

# Earth's Vanishing Medicine Cabinet: Rain Forest Destruction and Its Impact on the Pharmaceutical Industry

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Todos tem direito ao meio ambiente ecologicamente equilibrado.<sup>1</sup> Everyone has the right to an ecologically balanced environment. In 1988, the Brazilian Constitutional Assembly incorporated this imperative into the Brazilian Constitution as part of a chapter on environmental protection.<sup>2</sup> After hundreds of years of environmental ignorance, our planet's inhabitants have experienced a growth of environmental awareness. One global environmental tragedy garnering substantial recent attention is the depletion of the planet's tropical rain forests.<sup>3</sup> In addition to eternally altering the human environment, rain forest destruction poses a serious threat to both the pharmaceutical industry and individuals in need of medical care. A substantial portion of existing pharmaceuticals are plant-based and animal-based, and the pharmaceutical industry continues to explore additional species for medicinal potential, particularly in tropical regions. As mass deforestation of these areas forces countless species into extinction, specimens yet to be analyzed for their pharmaceutical potential will be eternally lost.<sup>4</sup> As one noted conservationist explained, "Even severe pollution is reversible, but species extinction is irreversible."<sup>5</sup>

This Note will examine rain forest destruction, the threat this crisis poses to the pharmaceutical industry, and alternative solutions to this problem. Part I explains the role of plant-based and animal-based research in the pharmaceutical industry and its resurgence in recent years. Part II examines the tragedy of deforestation and the impact of this crisis on the pharmaceutical industry. Notably, rain forest depletion results in the loss of biodiversity, or the destruction of the living

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<sup>1</sup> C.F. Capitulo VI, art. 225 (Braz.).

<sup>2</sup> Henry W. McGee, Jr. & Kurt Zimmerman, *The Deforestation of the Brazilian Amazon: Law, Politics, and International Cooperation*, 21 U. MIAMI INTER-AM. L. REV. 513, 530 (1990). According to McGee and Zimmerman, similar provisions appeared in the Portuguese Constitution in 1976, the Spanish Constitution in 1978, and the Yugoslavian Constitution in 1974. *Id.* at 531-32.

<sup>3</sup> See, e.g., Tamara J. Hrynik, Note, *Debt-for-Nature Swaps: Effective but Not Enforceable*, 22 CASE W. RES. J. INT'L L. 141 (1990).

<sup>4</sup> See *infra* notes 86-90 and accompanying text.

<sup>5</sup> Harriet Shapiro, *Destruction of Rain Forests, Warns a Conservationist, is Endangering Many Species—Including Our Own* (interview with Russell Mittermeier), PEOPLE, NOV. 28, 1988, at 165 (quoting Dr. Russell Mittermeier, Vice President for Science of the World Wildlife Fund and an associate professor of anatomical sciences at the State University of New York at Stony Brook).

organisms on which plant-based and animal-based pharmaceutical research depends. Part III addresses the major cause of deforestation: the urgent need of developing nations for quick financial gain. An effective solution to the deforestation problem necessarily requires consideration of this factor. Part IV looks at international efforts to halt deforestation in order to maintain biodiversity, and Part V examines recent private efforts to achieve the same result. In both contexts, the intellectual property concerns associated with drug patents are relevant. Part VI concludes that success at preventing global rain forest destruction in order to preserve biodiversity requires involvement by all concerned parties—the pharmaceutical industry, governments of the developing nations that are host to the world's rain forests, and indigenous populations of the same. Most importantly, a successful solution will make the elimination of deforestation practices profitable for each of these actors and will compensate developing nations for the sustainable use of their precious resources.

## I. PHARMACEUTICAL IMPORTANCE OF PLANTS AND ANIMALS

Naturally occurring compounds provide the basis for a substantial portion of the world-wide pharmaceuticals. In the United States, approximately twenty-five percent of prescription drugs derive from plant extracts,<sup>6</sup> thirteen percent from microorganisms, and three percent from animals.<sup>7</sup> “[C]ompounds derived from plants, microbes, and animals were involved in developing all of the twenty best-selling drugs in the United States, drugs whose combined sales approached \$6 billion in 1988.”<sup>8</sup> In developing nations, upwards of eighty percent of the populations rely upon similar plant-based and animal-based medicines.<sup>9</sup>

History is rife with numerous examples of drugs derived from biological resources.<sup>10</sup> For example, digitalis, a drug widely used to treat congestive heart failure and other cardiac ailments, derives from the purple foxglove.<sup>11</sup> The roots of tropical shrubs of the Rauwolfia genus give the pharmaceutical industry reserpine for use as a sedative and for the treatment of high blood pressure.<sup>12</sup> The larvae of

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<sup>6</sup>David R. Downes, *New Diplomacy for the Biodiversity Trade: Biodiversity, Biotechnology, and Intellectual Property in the Convention on Biological Diversity*, 4 *TOURO J. TRANSNAT'L L.* 1, 16 (1993); Linda Fellows, *What Are the Forests Worth?*, 339 *LANCET* 1330, 1331 (1992); Sam Thernstrom, *Jungle Fever: Lost Wonder-Drugs of the Rainforest*, *NEW REPUBLIC*, Apr. 19, 1993, at 12, 12.

<sup>7</sup>Thernstrom, *supra* note 6, at 12.

<sup>8</sup>Downes, *supra* note 6, at 16 (quoting WORLD RESOURCES INSTITUTE ET AL., *GLOBAL BIODIVERSITY STRATEGY* 4 (1992)). In addition to the pure economic value of such pharmaceuticals, these drugs have an invaluable benefit—the alleviation of human suffering and improvement of human health. See Liz Hanellin, Note, *Protecting Plant-Derived Drugs: Patents and Beyond*, 10 *CARDOZO ARTS & ENT. L.J.* 169, 171 n.17 (1991) (citing Norman Farnsworth, Professor of Pharmacology at the University of Illinois at Chicago).

<sup>9</sup>Fellows, *supra* note 6, at 1130.

<sup>10</sup>Biological resources means “genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.” United Nations Conference on Environment and Development, *Convention on Biological Diversity*, 31 *I.L.M.* 818, art. 2 (1992) [hereinafter *Convention*].

<sup>11</sup>Douglas O. Heiken, *The Pacific Yew and Taxol: Federal Management of an Emerging Resource*, 7 *J. ENVTL. L. & LITIG.* 175, 175 n.3 (1992); Dori Stehlin, *Harvesting Drugs from Plants*, *FDA CONSUMER*, Oct. 1990, at 20, 21.

<sup>12</sup>Stehlin, *supra* note 11, at 21.

blowflies secrete a substance that helps in the healing of deep wounds.<sup>13</sup> A recently developed, plant-derived drug is the highly controversial taxol, a drug initially touted as a miracle in the treatment of ovarian, breast, and lung cancer.<sup>14</sup>

Tropical plants, animals, and insects are a particularly logical source to examine for medicinal potential, "since these species have had to develop complex chemical arsenals to survive against a myriad [of] attackers: other insects, fungi, viruses, and bacteria."<sup>15</sup> In fact, up to ten percent of some species of plants are made up of such a chemical arsenal "designed for defense against predators."<sup>16</sup> For example, capoten, a recently developed drug effective for the treatment of hypertension, is derived from venom of the deadly Brazilian pit vipers.<sup>17</sup> Similarly, physicians use curare, a poison used by Yanomani Indians on arrow tips, as a muscle relaxant.<sup>18</sup> Additionally, the saliva of the vampire annelid worm produces a drug for the treatment of rheumatism and contusions.<sup>19</sup>

Perhaps the most oft-cited success story of plant-derived pharmaceuticals is the Madagascar rosy periwinkle.<sup>20</sup> While screening the periwinkle for medicinal potential, United States scientists from Eli Lilly, a large drug company, isolated two powerful alkaloids.<sup>21</sup> One, vinblastine, has proven effective in fighting Hodgkin's disease, achieving an eighty percent remission rate, compared to the previous rate of only nineteen percent.<sup>22</sup> The second alkaloid, vincristine, has become effective in battling childhood leukemia, providing a ninety percent remission rate.<sup>23</sup>

<sup>13</sup> John C. Kunich, *The Fallacy of Deathbed Conservation Under the Endangered Species Act*, 24 ENVTL. L. 501, 523 n.61 (1994).

