Protecting Biodiversity: Recognizing International Intellectual Property Rights in Plant Genetic Resources

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SUMMARY

Accelerating deforestation in many tropical countries with the concomitant loss of plant species diversity incites increasing international concern. Until very recently, international environmental law tended to regard natural plant species as a "common heritage," a universal resource immune to private property claims. This common heritage approach to the problem of biodiversity loss has left the majority of plant species in a jurisprudential void, unprotected by property rights and subject to conflicting claims by countries with divergent goals. Unrelieved economic pressures force impoverished peoples in species-rich developing nations to resort to activities that ravage the forests, and the tragedy of biodiversity loss continues to play itself out on the global commons.

The United Nations Framework Convention on Biological Diversity, concluded on June 5, 1992 in Rio de Janeiro, Brazil, addressed the worsening problem of global biodiversity loss and focused on creating economic incentives for developing nations to conserve species diversity. Despite copious criticism and discordant interpretations of the text, the Convention marks a discernible evolution in international legal standards on plant diversity preservation. In manifesting nearly uniform agreement on the principle that nations exercise sovereign rights over plant genetic resources within their borders and deserve to share in the benefits accruing from the exploitation of these resources, the Convention rejects a decades-long attempt by many nations to classify naturally-occurring plant genetic materials as a common heritage of humanity. In adopting an approach which could recognize intellectual property entitlements both in discovered or protected natural plant germplasm\(^1\) and in the end products of biotechnology research, the Convention heralds a new direction for analyzing plant genetic resources under international law.

More than 150 nations signed the Convention, with only the United States refusing to participate in the final treaty.\(^2\) Several of the Convention's clauses appearing to limit intellectual property rights in technological products proved unacceptable to the U.S. government. At the same time, though, the treaty's underlying philosophy, an implicit acknowledgment of property entitlements in naturally-occurring

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1. "Germplasm" refers generally to the hereditary information contained in the germ cells of an organism.

An international system of reciprocal intellectual property rights in natural and improved plant germplasm combined with economic inducements, in any of several possible forms, would benefit both developed and developing countries. Developing nations desire compensation and technology transfers in exchange for the use of their natural resources; industrialized countries seek continued access to new, unimproved species and fiercely guard their grants of intellectual property rights in technological products and processes. Licensing access to raw germplasm would remunerate developing countries for the use of their plant material and would ensure that companies and countries that profit from the use of plant species pay for some of the costs of conserving wild species. A system of property rights recognizing entitlements in plant genetic material and in the technology resulting from modification of plant material would create incentives to conserve, continue inducements to invest in technologies, and focus on the needs and interests of both developed and developing countries.

The Biodiversity Convention indicates a willingness to balance the contributions and needs of developing countries wealthy in species diversity with those of industrialized nations. Recently, several private companies have arranged to compensate developing countries for the use of their natural plant materials. These instances of a growing practice of recognizing the property rights of nations in their native species, together with the near-global consensus on the essential philosophy of the Biodiversity Convention, evidence an emerging legal model that may achieve more success in preserving biodiversity and in distributing benefits equitably among nations than the common heritage approach of international environmental law.

I. THE IMPORTANCE OF PROTECTING PLANT BIODIVERSITY

The crisis of global species depletion encompasses the quickening extinction of plant and animal varieties, the accompanying genetic erosion as their genes disappear forever, and the resulting genetic uniformity of species. This loss of biodiversity, the "death of birth," assumes catastrophic proportions as species disappear from the earth at a furiously increasing pace. Although no one knows the number of plant materials, resonates with echoes of the U.S. plant patent regime and can be compatibly aligned with U.S. law.


current plant species "even to the nearest order of magnitude," biologists estimate the existence of five to thirty million different species, of incalculable value to human beings.7

Plant genetic resources, the chemical chromosomal information carried in gene alleles of living plant cells, furnish the raw materials for plant breeders and biotechnologists.8 Plant genetic materials provide valuable resources for human beings all over the world as sources of fibers, petroleum substitutes, ornamentation,9 and, particularly, of pharmaceuticals and food crops.10

Scientists estimate that twenty-five percent of all drugs sold in the United States over the past twenty-five years derive from plants11 and that more than eighty percent of the people in developing nations rely on traditional medicine, of which eighty-five percent of the preparations are based on extracts from higher plants.12 Worldwide, approximately 3.5 - 4 billion people rely on medications deriving from plants.13 The rosy periwinkle of Madagascar, for example, yields two compounds used to treat Hodgkin's disease and juvenile leukemia with great success.14 Researchers and scientists have only begun to tap the


9. Recently, researchers have been trying to develop flowers which won't wilt as quickly by searching for the genetic signal to switch off production of the ethylene responsible for biodegradation. If Love Can Last, Why Not Flowers?, N.Y. TIMES, Feb. 14, 1992, at A14.

10. Wilson, supra note 7, at 8. There are many other motivations apart from existing and potential economic benefits of plant resources to conserve living species, such as aesthetic and moral reasons. OFFICE OF TECHNOLOGY ASSESSMENT, TECHNOLOGIES TO MAINTAIN BIOLOGICAL DIVERSITY 27 (1987). Also, one theory maintains that instability in countries such as Haiti and El Salvador is due in part to the destruction of natural resources in those areas. Id. at 286. Still, economic arguments for preservation of biodiversity tend to gather the strongest support for conservation goals. NORMAN MYERS, A WEALTH OF WILD SPECIES 10 (1983).


12. Farnsworth, supra note 11, at 83.

13. Id. at 91. The bark of the cinchona tree has been known to combat malaria since the time of the Incas. Eisner, supra note 5, at 197.

14. Birds and Bees, THE ECONOMIST, May 30, 1992, at 15, 17 (survey following p. 54) ("one of the most quoted examples" of the potential value of unimproved germplasm). Before the discovery of the rosy periwinkle in 1960, a child afflicted with leukemia had a 1 in 5 chance of survival; today that rate is 4 in 5. MYERS, supra note 10, at 96. Foxglove (digitalis) has achieved
vast chemical storehouse of plant genetics for medicinal products.\textsuperscript{15} The loss of a species entails the loss of a unique set of chemicals and genetic materials not likely to be invented by human beings.\textsuperscript{16} Among the unexplored wealth of plant species may lie the components of innumerable potential vaccines and drugs needed to protect humanity against present and future diseases.\textsuperscript{17}

Preservation of plant genetic diversity also plays a crucial role in agriculture. Landraces, traditional peasant farming crops, consist of varieties of wild strains containing heterogeneous genetic information and manifesting diverse characteristics and different immunities to plant diseases.\textsuperscript{18} Modern industrial modes of agricultural production concentrate heavily on a few commercial crops which perform well in mass farming but exhibit genetic uniformity. Since uniform species run a high risk of vulnerability to new pests and pathogens,\textsuperscript{19} plant breeders seek to generate disease-resistance or other traits in their hybrids by crossing plants with their wild and weedy natural relatives.\textsuperscript{20} To continue to develop viable crop varieties, breeders and seed companies need access to a wide array of indigenous, genetically diverse plant species evolving in their local environments.

Unfortunately, the Green Revolution caused many subsistence farmers to replace their traditional, genetically variable landraces with uniform, high-yielding varieties based on native landraces.\textsuperscript{21} The de-

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\textsuperscript{15} Only an estimated 1\% of the flowering plants on the planet have been assayed and phytochemically examined for potential uses. \textit{Myers, supra} note 10, at 94.

\textsuperscript{16} Eisner, \textit{supra} note 5, at 197.

\textsuperscript{17} Smith-Kline Beecham Pharmaceuticals announced the discovery in China and India of a tree which provides a compound potentially useful in attacking lung and ovarian cancers. William K. Stevens, \textit{Shamans and Scientists Seek Cures in Plants}, \textit{N.Y. Times}, Jan. 28, 1992, at C1, C9.

\textsuperscript{18} Miguel A. Altieri & Laura C. Merrick, \textit{Acroecology and In Situ Conservation of Native Crop Diversity in the Third World, in Biodiversity} 361, 362 (Edward O. Wilson ed., 1988).


\textsuperscript{20} Altieri & Merrick, \textit{supra} note 18, at 362.

\textsuperscript{21} \textit{Id.} at 361. The amount of land in developing countries devoted to cultivating these highly productive but genetically uniform specialized varieties increased 40\% from 1960 to 1980. \textit{Birds and Bees, supra} note 14, at 16. More than 70\% of agricultural land in the world is devoted to cereal production. \textit{Martin Ingrouille, Diversity and Evolution of Land Plants} 291 (1992).

The replacement of variable landraces with uniform breeding varieties can lead to a drastic decrease in the stock of landraces needed for response to pests and pathogens, sometimes with
development of future crop strains able to withstand diseases depends on the continued cultivation of evolving landraces, but native farmers often prefer to raise more profitable, commercial agricultural varieties. Similarly, the maintenance of the global chemical storehouse of plant genetic information depends upon the preservation of the tropical rain forests, even though people in tropical countries receive money from sources outside their countries for logging, agriculture, mining, oil exploration, and other activities which destroy the forests.

