even regressive. The reaction of groups who were excluded from bioprospecting agreements confirms that exclusion is a liability (Nigh 2002). If conceived as a market situation between community "sellers" and seed company "buyers," Farmers' Rights exist in a monopsony environment in which a multitude of farmers with genetic resources face an extremely limited set of potential "buyers" for their resource. Mendelsohn (2000) observes that this situation leads to market failure and argues that a monopoly acting on behalf of farmers is necessary.

Possible titleholders of Farmers' Rights include farming communities and states (Correa 2000). Inter-community exchange and seed flows expose claims by one community for rights to a specific crop resource to challenges from other communities. The same may be true at the international level where informal seed movement also exists (e.g., Valdivia et al. 1996). Transaction costs to settle such disputes may be higher than the value of the right, and arbitrary allocation presents ethical problems of favoring one community over others. The possibility of international disputes or price competition has led some regions, such as the Andean nations, to initiate a consortium approach to providing biological resources (ten Kate and Laird 1999), but the number of possible participants and other factors are likely to make the costs of similar approach among communities prohibitive.

The subject matter of Farmers' Rights is equally ambiguous. Characterization of gene bank collections is limited, and much of the material is stored without adequate documentation to identify farmers' who might be considered as the sources (Peeters and Williams 1984). Defining knowledge rather than genetic resources as the subject matter of Farmers' Rights is problematic because farmers' knowledge is local, widely shared, changeable, and orally transmitted. Lastly, the concept does not specify whether wild relatives of crops, which have provided valuable traits to crop improvement but are not always known or used by farmers, are covered by Farmers' Rights.

The final criterion that distinguishes Farmers' Rights from intellectual property is their duration (Correa 2000). The monopoly right of a grant of the intellectual property is made to be temporary as a way to balance the goal of increased invention over the goal of open competition. The unlimited duration of Farmers' Rights foregoes this balance, a policy of dubious merit if other communities or nations have valuable genetic resources or prove to more effective conservationists. The ITPGRFA moves away from a binding international resolution to create Farmers' Rights and assigns the realization of Farmers' Rights to national governments. The treaty inveighs on its Contracting Parties to provide for these rights in three ways: (a) protection of traditional knowledge; (b) provide equitable participation in sharing benefits; and (c) the allow participation in making decisions related to the conservation and use of plant genetic resources for food and agriculture. (FAO 2001). As in the ex ante common heritage period, farmers are not granted the right to exclude others from using or benefiting from crop resources..

Negotiating Farmers' Rights at the national level faces obstacles that were not critical in the international arena, such as political weakness of the traditional farming sector, urban and consumer demand for low cost commodities, and the need to promote agricultural development. Although the CBD does not distinguish crop genes as a special category of biological resource, negotiations for Farmers' Rights will have to acknowledge the regime established by the ITPGRFA. Research on crop populations in traditional farming provide three lessons that will weigh on Farmers' Rights negotiations. First, crop genetic resources are collective inventions and meta-populations rather than assets that are privately derived and managed. Second, developing nations have benefited from adopting new technology, including new crop varieties, but landraces still exist in specific agricultural niches. Third, demand for crop genetic resources from outside sources is greatest in developing countries.

The history of negotiating mechanisms to protect farmers' knowledge offers four guidelines for crafting national Farmers' Rights programs. First, the goals of Farmers' Rights are to balance Breeders' Rights and encourage farmers to continue as stewards and providers of crop genetic resources. Second, Farmers' Rights are held collectively rather than by individual farmers or communities. Third, Farmers' Rights are not exclusive or meant to limit access to genetic resources. Finally, mechanisms are needed to share benefits received by the international community from genetic material from farmers' fields or international collections.