<sup>14</sup> Taxol is a "naturally occurring poison found in the bark of the Pacific yew tree," an evergreen found in Pacific Northwest old growth forests. William Holy et al., *Wishing on a Falling Star*, 7 HEALTH 62 (Sept. 1993). The introduction of taxol was met with extreme controversy because the treatment of a single cancer patient required the bark of several hundred-year-old, rare yew trees. The logging industry, desirous of logging the old growth forests, ran headlong into conservation groups intent on preserving the forests which were threatened with extinction, a result that the industry claimed was at the expense of cancer patients' lives. Since the initial controversy, however, information has surfaced indicating that the yew never faced shortage, nor is the drug the miracle it once appeared to be. *Id.* Further, much of the debate is now moot, since scientists recently succeeded at synthesizing taxol. See *Cancer Researchers Synthesize Taxol*, BOSTON GLOBE, Feb. 17, 1994, at 3. For a comprehensive discussion of taxol and history, see Heiken, *supra* note 11.

<sup>15</sup> Cathy Sears, *Jungle Potions*, AM. HEALTH, Oct. 1992, at 70, 71.

<sup>16</sup> Philip H. Abelson, *Medicine From Plants*, 247 SCI. 513 (1990).

<sup>17</sup> McGee & Zimmerman, *supra* note 2, at 516.

<sup>18</sup> *The Foundering Ark*, ECONOMIST, Jan. 6, 1990, at 83; Usha Lee McFarling, *Nature's Vanishing Pharmacy*, BOSTON GLOBE, Oct. 3, 1994, at 25.

<sup>19</sup> Betsy Carpenter, *Living with Nature*, U.S. NEWS & WORLD REP., Nov. 30, 1992, at 60, 66.

<sup>20</sup> See, e.g., Elissa Blum, *Making Biodiversity Conservation Profitable: A Case Study of the Merck/INBio Agreement*, ENV'T, May 1993, at 16, 18; Tracy Dobson, *Loss of Biodiversity: An International Environmental Policy Perspective*, 17 N.C. J. INT'L L. & COM. REG. 277, 283 (1992); Fiona Godlee, *Medicinal Plants: Another Man's Poison*, 305 BRIT. MED. J. 1583 (1992); Diane Jukofsky, *Medicinal Plant Research Leads Scientists to Rain Forests*, DRUG TOPICS, Apr. 22, 1991, at 26; Shayana Kadal, Note, *Plants, Poverty, and Pharmaceutical Patents*, 103 YALE L.J. 223, 223 (1993); Ted Kerasote, *Biodiversity: More Than Just a Word*, SPORTS AFIELD, May 1993, at 14; Mark Nichols, *The Fate of the Earth*, MACLEAN'S, Dec. 16, 1991, at 35; Leslie Roberts, *Chemical Prospecting: Hope for Vanishing Ecosystems?*, 256 SCI. 1142, 1142 (1992); Paul Roberts, Note, *International Funding for the Conservation of Biological Diversity: Convention on Biological Diversity*, 10 B.U. INT'L L.J. 303, 330 (1992); Sears, *supra* note 15, at 70; Thernstrom, *supra* note 6, at 12; *Just What the Witch-Doctor Ordered*, ECONOMIST, Apr. 2, 1988, at 75.

<sup>21</sup> Jukofsky, *supra* note 20, at 26.

<sup>22</sup> *Id.*

<sup>23</sup> *Id.*

However, scientists have yet to synthesize these alkaloids and, consequently, remain dependent on large amounts of the actual periwinkle, which only produces one ounce of vincristine for every fifteen tons of periwinkle leaves.<sup>24</sup> This alkaloid sold in 1991 for \$100,000 per pound. Sales of the two drugs now total \$180 million a year.<sup>25</sup> Thus, to many, the Madagascar rosy periwinkle represents a win-win consequence of plant-based medicine. The medical community receives two powerful cancer-fighting drugs, while the pharmaceutical company reaps windfall profits from its discovery.<sup>26</sup>

A less successful but equally poignant example of the importance of plant-based drugs, particularly in the deforestation context, concerns the raging battle against the HIV virus. In 1987, a group of researchers collected approximately a kilogram of twigs, bark, and fruit from a Malaysian gum tree.<sup>27</sup> Tests conducted on the twigs in 1991 led to the isolation of a "compound that blocked the spread of the HIV-1 virus in human immune cell" in a lab.<sup>28</sup> Biologists immediately returned to the Malaysian swamp from which the samples were originally taken, only to find that the tree had been felled shortly after the original material was collected.<sup>29</sup> No similar tree, nor different tree yielding the same compound, has since been found.<sup>30</sup> Although tests had not yet been conducted on humans, the results looked promising in the possible eradication of the virus.<sup>31</sup> Unfortunately, because of the tragedy of deforestation, the scientific world may never be able to fully explore the potential cure which nature may have had to offer.

A rare second chance may exist in a vine native to the Cameroon rain forest, from which researchers at the National Cancer Institute isolated a compound that inhibits the reproduction of HIV *in vitro*.<sup>32</sup> Researchers have only been able to locate the vine in a small area of Cameroon's 740,000-acre rain forest.<sup>33</sup> While the location of the vine is currently known, thereby allowing for further medical research, the loss of the Malaysian gum tree serves as a calamitous reminder of the threat that deforestation poses to on-going pharmaceutical discoveries.

In recent decades, pharmaceutical research involving natural resources has gone through cycles of popularity for various reasons. Prior to the 1960s, many drug companies conducted plant-based and animal-based research in pursuit of pharmaceutical discoveries. With the advent of computer modeling techniques<sup>34</sup> in the 1960s, however, researchers switched their focus to the derivation of synthetic drugs in the laboratory.<sup>35</sup> Given the seeming wonders of synthetic research,

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<sup>24</sup> *Id.* As a result of this high demand for the plant, the entire native rosy periwinkle habitat in Madagascar has been depleted. Hanellin, *supra* note 8, at 173 n.21.

<sup>25</sup> Thernstrom, *supra* note 6, at 12.

<sup>26</sup> Many consider it a win-win-lose situation, however, because Madagascar has yet to receive any compensation for its natural resources, without which the creation of the drugs would have been impossible. Tim Johnson, *From Rain Forest to Medicine Chest*, MIAMI HERALD, June 2, 1992, at 1A. See *infra* notes 197-200 and accompanying text.

<sup>27</sup> *Researchers Still Searching for Lost AIDS Tree*, AIDS WEEKLY, May 17, 1993, at 13.

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

<sup>30</sup> *Id.*

<sup>31</sup> *Id.*; see also McFarling, *supra* note 18, at 28.

<sup>32</sup> *Scientists Say Rare Vine Offers Hope for AIDS Cure*, AIDS WEEKLY, May 3, 1993, at 8.

<sup>33</sup> *Id.*

<sup>34</sup> Michael D. Coughlin, Jr., Recent Development, *Using the Merck-INBio Agreement to Clarify the Convention on Biological Diversity*, 31 COLUM. J. TRANSNAT'L L. 337, 338 n.6 (1993).

