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Property Rights and Genetic Resources: A Framework for Analysis

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THAT the world is losing biological diversity at an unprecedented rate is no longer any more surprising than the persistence of warfare in the post–Cold War era. Having failed to learn charity toward each other, can anyone find it remarkable that we are unable to treat our fellow species with care or respect? This is not to say, however, that humankind is indifferent to the loss of genetic diversity. What it does mean is that the global rationale for the preservation of threatened toucans and bromeliads and sponges is moving toward utilitarian as well as ethical issues. Relating to each other principally through the instrumentality of the market, we now apply the principles of the General Agreement on Tariffs and Trade (GATT) and the North American Free Trade Agreement (NAFTA) to other species. Much of the overriding theme of the discourse regarding the loss of organisms now has to do with the loss of potential utility associated with disappearing organisms, not with integrity of the creatures themselves.

Increasing scarcity alone might have been expected to enhance the perceived value of biochemical and genetic materials. And this valorization through restriction of the supply of biochemical and genetic resources is occurring precisely at the moment when the vast bulk of those resources is becoming accessible to us. Before 1975, the genetic information embodied in the toucan was pretty much locked up in the toucan. As such, it was almost exclusively useful in its capacity to reproduce toucans. With biotechnology and genetic engineering, it becomes possible to move that information around and combine it with the DNA from other organisms. Suddenly, organisms such as the toucan are of interest for their potential as sources of industrial, agricultural, and medical substances. Hence the emergence of broad corporate and governmental concern with biodiversity and the simultaneous development of the "chemical prospecting" (Clifford 1993; Eis-

ner 1989) in which the academic-industrial complex is now so busily engaged (see, e.g., National Institutes of Health 1993; Plotkin and Famolare 1992; Reid et al. 1993).

The World Resources Institute (WRI) may be right; biochemical and genetic resources may well be the "oil of the information age." And if those toucans and bromeliads are indeed the essential raw materials of the genetic engineers, then the distribution of rights in and access to those materials is a matter of great importance. As the value of genetic materials of all kinds—crop germplasm, wild medicinal plants, diseased human tissue—increases, there is struggle over the social arrangements in place to regulate access to and ownership of those materials (Kloppenburg 1988; Fowler and Mooney 1990).

Genetic and biochemical resources have long been collected from peasant farmers and indigenous peoples as the "common heritage of mankind," a public good for which no payment was appropriate or necessary (Wilkes 1983). Though the industrialized North has enjoyed uncountable benefits from access to such materials, there have not historically been mechanisms for systematically ensuring a reciprocal flow of benefit to those who have supplied genetic or cultural information in the first place. If we in the North are in a position to make ourselves better off by using resources supplied by others, is it not ethically appropriate to make sure that they are better off as well? And if ethics is not persuasive to the corporate and foundation practitioners of conservation realpolitik, may they not find good pragmatic reasons to ensure such a reciprocal flow of benefit? If preservation of biodiversity is an objective, what better way to accomplish this than to reward people for its production, reproduction, and maintenance? Moreover, whatever ethical or instrumental stance is favored by representatives of the North, farmers and indigenous communities are increasingly demanding that those who come to take are also obligated to give (Shiva 1990; Suhai 1992).

The resulting transition to a new problematic in the "seed wars" is best exemplified by the now well-known arrangement between Costa Rica's National Biodiversity Institute (INBio) and the pharmaceutical multinational Merck and Co., Inc. (Blum 1993; Kloppenburg and Rodriguez 1993). In this arrangement a nongovernmental organization (NGO) and a company are voluntarily adhering to the principle that access to genetic materials merits compensation. Further, that compensation is not merely rhetorical but also material. The INBio-Merck arrangement is the first instance of systematic, contractual conjoining of both the willingness to sell genetic materials and the willingness to pay for them.

Over the last few years, a wide variety of other arrangements for acquisition of biochemical and genetic materials from farmers and indigenous peoples have been developed. These range from detailed and highly legalistic models typical of Western patent law to frameworks that are more like a treaty than a contract. The parties to the agreements may be—on the suppliers' side—individual shamans, communities, peoples, or nations. The parties on the receiving end may be government agencies, companies, or individual scientists. Mediating the exchange

are often NGOs and activist/advocacy groups. The situation is extremely complex. Whatever their form, all such agreements purport to manage the exchange of genetic resources on a legitimate, equitable, and compensatory basis.

The central issue is no longer whether or not compensation is appropriate but under what conditions compensation will be paid and—most importantly—which social groups or institutions will have the right to determine those conditions. We can expect continuing proliferation of models. If indeed the world is going to move to a truly new and more just regime for the exchange of biochemical and genetic materials, we will need to think critically about the models that arise. Our purpose in this article is to provide a conceptual framework to facilitate clear analysis of the diverse arrangements now being promulgated.

The Convergence of the Twain

We first met in debate over these issues at an annual meeting of the Society for Economic Botany. At the time, both of us had recognized the legitimacy of "compensation," but our attentions were focused on the problem at different levels. Kloppenburg had taken a global perspective, viewing the question principally in the context of North/South structural relations (e.g., Kloppenburg and Kleinman 1987). Balick, on the other hand, had been involved quite personally in the collection of genetic and cultural information and had focused on needs at the community and individual levels. Both of us initially had a difficult time accepting the relevance of the other's point of view. Nevertheless, in discussion, we both came to see that our positions were incomplete.

