SUSTAINABLE BIOPROSPECTING: USING PRIVATE CONTRACTS AND INTERNATIONAL LEGAL PRINCIPLES AND POLICIES TO CONSERVE RAW MEDICINAL MATERIALS

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I. INTRODUCTION

In 1987, a group of biologists were slogging through swampland in Malaysia seeking plants that they hoped would yield medicinally useful chemical compounds upon examination in a laboratory.[1] One of the plant samples this group extracted was a one-kilogram collection of twigs, bark, and fruit from a Malaysian gum tree.[2] Four years later, these biologists isolated from the twigs a compound that blocked the spread of the HIV-1 virus in an experiment with a human cell.[3] Upon making this discovery, collectors returned immediately to the Malaysian swamp and to where they thought the source tree was located.[4] The tree was gone, however, felled shortly after the original material had been collected.[5] Destruction of that Malaysian gum tree also destroyed a genuinely promising discovery in the search for a cure for AIDS.[6]

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[1] *See* Erin B. Newman, Note, *Earth's Vanishing Medicine Cabinet: Rain Forest Destruction and Its Impact on the Pharmaceutical Industry*, 20 AM. J. LAW & MED. 479, 482 (1994).

[2] *See id.*

[3] *See id.*

[4] *See id.*

[5] *See id.*

[6] *See* Newman, *supra* note 1, at 482 (citing Usha Lee McFarling, *Nature's Vanishing Pharmacy*, BOSTON GLOBE, Oct. 3, 1994, at 25). Scientists made another similarly promising discovery with respect to AIDS vaccines—a compound from a vine native to the Cameroon rain forest.

In the 1950s, scientists from the pharmaceutical manufacturer Eli Lilly & Co. discovered the rosy periwinkle, a plant from which they were able to derive compounds leading to the development of anti-cancer agents vincristine and vinblastine.[7] Vincristine is used to battle childhood leukemia, achieving a ninety percent remission rate, while vinblastine is deployed against Hodgkin's Disease with an eighty percent remission rate.[8] Eli Lilly & Co., which developed vincristine and vinblastine, relied initially on several source countries for its rosy periwinkle supply.[9] High demand for a high quality plant ultimately led Eli Lilly to Madagascar, where the French cultivated rosy periwinkle plantations.[10] With a steady supply of high quality plants, Eli Lilly consistently earned over $100 million annually from vincristine and vinblastine.[11] The Madagascar plantations proved to be fertile field for the rosy periwinkle, not to mention for Eli Lilly's annual net revenue. As one of Eli Lilly's researchers tells it, however, the people of Madagascar living around the plantations became "'restless, threw the French out, and took over the supply.'"[12] Not only did this disrupt supply deliveries, it also detracted from supply quality.[13] Consequently, Eli Lilly established its own plantations, in Texas, with rosy periwinkles imported from Madagascar.[14] Today, Eli Lilly's annual sales from vincristine and vinblastine exceed $180 million.[15] Madagascar's share of the revenue from those sales is, as it always has been, zero.[16]

See id. Researchers at the National Cancer Institute say that this compound also "inhibits the production of HIV in vitro." *Id.*

[7] *See id.*

[8] *See id.*

[9] *See* Sarah A. Laird, *Contracts for Biodiversity Prospecting, in* BIODIVERSITY PROSPECTING 99, 118 (1993). The original source country was India; India was followed by the Philippines and then by Australia. *See id.*

[10] *See id.*

[11] *See* Walter V. Reid, et al., *A New Lease on Life, in* BIODIVERSITY PROSPECTING 1, 15 (1993) [hereinafter Reid, *New Lease*].

[12] Laird, *supra* note 9, at 118 (referencing a personal communication with Gordon Svoboda, who was involved in prospecting for the rosy periwinkle).

[13] *See id.*

[14] *See id.*

[15] *See* Newman, *supra* note 1, at 482.

[16] *See* Steven M. Rubin & Stanwood C. Fish, *Biodiversity Prospecting: Using Innovative Contractual Provisions to Foster Ethnobotanical Knowledge, Technology, and Conservation*, 5 COLO. J. INT'L ENVTL. L. & POL'Y 23, 27 (1994).

Searching the world's wildlands, as the team of biologists did for the Malaysian gum tree or as Eli Lilly's scientists did for the rosy periwinkle, is known as biodiversity prospecting or bioprospecting.[17] Bioprospectors—ranging from a village shaman in a developing country to a professionally-trained botanist from a multinational pharmaceutical company headquartered in a developed country—search the Earth's sanctuaries of biodiversity for flora and fauna that may offer the salve for a wound or the cure for a disease.[18] Shamans, botanists, and others have discovered sources for many such salves and cures already, but many more discoveries await. The task for our time is to ensure that species survive so that discovery remains a possibility.

This Comment addresses the legal framework within which bioprospecting is and should be conducted. Section II briefly defines biodiversity.[19] Section III explains biodiversity prospecting in greater detail.[20] Section IV introduces the policy of sustainable development as it relates to biodiversity, and focuses on the significance of conservation incentives to that policy.[21] Section V reveals the prominence of the policies of sustainable development of biodiversity and of conservation incentives in the United Nations Convention on Biological Diversity.[22] Section VI focuses specifically on the Costa Rican experience with sustainable development of its biodiversity resources, and the significance to that experience of a scientific research institute known as INBio.[23] Section VII briefly describes a landmark contractual agreement between INBio and pharmaceutical giant Merck & Co., and discusses characteristics of bioprospecting contracts in general.[24] Section VIII integrates these experiences by proposing contractual relationships between a national biodiversity institute modeled on Costa Rica's INBio and parties (such as pharmaceutical companies) seeking access to a country's biodiversity resources as an appropriate method of conserving the world's raw medicinal materials.[25]

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[17] *See, e.g.*, Reid, *New Lease*, *supra* note 11, at 1.
[18] *See id.* at 7.
[19] *See infra* notes 26–57 and accompanying text.
[20] *See infra* notes 58–103 and accompanying text.
[21] *See infra* notes 104–39 and accompanying text.
[22] *See infra* notes 140–95 and accompanying text.
[23] *See infra* notes 196–263 and accompanying text.
[24] *See infra* notes 264–331 and accompanying text.
[25] *See infra* notes 332–86 and accompanying text.

II. BIODIVERSITY'S VARIETY

Gila monster venom,[26] bark from a scraggly "junk tree,"[27] and a plant whose popular name is the "stinking tree"[28] may not immediately conjure up images of nature's lushness and richness. Yet, each of the above is a part of what broadly is termed "biodiversity," and each is a potential "biodiversity resource" of the country in which it is found. In the venom of the Gila monster lizard, Amylin Pharmaceuticals, Inc., discovered a compound, exendin, which the company hopes to use to develop a drug for treating diabetes.[29] From the bark and the needles of the Pacific yew tree, found in old-growth forests of the Pacific Northwest of the United States, the National Cancer Institute (NCI) derived the potent anticancer compound, taxol, a powerful chemotherapy used against ovarian, breast, and other cancers.[30] Finally, to the people of India and China, the plant is known as the "stinking tree."[31] To SmithKline Beecham, however, the stinking tree is the source of campotothecin, an analog of which scientists have developed into the drug topotecan, another promising treatment against ovarian cancer.[32] The plants and animals from which these chemical compounds have been derived are known as "biodiversity," and increasingly are becoming known also as valuable natural resources.

Specific examples help conceptualize the notion of biodiversity, but a general definition demonstrates just how much of life on Earth is captured by the term biodiversity. The United Nations Convention on Biological Diversity defines "biodiversity" as follows: "[T]he variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological

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[26] *See* Amylin Pharmaceuticals Acquires Rights To Potential Diabetes Drug Derived From Gila Monster Venom, Press Release, Oct. 7, 1996, New York (Amylin Pharmaceuticals, Inc.) [hereinafter Amylin Press Release].

[27] *See* Douglas O. Heiken, *The Pacific Yew and Taxol: Federal Management of an Emerging Resource*, 7 J. ENVTL. L. & LITIG. 175, 176 (1992).

[28] *See Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines*, PHARMACEUTICAL BUS. NEWS, Aug. 21, 1992 (page unavail.).

[29] *See* Amylin Press Release, *supra* note 26.

[30] *See Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines*, *supra* note 28. For a detailed discussion of the story of the Pacific yew tree and federal management of it, *see* Heiken, *supra* note 27, at 175–77.

[31] *See Pharmaceutical Companies Go 'Chemical Prospecting' For New Medicines*, *supra* note 28.

[32] *See id.*

complexes of which they are part."[33] These "ecological complexes" include "diversity within species, between species and of ecosystems,"[34] and correlate to three hierarchical categories of living systems.[35] The first is genetic diversity, defined as the variation of genes within a species.[36] The second is species diversity, defined as the variety of species—"plants and animals, including fungi and microorganisms"[37]—within a region.[38] The third is ecosystem diversity, defined as the variety of ecosystems within a region.[39] Thus, genes of species, species themselves, habitats in which species live, and ecosystems comprised of individual habitats all constitute "biodiversity," just as each alone constitutes biodiversity.[40] In *Global Biodiversity Assessment: Summary for Policy-Makers*, The United Nations Environment Programme (UNEP) summarized the definition of biodiversity as the "variety of the world's organisms, including their genetic makeup and the communities they form."[41] "In short, biodiversity is life."[42]

Biodiversity is also, however, a rich natural resource.[43] The Convention on Biodiversity expressed this notion of biodiversity as a resource in its definition of "biological resources" as including "genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity."[44] Gila monster venom, tree bark and plant leaves all contain within their genetic structure chemical compounds "with actual or potential . . . value for humanity."[45] Genetic manipulation of these and other chemical compounds from plants, fungi, bacteria, and ma-

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[33] Convention on Biological Diversity, U.N. Conference on Environment and Development, June 5, 1992, *reprinted in* 31 I.L.M. 818, 823 (1992) [hereinafter Biodiversity Convention].

[34] *Id.*

[35] *See* PHILIPPE SANDS, PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW VOL. 1 368 (1995); *see also* Klaus Bosselmann, *Plants and Politics: The International Legal Regime Concerning Biotechnology and Biodiversity*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 111, 112 (1996).

[36] *See* SANDS, *supra* note 35, at 368.

[37] *See* Bosselmann, *supra* note 35, at 112.

[38] *See* SANDS, *supra* note 35, at 368.

[39] *See id.*

[40] *See id.*

[41] R.T. WATSON, UNITED NATIONS ENVIRONMENT PROGRAMME, GLOBAL BIODIVERSITY ASSESSMENT: SUMMARY FOR POLICY-MAKERS 8 (1995) [hereinafter GLOBAL BIODIVERSITY ASSESSMENT].

[42] BIODIVERSITY AND THE LAW xix (William J. Snape III ed., 1996).

[43] *See generally* E.O. WILSON, THE DIVERSITY OF LIFE 281 (1992).

[44] Biodiversity Convention, *supra* note 33, at 823.

[45] *See id.* (defining biological resources).

rine invertebrates has turned some countries' biodiversity into their most valuable raw material, especially as an increasing number of medicines and vaccines are developed from naturally occurring chemical compounds.[46] Biodiversity resources thus have become valued directly for their consumptive use and their productive use as raw medicinal materials.[47] Biodiversity resources also have indirect values such as option value, existence value, and non-consumptive value.[48] Examples of indirect values include soil erosion prevention, water purification, biodegradation of pollutants and wastes, as well as cultural or spiritual appreciation of biodiversity.[49] Although the utility of these indirect values is significant, biodiversity will be appreciated as valuable in and of itself only by recognizing the utility that comes directly from ecosystems and the species dwelling within them.[50] As appreciation for biodiversity and for its direct utility is expanding, however, the Earth's warehouse of biodiversity resources is shrinking.

The Earth is in the midst of what has been called a "biodiversity crisis."[51] Biodiversity conservationists struggle against agriculture and timber interests' agendas of destruction, and, too often, lose the struggle.[52] Scientists have estimated that, without greater global conservation efforts, twenty-five percent of the world's species will become extinct within the next fifty years, while the habitats in which they live will suffer a similar rate of extinction through deforestation, desertification, and destruction of wetlands.[53] Some estimates suggest that approximately 150 species become extinct each day,[54] while twenty-seven million acres of tropical forests—which are home to a majority of the world's biodiversity—are destroyed each year.[55] The

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[46] *See, e.g.*, John Vidal, *The Gene Rush*, TORONTO STAR, July 10, 1993, at D6.

[47] *See* JEFFREY A. MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY: DEVELOPING AND USING ECONOMIC INCENTIVES TO CONSERVE BIOLOGICAL RESOURCES 14–19 (1988) [hereinafter MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY].

[48] *See id.* at 15, 19–24.

[49] *See* GLOBAL BIODIVERSITY ASSESSMENT, *supra* note 41, at 12; MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY, *supra* note 47, at 21.

[50] *See* MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY, *supra* note 47, at 1.

