Saving the blueprints: The international legal regime for plant resources
David S Tilford
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SAVING THE BLUEPRINTS: THE INTERNATIONAL LEGAL REGIME FOR PLANT RESOURCES

David S. Tilford[*]

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[*] Director of Special Projects for the Center for a New American Dream, Takoma Park, Maryland; L.L.M., University of Washington, 1996; J.D., Pepperdine University, 1989. The author wishes to thank Dan Bodansky, Director of the International Environmental Law Program at the University of Washington, for his sagacious instruction. The author also wishes to thank Robert and Helen Tilford for providing key genetic materials, and for carefully tending the resulting cultivat - the author.

I. INTRODUCTION

THE CONVENTION ON BIOLOGICAL DIVERSITY was signed in Rio de Janeiro in 1992 at the United Nations Conference on Environment and Development (UNCED).[1] The ambitious goal of the treaty is to stem the world-wide loss of biodiversity. The treaty also has another purpose, one intertwined with the primary goal: The Convention is, in part, an attempt to establish an international legal regime governing the use of and access to plant genetic resources. This issue has been the subject of acrimonious debate between Southern developing countries, "the source of most genetic resources, and Northern industrial countries, "those countries currently in the best position to reap financial gains from genetic resource use." This Article traces the historical background for this issue, including human uses of plant genetic resources, prior international and U.S. laws on the subject, conservation efforts to date, and the role played by biotechnology. Particular attention is paid to the Convention's relationship to the International Undertaking on Plant Genetic Resources, a 1983 U.N. Food and Agriculture Conference Resolution that served as the first major international attempt to define the legal status of plant genetic resources.[2] The Article examines the approaches taken by each document, and illustrates how the Convention seeks to promote its conservation goals by making genetic resources profitable to the developing countries that harbor them. Finally, the Article charts how the Convention has shaped international activity since UNCED.

II. THE ROLE OF PLANT GENETIC RESOURCES IN HUMAN EXISTENCE

A. *The Cause for Concern*

In recent years, prominent scientists such as E.O. Wilson have alerted humankind to the value of biodiversity and the folly of instigating its current precipitous decline.[3] While Dr. Wilson points to the more general role diversity plays in supporting the web of life, two aspects of

[1] Convention on Biological Diversity, opened for signature June 5, 1992, 31 I.L.M. 818 (1993) (entered into force December 29, 1993) [hereinafter Biodiversity Convention].

[2] International Undertaking on Plant Genetic Resources, at 22, U.N. Doc. c/83/REP (1983) [hereinafter International Undertaking].

[3] *See generally* BIODIVERSITY (Edward O. Wilson ed., 1988).

plant diversity are of specific concern to humankind: its role in agriculture and its role in medicine.

Human agriculture involves the screening and manipulation of plants' genetic components. The larger the pool of genetic resources, the greater the options farmers have to meet changing conditions. In the medical arena, humans have long drawn upon the properties of various plants to deal with illnesses. Such use probably pre-dates human civilization by a wide margin. Though recently humans have manufactured many synthetic medicines, the chemical blueprints for such pharmaceutics were in many cases first discovered in natural plant materials before they were reproduced in the laboratory.[4]

Today, biotechnology is helping both farmers and medical researchers sift through the available genetic options to produce more precisely tailored crops and drugs.[5] As these genetically manipulated items begin to take on the nature of human invention rather than of nature itself, there has been an increasing push within the biotechnology industry to protect the innovations under the mantle of intellectual property rights regimes.[6] The general effect of intellectual property protection is to give the rights holders greater control over access and use of the protected materials.

These technological advances are occurring as the actual pool of plant genetic resources (PGR) shrinks. Many countries in which biodiversity is the richest are eager to develop rapidly to catch up with the standard of living enjoyed by the developed world and to keep up with an exploding human population. Often this development comes at the direct expense of the richest biodiversity centers. An additional blow to genetic diversity has come from within the agricultural industry. Even as large parcels of land remain in farmland, the genetically diverse

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[4] The most common example is acetylsalicylic acid, the active ingredient in aspirin. This chemical is derived from salicylic acid, a natural pain reliever found in willow bark. *See* Oliver Phillips & Brien Meilleur, *Survey by CPC Reveals "Extraordinary" Contributions of Wild Plants to U.S. Economy*, DIVERSITY, vol. 11, no. 3 (1995), at 10, 11.

[5] *See* Neil D. Hamilton, *Who Owns Dinner?*, 28 TULSA L.J. 587, 589 (1993).

[6] The American Seed Trade Association (ASTA) Board of Directors adopted the ASTA Position Statement on Intellectual Property Rights for the Seed Industry on June 29, 1990. This position statement called for more expansive intellectual property rights for genetic materials. *See ASTA Takes Step to Protect Intellectual Property Rights*, DIVERSITY, vol. 6, nos. 3 & 4 (1990), at 53. Members of the ASTA include plant breeders, seed companies, and biotechnology firms. *See* Hamilton, *supra* note 5, at 596 n.33.

traditional crops called land races[7] are being replaced with high-yielding but genetically narrow elite cultivars.

Though developing countries serve as suppliers of the raw materials for these biotechnological advances, they have seldom shared in the profits. In fact, they sometimes purchase "from interests in the developed world" these elite cultivars and medicines derived from the materials they supplied without charge.[8] In recent years, many developing countries have threatened to restrict access to their genetic resources unless some form of profit-sharing is instituted.

The protests of genetic source countries highlight an issue still unresolved by the international community: How much are PGR, as *individual* genes, really worth? Although there is general agreement about the benefits of maintaining a diverse gene pool, the argument that some value or claim of ownership could attach to a particular handful of PGR (usually in the form of seeds) has been rejected until recently at the level of the international legal regime.

Previous declarations, most recently the International Undertaking, had instead proclaimed PGR to be the "heritage of mankind."[9] This stance was felt to promote free and open access to PGR, for the benefit of all. In the view of source countries, however, it has allowed developed countries to appropriate PGR to produce agricultural and pharmaceutical products for their own use and profit. This appropriation was not considered particularly egregious by the developed world, which pointed out that much of the benefits (if not the initial profits) flowed back to the developing world in the form of better crops and lifesaving medicines.[10]

Today, questions arise over whether this flow back has been entirely beneficial. Additional questions surface as to whether the flow will

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[7] Jack R. Kloppenburg explains land races as follows:

> Land races are genetically variable populations that exhibit different responses to pests, diseases, and fluctuations in environmental conditions . . . . The genetic diversity of these land races was, and remains, a form of insurance for peasant cultivators. By planting polycultures comprising genetically diverse varieties, peasant farmers made certain that, whatever the year might bring in the way of weather or pests, some of the seed sown would grow to maturity and provide a crop. The objective of these early breeders was not high yield but consistency of production. And the result of their efforts was the development of great inter- and intra-specific genetic variability in particular and relatively confined geographic regions.

JACK R. KLOPPENBURG, FIRST THE SEED 46 (1988).

[8] *See id.* at 171.

[9] International Undertaking, *supra* note 2.

[10] *See* Rebecca L. Margulies, *Protecting Biodiversity; Recognizing International Intellectual Property Rights in Plant Genetic Resources*, 14 MICH. J. INT'L L. 322, 347-49 (1993).

continue in either direction unless more financial benefits flow back into the source countries. The Biodiversity Convention recognizes source country control over its genetic resources,[11] and thereby recognizes the right to demand compensation for such resources. The Biodiversity Convention, however, does not attempt to determine the amount and form of compensation.[12]

B. *The Evolution of Plant Genetic Diversity*

Within the chromosomes of a plant are found the genes that determine the characteristics the plant will display in life. Each plant has a genetic code, its own allotment of genetic material from its species' pool of genes. In the wild, the evolutionary process shapes the pool and selects the genes for inclusion. The passage of genes into the next generation is a function of the plant's ability to successfully reproduce. Though this process involves complexities and interrelationships well beyond human understanding, the fundamental concept is simple: survival of the fittest. Those genes that increase the plant's fitness to its environment, or more precisely, the plant's reproductive fitness, will have a higher probability of flowing into subsequent generations. As would be expected, those that decrease reproductive fitness will experience a higher attrition rate and will be less likely to reappear.

This is not a single path process in which a discrete set of "best" genes eventually win out and occupy the entire gene pool. Conditions change over space and time, and genetic combinations change with them. One genetic code may facilitate a plant's growth in hot, dry conditions, while another may adapt a plant of the same species to tolerate cooler and wetter conditions. Which combination is best (i.e., which increases the ability to survive and reproduce) depends upon the conditions in which the plant finds itself.

Changes in gene structure, leading to greater amounts of diversity, are sometimes facilitated through genetic mutations. These mutations most often hurt the plants survivability, leading to a pre-reproductive death.[13] Sometimes, however, these mutations can lend the plant some competitive

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[11] "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." Biodiversity Convention, *supra* note 1, art. 15(1) (emphasis added).

[12] Various methods to provide compensation are discussed *infra*.

[13] *See* KINGSLEY R. STERN, INTRODUCTORY PLANT BIOLOGY 215 (1994).

advantage.[14] If so, the number of these new genes will begin to expand within the genetic pool.

In sum, gene selection is a dynamic process. As ecosystem conditions shift across time and space, genetic combinations must shift as well. The ebb and flow of success versus failure within a given gene pool is directly dependent upon competition from within the species and from other species, consisting of other gene pools. A tremendous amount of diversity results, both in the number of species and the genetic variability within individual species.

C. *Agriculture as a Function of Genetic Diversity*

Human agriculture has existed for some ten thousand years.[15] Throughout all but the past few decades of the ten millennia humans have farmed plants, however, we have had no actual knowledge of the microscopic gene that drives the process. Nevertheless, through selective breeding we have attempted to harness these unseen forces and channel the plants' genetic interactions to produce food.

Though genes themselves remained unseen and even unimagined until the late nineteenth century,[16] the human race has counted upon the pool of plant genetic diversity to sponsor the proliferation and spreading of our own species. Early farmers saved and planted the seeds of desired food crops. Preferred foods that survived better were maintained, those that showed poorer performance were abandoned. Agriculture, in a sense, is the redirection of plant genes to coincide with human desires. As in nature, undesirable traits are filtered out while desirable traits are encouraged.

In one sense, however, the "free market" of nature no longer applies to agricultural crops. Rather than survival of the fittest under the unfettered competition of nature, agricultural genes are subsidized. They pass into the next generation under the partial direction of human efforts. In some instances, genes that are already indicators of reproductive success are given an extra boost. In other cases, genes that might otherwise have decreased reproductive fitness and normally would have drifted toward

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[14] *See id.*

[15] *See* THE KEYSTONE CENTER, KEYSTONE INTERNATIONAL DIALOGUE SERIES ON PLANT GENETIC RESOURCES, OSLO PLENARY SESSION, FINAL CONSENSUS REPORT: GLOBAL INITIATIVE FOR THE SECURITY AND SUSTAINABLE USE OF PLANT GENETIC RESOURCES 3 (1991) [hereinafter KEYSTONE REPORT].

[16] The science of genetics was pioneered by the Austrian monk, Gregor Mendel. *See* STERN, *supra* note 13, at 192-98.

extinction, (but which produce some characteristic palatable to humans), are offered a ladder into the next generation.[17]

As human selective processes sometimes diverge from natural selective processes, the altered plants might lose their ability to compete in the wild. Many agricultural crops are completely dependent upon human protection and cultivation. They grow only if sown in season by humans, are watered under controlled conditions, are provided the necessary nutrients, and are protected from predation and competition.[18]

In imitation of nature, however, plant breeders have attempted to maintain access to a wide range of genetic variability to develop heartier strains and meet changing conditions.[19] Agricultural strategies involve maintaining a diversity of genetic possibilities coupled with the diversity of environmental possibilities. Thus, the genetic variability of crop species developed in response to human variations. As crops species were carried along with human migrations, different characteristics were preserved to suit changing climactic and soil conditions, as well as changing tastes.[20]

But even when humans stayed immobile, farmers generally did not save only the seeds that worked best for that one location and one time period.[21] Even in discrete settled areas, environmental conditions fluctuate season to season and over the long term. Farmers had to retain the resources to adapt to such changes.

The threat posed by herbivorous insects is representative of the many reasons why farmers must remain flexible and maintain diversity. Insects generally breed rapidly, producing large numbers of offspring in a relatively short time. Under such conditions, insect gene flow is rapid and constructive genes quickly gain ascendance in the pool. Though casualties may be high, adaptations to prey defenses can develop and spread quickly.[22]

The plant species preyed upon by insects respond in kind by producing more offspring resistant to the threat.[23] In the wild, these adaptive shiftings of genes within the respective gene pools happen in concert, a sort of genetic dance between predator and prey. The same sort of give

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[17] *See* KLOPPENBURG, *supra* note 7, at 2.

[18] *See* H. Garrison Wilkes, *Plant Genetic Resources Over Ten Thousand Years: From a Handful of Seed to the Crop-Specific Mega-Gene Banks*, *in* SEEDS AND SOVEREIGNTY, THE USE AND CONTROL OF PLANT GENETIC RESOURCES 67 (Jack R. Kloppenburg, Jr. ed., 1988).

[19] *See* KEYSTONE REPORT, *supra* note 15, at 5.

[20] *See* KLOPPENBURG, *supra* note 7, at 46.

[21] *See id.*

[22] *See* DAVID A. PERRY, FOREST ECOSYSTEMS 439-42 (1994).

[23] *See id.* at 453-59.

and take occurs between plants and other stressors such as fungal pathogens and plant competitors.[24]

With cultivars, however, the farmer often must enter the fray and determine on behalf of the plant which defenses to bring forward against the assault. Success hinges on luck, the skill of the farmer, and the flexibility of the resources in the form of multiple genetic varieties. Because of this, a high degree of diversity has been maintained even as the crop gene pools have branched off from those of their wild relatives.[25] Diversity, therefore, has served as the traditional weapon available to farmers to ensure the stability of their crops.[26]

The efforts of early farmers in redirecting the gene pool, combating predators, and selecting for other environmental conditions produced for us the land races.[27] These traditional cultivars serve as the foundation of our food crops today. The actual number of plant species "chosen" by humans over the course of our agricultural history has been quite small. Only about 5,000 plant species, a fraction of a percent of the world's total flora, feed the human population.[28] Fewer than twenty plant species are responsible for ninety percent of the world's food supply,[29] and a mere three species cover sixty percent of the total supply.[30]

D. The Twentieth Century: Severing the Connection Between Agricultural Success and Diversity

Though technological advances over the course of human development have altered many agricultural processes, the selection by farmers of seeds from the previous years' harvests remained a fundamental aspect of farming into the early twentieth century.[31] By way of illustration, the following anecdote is taken from a *National Geographic* article on sustainable agriculture. The author recounts a story of his family farm, and the farming methods employed by his grandfather in the 1930s:

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[24] *See* Otto H. Frankel, *Landraces in Transit-The Threat Perceived,* DIVERSITY, vol. 11, no. 3 (1995), at 14 [hereinafter Frankel, *Landraces*].

[25] *See id.*

[26] *See* KLOPPENBURG, *supra* note 7, at 46.

[27] *See id.* Landraces are "dynamic natural laboratories in which host-pathogen coevolutionary interactions are played out far into the future." Frankel, *Landraces, supra* note 24, at 15.

[28] *See* Wilkes, *supra* note 18, at 68.

[29] *See* Howard G. Buffett, *The Partnership of Biodiversity and High-Yield Agricultural Production,* DIVERSITY, vol. 12, no. 1, at 16 (1996).

[30] *See* Boyce Rensberger, *Nurturing a Cornucopia of Potential; Project Aims to Revive Ancient Food Sources,* WASH. POST, Oct. 20, 1993, at A1.

[31] Verlyn Klinkenborg, *A Farming Revolution,* NAT'L GEO., Dec. 1995, at 66.

> In the fall the wagons came back full from the cornfields, and as the corn was being put into cribs, my grandfather watched for ears that looked especially full and large. These he tossed into bushel baskets, which were carried to the basement of the farmhouse. There, in the furnace room, it was my father's job to sort the corn onto wire grids 24 ears across.
>
> From each ear of corn my grandfather took three or four kernels and placed them on an incubator tray-the position of the seeds on each tray matching the position on the wire grid of the ear from which they came. Then he dampened the kernels and waited. The ears whose kernels didn't sprout were fed to the hogs and chickens. The ears whose kernels showed good germination were set aside, shelled, and used as the next year's seeds.[32]

This story, however, represents a form of agriculture that would experience a rapid decline over the next few decades. The late twentieth century has brought about a radical departure from the agricultural methods that had existed for millennia. An example of the agriculture that was to come is found in the continuation of the same *National Geographic* story. The author recounts the story of the same farm after the passage of thirty years:

> By the 1950s and early 1960s, when I first began visiting that farm, the corn they were using had changed. The seeds no longer came from last year's crop; by then it was patented hybrid corn. It came in pallets full of 80,000 seed bags from national seed companies. It was purchased anew every year, because every year there was a new improvement and because hybrid corn will not develop properly from the planting of a previous year's kernels. Given enough chemical fertilizer, pesticides, and machine power, hybrid varieties of corn now result in yields my grandfather would have thought impossible in the 1930s, 180, 200 bushels an acre, three or four times the yields he was getting in the good years. But to get these yields, farming had to change almost beyond recognition. It came to rely less on the skills of farmers and more on a chemical arsenal to suppress weeds and insects and to replace the diminishing fertility of the soil.[33]

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[32] *Id.* at 66.
[33] *Id.*

E. The Origins of the Change

What prompted such a rapid alteration in farming technique? Three events stand out as the primary catalysts. The roots of the revolution probably began with the work of Gregor Mendel, an Austrian monk and botanist in the late 1800s.[34] His simple breeding experiments with garden peas gave us a better understanding of how traits are passed from one generation to the next.[35] They laid the foundation for the modern science of genetics, and led agricultural scientists toward the development of hybridization methods in the early twentieth century. The second event was the work of Russian geneticist Nikolai Vavilov, who theorized in the 1920s that there were discrete agricultural "centers of origin," or geographic regions from which our cultivated species evolved. Vavilov pointed plant breeders toward a source of genetic materials with which to bolster the gene pool of modern cultivars, and pioneered the development of national and international gene banks.[36] The third event, actually two separate breakthroughs, were the discoveries in the 1960s that certain dwarfing wheat and rice genes could be inserted into modern cultivars to greatly improve crop yields.[37] These discoveries spawned the "Green Revolution" and a dramatic increase in world food production. A fourth event, still taking shape, is the role of biotechnology and its promise of more precise gene manipulation.[38]

1. Gregor Mendel

The study of genetics usually starts with the story of Gregor Mendel and his 1865 experiments with two strains of garden peas.[39] Bred separately for generations, one of Mendel's varieties produced offspring with smooth peas, the other produced wrinkled peas. When Mendel tried crossing the two strains, it always resulted in smooth offspring. At that point, Mendel pondered whether the "wrinkledness" trait had simply disappeared, obliterated by the "smoothness" trait. He received his answer

[34] *See* STERN, *supra* note 13, at 192-98.

[35] *See id.*

[36] Vavilov's work reconnected us with our agricultural past by revealing the possible geographic origins of modern crop varieties. Ironically, his work also served as a catalyst for a breeding industry that would effectively sever our ties to this past, and to farming methods that had evolved over the previous 10,000 years of agriculture.

[37] *See* KEYSTONE REPORT, *supra* note 15, at 2-3.

[38] *See* Hamilton, *supra* note 5, at 589.

[39] *See* STERN, *supra* note 13, at 192.

when he crossed a smooth offspring back with a wrinkled parent. This time, half the offspring were smooth, half wrinkled.