8. FARMERS' RIGHTS AT THE NATIONAL LEVEL

India's Act N° 53, 2001 for The Protection of Plant Varieties and Farmers' Rights recognizes Farmers' Rights in four ways (India 2001). First, farmers' roles as keepers of genetic resources and sustainers of crop evolution are to be recognized and rewarded through a National Gene Fund that will be financed by annual fees levied on breeders of registered varieties in proportion to the value of these varieties [Section 39 (1) (iii)]. Benefit sharing to communities that provided germplasm used in a registered variety will be determined according to the extent and nature of the use of genetic material in the registered variety [Section 26(5)]. Second, India's Act 53 establishes the farmers' exemption that was present in early plant variety protection regimes (Baenziger et al. 1993), allowing farmers are entitled to "save, use, sow, resow, exchange, share or sell his farm produce including seed of a variety protected under this Act in the same manner as he was entitled before the coming into force of this Act" [Section 39 (1) (iv)]. Third, breeders are required to disclose in their application for registration information regarding tribal or rural families' use of genetic material used in the breeding program [Section 18 (1) (e)]. Failure to disclose this information is grounds for rejecting an application for variety registration. Fourth, any interested party may file a claim on behalf of a village or local community stating its contribution to the evolution of a registered variety (Section 26). If this claim is substantiated, the breeder is required to pay compensation to the National Gene Fund.

Although farmers are recognized as potential breeders in the Indian law, they are not given unusual privileges in registering varieties. Section 39 (1) (i) of India's Act 53 (India 2001) allows farmers to register varieties but only insofar as these varieties meet the same criteria (novel, distinct, and uniform) as breeders' varieties [Section 15 (3) (a) – (c)]. However, farmers who wish to register a variety are exempt from the need to demonstrate that the genetic or parental material was lawfully acquired [Section 18 (1) (h)]. Section 15 (2) also provides for the registration of "extant varieties" that meet criteria such as distinctiveness, uniformity, and stability that are to be determined by the Protection of Plant Varieties and Farmers' Rights Authority. However, extant varieties are to be owned by the State Government [Section 27 (1)], making this a means to limit the ability of persons to certify varieties that they have not bred.

The Organization of African Unity's African Model Legislation for the Protection of the Rights of Local Communities, Farmers and Breeders, and for the Regulation of Access to Biological Resources (OAU 2000) envisions Farmers' Rights in four ways. First, farmers can certify their varieties as intellectual property without meeting the criteria of distinction, uniformity, and stability that breeders must meet. This certificate provides farmers with "the exclusive rights to multiply, cultivate, use or sell the variety, or to license its use" (OAU 2000, Article 25). Second, farmers are given the right to "obtain an equitable share of benefits arising from the use of plant and animal genetic resources" (OAU 2000, Article 26). The African Model Law (Article 66) envisions a Community Gene Fund to accomplish benefit sharing and to be financed by royalties fixed to registered breeders' varieties. Third, farmers are guaranteed an exemption to Breeders' Rights restrictions, to "collectively save, use, multiply and process farm-saved seed of protected varieties" [OAU 2000, Article 26 (1e)]. Fourth, farmers' varieties are to be certified as being derived from "the sustainable use of a biological resource" (OAU 2000 Article 27). This certificate does not imply financial reward.

The ITPGRFA, Indian Act 53, and the African Model Legislation accept the co-existence of Breeders' Rights along with Farmers' Rights and intend to accomplish benefit sharing through a centralized funding mechanism linked to Breeders' Rights. This same benefit sharing mechanism is present in the Genetic Resources Recognition Fund (GRRF) of the University of California that imposes a licensing fee on the commercialization of patented plant material involving germplasm from Developing Countries (ten Kate and Laird 1999). This mechanism is a generic tool for reciprocity rather than one to reward specific farmers or communities. The African Model Legislation goes furthest in signifying individual communities as property holders and beneficiaries, while the Indian Act 123 combines both the generic and specific uses of compensation through the centralized gene fund. Farmers' Rights are also provided in farmers' exemptions to restrictions embedded in Breeders' Rights. Contradicting the view that Farmers' Rights are not a form of intellectual property (CIPR 2002), the Model African Law goes beyond the ITPGRFA and the Indian Act 123 in granting exclusive rights to farmers over their varieties.