[51] Jeffrey A. McNeely, *The Biodiversity Crisis: Challenges for Research and Management*, *in* CONSERVATION OF BIODIVERSITY FOR SUSTAINABLE DEVELOPMENT 15, 16 (O.T. Sandlund, et al. eds., 1992) [hereinafter McNeely, *Biodiversity Crisis*].

[52] *See id.*

[53] *See id.*

[54] *See, e.g.*, Tracy Dobson, *Loss of Biodiversity: An International Environmental Policy Perspective*, 17 N.C. J. INT'L L. & COM. REG. 277, 279 (1992).

[55] *See* Bosselmann, *supra* note 35, at 113.

refrain is not new. Rainforest destruction and its consequences have been a popular socio-political issue for years. Confronting biodiversity loss by building the reality of self-interested human nature into a framework for conservation through use of tropical rainforests and other biodiversity-rich areas may be gaining cachet.

Presently, the total number of species on Earth is estimated to be between thirteen and fourteen million, while only 1.75 million species have been described scientifically.[56] The latter figure is misleading, however, because no official list of described species exists; even if such a list did exist, the area in which a species was found initially and described may have changed so dramatically as to make it impossible to relocate the species there.[57] The foregoing combination of circumstances surrounding biodiversity continues to be alarming: The rate of species extinction, general ignorance as to the existence and constitution of a vast majority of the world's species, and fluctuating knowledge of the majority of species with which we are scientifically familiar produces a dangerous situation where we do not know what we are losing. (Re-)discovering the medicinal utility of the Earth's biodiversity should awaken a broader cross-section of the world's peoples to the need to conserve biodiversity in order to maintain sustainability of the Earth's vanishing raw medicinal materials.

III. BIOPROSPECTING: (RE-)DISCOVERING THE MEDICINAL POWER OF NATURE

A "new breed" of species has appeared and proliferated over the last decade, however, especially in tropical forests—the "biodiversity prospector."[58] This species has many varieties, ranging from a single villager dwelling within biodiverse areas to a professionally-trained team of botanists foraging through biodiverse areas.[59] Most varieties of biodiversity prospector, though, have this in common: They search for naturally occurring palliatives or curatives in the bark, leaves, fruits, stalks, and roots of plants, in soil-dwelling microbes, in the genetic constitution of both vertebrate and invertebrate species, and in all other varieties of life.[60] In short, bioprospecting is the "search

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[56] *See* GLOBAL BIODIVERSITY ASSESSMENT, *supra* note 41, at 8.

[57] *See id.* at 16.

[58] Jonathan Lash, *Foreword*, *in* BIODIVERSITY PROSPECTING v (1993).

[59] *See, e.g.*, Reid, *New Lease*, *supra* note 11, at 3–4.

[60] *See generally* Lash, *supra* note 58; Reid, *New Lease*, *supra* note 11.

for bioactive compounds in natural sources such as plants, fungi, insects, microbes, and marine organisms."[61]

Most bioprospectors focus primarily on searching for species which may possess some medicinal value; the great hope always is that upon opening "nature's medicine cabinet,"[62] scientists will be able to remove the "top" of a plant and discover inside a chemical compound that ultimately will yield, for example, a potent anticancer agent or a cure for Alzheimer's Disease.[63] This is the type of bioprospecting discussed in this Comment, the "search for wild species of flora and fauna whose genes can yield new medicines."[64] The public health and private financial interests in natural product drug development are significant.[65] The active ingredients in twenty-five percent of all prescription drugs sold in the United States are extracted or derived from plants.[66] In 1990, sales from these plant-based drugs were estimated to be $15.5 billion.[67]

Remedies derived from plants have been for many centuries the primary form of medical care for most of the world's people.[68] At one time, plants were also the primary source of material for pharmaceutical companies engaged in drug development.[69] An example of these early discoveries is digitalis, derived from the foxglove, and used to treat congestive heart failure.[70] Beginning in the 1950s, however, natural product drug development fell into disfavor for several reasons.[71] First, the pharmaceutical industry became enamored of its own ability to manufacture synthetic drugs.[72] Technological advances allowed biochemists to create drugs in the laboratory using computer

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[61] Edgar J. Asebey & Jill D. Kempenaar, Note, *Biodiversity Prospecting: Fulfilling the Mandate of the Biodiversity Convention*, 28 VAND. J. TRANSNAT'L L. 703, 706 (1995).

[62] Newman, *supra* note 1, at 479.

[63] *See id.* Bioprospectors also might seek out species from which, for example, new insecticides can be developed for agricultural use. *See generally* SEEDS AND SOVEREIGNTY: THE USE AND CONTROL OF PLANT GENETIC RESOURCES (Jack R. Kloppenburg, Jr., ed., 1988).

[64] Margot Cohen, *Forest Fire: The Biodiversity Debate Heats Up in Asia*, FAR E. ECON. REV., Jan. 11, 1996, at 66.

[65] *See* Reid, *New Lease*, *supra* note 11, at 7.

[66] *See id.*

[67] *See id.*

[68] *See* William K. Stevens, *Scientists and Shamans Seek Cures in Plants*, MIAMI HERALD, Feb. 2, 1992, at 7C. Even today, researchers estimate that three-fourths of the world's population still relies on such traditional herbal medicines. *See id.*

[69] *See, e.g.*, CHRISTOPHER JOYCE, EARTHLY GOODS: MEDICINE-HUNTING IN THE RAINFOREST 8 (1994).

[70] *See id.* at 18–19.

[71] *See, e.g.*, Asebey & Kempenaar, *supra* note 61, at 706.

[72] *See id.*

modeling.[73] While technological advances in synthetic drug manufacturing in part shifted attention away from natural products research, technological stagnation in natural products research and development also shifted the focus of attention. Collection methods were inefficient, and, once samples of natural products were collected, screening them for chemical activity was slow and expensive.[74] Prospecting for plants with bioactive compounds was in some ways a random, haphazard process earlier in this century than it was a structured, focused process.[75] Especially in the last decade, however, this bias against natural product drug development has been changing dramatically, as scientists have realized that natural products often offer the best starting points for drug discovery, and as screening technology has improved.[76]

Although random screening methods still are used, companies such as Merck today can screen thousands of samples at a much quicker rate and for a much cheaper cost.[77] An explanation of the modern screening process follows. Extracting chemicals from the natural product is the first step.[78] That extract then is divided into chemically distinct samples, and screened through numerous bioassays to look for chemical activity against a specific disease.[79] If a sample shows activity, screening becomes more precise, as the sample is divided further and screened again to identify the active chemical, and to determine whether it is already in use or whether it was the subject of an earlier study which resulted in its rejection.[80] The results of this second round of screening determine whether a company proceeds with further evaluation and, eventually, clinical trials.[81] Because of advanced screening technology and renewed appreciation for the complex chemical composition of plants and other organisms, natural product pharmaceutical research seems finally to have proven its

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[73] *See Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines, supra* note 28.

[74] *See* Walter V. Reid, *Screening for New Drugs*, ENV'T., July 1, 1995 at 12 (containing related article on screening for new drugs) [hereinafter Reid, *Screening*].

[75] *See id.*

[76] *See Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines, supra* note 28.

[77] *See id.*

[78] *See* Reid, *Screening, supra* note 74.

[79] *See id.*

[80] *See id.*

[81] *See id.*

worth. As a Glaxo spokesman poignantly put it, "It's hard to find a chemist that can compete with nature."[82]

Bioprospecting is subject, however, to excesses and abuses. Enthusiasm over discovering a promising plant may propel scientists and their collectors to extract species or samples of species at a rate and volume that threaten the source species' very existence.[83] For example, the "entire adult population of *Maytenus buchananni*—source of the anticancer compound maytansine"—is gone, harvested to extinction by a U.S. National Cancer Institute-sponsored prospecting team that collected 27,215 kilograms of the plant in Kenya for testing in NCI's drug development program.[84]

The anticipated public health benefits from a plant that holds potential anticancer agents within its chemical composition not surprisingly may excite scientists to such a pitch that they fail to consider conserving the resource, even though conservation would be in everyone's—especially their own—best interests. If a major pharmaceutical company had been behind the prospecting team in Kenya, one might suspect excitement over such a find to be stimulated by anticipated increase in corporate wealth, rather than by anticipated improvement to public health.[85] The simple point is that impulse, whether altruistic or commercial, may blind individuals, institutions, and corporations to the necessity of maintaining long-term sustainability of biodiversity resources.

Bioprospecting also is susceptible to abuse through exploitation of citizens of the country in which the prospecting is conducted[86] as well as of the source country itself.[87] Both types of exploitation generally

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[82] *Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines*, *supra* note 28.

[83] *See, e.g.*, Reid, *New Lease*, *supra* note 11, at 3.

[84] *Id.* at 3–4.

[85] *See id.* at 3 (noting that "commercial interest in biodiversity will not necessarily fuel increased investment in resource conservation").

[86] *See, e.g.*, Naomi Roht-Arriaza, *Of Seeds and Shamans: The Appropriation of the Scientific and Technical Knowledge of Indigenous and Local Communities*, 17 MICH. J. INT'L L. 919, 920 (1996).

[87] *See, e.g.*, *The Costs of 'Bio-Piracy' To the Third World*, MARKETLETTER, Dec. 19, 1994 (page unavail.) [hereinafter *Costs of Biopiracy*]. A study commissioned by the United Nations and conducted by the Rural Advancement Foundation International reported that pharmaceutical companies receive over thirty billion dollars annually from drugs derived from plants discovered in developing nations, but that those countries receive minimal, if any, payment for the raw materials. *See id.*; *see also* Cohen, *supra* note 64 (noting that even where pharmaceutical companies negotiate with the government of a country for access to its country's biodiversity resources, environmentalists urge caution "lest the prospectors make off with all of the treasure").

are referred to as "biopiracy."[88] Biopiracy that victimizes individuals has been defined as the exploitation of "indigenous peoples to locate and understand the uses of medicinal plants"—i.e., the exploitation of their "ethnopharmacological" knowledge[89]—and then to develop and market drugs derived from those plants, while returning little or no compensation from sales of the drug to the indigenous peoples.[90]

Biopiracy of indigenous peoples has not been limited only to their knowledge of local flora and fauna, however. For example, in 1983, field scientists stumbled upon the Hagahai tribe, a Melanesian tribe of approximately 300 members, in a remote jungle in the interior of Papua New Guinea.[91] In May, 1989, during the course of a decade of research on this tribe, U.S. scientists isolated a rare virus strain in some members, extracted blood samples from twenty-four of them for further study, and staked a patent claim to the blood.[92] Research showed that a cell line from Hagahai members' blood ultimately might prove valuable in "diagnosing adult leukemia and chronic degenerative neurologic disease."[93] As this and other examples[94] suggest, re-

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[88] *See, e.g.*, Roht-Arriaza, *supra* note 86, at 920; *Costs of Biopiracy*, *supra* note 87.

[89] *See, e.g.*, Curtis M. Horton, *Protecting Biodiversity and Cultural Diversity Under Intellectual Property Law: Toward a New International System*, 10 J. ENVTL. L. & LITIG. 1, 4, 6–8 (1995). Because indigenous peoples have used native plants for medicinal purposes for generations, accessing the accumulated knowledge within these local communities has allowed prospecting pharmaceutical companies to increase greatly the percentage of "hits" the companies get when screening plant extracts for potential medicinal activity. *Id.* Horton illustrates the value of ethnopharmacological knowledge to pharmaceutical companies with the following: "Assuming a six-fold increase in screening efficiency, and using other industry assumptions, the probability of developing at least one marketable pharmaceutical from 1,000 samples grows from twenty-two percent to seventy-eight percent." *Id.* at 5. One United States company has bet all of its drug exploration activity on ethnopharmacological knowledge. *See, e.g.*, Reid, *New Lease*, *supra* note 11, at 7. Founded in 1989, Shaman Pharmaceuticals, Inc., based in San Carlos, California, prioritizes its drug exploration and sample screening on existing traditional uses of plants. *See* Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines, *supra* note 28. Several of Shaman Pharmaceutical's drugs derived in this way have made it to clinical trials, but none have made it on the market yet. *See id.*

[90] *See* Andrew Kimbrell, *Biotechnology: 'Biodemocracy' Needed To Replace 'Biopiracy,'* Inter Press Serv., Aug. 8, 1996 (page unavail.).

[91] *See* David Robie, *Biotechnology-South Pacific: Tribe Caught in Blood Tug-of-War*, Inter Press Serv., Oct. 25, 1995 (page unavail.).

[92] *See id.*; Kimbrell, *supra* note 90.

[93] Kimbrell, *supra* note 90.