In particular, we have come to believe that the stickiest issues, and the most complicated analysis, will come not at the level of global regimes or individual rights, but at a wide variety of levels in between. We have chosen to refer to this terrain between the individual and the global as the "middle ground." Only rarely will questions of rights to access to genetic materials involve individuals as independent actors. The shaman is a member of a community; the collector is an employee of a company or a government agency. The interests of those collective groups or institutions are what will generally be at issue. At the other extreme, while much concern has been focused on intergovernmental and geopolitical maneuvering, the exchange of genetic materials will most typically occur at a lower level of organization.

Allocation of property rights in genetic resources will involve not only a variety of social levels (international, national, ethnic, community, individual) but also a wide variety of different social actors (academics, NGO representatives, officials, farmers, indigenous peoples) and different institutional actors (international organizations, NGOs, government offices, companies, popular organizations, indigenous organizations). While global and individual dimensions will remain important, we believe that most of the critical action will take place at levels that are less abstract than the global and more complex than the individual.

The fundamental question is "Whom does one compensate and how?" We cannot answer that question phrased at that level of generality, for an adequate answer will be a function of the diverse circumstances in which exchanges may occur. We do hope that our analysis will be of value in helping people to locate the social actors in an exchange. We also hope that this concrete evidence of interdisciplinary collaboration might be an encouragement to those who may be contemplating the possibility of such work. A sociologist and an ethnobotanist, respectively, we are from two quite different disciplines with very different training, and, indeed, we work from very different political positions. Yet we have learned from each other and have established a productive working relationship. We would like to think that our joint work represents a methodological example for the generation of solutions: interdisciplinary work and discussion between those with quite different views.

It ought to be clear that the foundation for our cooperation is our agreement on one essential point: compensation for the appropriation and use of "raw" genetic materials is appropriate in principle. Accepting the principle of compensation provides the necessary "equitability" or "symmetry" needed to develop a politically practicable new regime of germplasm exchange.

A Framework for Analysis

But given agreement that compensation is appropriate, who is to be compensated? And how? We are really talking about how to foster conditions for a just exchange: those who supply genetic or cultural information should receive some reciprocal flow of benefit from the recipients of genetic and cultural information. A useful first step toward grappling effectively with the problem is to identify the participants—the "social actors"—in the exchange. In figures 13.1, 13.2, and 13.3, we present graphic representations of a framework we have found heuristically useful in engaging the issues that arise in our own work.

In figure 13.1 we identify six classes of social actors who frequently participate in such exchanges. These actors are placed in a grid that should facilitate conceptualization or visualization of their participation in the process of exchange of biochemical and genetic information. Each social actor may be either a supplier (donor) or a recipient (demander) of germplasm. Our model encompasses all types of germplasm from wild species to landraces and commercial seed, to bulk samples of medicinal plants. We have established our classes of social actors based on the different objectives and interests that the social actors have. That is, companies (e.g., Monsanto, Merck, Shaman Pharmaceuticals, Pioneer Hi-Bred) have different interests than NGOs (e.g., New York Botanical Garden, Nature Conservancy, Conservation International), which in turn have different interests than government agencies (e.g., United States Department of Agriculture [USDA], National Cancer Institute [NCI], Brazil's National Center for Genetic Resources and Biotechnology—CENARGEN), which in turn have different interests than international