Two-thirds of existing plant species are located in the developing world. The majority of plant species grow in the tropical moist forests, which cover only six percent of the earth’s surface area, and fall primarily within the borders of developing nations. As the pressures of foreign debt and increasing population push the people of species-rich developing countries to try to improve their agricultural output, they seek more and more arable land. Deforestation, the largest threat to biodiversity, stems mainly from attempts to cultivate land in order to pay off debts, buy manufactured goods from industrial nations, attain economic self-sufficiency, and support exploding populations at subsistence levels. Thus, the pressures leading to unchecked devastating consequences. Kloppenburg & Kleinman, supra note 19, at 9. In 1991 genetic uniformity led to the “worst outbreak of citrus canker ever recorded” in Brazil, and almost 80% of the vegetable varieties used in the United States 100 years ago have since disappeared. WWF Urges Governments to Protect Wild Food Crops to Ensure World Food Security, Int’l Envtl. Rep. (BNA), at 364 (Jun. 3, 1992) [hereinafter WWF Urges Governments]. Rice breeders in the Philippines have suffered from the same phenomenon. Many switched to a different variety of rice when the Taiwanese strain they had been using showed certain susceptibilities to disease. Discovering that the second hybrid could not withstand high winds, they decided to replant the original variety but found that Taiwanese farmers had also all planted the “improved” version. As native farmers had ceased to cultivate it, the original variety vanished forever.


23. Wilson, Biodiversity, Prosperity, and Value, supra note 6, at 5. Human activity has already reduced the tropical forest by 45%, and about 100,000 square kilometers (approximately the areas of Switzerland and the Netherlands combined) go up in flames or are felled for timber each year. Id. at 6. 93% of Madagascar’s forests has already vanished, and 99% of Brazil’s Atlantic coastal forests has disappeared. Wilson, supra note 7, at 10. The rate of deforestation in 1989 was 90% greater than that in 1979. Norman Myers, Viewpoint, 41 BIOSCIENCE 282 (1991). “At this rate, most of the rain forest of the world will be gone within 30 years.” Wilson, Biodiversity, Prosperity, and Value, supra note 6, at 6.

24. Baker, supra note 4 at 539.

25. Cameron Tyler, International Conservation of Plant Genetic Resources, 11 L.I.S.A. J. INT’L L. 41, 54 (1987). Twenty years ago, Africa produced enough grain to feed itself, but it now finds itself a food importer as its rate of population increase outstrips that of its rate of cultivation. JUMA, supra note 21 at 25. Population in the Brazilian state of Rondonia in the southern Amazonia has skyrocketed in 12 years from 110,000 to over one million, mainly due to the influx of migrant farmers. Whereas 1,250 square kilometers had been cleared from the area as of 1975, more than 16,000 square kilometers had been razed by 1985. Norman Myers, Draining the Gene Pool: the Causes, Course, and Consequences of Genetic Erosion, in SEEDS & SOVEREIGNTY: THE USE AND CONTROL OF PLANT GENETIC RESOURCES 90, 102-03 (Jack R. Kloppenburg, Jr. ed., 1988).

26. Michael H. Robinson, Are There Alternatives to Destruction?, in BIODIVERSITY 355 (Edward O. Wilson ed., 1988). Statistics bear out the assertion that the major impetus for deforestation...
deforestation and the extinction of innumerable species are mainly economic.

Appealing to developing countries to forego potential sources of income or to assume voluntarily the costs of conserving native landraces and tropical forests is unrealistic. In order to spur conservation of genetic materials and plant species, economic incentives need to be designed to counterbalance the economic forces leading to the destruction of natural habitats.

II. PREVIOUS ANALYSIS OF PLANT GENETIC RESOURCES UNDER INTERNATIONAL LAW

A. Classifying Plant Species as a Common Heritage of Humanity

Exotic plant species found in nature have historically been free to the taker. Since the Age of Exploration researchers and travelers have brought discovered plant species back to their own countries as new foods and as raw material for plant breeding. Although naturally-occurring plant genetic resources are now often treated as subjects of free exchange among nations, industrial countries with intellectual property systems protect plant-derived breeding and bioengineering products developed by their seed and pharmaceutical companies.

Less-developed nations complain that researchers from large multinational corporations freely prospect in the tropical forests for native landraces and new species and then sell expensive, patented varieties and biotechnology based on the native species back to developing countries. These nations' assertions of unfair exploitation have en-
gendered deep bitterness and political controversy between the “rich, but gene-poor North” and the “poor, but gene-rich South.” The deep resentment harbored by many developing countries found expression in a resolution, the International Undertaking on Plant Genetic Resources, passed by the United Nations Food and Agriculture Organization (FAO) in 1983 deeming *all* plant germplasm the “common heritage of mankind.” Developing nations maintained that, so long as their raw plant germplasm remained freely available to other nations, they could lay equal claim to “special genetic stocks,” including breeders’ lines protected by patents and plant breeders’ rights certificates in the developed world.

Industrial nations either completely rejected the Undertaking’s principles or made express reservations to provisions dealing with the absence of breeders’ rights. That the ensuing controversy over control of plant genetics has been termed “seed wars” testifies to the depth of discord on the issue. According to critics, the Undertaking polarized nations instead of seeking compromise, and failed to motivate states to conserve and to grapple with the difficult issues of access to germplasm. In fact, most industrial nations already belonged to the International Union for the Protection of New Varieties of Plants (UPOV), a multilateral convention created to set uniform, minimum standards for plant breeders’ rights and to safeguard breeders’ interests. Eight UPOV nations at the FAO Conference protested that the Undertaking contravened existing law - both national plant breeders’ rights legislation and the UPOV treaty - and reserved to the Undertaking.

32. Kloppenburg & Kleinman, *supra* note 19, at 3. “Whereas germplasm flows out of the South as the ‘common heritage of mankind,' it returns as a commodity.” Id. at 10. Although this conflict is often phrased as a division between the Northern and Southern Hemispheres, the phrase is misleading. Most centers of rich biodiversity are actually located north of the equator. Jack R. Harlan, *Seeds & Sovereignty: An Epilogue, in Seeds and Sovereignty: The Use and Control of Plant Genetic Resources* 356, 356-57 (Jack R. Kloppenburg ed., 1988).


36. JUMA, *supra* note 21, at 169.


39. *Id.* at pmbl. Over nineteen nations have ratified UPOV, which now numbers the United States, Canada, Japan, New Zealand, Australia, South Africa, Israel, and “the major countries of Western Europe” among its members. William L. Hayhurst, *Exclusive Rights in Relation to Living Things, 6* INTELL. PROP. J. 171, 179 (1991).

40. Harold J. Bordwin, *The Legal and Political Implications of the International Undertaking*
Many developed countries perceived the common heritage premise of the Undertaking as an assault on their private property systems. These nations clung fiercely to their intellectual property systems, and remained unwilling to relinquish them in the face of a global call to plant communism. Thus, the Undertaking’s common heritage approach did not prevent industrial countries from protecting their intellectual property rights in plants, and it failed to win any sort of compensation for developing countries that protect their plant species.

B. Imperfections of the Common Heritage Model as Applied to Plant Genetic Resources

Plant germplasm, often treated as national or private property, falls outside the scope of the traditional definition of a common heritage of humanity. The common heritage principle was first enunciated in the Law of the Sea negotiations. It has since gained universal acceptance in areas, such as the deep sea-bed, the lunar surface, or Antarctica, which fall outside of the jurisdiction of any one state and not yet subject to exploitation. However, as plants grow within national borders, sovereign nations can exercise de facto ownership of their national germplasm collections and choose to exploit or preserve their native species as they please. Nations may and do set export restrictions on the transfer of native plant germplasm, albeit with varying degrees of success. Furthermore, the legal structures of many countries do recognize personal property rights in living organisms.

Even if plant germplasm unequivocally fit the common heritage

on Plant Genetic Resources, 12 ECOLOGY L.Q. 1053, 1069 (1985). The United States, for example, would not have been able to join the original Undertaking without changing its domestic laws on plant breeders’ rights or expressing major reservations to the text. OFFICE OF TECHNOLOGY ASSESSMENT, supra note 10, at 26.


42. Kloppenburg & Kleinman, supra, note 41, at 192.


44. JUMA, supra note 21, at 172.


46. Harlan, supra note 32, at 361.

47. Id. Although countries exercise jurisdiction over their species, this right to physical control differs from an intellectual property right. At present, a researcher who successfully smuggles out a plant sample (a fairly frequent occurrence) may use it to develop profitable products with impunity. A species-rich nation which has an intellectual property right in germplasm, though, could prohibit certain uses of the plant genetic material even beyond its borders.

48. One may own a pet, capture an animal and sell it to a zoo, or prevent others from taking apples from one’s tree. “The concept of ownership of plant products is as old as trade in seeds….” Donald N. Duvick & William L. Brown, Plant Germplasm and the Economics of
model, the tragedy of the commons would reason in favor of its privatization. When no ownership rights in plant species exist, economic incentives stimulating individuals or countries to overexploit plant species outweigh the inducements to preserve natural habitats. In many developing countries, economic values subordinate conservation impulses, and only those who find it in their self-interest to protect diversity do so. In sum, the classification of plant genetic materials as a common heritage, as advocated by the initial FAO Undertaking, would not solve and would perhaps even exacerbate the problem of protecting plant species diversity from inadvertent destruction.

The attempted denial of private property in plant germplasm was doomed from the start. Private companies rely on sales to recoup research investment costs and reap profits, and countries with seed industries eagerly endorse the concept of guaranteed free access to the raw germplasm but refuse to surrender their competitive superiority.