<sup>35</sup> *Rainforest Pharmaceuticals*, E. W. NAT. HEALTH, May-June 1992, at 17.

analysis of natural compounds seemed excessively time-intensive and labor-intensive, as well as haphazard and relatively unproductive.<sup>36</sup> For example, only one plant or animal sample in 10,000 leads to a useful medication, while getting the drug to market generally costs over \$200 million and takes ten years.<sup>37</sup> Problems such as seasonal and geographic variations in the chemical compositions and availability of plants can make plant-based research inconsistent and unpredictable.<sup>38</sup> Further, pure products of nature are nonpatentable, leaving pharmaceutical companies reluctant to invest in the development of plant-derived drugs to which they may not receive exclusive rights.<sup>39</sup> Consequently, from the 1960s to the 1980s, natural resources research slowed, and in 1980, not one U.S. company admitted to doing research in higher plants.<sup>40</sup>

In the late 1980s and early 1990s, however, the pharmaceutical industry largely reverted back to traditional screening of plant and animal specimens from synthetic research.<sup>41</sup> Numerous realizations on behalf of the pharmaceutical industry prompted this change. First, natural resources are useful in part because tropical plants contain powerful chemical defenses,<sup>42</sup> many of which are too complex to be accurately replicated in a lab.<sup>43</sup> Additionally, scientists have already synthesized many of the substances which are reproducible.<sup>44</sup> Also, advances in biotechnology<sup>45</sup>

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<sup>36</sup> Blum, *supra* note 20, at 16. Working with plants tends to be even more labor-intensive than working with microbes. Specifically,

[u]nlike bacteria or fungi, for example, which can be cultured in large vats, plants must either be collected in the wild, grown in large greenhouses, or cultivated on plantations. Leaves, stems and roots often contain different chemicals, so each part must be tested separately to see what kinds of effects it has on human cells. Then chemists must sort through the hundreds of different chemicals that often share space in a single leaf or root, to determine exactly which ones are responsible for the observed effects.

Rick Weiss, *Plants that Heal: Scientists Try to Turn Weeds into Wonder Drugs*, WASH. POST, May 10, 1994 (Health Section), at 12 (quoting Lynn Caporale, a senior director at Merck & Co.).

<sup>37</sup> Harlan C. Clifford, *Medicine Men Tropical Cures*, S.F. CHRON., May 22, 1994 (This World, Sunday Ed.), at 13. Another estimate places expenditures for discovering, testing, and securing marketing approval for a new drug in the United States at over \$125 million. Gerald J. Mossinghoff, *Research-Based Pharmaceutical Companies: The Need for Improved Patent Protection Worldwide*, 2 J.L. & TECH. 307, 308 (1987).

<sup>38</sup> Hanellin, *supra* note 8, at 169, 172-73.

<sup>39</sup> *Id.* A widespread practice in the pharmaceutical industry now is to add "small modifications to the chemical structure of the original compound" to create a "new" chemical with a slightly different structure that retains the beneficial effects of the original compound but circumvents the product-of-nature prohibition. See Kadidal, *supra* note 20.

<sup>40</sup> See Sears, *supra* note 15, at 70. See also Weiss, *supra* note 36, at 12 (quoting Michael J. Balick, director of the New York Botanical Garden's Institute of Economic Botany, as saying, "[i]f we were talking 10 years ago I would have said there were no major pharmaceutical companies with a serious focus on medicinal plants . . . . Now there are many dozens of U.S. companies doing this, propelled by the recognition that plant biodiversity has great potential as a source of [medicinal] raw materials.").

<sup>41</sup> Blum, *supra* note 20, at 19.

<sup>42</sup> See *supra* notes 15-19 and accompanying text.

<sup>43</sup> Blum, *supra* note 20, at 16; Hanellin, *supra* note 8, at 169.

<sup>44</sup> Kirstin Peterson, *Recent Intellectual Property Trends in Developing Countries*, 33 HARV. INT'L L.J. 277 (1992).

<sup>45</sup> Biotechnology is a term shortened from biological technology and is defined as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use," Convention, *supra* note 10, art. 2, and is "vital to an ever increasing variety of industries, most notably the research-based pharmaceutical, medical, and agricultural industries." Adam L. Stretzer, Comment, *U.S. Biotechnology Intellectual Property Rights as an Obstacle to the UNCED Convention on Biological Diversity: It Just Doesn't Matter*, 6 TRANSNAT'L LAW. 271, 286 (1993).

and chemical prospecting techniques<sup>46</sup> in recent decades have made research based on natural compounds more cost effective, time efficient, and accurate.<sup>47</sup> Researchers also realized the utmost importance of maintaining a "diverse gene pool for new treatments," as many diseases eventually become resistant to current drugs.<sup>48</sup> Lastly, the commercial success of new plant-based pharmaceuticals provided the needed incentive for other drug companies to resume their plant-screening programs.<sup>49</sup> For example, by 1990, the United States' plant-based prescription drug market, which is twenty-five percent of all available prescription drugs, was worth \$15 billion.<sup>50</sup>

## II. THE DEFORESTATION CRISIS

### A. THE CURRENT RATE OF RAIN FOREST DESTRUCTION

The future success of natural resources research in the pharmaceutical industry clearly depends on the continued existence of compounds that can be analyzed for their medicinal potential.<sup>51</sup> However, this need for natural resources is seriously threatened by the deforestation of tropical regions, a crisis that has claimed a daunting quantity of rain forests and the resources contained therein.

While experts agree that the problem of deforestation is extensive, they are generally unable to precisely estimate the current rate of deforestation. Estimates of the deforestation rate of the world's tropical rain forests range from 27 million acres (the size of New York or Pennsylvania)<sup>52</sup> to 50 million acres (seventy times the size of Rhode Island)<sup>53</sup> per year. In terms of other geographic references, this annual destruction totals an area larger than that of the Netherlands and Switzerland combined.<sup>54</sup> One can also conceptualize this in smaller time increments: earth's inhabitants are destroying rain forests at the rate of one football field's

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<sup>46</sup>Coughlin, *supra* note 34, at 338 n.6. For an explanation of chemical prospecting, see *infra* note 187 and accompanying text.

<sup>47</sup>Blum, *supra* note 20, at 16; Peterson, *supra* note 44, at 277. At the National Cancer Institute ("NCI") in Maryland, the development of a new screening system allows researchers to analyze up to 20,000 specimens per year. Contractors in 25 nations provide pounds of plant samples, which the NCI researchers deep freeze for 48 hours to kill "hitchhiking insects." Researchers then grind the plant specimens into powder, which they then soak in solvents to leach out medical ingredients. These extracts are added to numerous different laboratory dishes that contain different kinds of cancer cells as well as HIV-infected white blood cells. In these experiments, researchers are looking for extracts that interfere with the growth of certain cancer cells or help the HIV-infected cells survive. Extracts exhibiting such potential are analyzed for their chemical contents. Because an extract from one plant can contain hundreds or thousands of compounds, the search for their active chemical ingredients can take from six months to a few years. The next stage involves testing for toxicity and efficacy in animals and can take an additional two to five years. The next step involves clinical trials. Compounds that succeed past this step begin the process of seeking Food and Drug Administration approval. Weiss, *supra* note 36, at 14.

<sup>48</sup>Sears, *supra* note 15, at 73. For example, chloroquine, a synthetic drug, replaced quinine when certain malaria strains became quinine-resistant. However, chloroquine is now becoming ineffective. *Id.*

<sup>49</sup>Eli Lilly's rosy periwinkle-based drugs reailed for millions in 1985. Johnson, *supra* note 26, at 1A.

<sup>50</sup>*Id.*; Sears, *supra* note 15, at 72.

<sup>51</sup>Ted Gup, *Down with the God Squad*, TIME, Nov. 5, 1990, at 102.

<sup>52</sup>136 Cong. Rec. H13642-01, H13643 (daily ed. Oct. 25, 1990) (statement of Rep. Vento).

<sup>53</sup>Nichols, *supra* note 20, at 35.