[94] *See, e.g.*, Mahesh Uniyal, *Trade: Biopirates Stake Claim To Southern Knowledge*, Inter Press Serv., Aug. 29, 1996 (page unavail.). Tumeric powder has been used in India for generations as an ingredient in cooking, but also as an antiseptic and "wound-healer." *See id.* A university medical center from the United States, however, was awarded a patent on the medicinal properties of tumeric powder. *See id. See also* Roht-Arriaza, *supra* note 86, at 921–26 (discussing several other examples).

searchers historically have had relatively open access to ethnopharmacological knowledge and to raw medicinal materials themselves, even if those materials have been fellow human beings.

Countries also may be victimized by biopiracy.[95] Developing countries from the Southern Hemisphere typically are the victims of this type of biopiracy.[96] These countries, whose landscapes are lush with biodiverse tropical forests, are home to a majority of the world's species, but they do not have the capability always to assert and protect their national sovereignty over these biodiversity resources.[97] A persistent complaint from many of these countries is that developed nations from the Northern Hemisphere either themselves engage in unauthorized resource extraction, or are complicit in their pharmaceutical and biotechnology companies' unauthorized resource extraction.[98] A recent confrontation involving two developed countries, the United States and Australia, illustrates this type of biopiracy. In 1980, prospectors from the U.S. Department of Agriculture collected samples of Smokebush, an Australian plant found in the deserts of Western Australia, and brought it to NCI laboratories in the United States.[99] Using those samples, scientists at NCI were able to isolate a drug called conocurvone which "stops the replication of the HIV virus in test tubes."[100] NCI then applied for a patent.[101] Aware of this discovery and, more importantly, aware of the possibility of being excluded from any profits made from the sale of conocurvone, the Western Australia Department of Conservation and Land Management investigated Smokebush collecting activities, and actually "caught an NCI collector allegedly smuggling Smokebush" out of Australia in 1992.[102] NCI now has an agreement with the Australians

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[95] *See Costs of Bio-Piracy*, *supra* note 87.

[96] *See id.*

[97] *See generally* Thomas T. Ankersen, *The MesoAmerican Biological Corridor: The Legal Framework for an Integrated, Regional System of Protected Areas*, 9 J. ENVTL. L. & LITIG. 499, 537–47 (1994) (proposing regional coordination of biodiversity management in Central America).

[98] *See id.*

[99] *See* Pratap Chatterjee, *Environment: Medicine Hunters Scour Rainforests, Deserts*, Inter Press Serv., July 10, 1995 (page unavail.).

[100] *Id.*

[101] *Id.*

[102] *Id.* This type of thievery is not new. In 1876, Henry Wickham smuggled 70,000 rubber seeds out of Brazil and distributed them to British colonies in Asia. *See* Bosselmann, *supra* note 35, at 121. By 1919, the British colony of Singapore was the world's leading producer of rubber, supplanting Brazil which had produced nearly all of the world's rubber just two decades prior. *See id.* Despite having one of its most prized natural resources pirated without permission, Brazil had no way to redress its grievance. *See id.*

guaranteeing a share of profits from sales of this and other drugs for any local Australian community with which NCI works.[103]

IV. Sustainable Development of Biodiversity

The leaves of the jaborandi tree, native to Brazil, contain pilocarpine, an alkaloid used to make eye-drops to treat glaucoma.[104] A pharmaceutical company had contracted with villagers living near stands of jaborandi trees in northeastern Brazil to provide the company with a steady supply of the leaves, which it then exported for processing.[105] When Brazilian authorities halted exportation of the raw material in part because of diminishing supply, the company began processing the leaves in Brazil.[106] While demand for jaborandi leaves did not abate, supply of the trees did, forcing the company to try to plant and cultivate the tree out of fear that its supply of pilocarpine would be exhausted.[107] The faveiro, a plant native to southern Brazil, faced a similar crisis.[108] A blood coagulant can be derived from the leaves of the plant, but uncontrolled extraction of the faveiro also has threatened its survival.[109]

These two examples illustrate the unique challenge inherent in bioprospecting for medicinally valuable plants. The availability of glaucoma treatment and of blood coagulants is unarguably beneficial to the public health. When there is a finite supply of the natural product used in developing eye-drops or coagulants, however, maintaining availability of the commercial product necessitates taking a long-term perspective on viability of the natural product. That is, plants may replenish over time, but in order for that to happen, some must be left untouched. If a plant is to be harvested and used for drug development without regard for its continued existence, the natural source of a medicine will disappear, as a once-viable species rapidly becomes extinct. Within the policy of sustainable development is a response to the challenge of maintaining medicinal availability and species viability.

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[103] *See* Chatterjee, *supra* note 99.

[104] *See* Mario Osava, *Environment: Medicinal Plants Under Threat*, Inter Press Serv., May 29, 1996 (page unavail.).

[105] *See id.*

[106] *See id.*

[107] *See id.*

[108] *See id.*

[109] *See* Osava, *supra* note 104.

Sustainable development is a policy by which present needs are met and future needs are accounted for.[110] More formally, it is a "pattern of social and structural economic transformations (i.e., 'development') which optimizes the economic and other societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future."[111] As applied in the context of biodiversity, sustainable development requires "husbanding" biodiversity resources so that those resources may be used to "improve the human condition," yet endure indefinitely.[112] The policy, then, has two seemingly competing components—conservation and use. Emphasizing the "conservation" component means focusing on the Earth's "abundance and distribution of living organisms without regard for their significance to human health."[113] Emphasizing the "use" component means seeing the Earth as a "storehouse of resources made available to us for our exploitation and consumption."[114]

The commercialization of biodiversity, the "use" component, tends to be driven by self-interested profit incentives, and has the potential to subsume the "conservation" component, which tends to be driven by altruistic—albeit not entirely benign—incentives often having less force in the market.[115] Walter V. Reid of the World Resources Institute (WRI) cautions that three problems must be overcome if commercialization is to be prevented from subsuming conservation.[116] The first problem is that the commercial interest in biodiversity does not necessarily "lead to investment in resource conservation."[117] In fact, the commercial interest poses a potential example of the "free rider" phenomenon. Biodiversity can benefit many people simultaneously.[118] Similarly, one individual's conservation efforts can benefit many other biodiversity users.[119] Market incentives, however, dictate that each

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[110] *See, e.g.*, Arne Naess, *Sustainability! The Integral Approach*, *in* CONSERVATION OF BIODIVERSITY FOR SUSTAINABLE DEVELOPMENT 303, 306 (O.T. Sandlund et al. eds., 1992).

[111] *See* MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY, *supra* note 47, at 198.

[112] WORLD RESOURCES INSTITUTE, ET AL., GLOBAL BIODIVERSITY STRATEGY: GUIDELINES FOR ACTION TO SAVE, STUDY AND USE EARTH'S BIOTIC WEALTH SUSTAINABLY AND EQUITABLY 20 (1992) [hereinafter GLOBAL BIODIVERSITY STRATEGY].

[113] Walter V. Reid, *Biodiversity and Health: Prescription for Progress*, ENV'T. July 1, 1995 (page unavail.) [hereinafter Reid, *Biodiversity and Health*].

[114] James P. Karp, Essay, *Sustainable Development: Toward a New Vision*, 13 VA. ENVTL. L. J. 239, 246 (1994).

[115] *See* Reid, *Biodiversity and Health*, *supra* note 113.

[116] *See id.*

[117] *Id.*

[118] *See id.*

[119] *See id.*

user maximize the utility of the resource by, for example, harvesting one more bed of medicinally valuable flowering plants, rather than abstaining from harvesting.[120] That is, users of biodiversity resources will count on each other to be conservation-minded, when in fact each user is seeking to maximize its own utility from biodiversity through continued development. In this way, bioprospecting could quicken the destruction of biodiversity.[121]

Solving the second problem requires devising a way to encourage conservation by source countries.[122] Even if bioprospectors from transnational corporations are judicious with respect to the scope of their collecting activity, the source country, typically a developing nation, often is forced to sell its biodiversity resources to the highest bidder, regardless of the use to which it will be put.[123] Developing nations generally do not have any economic incentive to conserve biodiversity, even though biodiversity is some nations' most valuable natural resource.[124] Ensuring that the source countries share in the benefits from their biodiversity resources co-opts the need of developing countries to profit from their biodiversity, while simultaneously encouraging conservation.[125] A third, related problem is the need to ensure that indigenous peoples living among biodiversity—the "custodians" of biodiversity resources[126]—also are motivated by conservation incentives.[127] To do this, indigenous peoples also must be able to share in the benefits of bioprospecting.[128]

While sustainable development implies limits on current consumption in order to fulfill a responsibility to present and future generations,[129] this conservation component of the theory is problematic, because conservation seldom has a market value.[130] A market value can be affixed to biodiversity resources generally, however. Biodiversity resources could be considered quasi-non-renewable resources.[131] Re-

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[120] *See* Reid, *Biodiversity and Health*, *supra* note 113.

[121] *See id.*

[122] *See id.*

[123] *See id.*

[124] *See id.*

[125] *See* Reid, *Biodiversity and Health*, *supra* note 113.

[126] *See, e.g.*, Reid, *New Lease*, *supra* note 11, at 2 (among those considered "custodians" are "forest dwellers and indigenous people who maintain or tolerate the resources involved").

[127] *See* Reid, *Biodiversity and Health*, *supra* note 113.

[128] *See id.*

[129] *See* Karp, *supra* note 114, at 253.

[130] *See, e.g.*, MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY, *supra* note 47, at 9.

[131] *See id.* at 1–2 (describing non-renewable resources).

newable resources include "forests, animals and grasslands; the renewable resources are inexhaustible when managed appropriately."[132] Non-renewable resources include "oil, coal, gold, and iron," and have a finite supply.[133] Biodiversity resources could be considered quasi-nonrenewable resources, because "they are renewable if conserved; and they are [destroyed] if not conserved."[134]

An effective policy of sustainable development requires, therefore, mechanisms of accountability for environmental and socioeconomic consequences of human activities, as well as for the problems discussed above.[135] Because the sustainable development of biodiversity transcends the boundaries of individual countries, the burden of accountability falls on many actors, on several levels.[136] Actors who have a role to play in accountability include the following: individuals living among biodiversity resources; companies engaged in bioprospecting; source countries, rich in biodiversity resources; countries that benefit, either directly or derivatively, from use of biodiversity resources; and international governmental organizations, which are important to the formulation of a coherent policy for sustainable development.[137]

Constructing a legal framework in which accountability for sustainable development of biodiversity resources may take place is a collaborative task, therefore, that must be undertaken by both the international community and individual countries.[138] Sustainable development can be a unifying policy of conservation and use, satisfying the objectives of each of those two components. This notion of sustainable development, as one commentator noted, may sound like "idealistic pie in the sky."[139] Were it not for specific actions taken by both the international community and individual countries, such a criticism of the policy of sustainable development might have merit.

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[132] *See id.* at 1.

[133] *Id.*

[134] *Id.* at 2, 195.

[135] *See* Ellen Hey, *Increasing Accountability for the Conservation and Sustainable Use of Biodiversity: An Issue of Transnational Global Character*, 6 COLO. J. INT'L ENVTL. L. & POL'Y 1, 2, 4–6 (1995).

[136] *See id.* at 6; *see also* GLOBAL BIODIVERSITY STRATEGY, *supra* note 112, at 20.

[137] *See* Hey, *supra* note 135, at 6–7.

[138] *See, e.g.*, GLOBAL BIODIVERSITY STRATEGY, *supra* note 112, at 20.

[139] Karp, *supra* note 114, at 254.

V. THE BIODIVERSITY CONVENTION: AN INTERNATIONAL EMBRACE OF MARKET-BASED INCENTIVES FOR CONSERVATION

On December 29, 1993, an international legal instrument signed by more than 160 countries and ratified by approximately forty went into force with the desired effect of securing the blessings of biodiversity to the citizens of the signatory countries and their posterity.[140] That instrument, the United Nations Convention on Biological Diversity (Convention, or, Biodiversity Convention), is an international agreement designed to protect the world's biodiversity by harmonizing environmental and economic goals under the policy of sustainable development.[141] Through new international legal obligations as well as through commitments to adopt national legislation, the Convention calls upon countries to recognize the inherent and economic values of biodiversity, and to take advantage of those values by taking affirmative steps on the national and local level.[142] In this way, the challenge of the Convention resides in the individual countries to find ways to implement the ideals expressed in the articles.[143]

Prior to adopting the Convention, however, the United Nations Conference on Environment and Development (UNCED), which convened June 3–14, 1994, in Rio de Janiero, Brazil,[144] had to overcome one of the most intractable problems common to international agreements that are designed to be more than merely aspirational. UNCED had to reconcile respect for national sovereignty with the need for shared global responsibility.[145] Each individual country, even though it may be a member of the international community, cherishes its basic right of self-determination.[146] This notion of self-determination historically has included "freedom of action with regard to the natural resources found within a nation's boundaries."[147] As discussed

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[140] *See* Catherin Tinker, *A 'New Breed' of Treaty: The United Nations Convention on Biological Diversity*, 13 PACE ENVTL. L. REV. 191, 191 (1995).