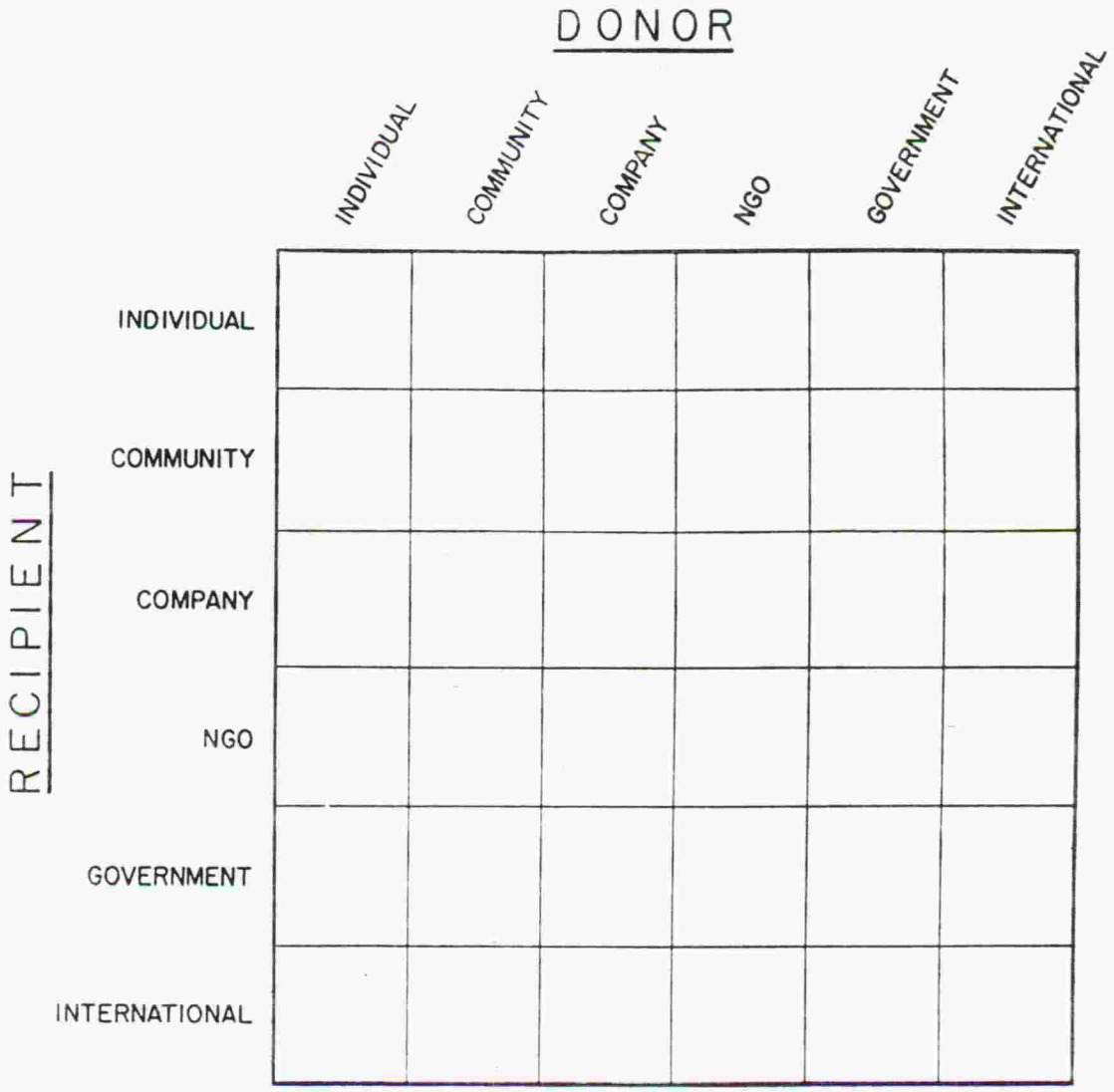

FIGURE 13.1 Social actors in genetic resource exchange regimes.

agencies (e.g., United Nations Environmental Program, Food and Agricultural Organization [FAO] of the United Nations [UN], international germplasm centers).

In figure 13.2, we use our framework to illustrate the types of germplasm exchange regimes that have operated until recently. For centuries, germplasm has been supplied by individuals and communities. Over the last hundred years there have emerged in the advanced industrial nations a range of companies, NGOs, and national and international government organizations with an interest in collecting such materials. Concentration of seeds and cuttings and whole plants in the gene and plant banks of the North has proceeded apace since the "Golden Age of Plant Hunting" in the late nineteenth century (Klose 1950; Brockway 1979). The bulk of such collection has been accomplished not by private companies, but by individual scientists working for such government agencies as the USDA's Plant Introduction Office and the Consultative Group on International Agricul-

tural Research (CGIAR's) network of Green Revolution research centers. More recently, such agriculturally oriented work has been supplemented by herbaria, botanical gardens, and medical research agencies more interested in medicinal and industrial than in agricultural uses of plants.

We term this collection of materials by (mostly) ethnobotanists and agronomists *free appropriation* because the plants and seeds were obtained free of charge or at limited cost, principally from peasant farmers and traditional and tribal peoples in the Third World. The unrecompensed appropriation of these materials has been predicated on a widely accepted ideology that has defined germplasm as the "common heritage of mankind" (Wilkes 1983). As "common heritage," biochemical and genetic information has been looked upon as a public good for which no payment is necessary or appropriate.

But though nothing (or relatively little) was paid for them, those seeds and plant cuttings were extremely valuable. And the individuals doing the collecting were rewarded for their skill at extracting and appropriating those seeds and