<sup>54</sup>Leaf Alexander, *The Potential Health Effects of Local Climatic and Environmental Changes*, 321 NEW ENG. J. MED. 1577, 1579 (1989).

worth *every second*<sup>55</sup> and at least fifty<sup>56</sup> to eighty<sup>57</sup> acres *every minute*. This deforestation represents a net loss of approximately two percent each year.<sup>58</sup> By 1989, tropical rain forests had been reduced to fifty-five percent of their original size.<sup>59</sup> If deforestation continues at this astronomical rate, the world's tropical rain forests will be completely and eternally destroyed within thirty years.<sup>60</sup>

## B. LOSS OF BIODIVERSITY

Beyond the most obvious consequence of deforestation—the loss of mother nature and her inherent beauty—this practice has severe ramifications for all of the earth's inhabitants.<sup>61</sup> With regards to the medical field, the depletion of the planet's rain forests poses a threat to continued plant-based and animal-based research because deforestation is rapidly diminishing global biological diversity.<sup>62</sup>

Biological diversity, or biodiversity, represents “the totality of living things, embracing all species of organisms, big and little, on land and in the sea.”<sup>63</sup> As with rates of deforestation, estimates regarding the number of species in existence are extremely imprecise.<sup>64</sup> Experts approximate the number of plant and animal species world-wide to range from 5 to 50 million, with somewhere in the neighborhood of 10 million species regarded by biologists as the best approximation.<sup>65</sup>

<sup>55</sup> Vice President Albert Gore, *U.S. Support for Global Commitment to Sustainable Development*, Speech, June 14, 1993, 4 U.S. DEP'T ST. DISPATCH 430.

<sup>56</sup> Shapiro, *supra* note 5, at 165.

<sup>57</sup> Jonathan Burton, *Paradise Lost?*, SCHOLASTIC UPDATE, Feb. 12, 1993, at 20.

<sup>58</sup> *Ecologists Make Friends with Economists*, ECONOMIST, Oct. 15, 1988, at 25.

<sup>59</sup> Alexander, *supra* note 54, at 1579.

<sup>60</sup> Fellows, *supra* note 6, at 1331.

<sup>61</sup> Another health-related consequence of deforestation is the atmospheric accumulation of carbon dioxide. *Saving the Rain Forests*, SCHOLASTIC UPDATE, Nov. 3, 1989, at 11. *See also* Burton, *supra* note 57, at 20 (rain forests are essential in producing oxygen and absorbing carbon monoxide); Shapiro, *supra* note 5, at 165 (the slash-and-burn method of forest clearing releases massive amounts of carbon dioxide into the atmosphere).

<sup>62</sup> Kerasote, *supra* note 20, at 14.

<sup>63</sup> Robert M. May, 266 SCI. AM. 146 (1993) (reviewing EDWARD O. WILSON, THE DIVERSITY OF LIFE). Biodiversity has also been defined as “the variability among living organisms from all sources, including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.” Convention, *supra* note 10, at 823. Biological diversity has also been defined as “the totality of genes, species, and ecosystems in a region.” Paul Roberts, *supra* note 20, at 305.

Biodiversity has both economic and noneconomic values. These values include “ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values . . .” Convention, *supra* note 10, Preamble at 822. *See also* Paul Roberts, *supra* note 20, at 306-07 (discussing the numerous values of biological diversity). While appreciating these numerous benefits, this Note focuses on biodiversity's significance to the pharmaceutical industry.

<sup>64</sup> In fact, the notion of a species is also of scientific debate. Kunich, *supra* note 13, at 505. According to the biological concept of species, “a species is a population of organisms that can at least potentially breed with one another, but do not breed with other populations.” *Id.* at 506. A phylogenetic concept “defines species as the smallest recognizable cluster of individuals that share a common trait and have a common pattern of ancestry.” A genealogical concordance method “compares large numbers of gene sequences in various organisms, attempting to measure ‘genetic drift.’” *Id.* at 506-07.

<sup>65</sup> Thernstrom, *supra* note 6, at 12. The World Bank estimates that Earth is home to approximately 33 million species. Paul Roberts, *supra* note 20, at 308 (citing WORLD BANK, WORLD DEVELOPMENT REPORT: DEVELOPMENT AND THE ENVIRONMENT 7 (1992)).

While tropical rain forests cover only five to seven percent of the globe's land surface, they contain more than half of all of the world's species,<sup>66</sup> a concentration known as "species exuberance."<sup>67</sup>

To date, scientists have identified merely 1.4 million species of these multitudinous organisms.<sup>68</sup> Despite the significant reliance on biological resources in the production of pharmaceuticals, only one<sup>69</sup> to three percent<sup>70</sup> of the 250,000 known flowering plants world-wide<sup>71</sup> have been fully explored for medicinal potential.<sup>72</sup> Given the current rate of deforestation,<sup>73</sup> about twenty-five percent of these known plants may be extinct by the year 2050,<sup>74</sup> if not sooner.

As the planet's "ecosystems are being plundered for their natural resources . . . [the corresponding] habitat destruction on a massive scale has resulted in a world wide loss of species."<sup>75</sup> Clearly, as rain forests are destroyed and known plants and animals are lost, so too are unknown species.<sup>76</sup> The astronomical speed of deforestation is pushing species into extinction "at a cataclysmic rate: 27,000 species a year, seventy-four a day, three per hour."<sup>77</sup> In fact, estimates range as high as *150 species lost per day*.<sup>78</sup>

Species extinction may be attributable to various causes. A limited degree of extinction occurs at a natural rate, which is the estimated rate at which extinction would occur without any human involvement.<sup>79</sup> Other species become extinct,

<sup>66</sup> Fellows, *supra* note 6, at 1130. Again, estimates concerning the percentage of species concentrated in tropical forests vary. See Paul Roberts, *supra* note 20, at 308 (citing the World Resources Institute's approximation that an "estimated 50 to 90 percent of the total species are located in tropical forests."). The tropics contain approximately two-thirds of the known 250,000 flowering plant species and over one million animals and insects. Sears, *supra* note 15, at 70.

<sup>67</sup> George H. Colt, *The Secret Life of a Tree in the Rain Forest*, LIFE, June 1994, at 58. In an example of species exuberance, "botanists report that one twenty-acre tract in Malaysia supports 750 tree species, more than all of the U.S.; a single tree in Peru was recently found to host 1,700 species of beetle." *Id.*

<sup>68</sup> Thernstrom, *supra* note 6, at 12.

<sup>69</sup> Johnson, *supra* note 26, at 1A.

<sup>70</sup> Thernstrom, *supra* note 6, at 12. Other estimates put the percentage analyzed at five percent of known plant species. See, e.g., Susan K. Laue, *Is Our World's Natural Diversity in Danger?*, 19 CURRENT HEALTH 14 (1992).

<sup>71</sup> Fellows, *supra* note 6, at 1330. Other sources state that there are between 260,000 and 300,000 known plant species. See, e.g., Abelson, *supra* note 16, at 513; Johnson, *supra* note 26, at 1A.

<sup>72</sup> Johnson, *supra* note 26, at 1A; Laue, *supra* note 70, at 14; Thernstrom, *supra* note 6, at 12.

<sup>73</sup> See *supra* notes 52-60 and accompanying text.

<sup>74</sup> Fellows, *supra* note 6, at 1330.

<sup>75</sup> Streltzer, *supra* note 45, at 284. The author defines "ecosystem" as a "particular physical environment, the organisms that inhabit that environment, and the interactions among those organisms." *Id.* at n.104. Ecosystem also means a "dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." *Convention*, *supra* note 10, art. 2.

<sup>76</sup> Thernstrom, *supra* note 6, at 12.

<sup>77</sup> Kerasote, *supra* note 20, at 14. As with estimates pertaining to rates of deforestation, these numbers vary. Other experts state the rate of extinction to be three species per day and up to 50,000 per year. See, e.g., Laue, *supra* note 70, at 14.

<sup>78</sup> Dobson, *supra* note 20, at 277.