Intrigued, Mendel carried the experiment further. In the next round of experiments, he crossed two smooth siblings that were offspring of a smooth/wrinkled pairing. This time, three quarters of the offspring were smooth, but one quarter turned up wrinkled. The "wrinkledness" trait had skipped a generation and had shown up again in the second generation removed from the wrinkled ancestor.[40]

These simple experiments had profound implications. It showed that these plants carried some hidden code, a code that did not necessarily manifest itself in the plants' outward physical appearance. These hidden codes could be passed on to subsequent generations and reappear to produce a plant that did not resemble either of its immediate parents (as in the one-in-four wrinkled offspring from a pair of smooth parents). Though Mendel did not use the term "gene" for these codes, his work was among the first experimental evidence of the presence of genes.[41]

Mendel's experiments did not gain wide attention initially. Ignored for over three decades, they were rediscovered around 1900.[42] William Bateson, the "father" of the science of genetics, used Mendel's work as a basis for his own studies.[43]

2. Nikolai Vavilov

In the 1920s, Nikolai Vavilov, a Russian geneticist who had studied with Bateson in London, was placed in charge of the Soviet Union's Institute of Plant Industry in Leningrad where he initiated a plant breeding research program based on genetics.[44] Vavilov believed that plant breeders should look for "fresh" genetic materials to revive the vigor of cultivated varieties.[45] Vavilov theorized that this fresh material was available in the more primitive land races and wild relatives of modern cultivars. He felt that the genes of these wilder species could provide some of the environmental tolerance lacking in the cultivated varieties.[46]

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[40] *See id.* at 194.

[41] *See id.* at 192.

[42] *See id.*

[43] *See* CALESTOUS JUMA, THE GENE HUNTERS 33 n.4 (1989). Bateson must have taken his title as "father of genetics" seriously. He named his son "Gregory" after Gregor Mendel. *See id.*

[44] *See* John Reader, *The Rights and Wrongs of Vavilov*, GUARDIAN, July 24, 1992, *available in* LEXIS, Nexis Library, Arcnws File.

[45] *See id.*

[46] *See id.*

In an effort to acquire greater access to these potentially useful genetic materials, Vavilov called for a global inventory of both cultivated plants and their wild relatives. With initial backing from Lenin, Vavilov sent hunting expeditions to all parts of the Soviet Union and to sixty other nations.[47] In some cases the results were immediate. An expedition to the Andes brought back twelve new potato species, to supplement the one species previously known.[48]

Due to Vavilov's efforts, the Soviet Union would lead the way in the development of agricultural research institutions. Vavilov established a network of 400 research and experimental stations throughout the Soviet Union, maintaining links with related centers in other parts of the world.[49] At one point, he had amassed 25,000 wheat varieties.[50]

In connection with this work, Vavilov identified eight regions of the earth (he later expanded the number to twelve) that showed a high degree of diversity in connection with the major crop species.[51] Vavilov theorized that these centers of diversity were in fact the "centers of origin" for the world's food crops.[52] According to Vavilov, almost all the major food crops originated within these (subsequently named) "Vavilov Centers."[53] For the most part, these centers are located in developing countries, and in total consist of less than a quarter of the earth's arable land.[54] Though the direct connection between centers of "diversity" and centers of "origin" has subsequently been called into question, the discovery of the Vavilov Centers still provide an important source of fresh genetic material to revive modern cultivars.[55]

3. Hybridization

Vavilov became the major pioneer in the movement to collect and analyze untapped genetic resources. Even prior to Vavilov, however, the

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[47] *See id.*

[48] *See id.*

[49] *See id.*

[50] *See id.*

[51] *See id.*

[52] *See* JUMA, *supra* note 43, at 16.

[53] *See id.*

[54] *See The Vanishing Seeds*, 6 ENVTL. POL'Y & L. 163 (1980).

[55] *See* Jack R. Kloppenburg, Jr. & Daniel Lee Kleinman, *Seeds of Controversy: National Property Versus Common Heritage, in* SEEDS AND SOVEREIGNTY: THE USE AND CONTROL OF PLANT GENETIC RESOURCES, 173, 177 (Jack R. Kloppenburg, Jr. ed. 1988) [hereinafter Kloppenburg & Kleinman, *Seeds of Controversy*]; *see also* KLOPPENBURG, *supra* note 7, at 175.

new field of genetics had led to more controlled plant breeding efforts.[56] The rudimentary understanding of gene function beginning with the turn of the twentieth century allowed breeders to reduce the amount of time and materials used in breeding experiments.[57] Attempts to improve the vigor of agricultural plants, therefore, became more focused and more successful.[58]

Within the first two decades of the twentieth century, this focus led to a breakthrough method of breeding corn: hybridization.[59] Under natural conditions, inbreeding in plants such as corn leads to reduced vigor.[60] However, when two separate inbred lines are crossed, the offspring from the cross experience an immediate recovery of vigor (known as "heterosis").[61]

Since hybridization promised higher-yielding varieties, research efforts and government finance in the United States for research began to concentrate on the production of hybrid seeds.[62] Other research efforts were virtually abandoned.[63] The hybrid techniques received wide publicity as a revolutionary new process. As a sign of what was to come, in the mid-1920s Pioneer, Inc. (later, Pioneer Hi-Bred) became the first private hybrid seed company in the United States.[64]

It was not until after the Great Depression that this new technology really took hold.[65] When it did, the change was dramatic. In less than a decade, from 1937 to 1945, hybrid corn seed use in the United States increased from thirteen percent to eighty-eight percent.[66] By the 1950s, over ninety-five percent of the American Corn Belt was planted with hybrid varieties.[67]

As mentioned in the *National Geographic* anecdote, the use of hybrids involved purchasing seeds from a seed company each year rather

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[56] *See* JUMA, *supra* note 43, at 80.

[57] *See id.*

[58] *See id.*

[59] *See* Norman E. Borlaug, *Contributions of Conventional Plant Breeding to Food Production*, 219 SCIENCE 689 (1983).

[60] *See id.*

[61] *See id*; *see also* KLOPPENBURG, *supra* note 7, at 98.

[62] *See* KLOPPENBURG, *supra* note 7, at 92-94.

[63] *See id.*

[64] *See id.*

[65] *See id.*

[66] *See* Jean-Pierre Berlan & R.C. Lewontin, *The Political Economy of Hybrid Corn*, MONTHLY REV., July 1986, at 35.

[67] *See* H. Garrison Wilkes & Susan Wilkes, *The Green Revolution*, ENVIRONMENT, vol. 14, no. 8 (1972), at 33.

than replanting seeds the farmer had saved from the previous year. In general, replanting hybrids results in a precipitous decline in yield, whereas the purchase of "new" seeds and "new" varieties keeps production high.[68] Farmers, of course, were willing to purchase the seeds anew as long as they believed the extra income from the higher-yield hybrid exceeded the extra cost of the seeds.[69]

The switch to hybrids meant both a change in farmer preferences and a fundamental transformation of the agricultural industry. With the switch to hybrids, seeds became a commodity.[70] The incentive for seed improvement shifted to the industry that could support agricultural research.[71] With the birth of a large seed industry there arose a sense of proprietary rights over the elite plant varieties, and intellectual property issues entered the world of agriculture.

III. NATIONAL AND INTERNATIONAL EFFORTS TO CONSERVE PLANT GENETIC RESOURCES

A. *U.S. Conservation Efforts*

Because of the commercial incentive to innovate through the influx of new genetic materials, national and international gene banks were established to facilitate the collection, evaluation, and conservation of PGR. Breeders began to make collection trips to very specific areas of the world in an effort to amass genes for their breeding experiments.[72]

Though Russian efforts at seed storage and research suffered a drastic downturn under the reign of Joseph Stalin,[73] efforts elsewhere,

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[68] *See* Berlan & Lewontin, *supra* note 66.

[69] Berlan and Lewontin suggest that increased yields due to hybrids may have been a myth or a case of commercial propaganda. A combination of events coincided with the introduction of hybrids, any one or more of which may have caused the actual yield increases:

> 1. The introduction of a planned breeding program itself,
> 2. Unprecedented effort by government agencies to develop improved varieties in support of a hybrid-seed strategy,
> 3. Changes in cultivation techniques, crop rotation, increase in fertilizer use, mechanization, and,
> 4. The introduction of more efficient experimental and statistical test procedures.

Id.; *see also* KLOPPENBURG, *supra* note 7, at 92-94. *But see* Major M. Goodman, *In Review: First the Seed: The Political Economy of Plant Biotechnology, 1492-2000*, DIVERSITY, vol. 5., no. 1 (1989), at 33, 34 (disputing conclusions by Lewontin, conclusions accepted by Kloppenburg, regarding the feasibility of producing non-hybrid high-yield crops).

[70] *See* KLOPPENBURG, *supra* note 7, at 9-11.

[71] *See* Berlan & Lewontin, *supra* note 66.

[72] *See* Wilkes, *supra* note 18, at 73.

[73] The personal fate of Vavilov suffered as well. Stalin was suspicious of scientific

particularly in the United States, increased. In the first third of the twentieth century, the U.S. State Department sent fifty expeditions to search for useful new plant types.[74]

The Regional Plant Introduction Station, the first center for the conservation of crop germplasm, was established in Ames, Iowa in 1947.[75] In 1948, another center was established in Geneva, New York, and in 1949, two more were added in Experiment, Georgia and Pullman, Washington.[76] In 1959, the U.S. Department of Agriculture established the first national gene bank, the National Seed Storage Laboratory (NSSL), at Fort Collins, Colorado.[77] The NSSL also represented the first national attempt at long-term refrigerated seed storage.[78]

B. International Conservation Efforts

By the 1960s, both national and international efforts increased to collect and preserve PGR, especially from tropical and subtropical areas.[79] Two motivations drove these efforts: research facilitation and conservation. The first motivation stemmed from the desire to house the building materials (the genes) in international "genetic warehouses" accessible to all, rather than have them haphazardly stored in various jurisdictions throughout the globe. Centralization was believed to facilitate the development of newer and better crops for the entire world.

The second incentive recognized the need to preserve genetic information being lost to twentieth century development. By the 1950s, the centers of diversity and the genetic resources they contained were fast disappearing.[80] The rate of genetic erosion was especially high in the

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works originating in the capitalist world. A rival of Vavilov scoffed at his application of the principles of genetics to agricultural policies and at his introduction and use of exotic germplasm. Vavilov was eventually arrested in the Ukraine while on a mission to collect indigenous Ukrainian plants that were being replaced by Russian varieties. He was charged with agricultural sabotage and imprisoned. The pioneer of agricultural research died soon after in Siberia of malnutrition. *See* JUMA, *supra* note 43, at 17-19. Long-term storage facilities would not be established in the Soviet Union until the 1970s; *see also* D.L. Plucknett et al., *Crop Germplasm Conservation and Developing Countries*, 220 SCIENCE 163 (1983).

[74] Jack R. Kloppenburg, Jr. & Daniel Lee Kleinman, *Plant Genetic Resources: The Common Bowl, in* SEEDS AND SOVEREIGNTY, supra note 18, at 6.

[75] *See* Plucknett et al., *supra* note 73.

[76] *See* JUMA, *supra* note 43, at 86.

[77] *See id.* at 87.

[78] *See* Plucknett et al., *supra* note 73.

[79] *See id.*

[80] *See* June Starr & Kenneth C. Hardy, *Not by Seeds Alone: The Biodiversity Treaty*

Mediterranean region and in the Near East, a major diversity center for wheat and other grains.[81] Despite this, the initial efforts were probably motivated less by conservation concerns than by the potential to facilitate research.[82] In 1961, the FAO organized the first international technical meeting on plant exploration and introduction.[83] The primary result of this conference was a proposal to assemble a panel of experts to advise and assist efforts to find and map plant genetic resources.[84]

In 1967, the FAO and the International Biological Program convened a second technical conference at FAO's Rome headquarters.[85] Diversity loss was a more prominent issue at this second conference, and strategies were discussed to counter genetic erosion.[86] The most significant proposal to emerge from this conference was a call to establish a global network of gene banks to store representative collections of the main varieties of food.[87] Priority was given to preserving the land races, many of which were immediately threatened.[88] The conference also called for the implementation of long-term storage methods as opposed to the then-common practice of regeneration every few years.[89]

To oversee this global system, the FAO, along with the World Bank and the U.N. Development Program, founded the Consultative Group on International Agricultural Research (CGIAR) in 1971. Today the CGIAR remains the primary caretaker of the international germplasm collections. Its membership includes governments, private foundations, and regional development banks.

Even before the 1967 Conference and the formation of the CGIAR, a number of international research centers had been established to facilitate the development of an international gene bank system.[90] Under the initiative and funding of the Rockefeller and Ford Foundations, four

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and the Role for Native Agriculture, 12 STAN. ENVTL. L.J. 85, 104 (1993).

81 *See* JUMA, *supra* note 43, at 87.

82 *See* Otto H. Frankel, *Genetic Resources: Evolutionary and Social Responsibilities*, *in* SEEDS AND SOVEREIGNTY, *supra* note 18, at 21 [hereinafter Frankel, *Genetic Resources*].

83 *See* Plucknett et al., *supra* note 73.

84 *See* Starr & Hardy, *supra* note 80, at 104.

85 The International Biological Program is a non-governmental arm of the International Council of Scientific Unions. *See* Frankel, *Genetic Resources*, *supra* note 82, at 21.

86 The term "genetic resources" was coined at the 1967 Conference. *See id.* at 21.

87 *See id.*

88 *See id.*

89 *See* Plucknett et al., *supra* note 73.

90 *See* Frankel, *Genetic Resources*, *supra* note 82, at 26.

International Agricultural Research Centers (IARCs) were established between 1960 and 1967: the International Rice Research Institute (IRRI) in the Philippines (1960), the International Maize and Wheat Improvement Center (CIMMYT) in Mexico (1966), the International Institute of Tropical Agriculture (IITA) in Nigeria (1967), and the International Center for Tropical Agriculture (CIAT) in Columbia (1967).

The CGIAR eventually took control of the IARCs and the international system of gene banks developed through these centers. Today, there are sixteen IARCs, mostly located in developing countries.[91] Twelve of the sixteen hold germplasm collections, together holding well over 500,000 samples representing more than 3,000 species.[92] Aside from being centers of germplasm storage, the IARCs function as centers of international research and testing of crop germplasm.[93] A large part of their mission is to train scientists for national agricultural research programs.[94] As such, the IARCs serve as a source of information and technology-sharing for the benefit of scientists in developing countries.[95]

Between 1968 and 1973, the FAO panel of experts on plant exploration and introduction and the FAO Crop Ecology Unit's genetic resources group attempted to implement the recommendations of the 1967 Conference.[96] In areas where land races were threatened, they sponsored surveys of genetic resources, defined collecting priorities, and surveyed storage facilities.[97] They outlined the methodology of long-term seed storage, planned education and training, and designed the global storage network.[98]

In 1972, two high-profile international gatherings emphasized the need to coordinate international PGR activities. One was the U.N. Conference on the Human Environment in Stockholm, out of which came a resolution calling for an international program to preserve the germplasm of tropical crops.[99] The other was the Beltsville Conference in Maryland,

[91] *See id.*

[92] Ismail Serageldin, *Genetic Resources Conservation in the CGIAR: Protecting an Irreplaceable Resource for Future Generations*, DIVERSITY, vol. 10, no. 2 (1994), at 19.

[93] *See id.*

[94] *See id.*

[95] *See id.*

[96] *See* JUMA, *supra* note 43, at 88-89; Frankel, *Genetic Resources*, *supra* note 82, at 22.

[97] *See* Frankel, *Genetic Resources*, *supra* note 82, at 22.

[98] *See id.*

[99] *See* Plucknett et al., *supra* note 73.

which recommended the establishment of the International Board for Plant Genetic Resources (IBPGR).[100]

The IBPGR was subsequently established in 1974 with a secretariat in the FAO and financial resources provided by the CGIAR.[101] The IBPGR's goal is to encourage and coordinate efforts to conserve, document, evaluate, and use plant germplasm.[102] This organization has served as the primary international coordinator of worldwide genetic resource activities.[103] In 1993, the IBPGR was reorganized and renamed the IPGRI (International Plant Genetic Resources Institute).[104]

IV. THE GREEN REVOLUTION

A. *The High-Yield Breakthrough*

These international efforts precipitated a dramatic revolution in world agriculture. The "Green Revolution," as it came to be called, began with the development in the late 1960s of a new set of high-yield varieties that greatly increased agricultural production.[105] The Green Revolution dramatically boosted world food supply and was considered a great triumph, one that earned its instigator, Norman Borlaug, a Nobel Peace Prize.[106] Unfortunately, the success of these Green Revolution "super crops" has come at the expense of traditional cultivars, many of which have been overrun by the high-yield varieties.[107] For this and other reasons, the Green Revolution has also been condemned by some as an ecological disaster.[108]

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[100] *See id.*

[101] *See* Jack Harlan, *Our Vanishing Genetic Resources,* 188 SCIENCE 618, 619 (1975). Though physically placed in the FAO, the IBPGR was formed as an institution under the CGIAR. The IBPGR budget has been set directly by national governments rather than through the United Nations. *See* KLOPPENBURG, *supra,* note 7, at 164.

[102] *See* Starr & Hardy, *supra* note 80, at 105.

[103] *See* JUMA, *supra* note 43, at 89.

[104] Ruth D. Raymond, *Conserving Nature's Biodiversity: The Role of the International Plant Genetic Resources Institute,* DIVERSITY, vol. 9, no. 3 (1993), at 17.

[105] *See* Kloppenburg, *supra* note 7, at 157-61; *see also* Kloppenburg & Kleinman, *supra* note 74, at 1-3.

[106] Borlaug received the 1970 Nobel Peace Prize for his efforts. *See* Kloppenburg & Kleinman, *supra* note 74, at 1. Note that Borlaug's prize was for *peace*. He was recognized not for a breakthrough scientific discovery, but rather for his management over the distribution of high-yield varieties of wheat. His contribution to the eradication of world hunger was thought to facilitate peace and security in the human population. *See id.*

[107] *See, e.g.,* JUMA, *supra* note 43, at 100-03.

[108] *See id.* at 65.

The Green Revolution took root in the International Center for Maize and Wheat Improvement (CIMMYT), the IARC established in Mexico in 1966.[109] Through its early years, the Wheat Program at CIMMYT was headed by American geneticist, Norman Borlaug.[110] During Borlaug's directorship, a wheat variety known as "Norin 10" came to his attention.[111] Norin 10 was a variety of wheat brought from Japan to the United States in 1946, and was noted for its diminutive stature.[112] Borlaug discovered that by inserting the dwarfing genes from the Norin 10 variety into Mexican wheat lines, the resulting offspring were dwarf varieties that, in response to heavy fertilizer applications, gave unprecedented wheat yields.[113] Soon afterwards, a similar discovery was made with rice at the International Rice Research Institute (IRRI), the Philippines IARC.[114] The "Dee-gee-woo-gen" gene, originating in China, also produced unprecedented boosts in rice yields.[115]

The impact of these discoveries was felt almost immediately. It allowed farmers, at least on a temporary basis, to cover the food requirements of an expanding human population.[116] One noted expert, H. Garrison Wilkes, stated over a decade ago that "[t]he specific use of the dwarfing gene from Norin 10 has affected the food supply of one quarter of the people of the world (one billion plus) and for over 100 million it has been the margin of survival."[117]

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[109] *See id.* at 170; Wilkes, *supra* note 18, at 18.

[110] *See State of the Art Genebank at CIMMYT to Usher in "Double Green Revolution,"* DIVERSITY, vol. 12, no. 3 (1996), at 4.

[111] *See* Kloppenburg & Kleinman, *supra* note 74, at 1-3.

[112] *See id.*

[113] *See* KEYSTONE REPORT, *supra* note 15, at 2.

[114] *See* M.S. Swaminathan, *Seeds and Property Rights: A View From the CGIAR System, in* SEEDS AND SOVEREIGNTY, *supra* note 18, at 231; KEYSTONE REPORT, *supra* note 15, at 2.

[115] *See* KEYSTONE REPORT, *supra* note 15, at 2.

[116] *See id.* at 3.