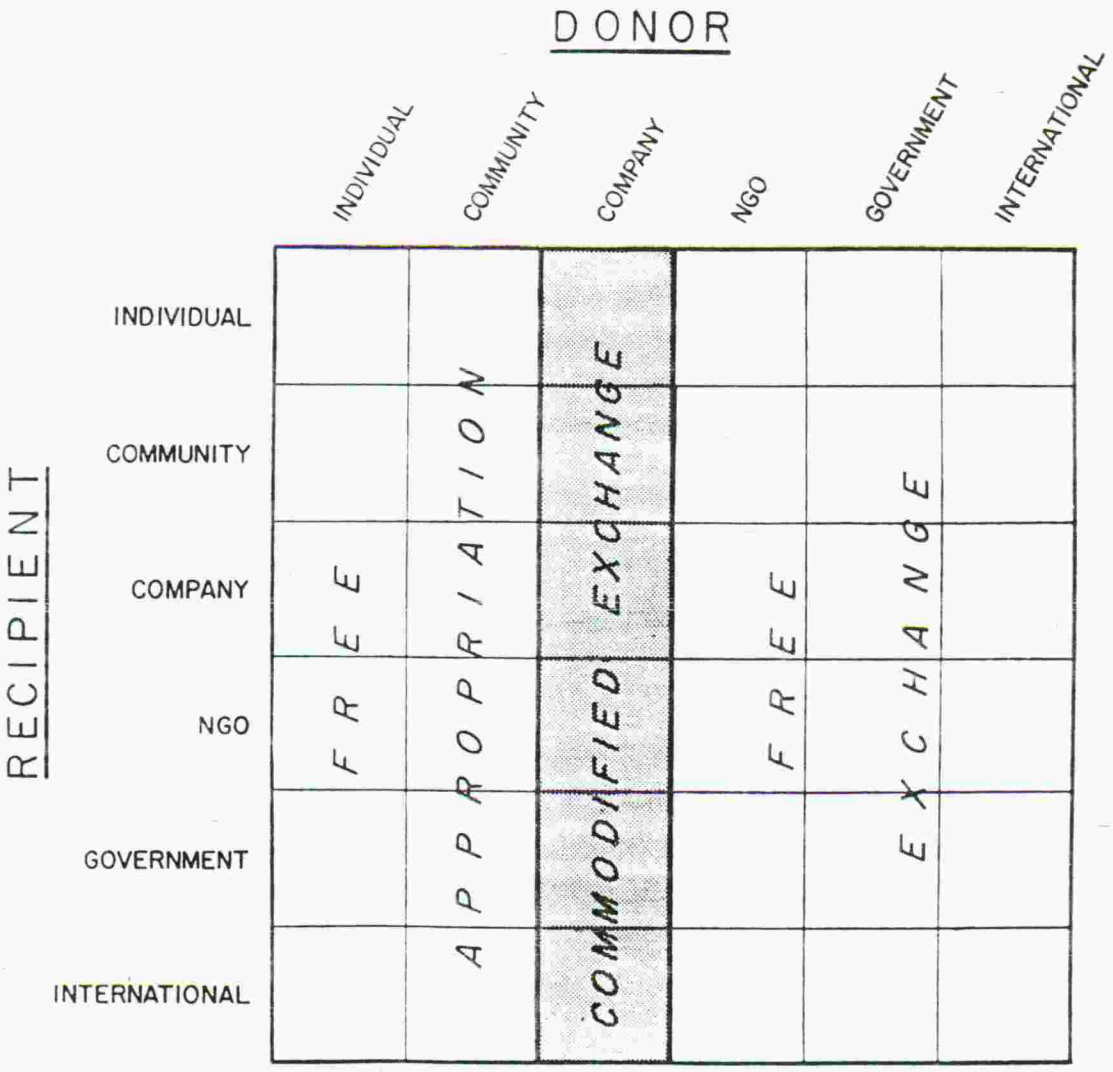

FIGURE 13.2 Free and commodified genetic resource exchange regimes.