<sup>79</sup> Kunich, *supra* note 13, at 510; Paul Roberts, *supra* note 20, at 309. Roberts further notes that [a]gainst this 'natural' standard, from 1700 to 1799 the extinction of approximately ten species of mammals and 25 species of birds were recorded. During the nineteenth century, the extinction of approximately 28 species of mammals and 61 species of birds were recorded. From 1900 until 1987 the extinction of 52 species of mammals and 65 species of birds were recorded. These statistics indicate an alarming increase in the recorded instances of extinc-



however, when their habitat is altered, generally by man, and the species is unable to adapt to the alteration.<sup>80</sup> Experts estimate the natural rate of extinction to be merely two to three species per one hundred years.<sup>81</sup> Clearly, estimates of today's extinction rate far exceed this natural rate.<sup>82</sup> This has led to the conclusion that "[h]uman activities in the last quarter of the twentieth century are reducing biological diversity at a rate that may be unprecedented in the history of life on Earth,"<sup>83</sup> a rate as fast as at any time since the dinosaurs became extinct over 65 million years ago.<sup>84</sup> As another author stated, "*Homo sapiens* has undeniably made a disproportionate impact on the rate of extinction of other species, generally paying greater heed to his mission to have dominion over and to subdue the earth and its living things than to his mission to replenish them."<sup>85</sup>

Based on statistical likelihood,<sup>86</sup> some of the thousands of species threatened with extinction possess yet unexplored pharmaceutical potential.<sup>87</sup> Indeed, possibly 1,400 rain forest plant species possess compounds with cancer-fighting potential.<sup>88</sup> With the continual extinction of an unknown number of these potentially valuable species, the likelihood of finding a cure for cancer and, similarly, many other as-yet incurable diseases, also diminishes. At the present rate of extinction, experts estimate that over the next ten years, approximately twenty-five potential prescription drugs will be lost as a result of deforestation.<sup>89</sup> This translates into an estimated loss to the pharmaceutical industry in the year 2000 and each subsequent year of \$15 billion.<sup>90</sup>

### III. THE PRIMARY CAUSES OF DEFORESTATION

As the deforestation crisis is extensive, so too are the causes of the tragedy. Foremost among the causes of global deforestation is the impoverishment of many developing nations.<sup>91</sup> People in overcrowded tropical lands continually face ever-expanding populations which place increasing pressure on the already strained

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tion of mammals and birds. What is alarming is that scientists have identified only approximately one thirtieth of the species on Earth, indicating that the number of *unrecorded* extinctions is considerably higher.

Paul Roberts, *supra* note 20, at 309 (citations omitted).

<sup>80</sup> Kunich, *supra* note 13, at 511.

<sup>81</sup> Paul Roberts, *supra* note 20, at 309.

<sup>82</sup> See *supra* notes 77-79 and accompanying text.

<sup>83</sup> Paul Roberts, *supra* note 20, at 308 (quoting G. LEDEC & R. GOODLAND, *WILDLANDS: THEIR PROTECTION AND MANAGEMENT IN ECONOMIC DEVELOPMENT* 7 (1988)).

<sup>84</sup> *Id.* at 309 (quoting WORLD BANK, *WORLD DEVELOPMENT REPORT: DEVELOPMENT AND THE ENVIRONMENT* 7 (1992)). See also Kunich, *supra* note 13, at 514 (quoting Kathryn A. Kohm, *Introduction*, in *BALANCING ON THE BRINK OF EXTINCTION: THE ENDANGERED SPECIES ACT AND LESSONS FOR THE FUTURE* 4-5 (Kathryn A. Kohm ed., 1991)).

<sup>85</sup> Kunich, *supra* note 13, at 503.

<sup>86</sup> The possibility that any given plant will yield a marketable prescription drug ranges from one in 1,000 to one in 10,000. Downes, *supra* note 6, at 1; Fellows, *supra* note 6, at 1330.

<sup>87</sup> Abelson, *supra* note 16, at 513. Michael Balick, a New York Botanical Garden Botanist, estimates that less than one half of one percent of the planet's half-million flowering plants have been tested for their medicinal potential. He adds, "It doesn't take a rocket scientist to realize the other ninety-nine percent has to have something." McFarling, *supra* note 18, at 28.

<sup>88</sup> Hanellin, *supra* note 8, at 169.

<sup>89</sup> *Id.*

<sup>90</sup> *Id.* at 171.

<sup>91</sup> Laue, *supra* note 70, at 14.

means of survival.<sup>92</sup> As a result, these nations pursue methods of short-term cash generation in lieu of practices that are profitable in the long-run and that conserve natural resources.<sup>93</sup> Too frequently, these indigenous populations see their nearest and seemingly abundant natural resource—the tropical forests—as a source for this cash generation.<sup>94</sup> Consequently, they clear the forest areas for various income-producing uses, including timber extraction, cattle ranching, crop production,<sup>95</sup> mining, road construction,<sup>96</sup> and even production of charcoal for sale as cooking fuel.<sup>97</sup>

Much of the forest clearing is achieved through a method called swidden, or slash-and-burn, agriculture,<sup>98</sup> whereby farmers cut down masses of trees and burn them where they lie.<sup>99</sup> The resulting ash, which contains the nutrients once possessed by the rich tropical trees and organisms, sustains crops and cattle for only a few years.<sup>100</sup> Without the tropical canopy to protect the ground, however, frequent and heavy rains leach nutrients from the soil, rendering the land virtually worthless.<sup>101</sup> After a few years of farming, the land becomes useless and must be abandoned, requiring the deforestation of yet another area.<sup>102</sup>

Thus, struggling nations opt for immediate, short-term profit-making activities, such as timber production and cattle grazing, unaware of both the extremely temporary nature of these benefits and the long-term damage to the global environment.<sup>103</sup> Because of this urgent need for financial resources, indigenous populations, often supported by their governments, value the short-term benefits of farming, logging, and grazing over extractive forest uses, such as production of fruits, rubber, and medicine, which are more lucrative in the long run.<sup>104</sup> They fail to appreciate the long-term benefits of sustainable development, or “progress without destruction of the environment,”<sup>105</sup> due to their dire need for immediate infusion of cash.

<sup>92</sup> *Saving the Rain Forests*, *supra* note 61, at 11; Shapiro, *supra* note 5, at 165.

<sup>93</sup> Coughlin, *supra* note 34, at 339.

<sup>94</sup> Laue, *supra* note 70, at 14; *Saving the Rain Forests*, *supra* note 61, at 11.

<sup>95</sup> Shapiro, *supra* note 5, at 165.

<sup>96</sup> McGee & Zimmerman, *supra* note 2, at 524.

<sup>97</sup> Philip Elmer-Dewit, *Rich vs. Poor*, TIME, June 1, 1992, at 45.

<sup>98</sup> Dobson, *supra* note 20, at 294.

<sup>99</sup> Shapiro, *supra* note 5, at 165.

<sup>100</sup> *Id.*

<sup>101</sup> *Id.*; Laue, *supra* note 70, at 14; *Saving the Rain Forests*, *supra* note 61, at 11.

<sup>102</sup> Dobson, *supra* note 20, at 294.

<sup>103</sup> Blum, *supra* note 20, at 16. Some countries are beginning to appreciate that the rain forests can be protected from predatory development while still recognizing some economic value. For example, the Brazilian government created four reserves for rubber tappers and nut gatherers based on the idea that these extractive activities, if properly executed, can continue indefinitely and can prove profitable for the indigenous people, thus removing incentive to destroy the habitat. While the notion of such cooperatives seems to be feasible in theory, economic realities have thus far prevented the plan from realizing its potential because gatherers have reaped only a nominal income. *See, e.g.*, Don Podesta, *Nasty Feud Keeps Life in Amazon Rain Forest from Improving*, S.F. CHRON., Nov. 27, 1993, at C18; Fred Pearce, *First Aid for the Amazon*, NEW SCI., Mar. 28, 1992, at 42.

<sup>104</sup> Dobson, *supra* note 20, at 284.

<sup>105</sup> Eugene Linden, *Rio's Legacy*, TIME, June 22, 1992, at 44. Sustainable development refers to meeting “the needs of the present without compromising the ability of future generations to meet their own needs.” *Meeting the Challenge of Sustainable Development*, FORBES, May 25, 1992, at 118 (quoting a “well-accepted definition” offered by the World Commission on Environment and Development).