[117] H. Garrison Wilkes, *Current Status of Crop Germplasm*, 1 CRITICAL REV. PLANT SCI. 133, 142 (1983). In addition, there were environmentally friendly aspects of the Revolution: less space used to grow more productive crops meant less pressure to convert forests to farmland. "By sustaining adequate levels of output on land already being farmed in environments suitable for agriculture, we restrain and even reverse the drive to open more fragile lands to cultivation." Buffett, *supra* note 29, at 16 (quoting Norman Borlaug); *see also* KEYSTONE REPORT, *supra* note 15, at 73.

B. *The Aftermath of the Green Revolution*

> Never before in human history have there been comparable monocultures . . . of billions of genetically similar plants covering millions of acres across whole continents.[118]

1. Genetic Erosion

The negative aspects of the Green Revolution are now believed by many to outweigh its benefits.[119] The move toward hybridization has already begun to erode the genetic diversity of much of the world's croplands, especially in the developed world.[120] The Green Revolution has been instrumental in spreading that erosion to the developing world as well.[121] The ultimate price may be a collapse of that same food supply somewhere down the road, a direct result of the farming practices encouraged by the Revolution.

Through the Green Revolution, a great number of varieties that formerly served as an agricultural insurance plan have been cast aside. As traditional varieties have been replaced and abandoned, some have become extinct. In the process their genetic characteristics, the raw materials, have been lost.[122] As one author states, "The technological bind of improved varieties is that they eliminate the resource upon which they are based."[123]

Within a century, genetic diversity became economically obsolete.[124] The push toward commercially mass-produced high-yield hybrids and Green Revolution "super crops" led to the abandonment of diverse, but relatively low-yielding land races.[125] Insects, fungal pathogens, and other dangers that might threaten a genetically narrow base are now subdued through irrigation, machinery, fertilizers, and pesticides. Because higher income from higher yields offsets the time and expense of implementing

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[118] Wilkes, *supra* note 18, at 73.

[119] *See* KLOPPENBURG, *supra* note 7, at 6.

[120] *See* Frankel, *Genetic Resources*, *supra* note 82, at 40-41.

[121] *See The Vanishing Seeds*, *supra* note 54, at 163.

[122] *See* KEYSTONE REPORT, *supra* note 15, at 5.

[123] KLOPPENBURG, *supra* note 7, at 162 (quoting Garrison Wilkes).

[124] *See The Vanishing Seeds*, *supra* note 54; *see also* KLOPPENBURG, *supra* note 7, at 121.

[125] *See* KEYSTONE REPORT, *supra* note 15, at 5; *see also* KLOPPENBURG, *supra* note 7, at 121-22 (drawing a parallel between the genetic erosion resulting from the spread of hybrid corn in the United States and that resulting from the spread of Green Revolution wheat and rice in the developing world).

these technological solutions, the incentive to continue propping up the monocultures and neglecting land races persists despite ample warnings of the risks.[126]

Incidents before and during the Green Revolution illustrate the danger of having too many eggs in one basket. The most memorable incident is the Irish Potato Famine of 1846.[127] The potato came to Europe from South America in the post-Columbian exchange of species.[128] Potatoes were introduced to Ireland in the eighteenth century, and proved a tremendous boon to the Irish poor. The population tripled to eight million, a direct result of this cheap and plentiful new crop.[129]

The potatoes introduced consisted of a fairly small number of genetic varieties. They did very well initially in a land absent their native diseases. However, this head start did not hold up. The diseases of Ireland eventually "figured out" the potato before the potato could mount a genetic defense. In 1846, an unknown disease caused by the fungus Phutophtora infestans attacked. The result: half the crop was lost, two million Irish died, two million more emigrated, and much of the remaining population was thrown back into a state of abject poverty.[130]

Today, of course, farmers have technological weapons to combat the less benevolent forces in nature. Even in this age of pesticides, herbicides and fertilizers, however, pathogens are sometimes able to exploit specific weaknesses passed down from common parent lines. For instance, in the 1940s, most of the American oat crop was planted in lines derived from the same "Victoria" variety.[131] In 1946, the "Victoria blight" hit.[132] This disease, to which this particular variety was uniquely susceptible, caused major damage to the crop.[133] Likewise, in 1970, ninety percent of the corn crop in the United States shared genetic material from the same parent line.[134] A particular fungus attacked a cytoplasmic character passed down from this parent, and the resulting "Corn Blight of 1970"

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[126] *See* Klinkenborg, *supra* note 31, at 77.

[127] *See* Wilkes & Wilkes, *supra* note 67, at 35; *see also* Wilkes, *supra* note 18, at 73-75.

[128] *See* Wilkes, *supra* note 18, at 73.

[129] *See id.* at 75.

[130] *See id.* Irish emigration might be seen as a delayed step in the Columbian Exchange. The Americas sent potatoes to Ireland. In return Ireland sent two million Irishmen *Cf.* KLOPPENBURG, *supra* note 7, at xii.

[131] *See* Kloppenburg & Kleinman, *supra* note 74, at 6.

[132] *See id.*

[133] *See id.*

[134] *See id.*

cut yields by fifteen percent, costing farmers hundreds of millions of dollars.[135]

Green Revolution super crops introduced into developing countries have also shown signs of weakness. According to a FAO regional representative, Green Revolution rice yields are declining in Asia.[136] The Revolution's potential pitfall is summed up nicely in the following anecdote, concerning elite rice cultivars:

> When the IR-8 variety was attacked by the tungro disease, the farms switched to IR-20, but this hybrid proved vulnerable to grassy stunt virus and brown hopper insects. The farmers were then supplied with the IR-26 hybrid which appeared to be resistant to most of the diseases and pests in the country but it proved vulnerable to strong winds. When the breeders decided to try the original Taiwanese variety that withstood strong winds, they found that it had been lost as Taiwanese farmers planted their farms with IR-8.[137]

2. Environmental Degradation

A second criticism of the high-yield monocultures is that even if farmers are able to stay one technological step ahead of the assaults on their narrowly based crops, the price paid is more than just the out-of-pocket expense of the fertilizers and pesticides. The environmental degradation resulting from these farming practices, if not faced in the present, will have to be dealt with in the future.

The "elite" hybrids and Green Revolution varieties might fairly be described as "high-responding" rather than "high-yielding."[138] Most agricultural crops are not self-supporting, they must be cultivated by humans before they will produce. The concern over the elite varieties, however, is the *degree* to which they must be supported, and the nature of the support system. The catalysts used to trigger these crops' impressive responses are generous applications of environmentally harmful nitrogen fertilizers and chemical pesticides.[139]

The harmful effects of pesticides are now widely recognized, due in large part to the 1962 publication of *The Silent Spring* by Rachel Car-

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[135] *See id*; *see also* Plucknett, *supra* note 73; JUMA, *supra* note 43, at 102.

[136] *See* Martin Khor, *Asia: The Greening of the Green Revolution,* Inter Press Service, Sept. 22, 1993, *available in* LEXIS, News Library, Arcnws File.

[137] JUMA, supra note 43, at 100.

[138] *See The Vanishing Seeds, supra* note 54, at 163.

[139] *See id.*

son.[140] Along with poisoning the environment, pesticides also are no proof against monoculture weakness. Just as insects and other pests can figure out narrowly based *genetic* defenses, they can figure out *chemical* defenses as well. An effective pesticide one year may prove useless the next.[141]

The damage due to the use of chemical fertilizers, particularly nitrogen, is a cause of increasing concern as well. Though chemical fertilizers are able to pump nutrients into specific plants, facilitating their growth as individual organisms, they interfere with the natural ecosystem and make it more difficult for the system to support itself in the future.[142] Under fertilizer applications, the soil's natural cycles, which regulate nutrient uptake, are thrown into high gear. Organic matter is stripped away, and with it goes the ability of the soil to maintain itself.[143] Soil texture, nutrient stores, and the ability to hold moisture are all diminished.[144] Absent rehabilitation, the land is rendered infertile, and the continuous influx of chemicals becomes a necessity.[145]

3. Lessons Unlearned

Comparisons between the Irish Potato Famine and the Green Revolution should not be taken lightly. The effect of the Irish potato was to ratchet up the population of the countryside, as more and more poor Irish crowded onto the wide pedestal balanced upon a genetically narrow base. When this base finally snapped, two million Irish perished, and two million more set sail for America to avoid the misery of starvation.

The Green Revolution super crops, on the other hand, were a crisis response. The possibility of mass starvation loomed if these high-yield cultivars were *not* introduced. No other choice was apparent at the time, and in the short term, the solution succeeded. The solution did not, however, strike at the root of the problem. The end result could parallel that of the Irish potato. Instead of millions, billions now crowd onto the pedestal. Replacing land races with elite cultivars increases the size of the pedestal, but does so by continuously chipping building materials from the already thin support stand.

The Green Revolution, despite its shortcomings, might have been used to buy the time needed to figure out more sustainable solutions. In

140 RACHEL CARSON, THE SILENT SPRING (1962).

141 *See* Klinkenborg, *supra* note 31, at 80.

142 *See id.* at 77.

143 *See id.*

144 *See id.*

145 *See id.*

some respects, however, it appears to have diverted our attention from the larger problem. Biotechnology allows us to stay out in front of the food crisis for the moment. Yet the crisis looms still. According to the CGIAR, food production lagged behind population growth in seventy-five developing countries during the 1980s.[146] Moreover, the FAO Secretary General has offered the grim opinion that "[i]n the case of some staple foods, there is scarcely any more chance of increasing yields," adding further that "[p]lant diseases and damage incidence are increasing."[147] If the human population cannot come to grips with its own prolific growth, the Green Revolution, and the biotech revolution on its heels, will have purchased time not to solve the problem, but to build a bigger one.[148]

V. BIOTECHNOLOGY: RAISING THE FINANCIAL STAKES

The field of biotechnology emerged in the 1980s. It builds upon the foundation laid down by Mendel, Vavilov, and Borlaug, but promises even more profound alterations in the agricultural industry and the battle over genetic resources.[149] The enormous potential to isolate and exploit specific genetic characteristics will result in greater opportunities to engineer new life forms.[150] This potential, coupled with the huge expense of conducting such research, makes issues involving ownership and preservation of genetic materials more pressing. The desire of the United States to protect its biotechnology industry was the major factor causing it to balk at signing the Biodiversity Convention in Rio.

The event usually cited as the origin of modern biotechnology is the discovery, in 1953, by J.D. Watson and Francis Crick of the double helical structure of the deoxyribonucleic acid molecule, better known as DNA.[151] One result of this discovery is that agricultural science has

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[146] *See Agricultural Research Brings Big Crop Gains*, UPI, Feb. 6, 1995, *available in* LEXIS, News Library, Curnws File.

[147] *Fading Plant Diversity Spells More Hunger, Warns FAO*, Deutsche Presse-Agentur, June 17, 1996, *available in* LEXIS, News Library, Curnws File.

[148] The effects of population growth on world food supply was one topic at the FAO-sponsored World Food Summit, that was held in Rome in November, 1996.

[149] *See* Hamilton, *supra* note 5, at 589.

[150] *See* KLOPPENBURG, *supra* note 7, at 2-4.

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> The DNA molecule contains nature's blueprints, determining the hereditary characteristics passed on from one generation of plant or animal to its offspring. Watson's and Crick's work touched off an avalanche of genetic research seeking to unlock the secrets hidden within the double helix. Their early work has since given rise to the modern multi-billion dollar industry known as biotechnology.

David G. Scalise & Daniel Nugent, *Patenting Living Matter in the European Community*, 16 FORDHAM INT'L L.J. 990, 993-94 (1993) [hereinafter Scalise & Nugent, *Patenting* become a more focused endeavor. No longer restricted by the hit-and-miss vagaries of traditional breeding methods, breeders are now able to move beyond simple Mendelian techniques:

> Application of biotechnology in agriculture has resulted in faster and more accurate methods of enhancing crop production than those formerly attained through selective breeding techniques. By studying a plant's genetic blueprints, researchers can isolate and alter the genetic material that determines its specific characteristics. Therefore, scientists can achieve in one generation with certainty what might have otherwise required years or decades of specialized breeding.[152]

Biotechnology also possesses the potential to wean agriculture of chemical pesticides and fertilizers by efficiently enhancing genetic defenses and growth mechanisms.[153] The CGIAR stated its determination to use biotechnology to steer crop production in this direction.[154] Nonetheless, there is ample evidence at present that biotechnology research is directed at *increasing* the consumption of chemicals.[155] Crops are being developed that are uniquely responsive to particular brands of herbicides.[156] Perhaps this is inevitable when some of the leading pesticide companies are moving to monopolize the seed industry.[157] A major

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Living Matter].

[152] *Id.* at 994. However, those intimately familiar with the science of plant breeding state that, for now at least, biotechnological breakthroughs supplement, rather than replace traditional breeding methods. *See generally* Frankel, *Genetic Resources*, *supra* note 82; *see also* KLOPPENBURG, *supra* note 7, at 202-07. The two sciences of molecular biology and plant breeding come from vastly different perspectives. They often find communication, and, therefore coordination, difficult. *See* KLOPPENBURG, *supra* note 7, at 220-22.

[153] Frankel, *Landraces*, *supra* note 24, at 15; *see also* Scalise & Nugent, *Patenting Living Matter*, *supra* note 151, at 994-95.

[154] *See* Frederick Brown, *Serageldin Credited with CGIAR Renaissance*, DIVERSITY, vol. 10, no. 4 (1994), at 5, 7-8.

[155] *See* JUMA, *supra* note 43, at 112.

[156] The Monsanto Company, a leading pesticide producer (and maker of the familiar brand, "Roundup") provides one example of this approach. Monsanto research produces herbicide-resistant crops. Competing weeds can thus be thoroughly doused and effectively obliterated while growth of the desired crop is unimpaired. *See id.* at 113.

[157] *See* KLOPPENBURG, *supra* note 7, at 207-20. This symbiotic paring of chemical and crop need not be nurtured within a parent chemical/subsidiary seed company atmosphere, however. For example, agrichemical company American Cyanamid simply provided a genetic "gift" to Pioneer Hi-Bred, the largest corn seed producer in the world and a company not controlled by American Cyanamid. The gift, however, was uniquely self-serving: a gene altered to tolerate American Cyanamid herbicides. *See*

controversy exists regarding the direction of research in this area. A sometimes skeptical public listens as agrichemical and seed companies laud the development, not of pesticide-free crops, but of a "safer" generation of pesticides.[158]

Apart from suspicions concerning the self-interests of chemical manufacturers, there is a more general skepticism in less-developed regions concerning the potential benefits of biotechnology. The Southern view is that biotechnology is just another tool to widen the standard of living gap between the North and South.[159] Some commentators in the South simply fear the uncertain effect biotech advances will have on regions of the world ill-prepared for such technological surprises.[160] As discussed, fear of being left behind in the new biotechnologically enhanced world prompted developing countries to demand that the Biodiversity Convention contain a commitment to technology-sharing.[161] Southern attempts to become biotechnology business partners, however, have not been well-received by the biotech industry.

VI. INTELLECTUAL PROPERTY REGIMES GOVERNING PLANT GENETIC RESOURCES

A. *U.S. Plant-Related Intellectual Property Rights*

1. Owning Genetic Codes

Genetic manipulation today is more scientific, more focused, and more precise than ever before. While farmers toil in their fields, agricultural scientists busy themselves in laboratories, trying to produce superior seeds. Like the farmer, the scientist expects to profit from her labors. Unlike the farmer, however, the scientist's product is much less tangible.

JUMA, *supra* note 43, at 114. As mentioned earlier, however, the relationship between plant, "pest," and chemical is not static. Several dozen weed species and several hundred insect species are known to have developed their own agrichemical resistances through evolutionary processes. *See id.* at 113.

[158] *See* Hamilton, *supra* note 5, at 654 n.217.

[159] *See* Klaus Bosselmann, *Focus: Plants and Politics: The International Legal Regime Concerning Biotechnology and Biodiversity*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 111, 127 (1996).

[160] Prior to his appointment as Executive Secretary for the Secretariat for the Biodiversity Convention, Dr. Calestous Juma, a Kenyan, opined that "[t]he potential impacts of advances in biotechnology will not only be irreversible, but they will also introduce major and unpredictable transformations in the global organization and distribution of production which will have far-reaching implications for Africa." *See* JUMA, *supra* note 43, at 1.

[161] *See* Biodiversity Convention, *supra* note 1, art. 16.

It is not strictly the seed itself. It is the idea behind the seed, the process of designing a successful genetic combination. Once the seed hits the market, however, competitors can copy the design without having spent the time and energy on development. The "seed designer," therefore, needs some method of protecting her idea.

Seed companies contend that this need to protect their investment entitles them to intellectual property protection over their genetic creations. Indeed, the economic considerations are similar, and the subject matter may seem an appropriate graft onto the patent law regime.

Philosophical considerations, however, concerning ownership of biological processes have caused some to reject this new branch of the regime. At the level of conflict between Northern and Southern countries, it has not been so much a matter of how one feels about the appropriateness of the particular graft, but how one feels about the entire organism. Southern countries see intellectual property protection as a method of denying them valuable technology.[162]

The United States, the country with the largest seed industry and the strongest biotech industry, is not coincidentally a leading advocate of plant-related intellectual property rights.[163] It is the policy of the United States to ensure that its version of an expansive intellectual property regime includes protection for all plant varieties. Even the United States, however, faced some initial trouble accepting the concept of placing patents on life.

2. U.S. Patent Law

U.S. patent law originates within Article 1, Section 8 of the U.S. Constitution, which authorizes Congress to enact laws protecting inventions and discoveries.[164] The first patent act was passed in 1790.[165] The most recent version is the Patent Act of 1952, which retains the original act's three basic requirements for an invention to be eligible for

[162] *See generally* PAT R. MOONEY, SEEDS OF THE EARTH (1980).

[163] *See* OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONG., COMMERCIAL BIOTECHNOLOGY: AN INTERNATIONAL ANALYSIS 3 (1984); *see also* Hamilton, *supra* note 5, at 611.

[164] U.S. CONST. art. I, § 8, cl. 8.

[165] *See* David G. Scalise & Daniel Nugent, *International Intellectual Property Protections for Living Matter: Biotechnology, Multinational Conventions and the Exception for Agriculture*, 27 CASE W. RES. J. INT'L L. 83, 89 (1995) [hereinafter Scalise & Nugent, *International Intellectual Property*].

a "standard utility patent": the invention must be novel, useful, and non-obvious.[166]

Traditionally, the courts have excluded certain subject matter as unsuitable for patent protection. Examples of items considered per se unpatentable include scientific principles, laws of nature, physical phenomena, abstract ideas, and products of nature.[167] The "products of nature" exception has been the traditional bar to patents on plants. It is based on the notion that something already existing in nature cannot be "novel," and therefore cannot be patented.[168]

The "products of nature" exception, however, is harder to justify in connection with modern plant breeding efforts. Though certainly the tinkerings of plant breeders cannot match what has already been accomplished in the "raw" materials, the innovations of plant breeders grow ever more apparent in the finished product. Further, as is the case for inventions of an inorganic nature, the business of plant breeding involves time and expensive research.[169] Nevertheless, until the 1980s, U.S. courts prevented plant breeders from receiving standard utility patents.

To compensate for barred access to the Patent Act, Congress enacted statutes outside the traditional patent scheme that dealt exclusively with the protection of plant materials. The first of these was the Plant Patent Act of 1930 (PPA).[170] The PPA, however, only allows patents on asexually reproduced plants.[171] It does not cover plants which reproduce sexually through seeds, a category comprising the bulk of U.S. agriculture.[172] Nevertheless, 2,700 plant patents were issued under the PPA between 1930 and 1970.[173]

The emergence of the U.S. hybrid seed industry[174] and the strength-

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[166] *See* 35 U.S.C. §§ 101-103 (1988 & Supp. 1996).

[167] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 89.

[168] *See id.* at 90.

[169] *See* JUMA, *supra* note 43, at 152.

[170] *See* 35 U.S.C. § 161 (1988 & Supp. 1996).