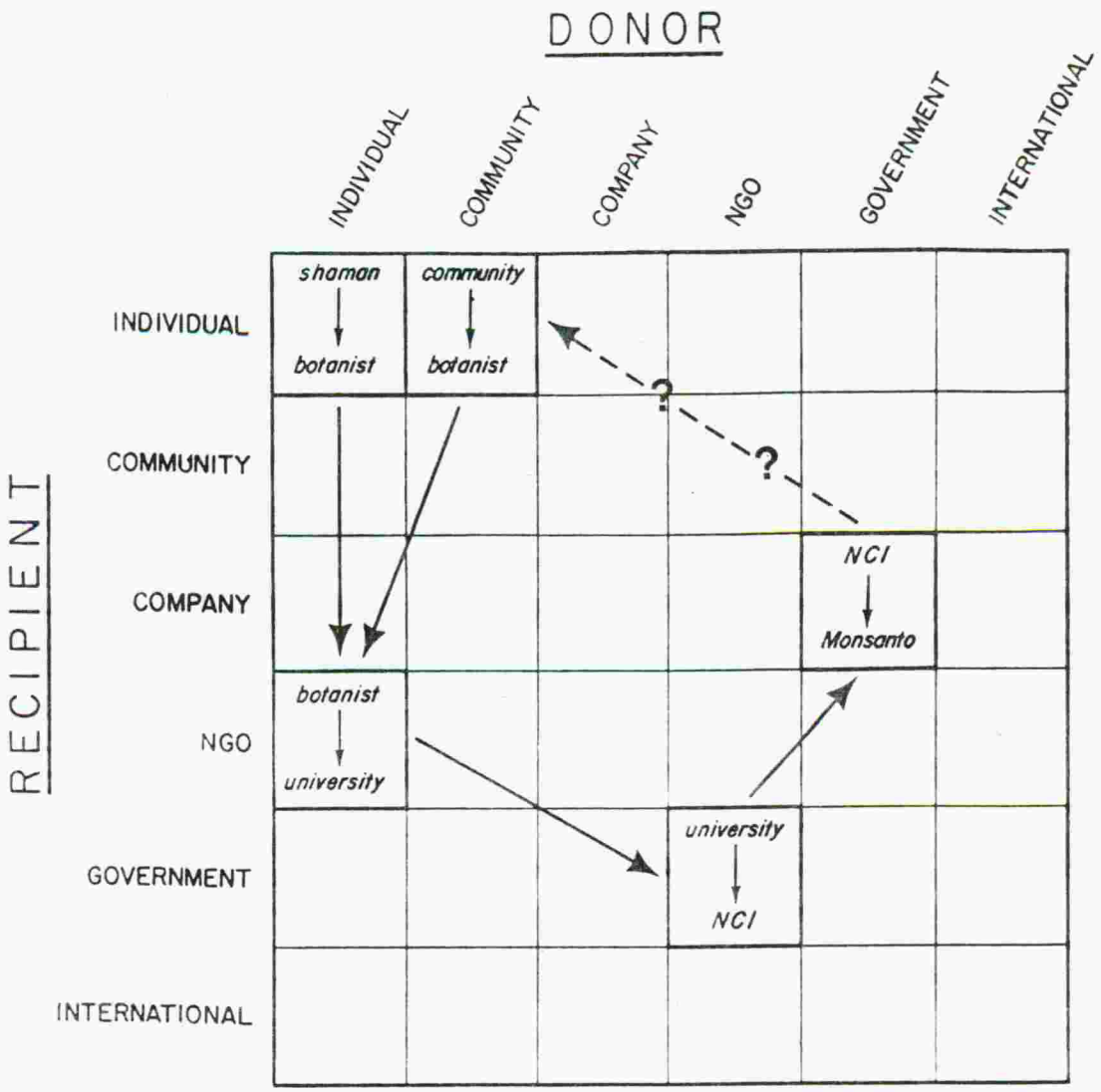

FIGURE 13.3 Information and benefit flows associated with biodiversity prospecting.

plants. The ethnobotanists and agronomists of the USDA, the Missouri Botanical Garden, the University of Wisconsin department of horticulture, or the International Rice Research Institute receive salaries for their work. They obtain grants, produce publications, and achieve professional advancement and prestige for their recovery and analysis of materials they collect from the lands and peoples of the Third World.

Note that they are paid directly, not for the plants but for the labor they are engaged in: collection and analysis. While the scientists and professionals of the collecting organizations benefit from their biological prospecting, they are rewarded indirectly rather than directly for their work. Nor do they necessarily retain the plant materials or the rights to these materials. In fact, after being collected, seeds stored in "gene banks" are made available to any qualified (i.e., another scientist or professional) person who wishes to use or further work on

the material. Thus, the NGOs, government offices, universities, and international agencies that do the bulk of collecting supply the materials they collect to other NGOs, government offices, universities, international agencies, and—a new actor—companies, on demand. This is done freely, with no more than a shipping charge assessed of the recipient. We term this type of interchange "free exchange" in figure 13.2. Note that while this arrangement appears equitable—Third World farmers could theoretically ask for a sample of seed collected in another part of the world, Third World plant breeders can have access to the USDA's gene banks—in practice free exchange benefits the North disproportionately. This is because the capacity to benefit from access to a resource is a function of the capacity to use that resource. Since that technical capacity exists overwhelmingly in the North, "free exchange" is not the even-handed opportunity its proponents have made it out to be, and the benefits of collecting biochemical and genetic information have accrued to the North in extremely disproportionate fashion.

The appearance of companies—profit-making commercial businesses—in the equation marks the demarcation of yet a third form of exchange. While they are recipients of materials under free exchange, seed and pharmaceutical companies are less interested in academic publications than they are in the development of new products from the information they receive. Companies exist to sell products in a market. They are suppliers of germplasm under free exchange only in very limited circumstances associated with public relations and the maintenance of preferential relations with scientists and institutions whose cooperation they value highly. The business of business is business. Companies process biochemical and genetic information received under the regime of free exchange and sell those products as commodities. This simple social fact is illustrated in the "commodified exchange" section of figure 13.2. Companies are suppliers of germplasm at a price in the form of commercial seed or drugs or they do not make materials available at all for proprietary reasons. Effectively, companies have had free access to the genetic resources of the globe, but their germplasm is available only for a price.

A New International Genetic Order?

These regimes of exchange are now in flux as a variety of events and forces reshape the social and biological terrain in which genetic resources are embedded. A number of factors have combined to galvanize the emergence of global political conflict around the increasingly apparent asymmetries and inequities associated with the distinctions between the forms of exchange we represented graphically in figure 13.2.

Over the last fifteen years there has been a growing awareness that global processes of industrial and agricultural development have often resulted in substantial environmental externalities. One of the most serious of these has been the

accelerating destruction of biological diversity. General concern over the broad problem of biological destruction helped focus attention on the question of plant genetic resources in particular. On the one hand it has been recognized that one of the consequences of the Green Revolution has been the gradual displacement of the traditional landraces upon which the development of high-yielding varieties of Northern industrial agriculture have been based (Frankel 1970). On the other hand there is the more recent revival of interest in the potential therapeutic applications of the many organisms that are now threatened with extinction. The principal rationale for developed-nation support for biological conservation in the Third World is now the potential utility and economic value of the genetic resources located there, a point that has not been lost on developing nations.