While the indigenous peoples of the tropical regions frequently conduct these destructive activities, the practices are often done with the support, and indeed the encouragement, of the governments. Brazilian history provides a vivid example of such a relationship. Rather than appreciating the Amazon for its beauty, culture, extractive resources, and pharmaceutical potential, Brazilian politicians and military officers long viewed the region's resources as goods that "must be exploited for short-term benefits" and encouraged deforestation for at least two major reasons.<sup>106</sup> First, deforestation resulted in land for agribusiness, including small, self-sustaining farms and large cattle ranches.<sup>107</sup> Second, factions of the government and military believed that national security demanded a redistribution of Brazil's coastal and landless population to the Amazon region, a feat achievable only through the construction of an extensive highway system connecting the Amazon region with the rest of the country.<sup>108</sup>

These domestic objectives resulted in numerous development plans requiring the destruction of the Amazonian rain forest. The Brazilian government provided various financial incentives, such as tax breaks, to encourage agriculture, industry, mining, transportation, communications, and energy production in furtherance of this commitment to rapid development and emigration to sparsely populated regions.<sup>109</sup> A 1980 study estimated the impact of these practices on deforestation: "road construction is responsible for twenty-six percent of deforestation in the Amazon, small farming and colonization for thirty-one percent, lumbering (the clearing of trees for sale) for only four percent, and agribusiness and cattle ranching for thirty-eight percent."<sup>110</sup> Cattle ranching, while the most destructive, is the "least cost-effective use because raising one million dollars worth of cattle for market requires the destruction of one hundred square kilometers of forest. In comparison, extracting one million dollars worth of rubber destroys only 6.8 square kilometers of forest."<sup>111</sup>

Recently, new environmental factions in Brazil have attempted to halt the destructive policies of the government.<sup>112</sup> The Brazilian government has become increasingly receptive to environmental preservation, going so far as to incorporate an environmental protection chapter into the Brazilian Constitution in 1988.<sup>113</sup> Additionally, facing pressure from global environmentalists, the government ended tax subsidies that had previously encouraged clearing of the Amazon forests and agreed to finance forest conservation projects.<sup>114</sup> However, given the country's poor record on deforestation, continued attempts to disperse the country's population, lack of experience and knowledge in the realm of environmental preserva-

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<sup>106</sup> McGee & Zimmerman, *supra* note 2, at 522-23. See also Michael S. Giaimo, *Deforestation in Brazil: Domestic Political Imperative—Global Ecological Disaster*, 18 ENV'T L. 537 (1988).

<sup>107</sup> McGee & Zimmerman, *supra* note 2, at 523.

<sup>108</sup> *Id.*; see also Pearce, *supra* note 103, at 42.

<sup>109</sup> McGee & Zimmerman, *supra* note 2, at 523.

<sup>110</sup> Grainger, *The State of the World's Tropical Forests*, 10 ECOLOGIST 6, 34, 47 (1980).

<sup>111</sup> McGee & Zimmerman, *supra* note 2, at 527. According to U.S.D.A. reports, Brazil produced 4,300,000 metric tons of beef and veal in 1986 and 1987 and exported meat totaling 1,155,000 tons from 1985 to 1987. U.S. DEP'T OF AGRICULTURE, 1988 AGRICULTURAL STATISTICS 301, 304 (1988).

<sup>112</sup> McGee & Zimmerman, *supra* note 2, at 528-29.

<sup>113</sup> *Id.* at 530.

<sup>114</sup> Myles Gordon, *One Step at a Time: Environmental Protection Measures*, SCHOLASTIC UPDATE, Apr. 15, 1994, at 4. These moves, however, were not well received by cattle ranchers, miners, and settlers, who protested the actions and continue to destroy the forests. *Id.*

tion, and the "limited budgets of government environmental agencies charged with the protection of the forest . . . deforestation will continue on its accelerated course"<sup>115</sup> in the absence of external assistance.

Given the resurgence of drug research based on natural compounds, the pharmaceutical industry, and indeed the global population, has a vested interest in preserving biodiversity and preventing the further extinction of the planet's species that may contain medicinal potential. Since rain forest depletion is primarily caused by the immediate need of developing nations for capital, any proposal for halting deforestation must provide indigenous populations and the governments of these nations with sufficient financial incentive to leave rain forests intact. These parties must believe that they can benefit as much from leaving the forests standing as they can from burning them down. Ultimately, they must be compensated for the "cost of lost opportunities," or the money lost by forbearing from logging, farming, or any other short-term money producing activity that threatens biodiversity by destroying the rain forests.<sup>116</sup>

#### IV. INTERNATIONAL EFFORTS AIMED AT PRESERVING BIODIVERSITY

Experts generally agree that the best way to preserve biodiversity and stop rain forest depletion is by ensuring that the custodians of these natural resources benefit from their conservation.<sup>117</sup> Numerous strategies, including both international initiatives and private agreements, have been proposed in the struggle to achieve this goal.<sup>118</sup> This Note will examine three models recently attempted. First, the Biodiversity Treaty represents an international initiative in which governments world-wide united to reach a consensus on global efforts necessary to preserve biodiversity.<sup>119</sup> Alternatively, Shaman Pharmaceuticals has worked towards the same goal through ethnobotany and private agreements with native healers.<sup>120</sup> Lastly, Merck & Co. is attempting to preserve natural resources through a private, contractual arrangement with a Costa Rican conservation organization, which in return stands to receive financial benefits such as royalties from any drug Merck develops based on Costa Rican specimens.<sup>121</sup>

The United Nations Conference on Environment and Development ("UNCED" or "Earth Summit"), held in Rio de Janeiro on June 3-14, 1992, represents the most recent and notable international effort to conserve biological diversity and preserve "use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources . . ."<sup>122</sup> At the focal point of this

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<sup>115</sup> McGee & Zimmerman, *supra* note 2, at 535.

<sup>116</sup> Carol Kaesuk Yoon, *Drugs from Bugs*, GARBAGE, Summer 1994, at 22.

<sup>117</sup> Michael A. Gollin, *Using Intellectual Property to Improve Environmental Protection*, 4 HARV. J.L. & TECH. 193, 216 (1991).

<sup>118</sup> See, e.g., Laurie P. Greener, Comment, *Debt-for-Nature Swaps in Latin American Countries: The Enforcement Dilemma*, 6 CONN. J. INT'L L. 123 (1991) (discussing debt-for-nature swaps as a solution for stopping the elimination of natural resources); Hrynik, *supra* note 3; Antonio N. Piccirillo, Note, *The Metamorphosis: Expected Changes in the Brazilian Debt-for-Nature Swap Process and Policy Implications*, 17 FORDHAM INT'L L.J. 547 (1994) (discussing the debt-for-nature program in Brazil).

<sup>119</sup> See *infra* notes 122-63 and accompanying text (Biodiversity Treaty resulted from the United Nations Conference on Environmental and Development held in Rio de Janeiro on June 3-14, 1992).

<sup>120</sup> See *infra* notes 164-79 and accompanying text.

<sup>121</sup> See *infra* notes 180-15 and accompanying text.

<sup>122</sup> Convention, *supra* note 10, art. 1.

goal was a treaty designed to end the destruction of the rain forests<sup>123</sup> and to halt further decline in biodiversity.<sup>124</sup> The proposed treaty recognized that because developing nations continually strive for economic development, these countries will only undertake efforts to conserve their natural resources, and thus biodiversity, where they receive substantial economic benefit from doing so.<sup>125</sup> Thus, the treaty sought to "give nations a right to share in the profits of products made using the genetic materials native to their territories."<sup>126</sup>

Various provisions of the proposed treaty, notably those controlling the transfer and sharing of patented biotechnology and distribution of the economic benefits of biodiversity, proved to be extremely controversial.<sup>127</sup> Debate concerning these issues was essentially divided into two camps: the "North" and the "South."<sup>128</sup> The South, or developing nations with significant genetic resources,<sup>129</sup> sought a share of the benefits derived from the resources within their own borders and reduced intellectual property rights ("IPR") protection for the North in order to encourage technology transfer to these developing countries.<sup>130</sup>

On the other hand, developed countries in the North, with biotechnology industries long accustomed to exploiting these resources solely for their own economic gain, argued that IPR protection was necessary to make biotechnology research economically feasible for pharmaceutical companies.<sup>131</sup> Further, such protection would actually promote technological benefits by increasing the value of the genetic resources and providing incentive for conservation of biodiversity.<sup>132</sup>

Specifically, the pharmaceutical industry explained that chemical prospecting and biotechnology experimentation is extremely expensive and laborious.<sup>133</sup> The detailed regulations and the mandatory, time-consuming testing programs contribute to the exorbitant costs of medical research.<sup>134</sup> Extensive development programs, intense competition, continually evolving technology, and the speculative nature of biotechnology mandate enormous capital investment in order to make such research possible.<sup>135</sup> Consequently, investors must be guaranteed substantial profits in order to make any such undertaking worthwhile.<sup>136</sup> Intellectual property rights are designed to do exactly that by "granting the holder an exclusive right to

<sup>123</sup> See *id.*; see also Steven Manning, *The Cost of Survival*, SCHOLASTIC UPDATE, Apr. 17, 1992, at 10.