[141] *See, e.g.*, David R. Downes, *Global Trade, Local Economies, and the Biodiversity Convention*, *in* BIODIVERSITY AND THE LAW 202, 202–03 (William J. Snape III ed., 1996).

[142] *See* Tinker, *supra* note 140, at 192.

[143] *See* Downes, *supra* note 141, at 203.

[144] *See* Edith Brown Weiss, *Introductory Note*, 31 I.L.M. 814 (1992) (providing background for the Biodiversity Convention and other UNCED documents).

[145] *See* Susan H. Bragdon, *National Sovereignty and Global Environmental Responsibility: Can the Tension Be Reconciled for the Conservation of Biological Diversity?*, 33 HARV. INT'L L.J. 381, 381–82 (1992).

[146] *See id.* at 382.

[147] *Id.*; *see generally* Subrata Roy Chowdhury, *Permanent Sovereignty Over Natural Re-*

earlier, biodiversity is recognized as a valuable natural resource, but it also is a resource that cannot be contained by political boundaries. A nation might be sovereign over biodiversity within its boundaries, but it also must take responsibility for conserving those resources because of the unique trans-boundary quality of biodiversity and of the global importance of biodiversity.

Countries both rich and poor in biodiversity resources have identified (in platitudes if not in practice) conservation as being in their individual self-interest.[148] Northern Hemisphere countries, generally poor in biodiversity resources but rich in technology capable of developing those resources, have an interest in conservation, because biodiversity resources offer the raw material for new medicines.[149] Southern Hemisphere countries, generally rich in biodiversity resources but poor in biotechnology and capital to acquire biotechnology, have an increasing interest in conservation because of developed countries' demand for biodiversity resources, and because of the economic growth this demand can create.[150] The common cloth of interests frays, however, over the implications of the traditional understanding of national sovereignty as including freedom of action over natural resources within a country's borders.[151] Beneath the fraying of interests is the "reality that while [biodiversity] resources are predominantly located within the territories of the South, the profits derived from their use are almost exclusively reaped by the industrialized North."[152] This is especially troublesome to developing countries, where fulfilling basic immediate needs for survival takes precedence over fulfilling long-term sustainability needs which may be difficult even to perceive when existence is at a subsistence level.[153] Thus, when it comes to how best to allocate its natural resources, including its biodiversity, a developing country that receives no share of the profit from biodiversity conserved will manage its resources so that it does profit from biodiversity exploited.[154] Self-interest demands nothing less.

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sources, in PERMANENT SOVEREIGNTY OVER NATURAL RESOURCES IN INTERNATIONAL LAW, 1–41 (Kamal Hassain and Subrata Roy Chowdhury eds., 1984).

[148] *See* Bragdon, *supra* note 145, at 388.

[149] *See id.*

[150] *See id.*

[151] *See id.*

[152] *Id.*

[153] *See* Bragdon, *supra* note 145, at 388.

[154] *See id.* at 389.

A. *Encouraging Reponsibility for Conservation and for Use*

The Biodiversity Convention is a compromise between developing and developed countries, representing their collective best efforts to reconcile the tension between national sovereignty and global environmental responsibility.[155] Article Three of the Biodiversity Convention is the provision that specifically articulates the guiding principle on the appropriate balance between national sovereignty and global responsibility.[156]

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of their national jurisdiction.[157]

This principle recognizes national sovereignty over biodiversity resources, but it also recognizes the reality that the "environment" does not stop at political boundaries.[158] Instead, Article Three appends to the right of national sovereignty a concomitant responsibility to ensure that activity taken pursuant to that right does not impinge upon the national sovereignty of any other country by, for example, harming another country's biodiversity resources.[159]

The number of countries that ultimately signed the Convention suggests success at striking this compromise.[160] The objectives stated in the Convention incorporate this compromise as a foundation for the individual articles.[161] The threefold objectives are "conservation of biological diversity, sustainable use of its components, and the fair and

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[155] *See, e.g.*, SANDS, *supra* note 35, at 49.

[156] *See* Biodiversity Convention, *supra* note 33, at 824; *see also* Bosselmann, *supra* note 35, at 135.

[157] Biodiversity Convention, *supra* note 33, at 824.

[158] *See id.*; *see also* Bosselmann, *supra* note 35, at 135; Tinker, *supra* note 140, at 195.

[159] *See id.* Article Three is a verbatim version of Principle Twenty-one of the Stockholm Conference of 1972 (which was the first United Nations Conference on the Human Environment). *See* Bosselmann, *supra* note 35, at 134–35; Tinker, *supra* note 140, at 195. Principle Twenty-one, called the "cornerstone" of international environmental law, established each country's basic individual right of national sovereignty, and placed an other-directed obligation on that country if it wants to exercise that right. *See* Sands, *supra* note 39, at 186. The Biodiversity Convention was constructed relying on this cornerstone.

[160] *See* Tinker, *supra* note 140, at 191–95.

[161] *See* Biodiversity Convention, *supra* note 33, at 823.

equitable sharing of benefits."[162] To fulfill those objectives, the Convention generally provides for the following:

> [N]ational monitoring of biological diversity, the development of national strategies, plans and programs for conserving biological diversity, national *in situ* and *ex situ* conservation measures, environmental impact assessments of projects for adverse effects on biological diversity, and national reports from parties on measures taken to implement the convention and the effectiveness of these measures.[163]

Specifically, the Convention contemplates several interrelated methods of action to accomplish its objectives.[164] First, the Convention itself is a new international legal instrument, with particular provisions for international action, and it supports a second method of action, which is implementation by individual countries of new national laws and policies designed to conserve biodiversity resources and to use those resources sustainably.[165] Third, the Convention sets up new rules for the international transfer of genetic resources.[166]

Several of the provisions are of particular importance to bioprospecting. The preamble to the Biodiversity Convention, though it does not establish binding international legal obligations, nevertheless reflects the more forward-thinking aspirations of the signatory countries.[167] The preamble recognizes the "intrinsic value of biological diversity," a first for this type of international legal instrument.[168] It also recognizes the economic value of biodiversity, another international first, thereby setting up the two rationales for conservation.[169] Article Fifteen addresses "rights and obligations regarding access to genetic [and biodiversity] resources and their subsequent use," and reaffirms national sovereignty over resources.[170] Article Fifteen calls

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[162] *Id.*

[163] *Id.* at 817.

[164] *See* Downes, *supra* note 141, at 204.

[165] *See id.*

[166] *See id.* at 204–05.

[167] *See* LYLE GLOWKA, ET AL., A GUIDE TO THE CONVENTION ON BIOLOGICAL DIVERSITY 9 (IUCN Environmental Law Center, IUCN Biodiversity Programme, World Conservation Union Environmental Policy and Law Paper No. 30, 1994) [hereinafter GUIDE TO THE CONVENTION].

[168] Biodiversity Convention, *supra* note 33, at 822; *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 9.

[169] *See* Biodiversity Convention, *supra* note 33, at 822; *see also* Victor M. Marroquin-Merino, *Wildlife Utilization: A New International Mechanism for the Protection of Biological Diversity*, 26 LAW & POL'Y INT'L BUS. 303, 324 (1995).

[170] GUIDE TO THE CONVENTION, *supra* note 167, at 76; *see also* Biodiversity Convention, *supra*

upon each country, however, to facilitate access to those resources for "environmentally sound uses."[171] Specifically, paragraph seven of Article Fifteen requires each country to take "legislative, administrative or policy measures . . . with the aim of sharing . . . the results of research and development and the benefits arising from the commercial and other utilization" of biodiversity resources.[172] Article Nineteen also requires each country to take similar measures to provide for the "effective participation in biotechnological research activities . . . especially [by] developing countries, which provide the genetic resources for such research."[173]

Several articles address financing these measures.[174] The first paragraph of Article Twenty calls upon each individual country "to provide financial support and incentives for the national measures needed to implement the Convention."[175] Paragraphs two through four call upon developed nations to provide "new and additional financial resources" to developing countries to aid them in meeting their obligations under the Convention and in benefiting from its provisions.[176]

B. *Sustainable Development: Guiding the Principles with the Policy*

The Biodiversity Convention embraces the policy of sustainable development.[177] The concept of "sustainable use," ubiquitous both explicitly and implicitly throughout the document, is defined as the "use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs . . . of present and future

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note 33, at 828. "Genetic resources" is defined as "genetic material—material of plant, animal, microbial or other origin containing functional units of heredity—of actual or potential value." Biodiversity Convention, *supra* note 33, at 824.

[171] Biodiversity Convention, *supra* note 33, at 828. Paragraph three limits the definition of "genetic resources" for the purposes of Articles Fifteen, Sixteen, and Nineteen. *See id.*

[172] *Id.*; *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 82.

[173] Biodiversity Convention, *supra* note 33, at 830; *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 96.

[174] *See* Biodiversity Convention, *supra* note 33, at 830–32 (Articles Twenty and Twenty-one), 837–38 (Article Thirty-nine).

[175] GUIDE TO THE CONVENTION, *supra* note 167, at 100; *see also* Biodiversity Convention, *supra* note 33, at 830.

[176] Biodiversity Convention, *supra* note 33, at 830; *see also* GUIDE TO THE CONVENTION, *supra* note 178, at 100.

[177] *See, e.g.*, W. Robert Ward, *Man Or Beast: The Convention On Biological Diversity and the Emerging Law of Sustainable Development*, 28 VAND. J. TRANSNAT'L L. 823, 829–30 (1995).

generations."[178] Article Six requires countries to develop "national strategies, plans or programmes," or adapt existing ones, for the "conservation and sustainable use" of biodiversity resources.[179] Moreover, Article Six requires integrating the goals of conservation and sustainable use into seemingly unrelated governmental ministries, such as transport or health ministries.[180]

The Convention recognizes implicitly that a source country cannot conserve biodiversity, let alone use it sustainably, if the country does not know what particular resources it has.[181] Identifying and monitoring the "components" of biodiversity, namely, individual species of flora and fauna, is the subject of Article Seven.[182] Article Eight calls upon countries to manage their biodiversity resources and the areas surrounding those resources, especially by establishing "a system of protected areas."[183] In doing so, it "recognizes *in-situ* conservation as the primary approach for biodiversity conservation," and suggests national legislation as the method to implement *in-situ* conservation management strategies.[184] "Article 10 is the focus of the Convention's sustainable use requirements,"[185] requiring countries to adopt measures to minimize the adverse impact on biodiversity resources from use of those resources, to protect harmless traditional cultural uses of biodiversity resources, and to encourage cooperation between government and private parties in "developing methods for sustainable use of [biodiversity] resources."[186] Article Eleven specifically calls for countries to adopt measures that would "act as incentives for the conservation and sustainable use of components of [biodiversity]."[187]

Individual countries and private parties may contract with one another, as Article Ten contemplates, to develop biodiversity resources in a sustainable manner.[188] To the extent a dispute arises between contracting parties, Article Twenty-seven expresses UNCED's

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[178] Biodiversity Convention, *supra* note 33, at 824 (Article Two).

[179] *Id.* at 825; *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 29.

[180] *See* Biodiversity Convention, *supra* note 33, at 825 (Article Six); *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 32.

[181] *See* Biodiversity Convention, *supra* note 37, at 825 (calling for identification and monitoring activities per Article Seven and Annex I).

[182] Biodiversity Convention, *supra* note 33, at 825 (Article Seven), 838 (Annex I); *see also* GUIDE TO THE CONVENTION, *supra* note 167, at 33.

[183] Biodiversity Convention, *supra* note 33, at 825 (Article Eight).

[184] GUIDE TO THE CONVENTION, *supra* note 167, at 39; *see also* Biodiversity Convention, *supra* note 33, at 825–26.

[185] GUIDE TO THE CONVENTION, *supra* note 167, at 57.

[186] Biodiversity Convention, *supra* note 33, at 826–27 (Article Ten).

[187] *Id.* at 827 (Article Eleven).

[188] *See id.* at 826–27 (Article Ten).

desire that it be resolved by alternative dispute resolution methods.[189] Negotiation is the preferred method of dispute resolution.[190] If negotiation is unsuccessful, the next preferred method is mediation.[191] If mediation fails to result in resolution, the parties then must submit their dispute to arbitration or to the International Court of Justice, depending upon which one of those two methods the country in which the dispute occurs chose at the time of ratification of the Convention.[192]

Even though the language used in the articles of the Convention—specifically, the word "shall"—is in the form of requiring countries to fulfill certain objectives,[193] the Biodiversity Convention, like most international instruments, allows for great flexibility. Many of the articles, although purporting to impose a duty upon individual countries, soften any imposition of duty with the phrase "as far as possible and as appropriate."[194] Whether bioprospecting "contributes to sustainable development[, therefore,] will ultimately depend on the effectiveness of local and national government policies for conservation and development."[195]

VI. Costa Rica: A Case Study in the Sustainable Development of Biodiversity

One nation's government that has instituted polices to ensure that bioprospecting contributes to sustainable development is Costa Rica.