[171] The PPA provides: "Whoever invents or discovers and asexually reproduces any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber propagated plant or a plant found in an uncultivated state, may obtain a patent therefor . . . ." *Id.*

[172] The PPA gives the inventor the exclusive right to propagate plants by asexual reproduction by grafting, budding, cutting, layering, and division, but not by seeds. *See* Kim Bros. v. Hagler, 167 F. Supp. 665 (S. D. Cal 1958), *aff'd* 276 F.2d 259 (9th Cir. 1960).

[173] Scalise & Nugent, *International Intellectual Property, supra* note 165, at 93.

[174]

> The use of hybrid varieties helped rejuvenate the U.S. seed industry . . . . With anticipated growth potential, especially with the use of hybrids, the industry began to

ening of plant variety protection laws by Western European nations in the early 1960s[175] spurred Congress to pass the Plant Variety Protection Act (PVPA) in 1970.[176] The PVPA extended protection to new varieties of sexually reproducing plants, including most commercial agricultural crops.[177] Under the PVPA, to have a plant variety certified, a breeder must show that the variety has novelty, uniformity, stability, and distinctness.[178]

"Breeders' rights" obtained under the PVPA are similar, but not identical, to intellectual property rights obtained under the Patent Act.[179] Though the standards are easier to comply with than those of the Patent Act,[180] the protection offered by the PVPA for plant varieties is not as complete.[181] Until recently, the PVPA contained a major exception relating to farmers' use of certified seeds.[182] The "farmers privilege" exception allows farmers to save seeds produced by certified varieties and replant them without paying an additional royalty.[183] Previously, "brown bagging," a practice by which farmers could sell these first generation seeds to other farmers as "just like" the commercial varieties, was also sanctioned.[184] In 1994, however, Congress revised the PVPA to eliminate the unauthorized sale of seeds from certified varieties.[185] In addi-

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> expand although it remained diverse in the 1930s . . . . By the 1960s, 10 major national U.S. firms were selling seeds, with numerous others selling to various parts of the world.

JUMA, *supra* note 43, at 81.

[175] *See* KLOPPENBURG, *supra* note 7, at 136-40.

[176] *See* 7 U.S.C. § 2402 (1988 & Supp. 1996); Scalise & Nugent, *International Intellectual Property, supra* note 165, at 93.

[177] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 93.

[178] *See* 7 U.S.C. § 2401(a).

[179] *See* Hamilton, *supra* note 5, at 597.

[180] The purpose of substituting the word "distinctiveness" in place of the Patent Act's "non-obviousness" is to set a less exacting standard. *See id.* at 539.

[181] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 94.

[182] *See id.* The PVPA also contains a narrow exception in favor of "bona fide research." *See* 7 U.S.C. § 2544 (1988 & Supp. 1996). Through this exception, breeders can use a protected variety to develop their own varieties without having to pay a royalty to the certificate holder. However, the derived variety must be separated from the original by some "minimum distance" by its performance or essential characteristics. *See* Hamilton, *supra* note 5, at 598.

[183] *See* Hamilton, *supra* note 5, at 599.

[184] *See id.* at 532.

[185] *See Bill Adds Protection for Breeders of Plants*, TIMES-PICAYUNE, Aug. 13, 1994, at A14. The PVPA was amended to bring U.S. law into conformity with 1991 revisions to the International Convention for the Protection of New Varieties (UPOV Convention). *See Plant Variety Protection Act Amendments of 1994*, S. 13090, 103d

tion, in *Asgrow v. Winterboer*,[186] the Supreme Court retroactively curtailed this practice in relation to varieties certified prior to the revision.[187]

Though intellectual property laws specific to plant breeding have been strengthened, plant breeders' actual dependence on these laws has slackened. This is because U.S. courts now look more favorably on the patenting of living matter. The door was opened in 1980 by the landmark U.S. Supreme Court case of *Diamond v. Chakrabarty*.[188] In *Chakrabarty*, a genetically altered strain of bacteria useful in cleaning up oil spills was ruled eligible for patent protection, and the court added that patent eligibility extended to "anything under the sun made by man," even if the materials were alive.[189]

Ex Parte Hibbard followed five years later.[190] In this case, the court specifically extended the *Chakrabarty* holding to plant breeding. In *Ex Parte Hibbard*, the Patent and Trademark Office (PTO) originally rejected a patent for a corn plant genetically engineered to possess an abnormally high level of amino acids.[191] The PTO based its decision on

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Cong., 140 CONG. REC. 133 (1994).

[186] 513 U.S. 179 (1995).

[187] The Supreme Court limited the farmer's right to sell seeds to only that amount necessary to replant the farmer's own acreage. *See id.* This remained an issue even with the new law in place because the 1994 revision did not erase the exemptions attached to pre-1994 certificates. A pre-1994 PVPA certificate offers protection of the variety and a brown bagging exemption for 18 years. *See Supreme Court Hears Arguments on Asgrow v. Winterboer Case*, DIVERSITY, vol. 10, no. 4 (1994), at 41.

[188] 447 U.S. 303 (1980).

[189] *Id.* at 309. *Chakrabarty* involved a genetically engineered strain of bacteria capable of breaking down multiple components of crude oil. Chakrabarty, the inventor, had devised a method of introducing plasmids (genetic components of a cell outside the nucleus) into a host bacteria. Only the modified bacteria, not the bacteria as it occurred in nature, is capable of breaking down the oil molecule. *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 96.

Chakrabarty's standard utility patent application was denied by the Patent and Trademark Office (PTO) on the grounds that microorganisms are living "products of nature" and therefore not patentable. *See id.* The Patent Board of Appeals (Patent Board) disagreed, noting that Chakrabarty's modified bacteria were not, in fact, naturally occurring. Nevertheless, the Patent Board also denied the patent on the grounds that Congress intended the 1930 PPA to be the sole source of intellectual property protection for this type of living matter. (The PVPA was not available in this case as it specifically excludes bacteria. *See* 7 U.S.C. § 2402 (1988).) The Supreme Court reversed, holding that living matter was not *per se* barred from standard utility patent protection. *See* Chakrabarty, 447 U.S. at 309.

[190] 227 U.S.P.Q. (BNA) 443 (P.T.O. Bd. App. & Int. 1985).

[191] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 98.

the view that Congress had intended the 1970 PVPA to be the exclusive source of intellectual property protection for sexually reproducing plants.[192] The Patent Board, citing *Chakrabarty*, reversed and held that neither the PPA nor the PVPA expressly excluded protection under the Patent Act.[193]

The PTO signaled a full retreat in its Notice of April 7, 1987.[194] In this official notice, the PTO indicated that, in deference to the *Chakrabarty* decision, it would begin issuing patents to "anything under the sun that is made by man," including all "non-naturally occurring non-*human* multi-cellular living organisms, including animals . . . ."[195]

U.S. plant breeders can now seek the more complete protection offered by a standard utility patent. Patents may remain out of reach for some varieties, due to the inexact nature of traditional breeding methods and the resulting inability to meet the stringent disclosure requirements of the Patent Act.[196] Other varieties, however, particularly those most markedly the product of biotechnological manipulation,[197] can be patented and can therefore circumvent the research and farmers' exemptions found in the PVPA.[198] Hybrid corn is included in this latter category of plant varieties able to meet the requirements for a standard utility patent.[199] Pioneer Hi-Bred, one of the leading U.S. corn producers, began securing patents for some of its hybrids in the late 1980s.[200] Recently, Pioneer announced that it will seek patents for all its corn hybrids.[201] The move will allow Pioneer to impose license fees on other companies for using

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[192] *See id.*

[193] *See* Hamilton, *supra* note 5, at 595 n.29.

[194] *See* 1077 OFFICIAL GAZ. PAT. OFFICE 24, 31 (April 21, 1987).

[195] *Id.* (emphasis added).

[196] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 100.

[197] Scalise and Nugent explain why genetically engineering a plant variety, as opposed to standard breeding methods, would make it easier to obtain standard utility patent protection:

> The process of genetic engineering entails isolating the DNA molecule that represents a desired characteristic and replacing that molecule with new DNA material that contains the living code for reproducing said characteristics. This is an exact science, subject to precise descriptions of replication. Conversely, the art of plant breeding involves the blending of two plants and is not subject to the type of exacting specifications required for a utility patent . . . .

Id. at 100 n.71.

[198] *See id.* at 101.

[199] *See* Anne Fitzgerald, *Pioneer to Patent Seed Corn Hybrids,* DES MOINES REG., Apr. 9, 1996, at S8.

[200] *See id.*

[201] *See id.*

Pioneer hybrids in research and development efforts, and impose royalties on farmers who bring Pioneer products to market.[202]

B. International Treatment of Plant-Related Intellectual Property Rights

1. WIPO and the Paris Union

Modern attempts to coordinate general patent laws internationally date from the Paris Convention of 1883.[203] The Paris Convention did not create a harmonized international patent system. Rather, it created a system of reciprocity whereby the parties agree to offer the same level of protection to both foreign and domestic applicants.[204] In 1967, the United Nations established the World Intellectual Property Organization (WIPO) to oversee international intellectual property agreements, including the Paris Convention.[205] WIPO's initial mission was to organize the creation of an international patent system providing some minimal level of protection upon universal filing.[206]

WIPO's attempts to create this basic level of international protection have not been successful. As an agent of the United Nations, WIPO has generally served as the voice of the developing world on the subject of international patent treatment, calling for increases in technology transfer and some restraints on patent coverage.[207] WIPO has not been inclined to support inclusion of plant varieties within the scope of patentable sub-

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[202] *See id.* In contrast to the more lenient PVPA, under the Patent Act the breeders' rights more clearly flow into each generation of crops planted by the farmer. If the farmer purchases seeds, grows his crop, and gathers some of the seeds from that crop to replant, he will find that intellectual property rights have attached with the genetic code on the second generation seeds. The patent holder may condition sale or replanting of the product upon payment of royalties. *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 101.

[203] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 106 n.84.

[204] The Paris Convention provides for: (1) national treatment, providing foreign applicants the same access to intellectual property protection as domestic applicants, (2) right of foreign priority, recognizing the original date of foreign application, and (3) establishment by national jurisdictions of basic unfair competition laws in relation to international trade. *Id.* at 106.

[205] *See id.*

[206] Absent a unified system, an applicant must file in each jurisdiction where protection is sought. *See id.*

[207] *See id.* at 107.

ject matter.[208] As such, WIPO is looked upon with some suspicion by industry forces in the developed world.[209]

2. UPOV Convention

Despite WIPO's reluctance, there have been international efforts to provide intellectual property protection for plant varieties. The organization responsible for coordinating these efforts is the International Union for the Protection of New Varieties of Plants (UPOV), established in 1961.[210] UPOV is an organization whose members are parties to the International Convention for the Protection of New Varieties of Plants (UPOV Convention), entered into by European nations in 1961 and amended in 1978 to allow non-European countries to join.[211] As of January 1996, thirty nations had joined UPOV.[212] Along with the United States and all members of the European Union, UPOV membership consists of developed or rapidly developing nations; those nations with the greatest incentive to secure strong patent protection.[213]

The goal of the UPOV Convention is to introduce uniformity in plant variety protection laws while allowing for variations in national plant patent legislation.[214] Like the Paris Union, UPOV calls for non-discrimination of foreign applicants and recognition of the original application date within any member jurisdiction for purposes of priority.[215] Under UPOV, plant breeders can protect new plant varieties for a limited time, preventing others from producing propagating materials of their protected variety.[216] Under a set of 1991 amendments, UPOV

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[208] *See id.*; *see also* Shayana Kadidal, *Plants, Poverty, and Pharmaceutical Patents*, 103 YALE L.J. 223, 237 (1993).

[209] *See* Scalise & Nugent, *International Intellectual Property*, *supra* note 165, at 107.

[210] International Convention for the Protection of New Varieties of Plants, 815 U.N.T.S. 89 (1961). UPOV is located in Geneva and is housed with WIPO. *See* Hamilton, *supra* note 5, at 605.

[211] *See* Hamilton, *supra* note 5, at 605.

[212] *See Chile Signs Up to International Plant Variety Convention*, European Information Service, Agri Service International, Dec. 21, 1995, *available in* LEXIS, News Library, Allnws File.

[213] *See* Scalise & Nugent, *International Intellectual Property*, *supra* note 165, at 108. The United States joined the UPOV Convention in 1981. *See* Hamilton, *supra* note 5, at 605.

[214] *See* JUMA, *supra* note 43, at 156.

[215] *See* Scalise & Nugent, *International Intellectual Property*, *supra* note 165, at 108.

[216] *See* KEYSTONE REPORT, *supra*, note 15, at 35, app. A. The Keystone Report summarizes the protections provided under the 1978 version of UPOV and the 1991 amendment (which was not scheduled to enter into force until 1995) as follows:

members may also offer standard utility patent rights for plant varieties in addition to or alternatively to plant breeder rights like those provided for in the United States under the PPA and PVPA.[217] The UPOV Convention was further amended in 1991 to include an optional farmers' exemption, allowing farmers to save and replant protected variety seeds but not to sell them.[218] The 1991 amendments serve generally, however, to strengthen breeders' rights.[219]

> Plant Variety Protection (PVP) is a specific system of protection for plant varieties. It has analogies to patents, but also important differences. Rights are granted for a limited period of time (typically 20 years) to the breeder of the specific unit of plant material that constitutes a plant variety. In contrast to rights granted under patent systems, the breeder of a protected plant variety cannot seek exclusive rights in a unique feature of her/his variety. The breeder of the first blue rose cannot monopolize blueness. It is open to all other breeders to breed and protect blue roses which are distinct from the first such variety . . . .
>
> Under the [1978 UPOV Convention], the holder of [PVP] can prevent others from producing propagating material of the variety, and can prevent others from marketing such material. Under the [1991 Amendment] . . . the Breeder's Right has been further extended to harvested material produced from propagating material whose use was not authorized by the breeder, unless the breeder has had reasonable opportunity to exercise his right in relation to the propagated material . . . .
>
> The breeders' permission is also required . . . for the repeated use of the variety in question as a parent line [to produce hybrids, or as of the 1991 Amendment, to produce a variety which is "essentially derived" from the parent, retaining virtually the entire genetic structure of the parent] . . . .
>
> [Subject to the above restrictions, a]ny protected variety can be freely used as a plant genetic resource for the purpose of breeding other varieties . . . .

Id.

[217] *See id.* Under the 1978 version, in reference to a particular species, parties could offer *either* separate plant variety protection laws *or* standard utility patents. Parties could not make both available for the same species. *See* Hamilton, *supra* note 5, at 605.

[218] *See* Neil D. Hamilton, *Why Own the Farm If You Can Own the Farmer (and the Crop)?: Contract Production and Intellectual Property Protection of Grain Crops*, 73 NEB. L. REV. 48, 101 (1994). As noted earlier, the United States modified its plant protection laws to comply with this latest version of UPOV. *See Plant Variety Protection Act Amendments of 1994*, S. 13090, 103d Cong., 140 CONG. REC. 133 (1994).

[219] *See* Hamilton, *supra* note 5, at 606. Though adding and tightening protections offered plant breeders, the actual effect of the 1991 amendments on biotechnology is apparently in the eyes of the beholder. *Compare id.* (stating that the amendments "increase the IPR protection available for the products of biotechnology"), *with* Scalise & Nugent, *International Intellectual Property*, *supra* note 165, at 109 (stating that the amendments are a "drawback" and render the convention "potentially meaningless for the biotechnology industry"; and "regarding the needs of the biotech industry, UPOV

3. GATT: Trade-Related Intellectual Property Accord

The General Agreement on Trade and Tariffs (GATT) is another forum for international treatment of intellectual property issues. In contrast to WIPO, the direction of GATT negotiations have been determined to a great extent by the dominant world trade nations.[220] Nations that have the greatest stake in a clear, uniformly recognized intellectual property regime have attempted to use GATT as a vehicle to promote plant-related intellectual property rights.[221] The most recent Uruguay Round of GATT negotiations, which began in 1986 and concluded in December of 1993, included a Trade Related Intellectual Property (TRIPs) agreement with a section on plant variety protection.[222]

The United States was the primary force behind the TRIPs agreement.[223] Nevertheless, the final version of TRIPs omitted some key provisions from the proposal originally submitted by the United States[224] which called for mandatory recognition of plant patents to bring the trade agreement in line with U.S. policy since the *Ex Parte Hibbard* decision.[225] The final version of the agreement specifically states that parties may exclude plants from patentability, though it requires parties to provide some form of intellectual property protection, "*either* by patents or by an effective sui generis system or by any combination thereof."[226] Parties may therefore choose to offer a separate and perhaps weaker form of breeders' rights rather than the full patent rights favored by the United States.

It is notable, however, that GATT requires parties to offer at least some form of plant variety protection. The Uruguay Round produced an agreement consistent with the 1991 UPOV Convention.[227] GATT, however, was negotiated by over 100 nations,[228] over three times the number of nations that are presently party to the UPOV Convention.[229] Therefore, while some commentators bemoan the biotechnology applications left *out* of the GATT agreement,[230] others observe that the effect

is materially incomplete").

[220] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 115.

[221] *See* Hamilton, *supra* note 5, at 613.

[222] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 114.

[223] *See id.*

[224] *See* Hamilton, *supra* note 5, at 614.

[225] *See id.* at 595, 614.

[226] *Id.* at 614 (emphasis added).

[227] *See id.*

[228] *See id.* at 612.

[229] *See id.* at 614.

[230] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 114-

of GATT will be to compel nearly all the world's trading nations to meet minimum intellectual property standards relating to plant varieties.[231] Developed nations will have to alter their intellectual property systems very little, while many developing nations will have to make significant changes to their present laws.[232]

VII. The International Undertaking on Plant Genetic Resources

A. *Advent of the Seed Wars*

The increased efforts during the 1970s to collect and conserve plant genetic resources in gene banks coincided with the amendment to the UPOV Convention in 1978 opening it to non-European nations, and expanding international cooperation in the recognition of plant-related intellectual property rights. Together, these events brought greater attention to questions of ownership, and how the international community planned to manage the *ex situ* seed collections.[233]

The United Nations, through the FAO, responded to this issue in 1983 by establishing the Global System for the Conservation and Utilization of Plant Genetic Resources.[234] As part of the Global System, FAO established the Commission on Plant Genetic Resources to serve as the "world forum for discussion of use, control, and conservation of PGR."[235] The Commission's first major action was the adoption of the International Undertaking, a non-binding resolution meant to serve as a framework for the operation of the Global System.[236]

In contrast to the broad scope of the Biodiversity Convention, the International Undertaking focuses on conservation and use of agricultural plants only.[237] In contrast to the UPOV Convention, established to meet

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15 (stating that GATT is an "unqualified defeat for the biotechnology industry and particularly for those engaged in agricultural genetic engineering").

[231] *See* John H. Barton, *The Mediterranean Region Provides a Microcosm for the Global Intellectual Property Rights Debate,* DIVERSITY, vol. 11, nos. 1 & 2 (1995), at 146.

[232] *See id.* The North American Free Trade Agreement (NAFTA) also expands the influence of the UPOV Convention. NAFTA specifically requires parties to comply with the minimum standards established by UPOV. *See* Hamilton, *supra* note 5, at 616-17.

[233] *See* KEYSTONE REPORT, *supra* note 15, at 9.

[234] *See* Hamilton, *supra* note 5, at 600.

[235] *Id.*

[236] *See id.*

[237] *See* Gregory Rose, *International Regimes for the Conservation and Control of Plant Genetic Resources, in* INTERNATIONAL LAW AND THE CONSERVATION OF BIOLOGICAL DIVERSITY, at 145, 153 (Michael Bowman & Catherine Redgewell eds., 1996).

the needs of a fairly homogenous group of developed nations, negotiations for the International Undertaking commenced with the intent of establishing widespread international consensus on the issue of plant genetic resources. Unfortunately, the international community was not yet ready to come to terms with that issue in 1983.