Additionally, in order to facilitate creation of a world market for commodities—including seeds and pharmaceuticals—the companies and nations of the North have sought global extension of a legal framework that would give them proprietary rights to the new seed varieties and drugs they are developing for sale. One of the most contentious components of the GATT is the issue of Trade-Related Intellectual Property Rights (GRAIN 1993). Controversy over the possible impact of the extension of patent rights necessarily has entailed consideration of the commercial value of the various forms of biochemical and genetic information.

Attention to questions of value and property rights in germplasm has been further emphasized by the emergence of the cluster of new genetic technologies commonly referred to as "biotechnology." Germplasm is the fundamental raw material of the genetic engineer, and as Winston Brill (then an executive of the American biotechnology firm Agracetus) observed, with the development of such techniques as rDNA transfer and protoplast fusion, "genetic wealth, . . . until now a relatively inaccessible trust fund, is becoming a currency with high immediate value" (quoted in Myers 1983:218).

As a result of this constellation of factors, there has been a growing unease with the established structure of the global genetic order among Third World politicians, diplomats, scientists, and farmers. Indigenous peoples have also become aware of these issues as the process of "chemical prospecting" finds the knowledge of traditional peoples and their healers to be one of the most efficient and effective routes to the identification of which species are endowed with possible therapeutic or industrial characteristics of relevance to humans.

Third World nations and peoples are now asserting what they see as their right to insist upon an end to the unrecompensed appropriation of cultural, biochemical, and genetic information and to require that chemical, cultural, and biological prospecting be undertaken in accord with well-defined rules that assure the suppliers of a reciprocal flow of benefit (e.g., Shiva 1990). In response to the ethical and practical principles now being affirmed in the Third World, Northern governments, companies, universities, and other organizations with an interest in maintaining access to Southern biodiversity are finding innovative ways to pro-

vide this reciprocal flow of benefits. What those rules should be is a matter of struggle. It is no surprise that questions regarding biotechnology and access to genetic resources were the two foci of disagreement in Rio de Janeiro and continue to be the pivots around which global cooperation in the Biodiversity Treaty will depend (Athanasiou 1992).

In brief, what is happening now is that with recognition of the possible value of germplasm and genetic resources, characteristics of commodified exchange are beginning to penetrate the areas of figure 13.2 previously restricted to free appropriation or free exchange. Some form of a "New International Genetic Order" is clearly in the offing. The degree to which this altered order is truly "new," or whether it is simply a kinder and gentler version of the old exploitative relationships, remains to be seen.

Questions of Compensation

If a new set of rules—a new regime—for the exchange of biochemical and genetic information is to be developed, what should those rules be? We are particularly concerned with individuals and communities in their roles as suppliers. We privilege these social actors, as it were. Individuals and communities are prime sources for the collection of "new" or unidentified genetic material. Farmers are the producers and reproducers of crop genetic variability. Indigenous peoples' communities are frequently the social integument through which useful materials are identified, domesticated, and distributed. Traditional healers are the source through which useful species of medicinal plants are identified and dispensed. Yet farmers, indigenous communities, and traditional healers usually receive limited medium- and long-term benefits for the services they provide to others. But consideration of how the rights of such peoples and communities may be protected means analysis at a number of levels.

For example, let us assume that a botanist obtains a plant from a shaman that ultimately becomes the drug of choice for AIDS therapy. Figure 13.3 illustrates a hypothetical flow of information through a series of exchanges that run from the shaman to the botanist, who in turn transmits the plant to a university, whose researchers' preliminary analysis suggests the plant might be useful in cancer therapies and who provide the material to the NCI, where NCI scientists isolate a substance from the plant that is appropriate for AIDS treatment, and finally the NCI licenses the active principle in the plant to Monsanto for development of a commercially available drug. All the participants in the various transformations of the shaman's information are rewarded for their activities in some fashion, except that the shaman provided the plant free or for a relatively small amount of money, to reflect his/her labor involved in the collection. Our concern is to see that some of the benefits are enjoyed at all nodes in the flow of information.

THE INDIVIDUAL AND COMMUNITY LEVEL: THE POINT OF APPROPRIATION

Collection of genetic materials frequently implies contact between individuals—a supplier and a collector. Certainly those choosing to donate genetic and cultural information deserve respect and some immediate concrete reward: the results of research, an acknowledgment of their contribution in cash or kind, or recognition in nonmaterial fashion such as a day of celebration for a shaman. The decision about what form such compensation should take must be determined by the people from whom genetic and cultural information is being collected. This implies a condition of informed consent. People should know what might be done with information they provide and must be given the opportunity to place their own restrictions on how that information is used. Researchers and collectors are becoming more sensitized to these imperatives. For example, the Society for Economic Botany has developed a code of ethics for collection and the FAO of the UN has already developed such a model protocol (FAO 1993b).

Evidence exists that indigenous peoples can act effectively in defense of their resources, though the effectiveness of such regulation is crucially dependent on the strength and character of indigenous rights over the land on which the resources are located and on the exigencies of national laws. For example, the Kuna people of Panama require payments from scientists wanting to engage in collection or research activities on Kuna land. Moreover, recognizing that real control of genetic information lies ultimately in knowing more about what it is and especially about how it might be used (and what it might be worth) in an industrial society, the Kuna require that an indigenous assistant accompany the scientists and that reports resulting from the research or collection be made available to them.