A. *Conservation in the Crucible*

Costa Rica is home to approximately five percent of the world's species, even though it has only 0.035 percent of the world's land area, an area about the size of the state of West Virginia.[196] Costa Rica's climate and topography, ranging from habitats with almost desert-like

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[189] *Id.* at 834.

[190] *See id.*

[191] *See* Biodiversity Convention, *supra* note 33, at 834.

[192] *See id.*

[193] For example, Article Seven provides that a country "shall" perform some sort of biodiversity inventory, but only "as far as possible and as appropriate." Biodiversity Convention, *supra* note 33, at 825. Another example of this type of language is Article Six, requiring countries to develop plans for "conservation and sustainable use of biodiversity," but, again, only "in accordance with its particular conditions and capabilities." *Id.*

[194] *See id.* While such loophole language casts doubt upon actual enforcement of Convention provisions, it is an issue deserving in-depth discussion beyond the scope of this Comment.

[195] Reid, *New Lease*, *supra* note 11, at 9.

[196] *See* David Tenenbaum, *The Greening of Costa Rica*, Tech. Rev., Oct. 1, 1995, at 42.

conditions to tropical rainforests, and fluctuating in elevation from sea level to over 3500m, are the characteristics and conditions that created this bountiful biodiversity.[197]

Costa Rica's biodiversity also has benefited from another set of characteristics and conditions—a stable political, economic, and social order.[198] In 1948, the Costa Rican government abolished the national army, and used the resulting "peace dividend" for domestic programs such as "education, rural electrification, and health."[199] The success of this progressive policy approach adopted by successive Costa Rican governing administrations is reflected today in the relative health of the country.[200] Even though the per capita income, for example, is significantly less than that of industrialized developed nations, Costa Rica enjoys "widespread relative prosperity" producing a sense of security and self-confidence comparable to that of developed nations.[201]

Due in part to this relative prosperity, biodiversity conservation efforts spanning six governing administrations have been supported with enthusiasm by both major political parties and by private citizens.[202] Costa Rica's political, social, and economic climate has made it somewhat less susceptible to the temptation faced by other developing nations to allow the exploitation of their biodiversity resources for short-term profit.[203] Costa Rica, while less susceptible to temptation, has not been impervious to it, however.[204]

Costa Rica, as one author has noted, is "no modern-day Garden of Eden."[205] As recently as the mid-1980s, the country's tropical forests were being razed faster than in most other parts of the world.[206] In fact, the deforestation rate had reached a high of 100,000 acres per

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[197] *See* Rodrigo Gàmez et al., *Costa Rica's Conservation Program and National Biodiversity Institute (INBio), in* BIODIVERSITY PROSPECTING 53 (1993). Dr. Gàmez is the Director of the National Biodiversity Institute (INBio) of Costa Rica. *See id.* at 325.

[198] *See id.* at 54.

[199] Tenenbaum, *supra* note 196.

[200] *See id.* Costa Rica boasts a ninety-three percent literacy rate, a per capita income of US$2,000 per year, "an infant mortality rate of 21 per 1,000 (the other Central American nations report between 30 and 89 per 1,000), and a life expectancy for citizens born [in 1995] of 77.5 years, a figure that exceeds the world average by ten years." *Id.*

[201] Gàmez, *supra* note 197, at 54.

[202] *See id.*

[203] *See id.*

[204] *See* Tenenbaum, *supra* note 196.

[205] *Id.*

[206] *See id.*; *see also* Michael Milstein, *The Microbe Hunt: Costa Rica Stakes Future On Rich Value of Nature*, SAN DIEGO UNION-TRIB., Mar. 27, 1996, at E1 (noting how Costa Rica used to yield to temptation, razing its forests for short-term profit).

year.[207] Costa Rica also has not been immune to the excesses of the agricultural industry.[208] Range fires set to clear pastures for cattle grazing, pesticides used on banana plantations, and overfishing off the coast of Cocos National Park all have caused environmental problems.[209] One estimate of the financial loss to Costa Rica from failure to nurture its natural biodiversity resources is US$4.1 billion from 1970 to 1989.[210] Costa Rica now, however, is staking its "environment and its economy on the long-term value of nature."[211]

The current government, headed by president Jose Maria Figueres, has adopted a "use it or lose it" theme for its biodiversity conservation initiatives.[212] This is a less formal moniker for the policy of sustainable development, a policy which now permeates the governance of Costa Rica.[213] On Figueres' first day as president, he organized a symposium for all cabinet ministers whose activities in any way dealt with natural resources; declared his commitment to sustainable development; and asked what each ministry would do in furtherance of that policy.[214] With regard specifically to biodiversity conservation and use, Figueres has instituted several different taxes, the revenues from which go toward conservation and restoration of biodiversity-rich areas, and has exercised authority to halt environmentally harmful business development.[215]

Innovative ecosystem, habitat, and species management has been one of the most significant, and, by all accounts, successful biodiversity-related initiatives of the Costa Rican government.[216] Costa Rica is in the process of consolidating its national parks into a number of vast conservation areas designed to protect the larger ecosystems necessary for long-term species survival.[217] This process began two

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[207] *See* Tenenbaum, *supra* note 196. The rate today is down to 20,000 acres per year. *See id.*

[208] *See id.*

[209] *See id.*

[210] *Id.* (quoting economist Robert Repetto of the World Resources Institute).

[211] Milstein, *supra* note 206.

[212] Leslie Roberts, *Chemical Prospecting: Hope for Vanishing Ecosystems?*, SCI., May 22, 1992, at 1142.

[213] *See id.* Daniel Janzen, an internationally renowned biologist from the University of Pennsylvania, who has lived half of each of the past thirty years in Costa Rica, has characterized the government's level of commitment as follows: "'[Costa Rica has] become a guinea pig: If [it] fail[s], everybody will see every aspect of [the failure] as [Costa Rica] goes down in flames. If [Costa Rica] succeed[s], [its biodiversity is] all there for the world's people to use . . . .'" *Id.*

[214] *Id.* (quoting Janzen).

[215] *See id.* Examples include using revenue from a carbon tax to restore tropical forests on idle cow pastures, and "canceling a planned oil-fired electric generating facility in favor of a new geothermal plant." Roberts, *supra* note 212.

[216] *See* Tenenbaum, *supra* note 196.

[217] *See id.*

decades ago, and has resulted in approximately twenty-five percent of Costa Rica's land being set aside in this manner.[218] The consolidation into conservation areas is a more recent policy initiative, however, and boasts the 423-square-mile Guanacaste Conservation Area as a pilot project.[219] Guanacaste, about half the size of the state of Rhode Island, is home to approximately 330,000 species,[220] and is in the process of being enlarged through restoration of land that had been used for agriculture.[221] In addition, by creative cattle grazing and fire-prevention methods,[222] a closed-canopy forest is expected to return to a 700-square-kilometer area within fifty years.[223]

These conservation initiatives by Figueres' government, however, are motivated by more than biodiversity conservation for its own sake—Figueres believes in the second half of sustainable development as strongly as he believes in the first half.[224] Guanacaste and the other conservation areas "are supposed to earn a non-destructive profit from ecotourism and pharmaceutical harvesting."[225] The underlying premise is that Costa Ricans will want to conserve biodiversity-rich areas, because conservation will result in the most profitable use of the land.[226] Managing these conservation areas and facilitating the sustainable development of biodiversity resources, however, required centralized institutional support.

B. *Instituto Nacional de Biodiversidad: The Institutional Steward*

Costa Rica laid the institutional foundation for carrying out its conservation and sustainable development policies in two primary ways.[227] First, in 1986, during the administration of President Oscar Arias, Costa Rica created the Ministry of Natural Resources, Energy,

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[218] *See* Daniel H. Janzen, *A South-North Perspective on Science in the Managment, Use, and Economic Development of Biodiversity*, in CONSERVATION OF BIODIVERSITY FOR SUSTAINABLE DEVELOPMENT 32 (O.T. Sandlund et al. eds., 1992). This ranks Costa Rica second only to Ecuador "among countries with the highest proportion of nationally owned nature reserves." Tenenbaum, *supra* note 196.

[219] *See* Tenenbaum, *supra* note 196.

[220] *See id.*

[221] *See* GLOBAL BIODIVERSITY STRATEGY, *supra* note 112, at 112.

[222] *See id.* at 112. Since cattle eat grass and not tree seedlings, they continue to graze in the area, actually aiding the reforestation by reducing the tree seedlings' competition for nutrients, and allowing them to grow faster. *See id.* In addition, cattle "spread organic matter and disperse seeds." *Id.*

[223] *See id.*

[224] *See* Tenenbaum, *supra* note 196.

[225] *Id.*

[226] *See id.*

[227] *See* Gàmez, *supra* note 197, at 54.

and Mines (MIRENEM), elevating the environment to cabinet-level concern and consolidating the national parks, forestry, and wildlife services under one ministry.[228] MIRENEM's initial innovations included setting up the new National System of Conserved Areas to manage the protected wildlands, developing the government's National Conservation Strategy for Sustainable Development, and devising creative ways to finance biodiversity conservation through, for example, debt-for-nature swaps.[229]

In October, 1987, MIRENEM also established its own Biodiversity Office (which was to be the forerunner of Costa Rica's national biodiversity institute) with financial assistance from the MacArthur Foundation.[230] MIRENEM created the Biodiversity Office to develop "'a new strategy and conservation program for Costa Rica's wildlands,'" a process that engaged various individuals and institutions involved with conservation throughout Costa Rica.[231] In addition, the Biodiversity Office developed a new "conceptual framework for conservation" consisting of three tasks:

> (1) Establishing large conserved wildlands, the Conservation Areas;
> (2) Determining what biodiversity lies in these protected areas and where it is located; and
> (3) Integrating the non-destructive use of this biodiversity into the intellectual and economic fabric of national and international society.[232]

The National System of Conservation Areas accomplished the first task, but the latter two tasks called for a more unified biodiversity program than existed at that time.[233] Several regional and national meetings and conferences later, Costa Rica consolidated under one organization the fragmented biodiversity programs then in both public and private hands.[234] At a February, 1989 meeting convened by the Biodiversity Office, participants reached consensus that a national biodiversity institute should be formed to do the following:

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[228] *See id.* These latter three formerly had been under the auspices of the Ministry of Agriculture. *See id.*

[229] *See id.* at 55.

[230] *See id.*

[231] Gàmez, *supra* note 197, at 55.

[232] *Id.* at 55–56.

[233] *See id.* at 56.

[234] *See id.*

- Develop a national-level strategy and carry out an inventory of Costa Rica's biodiversity;
- Begin integrating all national collections into one physical and administrative entity;
- Centralize all information on Costa Rica's biodiversity; and
- Put this information into an easily accessible format and distribute it to the public.[235]

A presidential decree established a planning commission directed by the Biodiversity Office for the purpose of developing a national biodiversity institute.[236] The planning commission's work resulted in the creation of a "private, non-profit, public-interest association [called] 'La Asociaciòn Instituto Nacional de Biodiversidad,' or INBio." On October 24, 1989, INBio was "legally established and formally incorporated."[237]

1. Administration and Operation of INBio

A fifteen-member Assembly and a six-member Board of directors governs INBio, while a full-time administrative and scientific-technical staff and a team of dozens of "parataxonomists"[238] conduct the daily operations of the institute and its affiliated offices.[239] As a private, non-profit institution, INBio is tax-exempt, receives grants and tax-free donations of specimens and other materials, and manages its own finances[240] as well as hires its own personnel.[241]

INBio's general objective is "to promote the wise management and use of [Costa Rica's] biotic wealth through the development and distribution of information on species, genes, and ecosystems."[242] One of INBio's most important projects toward fulfilling this objective is to

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[235] *Id.* at 57.

[236] *See* Gàmez, *supra* note 197, at 57.

[237] *Id.*

[238] *See generally* Daniel H. Janzen et al., *The Role of the Parataxonomists, Inventory Managers, and Taxonomists in Costa Rica's National Biodiversity Inventory, in* BIODIVERSITY PROSPECTING 223 (1993).

[239] *See* Gàmez, *supra* note 197, at 57, 59.

[240] In order to launch INBio, three stages of fundraising were conducted. *See id.* at 58. First, from April 1989 through late 1990, US$500,000 was raised for capital costs such as land, buildings, training, and operations. *See id.* at 59. The second stage, from 1991–1992, netted US$2.5 million from a variety of national and international sources, both public and private, which INBio used for planning, infrastructure, and development. *See id.* at 59–60. The final stage is an on-going one, seeking long-term financing to sustain INBio and its major projects. *See id.* at 60.

[241] *See* Gàmez, *supra* note 197, at 58.