Prior to the negotiations, acrimonious debate on the subject had been sparked in part by the 1979 publication of *Seeds of the Earth* by Pat Mooney.[238] Mooney's book accused the North of "robbing" the South of precious genetic resources and making huge profits from the theft.[239] The accusation served to rally Southern policy-makers, who came into the FAO meeting ready to fight.[240]

Policy-makers in the North, however, came into the meeting with a decidedly different agenda. Some, perhaps, were merely interested in maintaining the status quo. Others may have been genuinely bewildered by the claim of theft. Unlike the extraction of, for example, minerals, the removal of seeds does not generally deplete the resource, and samples from the collection efforts were usually left in the host country.[241] One might speculate that many in the North simply had never considered the need to recompense Southerners for their seeds. At any rate, in failing to comprehend or to placate the South's frustration, the North came to the FAO meeting unprepared for battle, yet unready to concede the validity of the South's claims.[242] As a result, no consensus was reached. Instead, the South with greater numbers on their side pushed through a resolution decidedly against the immediate economic interests of the North. The ensuing rift came to be known as the "Seed Wars."[243]

B. The Language of the International Undertaking

Article I of the International Undertaking states its objective mildly and without controversy: "to ensure that plant genetic resources of economic and/or social interest, particularly for agriculture, will be explored, preserved, evaluated and made available for plant breeding and

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[238] *See* Frankel, *Genetic Resources, supra* note 82, at 40; *see generally* MOONEY, *supra* note 162. Pat Mooney currently heads the Rural Advancement Foundation International (RAFI), a prominent NGO dedicated to the promotion of farmers' rights in relation to plant genetic resources. *See Profile: A Small Group with a Big Agenda Influences Global Biodiversity: RAFI*, DIVERSITY, vol. 9, no. 3 (1993), at 47.

[239] *See* Frankel, *Genetic Resources, supra* note 82, at 40-41.

[240] *See id.*

[241] *See id.*

[242] *See* John Willoughby, *Seed Wars*, SAN FRAN. CHRON., June, 2, 1991, at 14.

[243] *Id.*

scientific purposes."[244] The philosophical stance of the 1983 Undertaking, which stands in stark contrast to that of the Biodiversity Convention, is contained in the second sentence of Article I.

> This Undertaking is based on the *universally accepted* principle that plant genetic resources are *a heritage of mankind* and consequently should be *available without restriction.*[245]

This statement reflects the "common heritage" principle that plant genetic resources exist for the benefit of humankind collectively, and cannot be appropriated for exclusive use by any individual.[246]

Had this blanket "common heritage" proclamation in reference to plant genetic resources been issued with the intent merely to cover land races or wild germplasm, no outcry would have ensued from the laboratories of Northern seed companies. In fact, it would have been exactly the pronouncement they would have desired, affirming their open access to the "raw materials" necessary to construct the elite varieties.

However, Article 2 of the Undertaking makes it clear that much more ground is covered by the term "plant genetic resources." Article 2 defines "plant genetic resources" to include the reproductive or vegetative propagating material of:

> (i) cultivated varieties (cultivars) in current use and newly developed varieties;
> (ii) obsolete cultivars;
> (iii) primitive cultivars (land races);
> (iv) wild and weed species, near relatives of cultivated varieties;
> (v) *special genetic stocks (including elite and current breeders' lines and mutants)*;[247]

Developing countries, by including "special genetic stocks," intended to subject elite cultivars to the common heritage principle. In doing so, the developing world was emphatically rejecting intellectual property restrictions over these plant varieties.[248] By the terms of the 1983 Undertaking, the common heritage blanket spreads over not only the Vavilov Centers and third world farmers' fields, but over Northern agricultural laboratories as well.

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[244] International Undertaking, *supra* note 2, art. 1.

[245] *Id.* (emphasis added).

[246] *See* Kloppenburg & Kleinman, *supra* note 74, at 10.

[247] International Undertaking, *supra* note 2, art. 2 (emphasis added).

[248] *See* Willoughby, *supra* note 242.

The response by the U.S. seed industry was immediate and intense. The American Seed Trade Association declared that the International Undertaking "strikes at the heart of free enterprise and intellectual property rights."[249] The U.S. government refused to sign the Undertaking or to join the Commission on Plant Genetic Resources, and promised no financial support.[250] Other developed countries followed suit.[251] Developing countries countered by talking of forming a "genetic OPEC;" several nations even declared their borders closed to germplasm export.[252] Six years after the Rome meeting, at about the same time developed nations were planning UPOV amendments designed to shore up legal protections for their elite varieties, FAO established the International Fund for Plant Genetic Resources. This act by FAO had little practical effect absent funding from developed nations.[253]

The International Fund came into being in an atmosphere of easing tensions, however. Eventually, a tentative compromise was reached, due in large part to the mediation efforts of the Colorado-based Keystone Center.[254] The Keystone International Dialogue on Plant Genetic Resources (Keystone Dialogue) was initiated in 1988 to "increase mutual understanding and develop consensus recommendations on the availability, use, exchange, and protection of plant genetic resources."[255] The Keystone Dialogue brought together representatives from national governments, the seed industry, NGOs, and scientific organizations.[256] A series of world-wide meetings produced a final report endorsing the concept of an international fund for PGR conservation, including mandatory contributions by participating nations.[257]

More visibly, the Keystone Dialogue led directly to a revision of the International Undertaking that softened its approach.[258] The Interpretation of the International Undertaking on Plant Genetic Resources (Agreed

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[249] *Id.*

[250] *See id.*

[251] The United States, Denmark, Finland, France, Norway, Sweden, United Kingdom, and New Zealand officially indicated their unwillingness to support the Undertaking. *See* KLOPPENBURG, *supra* note 7, at 174. Australia, Canada, and Japan offered no official proclamation, but were also disinclined to support the Undertaking. *See id.* at 304 n.16.

[252] *See id*; Kloppenburg & Kleinman, *supra* note 74, at 11.

[253] *See* Hamilton, *supra* note 5, at 603.

[254] The Keystone Center, located in the resort area of Keystone, Colorado, is a non-profit organization which serves as a mediator on environmental issues. *See* Willoughby, *supra* note 242.

[255] KEYSTONE REPORT, *supra* note 15, at 1.

[256] *See* Hamilton, *supra* note 5, at 604; *see also* KEYSTONE REPORT, *supra* note 15.

[257] *See* KEYSTONE REPORT, *supra* note 15.

[258] *See id.*

Interpretation) was one of two amendments adopted in 1989.[259] The Agreed Interpretation expanded on the theme of 1983 by including an endorsement of "Farmers' Rights" which called for compensation to farmers for their efforts to conserve and develop plant genetic resources.[260] The Agreed Interpretation also acknowledged the legitimacy of intellectual property protection for elite varieties.[261] In the first of five points, the Agreed Interpretation states unequivocally: "Plant Breeders' Rights as provided for under UPOV . . . are not incompatible with the International Undertaking."[262]

Another amendment, The Third Annex to the Undertaking, was passed in 1991.[263] The Third Annex re-emphasizes conservation of plant genetic resources and acceptance of both Farmers' Rights and Breeders' Rights.[264] It also includes a provision presaging the philosophical position staked out in the Biodiversity Convention. The Third Annex declares "that nations have *sovereign rights* over their plant genetic resources."[265]

As a result of these compromises reached in the language of the International Undertaking, the United States and Canada agreed in 1990 to join the FAO Commission on Plant Genetic Resources, though not to sign the Undertaking.[266] The compromise did not, however, solve the differences between the North and the South concerning control and ownership of PGR.[267] These differences surfaced once again in the negotiations over the Biodiversity Convention.

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[259] *See Interpretation of the International Undertaking on Plant Genetic Resources*, Food and Agriculture Organization of the United Nations, 25 Sess., U.N. Doc. C 89/24 (1989) [hereinafter *Agreed Interpretation*].

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> Proponents of farmers' rights, including Mexico, India and Ethiopia, argued that varieties found in the third world were often not mere accidents of nature but had been improved by tribesmen or farming communities. For generations, they argue, farmers have selected, bred and conserved plant species, including coffee, wheat, corn and cotton, and continue to do this without fitting into a system of laboratories and patents.

Marlise Simons, *Poor Nations Seeking Rewards for Contributions to Plant Species*, N.Y. TIMES, May 16, 1989, at C4.

[261] *See* Rose, *supra* note 237, at 155.

[262] Agreed Interpretation, *supra* note 259.

[263] *See* United Nations Conference Resolution 3/91 (1991) [hereinafter *Third Annex*].

[264] *See* Hamilton, *supra* note 5, at 603.

[265] *Id.* (emphasis added).

[266] *See id.* at 604-05.

[267] *See id.* at 605.

VIII. THE BIODIVERSITY CONVENTION

A. *The Scope of the Biodiversity Convention*

The 1992 UNCED, commonly referred to as the "Earth Summit," was perhaps the most publicized international environmental event since the Stockholm Conference twenty years earlier. The dominant news item at the event, unfortunately, was the U.S. refusal to sign the Biodiversity Convention. At the behest of its powerful biotech industry, the United States declined to join the 157 other nations that endorsed the treaty in Rio de Janeiro.[268]

As noted previously, one of the three stated objectives found in Article 1 of the Biodiversity Convention is "the fair and equitable sharing of the benefits arising out of the utilization of genetic resources."[269] This objective is similar in spirit to that stated in the 1983 International Undertaking. In contrast with the original Undertaking, however, the Biodiversity Convention attempts to serve that objective through affirming individual ownership of genetic formulas.

The Biodiversity Convention attempts much broader coverage than does the International Undertaking. While the Undertaking sets standards for the use and conservation of agricultural plants, the Convention concerns itself with the whole of biodiversity.[270] Quipped one expert, "the Convention on Biological Diversity . . . is much less a convention on biodiversity than a convention on access to genetic resources."[271]

Unlike the International Undertaking, the Biodiversity Convention does not specifically mention elite commercial varieties. The Convention, however, asserts the right of all parties to share in the benefits after *utilization* of such resources.[272] This implies that even if the term "genetic resource" is confined to unimproved "raw materials," the collective rights of humanity are not limited once those raw materials enter the laboratory.[273]

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[268] *See id.* at 619.

[269] Biodiversity Convention, *supra* note 1, art. 1.

[270] A large portion of the Convention, however, focuses on those same issues tackled by the Undertaking. It may be questioned whether any additional ground was covered in Rio.

[271] Barton, *supra* note 231, at 146.

[272] Biodiversity Convention, *supra* note 1, art. 1.

[273] Biotech companies might interpret this clause to mean "we make a socially-desired product, you get to buy it and use it; everyone benefits." Developing countries probably have more of a profit-sharing in mind.

B. *The Demise of the Common Heritage Principle*

It was evident well before UNCED that the common heritage principle in relation to genetic resources was losing stature. The Third Annex to the Undertaking had subjected the principle to the overriding sovereign rights of source countries.[274] That same year, UNEP and several dozen other governmental and non-governmental organizations sponsored the "Nairobi Expert's Workshop on Property Rights, Biotechnology, and Genetic Resources."[275] The workshop's panel of experts, broadly drawn from all parties to the debate, concluded that the treatment of biodiversity and genetic resources as common heritage was detrimental to conservation efforts and efforts to resolve inequities in the then-current system.[276]

C. *Article 15: State Sovereignty Over Genetic Resources*

Given the direction taken immediately prior to UNCED, it is not surprising that the Biodiversity Convention reasserts state sovereignty. The Convention, however, goes one step farther and consciously avoids restatement of the common heritage principle.[277] In the Preamble, biodiversity conservation is referred to as a "common concern of humankind."[278] The phrase was deliberately substituted to dilute the collective ownership implied by the term "common heritage."[279]

Article 15 addresses the issue of the sovereign rights of source countries. Paragraph 1 of the Article states: "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*."[280] Paragraph 5 adds: "Access to genetic resources shall be subject to the *prior informed consent* of the Contracting Party providing such resources, unless otherwise determined by the party."[281]

Paragraph 1 of Article 15 is the cornerstone of the Biodiversity Convention's treatment of PGR. It establishes the source country as

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[274] *See* Michelle Thom, *International Policy on Plant Genetic Resources*, INSTITUTE FOR AGRICULTURE AND TRADE POLICY, May 1995.

[275] *See African Center Hosts Expert Workshop on Property Rights, Biotechnology and Genetic Resources*, DIVERSITY, vol. 7, no. 3 (1991), at 10.

[276] *See id.*

[277] *See* Maria Clara Maffei, *Evolving Trends in the International Protection of Species*, 36 GERMAN Y.B. OF INT'L L. 131, 163 (1993).

[278] Biodiversity Convention, *supra* note 1, pmbl. (emphasis added).

[279] *See* Maffei, *supra* note 277, at 163.

[280] Biodiversity Convention, *supra* note 1, art. 15(1) (emphasis added).

[281] *Id.* art. 15(5) (emphasis added).

controlling authority over its own genetic resources. Paragraph 5 emphasizes that authority by mandating than no collector may remove genetic resources without first seeking permission from the state. Plant collectors no longer have the free and open access enjoyed under a "common heritage" regime.

Paragraph 2 of Article 15 places a check on the state's authority. Parties "shall endeavor to create conditions to facilitate access to genetic resources . . . " and may not "impose restrictions which run counter to the objectives of this Convention."[282] This passage provides a check on both intellectual property restrictions and on PGR access restrictions.

Nonetheless, the clear intent of Article 15 is to establish that the source country is owner and provider, and to place most of the cards in the hands of that country. Paragraph 2 might create vague obligations to negotiate terms of access in good faith, but the source country is still the arbiter as to what constitutes reasonable terms, and whether access will ultimately be granted.[283] This provision grants developing countries a basis in international law to require compensation for their PGR.[284]

D. *Article 19: Biotechnology and the Distribution of Benefits*

Article 19, Paragraph 1 obligates the contracting parties to "*take legislative, administrative or policy measures, as appropriate*, to provide for the effective participation in biotechnological research activities by those Contracting Parties, *especially developing countries*, which provide the genetic resources for such research, and *where feasible* in such Contracting Parties."[285] Though this article pointedly acknowledges the contribution of developing countries to biotechnology research, its "where feasible" and "as appropriate" language just as pointedly waters down obligations to bring these countries aboard on research projects.

Paragraph 2 provides: "Each Contracting Party shall take all practicable measures to promote and advance priority access on a fair and equitable basis by Contracting Parties, especially developing countries, to the results and benefits arising from biotechnologies based upon genetic resources provided by those Contracting Parties. Such access shall be on mutually agreed terms."[286]

The more precise language of Paragraph 2 creates an obligation to include developing nations in biotechnologically induced gains. What is

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[282] *Id.* art. 15(2).
[283] *See* Maffei, *supra* note 277, at 165-166.
[284] *See* Hamilton, *supra* note 5, at 621.
[285] Biodiversity Convention, *supra* note 1, art. 19(1) (emphasis added).
[286] *Id.* art. 19(2).

not clearly spelled out, however, is whether the term "benefits" includes a share of the financial rewards or just priority access to the finished products of biotechnology.[287] Also, questions remain as to whether a share of the rewards go directly to the country of origin or whether biotechnologically advanced nations must provide products at a favorable price, train source country personnel in use of such products, or donate a portion of the profits to international funds.

E. Article 16: Technology Transfer

By far the most contentious portions of the Biodiversity Convention are the provisions relating to technology transfer. This subject was the main sticking point cited by the United States in its reasons for refusing to sign the Convention at Rio.[288] Article 16 deals with technology transfer in relation to genetic resources as follows:

> 1. Each Contracting Party, recognizing that *technology includes biotechnology,* and that both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention, undertakes *subject to the provisions of this Article* to provide and/or facilitate access for and transfer to other Contracting Parties of technologies that . . . make use of genetic resources . . . .
> 2. Access to and transfer of technology referred to in paragraph 1 above to developing countries shall be provided and/or facilitated under fair and most favorable terms, including on concessional and preferential terms *where mutually agreed . . . . In the case of technology subject to patent and other intellectual property rights, such access and transfer shall be provided on terms which recognize and are consistent with the adequate and effective protection of intellectual property rights* . . . .
> 3. Each Contracting Party shall take legislative, administrative or policy measures, *as appropriate,* with the aim that Contracting Parties, in particular those that are developing countries, which provide genetic resources are provided access to and transfer of technology which makes use of those resources, *on mutually agreed terms, including technology protected by patents and other intellectual property rights* . . . .

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[287] At least one prior proclamation on the subject lends support to the notion that direct sharing of financial rewards are anticipated. The Bruntland Report, adopted by the United Nations five years earlier, stated that "[d]eveloping countries must be ensured an equitable share of the economic profit from the use of genes for commercial purposes." Maffei, *supra* note 277, at 171 n.159.

[288] *See* Steve Usdin, *Biotech Industry Played Key Role in U.S. Refusal to Sign BioConvention,* DIVERSITY, vol. 8, no. 2 (1992), at 8.

> 4. Each Contracting Party shall take legislative, administrative or policy measures, *as appropriate*, with the aim that the *private sector* facilitates access to, joint development and transfer of technology referred to in paragraph 1 above for the benefit of both government institutions and the private sector of developing countries and in this regard shall abide by the obligations included in paragraphs 1, 2 and 3 above.
> 5. 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.*[289]

U.S. biotechnology leaders looked past the deference Paragraph 2 gave to existing intellectual property schemes and expressed fear that Article 16 would rob them of their property rights. The Chief Executive of one company, in a letter to President Bush, stated, "[t]he vague language relating to 'technology transfer' and equitable sharing appear to be code words for compulsory licensing and other forms of property expropriation."[290] Others, some from within the biotech industry, felt this threat to be insubstantial and argued that the treaty was merely a framework through which the parties could negotiate mutually satisfactory terms of transfer.[291] The U.S. official delegation played an important role reworking Article 16 to include the protective language of Paragraph 2 and elsewhere.[292] Nevertheless, they remained harshly critical of the article as a whole and refused to endorse it.[293]

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[289] Biodiversity Convention, *supra* note 1, art. 16 (emphasis added).

[290] *U.S. Biotech Companies Leery of Biodiversity Treaty*, SAN FRAN. EXAM., June 11, 1992, at 13A (quoting Kirk Raab, CEO of Genentech Inc.).

[291] *See* R. Stone, *The Biodiversity Treaty: Pandora's Box or Fair Deal? Convention on Biological Diversity*, 256 SCIENCE 1624 (1992); *see also Administration Objections to Treaty Based on Misreading of Text, Study Says*, BNA WASH. INSIDER, Nov. 3, 1992, *available in* LEXIS, Nexis Library, Arcnws File.

[292] *See* Rose, *supra* note 237, at 149.

[293] The U.S. delegation stated that "[i]n regard to Article 16, this delegation finds it potentially deficient in the protection of intellectual property rights . . . . Article 16 fails to recognize the positive role of intellectual property systems in facilitating technology transfer and cooperative research and development by private entities." Maffei, *supra* note 277, at 170 (reprinting the *Annex to the Report of the Intergovernmental Negotiating Committee for a Convention on Biological Diversity on the Work of its Seventh Negotiating Session/ Fifth Session of INC,* May 27, 1992, Doc. UNEP/ Bio.Div./N7-INC.5/4).

F. Evaluation of the Biotech Industry's Opposition

Industry fears concerning the language of Article 16 are not surprising. Industry craves precise delineations of rights, while the Biodiversity Convention highlights uncertainty. In an attempt to pacify both Northern and Southern interests, Article 16 forcefully calls for technology transfer, hedges through application of "as appropriate" language, and then states that no transfers are allowed that would run counter to intellectual property schemes. Intellectual property schemes, however, do not allow for much transfer at all unless the holder of the intellectual property right is paid in full for the use of its technology. The point of the South calling for transfer on preferential terms is to reduce the compensation requirement. The South wants the technology and the North *wants* the South to have it. But while the South sees itself as potential partner, the North looks south and sees only paying customers. Article 16 achieves closure (or at least circularity) in Paragraph 5 by asserting that the intellectual property schemes themselves should be reworked so as not to interfere with the goals of the treaty (which are not to be implemented so as to interfere with intellectual property rights, and so on . . .).[294]

Based on this lack of clarity, industry opposition to the treaty in defense of its own interests is, arguably, a perfectly rational business decision.[295] Further, the biotech industry plays an important role in the

[294] That the delegates settled for this muddled language is perhaps just as understandable as the industry's hesitation. As with many negotiations, the delegates were trying to create a bridge between positions that were poles apart. The earnest desire to bring everyone on board, however, went unfulfilled when the primary biotech nation decided to sail on its own.