Such bilateral arrangements between a community or a people and an outside entity will surely be useful if intelligently crafted. But these community-based agreements also could well be subject to abuses, especially when the indigenous group has little experience with legalisms and when substantial commercial as well as academic applications of knowledge are a real possibility. Moreover, indigenous and other communities are not necessarily the homogeneous, solidarist, stable entities that some analysts romantically imagine. Not only are they subject to strains resulting from external pressures, they may also be characterized—as are most societies—by various gender and status divisions. Indigenous, rural, peripheral, farm, and peasant communities have had all manner of rural developers try to "do the right thing" as they saw it, or thought they saw it—almost always with little success (Chambers 1983). Effective consultation with a "community" is no more a simple matter when access to genetic resources is at stake than when any other issue arises.

In this regard, we note the possibly problematic approach to compensation recently introduced by the environmental NGO Conservation International in its

plans for a project in Surinam. That project envisions the possibility that patent rights could be allocated to specific shamans (Stone 1993). We regard all knowledge production as social, and this is nowhere clearer than in indigenous communities. Unreflective imposition of Western individual property rights on non-Western communities in the name of Western concepts of "equity" has possibly been more destructive than the unthinking introduction of technologies. Is introduction of individual patent rights appropriate? Or will such "inappropriate social rules" join "inappropriate technology" as a force eroding the very culture they purport to protect? Conservation International's approach might be considered in light of a vote taken recently by the Belize Association of Traditional Healers (BATH). BATH decided that any arrangements with the pharmaceutical industry for access to their plants should be returned, not to an individual shaman, but to the community of traditional healers via BATH (BATH n.d.).

The Middle Ground

As complex as the issues are at the individual and community level, they become considerably more complicated at what we are calling the "middle ground." In fact, agreements simply involving two parties—an individual or community supplier and a single nonlocal recipient—will probably be the exception rather than the rule. Often, we may expect that no single person or ethnic group or community will be associated with a particular plant of interest because of the plant's ubiquity. The plant may be used regionally, by more than one community or social group, and have different uses in different communities. And what of plants that the chemical prospectors may find to be valuable but are not actually used by the people on whose land it is found? In yet other cases, communities may not have the legal, technical, social, or political expertise or power to effectively structure an exchange in their own interests and may require the assistance of other organizations such as activist NGOs (Kloppenburg and Gonzales 1994). These sorts of situations involve supraindividual and supracommunity rights and interests, and there appears to be no clear-cut approach to the problem of equitably managing exchange.

A considerable amount of activity is now evident on this middle ground. As Northern corporations and research agencies become more interested in chemical prospecting, and as Southern nations and indigenous and peasant communities become aware of the need to defend their rights, a host of NGOs has stepped in to facilitate or manage the creation of new exchange mechanisms with an enhanced legitimacy that is derived from the inclusion of various forms of compensation for suppliers of biochemical and genetic information.

The Rainforest Alliance and WRI have developed a model contract that represents a valuable attempt to encompass the many legal issues that arise (Downes et al. 1993). But the complexity of the model may limit its usefulness to most indigenous or peasant communities. The NCI has, to its credit, felt an obligation

to engage these issues and has developed a policy that includes provisions for the transfer of "knowledge, expertise and technology" developed during the discovery process to the country where the organism was collected. Another clause in this document "requires the successful licensee to negotiate and enter into agreement(s) with the appropriate source country government agencies. These agreement(s) will address the concern on the part of the source country government that pertinent agencies, institutions, and/or persons receive royalties and other forms of compensation, as appropriate" (NCI, n.d.). Additional "up front" and long-term benefits are offered to the source country through this agreement. The NCI requires that if a promising compound is licensed to a company, the company is required to "negotiate and enter into agreement(s) with the appropriate source country Government agency(ies)." A similar version of this agreement has been recently signed between the NCI and Awa people of Ecuador (H. T. Beck, personal communication).

Another type of agreement, by Shaman Pharmaceuticals, Inc., seeks to compensate *all* parties in all countries who have entered into collaboration with the company since its inception, through the formation of a nonprofit foundation, the Healing Forest Conservancy (discussed elsewhere in this volume). Yet another approach has been developed by Darrell Posey (1994), who has drafted "A covenant on intellectual, cultural, and scientific property: A basic code of ethics and conduct for equitable partnerships between responsible corporations, scientists, or institutions, and indigenous groups." More like a treaty than a contract, an altered version of this model has apparently been implemented in an agreement between the Kayapó people of Brazil and the well-known company The Body Shop International (Foundation for Ethnobiology 1993).