Two factors indicate that taxing certified crop varieties will offer meager resources to finance Farmers' Rights. First, plant variety certificates in industrialized countries have relatively low or negligible value. Lesser (1994) determined that the price premium associated with soybean certified seed was only 2.3 percent in New York State and concluded that this form of protection is too weak to be an incentive to breeders. Second, modern breeding programs are increasingly dependent on the use of "elite" breeding lines that are several generations removed from farmers' varieties and show increasingly complex pedigrees involving crop genetic resources from many sources (Smale et al. 2002). Although India is a net exporter of landraces as breeding material, foreign landraces are equally important to India's rice program as national landraces (Gollin 1998). Because African agriculture is heavily dependent on crops originating in other regions, dependence on international germplasm is high. For instance, in Nigeria's rice breeding program, 180 out of 195 landrace progenitors used in breeding were borrowed from other countries (Gollin 1998). Estimating the contribution of a single landrace or collection to the value of a modern variety has not been accomplished and is likely to become more difficult as pedigrees become more complex.

In sum, Farmers' Rights are a moral but largely rhetorical recognition of the contribution of farmers to the world's stock of genetic resources, and they provide only a limited mechanism to share benefits from using crop genetic resources or to promote their conservation.

9. CONCLUSION

Numerous parties and participants have struggled with the issue of protecting traditional agricultural knowledge and crop resources through binding international resolutions, formal contracting, and non-contractual benefit sharing mechanisms. The impetus for this was the recognition that resources and knowledge were eroding under the pressures of modernization, but it also grew out of the North/South dialog from the mid-20th century. The move to end common heritage as a management scheme for genetic resources is understandable as both a liberal ideology to overcome the tragedy of the commons (Hardin 1968) and an anti-colonialist tool to stop uncompensated acquisition of resources from the South (Mooney 1983). However, these sources for justifying the closure of the genetic commons are based on inaccurate caricatures of traditional resource managers and the international crop germplasm system. They overlook successful and long-lived systems of managing common pool resources (Ostrom 1990), networks of interdependence among farming communities, and their links to a global flow of crop material. Moreover, the North/South dialog understates the value global public goods (Kaul et al. 1999) and international cooperation involving both North/South and South/South transfers.

Arguably, it is time to move beyond both the Tragedy of the Commons and North/South dialog as bases for developing mechanisms to protect traditional agricultural knowledge and crop resources. This conclusion is embedded in the negotiated settlement of the ITPGRFA that returns to common heritage for the world's most important crops. The weakness of that treaty, however, is that it does not give proper emphasis to the obligations of industrial countries and developing countries alike to support conservation of crop resources beyond funds raised in connection to commercializing improved crop varieties. This mechanism is likely to be inadequate to meeting conservation budgets that are already inadequate (NRC 1993). Rather, benefit sharing must come from a more traditional transfer of international capital: development assistance focused on programs to improve rural incomes in genetically diverse farming systems. An assortment of tools now exist to use those funds in a way that increases production and income without replacing traditional crop populations (Brush 1999). Bilateral and multilateral development assistance that funds rural development activities and benefits the stewards of the world's crop resources can be justified as part of the reciprocal obligations of industrial nations to developing nations. Multilateral efforts such as the Global Environmental Facility's program on Conservation and Sustainable Use of Biological Diversity Important to Agriculture (GEF 2000) and the McKnight Foundation's Collaborative Crop Research Program (McKnight Foundation

2002) embody reciprocity through international financial assistance. The irony of this conclusion is that it reverts to tools and principles that were established before the assault on common heritage.

Collective action was crucial to the creation of crop genetic resources, and it remains critical to maintaining the evolutionary system that generates these resources. However, the collective action involved in creating and maintaining crop genetic resources is substantively different from that involved in managing fixed assets, such as irrigation systems, pastures, and fishing territories, that are associated with common property. The moveable, replicable, and protean nature of crop resources led to the common heritage regime, and efforts to support collective action are most likely to succeed by working with this regime rather than trying to replace it with community property systems based on fixed asset models. Supporting collective efforts by farmers to improve their yields and livelihoods is eminently workable without imposing new forms of property to replace common heritage. The case studies of access and benefit sharing efforts under the CBD indicate that new property based schemes for farmers and communities are unworkable and likely to forestall more viable approaches to address the needs of conserving genetic resources and improving rural livelihoods. Meeting the challenge to establish Farmers' Rights should follow the lead of the ITPGRFA and India's Act 53 that emphasize multi-community solutions and a move away from individual contracts for accessing crop resources and sharing benefits from their use.

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