[242] GLOBAL BIODIVERSITY STRATEGY, *supra* note 112, at 152.

conduct a National Biodiversity Inventory (NBI).[243] The NBI is a ten-year project to develop a "taxonomically . . . organized database of the species that occur in the country, and to identify one or more localities where each occurs."[244] Some species of "conspicuous use to society" receive special emphasis in the inventory. Beyond this first level of identification and understanding, INBio hopes to "understand species' distribution, natural history, ecology, morphology, behavior, phenology, genetic variation, etc."[245] The NBI begins from a pre-existing base of knowledge and collection of specimens accumulated over the past century by a "wide variety of national and international conservationists and biologists."[246] An initial objective of the NBI is to gather the pre-existing information and integrate it with the organized national inventory.[247] Costa Rica contains approximately "13,000 species of plants, 10,000 fungi, 1,500 vertebrates, 290,000 species of insects, 75,000 species of aquatic organisms . . . 15,000 marine invertebrates, up to 50,000 spiders, mites, and other terrestrial invertebrates, as many as 10,000 nematodes," and as many as 50,000 varieties of bacteria and viruses.[248] Only about twenty percent of these approximately 500,000 species have been named and described.[249]

2. The Mission of INBio

A primary premise to the mission of INBio is that biodiversity will be conserved only if the areas to be protected generate enough intellectual and economic income to sustain conservation efforts and to offset revenue foregone from other potential uses.[250] One way to generate this kind of intellectual and economic income is through bio-

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[243] *See* Gàmez, *supra* note 197, at 60–61. Formally,

> INBio's immediate objectives are to: Undertake a total inventory of the biodiversity of Costa Rica between 1993 and 2003; Place that information in a computerized and physical format that Costa Ricans and others will find easy to use; Insure the preservation into perpetuity of the National Biodiversity Inventory Collections resulting from this activity; Facilitate access by national and international users to information related to Costa Rica's wildland biodiversity; and greatly increase local 'biological literacy' by providing information and fostering use.

Id.

[244] *Id.* at 62.

[245] *Id.*

[246] *Id.* at 61.

[247] *See* Gàmez, *supra* note 197, at 61.

[248] *Id.* at 61–62.

[249] *See id.* at 62.

[250] *See* Ana Sittenfeld & Rodrigo Gàmez, *Biodiversity Prospecting By INBio*, *in* BIODIVER-

prospecting. An "express goal" of INBio is to use bioprospecting to "generat[e] income from Costa Rica's conservation areas so as to contribute to Costa Rica's wildland management costs," as well as to the country's GNP.[251]

Profiting from biodiversity resources in this way is conditioned on the Costa Rican government's assertion of property rights over the resources.[252] Intellectual property rights for "improved genetic and biochemical resources" have existed for decades.[253] Ownership interests in unimproved genetic resources, however, traditionally have been understood in the context of the "common heritage doctrine."[254] The essence of the common heritage doctrine is that wild species are considered "ownerless, open-access resource[s]."[255] Bioprospecting involves "wild resources with commercial potential," placing the collected specimens somewhere in between an intellectual property rights system and a property rights system based on the common heritage doctrine.[256] To accommodate the type of resource valuable to bioprospecting, the Biodiversity Convention affirms a country's national sovereignty over its biodiversity resources.[257] The Convention also asserts, however, that source countries are obliged to facilitate access to their biodiversity resources, while all countries—owners of biodiversity resources as well as beneficiaries—are obliged to share the economic benefits from biodiversity.[258] It is on this basis that INBio, vested with authority over Costa Rica's biodiversity-rich Conservation Areas, has been able to halt what had been a one-way bioprospecting process, and transform the process into a two-way

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SITY PROSPECTING 69 (1993). Dr. Sittenfeld is the Director of the Division of Biodiversity Prospecting at INBio. *See id.* at 326.

[251] *Id.* at 69.

[252] *See* Ian Walden, *Intellectual Property Rights and Biodiversity, in* INTERNATIONAL LAW AND THE CONSERVATION OF BIOLOGICAL DIVERSITY 171, 181 (Michael Bowman & Catherine Redgwell eds., 1995). Property rights with respect to biodiversity is a subject deserving a more comprehensive discussion than can be provided here, but must be recognized as a significant issue.

[253] Reid, *New Lease, supra* note 11, at 19.

[254] *Id.* at 19, 23.

[255] *Id.* at 19.

[256] *Id.* at 19.

[257] *See* Biodiversity Convention, *supra* note 33, at 824; *see also* Reid, *New Lease, supra* note 11, at 24.

[258] *See* Biodiversity Convention, *supra* note 33, at 828; *see also* Reid, *New Lease, supra* note 11, at 24.

commercial exchange, allowing Costa Rica as the source country to profit from its natural biodiversity resources.[259]

In addition to profiting from facilitating the commercial transfer of biodiversity resources in a non-destructive manner, INBio also is able to profit from the value it can add to a party's bioprospecting efforts.[260] The NBI and the trained INBio staff transform haphazard bioprospecting into an efficient, organized, and focused endeavor.[261] This type of arrangement has been captured in contractual relationships between INBio and parties such as pharmaceutical and biotechnological companies interested in utilizing Costa Rica's biodiversity resources.[262] Significantly, INBio is "fully empowered [by the Costa Rican government] to enter into contracts and agreements with national and international institutions and individuals."[263]

VII. BIOPROSPECTING CONTRACTS

In September, 1991, INBio and U.S.-based pharmaceutical company Merck, Sharp and Dohme, Inc. (Merck) entered into a landmark two-year contractual relationship anchored on sustainably developing Costa Rica's rich biodiversity resources through bioprospecting.[264] Under the terms of the deal, which the parties renewed in 1993[265] and again in 1996,[266] INBio provides Merck with "chemical extracts from wild plants, insects, and micro-organisms" primarily, but not exclusively, from Costa Rica's conservation areas.[267] Using these chemical extracts, Merck hopes to develop—or find clues that will lead to developing—a new medicine.[268] In exchange, Merck paid INBio an up-front fee of US$1 million, donated US$135,000 worth of equipment for use in chemical extraction, and sent two natural products chemists to set up the facilities necessary for chemical extraction and to

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[259] *See* Sittenfeld & Gàmez, *supra* note 250, at 70–71.

[260] *See id.*

[261] *See id.* at 76–78.

[262] *See, e.g.*, Laird, *supra* note 9, at 99.

[263] Gàmez, *supra* note 197, at 58.

[264] *See, e.g.*, Jim Detjen, *Company's Accord On Rain Forests Could Be Model for Preservation*, PHILA. INQUIRER, Sept. 20, 1991, at A01; Reid, *New Lease*, *supra* note 11, at 1.

[265] *See id.*

[266] *Gene Prospecting for the Sustainable Use of the Biodiversity in Costa Rica*, GENETIC ENGINEERING NEWS, Apr. 1, 1996 (page unavail.) [hereinafter *Gene Prospecting*].

[267] Reid, *New Lease*, *supra* note 11, at 1; *see also* Julia Preston, *A Biodiversity Pact with a Premium*, WASHINGTON POST, June 9, 1992, at A16; Detjen, *supra* note 264.

[268] *See id.*

train INBio scientists in the extraction process.[269] In addition, INBio will receive a royalty from any commercially marketable drug developed from a compound it provides.[270] Although the percentage of the royalty is confidential, it is widely believed to be between one and three percent of net sales.[271] Because drug development usually takes as long as ten to fifteen years, and costs between US$300 and 400 million, the possibility of a royalty obviously is considered a long-term, prospective benefit of the contract.[272] Merck has succeeded in the past with natural product drug development, however; the multimillion-dollar cholesterol-lowering drug Mevacor, for example, is derived from a microbial extract from soil.[273]

INBio and Costa Rica benefit in several other ways from this contract. One is that the relationship with Merck is non-exclusive in that INBio is permitted to enter into agreements with other pharmaceutical companies, or other parties interested in gaining access to Costa Rica's biodiversity.[274] A second is that ten percent of the up-front fee and fifty percent of any royalties go to the Costa Rican government's National Park Fund to support conservation efforts.[275] This aspect of the relationship is significant, because it implies that conservation of the biodiversity resources is valuable in the market.[276] Contracts that create a demand for species samples also create collection-related jobs for Costa Ricans, a third, indirect benefit.[277] Although less tangible than the above benefits, this deal also has generated positive public relations for Merck; in 1993, the National Wildlife Federation bestowed its Environmental Achievement Award upon Merck for its work toward sustainable development as represented by its relationship with INBio.[278]

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[269] *See* Roberts, *supra* note 212; *see also* Michael D. Coughlin, Jr., Note, *Using the Merck-INBio Agreement To Clarify the Convention on Biological Diversity*, 31 COLUM. J. TRANSNAT'L L. 337, 356 (1993).

[270] *See* Roberts, *supra* note 212.

[271] *See id.*

[272] *See* Maricel Sequeira, *Environment: Biodiversity-Rich Costa Rica Takes Stock*, Inter Press Serv., May 12, 1996 (page unavail.).

[273] *See* Roberts, *supra* note 212.

[274] *See id.* (noting Merck's right of first refusal regarding samples, and INBio's relationships with other parties).

[275] *See Pharmaceutical Companies Go 'Chemical Prospecting' for New Medicines*, *supra* note 28; *see also* Reid, *New Lease*, *supra* note 11, at 1.

[276] *See* Sam Thernstrom, *Bio-diversity*, MONTREAL GAZETTE, Apr. 10, 1993, at B6.

[277] *See* Roberts, *supra* note 212.

[278] *See Merck Biodiversity Effort Wins NWF Award*, ENV'T WK., Feb. 4, 1993 (page unavail.).

Capitalizing on the positive exposure from its relationship with Merck, INBio since has entered into contractual relationships with other companies. In 1996, for example, INBio entered into an agreement with Recombinant BioCatalysis, Inc. (RBI), of Sharon Hill, Pennsylvania, to develop "genetic libraries from microbes acquired through environmental samples."[279] RBI plans to screen the "genetic library" for enzymes that may have industrial uses, while INBio will learn recombinant DNA research from RBI scientists.[280]

Because of the demand for samples as well as the enormous scope of the National Biodiversity Inventory, INBio entered into a different sort of contractual arrangement with Intergraph Corporation of Huntsville, Alabama.[281] Under the agreement, Intergraph and INBio are developing a computerized Biodiversity Information Management System (BIMS) for INBio to allow it to process the geographic and taxonomic information on all the species it gathers over the course of the inventory.[282] Intergraph is contributing U.S.$750,000 worth of "hardware, software, training and systems integration services," and INBio is contributing "what [Intergraph and INBio] describe as its 'experience and vision in conserving biodiversity through information management.'"[283] The in-kind compensation by Intergraph includes "customization and installation of the [software] system, the training of two INBio staff members, and software upgrades and hardware maintenance over 18 months."[284] This arrangement ultimately will provide INBio with technological sophistication in the form of a computerized database[285] which will enhance its ability to attract more requests for species samples due to the professional service it can provide, moving INBio closer to self-sufficiency. Thus, the international attention INBio attracted through its contract with Merck already has facilitated INBio's goals of conservation and sustainable use; INBio has been able to garner more bioprospecting contracts as well as to offer value-added bioprospecting through high technology.[286]

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[279] *Gene Prospecting, supra* note 266.

[280] *Id.*

[281] *See Biodiversity System Set for Costa Rica,* NEW TECH. WK., May 3, 1993 (page unavail.); *see also* Gàmez, *supra* note 197, at 63–65.

[282] *See* Gàmez, *supra* note 197, at 64.

[283] *Biodiversity System Set for Costa Rica, supra* note 281.

[284] Gàmez, *supra* note 197, at 64.

[285] *See id.*

[286] *See id.* at 63.

As the Merck-INBio deal illustrates, a private contract is one way to establish a legal framework within which bioprospecting can be conducted.[287] The parties to a typical bioprospecting contract are the source-country collector of biological samples and a pharmaceutical or biotechnology company desiring supplies of such samples for research.[288] Source-country collectors such as INBio "collect, taxonomically identify, and ship to soliciting companies a supply of samples for screening."[289] In return, companies generally pay a fee to collectors, as well as promise a royalty on proceeds from any drug that the company may develop from one or more of the samples provided by the collector.[290] An alternative arrangement is where the collector serves as an intermediary between the pharmaceutical company and a third party which does the actual collection work, known as an in-country collaborator.[291] An in-country collaborator may be a botanical or scientific institution, or, less likely, the collaborator may be a private individual or business.[292] While the collector will have a formal legal relationship with a company, the collector likely will have only an informal relationship with an in-country collaborator.[293] The particular terms of bioprospecting contracts will depend, of course, on the facts and circumstances of the proposed relationship.[294] There are, however, other general provisions that parties should consider.

A. *Primary Issues to Resolve by Contract: Access, Supply, and Enforcement*

One issue parties should consider providing for contractually is access to biodiversity resources, particularly with respect to any source country regulation of access.[295] A company may be able to contract for the actual biological samples, or only for extracts of those samples.[296] This likely will depend on how the source country government exercises its sovereignty over the biodiversity resources within its boundaries in light of the Biodiversity Convention.[297]

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[287] *See, e.g.*, Laird, *supra* note 9, at 99.
[288] *See id.*
[289] *Id.* at 100.
[290] *See id.*
[291] *See id.* at 107.
[292] *See* Laird, *supra* note 9, at 107.
[293] *See id.*
[294] *See* Rubin & Fish, *supra* note 16, at 37.
[295] *See id.* at 37–38.
[296] *See id.* at 37.
[297] *See id.* at 38.