[295] Neil Hamilton aptly summarized the biotechnology industry position as:

> The concerns of the American biotechnology industry are understandable when viewed from a business perspective. First, the financial investment companies have made in genetic engineering, plant breeding, and other biotechnologies and the fact that many of those investments are just now reaching commercial viability create a natural concern about sharing the technology on "concessional and preferential terms" with developing countries. Second, ***business relations are usually premised on exact language with understood interpretations and protections, making industry skeptical of the vague and undefined language employed in international treaties of this nature.*** Third, the uncertainty over future interpretations is of special concern to the biotechnology industry because of the U.S.'s reliance on developing a strong system of IPR protections for biotechnology. The uncertain and potentially contradictory positions of the Treaty in reconciling protections for IPR with the concepts of technology transfer and financing of biodiversity conservation efforts creates too much uncertainty for some observers.

Hamilton, *supra* note 5, at 623 (emphasis added). This is not to say that these concerns necessarily cancel out all other factors, factors that might have influenced the United States to support the Biodiversity Convention. Professor Hamilton merely provides insight into the understandable trepidation of the industry with regard to ill-

U.S. economy, and is projected to play a much bigger role in the future.[296] A certain amount of deference is therefore warranted. The common pro-business argument is that a nation must support its industry, lest that industry flee to other, more hospitable jurisdictions. Signing an international law that runs counter to a particular industry's interest might certainly be perceived as lack of support. The argument is somewhat less convincing, though, when every other jurisdiction has already endorsed the offending law. In the present case, from whom could the beleaguered industry seek refuge?

At any rate, it is never absolutely necessary for industry self-interest to completely dominate a country's stance during negotiations of an international environmental treaty. Other reasonable considerations, such as equity, or a broader, more farsighted look at environmental impact, might weigh in the equation.[297] At UNCED, the United States apparently decided that no difference existed between its own interests and those of its biotech industry. This position left little room for concession given the dominant view from the biotech industry that no treaty was preferable to a treaty not strictly on industry terms.[298] The experience at Rio is applicable to most global environmental treaties. Once a country charts its negotiating course based on excessive deference to a particular industry, it will find that it cannot easily maneuver into the mainstream.[299]

When President Clinton took office the year following UNCED, he reversed the U.S. position and signed the Biodiversity Convention, accom-

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defined regulations.

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> Biotechnology is one of the fastest growing industries in the world, and this growth is expected to continue accelerating in the near future. Between 1985 and 1990, the number of biotechnology patent applications filed in the United States grew by fifteen percent annually. Total product sales for the US biotechnology industry in 1991 totaled approximately $4 billion, a thirty-eight percent increase over 1990, and by the year 2000 sales are expected to grow tenfold to approximately $50 billion annually.

Bosselmann, *supra* note 159, at 115.

[297] This is not to assert that industry concerns necessarily always run counter to concerns for equity and the environment. The manner in which developing nations should be compensated has not been established. The relationship between biotechnology and biodiversity is complex. Nevertheless, the U.S. stance at Rio was notable in its singular focus on protecting its turf.

[298] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 113-14.

[299] Such a country might, in fact, find its solitary boat stuck at the "banks" unable at first to escape the mire and to follow all the other boats charting a new course down the river, unable later to replenish its genetic depositories, and ultimately, perhaps, unable to keep financial institutions dependant upon an isolated industry afloat.

panied by a letter of interpretation asserting industry rights.[300] Attempts to ratify the treaty stalled in Congress, however, and the United States is unlikely to become a party to the Biodiversity Convention anytime soon.

IX. In the Wake of UNCED: International Activity to Fulfill the Mandate of the Biodiversity Convention

A. Preservation of Agricultural Diversity

1. Revising the International Undertaking

The Biodiversity Convention represents a dramatic shift from the philosophical position staked out in the original 1983 International Undertaking.[301] The 1983 Undertaking itself altered the traditional principle of common heritage by extending its reach to elite varieties. But 1983 and 1992 represent opposite ends of the spectrum. The 1983 Undertaking, to promote conservation and the sharing of benefits, forcefully repudiated proprietary restrictions over specific genetic codes. The Convention, promoting the same goals, embraced such proprietary restrictions.

The Biodiversity Convention was not, however, a substantial leap from the International Undertaking as it existed immediately prior to UNCED. The 1989 Agreed Interpretation acquiesced to the notion of "Breeder's Rights,"[302] and the 1991 Third Annex had subordinated "common heritage" to "national sovereignty."[303] The Convention merely eliminated the concept of common heritage while elevating individual ownership through intellectual property schemes and national sovereignty.

Any differences still remaining between the Convention and the Undertaking may soon be eliminated. Agenda 21, the 800-page sustain-

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[300] *See* Scalise & Nugent, *International Intellectual Property, supra* note 165, at 112. The letter of interpretation (to be included with ratification) affirms a company's exclusive rights to its own technology. The letter further maintains the U.S. position that the treaty is not retroactive, that technology transfers must be voluntary, and that no compulsory licensing will be allowed. *See id.*

The international community has taken a dim view of President Clinton's letter of interpretation, accusing the United States of attempting to obtain unilaterally what it could not achieve through negotiation. The United States, on the other hand, has encouraged other developed nations to file similar letters. *See id.* at 113. Whatever the legal implications of one nation's attempts to attach "interpretation letter riders" to international treaties, the question is somewhat moot while both the treaty and the letter gather dust in Congress.

[301] *See* Neil A. Belson, *The Biodiversity Convention and the Private Sector*, DIVERSITY, vol. 12, no. 1 (1996), at 6.

[302] *See* Agreed Interpretation, *supra* note 259.

[303] *See* Thom, *supra* note 274.

able development policy resolution adopted at UNCED,[304] called for a fourth revision of the Undertaking for the express purpose of bringing it in line with the Convention.[305] The following year, the FAO officially resolved to begin work on such a revision.[306] Work is to proceed in three stages. The first will incorporate the annexes into the main body and will harmonize the Undertaking with the Biodiversity Convention. The second will deal with promoting "Farmers' Rights," a commitment to compensating developing world farmers and to assist them in their "*in situ*" conservation efforts. In the third stage, the Undertaking might even be drawn into the Biodiversity Convention's official framework, as a legally binding protocol to the Convention.[307]

2. Defining the Legal Status of IARC Collections

A major gap in the Biodiversity Convention is its silence concerning the legal status of the IARC reserves collected prior to the Convention.[308] The omission is glaring in that these vast reserves represent over one-third of the unduplicated samples of the world's germplasm,[309] and are a major portion of debate between North and South over access and sharing of PGR benefits.[310] A recent agreement between the CGIAR and the FAO, by which the FAO takes over control of the CGIAR's IARC gene banks, may help to close this gap left open by the Biodiversity Convention.[311]

The FAO, through establishment of the Commission on Plant Genetic Resources and enactment of the Undertaking, envisioned a global, coordi-

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[304] *See* James O. Odek, *Bio-Piracy: Creating Proprietary Rights in Plant Genetic Resources*, 2 J. INTELL. PROP. L. 141, 159-60 (1994).

[305] *See* Spirit of Cooperation Overshadows Disharmonies as FAO Commission Marks 10th Anniversary, DIVERSITY, vol. 9, nos. 1&2 (1993), at 4 [hereinafter *Spirit of Cooperation*].

[306] REVISION OF THE INTERNATIONAL UNDERTAKING, FAO Conference Resolution 7/93, Nov. 1993.

[307] *See* Thom, *supra* note 274.

[308] *See Spirit of Cooperation*, *supra* note 305; *see also IBPGR Director Hawtin Encouraged by BioConvention, But Uncertainties Remain*, DIVERSITY, vol. 8, no. 2 (1992), at 5.

[309] *See* Wolfgang Seibeck & John Barton, *The Implications of Applying the Legal Concept of Trust to Germplasm Collections in the CGIAR Research Centers*, DIVERSITY, vol. 8, no. 3 (1992), at 29.

[310] *See* Consultative Group Signs Landmark Agreement to Place CGIAR Genebanks Under FAO Trusteeship, DIVERSITY, vol. 10, no. 4 (1994), at 4 [hereinafter *Consultative Group*].

[311] *See id.*

nated system of national, regional, and international gene banks.[312] Absent participation and funding from the developed world during the Seed Wars of the 1980s, of course, there was little chance that this global system would reach substantial size.

National and "international" systems did, however, continue to function as they had prior to the Undertaking, the most extensive being that operated by the IARCs under the direction of the CGIAR. The CGIAR gene banks, housed in twelve of the sixteen IARCs, hold what is perhaps the world's largest collection of unique samples.[313] Developing nations have sometimes questioned the impartiality of the CGIAR.[314] The organization has been vilified at times as an agent of the North, using the IARCs to facilitate the uncompensated transfer of Southern resources to Northern laboratories.[315] Whether this view represents fact, rhetoric, or a bit of both, the question over who actually controls the IARC germplasm collections has never been settled. Their status remains in question despite the Undertaking and the Biodiversity Convention.

One difficulty has been the uneven legal status of the IARCs themselves. The research centers were not established through any sort of encompassing international "grand opening," but evolved separately and under varied legal arrangements with the host countries.[316] Though the CGIAR came to act as the international director and coordinator of this system, many of the centers operate under charters that pre-date the CGIAR.[317]

The CGIAR itself adhered to the principle of common heritage and free and open access. The CGIAR maintained that the IARC collections were held "in trust," with all of humanity the beneficiary.[318] Some of the IARCs, however, held a more independent view. A 1991 survey by the IBPGR revealed that all but one of the centers assumed that their collections were part of the centers' assets, assets that would be retained by the host country in the event of dissolution.[319]

A study conducted by the FAO in 1986 concluded that the CGIAR gene banks existed in a unique world between national and international

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312 *See International Understanding*, *supra* note 2, art. 7.

313 *See* Seibeck & Barton, *supra* note 309, at 31. The total number of samples, counting duplicates, is estimated at over 500,000. *See* Brown, *supra* note 154, at 5, 6.

314 *See* Consultative Group, *supra* note 310, at 5.

315 *See* Rose, *supra* note 237, at 159.

316 *See* Seibeck & Barton, *supra* note 309, at 30.

317 *See id.*

318 *See id.* at 32. According to Seibeck and Barton, "the CGIAR almost certainly" uses the concept of trust "in a relatively non-technical way." *See id.*

319 *See id.*

law: "[T]hey are not created by a formal treaty concluded among States or other international legal persons, and their activities are not directed by States or such other international legal persons . . . ."[320] Though the centers are usually incorporated and operate under the laws of the host state, policy is directed by both national and international representatives sitting on the Boards of Trustees.[321] The Report concluded that "the genebanks maintained by the IARCs are neither under the control of any given State or national authority, nor in the private sector. Their status is, in fact, *sui generis* . . . ."[322]

3. FAO/CGIAR Agreement

Debate over the status of the IARC collections was put to rest in October of 1994, when the CGIAR agreed to place the collections under the trusteeship of the FAO.[323] By the terms of the agreement, FAO operates the network of gene banks within the framework of the International Undertaking, a solution that received broad consensus approval.[324] CGIAR Chairman Ismail Serageldin pointed out that "CGIAR brings one third of the world's germplasm to FAO's Global System," a move which has the practical effect of finally launching the system eleven years after it was conceived.[325]

The FAO/CGIAR agreement helps resolve the fate of hundreds of thousands of seeds currently in storage. It brings these collections within the framework of the International Undertaking, which in turn could be incorporated into the Biodiversity Convention framework. Though some form of compensation is now likely, the precise structure remains in question. The question is especially difficult for many samples, collected under an assumption of common heritage, and for which lineage is uncertain.[326] The FAO has suggested that if the country of origin is unknown, "compensation might be provided to developing countries collectively."[327]

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[320] Seibeck & Barton, *supra* note 309, at 31 (reprinting *Legal Status of Base and Active Collections of Plant Genetic Resource* (CPGR/87/5)).

[321] *See id.*

[322] *Id.*

[323] *See* Consultative Group, *supra* note 310, at 4.

[324] *See id.*

[325] *Id.* at 5.

[326] *See* REVISION OF THE INTERNATIONAL UNDERTAKING, ISSUES FOR CONSIDERATION IN STAGE II: ACCESS TO PLANT GENETIC RESOURCES, AND FARMERS' RIGHTS, CPGR-Ex1/94/5, COMMISSION ON PLANT GENETIC RESOURCES, First Extraordinary Session Rome, Nov. 7-11, 1994.

[327] *Id.*

Compensation structure was a topic at the Sixth session of the Commission on Plant Genetic Resources of the FAO held in Rome in June 1995.[328] The FAO Commission received a report at the meeting from the IPGRI outlining the possible compensation structure to govern germplasm exchange through the IARCs and other Global System banks.

The IPGRI report proposed a multilateral framework that maintains the principle of open access but preserves the ownership rights of source countries.[329] A source country would place its germplasm in the bank, and others would have unrestricted access to the resources with no initial payment. But as a condition to receipt of the germplasm, users would have to sign a material transfer agreement (MTA) which recognizes the source country's continued financial interest in the germplasm.[330] If commercial profit results from the use of these materials, the user is obliged to negotiate a share of the profits with the source country.[331] Regarding materials collected and stored prior to the Convention, the report suggested either continuing access under the common heritage principle or funneling a share of any profits from such materials into an international fund for the implementation of Farmers' Rights.[332]

At least two of the IARCs, the International Center for Tropical Agriculture (CIAT) and the International Center for the Improvement of Maize and Wheat (CIMMYT), already use MTAs to handle transfers of

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[328] *See Commission Debates FAO Undertaking Revision as 4th ITC Approaches*, DIVERSITY, vol. 11, no. 3 (1995), at 4.

[329] *See id.*

[330] In a paper prepared for the IPGRI prior to the Sixth Session of the Commission on PGR, Barton and Seibeck explain:

> MTAs are a recent phenomenon, used in connection with the transfer of biological materials with potential commercial significance. They can be used for transfer of material for curation (e.g. storage in genebanks), for research, or for commercial use . . . . As agreements, they may take a variety of forms — from letter statements accompanying a shipment of materials to detailed and formally negotiated contracts signed by both parties before a transfer is made . . . .
>
> MTAs are generally subject to trade secret law. In those countries that protect trade secret contract, MTAs offer a form of intellectual property protection that can go beyond that available under patent law. An MTA, for example, can cover material that is not patentable; it can (at least as a matter of law) be effective for longer than the typical patent term. At the same time, it is ineffective against independent development of similar material, and an MTA may lose legal force once the material involved becomes significantly disseminated, whether voluntarily or not.

John H. Barton & Wolfgang E. Seibeck, *Material Transfer Agreements for the International Agricultural Research Centers?*, (Paper Presented for the International Plant Genetic Resources Institute (IPGRI), Final Draft, March 11, 1994).

[331] *See Commission Debates*, *supra* note 328, at 4.

[332] *See id.*

genetic materials.[333] The CIAT MTAs provide that users must inform the research center of any intended use, and may not protect a variety derived from CIAT materials outside the country of origin.[334] Under a more general plan for Global System gene banks, these conditions could change. This severe restriction might be loosened on developing protected varieties from CIAT-processed materials, but presumably only under a strengthened regime compensating the source country.

4. *In Situ* Preservation

Resolving the fate of genetic resources tucked away in gene banks is only one step toward implementation of the Biodiversity Convention. The Convention, in fact, makes it clear that such *ex situ* measures are important, but should be considered a secondary method of conserving genetic resources. The treaty emphasizes instead *in situ* preservation.[335] *In situ* preservation, though, is a more difficult task. *Ex situ* preservation involves a race to collect and store the resources before they are lost. *In situ* preservation strikes closer to the root of the problem; it seeks to turn back the forces leading to the loss of the resources. In the case of agriculture, the battle is on two fronts: Conservationists must fend off conversion to non-agricultural uses, and must fend off agricultural uses that are detrimental to diversity. To do both, developing world farmers must be paid to continue farming, but not to succumb to the temptation of high-yield varieties.

Creating an international fund to support farmers in these conservation efforts (a central goal for advocates of Farmers' Rights) was a contentious topic at the June 1996 Fourth Technical Conference on Plant

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[333] *See First Post-NAFTA and UPOV Findings on Plant Breeders' Rights Released, University of Amsterdam Report Shows Minimal Impact on Germplasm Exchange*, DIVERSITY, vol. 12, no. 1 (1996), at 10.

[334] *See id.* at 10.

[335] The tenth paragraph of the Convention's Preamble states that "the fundamental requirement for the conservation of biological diversity is the *in situ* conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings." The Biodiversity Convention, *supra* note 1, at pmbl. (emphasis added). The next paragraph adds "*ex situ* measures, preferably in the country of origin, also have an important role to play." *Id.* The wording and comparative length of these two provisions, and the order in which they were placed in the preamble, show an unmistakable order of preference. The preference is further emphasized by the greater detail devoted to Article 8, (*in situ*), compared to that of Article 9, (*ex situ*), and by the opening paragraph of Article 9, which states that *ex situ* conservation should be undertaken "predominately for the purpose of *complementing* in situ measures." *Id.* art. 9 (emphasis added).

Genetic Resources.[336] The FAO-sponsored Conference, held in Leipzig, Germany, was described as "the largest intergovernmental conference in history" devoted to "the conservation and better use of plant genetic resources for food and agriculture."[337] In preparation for the Conference, 154 governments submitted Country Reports to FAO, assessing the status of plant genetic resource conservation, use, and needs within their respective countries.[338] From these Country Reports, FAO prepared its Report on the State of the World's Plant Genetic Resources.[339] Using this encompassing global report as a guide, the delegates from 150 countries met in Leipzig to agree upon the Global Plan of Action (GPA), a specific plan to protect agricultural diversity and "enhance world food security" within the framework of the Biodiversity Convention and the soon to be revised Undertaking.[340] The GPA's twenty "priority activities" emphasize on-farm conservation.[341]

The big victory at the Conference was the grudging acknowledgement by the United States of Farmers' Rights. "The agreed text [of the GPA] will commit the world community to recognizing the 'needs and rights of farmers and farming communities to have access to the germplasm, information, technologies, financial resources and research and marketing systems necessary for them to continue to manage and improve plant genetic resources.'"[342] The U.S. delegation, with Canada's support, sought to dilute the text by referring to Farmers' Rights as a "concept,"[343] the better to study further rather than implement immediately. When the developing countries dug in their heels, the United States finally relented on the language.[344]

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[336] *See Agriculture: Deadlock Over Who Pays for Plant Genetic Resources*, Inter Press Service, June 20, 1996, *available in* LEXIS, News Library, Allnws File [hereinafter *Deadlock*].

[337] FAO, *FAO News & Highlights*: Action plan for plant genetic resources file.

[338] *See U.N. Warns of Erosion of Biodiversity, Loss of Genes*, Japan Econ. Newswire, Apr. 27, 1996, *available in* LEXIS, News Library, Allnws File.

[339] *See id.* The global report cites several examples of dramatic loss. Of the 10,000 wheat varieties used by China in 1949, only 1000 remained by the 1970s. In the past century, the U.S. has lost 95% of its cabbage, 91% of its field maize, 94% of its pea, and 81% of its tomato varieties. *See* Greg Tansey, *Crop Defenders Gather in Leipzig*, FIN. TIMES (London), June 14, 1996, at 31.

[340] *Biodiversity: Gov'ts OK Plan for Conserving Plant Genes*, Greenwire, June 26, 1996, *available in* LEXIS, News Library, Allnws File [hereinafter *Gov'ts OK*].