Even if developing countries could convince industrial states to engage in free global exchange of all plant germplasm, developing nations still would not necessarily gain much. The advanced breeding lines these countries claim to desire are technologically sophisticated but often designed specifically for industrial, energy-intensive agriculture. "Access to a Funk Seed Company sorghum line...[with] a bacterial gene added which provides resistance to a proprietary herbi-


49. In his classic essay, "The Tragedy of the Commons," Garrett Hardin argued that the natural tendency of all individuals to maximize their own profits will lead to the systematic overexploitation of free, common resources. According to Hardin, rational, profit-seeking people will choose to pollute common waters and air spaces as long as the cost to them of purifying their discharges outweighs their proportionate burdens of enduring a polluted environment. Similarly, self-interested individuals benefit from extracting the maximum possible gains from a common resource, even if that will eventually destroy the resource for society as a whole. Garrett Hardin, *The Tragedy of the Commons*, SCIENCE, Dec. 13, 1968, at 1243.

50. Sedjo, supra note 27, at 300.


52. Sedjo, supra note 27, at 294.

53. William L. Brown, *Plant Genetic Resources: A View from the Seed Industry, in Seeds and Sovereignty: The Use and Control of Plant Genetic Resources* 218, 225 (Jack R. Kleppenburg, Jr. ed., 1988). "To ask that an elite parental line which costs a company several hundred thousand dollars to develop be [freely] exchanged for cultivars of limited or unknown potential is simply not reasonable, and seed companies will not agree to such an arrangement." *Id.*

54. Kloppenburg & Kleinman, supra note 41, at 194.
cid produced by Funk's corporate parent."55 would probably be of little service to a state unable to afford an expensive, proprietary herbicide. Tropical countries might benefit more by claiming a property right in the plant genes underlying advanced breeding lines with a view towards demanding royalties when they are sold to agricultural industries. A system of patent-like breeders' and farmers' rights would provide the most promising options for resolving the present geopolitical impasse while improving the position of peoples in developing nations.56

C. Turning Away from the Common Heritage Approach

As arguments against the common heritage model of biodiversity resounded increasingly convincingly, as developing countries evidenced differing resources and needs which divided them, and as industrial nations firmly defended their grants of property rights, the international challenge to private property interests in plants inevitably began to abate.

The 26th FAO Conference amended the Undertaking on November 25, 1991 to admit the principle that "the concept of mankind's heritage, as applied in the International Undertaking on Plant Genetic Resources, is subject to the sovereignty of the states over their plant genetic resources."57 This amendment signalled a retreat from the Undertaking's original, explicit disavowal of intellectual property rights in any plant forms by referring to plant breeders' rights and farmers' rights.58 Since the intellectual property rights laws of many countries permit the patenting only of invented, not discovered, plant varieties,59 recognizing the sovereign rights of nations over their plant materials effectively allowed only improved varieties and breeding stocks to be sheltered under proprietary rights systems. Only naturally-occurring plant species remained accepted as part of the global common heritage. Thus, developing nations did not receive any benefits as compensation for their own efforts in preserving agricultural cultivars and natural forest areas, while industrial nations continued to affirm the rights of their companies to profit from their work in biotechnology research on plants.

The debate on the value of the common heritage approach continues. Some contemporary legal scholars argue that biodiversity resources still ought to be considered part of a global holding.60 In

55. Id. at 193.
56. Id. at 199.
58. Id.
59. See infra Part III (C)(2).
60. See, e.g., Roseanne Eshbach, A Global Approach to the Protection of the Environment:
recent debates in the European Parliament, opponents of proposed biotechnology patents resisted the prospect of permitting patents on wild species in the belief that natural genetic resources constitute a common heritage of humanity. In spite of the continuing controversy, though, many developing countries have begun to turn away from the common heritage theory and to focus on their sacrifices and efforts in conserving plant life as the foundation of a different structure of entitlements.

III. THE 1992 U.N. FRAMEWORK CONVENTION ON BIOLOGICAL DIVERSITY

A. Interpretations of the Biodiversity Convention

On June 5, 1992 the United Nations Conference on Environment and Development concluded the Framework Convention on Biological Diversity in Rio de Janeiro, Brazil. At the end of “arduous and acrimonious negotiations,” over twenty nations expressed major reservations about the final text. Nonetheless, over 150 countries, including all the major global powers except the United States, eventually signed the Convention.

No consensus truly exists as to the Convention’s likely effects. The document probably either serves as a “declaration of good intentions” or an important first step towards international action on the issue of biodiversity conservation.

*Balancing State Sovereignty and Global Interests, 4 TEMP. INT'L & COMP. L.J. 271, 280 (1990) (that the global environment is the common heritage of humanity, and states can not “exercise rights over their resources without ‘due regard to the corresponding rights of others’”); Gary D. Myers, Surveying the Lay of the Land, Air, and Water, 3 COLO. J. INT'L ENVTL. L. & POL'Y 479, 578 (1992) (that national sovereign control over biological resources is not the proper way to preserve biodiversity); Kathryn Rackleff, Note, Preservation of Biological Diversity, 3 COLO. J. INT'L ENVTL. L. & POL'Y 405 (1992) (that “world leaders are beginning to recognize the earth’s biological diversity as a global commons”).


63. Nations Forge Biodiversity Convention that is ‘Flawed’, Rio Support Doubtful Int'l, Envtl. Rep. (BNA), at 346 (June 3, 1992). “As so often happens in the UN, the negotiation process . . . turned into something of a soccer game, with the developed . . . and the developing countries . . . booting the ball back and forth.” Rodger Schlickeisen, Protecting the Earth’s Genetic Library, WASH. POST, May 24, 1992, at C7.

64. Rudy Abramson, Earth Summit Ends on Optimistic Note, L.A. TIMES, June 15, 1992, at A4. Sally Lehrman, Genentech’s Stance on Biodiversity Riles Staff, NATURE, July 9, 1992, at 97. How many of the signatory nations will ratify the Convention remains an interesting question. The treaty requires the deposit of 30 instruments of ratification before it can come into force. Convention, supra note 62, art. 36. Whether Japan and Western European countries uncomfortable with the language on intellectual property rights but anxious to avoid the spotlight of criticism at Rio will eventually ratify remains to be seen. Perhaps in the long run the United States will not be the only non-participant to the Convention.

tions which is very generic and open to interpretation,”66 or is “too vague to be threatening.”67 Viewed most positively, it can be considered a “framework within which more comprehensive agreements might be reached.”68

Consensus exists, by contrast, on the general philosophy of the treaty.69 The Convention most likely exhibits general agreement on a reciprocity theory - that countries which sacrifice to conserve natural species, as well as countries whose industries transform raw germplasm into useful products, should be entitled to receive a portion of the profits from the sale of these products. The Convention acknowledges the existence of intellectual property rights in plant germplasm,70 and repeated assertions throughout the text proclaim the sovereign rights of states over biological resources within their borders.71 In addition, the text obliges pharmaceutical, agricultural, and biotechnological industries to pay nations supplying plant germplasm with royalties and licensing of technology.72 Thus, the Convention implicitly disavows the theory that genetic resources constitute a common heritage of humanity, not private property, because their benefits reach beyond national borders.

The Convention’s proponents and detractors alike point out the text’s imperfections and its weak and imprecise wording.73 It is neither clear that the Convention creates a duty to conserve wild species nor obvious that such an obligation would be concrete and specific enough to be enforceable.74 Many of the “obligations” articulated in

67. Id. It has also been characterized as “[s]o watered down as to do no harm.” Two Successful Weeks at Rio, NATURE, June 18, 1992, at 523.
68. Id. at 524.
70. Convention, supra note 62, art. 16(2) (“the adequate and effective protection of intellectual property rights”); Id. art. 16(5) (“recognizing that patents and other intellectual property rights may have an influence on the implementation of this Convention”).
71. “Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation.” Id. art. 15(1). Also see id. pmbl and art. 3.
72. Id. arts. 1, 15, 16.
74. Some of the Convention’s supporters, though, do aver that the treaty creates for the first
the text relate to technology transfers and financial aid to developing countries rather than to any duties to preserve biodiversity. Moreover, the degree to which the Convention will achieve status as a legally binding document remains uncertain.

Spongy phrasing and vague clauses dilute much of the purported obligations contained in the Convention to merely precatory statements. Several of the Convention's provisions either set out requirements which countries should merely "endeavour" to fulfill or require performance only "as far as possible and as appropriate." Article 12 directs contracting states to "take[e] into account the special needs of developing countries," without providing further guidance as to the contours and weight of these needs. Not only are the Convention obligations "soft," with uncertain impacts, according to some critics, but the document limits itself to aiming at national conservation measures instead of addressing the biodiversity problem in global terms.

B. The United States Perspective on the Biodiversity Convention

Despite the ambiguous wording of the Convention's provisions and its likely ineffectiveness as a binding legal document, most of the world was willing to accept the treaty, at least as an exposition of general principles. The United States, though, chose to dissent and risk a "public relations disaster" because of a perception that the text worked against United States interests. The text of the Convention, according to a U.S. State Department Release, is "seriously flawed in a number of respects," and its provisions on funding did not meet U.S.