The United States Agency for International Development (USAID), the National Institutes of Health (NIH), and the National Science Foundation (NSF) are embarking on a program of biodiversity prospecting. These three agencies have just funded five consortia—or, as they phrase it, International Cooperative Biodiversity Groups (ICBGs)—in a $12-million, five-year program of chemical prospecting. These ICBGs comprise alliances of corporate, NGO, and academic organizations focusing on "the selection and acquisition of natural products derived from biological diversity as potential therapeutic agents" (NIH 1993). This work will be carried on by such well-known companies as Monsanto, American Cyanamid, Bristol-Myers Squibb, and Shaman Pharmaceuticals. Assisting these companies will be organizations like the Missouri Botanical Garden, Washington University, INBio, Cornell University, Conservation International, and the Walter Reed Army Institute. Projects will be carried out in Asia, Africa, and Latin America. According to the NIH, "Intellectual property agreements have been negotiated among participating institutions so that economic benefits from these discoveries are equitably shared and accrue to local communities and indigenous peoples involved in the discovery of the natural product" (NIH 1993:2). At this point, we cannot

assess these arrangements since they are considered to be proprietary information. Certainly, these projects will bear watching in the future.

The International Level

While the immediate appeal of such contracts for (some) farmers and indigenous people is considerable, they will work only in rather restricted circumstances: where a particular people/community/region can be unambiguously associated (i.e., have clear tenure) with a particular genetic component or organism with substantial value. We fear that this condition may hold rather less often than many people now anticipate. We have two concerns.

First, nearly all genetic contributions are very small. Yet in aggregate they are very large. Take the example of wheat in the U.S. It has benefited tremendously from genes from all over the world. But each piece of the genetic "stew" that is a modern wheat variety contributes rather little and has value only in interaction with millions of other genes. While there is no convenient way to follow each and every contribution, it is clear that in aggregate the South is a large net contributor of genetic materials. On the other hand, the North (with its superior capacity to use those materials) benefits enormously. Moreover, because the North benefits disproportionately from access to global genetic resources, it has a greater interest in ensuring—and a greater ethical responsibility to ensure—the preservation of those materials. For these reasons, it is appropriate that there be a concrete recognition of the North's greater debt. But this can be accomplished only through some global mechanism that does not depend on a detailed accounting of genetic contributions of peoples, communities, or nations.

Second, only a global framework can provide for compensation for materials for which there is no unique ethnic or geographic provenance. The neem tree (*Azadirachta indica*) is an example here. Native to Asia, its useful properties have long been understood by peasant farmers. These properties have also been recognized by companies. Extract of neem has been synthesized. Moreover, the synthesized extract has been patented and is now being produced commercially as a biopesticide by the agropharmaceutical transnational W. R. Grace (Burrows 1993). But there has been no reciprocal flow of benefit to Indian farmers. And even if there were, it is not clear who should be compensated: some Indian farmers, all Indian farmers, NGOs claiming to represent Indian farmers, or the Indian government? Additionally, the neem now grows in Africa and elsewhere. Should African farmers receive benefits as well? We may find that there are relatively few biological materials that can be clearly assigned to a community or even a region. It may be that most value will ultimately be transferred to the North in materials like neem and that the situation in which a particular ethnic group or community or even country can be compensated will be quite rare. In addition, companies will be looking for alternate suppliers for any material that has significant com-

mercial value. Without a compensation mechanism at the global level, relatively little compensation may ever flow to the South.

The Convention on Biological Diversity concluded in Rio de Janeiro recently is the obvious candidate for the global mechanism that we believe is required. However, as it stands, the convention is clearly inadequate (Athanasiou 1992; Shiva 1992). Rio was more a biological GATT than anything else, a debate over how the earth's resources would be exploited rather than protected. The convention established the global hegemony of the existing legal framework for the appropriation and patenting of biochemical and genetic material. On the other hand, it failed to deal with materials already appropriated and stored in gene banks and, even more critically, neglected to concretely engage the question of "farmers rights" to the genetic resources they produce and reproduce every day (GRAIN 1994). The FAO, which pioneered the concept of farmers rights in its International Undertaking on Plant Genetic Resources, is now in the process of revising its undertaking to make it compatible with the Biodiversity Convention (FAO 1993a). This initiative might provide an avenue for the institutionalization of a compensation mechanism appropriate to the global level as a means of facilitating a flow of benefit to communities of farmers and indigenous peoples who supply genetic materials. If the FAO initiative should show promise, a similar arrangement might be developed with regard to medicinal plants. The Convention on Biological Diversity may not be much, but it is now the only game in town.

Intellectual property rights agreements in the medicinal plant arena are evolving and proliferating at considerable speed, with new approaches being suggested or implemented every few months. It is appropriate that those developing the agreements have a clear understanding of the issues involved, as well as the complex interactions between the various "social actors"—individuals, communities, companies, and institutions, both local and international. If we are to achieve maximum benefits from the employment of "utilitarian" agreements for biodiversity conservation, then mechanisms must be worked out that recognize and include all the parties involved in the process of biodiversity prospecting in its broadest sense.

This will not be easy. Different arrangements are required for different levels, and at any one level no single approach will necessarily be appropriate. The diversity of initiatives and arrangements now emerging at least has the virtue of reflecting the principle of "tactical pluralism" that Michael Soulé (1991:748) believes to be the most appropriate path for concrete efforts at conservation. The variability of the social as well as the biological world appears to require diverse strategies. We need to develop innovative models, monitor those models, and have the courage and the political will to modify them as necessary to realize a just as well as a utilitarian regime of exchange of biochemical and genetic materials.

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