[341] *Id.*

[342] Dipankar De Sarkar, *Agriculture: U.S. Bows to Farmers Rights on Biodiversity*, Inter Press Service, June 21, 1996, *available in* LEXIS, News Library, Allnws File.

[343] *See id.*

[344] *See id.*

This achievement did not, however, result in any concrete provision in the GPA concerning how these Farmers' Rights would be funded. Without money, the argument over "concept" versus "reality" is a bit moot, earnest language contained elsewhere in the document notwithstanding. Developing countries called for a promise of "new and additional funds" to be written into the plan. Developed countries preferred to postpone the issue of how to pay for Farmers' Rights until the parties to the Undertaking could meet in December 1996 to discuss possible revisions.[345] The compromise reached at Leipzig has the GPA "underlin[ing] the need for additional funds" without delving into specifics.[346] Following Leipzig, therefore, Farmers' Rights remained somewhat in limbo.

B. *Preservation of Medicinal Plants*

1. Pharmaceutical Bio-Prospecting

The primary focus of this Article has been on agricultural use of plant genetic resources. As indicated above, progress is afoot toward global consensus on preservation of and benefit-sharing for agricultural diversity. The agricultural seeds that sprouted the initial conflict are not the only source of "green" under discussion though. Dramatic profits of a different nature are expected to arise out of places like the Brazilian rainforest and the mountains of Kenya. From these uncultivated lands, the genetic linchpin for the next miracle drug could be revealed.

Biotechnology, in a sense, has re-introduced the pharmaceutical industry to some of these untamed places. Twentieth century chemists have successfully synthesized the majority of drugs used in the developed world, but faster screening methods have made wild plants (the historical source of medicine and still the source for eighty percent of the developing world) more attractive.[347] Chemists receive insight from these natural combinations, finding nature to be more sophisticated than their computer-enhanced imaginations.[348]

Unlike agriculturalists, pharmaceutical companies have far less interest in what is currently in storage than what is still unknown.[349] Like some plant breeders, pharmaceutical companies seek plants that show unique characteristics. The purpose, however, is not to incorporate these

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345 *See Gov'ts OK*, *supra* note 340.

346 *Id.*

347 *See* Michael J. Huft, *Indigenous Peoples and Drug Discovery Research: A Question of Intellectual Property Rights*, 89 NW. U. L. REV. 1678, 1679 (1995).

348 *See id.*

349 "Medicinal . . . species are rarely found in long-term public collections." FAO, Plant genetic resources-biodiversity preserved file.

characteristics into other plants, but to incorporate them on a more temporary basis into humans. Germplasm discovered in developing countries has led to individual drugs worth millions, and profits for all plant-derived drugs running into the billions.[350] Source countries now expect a share of these profits.

Despite U.S. recalcitrance and the industry's own continued wariness, there are several examples of how U.S. pharmaceutical companies are participating in the new order following UNCED. Perhaps it has dawned on some U.S. companies that regardless of official abstention by their home country, source countries fully intend to condition access on the benefit-sharing mandated by the Biodiversity Convention.[351] By accepting this reality, U.S. companies stave off hostile receptions in their traditional hunting grounds. Innovative pioneers, who come to terms now, will be able to enter negotiations in the spirit of voluntary cooperation, good will, and importantly, good publicity.[352]

a. Merck/INBio Accord

A much publicized 1991 agreement between Costa Rica and U.S. pharmaceutical giant, Merck & Company, serves as a model of how source countries might receive a share of genetic resource profits.[353] The agreement provided that Merck pay Costa Rica's Institutio Nacional de Biodiversidad (INBio) one million dollars in exchange for approximately 10,000 plant, insect, and microbial soil samples.[354] In exchange, Merck can patent any drugs developed from the samples, but is obliged to pay INBio a royalty on profits realized from such drugs.[355] The amount of the royalty has not been disclosed, but is rumored to be in the range of one percent to three percent.[356] Ten percent of INBio's initial one million dollar fee, and one-half of subsequent royalties, will in turn go to Costa Rica's Ministry of Natural Resources.[357] The rest is to be used directly by INBio to fund conservation activities.[358]

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350 *See* Kadidal, *supra* note 208, at 224.

351 *See id.* at 737.

352 *See id.* at 728.

353 *See* Elissa Blum, *Making Biodiversity Conservation Profitable*, ENVT., May 1993, at 16.

354 *See id.* at 20.

355 *See id.*

356 *See id.*

357 *See id.*

358 *See* Karen Anne Goldman, Note, *Compensation for the Use of Biological Resources under the Convention on Biological Diversity: Compatibility of Conservation Measures and Competitiveness of the Biotechnology Industry*, 25 LAW AND POL'Y INT'L

A noteworthy aspect of the agreement is that the initial screening of the samples took place not in Merck's labs but in Costa Rica, using technology acquired from Merck.[359] Merck provided INBio with $135,000 worth of equipment to carry out the process of extracting the desired chemical compounds.[360] Along with providing jobs in Costa Rica, this arrangement provides a stronger connection between local residents and the potentially profitable resource.[361] Despite no significant leads in the first two years' worth of samples, Merck renewed its contract with INBio.[362]

b. National Cancer Institute

Other U.S. pharmaceutical concerns are striking similar deals. The National Cancer Institute (NCI) has been prospecting for anti-cancer drugs since 1955.[363] Recently, NCI agreed to begin compensating source countries for drugs developed from their resources.[364] NCI signed "Letters of Collection"[365] with several countries (and one indigenous group from Ecuador) obligating NCI to "make its best efforts" to provide royalties to these countries.[366] NCI obtains patents on drugs it develops, but actually licenses its inventions to pharmaceutical companies, which then bring the drugs to market.[367] In the future, NCI will require the pharmaceutical companies to enter royalty agreements with source countries.[368]

c. International Cooperative Biodiversity Groups

The formation of the International Cooperative Biodiversity Groups (ICBGs) represents another attempt to comply in spirit with the

BUS. 695 (1994).

[359] *See* Blum, *supra* note 353, at 20.

[360] *See id.* at 37.

[361] *See id.* at 38.

[362] *See* Edgar J. Asebey & Jill D. Kempenaar, *Biodiversity Prospecting: Fulfilling the Mandate of the Biodiversity Convention,* 28 VAND. J. TRANSNAT'L L. 703, 728 (1995).

[363] *See id.* at 719.

[364] *See* Fred Powledge, *Who Owns Rice and Beans? Patents on Plant Germplasm,* BIOSCIENCE, July 1995, at 440.

[365] These letters incorporated many of the terms of the Biodiversity Convention. *See* Asebey & Kempenaar, *supra* note 362, at 721-24.

[366] *Id.*

[367] *See id.* at 723.

[368] *See id.* In fact, "[t]here is no reason to assume that a developing country, government, or institution will be able to bargain on equal footing with the licensee, which is most likely a multinational pharmaceutical company." *Id.* at 724.

Biodiversity Convention. Formed in 1994, the ICBGs are five bio-prospecting agreements involving U.S. universities, NGOs, pharmaceutical companies, and developing world entities.[369] Funded in part by the National Science Foundation, the National Institute for Health, and the Agency for International Development, the agreements facilitate collection activities to support both academic research and commercial drug development.[370] The ICBGs are also meant to promote conservation and sustainable economic development in the developing world.[371]

Under the agreements, U.S. and source country organizations will inventory and screen native plant species.[372] Some joint research is involved.[373] Some aspects of these agreements mirror provisions of the Merck/INBio accord: initial collection, extraction, and preliminary screening is conducted in the source countries.[374] As with the Merck/INBio agreement, pharmaceutical companies agree to pay royalties to source countries, but royalty terms are not disclosed.[375]

2. Evaluation of the Agreements Involving U.S. Entities

These early efforts are promising signs. Nonetheless, some observers note that the terms of the agreements still reflect the difference in bargaining power between Northern industry and Southern resource providers.[376] Some U.S. companies clearly want to keep the peace and may honestly desire an equitable arrangement. But one gets the sense at present that their magnanimity is fueled more by a desire for good publicity than out of necessity. U.S. industry continues to stand in a uniquely dual situation: they go hunting in Convention territory, but retire with their spoils to the last bastion of common heritage.[377]

It is difficult to say whether U.S. cooperation in the Biodiversity Convention would have any practical effect on access negotiations. Merely entering the access agreements shows deference to some of the Convention's principles. Of themselves, these agreements achieve partial

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[369] *See id.* at 730.

[370] *See id.*

[371] *See* Goldman, *supra* note 358.

[372] *See id.*

[373] *See id.*

[374] *See id.*

[375] *See* Asebey & Kempenaar, *supra* note 362, at 731.

[376] *See, e.g., id.* at 725-36; Kadidal, *supra* note 208, at 234.

[377] The United States has not officially accepted either the Undertaking or the Convention. Prior to the Undertaking, of course, PGR was considered "common heritage."

implementation. U.S. ratification would certainly not cause any immediate boost in bargaining positions of the developing countries since the disparity in bargaining power would still persist. Even if the treaty should be transformed into U.S. law, the treaty's mandates are fairly nebulous. It is not clear whether the United States would be obliged to coerce its industry to do more than was already done in the examples given.

Arguably, though, U.S. industry retains an advantage by being outside the treaty's framework. One industry chief has gone so far as to say that the Merck/INBio accord, which pre-dates the treaty, could only have been possible in the *absence* of the Convention's "enormous slug of mandatory contract language."[378] Others within the industry disagree.[379] "Mandatory contract language" would seem to be an overblown assessment regarding the dictates of *any* framework convention, not excepting the Biodiversity Convention.

Regardless of U.S. government involvement, it does not appear for the moment that developing countries possess sufficient leverage to force U.S. industry into fulfilling all of the Convention's goals concerning benefit sharing and technology transfer. Unable to fully invoke binding or precise international law, and otherwise unable to bargain on equal footing, developing countries hold the majority of the resources but do not yet hold most of the cards.

The Merck/INBio agreement, the most visible of the agreements to date, has been lauded in general principle but criticized in detail.[380] The adequacy of the royalty is questioned.[381] Lack of accountability is a concern for the Merck deal as well as for the others, given the standard business practice not to disclose precise terms.[382] And Merck's transfer of technology, though it helps connect Costa Ricans to the resource, still leaves them in the unfavorable roles of lab technicians, assisting Merck's more exalted work.

It is understandable that Merck, the pioneer company in this area, would be reluctant to create in Costa Rica a full partner and potential

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378 Blum, *supra* note 353, at 42 (quoting Richard Godown, president of the International Biotechnology Association).

379 *Id.*

380 *See* Kadidal, *supra* note 208, at 234-35; Asebey & Kempenaar, *supra* note 362, at 725-30; Bosselmann, *supra* note 159, at 144; Blum, *supra* note 353, at 41.

381 *See* Kadidal, *supra* note 208, at 334 n.64 (stating that "typical royalty range for undeveloped drug products is two to four percent"); Asebey & Kempenaar, *supra* note 362, at 725 n.112 ("Range known to be 1-5%"). These figures would place the rumored Merck/INBio rate on the low side of the typical range. Even at the high end of the range, the fee may not be sufficient to promote conservation. *Id.* at 729-30.

382 *See* Asebey & Kempenaar, *supra* note 362, at 725, 731.

future competitor possessing its own resource base.[383] The idea that Costa Rica could be quickly and efficiently brought up to technological speed, and could undertake the work performed in Merck's highly specialized labs is unrealistic anyway.[384] The Biodiversity Convention, though, contemplates a more elevated position for source countries in the drug development process. It will be exceedingly difficult for even well-meaning pharmaceutical companies and source countries to draw a technology transfer line that is both feasible and satisfactory to both parties.[385]

If Costa Rica has in fact agreed to sell its resources too cheaply,[386] this does not bode well for other developing countries. Most of them cannot hope to best Costa Rica's bargaining efforts. Costa Rica represented an excellent locale for Merck to test the waters, but it is not altogether representative of the developing world. It is one of the world's most biologically-diverse countries, and faces many of the same economic hardships faced by other developing countries.[387] Costa Rica, however, possesses many of the advantages enjoyed by nations that have long since plowed under their biological resources. It has maintained a stable, democratic government throughout the twentieth century.[388] It has a phenomenally high adult literacy rate of ninety-eight percent.[389] It has a fairly sophisticated business and scientific community, and perhaps due to these factors, Costa Rica has long been committed to environmental protection.[390] These conditions might buy for Costa Rica what other developing nations simply cannot afford: the time and inclination to wait, to bypass immediate resource-depleting income to gamble on future, possibly larger returns. Equitable or not, the Merck/INBio deal might have little chance of surviving in most other developing countries.[391]

One possible way to bring poorer, more desperate countries on board is to juggle the compensation scheme. Poorer countries could enter deals that provide for larger fees up front, with a corresponding decrease in the royalty rate. Under this arrangement, benefits from their genetic resources are more assured and more immediate. Economic conditions in these

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383 *See id.* at 728.

384 *See* William H. Lesser & Anatole F. Krattiger, *The Complexities of Negotiating Terms for Germplasm Collection*, DIVERSITY, vol. 10, no. 3 (1994), at 6,9.

385 *See* Asebey & Kempenaar, *supra* note 362, at 728.

386 *See* Blum, *supra* note 353, at 41.

387 *See id.* at 39-40.

388 *See* Asebey & Kempenaar, *supra* note 362, at 729.

389 *See* Blum, *supra* note 353, at 39.

390 *See* Asebey & Kempenaar, *supra* note 362, at 729.

391 *See id.* at 729.

countries cause them to discount future gains more heavily, so this approach might even increase awareness and promote conservation more effectively than the hope of future royalties.[392]

There is, of course, a downside to this large initial payment. A larger up-front payment shifts the risk to the pharmaceutical company. If nothing of marketable value is discovered, the company will lose more money. This shifting of the risk is exactly what developing countries desire. Reduction of this risk, though, is itself a valuable commodity, and one that pharmaceutical companies figure into their costs. It has been suggested that an increase in the initial collection fee might, in balance, result in lower overall gains for the source country.[393]

The main concern of developing countries, however, is not whether to emphasize initial payments or eventual royalties. The main goal is to increase the size of the entire package, and to obtain more significant transfers of technology. To do this, developing countries must, in effect, reconstruct the marketplace.

C. *Placing a Price Tag on Germplasm*

The initial problem faced by developing countries is that they are trying to sell something to a customer not convinced that the goods possess financial worth. What source countries view as fair compensation, industry views as subsidy. The traditional view of genetic resources is that they are a common resource worthy of conservation perhaps, but not of a price tag. Furthermore, prospectors only take "copies"; removing them from the source country does not deplete the resource base itself.[394] The traditional view of bio-prospecting might be analogized to drawing water from a series of bottomless wells. Industry might grasp the need to preserve a few of the wells, but cannot bring itself to pay much for the water.

Northern industry has excused its failure to pay for genetic resources by claiming that, in their unrefined state, they simply have no market value.[395] A particular sample may or may not lead to anything commer-

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[392] *See* Lesser & Krattiger, *supra* note 384, at 9,10.

[393] *See id.* Of course, the risk does not just go away in a scheme offering higher royalties and lower initial payments. It is transferred to the source countries. The suggestion, however, is that even with this factored in, the source countries are better off if they can wait for royalties. *See id.* at 10.

[394] *See* Kloppenburg & Kleinman, *Seeds of Controversy, supra* note 55, at 190.

[395] To illustrate this traditional view, a passage from the Executive Summary distributed at a 1983 plant breeders' conference, sponsored by Pioneer Hi-Bred:

cially useful. Even if a sample proves beneficial, it must be substantially refined before it enters the market. Such resources might very well become vital *ingredients* in products sold to millions, but the real work, and hence the real value, is in putting the ingredients together. This view is deeply rooted in the labor theory of property expressed by John Locke:[396] Northern industries exert labor upon the goods, "value" is added, and property rights are thus bestowed upon the laborers.

The labor theory of value creates an initial assumption that the value of raw germplasm is extremely low relative to that of the final product. By comparing the amount of work done to get from the raw germplasm to the elite variety or to the drug, the value of the raw germplasm must be calculated as a very small fraction of the total price. Zero to one percent might seem fair. Two to three percent would certainly be considered generous.

In reference to land races, this form of calculating the relative value errs by ignoring centuries of fine tuning performed by farmers.[397] The toil of countless generations should not be so easily dismissed, even if it was performed with no thought toward future commodity value. Yet even this counterpoint relies on Locke's labor theory: land races are valuable because farmers worked, and still work to create them. They are not mere "products of nature," but instead are products of human labor.[398] This is a sound counter to the traditional view, but fails to represent the whole of source country interests. If value is based solely upon the labor exerted on the resource, then what compensation can source countries expect to receive for that which is truly a product of nature, i.e., wild germplasm? In reference to pharmaceutical bio-prospecting, what is the value of samples taken from the uncultivated rainforest?

Some question the insurmountability of this problem. Perhaps the developed world's failure to carve out a place for germplasm in the marketplace is better explained by citation to selfish motives than to the writings of seventeenth century philosophers.[399] Northern industry could

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> "[R]aw" germplasm only becomes valuable after considerable investment of time and money, both in adapting exotic germplasm for use by applied plant breeders and in incorporating the germplasm into varieties useful to farmers.

KLOPPENBURG, *supra* note 7, at 185. The Executive Secretary of the IBPGR at the time concurred in this viewpoint. *Id.*

[396] *See* Odek, *supra* note 304, at 153 n.69.

[397] *See id.* at 154.

[398] *See id.*

[399] "Market failure is an excuse rather than a logical justification for current practice. It speaks of lack of will to make compensation; it is not a legitimate reason for failing to do so." KLOPPENBURG, *supra* note 7, at 187. Of course, Locke would not necessarily

certainly be expected to hold whatever method of valuation best preserves its own power and profit. Yet even among those who earnestly seek an equitable solution, sincere bewilderment exists concerning how much raw germplasm should cost.[400]

Increasing compensation to source countries does not hinge solely on finding this mysterious value. At least one method exists that could increase the level of compensation to source countries while remaining true to Locke's principles: increase the amount of labor the source country performs on the germplasm. The initial screening performed by INBio before shipping the samples off to Merck is one, small example of this. Even this solution has it limits, however. As discussed earlier, technology transfer was one of the most bitterly contested issues at UNCED.

If source countries possessed the requisite technology, they could increase the amount of value they themselves add to their germplasm. Industry, though, fears that a source country with too much technology is a competitor with its own resources. The key from Northern industry's perspective is to transfer just enough money and technology to satisfy the source countries, inducing them to conserve, but not enough to erode industry's own power base. Industry will voluntarily accept a low risk transfer, such as Merck's donation of screening equipment to INBio, but will continue to show caution in approaching the technology transfer line. Whatever the greater good, Northern industry has no intention of instigating its own obsolescence.[401]

D. *The Response from the South: Regional Accords*

1. Genetic Cartels

The current market starts with the assumption that "unrefined" resources have very little value. Source countries could increase compensation through bargaining for greater participation in the refinement process, thereby adding recognizable value to their product. Northern industry, however, cannot be expected to share significant amounts of technology without significant amounts of pressure. Source countries do not possess the means to exert individual pressure. Although the Biodiversity Convention is a means of exerting collective pressure, it is not concrete enough to force specific concessions.

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disagree with the notion that selfish motives drive the process. He merely explains why the outcome might be thought fair.

[400] *See* Lesser & Krattiger, *supra* note 384, at 10.

[401] *See* Asebey & Kempenaar, *supra* note 362, at 728.