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75. "The developed country Parties [to the treaty] shall provide new and additional financial resources to enable developing country Parties to meet the... of implementing measures which fulfill the obligations of this Convention." Convention, supra note 62, art. 20(2). Also, see id. arts. 16(1), 16(4), 20(2).

76. The Convention, to be legally binding on its signatories, will only enter into force when at least 30 nations ratify it. Id. 36(1). However, "the extent to which developing country Parties will effectively implement their commitments" under the Convention is left explicitly conditioned upon their receipt of financial support and technology from the developed world. Id. art. 20(4).

77. See, e.g., id. arts. 8(i), 15(2), 15(6).

78. Id. arts. 5, 7-11, 14.

79. Article 20(5) stands as a prime example of obfuscating emptiness: "The Parties shall take full account of the specific needs and special situation of least developed countries in their actions with regard to funding and transfer of technology." Id. art. 20(5).

80. Nations Forge Biodiversity Convention That is 'Flawed,' supra note 63, at 347. A "hodgepodge of provisions advocated by the two sides," the treaty resulted from "efforts... to water it down to a vague and meaningless initiative that would have no significant benefit for wildlife." Schlicker, supra note 63, at C7.


expectations. In addition, the State Department declared that "[t]he convention focuses on [intellectual property rights] as a constraint to the transfer of technology rather than as a prerequisite."

The argument that some provisions of the Convention would contravene domestic laws is valid from a U.S. legal perspective. Article 16(5), for instance, directly conflicts with U.S. legal interests by simultaneously affirming, while qualifying, existing intellectual property rights:

The Contracting Parties, recognizing that patents and other intellectual property rights may have an influence on the implementation of this Convention, shall cooperate in this regard subject to national legislation and international law in order to ensure that such rights are supportive of and do not run counter to its objectives.

The "objectives" of the Convention include the preservation of biodiversity and the "fair and equitable sharing of the benefits arising out of the utilization of genetic resources." Thus, the text acknowledges the existence and validity of intellectual property rights, with the apparent limitation that these rights not interfere with the "fair and equitable sharing" of the advantages of technological and agricultural products. According to the treaty, then, patents would be respected only where they do not prevent universal distribution of patented products. Moreover, article 16(5) permits "national legislation" to limit obligations to respect intellectual property rights even further.

Article 16(4) similarly may be read as permitting the abrogation of full grants of intellectual property rights. It directs party countries to undertake measures to force private industries to transfer technology to private institutions and governments in developing countries. For the United States this would entail implementing additional domestic legislation regulating private technological firms and possibly creating new causes of action in U.S. courts.

At present, industries acquire biological materials from developing nations primarily on a commercial basis. Home to both the most profitable and developed biotechnology industry in the world and a strong property rights system, the United States prefers to allow market forces, rather than administrative regulations, to influence contracts between U.S. companies and gene-rich nations. Some U.S. critics

83. According to the United States, text provisions contain "unacceptable language on the transfer of funds from developed to developing countries." Id.
84. Id.
85. Convention, supra note 62, art. 1.
86. "Each Contracting Party shall take legislative, administrative or policy measures... with the aim that the private sector facilitates access to, joint development and transfer of technology... for the benefit of both governmental institutions and the private sector of developing countries." Id. art. 16(4).
87. Stone, supra, note 65, at 1624.
objected that the Convention steers away from free market arrangements, instead emphasizing national and international legislation to regulate commerce in plant germplasm. The U.S. government believes that private companies negotiating with countries for plant resources might lose competitive advantages if the government signed the Convention and that, by refusing to sign, the United States avoided binding its companies to any open and unsettled arrangements.

Article 15(7) also appears inimical to U.S. patent law standards. This provision mandates "sharing in a fair and equitable way the results of research and development and the benefits arising from the commercial and other utilization of genetic resources with the Contracting Party providing such resources." Exactly what "fair and equitable" sharing would be in this context is unclear. Normally, transfer of the benefits of technology occurs either by contract or by compulsory licensing provisions of patent law. Presumably, U.S. patent licensing standards would be "unfair" and invalid internationally under this treaty if enough other countries found them overly restrictive. The United States has taken the position that this article would permit countries to disregard patent rights or to claim a share of the patent benefits of products derived from their natural resources even in the absence of any royalty contract.

Some supporters of the treaty accused the United States of "reading demons" into the text, and several of its allies greeted with skepticism the U.S. interpretations of the Convention's clauses as hostile to intellectual property rights in technology. Article 16(2), which mentions "adequate and effective protection of intellectual property rights," highlights this problem of construction. The Convention lacks any definition of "adequate and effective protection," and at least one developing nation has read the phrase as a mandate to ignore technological patents based on biological resources found in its territory.
Thus, the U.S. interpretations appear well-grounded in reality, particularly in light of the indistinct language of the text and other countries' reactions to it.

Even if the Convention text would not justify summary abridgment of U.S. intellectual property rights by other nations, it might still mandate more expansive compulsory licensing rules than the United States currently allows. Article 16(2) of the treaty calls for "access to and transfer of technology... to developing countries... under fair and most favourable terms, including on concessional and preferential terms." Some U.S. industries feared that "most favourable terms" would require broader compulsory licensing than is presently accepted under prevailing U.S. standards and that "preferential terms" would lead to non-free market licensing.

Several technological trade groups had urged the United States to oppose the treaty and supported its refusal to sign the document. Some commentators agreed with the U.S. government that signing the Convention would have impeded progress and hindered continuing improvements in biodiversity protection, since it is always more difficult to renegotiate a closed text. Strong voices within the country argued in favor of signing the treaty and working out the details later, in the interests of maintaining competitive advantages and a leadership role for the United States. Some maintained that the refusal to adhere to the Convention might place U.S. companies at a disadvantage, since species-rich countries might limit access to their genetic resources to those industries from signatory nations. The United States is currently pressing in GATT negotiations for stronger international protection of intellectual property rights and reduced compulsory licensing. There was some concern that agreeing to the ambiguous and controversial provisions of the Convention would compromise the U.S. position and inhibit U.S. negotiators in GATT rounds.

98. Convention, supra note 62, art. 16(2).
99. "To some biotech analysts, vague and legalistic passages in the treaty open the way to a nightmare scenario of compulsory licensing," which would require licensing of products and technology on preferential terms. Stone, supra note 65, at 1624. The U.S. government does not want to legally oblige private entities to provide preferential transfer of technology. U.S. May Not Sign Biological Treaty, N.Y. TIMES, May 23, 1992, at I.

The United States is currently pressing in GATT negotiations for stronger international protection of intellectual property rights and reduced compulsory licensing. There was some concern that agreeing to the ambiguous and controversial provisions of the Convention would compromise the U.S. position and inhibit U.S. negotiators in GATT rounds. Treaty Interferes with Principles of Patent Protection, supra note 89, at 406. Coghlan, supra note 73, at 9.

100. Industry Officials Call Biodiversity Treaty Vague, supra note 66, at 511.
101. Coghlan, supra note 73, at 9; Stone, supra note 65, at 1624.
102. The United States "cannot sign an agreement that is fundamentally flawed merely for the sake of having that agreement." Convention on Biological Diversity, supra note 82, at 423.
104. David P. Hackett, No: A Competitive Disadvantage, A.B.A. J., Sept. 1992, at 43. Some employees of biotechnological and pharmaceutical industries like Genentech, Inc. publicly criticized their companies' anti-treaty stances. Lehrman, supra note 64, at 97. A director of Smith-Kline Beecham mused that it was "puzzling that a number of other nations with a substantial interest in the technology have somehow made themselves comfortable enough to sign the treaty." Christopher Anderson, Industry Surprised by Firm U.S. Stance on Biodiversity Treaty, NATURE, June 11, 1992, at 428.
treaty does not prohibit private contracts, though, and U.S. companies remain free to negotiate royalties and technology transfers with other countries.106

Opposition to the Convention by no means commanded uniform approval throughout the United States. The internal debate continues,107 and the future international effect of U.S. non-participation remains unclear. Many observers claim that U.S. refusal to accede to the treaty matters little. The United States contains comparatively little of the world’s plant diversity; whereas its participation (as a huge emitter of greenhouse gases) would be crucial to the functioning of a climate convention, the U.S. role in biodiversity issues is negligible.108 According to UNEP’s director, Mostafa Tolba, the lack of U.S. participation will not undermine the treaty, as the “North needs the South in this agreement just as much as the South needs the North.”109

Overall, U.S. discomfort with the Convention arose where the text strayed from protecting biodiversity to regulating the results of biotechnology.110 U.S. reluctance to participate in the Convention focused primarily on exceptions to intellectual property rights in technology and potentially broad precedents on licensing that would create serious disincentives for private investment in developing nations. The principle of entitlements in raw genetic material for countries which have preserved these resources remains generally acceptable in the United States.111

106. U.S. Stands Alone, supra note 2, at 415.

107. The debate continues, in part because the treaty will remain open for signature until June 4, 1993. Convention, supra note 62, art. 33. Some predict that the United States will cave in to pressure to sign on at some time before then. U.S. Rio Stance Said to Hurt Competitiveness, supra note 105, at 5. Dolan & Abramson, supra note 97, at A16. The fact that then-Senator Albert Gore had publicly decried U.S. refusal to participate in lieu of working to improve some particular provisions, U.S. Stands Alone, supra note 2, at 415, leads to speculation that the new Administration may alter the U.S. stance.