A second major issue that should be subjected to contract is sample supply.[298] Pharmaceutical companies are interested in both quality and availability of the samples.[299] Quality samples that come from a stable supply are found more often in institutions whose collectors are skilled scientifically and taxonomically.[300] The desire on the part of the companies for trained collectors and for an infrastructure to ensure the future delivery of the same or similar samples has resulted in species collection being conducted by non-profit institutions.[301] In addition to selection of the collector, actual collection of the samples is also important.[302] Three primary methods of collection are comprehensive,[303] ethnobotanical,[304] and combined.[305] A contract likely will specify what methods may be used.[306]

Compensation for sample supply can take many forms, both monetary and non-monetary.[307] Monetary compensation includes providing for advance payments and royalties provisions, mentioned above.[308] Non-monetary compensation may be in the form of technology transfer to the source country or to a representative institution,[309] but more creative possibilities exist.[310] Consider the following:

> [P]rovision of health care and medicine, education and related material, training in collection and specimen-identification techniques, screening and other aspects of drug discovery, sharing of lab results, opportunities to be co-authors of publications, herbarium specimens for national and local herbaria, contributions to institutional infrastructure, development of field guides and databases, field equipment, botanical literature, academic exchanges, research exchanges with contracting companies, research on source country diseases, and the distribution of drugs at cost in countries of collection.[311]

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[298] *See id.* at 37.

[299] *See* Laird, *supra* note 9, at 106.

[300] *See id.*

[301] *See id.* at 105–06. That is not to say that the institutions do not rely on individuals; they do. *See* Rubin & Fish, *supra* note 16, at 38.

[302] *See* Rubin & Fish, *supra* note 16, at 38.

[303] As the name suggests, this method provides access to, for example, all flowering plants. *See id.* at 39.

[304] This method is "directed by the knowledge of indigenous and local peoples." *Id.*

[305] This method is a combination of the first two, in that the ethnobotanical knowledge defines the degree of comprehensiveness. *See id.* at 40.

[306] *See id.* at 38.

[307] *See* Laird, *supra* note 9, at 108–16.

[308] *See id.* at 108.

[309] *See id.* at 114; *see also* Calestous Juma with Bernard Sihanya, *Policy Options for Scientific and Technological Capacity-Building, in* BIODIVERSITY PROSPECTING, 199, 199–219 (1993).

[310] *See* Laird, *supra* note 9, at 114.

[311] *Id.*; *see also* Rubin & Fish, *supra* note 16, at 53.

Bioprospecting agreements also should "create incentives for sustainable use and conservation of biodiversity . . . ."[312] This raises a related issue that should be decided by contract: how conservation of biodiversity will be achieved, both for the ecological value of conservation, and for the utilitarian value of sample species availability in the future.[313] "Most existing contractual agreements between companies and collectors, however, include few explicit provisions for the conservation of biodiversity."[314] Instead, conservation is encouraged indirectly through the promise of possible future financial gain from species re-collection and from solicitations for new sets of samples.[315] Some commentators have suggested more direct conservation incentives be included in the contract.[316] Others have suggested that the anticipated revenue from existing and future bioprospecting contracts provides sufficient incentive to conserve biodiversity.[317] A final issue contracting parties should address explicitly is the method of enforcement of the terms of the agreement.[318] The Biodiversity Convention encourages use of alternative dispute resolution methods.[319]

B. *Financing Sustainable Development*

Two innovative contractual methods of financing sustainable development by source countries deserve special mention. Material transfer agreements and debt-for-nature swaps can help developing countries make an initial commitment to conserving their biodiversity resources, and also can provide the technology and financial incentive to sustain that commitment.

A material transfer agreement (MTA) is a contract by which biotechnology and biological material are shared for mutual benefit.[320] An MTA can be a freestanding contract, or it can be incorporated as part of the compensation arrangement in a comprehensive bioprospecting contract.[321] Either way, this contractual arrangement is

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[312] Rubin & Fish, *supra* note 16, at 32.

[313] *See id.* at 55; Laird, *supra* note 9, at 123.

[314] Laird, *supra* note 9, at 124.

[315] *See* Rubin & Fish, *supra* note 16, at 55.

[316] *See, e.g.*, Laird, *supra* note 9 at 124.

[317] *See id.*

[318] *See* Rubin & Fish, *supra* note 16, at 57.

[319] *See id.*

[320] *See* Daniel M. Putterman, *Model Material Transfer Agreements for Equitable Biodiversity Prospecting*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 149, 150–51 (1996).

[321] *See, e.g.*, Laird, *supra* note 9, at 114.

itself one way of implementing Article Sixteen of the Biodiversity Convention, calling for facilitating access to and transfer of biotechnology[322]

A second contractual relationship that facilitates the commingling of economic incentives with biodiversity conservation incentives is a "debt-for-nature swap."[323] The basic structure of a debt-for-nature swap is as follows: Public or private actors, usually in developed countries, purchase developing country debt on the secondary market.[324] "The purchaser then trades its right to repayment of the debt for a commitment on the part of the developing nation to protect . . . the environmentally vulnerable lands within its territory."[325] The rationale for these exchanges is to stop developing countries from wastefully exploiting their biodiversity resources by recognizing their need to replace conservation-related income loss with economic benefits of some type.[326] Costa Rica is one country that has benefited from this type of exchange.[327] By March 1990, World Wildlife Fund - US, The Nature Conservancy, The Netherlands, Sweden, and others had acquired Costa Rican debt worth a total of $79,253,631.[328] Being financially unburdened in this way was part of what allowed Costa Rica's government, as mentioned, to "bet its entire economy on biodiversity conservation."[329] While some have criticized these exchanges,[330] debt-for-nature swaps have proven to be beneficial among developing countries.[331]

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[322] *See* Biodiversity Convention, *supra* note 33, at 829 (Article 16). *See* Putterman, *supra* note 320, at 156–69 (proposing model MTAs).

[323] *See, e.g.*, Catherine A. O'Neill & Cass R. Sunstein, *Economics and Environment: Trading Debt and Technology for Nature*, 17 COLUM. J. ENVTL. L. 93, 93 (1992); Maurizio Levi Minzi, Note, *The Pied Piper of Debt-for-Nature Swaps*, 14 U. PA. J. INT'L BUS. L. 37, 37–38 (1993).

[324] *See* O'Neill & Sunstein, *supra* note 323, at 107, 109.

[325] *Id.* at 109.

[326] *See id.* at 97, 103.

[327] *See id.* at 108.

[328] *See id.*

[329] Tenenbaum, *supra* note 196. Bolivia provides another example. *See* Minzi, *supra* note 323, at 49. In 1987, Conservation International (CI) purchased approximately US$650,000 of Bolivian debt. *See id.* CI then canceled the debt in exchange for the Bolivian government's protection of the 334,000-acre Beni Biosphere Reserve, as well as of a nearby regional park and water basin, a 3,870,561-acre forest reserve, and for the establishment of a management and protection fund for the biosphere. *See id.* at 49–50.

[330] *See* O'Neill & Sunstein, *supra* note 323, at 112–18 (articulating common criticisms).

[331] *Id.* at 121.

VIII. Building the Contractual Framework

Conserving raw medicinal materials with which scientists are presently familiar and with which scientists hope to become familiar must be a primary motivation for protecting the world's biodiversity. A legal framework which simultaneously encourages conservation and sustainable use of biodiversity (the source of raw medicinal materials) must be constructed in order to accomplish that objective. That legal framework can be held together only by the mortar of sustainable development and its three interconnected components: saving, knowing, and using biodiversity.[332] Yet, bioprospecting for raw medicinal materials occurs today in a "policy vacuum."[333] To construct a sturdy and finished legal framework in that vacuum, then, we must integrate experiences with existing methods of sustainable development. The international legal principles articulated in the Biodiversity Convention should form the foundation.[334] Next, individual countries, particularly those rich in biodiversity resources, each should establish its own national biodiversity institute modeled in form and function on Costa Rica's INBio.[335] Finally, both biodiversity-rich countries—relying on their national biodiversity institutes—and parties seeking access to biodiversity resources should enter into contractual relationships designed to facilitate the conservation and the use components of sustainable development.[336]

A. *The Biodiversity Convention: Foundation of Law and Policy for Bioprospecting Contracts*

Developed countries and others can bemoan the destruction of biodiversity-rich tropical rainforests, but until the countries which are sovereign over biodiversity-rich areas receive financial incentives to conserve those areas, biodiversity destruction will continue.[337] Sustainable development is a policy that accepts this reality by seeking to align economic incentives with biodiversity conservation.[338] Relying on economic incentives to promote biodiversity conservation is an

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[332] *See* Janzen, *supra* note 218, at 27–28 (discussing these three steps in the process of biodiversity conservation).

[333] Reid, *New Lease*, *supra* note 11, at 2.

[334] *See supra* notes 140–95 and accompanying text.

[335] *See supra* notes 227–63 and accompanying text.

[336] *See supra* notes 104–39, 264–331 and accompanying text.

[337] *See, e.g.*, Marroquin-Merino, *supra* note 169, at 316–17.

[338] *See* McNeely, Economics and Biological Diversity, *supra* note 47, at 40.

explicit rejection of morality as an alternative incentive for conservation. The morality incentive states that "all forms of life warrant respect, regardless of their worth to people," and therefore should be conserved as a matter of moral virtue.[339] The morality incentive denies, however, the reality of developing nations: Developing nations must rely on the wealth they have, which is often natural resource wealth, in order to meet the needs of the people and their government.[340] Morality may be an adequate rationale to act against human rights abuses. As applied in this instance, however, morality would require an impenetrable fence built around biodiversity-rich areas, effectuating a different kind of human rights abuse by depriving developing countries of the use of their own natural resources by which they sustain themselves. The international community, therefore, embraced an economic-incentive-based view on biodiversity conservation.[341]

The United Nations Convention on Biological Diversity adopts international legal principles which legitimize this economic approach to biodiversity conservation.[342] Recall that Article Eleven provides that each country "shall . . . adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity."[343] Article Fifteen then obliges countries to "shar[e] in a fair and equitable way the results of research and development and the benefits arising from the commercial . . . utilization" of biodiversity resources.[344] Article Eleven's call for economic incentives for sustainable development and Article Fifteen's requirement for sharing benefits from sustainable development together indicate that the Convention contemplates compensation for biodiversity resources.[345] With Article Fifteen's reaffirmation of national sovereignty over biodiversity resources, individual countries should act affirmatively to avail themselves of the new market in biodiversity resources created by the Convention.

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[339] *See* McNeely, *Biodiversity Crisis*, *supra* note 51, at 15, 16.

[340] *See* Marroquin-Merino, *supra* note 169, at 320, 322.

[341] *See* Biodiversity Convention, *supra* note 33, at 826–27 (Articles Ten and Eleven).

[342] *See* Marroquin-Merino, *supra* note 169 at 324.

[343] Biodiversity Convention, *supra* note 33, at 827.

[344] *Id.* at 828; *see also* Karen Anne Goldman, Note, *Compensation for Use of Biological Resources Under the Convention on Biological Diversity: Compatibility of Conservation Measures and Competitiveness of the Biotechnology Industry*, 25 LAW & POL'Y INT'L BUS. 695, 708 (1994) (noting that Article Fifteen provides the basis for compensation).

[345] *See* Goldman, *supra* note 344, at 708.

Even though international agreements such as this one tend toward the general and the aspirational, this Convention should not be cast aside as just another hortatory international document. It is, instead, a useful instrument of "nonbinding international 'soft law,'"[346] calling upon countries to develop their own biodiversity conservation strategies and enact their own legislation designed to allow them to benefit economically from biodiversity.[347] One author has called the Convention a "'menu' of best practices," which governments of individual countries may adapt to their unique needs, and may rely upon for guidance in formulating national policies and strategies.[348] The next logical step, then, is for individual countries to build upon the foundation of the Convention by erecting institutional structures to capitalize economically on biodiversity resources.