Source countries may yet have the means to force greater technology transfer and even to drive up the market price of their "raw" germplasm. Through regional accords, source countries have a shot at accomplishing what they could not hope for through individual leverage or through naked invocation of the Biodiversity Convention. One example of this collective action occurred immediately in the wake of UNCED. In June 1992, the nations of Central America, including Costa Rica, banded together to sign a non-binding agreement on genetic resource use.[402] They agreed to coordinate national legislation and develop rules that firmly condition access to genetic resources on technology transfers and training.[403]

An even stronger statement of solidarity has been issued by the nations of northwestern South America. Columbia, Venezuela, Ecuador, Peru, and Bolivia are parties to the Cartagena Agreement on Access to Genetic Resources.[404] The Cartagena Agreement requires prospectors to negotiate access agreements before they will be allowed into the region.[405] Though access agreements will probably be negotiated on an individual basis, the Cartagena Agreement provides guidance on royalties, technology transfer, and research participation.[406] The Agreement also provides for sanctions if the parties fail to comply with the terms.[407] Penalties include expulsion, fines, cancellation of contracts, and refusal to recognize intellectual property rights for materials developed in violation of the Agreement.[408] International law challenges to this specific, retaliatory rejection of IPR would seem disingenuous, given that the Cartagena Agreement asks no more than the Biodiversity Convention requires.

These type of agreements increase source country leverage. In the absence of such agreements, prospectors have the advantage. Any money they offer is more than that particular country has ever received for its resources. Other jurisdictions might harbor similar resources, and might be willing to allow access for the same or lower prices. For the bio-prospector on a non-specific fishing expedition, it is a matter of who will take the least amount of bait. If, on the other hand, the source countries form a strong union, there would be in effect one source for the goods. Under these conditions, the question for prospecting industries changes from

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[402] *See* Margulies, *supra* note 10, at 353.

[403] *See id.*

[404] *See* Belson, *supra* note 301, at 6,7.

[405] *See id.* at 7.

[406] *See id.*

[407] *See id.*

[408] *See id.*

"Who will try hardest to attract my business?" to "How much am *I* willing to *pay*?"

If these regional accords become widespread, prospectors will no longer be able to shop around to find the government most desperate to sell its resources for quick cash. The market effect could be significant. If each country that possesses a particular type of resource agrees not to bid against other such countries, a cartel of sorts would be formed.[409] Similar types of source country cartels have worked before. Governments in the developed world might have paid scant attention to the needs of oil-producing nations, had such oil producers not banded together to form OPEC. OPEC was able to wield a great deal of influence over the price of oil during the 1970s.[410]

Even assuming genetic resource countries could display the extraordinary amount of unity needed to reduce the competition among themselves,[411] the battle is not won. Creating a cartel shifts the market burden to the consumer countries, but it does not erase all the complexities of trying to price something that does not flow easily into that market place. OPEC might be considered an apt role model, an example of success, but the comparison between the two situations is very limited. The subject matter in the present discussion is fundamentally different than oil. Nonetheless, a comparison between the two sharpens the focus on problems faced by genetic resource countries.

For one thing, OPEC restricts supply of a fairly uniform, known resource. In contrast, genetic resource countries do not collectively hold "one" definite resource. What genetic resource countries sell could be compared to lottery tickets for a thousand different lotteries. One country might supply the genetic answer to leukemia, another might harbor the secret to keeping rice crops healthy. Prospectors would expect to find regional similarities, but each country presents unique prospecting opportunities.

This uncertain and varied nature of the genetic product makes the bond between genetic resource countries much more complex. Both advantages and disadvantages can be predicted. Nations shopping for oil could get the same product from a number of source countries; the better to play one off the other and break the union.[412] On the other hand,

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[409] *See* Asebey & Kempenaar, *supra* note 362, at 737-46.

[410] *Id.*

[411] Asebey and Kempenaar point out that this degree of unity may be unrealistic. OPEC itself is cited as example in which the resource providers do not always speak with one voice. *See id.* at 737-46. Still, even a fraction of the power OPEC wielded in the 1970s would be impressive.

[412] *See id.* at 745.

oil's definite quality and quantity, a defined benefit from each barrel and a sense that oil is non-replenishable, make it easier for OPEC to set a price range.

Genetic resource countries do not peddle such a consumer-friendly product. Not only do they sell "chances to win" on numerous jackpots, they are unable to reveal the amount of any of the prizes. Past performance can serve as a rough guide in setting the initial, flat fee as in the Merck/INBio deal. The royalty arrangement further alleviates the need to determine beforehand the precise payoff.[413] But not knowing the exact amount of benefit that might flow from a particular handful of resources, or even from the entire pool of resources, makes it difficult to speculate on what is at stake with each royalty percentage point. Varied predictions on how much money can be expected make it difficult for source countries to know what they have and what to ask for in return.

Between OPEC's product and that of genetic source countries, a more salient difference than the compensation amount is the price tag itself. Oil prices may fluctuate, but the tag has long been plainly visible both to industry insiders and to end consumers. Every motorist in every developed country is keenly aware of his or her own addiction to the product. Television presents us with images of Middle Eastern men in turbans, gathered around a table, discussing ways to drive up the price of oil. The picture may have become heavily stereotyped, but it serves a purpose. At least for one segment of the oil-producing nations, it says clearly "We are here, at the other end of the fuel line. You must deal with us."

Concern for biodiversity may be on the rise, but the consumer relationship between genetic resource countries and the developed world is not similarly imprinted on the psyche of the global public. Even if a prescription drug is derived from a wild plant, it would be rare for the patient to know the source of the healing chemical or even the name of the chemical itself. Furthermore, prescription drugs are purchased sporadically. When they are purchased, the buyer is not in a "consumer mode." There is minimal shopping around, and electing not to buy because of the price is usually not an option. Often, insurance deadens the immediate sting of the cost anyway.

One might expect more awareness when it comes to food products, but the awareness does not extend very far down the line. Though the

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413 It also admittedly strains the analogy. Lottery officials generally do not give tickets away, asking only for a percentage back on the return. The initial flat fee, however, preserves the element of chance.

ASTA acknowledges its dependence on foreign germplasm,[414] U.S. farmers need not be aware of the battle waging between North and South on this issue. The farmer must know only that his seeds come from Pioneer Hi-Bred. The family at the grocer knows only that wheat grows in places like Kansas. In neither case does the knowledge leapfrog to the next provider in line. This is not undue ignorance. There just has never been any practical reason for farmers and consumers to trace the source further and learn the genetic lineage.[415]

It is obvious that source country solidarity, therefore, does not reduce the inherent complexities in making products more marketable. Regional agreements also do not cure the economic woes that plague developing countries, and that sometimes steer the course of negotiations. But joining together will at least afford the developed world the chance to develop a uniform pricing scheme, and to present that scheme at the bargaining table. This should make any given source country less fearful of being undercut by a neighbor with similar resources, and less apt to merely accept what industry decides, in fairness, it ought to pay. Developing countries might also use these accords to assist each other in expanding and solidifying enforcement mechanisms. This could help check resource smuggling and increase the volume of international protests aimed at prospecting companies that try to circumvent the rules.

2. Indigenous Rights

To complicate matters further, the compensation question does not stop once the money or technology is handed over to the source country. An issue not tackled in this Article, but relevant to the efficiency of the compensation scheme is who receives the financial benefit *within* the source country.[416] Historically, the primary battle ground has involved questions of equity and incentive between countries only. But it will not be exclusively the national governments that will decide whether genetic diversity is preserved. A quote by E.O. Wilson reminds us of what drives the process:

> The only way to make a conservation ethic work is to ground it in ultimately selfish reasoning . . . an essential component of this formula

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[414] *See* KLOPPENBURG, *supra* note 7, at 186.

[415] This discussion, of course, does not include finished (or near-finished) agricultural products received directly from source countries. One of the best examples in which the source country stands clearly in the limelight is gourmet coffee. The example is also an ironic one for this discussion, given that the consumer product, the coffee bean, is itself a seed.

[416] *See* Odek, *supra* note 304, at 175-81.

> is the principle that people will conserve land and species fiercely if they foresee a material gain for themselves, their kin, and their tribe.[417]

Unfortunately, some conservation strategies may not be designed to consider the interests of indigenous people.[418]

Of course, a government with a sufficient stake in the matter might have the incentive not only to establish conservation measures but to enforce them against interest groups within their jurisdiction. But some of that stake will be lost in the enforcement. Conservation is much more efficient if locals stand to benefit. The genetic resource issue in particular does not conjure up images of countries so fat from compensation received that they can afford to fend off an unwilling populace from the resource preserves.

The Biodiversity Convention, in an effort to reach consensus, made no attempt to tackle the issue of how local people will share in genetic resource compensation. Brazil, in fact, made clear at UNCED its view that such issues are a matter for the sovereign to decide.[419] Concerning the language of the Convention, Brazil fought even the appearance of vesting property rights in its indigenous peoples.[420] Brazil, for one, does

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[417] Ian Walden, *Intellectual Property Rights and Biodiversity*, in INTERNATIONAL LAW AND THE CONSERVATION OF BIOLOGICAL DIVERSITY, *supra* note 237, at 171 (quoting E.O. Wilson).

[418] *See* Asebey & Kempenaar, *supra* note 362, at 724. Absent participation and support of indigenous peoples and other members of the local population, preservation attempts are destined to fail. Columbia has an established national park system--much of which is protected on paper only. Government officials estimate 20% of the country's 2.2 million acres of park land are occupied by squatters and even by people with illegal deeds to the properties. *See* Pamela Mercer, *Columbia's National Parks Are in a Losing Battle for Survival*, N.Y. TIMES, Mar. 28, 1995, at C4. Such deeds are obtained through corrupt local officials. *See id.*

[419] *See* Walden, *supra* note 418, at 184.

[420] Brazil successfully lobbied to change "common concern of peoples" in the Preamble to "common concern of humankind". The Brazil delegation felt the word "peoples" might imply "indigenous peoples." *Id.* at 184. The Convention does recognize indigenous people in another section of the document. Article 8 provides:

> Each Contracting Party shall, as far as possible, and as appropriate:
>
> . . .
>
> (j) Subject to its *national legislation*, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holder of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilisation of such knowledge, innovations and practices; . . .

Biodiversity Convention, *supra* note 1, art. 8 (emphasis added).

not intend for the benefits emanating from Rio to flow back to the countryside until they are diverted through Brasilia.

X. CONCLUSION: DIRECTIONS FOR THE FUTURE

The common heritage principle, as applied to genetic resources, appears to be fading into insignificance. A commercial system is emerging in its place in which all germplasm collected for commercial purposes is itself a commercial product. In the future, source countries will attempt to regulate access to their resources, and will retain property rights in them even after the germplasm leave the country.[421]

If developing countries succeed, biological prospectors will be forced to sign access agreements calling for initial fee collection, royalties on commercial products developed from the resources collected, and some technology transfers enabling source countries to participate in the refinement of such resources. Source countries will also retain property rights to genetic resources passed to agricultural gene banks. Transfers in the future will be accomplished through MTAs which will reserve source country rights in the resources. These MTAs will provide that royalties from commercial development flow back to source countries.[422]

Despite its shortcomings, the initial fanfare that greeted the Merck/INBio agreement was probably justified. It marked the first widely-publicized model for how bio-prospecting industry and source countries might implement the Biodiversity Convention. It also opened the door for U.S. companies to participate in the new order, regardless of whether the United States ever officially accepts the treaty.

The trend toward universal acceptance of the need to compensate source countries does not answer the big question: how much? No agreement exists regarding what genetic resources should or can cost, and no one knows presently what benefits are to be expected from this new promise of compensation. The Merck/INBio agreement is a start, but in the long run it is not a model likely to satisfy source countries. Nor is it likely to accomplish the goals of conservation in most developing countries. For now, unfortunately, there are more immediate and more definite sources of income, though they deplete the resource base. Desperate people in developing countries continue to plow under or pave over their resources, and will continue to do so, until the market is up and running. Short term necessities will prevail, even if the path is fairly clear for greater, more sustained benefits in the future. It is not a matter of killing the goose to get to the store of golden eggs inside. It involves instead

[421] *See* Belson, *supra* note 301, at 6.
[422] *See generally* Barton, *supra* note 231.

killing the goose for its meat because there is no immediate market for the gold.

There is even little assurance that golden payoffs await those who can afford to be patient. Traditional thinking does not equate genetic resources with gold (or even "black gold," i.e. oil). Traditional thinking places "raw" germplasm more in the realm of free-flowing water. If this mindset proves insurmountable and makes it difficult to assign any real market value to the resource, the developed world can at least concentrate on paying not to have the wells developed over. The compensation scheme, at minimum, must induce source countries not to develop the land holding the resources. If the market fails to do so even after it is influenced by regional genetic resource "cartels," then national governments must step in to fill in the compensation gaps.

An international fund to compensate genetic resource countries has been suggested as an alternative to placing the burden on the biotech industry.[423] This route, should it prove necessary, will be difficult. Consumers reluctant to pay higher prices at the pump scream even louder when asked to hand over the conservation tax directly. The public, and the governments that represent them, do not seem to have the political will in the late twentieth century to spend large sums of money on conservation.[424] Moreover, political will decreases the farther from home conservation becomes, and the more it is burdened with the label of "foreign aid." A scenario in which industry shoulders much of the initial burden would be more effective, even if it means eventual higher costs to end consumers.

The potential exists for biotechnology to facilitate preservation of agricultural germplasm as well. Biotechnology facilitates incorporation of both wild and cultivated germplasm into elite plant varieties. The hunt for new samples thereby becomes more profitable for both seed and pharmaceutical companies. The Biodiversity Convention and the soon to be revised International Undertaking provide a path toward the sharing of agricultural profits. The relationship between biotechnology, agriculture, and the environment, though, is very different than is the case with medicine. In agriculture, a central paradox remains that should keep the relationship uneasy and should make conservation difficult, even in the wake of UNCED.

The paradox was brought to light by the Green Revolution. The Green Revolution, at the time of its inception, was regarded as a miraculous event. It provided high-yield crops that literally pulled large seg-

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[423] *See* Scalise & Nugent, *International Intellectual Property*, *supra* note 165, at 118.
[424] *See Deadlock*, *supra* note 336.

ments of the world population from the brink of starvation. However, it did so at considerable expense to the environment and to the traditional land races.

Biotechnology holds the promise of fixing some of the environmental problems associated with high-yield varieties. Crops addicted to nitrogen fertilizers and dangerous pesticides can and will be reinvented to grow in other ways. This re-invention will be slowed by the overly close relationship between seed and chemical companies, but the change will take place regardless. A desire to showcase more environmentally friendly practices will induce at least a small trickle of research in the direction of safer crops. Chemical companies might even accept the inevitability of this change in the winds and decide to pursue it. Profit realized from the new generation of super crops might even wean the chemical companies themselves off the chemicals they currently depend upon to make profits.

However, a more fundamental and less easily resolved problem regarding the relationship of high-yield varieties to the land races persists. Seed company profit is achieved through widespread planting of elite varieties. Widespread planting of elite varieties displaces land races. However, if the conservation scheme for agricultural diversity imitates that for medically valuable plants, land race conservation will depend upon the profit realized from elite varieties. Under this scenario a catch-22 exists where preservation of the land races is financed by the proliferation of the elite varieties that replace them.

The problem is inherent in the current market system. Seed companies cannot market diversity. To protect investment, the seed industry must have intellectual property protections. To receive protection under the current intellectual property system, seed companies must develop uniform products, a task made easier through biotechnology. To financially gain from these uniform products, the seed industry must then pursue the obvious strategy of mass production of products for a public willing to buy them. Industry in the present case seeks to induce its customers to plant the products far and wide, thereby displacing more diverse crops. Perversely, therefore, the agricultural industry must follow the typical formula for market success, it must do so by eroding the very pedestal upon which its success is built.

In the past, agricultural industry has turned to seed banks to solve this paradox. Seed banks can help by preserving large quantities of germplasm long after the base is destroyed. Improved long-term storage methods will make this more of a reality than it is now. At present, shoddy conditions continue to ruin the samples in many banks.[425] But

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[425] *See* Ramesh Jaura, *Agricultural-NGOs: Leipzig Plan of Action a Mixed Bag*, Inter

even under the best of conditions, seed banks are a limited answer.[426] Losing the base means losing untested genetic combinations that will never be retrieved. No matter how impressive and well-preserved the collections, it is naive to think the evolutionarily arrested samples in gene banks can compensate for this loss. Building up these stores while allowing the destruction of the ground from which they came may preserve current bridges, but effectively incinerates those still under construction.

The seed industry must find a new way to succeed in business. Seed companies must engage in a delicate balancing act in which they promote their products while intentionally limiting their spread. High-yield cultivars must be planted in fields long since drained of their genetic diversity. Land races and wild germplasm, however, must remain in place. A cycle in which developing world farmers supply raw germplasm to seed companies, who in turn supply high-yield varieties to those farmers' fields, will only go around one rotation.

Seed companies must somehow be turned away, and developing world farmers must be induced to stick with diverse, low-yield varieties. It is doubtful that seed companies will accept this limitation voluntarily. Already, concerned observers note the industry's "recent aggressive moves toward the agricultural fields of developing countries."[427] The potential for immediate profit tends to outweigh more diffuse concerns for future generations, even for future generations of seed companies. The natural temptation for the seed industry will be to continue unchecked market expansion.

Developing world farmers are even less likely, and far less able, to forego present profit for the good of humankind. Poor farmers can easily be enticed away from uncertain chances at future royalties by the sure income possible from planting elite varieties specially tailored for their fields. The lure of high-yield profit is especially strong given that low-yield royalty prospects remain distant.[428] An international fund would

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Press Service, June 17, 1996, *available in* LEXIS, News Library, Allnws File.

[426] Not everyone agrees with this conclusion. The eminently respected expert on genetic resources, Sir Otto Frankel, expresses strong reservations concerning our ability to foster *in situ* conservation of land races, and calls *ex situ* conservation "the only reliable long-term conservation measure." Frankel, *Landraces, supra* note 24, at 14, 15. Frankel believes that, for agricultural purposes, our *ex situ* stores are nearly complete, and the primary remaining task is "filling in the obvious and important gaps." *See* Frankel, *Genetic Resources, supra* note 82, at 24.

[427] Dipankar De Sarkar, *Agriculture: Rich-Poor Clash Looms at FAO Conference*, Inter Press Service, June 17, 1996, *available in* LEXIS, News Library, Allnws File.

[428] Immediate royalties seem even less likely in agriculture than in medicine.

seem absolutely necessary to support these fields of land races. Despite the inherent problem of underfunding, this solution should be the focus of international efforts if preservation is to succeed.

The world community attempted to come to grips with this urgent need at the FAO conference in Leipzig, Germany. Results from the Conference were mixed. Source countries came away from the Conference with an acknowledgement that Farmers' Rights are more than mere concept, but they did not go home with any money to make such rights a reality. The fight to solidify the necessary financial commitment will be taken up again when the International Undertaking is revisited, beginning in December 1996.

Whether the countries of the world will muster the political will to finance genetic resource conservation remains to be seen. Meanwhile, as developed and developing worlds wrangle over genetic and financial resources, the global population continues to increase dramatically. According to estimates, in the year 2030, 8.7 billion people will try to do what 5.7 billion are having difficulty doing today: farm enough land to produce enough food while leaving enough diversity so the system does not collapse.[429] In the short term, food production will have to increase. That increase will probably be realized through the planting of more high-yield crops. The struggle will be to do so without polluting the environment, eradicating land races, and cutting deeper into uncultivated centers of diversity. The problem of population growth will eventually be solved, of course, either through conscious human effort or by other means. Nature has its own methods of correcting overload. The task at hand is to insure that some of nature's more draconian methods will not be employed.

Pharmaceutical bio-prospecting has at least a reasonable potential to find substances with which to create whole new products, with new markets. With agriculture, most of the tinkering in the near future will be done with what is already in storage. Land races serve as more of the backup "insurance plan." Although the Biodiversity Convention and the International Undertaking contemplate compensation from use of these stored genes as well, the expectation of compensation cannot be high. For resources collected long ago and of uncertain pedigree, the outlook is for diffuse, watered down compensation at best. This outlook would not likely excite farmers trying to make a living.

[429] *See Table Set Thinly as Food Summit Pledges to Halve World Hunger in 20 Years*, U.N. CHRONICLE, Dec. 22, 1996, at 24.