109. Dolan & Abramson, supra note 97, at A17. The Convention may create a new, global standard of access to plant germplasm, and - with the signatures of most of the world’s nations, including specially-affected countries - the treaty may carry some weight as customary international law. The question of what legal effect the Convention would have on the United States as a dissenting state is practically moot, because U.S. firms will most likely have to abide by or one-up the terms of the Convention in order to compete with other firms offering financial and technological benefits. Hackett, supra note 104, at 43. “At this point, the only sure thing about the biodiversity treaty is this: The next rosy periwinkle won’t be free.” Stone, supra note 65, at 1624.


111. According to State Department officials, the United States agrees with the principle that underdeveloped nations should be compensated for use of their genetic resources. Jane Perlez, Environmentalists Accuse U.S. of Trying to Weaken Global Treaty, N.Y. TIMES, May 19, 1992, at B7.
C. Reconciling Rights in Natural Plants with Existing Intellectual Property Laws: A Comparative Analysis

By signing the Convention, many nations implicitly accepted the concept of granting property rights in naturally-occurring plant genetic materials. Only the United States rejected the Convention, because its broad language seemed aimed at diluting existing patent prerogatives in technology. Yet, U.S. intellectual property law recognizes ownership rights in new, invented or discovered living plant species. The prospect of rights in plant genetic materials found and protected within a country's borders is fundamentally compatible with U.S. intellectual property law.

1. The United States

The United States, the first nation to allow patents on plant genetic material, protects plants under the most expansive system of intellectual property rights in the world. A U.S. plant breeder may choose among three statutory options under which to shelter a new, genetically-engineered or discovered plant species: the utility Patent Act, the Plant Patent Act, and the Plant Variety Act.

U.S. law permits the protection of new plant varieties under the general, utility patent statute. The Supreme Court ended the 'product of nature' ban on patenting in 1980 and ruled in 1985 that the availability of plant patents and plant breeders' rights certificates did not preclude the possibility of utility patents for plants as well. Utility patents provide the strongest rights entitlements of all U.S. plant protection systems, but they also require the most stringent standards of novelty and are only available for invented, not discovered, species.

Congress passed the Plant Patent Act in 1930 to further extend patent rights to anyone who "invents or discovers and asexually reproduces any distinct and new variety of plant" except any "tuber-propa-

112. JUMA, supra note 21, at 149; Howard J. Brooks & Charles F. Murphy, Ownership of Plant Genetic Material, in BIOTIC DIVERSITY AND GERMPLASM PRESERVATION 493, 496 (Lloyd Knutson & Allan K. Stoner eds., 1989).
114. In the United States "anything under the sun that is made by man" may be patented. Diamond v. Chakrabarty, 447 U.S. 303, 309 (1980). Now that technological innovations allow clearer definitions of plant species, assigning definitive property rights in species is much more feasible. Sedjo, supra note 27, at 294. In addition, deposit samples of cultures, cells, tissues, etc. are now allowed to take the place of the § 112 written description and enabling disclosure. Baker, supra note 4, at 532-33.
In creating this patent legislation, Congress intended to stimulate a field of endeavor that had not yet blossomed into an industry and to vitiate the judicial interpretation that products of nature did not comprise statutory subject matter. The would-be plant patentee can apply once she invents or discovers a new and distinct variety of plant and reproduces it asexually. The patent owner's rights grant the ability to "exclude others from asexually reproducing the plant or selling or using" it. However, the sale or use of distinct mutants which arise from the plant, the sexual (seed) reproduction of the plant, and the independent development by one who breeds a similar variety do not infringe the patent. To date, over 6,000 plants have been patented under the U.S. Plant Patent Act.

The 1930 Plant Patent Act excluded sexually reproduced plants (the majority of higher plant species), but in 1970 Congress passed the Plant Variety Protection Act to protect sexually reproduced plants through a system of plant breeders' rights. Designed to stimulate breeders and discoverers to uncover new varieties for the public benefit and to promote progress in agriculture, the Plant Variety Protection Act provides patent-like protection to sexually reproduced plants through a registration process which issues certificates.

U.S. plant breeders' rights differ from patents in several important ways. Plant breeders' rights encompass sexually reproduced plants, whereas plant patents are available predominantly for asexually reproducing species. Plant breeders' rights protect the product only; patents shelter not only the product but also the process creating it. Breeders' rights proscribe a wider range of infringing activities, including sexually reproducing the protected variety or using it to produce a


121. CHISUM, supra note 117, at 1-272.

122. Brooks & Murphy, supra note 112, at 494.

123. 7 U.S.C. §§ 2321-2583 (1988); LIPSCOMB, supra note 119, at 177.


125. JUMA, supra note 21, at 162.
hybrid or different variety.\textsuperscript{128}

The Plant Variety Protection Act exempts specific activities of farmers and researchers from liability for infringement of plant breeders' rights.\textsuperscript{129} Also, unlike a patent, a grant of plant breeders' rights may be susceptible to compulsory licensing. While a patent-holder may choose to license, sell, or ignore her product, national authorities may force a breeder to license a novel plant variety to others at a "reasonable royalty" if "necessary to ensure an adequate supply of fiber, food, or feed... [when] the owner is unwilling or unable to supply the public needs for the variety at a price which may reasonably be deemed fair."\textsuperscript{130} Thus, plant breeders' rights balance societal requisites against private ownership rights slightly more than patents.

The United States recognizes intellectual property rights in many discovered or carefully bred and protected plant species. Therefore, the claim implicit in the 1992 Convention that countries have property entitlements in the plant species within their borders falls within accepted U.S. legal standards.

2. Other Nations

In contrast to the United States, many other countries resist classifying natural plant germplasm as patentable subject matter.\textsuperscript{131} The distinction many of these countries draw between property rights in natural plant materials and in developed varieties seems arbitrary and specious.\textsuperscript{132} The effort involved in maintaining or discovering useful plant species is often equivalent to that displayed in creating or developing new varieties. Traditional farmers have cultivated and preserved landraces and primitive cultivars for centuries; discovering and identifying a new plant species may require large investments of time.

\textsuperscript{130} 7 U.S.C. § 2404 (1988).
\textsuperscript{131} While U.S. law permits broad protection for plants, European nations separate "essentially biological" products and processes from patent protection. R.S. Crespi, PATENTS: A BASIC GUIDE TO PATENTING IN BIOTECHNOLOGY 158 (1988). These nations deny patent protection to plants "on bases which are more grounded in history and/or tradition than... reflective of the current state of legal and technological sophistication." STEPHEN A. BENT ET AL., INTELLECTUAL PROPERTY RIGHTS IN BIOTECHNOLOGY WORLDWIDE 167 (1987).
\textsuperscript{132} BENT, supra note 131, at 151.
and knowledge.\textsuperscript{133} No coherent reason justifies limiting patents to plants discovered in a cultivated state. Unrecognized varieties in nature are as effectively lost to humanity as are cultivated species.\textsuperscript{134} Furthermore, biotechnology industries develop more quickly in countries, like the United States and Japan, which protect broad intellectual property rights in practically all categories of biotechnological innovation.\textsuperscript{135}

Many of the industrial nations that deny patent protection to natural plant species do, however, permit the granting of plant breeders' rights. European nations adopted plant breeders' rights as an alternative to creating plant patent legislation analogous to the U.S. Plant Patent Act.\textsuperscript{136} Canada's Supreme Court proscribed the patenting of living organisms as inventions due to the perceived inadequacy of written specifications,\textsuperscript{137} but Canada acceded to the UPOV Convention in 1991 after passing its Plant Breeders' Rights Act.\textsuperscript{138} The Canadian Plant Breeders' Rights Act covers the asexual reproduction of distinct, stable, and homogenous cultivars, breeding lines, and hybrids,\textsuperscript{139} and provides for the revocation of the rights of breeders who refuse to comply with compulsory licensing.\textsuperscript{140}

New Zealand ratified the UPOV Convention in 1961 and updated its Plant Variety Rights Act in 1987 to attract breeders to supply the New Zealand market, after concluding that the lack of breeders' rights in neighboring Australia had inhibited overseas breeders from releasing their plant reproductive material there.\textsuperscript{141} New Zealand extended plant variety rights to anyone who has bred or discovered a new plant variety,\textsuperscript{142} and Australia eventually did enact its own Plant Variety

\begin{footnotes}
\footnotetext{133}{Sedjo, supra note 27, at 304.}
\footnotetext{134}{Jurgensen, supra note 34, at 326.}
\footnotetext{135}{BENT, supra note 131, at 80. "Experience has shown that dynamic, research-oriented companies and individuals gravitate to proprietary rights systems that afford maximum protection." \textit{Id.}}
\footnotetext{136}{Jurgensen, supra note 34, at 300. OFFICE OF TECHNOLOGY ASSESSMENT, supra note 10, at 261. Article 53(b) of the European Patent Convention excludes plant varieties from patentability, due to ethical qualms and to more rigid definitions of patentable subject matter than in the United States. BENT, supra note 131, at 149. Living matter falls outside the "technical" or "industrial" categories used by some of these countries. \textit{Id.} at 143. Nonetheless, breeders of new plant varieties can apply to the EEC Plant Variety Rights Office for registration certificates which bestow the "exclusive right to sell or produce the reproductive material of the plant variety." Susan Singleton, \textit{Plant Breeders' Rights}, SOLICITORS J., Sept. 27, 1991, at 1056.}
\footnotetext{137}{Hayhurst, supra note 39, at 175. The Canadian Supreme Court held that the disclosure requirements of the Canadian Patent Act cannot be satisfied by deposits of cultures or samples. \textit{Id.}}
\footnotetext{138}{\textit{Id.} at 180.}
\footnotetext{139}{\textit{Id.} at 181.}
\footnotetext{140}{\textit{Id.} at 189.}
\footnotetext{142}{\textit{Id.}}
\end{footnotes}
Rights Act in order to afford its breeders increased access to foreign breeders' varieties. Australian plant breeders' rights, however, extend only to plant varieties created by human intervention and not to discovered species.