B. *The Individual Importance of a National Biodiversity Institute*

Pedanius Dioscorides of Anazarbus, in Cilicia, a Greek physician who lived in the first century A.D., has been called the first medical botanist.[349] One of Dioscorides' earliest prescriptions was to use juice obtained from the white willow as a method of treating gout.[350] Eighteen hundred years later, chemists discerned that a compound called salicin was responsible for the "analgesic effects" of willow juice.[351] They then were able to modify salicin into salicylic acid, which proved to be effective against skin diseases.[352] Salicylic acid could not be taken internally, however, until 1899, when German chemists modified it further into acetylsalicylic acid—more popularly known as aspirin.[353] Two lessons can be learned from this brief history of aspirin. First, even though bioprospecting for medicinally valuable plants has been going on for centuries, understanding fully all the medicinal uses to

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[346] Lee A. Kimball, *The Biodiversity Convention: How To Make It Work*, 28 VAND. J. TRANSNAT'L L. 763, 766 (noting that "many international legal obligations in the environmental field are fairly general, with few international means for enforcement"). "Soft law" consists of rules "which are not legally binding per se but which . . . point[] to the likely future direction of formally binding obligations[,] . . . informally establish[] acceptable norms of behaviour, and . . . reflect[] rules of customary law." SANDS, *supra* note 35, at 103. "Hard law" establishes "legally binding obligations." *Id.*

[347] *See* Tinker, *supra* note 140, at 202–03.

[348] Kimball, *supra* note 346, at 766.

[349] *See* JOYCE, *supra* note 69, at 12–13.

[350] *See id.* at 13.

[351] *Id.* at 13–14.

[352] *See id.*

[353] *See id.* at 14.

which plants may be put is a continual, rather than a finite, process.[354] Second, that process often includes cycles of discovery, neglect, and rediscovery.[355] Drawing upon examples of bioprospecting mentioned earlier, a third lesson is that flora and fauna may not always survive for this process to run its recurring course.[356] Countries seeking to build on the Biodiversity Convention's foundation should understand these lessons to require a full commitment to sustainable development of biodiversity resources.

Establishing a national biodiversity institute modeled in form and in function on Costa Rica's INBio should be the first part of that commitment.[357] A national biodiversity institute should be characterized by its ability to perform three basic functions. First, it should be able to *save* "representative samples" of biodiversity resources as well as the ecosystems of which they are part.[358] That is, a national biodiversity institute should have the capability to collect and to store samples of individual species, but it also should have the conservation management capability to "save" the habitats and ecosystems in which those species live. Second, a national biodiversity institute should be able to *know* what the biodiversity resources are, and where they can be found.[359] This requires botanical, biological, and taxonomic knowledge on the part of employees of the institute, as well as basic data management capabilities on the part of the institute itself. (This sort of sophisticated knowledge of biodiversity adds value to basic sample collection, and allows an institute to command greater compensation for its services.) Third, the institute should be able to *use* biodiversity "non-destructively for societal aims."[360] A condition precedent to this characteristic function is that such an institute should be vested with a degree of autonomy in relation to the government which establishes it.[361] An institute's relative autonomy would insulate biodiversity conservation efforts from political whim, and would facilitate the commercialization of biodiversity. An autonomous institute would be able to enter into bioprospecting contracts with

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[354] *See* JOYCE, *supra* note 69, at 13.

[355] *See id.*

[356] Recall, for example, NCI harvesting Kenya's *Maytenus buchananni* into extinction. *See supra* notes 83–84 and accompanying text.

[357] *See generally* Gàmez, *supra* note 197, at 53; Sittenfeld and Gàmez, *supra* note 250, at 69.

[358] Reid, *New Lease*, *supra* note 11, at 28; *see* Janzen, *supra* note 218, at 28, 30–24.

[359] Reid, *New Lease*, *supra* note 11, at 28; *see* Janzen, *supra* note 218, at 28, 34–30.

[360] Reid, *New Lease*, *supra* note 11, at 28; *see* Janzen, *supra* note 218, at 28, 40–51.

[361] *See* Gàmez, *supra* note 197, at 58; *see also supra* note 263 and accompanying text.

parties seeking access to a country's biodiversity resources without, for example, suffering under the perceived management inefficiencies of governments.

C. *Drafting the Bioprospecting Contract*

Once a national biodiversity institute is established, and vested with legal autonomy, the second part of a full commitment to sustainable development of raw medicinal materials should be for the institute to enter into contractual relationships with parties seeking access to those resources. Other methods exist which seek to address the issue of access to biodiversity, such as selling use permits,[362] or creating an intellectual property rights scheme.[363] To accomplish the objective of conserving and using raw medicinal materials sustainably, however, the method facilitating access should have the following three conditions. First, there should be continuity of control over biodiversity resources. Second, the source country must have a vested economic interest in conservation. Third, parties seeking access must be accountable for their bioprospecting-related actions. Contracts, moreso than any other method, can help create and reenforce these three conditions.

First, contracts can maintain continuity of control over biodiversity resources. The Convention on Biological Diversity recognizes continuity of control as a goal, by reasserting the prominence of the international legal principle of national sovereignty over biodiversity resources.[364] The Convention also implicitly recognizes that developing nations often have been frustrated in their attempts to exercise national sovereignty over their own resources.[365] A contract would facilitate the exercise of national sovereignty over biodiversity resources, because one contracting party—the national biodiversity institute—retains ultimate ownership over resources. Selling the ownership rights to a species, or to a habitat, on the other hand, makes biodiversity a transferable commodity, subject to further resale. With

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[362] *See, e.g.*, Daniel H. Janzen et al., *Research Management Policies: Permits for Collecting and Research in the Tropics, in* BIODIVERSITY PROSPECTING 131, 133 (1993).

[363] *See, e.g.*, Michael A. Gollin, *An Intellectual Property Rights Framework for Biodiversity Propsecting, in* BIODIVERSITY PROSPECTING 159 (1993).

[364] *See* Biodiversity Convention, *supra* note 33, at 824 (Article Three); *see also* Bosselmann, *supra* note 35, at 135.

[365] For example, because of the economic realities of developing countries, national sovereignty often is sacrificed to timber or agricultural interests in order to generate income. *See* Bragdon, *supra* note 145, at 389.

each change in ownership comes a change in stewardship. Not all owners will perceive conservation to be in their best interest. A national biodiversity institute which enters into multiple contracts must engage in wise stewardship of biodiversity, or risk defaulting on, for example, an agreement to provide a continuous supply of a certain species. Contracts reward this desirable type of control.

Second, the source country must have a vested interest in conservation. One of the major premises of the policy of sustainable development (and of the Convention, which embraced this policy) is that biodiversity resources will not be developed in a sustainable manner unless the source country stands to benefit financially from conservation.[366] Selling ownership rights or use permits to biodiversity are passive approaches to resource management which remove the sense of responsibility that comes with ownership. Those approaches, moreover, offer only a one-time financial gain which, if a drug ultimately is developed, will prove to be inadequate compensation. Compensation packages, therefore, can help countries identify conservation as in their best interest. Contracts with terms specifying that money be used for conservation also can specify that a government receive a percentage of the compensation paid to the national biodiversity institute to enhance the government's other conservation-related efforts.[367] Moreover, natural product drug development knows no end as long as there are natural products from which drugs may be developed. This provides source countries with bargaining power, obviating the need for a quick financial fix. A contract term providing compensation for continued sample supply is one way contracts can provide a financial reward for conservation.

Third, contracts can force accountability on parties seeking access to biodiversity resources. If pharmaceutical companies, for example, were allowed to bioprospect with no check on their activity, the companies' prospecting teams might run roughshod over sensitive ecosystems, with little regard for much more than extracting the samples they wanted to extract in the quantities they desired. Unrestricted bioprospecting would result in continued species depletion or obliteration, habitat wreckage, and ecosystem imbalance. Requiring a

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[366] *See, e.g.*, Marroquin-Merino, *supra* note 169, at 316–17; MCNEELY, ECONOMICS AND BIOLOGICAL DIVERSITY, *supra* note 47, at 40.

[367] *See supra* notes 269–71 and accompanying text. Even though Merck does not pay Costa Rica directly, payment to the government-affiliated INBio achieves the desired effect of compensating the country.

company to contract with a party—a national biodiversity institute—whose mission is conservation would help to ensure that biodiversity resources would not be subjected to harmful bioprospecting methods.

A contractual relationship designed to promote sustainable bioprospecting does present potential problems, however. One problem would be if a source country is unable to establish a national biodiversity institute with the form and function—and degree of autonomy—of INBio.[368] Not having such an institute could undermine the condition of continuity of control.[369] Second, even if a national biodiversity institute exists and does enter into a contract with a pharmaceutical company, whether the terms of the contract could be enforced in the event of a breach is uncertain.[370] Parties at least should incorporate into their contract the alternative dispute resolution methods of enforcement articulated in Article Twenty-seven of the Biodiversity Convention.[371] A third problem arises out of the commercialization of biodiversity resources. Commodifying species or samples of species through contracts may exacerbate the problem of biopiracy.[372] Mitigating the threat of biopiracy, however, is the very process itself of natural product drug development.[373] One sample is useful in preliminary screening, but as raw medicinal material passes through successive clinical trials, a steady supply of the species sample is required.[374] Biopirates are unlikely to have the capability to sustain the supply over several years, let alone the decade that it takes for some natural products to be developed into marketable pharmaceuticals. Pharmaceutical companies and others simply are unlikely to bear the risk of an evaporating species supply.

A private contract between a national biodiversity institute and a party seeking access to biodiversity resources is the best way to facilitate the transfer of money and technology to biodiversity-rich countries so that raw medicinal materials will be conserved for present and future use. As has been demonstrated, bioprospecting contracts are one of the "most promising form[s]" of investment in biodiversity conservation, offering "substantial economic benefits" for all

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[368] *See supra* notes 227–63 and accompanying text.

[369] *See supra* notes 293–317 and accompanying text.

[370] *See* Laird, *supra* note 9, at 101 (noting that contracts of this type can prove "expensive and difficult to . . . enforce").

[371] *See* Rubin & Fish, *supra* note 16, at 57.

[372] *See supra* notes 86–103 and accompanying text.

[373] *See supra* notes 76–82 and accompanying text.

[374] *See* Reid, *Biodiversity and Health*, *supra* note 113.

parties.[375] The agreement between Merck and INBio illustrates the mutual economic benefit that can be achieved through contracts.[376] It also illustrates the market value of conservation management of biodiversity resources.[377] Of course, not all contracts will turn out as positively as the Merck-INBio deal has. The success of each contact will depend upon the particular facts and circumstances of the situation.

Bioprospecting contracts should contain, however, at least the following terms in order to align economic incentives with sustainable development practices. First, the party seeking access to biodiversity resources should "pay[] a flat fee" to the national biodiversity institute "to finance the protection of specific habitats and the collection of plant and animal species."[378] A flat fee allows an institute to profit immediately off of its conservation efforts. Second, the party seeking access should arrange financing for the purchase of technological equipment by the institute, or should include the transfer of technological equipment as part of the compensation package.[379] This would serve two purposes. An institute based in a developing nation would receive technological equipment which it otherwise may not have the capability to purchase. In-kind compensation of this type also would add value to an institute's bioprospecting efforts once the institute staff became proficient with the equipment. Third, the party seeking access should train or provide funding for the training of local scientists, technicians, taxonomists, and other skilled or semi-skilled workers involved with bioprospecting.[380] The second and third terms are, in effect, an investment in the institute, on which a pharmaceutical company can expect a reasonable return in the form of enhanced bioprospecting capabilities. Fourth, the company should agree to provide a royalty to the national biodiversity institute in the event that a drug derived from one of the samples reaches market.[381]

A national biodiversity institute also should have certain obligations under a contract. These obligations should reflect the bioprospecting-related capabilities of the institute at the time of contract, with an eye toward enhanced capabilities as a result of the

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[375] Marroquin-Merino, *supra* note 169, at 336.

[376] *See supra* notes 264–94, and accompanying text.

[377] *See id.*

[378] Marroquin-Merino, *supra* note 169, at 337.

[379] *See id.*

[380] *See id.*

[381] *See id.*

contract.[382] From the pharmaceutical company's perspective, the management, expertise, and stability of an institution make it a more attractive party with which to contract.[383] The institute should be able to do the actual collecting.[384] The institute should take steps to maintain quality and availability of sample supply.[385] Like INBio, it should develop sophisticated and comprehensive knowledge of biodiversity resources, and manage that knowledge in a way that will provide sharper direction to the search for nature's raw medicinal materials.[386]

IX. Conclusion

The foregoing are just some of the issues that contracting parties should consider when addressing access to and development of biodiversity resources. Drafting a bioprospecting contract is not simple, but the complexity of the endeavor should not dissuade companies and countries from doing so. Better than any other method, bioprospecting contracts can provide the type of economic-based incentives that encourage all parties to embrace conservation as being in their best interest. Identifying and understanding the issues, interests, and incentives of sustainable bioprospecting should clarify the type of conduct (and contract) required of the international community, individual countries, and private companies to ensure the continued viability of our raw medicinal materials.

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[382] *See supra* note 269 and accompanying text.

[383] *See* Laird, *supra* note 9, at 106 (highlighting characteristics of ideal collector from industry's perspective, and suggesting that those characteristics are present more often in institutional setting).

[384] *See id.* at 105.

[385] *See id.* at 102 (noting that companies enter into contracts to obtain "regular and reliable supplies of samples").

[386] *See generally* Gàmez, *supra* note 197, at 53.