<sup>124</sup> Paul Roberts, *supra* note 20, at 303.

<sup>125</sup> Coughlin, *supra* note 34, at 343.

<sup>126</sup> *Id.*

<sup>127</sup> See Downes, *supra* note 6, at 2-3, 7-8.; Cheryl D. Hardy, Comment, *Patent Protection and Raw Materials: The Convention on Biological Diversity and Its Implications for U.S. Policy on the Development and Commercialization of Biotechnology*, 15 U. PA. J. INT'L BUS. L., 299, 317-19 (1994); see also *U.S. Biotech Companies Leery of Biodiversity Treaty*, S.F. EXAMINER, June 11, 1992, at 13A; *Biodiversity: Treaty Interferes With Principles of Patent Production*, U.S. Official Says, Pat., Trademark & Copyright L. Daily (BNA), June 11, 1992 (available in Westlaw, BNA Library, BNA-PTD File).

<sup>128</sup> Downes, *supra* note 6, at 6.

<sup>129</sup> Genetic resources are defined as "a high diversity of wild species of plants and animals or varieties of domesticated crops and their wild relatives." *Id.*, at 6.

<sup>130</sup> *Id.* at 7.

<sup>131</sup> *Id.*

<sup>132</sup> *Id.*

<sup>133</sup> Streltzer, *supra* note 45, at 273. See *supra* notes 36-40 and accompanying text.

<sup>134</sup> Streltzer, *supra* note 45, at 276.

<sup>135</sup> *Id.* at 276, 283

<sup>136</sup> *Id.* at 283.

the new or unique product, design, or technology" and to profit therefrom.<sup>137</sup> This expectation of profits and control encourages investment and promotes further innovation, rendering patent protection crucial for ongoing research and development.<sup>138</sup>

Without exclusive intellectual property rights, investors and pharmaceutical companies would simply not be willing to undertake the enormous burden involved in developing potentially beneficial drugs.<sup>139</sup> According to the biotechnology and pharmaceutical industries, the proposed treaty required a virtual pharmaceutical gift of technology from the industrialized nations to the developing countries in exchange for access to natural resources, resulting in reduced protection for the industries' intellectual property rights.<sup>140</sup> The feared net result would be a reduction of profits, a corresponding curtailment in capital investments, and ultimately, loss of U.S. leadership in biotechnology and pharmaceuticals as a consequence of giving away this valuable information.<sup>141</sup>

While industrialized nations continued to press for the inclusion of IPR protection,<sup>142</sup> the South emerged from the Earth Summit fairly victorious. Ultimately, the United Nations Conference on Environment and Development, Convention on Biological Diversity ("Convention" or "Biodiversity Treaty"),<sup>143</sup> the agreement resulting from the Summit, was premised on the notion that "developing nations . . . have a right to own the genetic properties of the plants within their borders" and should be compensated for their contributions.<sup>144</sup> The Convention signaled the end of the developed nations' uncompensated exploitation of the natural resources in developing countries.<sup>145</sup> Rather, it advocates fair sharing of resources, financial gains, technology, and intellectual property resulting from chemical prospecting.

<sup>137</sup> *Id.* at 277-78.

<sup>138</sup> *Id.* at 279.

<sup>139</sup> Hanellin, *supra* note 8, at 186.

<sup>140</sup> Streltzer, *supra* note 45, at 294.

<sup>141</sup> Richard Stone, *The Biodiversity Treaty: Pandora's Box or Fair Deal?*, 256 *Sci.* 1624 (1992). One commentator noted that in addition to inflicting "substantial harm on intellectual property policy," the Convention "did little to protect biodiversity," since "every single substantive provision of the Convention dealing with obligations to preserve biodiversity is qualified by the phrase: 'as far as possible and appropriate'" as well as such other "weasel" words as "endeavor" and "taking into account the special needs of developing countries." C. Michael Hathaway, *Was the United States Right Not to Sign the Biodiversity Convention? Yes: A Threat to Property Rights*, 78-*SEP A.B.A. J.* 42 (1992).

<sup>142</sup> Downes, *supra* note 6, at 3.

<sup>143</sup> Convention, *supra* note 10.

<sup>144</sup> Toby Moore, *Earth Summit: The Planks Aimed at Shoring Up the Future*, *DAILY TELEGRAPH*, June 3, 1992, at 8.

Specifically, three articles of the Convention control this notion. Article 15 governs access to genetic and biological resources and recognizes each signatory nation's sovereign rights over its natural resources. Each nation is to allow access to its biological resources for environmentally sound uses on mutually agreed upon terms. The results of research and the benefits arising from the use of biological resources should be shared with the nation providing such resources. *See* Convention, *supra* note 10, art. 15.

Additionally, Article 16 recognizes that technology transfer is essential to the Convention's objectives. Consequently, contracting parties are to provide for technology transfer in "fair," "concessional," and "preferential" terms most favorable to developing countries. *See id.*, art. 16.

The third relevant provision, Article 19, governs the handling of biotechnology and the distribution of its benefits. The Article indicates that nations providing natural resources should be allowed to participate in biotechnological research activities. *See id.*, art. 19.

<sup>145</sup> *See infra* notes 197-98 and accompanying text (describing Madagascar's experience with the rosy periwinkle).

Ultimately, the Bush Administration, acting substantially in response to pressure from the U.S. biotechnology and pharmaceutical industries,<sup>146</sup> refused to sign the treaty on the basis that it did not adequately “protect patent and property rights for future discoveries based on substances or genetic material extracted from plant matter” in developing countries.<sup>147</sup> By the end of the Earth Summit, the United States remained the sole member of the United Nations that refused to sign the Biodiversity Treaty.<sup>148</sup> President Bush justified the U.S. refusal by explaining:

I believe that American biotechnology can help others. But it can't be if the product of that is taken away or if the incentive to innovate and the incentive to profit by your research is removed.<sup>149</sup>

And if the United States has to be the only nation to stand against the biodiversity treaty as now drawn, so be it.<sup>150</sup>

Although the Bush Administration held fast in its refusal to sign the Biodiversity Treaty, the Clinton Administration signed the Convention on June 4, 1993,<sup>151</sup> the last day the treaty was open for signature.<sup>152</sup> President Clinton expressed concerns similar to those of former President Bush, and in signing the treaty, U.S. officials announced that an “interpretive statement” expressing the pharmaceutical and biotechnology industries’ IPR concerns would accompany the treaty when submitted to the U.S. Senate for ratification.<sup>153</sup> This statement, detailing the Clinton Administration’s stance on the technology transfer and patent provisions, “adopts the position that commercially viable products will not make it to

<sup>146</sup> See, e.g., *U.S. Biotech Companies Leery of Biodiversity Treaty*, *supra* note 127, at 13A; *Industry Trade Groups Laud President Bush for Decision Not to Sign Biodiversity Treaty*, Pat. Trademark & Copyright L. Daily (BNA), June 15, 1992, available in Westlaw, BNA Library, BNA-PTD File).