Most of the industrial countries belong to UPOV, which sets minimum standards for plant breeders' rights issued in Member States and requires reciprocal treatment among members. Plant breeders' rights resemble patents as related but restricted forms of intellectual property rights in an end product. Both patents and breeders' rights grant limited monopolies to compensate for service to society and to stimulate inventive efforts, but breeders' rights are narrower than those of a patent-holder. Patents confer practically unlimited rights of exclusive control; plant breeders' rights permit researchers to breed with the protected variety and farmers to reuse protected seed without infringement liability. The UPOV treaty also allows the abridgment of plant breeders' rights for "reasons of public interest." A 1991 revision of the UPOV convention on the protection of plant varieties now permits the bestowal of proprietary rights on discoverers as well as breeders of new plant species. UPOV Member States will be permitted to change their national intellectual property laws and may consider revising their bans on the patenting of life forms, though there will probably be strong opposition to this, particularly in Europe.

Although previously most developing nations were hostile to intellectual property protection of plant varieties, many have been changing their minds. The 1991 UPOV amendments extended the period in which developing countries may join until December 31, 1995 because of a perception of profound changes in the attitudes of these countries toward the protection of plant varieties.

144. Id. at 743.
145. UPOV, supra note 38, art. 3. Section 2403 of the Plant Variety Protection Act, the legislation through which UPOV was implemented in the United States, extends protection to breeders of other nationalities depending on their countries' reciprocity. 7 U.S.C. § 2403 (1988).
146. Barton & Christensen, supra note 129, at 340.
147. UPOV, supra note 38, art. 9. (uniform standards of plant breeders' rights).
150. Robin Nott, Patent Protection for Plants and Animals, 14 E.I.P.R. 79, 83 (1992). Many recognize, however, that a general reluctance to permit patents on biotechnological products as well as restrictive research regulations in Europe have driven the most talented European researchers to the United States. Bent, supra note 131, at 80.
151. Greengrass, supra note 148, at 466. These countries may desire a system of breeders' rights (which can be tailored to their needs and includes fewer monopoly privileges than patents) in plants, because having an intellectual property system in place will help them bargain for
countries exclude plants, animals, and other biological materials from potential patentability.\textsuperscript{152} Kenya's Seed and Plant Varieties Act grants plant breeders' rights for any distinct, naturally-occurring breeding lines or discovered varieties cultivated, held in collections, or described in printed publications.\textsuperscript{153} Argentina, Brazil, Chile, Paraguay, and Uruguay have begun to contemplate creating their own uniform system of breeders' rights.\textsuperscript{154} Costa Rica has also started to recognize the value of intellectual property rights, as its fledgling software export industry and wealth of biological resources show signs of economic potential.\textsuperscript{155}

Thus, while some nations refuse to permit patents on plants, the related concept of plant breeders' rights has already gained wide international acceptance. Many nations grant intellectual property rights in new and distinct discovered varieties.\textsuperscript{156} The claim of developing nations to a legally recognized property interest, such as a plant breeders' right, in their discovered and protected plant species, as enunciated in the 1992 Biodiversity Convention, can be harmonized with legal principles established in the United States and in many other countries.

IV. USING PRIVATE PROPERTY ENTITLEMENTS TO PRESERVE PLANT BIODIVERSITY

A. Advantages of a System of Reciprocal Property Rights in Plants

Universally extending the concept of plant breeders' rights to discovered plants would provide a legal framework for compensating developing nations for the use of their native germplasm and would induce government action in these nations to conserve indigenous plant species. The acknowledgment by developing nations, in return, of patents and plant breeders' rights in biotechnological material and breeding lines would spur private companies in the industrial countries to sell products to developing countries. The compromise is not to negate all intellectual property rights in plant species, as would a common heritage principle, but, rather, to continue on the international plane the trend in many countries of investing those who protect and discover valuable species with proprietary rights in the plant material.\textsuperscript{157}

\textsuperscript{152} JUMA, supra note 21, at 231.
\textsuperscript{153} Id. at 173.
\textsuperscript{154} Correa, supra note 43, at 157.
\textsuperscript{155} New Measure Would Cover Extraction of Genetic Resources from Rain Forests, Int'l Envtl. Rep. (BNA), at 461 (July 15, 1992).
\textsuperscript{156} For example, the United States, New Zealand, Kenya, etc. as described above.
\textsuperscript{157} "If genetic resources continue to be available to all as part of our social heritage... we
International agreement to expand intellectual property rights to encompass the germplasm donations of developing countries would improve upon the common heritage approach in several ways. First, a system of property rights would furnish governments of nations rich in species and germplasm with non-altruistic incentives to conserve biodiversity. Present conservation efforts place disproportionate burdens on the poorest countries.158 If charged with the responsibility for maintaining rain forests, governments of tropical nations must choose whether or not to voluntarily forego modernization, use of their own land, and receipt of foreign income (from farming, ranching, and logging) for the benefit of the entire world. Giving the owners of natural habitats intellectual property entitlements in their natural plant species would provide an economic reason to conserve these habitats.159 Different statistical studies arrive at different results,160 yet a recognized right to compensation for efforts to catalogue and preserve plant species, combined with carefully planned economic incentives and government regulation, would spur conservation efforts more effectively than would a general sense of responsibility for the planet and an "unmanaged commons."161

Another benefit of a property rights system would be the extension of financial gain to countries that contribute the original gene pools from which plant-derived commodities derive. At present, developing countries often receive no remuneration for the use of their natural germplasm resources, as they are unable to patent them.162 With international acceptance of proprietary rights in raw germplasm, not only would plant breeding countries receive returns from their research investments in biotechnologies, but gene-rich nations would also receive compensation for discovering and conserving useful species.163 This would lead to an equitable distribution among nations of the benefits of the products of research based on plant genetic resources.164

can expect the uninterrupted continuation of the existing destruction of species." Sedjo, supra note 27, at 312-13.

158. Id. at 301.


160. One case study (on the conservation of seabirds in Iceland), for example, concluded that under a "pure property rights paradigm" natural species "fared far better than under a commons." Jon H. Goldstein, The Prospects for Using Market Incentives for Conservation of Biological Diversity, in The Preservation and Valuation of Biological Resources 246, 262 (Gordon H. Orians et al. eds., 1986).

161. Id. at 248-63.

162. Birds and Bees, supra note 14, at 17.

163. Sedjo, supra note 27, at 311.

164. Id. at 308.
1. Perspective of Developing Nations

The wealthiest countries contain the smallest and least interesting biotas, while the poorest countries, burdened by expanding populations and limited scientific knowledge, preside over the largest. Developing nations rich in natural species but lacking technological methods and products complain that, although private companies from developed countries enjoy unrestricted access to all natural plant germplasm, these companies adapt the germplasm into commercially valuable forms protected by patents and sell the improved products back to the developing countries at prohibitive prices.

Developing countries frequently lack strong intellectual property rights systems, preferring first to obtain access to important technologies and build up their patent protection schemes afterwards. The transfer of technology remains a key goal for them, and they believe scientific improvements should benefit all peoples of the world. Private companies, however, generally steer their products away from markets where their patents do not enjoy protection. Thus, biotechnology, which will have a major impact on agriculture, continues to elude developing countries, and they close themselves off from technological advances.

Since many developing countries do not guarantee patent protection for biotechnology and other modern inventions, their students often find impediments to their ability to study science abroad and bring back needed information. Moreover, differing levels of adherence to plant breeders’ rights by countries tend to restrict the transfer of genetic material to exchanges among UPOV Member States. For all practical purposes, large companies enjoy continued access to raw germplasm while restricting distribution of their products by means of secrecy and restrictive sales.

If species-rich countries had intellectual property entitlements of their own that made enforcement of property rights in their economic
interest, they would also find technologies more readily available to them.\textsuperscript{173} Tropical countries would gain from installing domestic intellectual property rights regimes, for they could internationally enforce some of their own claims of entitlements in plant genetics. Industrial nations could improve international observance of their own patent rights by training people to be patent office examiners in their countries,\textsuperscript{174} and these trainees would learn about molecular biology and appraisals of patent and breeders' rights applications.\textsuperscript{175}

Other benefits of an intellectual property rights system to a developing nation include disclosure of enabling technologies in the local language and increased availability of foreign technology in the country.\textsuperscript{176} Universities, governments, and scientists of various nations would find greater opportunities to work together if the industrial nations no longer feared misappropriation of their intellectual property, and science programs would improve as a result.\textsuperscript{177}

Developing countries often balk at paying to use patented inventions, but they might be able to pay part of the fees with royalties gained through initial licensing of raw genetic materials. Instead of trying to reverse-engineer technologies, patent-respecting developing countries would receive patent specifications that describe the invention in detail and facilitate dissemination of products and processes after the monopoly period expires. Restrictive patent grants endure only a limited time. Moreover, one can often invent around a patent to develop substitutable products once one understands the technology.\textsuperscript{178}

Access to technology and assistance in cultivating biotechnology capacities would be a boon to developing countries, even at the price of conceding observance of the intellectual property claims of developed nations. A labor-intensive field with low entry barriers and low initial capital investment requirements, biotechnology is ideal for a nation seeking to modernize.\textsuperscript{179} Kenya, for example, located near a rich source of plant diversity,\textsuperscript{180} boasts of a long tradition of farming re-

\textsuperscript{173} "The industrialization and economic strength of a country often correspond with \ldots the comprehensiveness of the country's intellectual property protection." Gollin, \textit{supra} note 159, at 214. "Experience has shown that dynamic, research-oriented companies and individuals gravitate to proprietary-rights systems that afford maximum protection." \textit{BENT, supra} note 131, at 80.

\textsuperscript{174} \textit{JUMA, supra} note 21, at 175.


\textsuperscript{176} Gollin, \textit{supra} note 159, at 215.

\textsuperscript{177} Goldstein, \textit{supra} note 175, at 328.

\textsuperscript{178} Gardner M. Brown, Jr., \textit{Valuation of Genetic Resources}, in \textit{THE PRESERVATION AND EVALUATION OF BIOLOGICAL RESOURCES} 203, 206 (Gordon H. Orians et al. eds., 1986).

\textsuperscript{179} \textit{JUMA, supra} note 21, at 208. "Biotechnology \ldots is one of those few families of techniques that are amenable to popular participation." \textit{Id.} at 218.

\textsuperscript{180} \textit{Id.} at 179.
search and could potentially take part in biotechnology research.\textsuperscript{181} One reason for an underdeveloped nation to take part in biotechnology research would be to conduct research programs that reflect its own needs.\textsuperscript{183} Few individuals in developing countries live long enough to run the risk of contracting cancer or heart disease, but many urgently need particular medicines.\textsuperscript{184} Similarly, in agriculture the private research sector of industrial countries presently focuses on improving machine-harvestable crops, not a pressing concern in regions with lower labor costs.\textsuperscript{185} Species other than the major commercial crops, such as millet and sorghum, receive little attention from companies focusing on industrial agriculture, but serve as staple food sources in many developing nations.\textsuperscript{186} By setting up intellectual property regimes, gene-rich countries could demand enforcement of their own rights in plant germplasm while acquiring technology to use for their own needs.

2. Perspective of Developed Nations

Developed nations focus primarily on maintaining access to undeveloped plant genetic resources\textsuperscript{187} and shielding their grants of intellectual property rights in technology. These nations believe that in order to make it worthwhile for private companies to develop new plant-based products, enterprises require assurances of solid patent protection.\textsuperscript{188} According to industrial nations, without guaranteed property rights and the attendant ability to sell compounds at market values, private firms would create fewer new pharmaceuticals and agricultural varieties, and those who invented would be driven to protect their creations by means of trade secrets. Absent the required full disclosure of production processes that forms the quid pro quo for patent grants, researchers would waste time and money attempting to duplicate each others' products, resulting in a general misallocation of resources.\textsuperscript{189} Technology-rich nations maintain that increased exchange of information among plant breeders would result if more nations implemented breeders' rights and that private industries would augment their activities if their patents were universally acknowledged.

\begin{itemize}
\item \textsuperscript{181} Id. at 176.
\item \textsuperscript{182} Id. at 203.
\item \textsuperscript{183} Id. at 225.
\item \textsuperscript{184} MYERS, supra note 10, at 99.
\item \textsuperscript{185} JUMA, supra note 21, at 84.
\item \textsuperscript{186} Id. at 85. "Instead of demonstrating the obvious, or chasing the trivial, molecular biologists in underdeveloped countries could be involved in the frontier of biological science . . . [performing] projects of national and international importance." Goldstein, supra note 175, at 328.
\item \textsuperscript{187} Preston, supra note 90, at A16. Schlickeisen, supra note 63, at C7.
\item \textsuperscript{188} Baker, supra note 4, at 533.
\item \textsuperscript{189} Note, supra note 129, at 108.
\end{itemize}
B. Considerations in Implementing a System of Intellectual Property Rights in Plant Species

Successful international implementation of any system of reciprocal property rights in plant germplasm will necessarily entail concretizing a number of practical details, including specifying the scope of the system and defining a method of enforcing the property rights. The theory underpinning the 1992 Biodiversity Convention could be implemented in a variety of ways, depending upon the preferences of negotiating nations. This section highlights some of the preliminary considerations that would need to be examined in establishing an international system of entitlements in natural plant species.

One of the initial problems confronting architects of a new structure in international environmental law would be determining who would qualify for proprietary rights in natural discovered or protected plant species. Approximately three billion of the world's people farm; perhaps property entitlements should reward their efforts in the collection, improvement, and conservation of genetically valuable cultivars. Indigenous peoples may also have valid claims to property rights in their knowledge of the plant materials in their environments. Any effective conservation measures must address the needs and concerns of these groups, which may not be adequately represented by national governments on the international plane.

On the other hand, most destruction of the tropical forests occurs on government-owned land. Ultimately, national governments have the greatest effect on species conservation efforts. Consequently, declaring discovered plant genetic resources the property of States in which they are discovered, subject to allocation by local private property distribution structures, might have the greatest positive impact on biodiversity preservation. National governments could determine whether to entertain claims by their farmers, finders, and corporations or to use all proceeds from licenses for the collective benefit of their citizens. Sovereign States might assign title as private rewards and incentives to persons who locate new plant species or to

192. Wilson, supra note 6, at 159.
193. National governments control almost 100% of the major tropical rain forests (particularly in Indonesia, Papua New Guinea, Malaysia, Ghana, and Thailand), as well as act as sovereign authorities in regulating and taxing all land use. Gillis, supra note 51, at 160.
194. Sedjo, supra note 27, at 308-09.
those on whose land they are discovered. Individual states might choose instead to set up a "large system of village-level landrace custodians (a farmer-curator system) whose purpose would be to continue to grow a limited sample of endangered landraces native to the region."197

Individual nations can best balance their own concerns with domestic rural development, conservation of local resources, short-term survival, and long-term agricultural self-sufficiency. Fee systems in various countries will vary by ideology and local needs.198 In addition, national sovereignty is a primary concern in the developing world,199 and solutions to environmental issues particularly ought to respect the independence of nations. General concord on the basic premise of the right of control over germplasm, combined with a legal structure of minimum standards, reciprocity, and a dispute resolution procedure, would provide a sufficiently flexible, generally acceptable framework.200

Nations could arrange specific accords under a general framework through a multilateral, centralized structure or through a network of individual negotiations. A bare minimum of international coordination would recognize a general duty of compensation and then treat plant germplasm like any other natural resource.201 For example, a nation with oil reserves may develop its own drilling capacities, negotiate drilling royalties with petroleum firms, or sell some or all of the drilling rights to a private company, which would take over development entirely.202 Countries with raw genetic material might negotiate with private industries or developed nations for scientific assistance, technology transfer, and training of native breeders;203 they might sell the exploration rights to the highest bidder204 or license several and collect royalties;205 or they might simply hold on to the resources and bide their time. As no one can know which species will be commercially valuable in the future,206 natural plant species would be like ge-

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196. Sedjo, supra note 27, at 308-09.
197. Altieri & Merrick, supra note 18, at 365.
198. Barton & Christensen, supra note 129, at 347.
199. Many of these States lack full confidence in the recognition of their own control over their territories, due to pressures from economic situations, frequent political struggles, and historical colonial dominance. José Goldemberg & Eunice Ribeiro Durham, Amazonia and National Security, 2 INT'L ENVT'L AFF. 22, 24 (1990).
200. A unified global system would provide advantages over the current "dizzying array of national protection schemes and treaty requirements." Jurgensen, supra note 34, at 293.
201. Sedjo, supra note 27, at 309.
202. Id. at 310.
203. Kloppenburg & Kleinman, supra note 19, at 198.
205. Sedjo, supra note 27, at 309.
206. Myers, supra note 51, at 20.
netic lottery tickets; some would have no value and some would eventually yield "jackpots." Thus, never knowing what portion of its natural germplasm might prove valuable, each nation would have an incentive to conserve all of it.207

More sophisticated international coordination efforts could establish a multilateral organization to oversee the use of plant germplasm similar to the organizations which detect unauthorized uses of copyrighted music selections on behalf of individual American musicians.208 Under this proposal, seed companies and other germplasm users might pay a blanket fee to a public or private international organization in exchange for access to banks of plant material. Germplasm donors would receive percentages of revenues from these licenses based on the value of the plants they contribute to the central organization.209 A contributing nation would not receive any compensation unless important genetic materials were found within its territory, and all would thus be inclined to become germplasm exporters.210

A slightly different structure might create a central world office for patent applications and registrations while allowing each nation to issue patents according to its own criteria. The central office could search the prior art (a difficult task for countries with limited resources) and send the information and the application specifications to all the nations designated by a prospective applicant.211 Each nation could then determine whether an application satisfies its novelty requirement,212 and any one nation could deny or invalidate a patent without affecting its legitimacy in other countries. National discretion might mandate compulsory licensing when necessary to require distribution of the patented product in the territory, to satisfy special State interests, or to license dependent patents.213 Such a system could also include infringement exemptions for experimental use in research.214

Other proposals have advocated taxing the sales of seeds and other

207. Sedjo, supra note 27, at 299.

208. The American Society of Composers, Authors, and Publishers (ASCAP) and Broadcast Music, Inc. (BMI) monitor radio and television stations in the United States to detect copyright infringement. ASCAP and BMI sell these stations blanket licenses, unlimited access to all their members' works, and then distribute the royalties to the artists depending on the frequency of the use of their musical compositions. So far, this system has withstood antitrust scrutiny. See Broadcast Music, Inc. v. Columbia Broadcasting System, 441 U.S. 1 (1979).

209. Barton & Christensen, supra note 129, at 348.

210. Id. at 349.

211. Jurgensen, supra note 34, at 318.

212. Id. at 324. The advantage in having each nation choose its own patent standards is that developing countries could require a high disclosure levels which would enable them to "exploit the technology after expiration of the patent or through a compulsory license should the patentee fail to exploit the patent within the nation." Id. at 323.

213. Id. at 328.

214. Id. at 329.
biological products by large companies and allocating the proceeds to different governmental, private, and international groups that preserve diversity.215 A system of taxes would provide regular, predictable income but would be difficult to enforce.216 Furthermore, few nations would probably accept an international tax scheme. Alternatively, developed countries might pay into a central fund (under the auspices of the FAO or other international body) based on “size of national seed industry, value of national agriculture production, frequency and size of drafts” upon genetic storage facilities.217 A central funding mechanism could research new specimens, file for patent rights on inventions, and use any royalties received to invest in conservation projects.218

C. Recent Examples Recognizing Proprietary Rights in Natural Plant Resources

States with a wealth of plant germplasm, seeking the profits and products accruing from natural materials for which they sacrifice to preserve,219 are beginning to condition access to genetic materials on the receipt of royalties and technical assistance.220 On June 6, 1992 the presidents of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama signed a non-binding agreement of intent to coordinate their legislation regulating the use of genetic resources found in Central America.221 These nations intend to develop rules on the export of biological materials and on technology and training in exchange for access to land. As Central America currently has no legislation on extracting plant species and other biological resources,222 this would be the first step towards developing a legal regime addressing biological resource concessions in the area.

The pharmaceutical giant Merck and Company implicitly acknowledged an obligation to compensate for the use of raw plant germplasm in a much-publicized venture with the government of Costa Rica. Merck has agreed to pay Costa Rica’s National Institute of Biodiversity (INBio) an initial fee of $1 million to undertake high-tech chemical prospecting in Costa Rica’s rain forests, and it will pro-

215. MCNEELY, supra note 3, at 120; MYERS, supra note 10, at 221-22.
216. Rackleff, supra note 60, at 425; Tyler, supra note 25, at 74.
217. Kloppenburg & Kleinman, supra note 19, at 198. Currently, botanical gardens in New York and London require users of their plant materials to agree to pay fees to the developing countries from which the samples come before starting any research. The Earth Conference: Biodivisive, supra note 73, at 93.
218. Rackleff, supra note 60, at 425.
219. UNCED Meeting, supra note 167, at 54.
220. The Earth Conference: Biodivisive, supra note 73, at 94.
222. Id.
vide INBio a percentage of the profits on any drugs derived from plants or microorganisms provided by Costa Rican researchers.\textsuperscript{223} Merck teaches parataxonomy to local bus drivers, housewives, students, and others\textsuperscript{224} who collect samples of plants, "wasp glands, snake venom, spider webs, ant hill matter, a wide array of fragments of life,"\textsuperscript{225} from which the company's researchers isolate compounds to modify chemically.\textsuperscript{226} Merck donated $135,000 worth of technological equipment to INBio, is training Costa Rican scientists in its own laboratories,\textsuperscript{227} and will keep all patent and intellectual property rights on any drugs developed.\textsuperscript{228}

The Merck-InBio arrangement appeals to nations, like Brazil, Indonesia, Mexico, Nepal, and Nicaragua, interested in making their own wealth of species pay for its own preservation.\textsuperscript{229} Mexico and Taiwan created national biodiversity institutes in 1992, and Argentina, Chile, and Indonesia are considering following suit.\textsuperscript{230} Smith-Kline Beecham is currently examining plants from Ghana, Malaysia, and Costa Rica, and the National Cancer Institute is investigating biological materials from China, Korea, Samoa, and the Red Sea.\textsuperscript{231} The World Wildlife Fund (WWF) presently distributes information to developing countries about creating arrangements such as the one between Merck and Costa Rica.\textsuperscript{232}

\textsuperscript{223} Stevens, \textit{supra} note 17, at C9. \textit{Birds and Bees}, \textit{supra} note 14, at 17. The government of Costa Rica will preserve 25\% of its land as a natural resource and funnel the pharmaceutical royalties into conservation projects. Stevens, \textit{supra} note 17, at C9. In a similar case, Smith-Kline Beecham Pharmaceuticals isolated an extract with potential capacities to combat lung and ovarian cancers from a medicinal plant found by traditional healers. In a procedure which might provide a hopeful trend, the company hired "bush masters" (at salaries more attractive than those they make by slash and burn agriculture) to prospect the forests. The company filed for a patent on the potential drug and will return some of the profits to the localities in which the native bush masters found the plants. \textit{Id.}

\textsuperscript{224} Roberts, \textit{supra} note 166, at 1142.

\textsuperscript{225} Preston, \textit{supra} note 90, at A16. Since the INBio program started in 1989, over 2.5 million species of insects alone have been gathered. \textit{InBio Sets Precedent in Biodiversity Prospecting, Biodiversity Conservation Strategy: Update, Summer 1992, at 6.}

\textsuperscript{226} These modifications are often necessary to make natural chemicals less toxic and more absorbable in the human body. Leslie Roberts, \textit{The Drug Industry Goes Green}, \textit{Science}, May 22, 1992, at 1143.

\textsuperscript{227} Roberts, \textit{supra} note 166, at 1143.

\textsuperscript{228} \textit{Deal Between Drug Firm, Costa Rica Called Example of What Treaty Would Do}, \textit{Int'l Envtl. Rep. (BNA)}, at 398 (June 17, 1992). An important aspect of this arrangement is the payment of money up front in order to permit conservation efforts to start immediately. Basing all funding on hopes of uncovering a miracle drug and then apportioning royalties would delay the conservation projects considerably, and simultaneous efforts to reduce economic pressures leading to biodiversity loss (promoting ecotourism, encouraging the exploitation of renewable forest products) are also wise. Roberts, \textit{supra} note 166, at 1143.

\textsuperscript{229} Stone, \textit{supra} note 65, at 1624. Roberts, \textit{supra} note 166, at 1142.


\textsuperscript{231} Roberts, \textit{supra} note 166, at 1143.

Examples such as these demonstrate an emerging acknowledgment of legal property entitlements in natural plant resources. Although until recently companies perceived no obligation to compensate countries for the use of biological samples collected from tropical rain forests, now more nations are requesting remuneration, and more germplasm users, like pharmaceutical companies and the National Cancer Institute, are acknowledging a duty to pay for the biological materials which generate commercial products. Under a system recognizing property rights in natural plant germplasm, a wide array of benefits would accrue: companies would earn profits; local peoples would receive compensation for their work and have a stake in the outcome; the world's pharmaceutical storehouse would be enriched; and the forests would be preserved so as to be able to shelter a wealth of species diversity while helping to stabilize the planet's climate.

**CONCLUSION**

Traditionally, the international legal framework for the conservation of plant genetic resources, especially those which provide valuable resources for curing human diseases and ensuring adequate global food supplies, has treated plant species as a common property resource. This legal model, though, offers no incentives to balance the economic pressures for deforestation in developing countries and does nothing to stem the catastrophic, continuing hemorrhaging of species biodiversity. In negotiating the 1992 Convention on Biological Diversity, United Nations officials strove for a compromise including fair compensation for transfers of technology by private companies with compensation for those who protect natural materials, thereby attempting to foster environmental protection, societal development, and the recognition of patent rights. The resulting Convention emphasizes the possibility of intellectual property rights both in naturally-occurring plant species and in the technological products derived from these species.

Despite U.S. refusal to sign the Convention, the concept of proprietary entitlements for countries with species diversity falls within accepted U.S. legal standards, and other nations manifested their assent to this principle by signing the document at Rio. In addition, recent arrangements between industrial companies and species-rich countries indicate a growing willingness internationally to respect the claims of these countries to remuneration for use of the plant material located

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234. Stevens, supra note 17, at C1.
235. Sedjo, supra note 27, at 312.
236. Biodiversity: Variety is the Spice of Life, supra note 22, at 53.
on their soil. Thus, the Convention and evidence of recent practice herald a shift in the focus of international law, and indicate an implicit rejection of the common heritage approach to plant genetic resources and the conservation of plant biodiversity, in favor of a potentially more successful and equitable model balancing the needs and goals of industrial and developing nations.