<sup>147</sup> Peter Eisner, *Earth Calling Bush, U.S. Isolated as White House Rejects EPA Chief's Bid for Treaty*, NEWSDAY, June 6, 1992, at 5. Sources also cite the funding provisions established by Article 20 (Financial Resources) and Article 21 (Financial Mechanism) as further reasons for U.S. refusal to sign the Convention. See Convention, *supra* note 10. For a comprehensive discussion of role of international funding in the preservation of biodiversity, see Paul Roberts, *supra* note 20.

<sup>148</sup> Streltzer, *supra* note 45, at 272. See also Paul Roberts, *supra* note 20, at 311.

<sup>149</sup> Streltzer, *supra* note 45, at 272 (citing the President's News Conference in Rio de Janeiro, Brazil, 28 Weekly Comp. Pres. Doc. 1043, 1049 (June 13, 1992)).

<sup>150</sup> Streltzer, *supra* note 45, at 272 (citing Remarks and an Exchange with Reporters Prior to a Meeting with Congressional Leaders, 28 Weekly Comp. Pres. Doc. 1035, 1036 (June 11, 1992)).

<sup>151</sup> Vice President Albert Gore, *U.S. Support for Global Commitment to Sustainable Development*, Speech, June 14, 1993, 4 U.S. DEP'T ST. DISPATCH 430. See also *Chronological Summary: Events of 1993*, 5 COLO. J. INT'L ENVTL. L. & POL'Y 181, 182 (1994); *As It Signs Treaty, United States Calls for Global Patent Protection for Biotech*, June 7, 1993, available in Westlaw, BNA-DEN database.

In contemplating reasons for this switch in the U.S. position, one author stated:

The position of the United States in 1992 regarding the Biodiversity Treaty may have reflected a lack of awareness of the U.S. biotechnology industry's dependence on the organisms supplied by developing nations. Perhaps the Bush Administration was unaware that the developing nations had recourse against the refusal of the U.S. biotechnology industry to share benefits and profits, such as forming more advantageous alliances with European nations and Japan.

Hardy, *supra* note 127, at 324.

<sup>152</sup> *The International Treaty to Protect the Diversity*, Oct. 6, 1993, available in Westlaw, BNA-ITR database.

<sup>153</sup> See Coughlin, *supra* note 34, at 344. See also Convention on Biological Diversity, S. Doc. No. 20, 103d Cong., 1st Sess. 12 (1993).

the market if patent protection is not afforded companies that discover and develop new biotechnology."<sup>154</sup> However, while still desiring IPR protection for U.S. industries, the Clinton Administration conceded that developing nations should benefit from access to their natural resources.<sup>155</sup> In its interpretative statement, the administration made clear that this compensation should be monetary, rather than in the form of technology transfers.<sup>156</sup>

On September 30, 1993, Mongolia became the thirtieth country to ratify the Convention; the Biodiversity Treaty then went into effect ninety days later on December 29, 1993.<sup>157</sup> The first post-Earth Summit meeting to negotiate the protocols<sup>158</sup> to the Convention took place November 28 through December 16, 1994, in Nassau, the Bahamas.<sup>159</sup> This first Conference of the Parties was typified by a "spirit of cooperation, persistence, and dedication" to the cause of preserving global biodiversity and equitably sharing its benefits, as the parties hammered out the details of the Convention.<sup>160</sup> However, because the U.S. Senate failed to ratify the treaty by the conference time, the United States was relegated to observer status at the conference and had no voting power over the negotiations.<sup>161</sup> Because the treaty's signatory countries have yet to convert the Convention's general principles and guidelines into concrete standards to which all parties may be held accountable,<sup>162</sup> whether the agreement will have an effect on the preservation of global biodiversity is not ascertainable and the controversial issues remain largely unresolved.<sup>163</sup>

<sup>154</sup> Hardy, *supra* note 127, at 318 n.123, 319.

<sup>155</sup> *Id.* at 321.

<sup>156</sup> *Id.* at 321-22.

<sup>157</sup> *Chronological Summary: Events of 1993, supra* note 151, at 187. Although more than 150 countries signed the treaty at the Earth Summit, *Biodiversity: Treaty Enters Into Force 18 Months After Its Signing at 1992 Earth Summit*, Dec. 30, 1993, available in Westlaw, BNA-DEN database, it did not enter "into force until 90 days after 30 countries ratif[ied], or agree[d] to abide by, the treaty." *The International Treaty to Protect the Diversity, supra* note 152.

<sup>158</sup> Such protocols may involve logistics of implementation, administration, enforcement, and financing; protocols are treaties which are separate but related to the original Convention. Downes, *supra* note 6, at 25. These negotiations are necessary because the Convention made "clear its goals but not the means to implement them." Kadidal, *supra* note 20, at 226. One reason cited to explain President Clinton's decision to sign the treaty was the desire for U.S. participation in negotiations of these protocols. Coughlin, *supra* note 34, at 344. Since the necessary number of countries ratified the Convention, it is likely that the U.S. would have to comply with its provisions, whether or not the U.S. signed the treaty, since "developing nations which harbor the world's genetic diversity will simply refuse to deal with U.S. biotechnology companies, denying them access to the critical wealth of genetic resources within their territories." *Id.* at 352. For a discussion of the strength and weaknesses of this argument, see *id.* at 352-55.

<sup>159</sup> *Biodiversity: No Vote for U.S. at Upcoming Talks Due to Legislative Delays in Senate*, Sept. 8, 1994, available in Westlaw, BNA-DEN database.

<sup>160</sup> *Biodiversity: UNEP Head Cites 'Uncommon Spirit' of Cooperation Demonstrated at Meeting*, Dec. 13, 1994, available in Westlaw, BNA-DEN database.

<sup>161</sup> *Biodiversity: Clinton Urged to Use Executive Powers to Meet Goals of Biodiversity Treaty*, Dec. 13, 1994, available in Westlaw, BNA-DEN database. The 103d Congress failed to ratify the treaty; by January 1995, the 104th Congress failed to do the same, despite the fact that "ninety-two countries including all of the major industrialized nations" have ratified it. *Endangered Species Push on for Reform of Act During Reauthorization*, Jan. 9, 1995, available in Westlaw, BNA-DEN database.

<sup>162</sup> For a detailed description of how participating countries should go about negotiating the follow-up issues left open by the vague language and framework of the Convention, see Downes, *supra* note 6, at 25.

<sup>163</sup> Coughlin, *supra* note 34, at 25.



## V. PRIVATE EFFORTS AIMED AT PRESERVING BIODIVERSITY

## A. SHAMAN PHARMACEUTICALS

In addition to the international effort represented by the Earth Summit's Biodiversity Convention, private actors have launched attempts to preserve biodiversity. One such private model is typified by Shaman Pharmaceuticals ("Shaman"), a California-based drug company which recognizes the medicinal potential of the tropical rain forests' natural resources and seeks to contribute to biodiversity preservation through ethnobotany.<sup>164</sup> Company botanists work directly with shamans, who are native healers, in forest areas to select tropical plants worthy of consideration.<sup>165</sup> Indigenous populations are frequently a wealth of information because, having lived in the same regions for thousands of years, they can guide researchers to natural resources that have been used successfully to treat ailments over a period of time.<sup>166</sup>

In order for Shaman Pharmaceuticals to accept a plant for laboratory research, at least three villages must use that plant for medicinal purposes.<sup>167</sup> According to the company, this ethnobotanical technique saves the time and resources wasted by larger companies who "pok[e] around in the dark" randomly picking and screening plants.<sup>168</sup> Shaman's work has already proven to be potentially fruitful: the company has tested more than one hundred plants in the lab, with half showing promise and three patents pending.<sup>169</sup> Testing has included potential drugs derived from Ecuadorian and Peruvian plants used by villagers to treat the flu, colds, and herpes sores.<sup>170</sup> The company is also testing a drug that may help treat secondary AIDS infections and cancer, as well as an analgesic that may be stronger than aspirin.<sup>171</sup>

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<sup>164</sup> *Rainforest Pharmaceuticals*, *supra* note 35, at 17. Ethnobotany is the "study of tribal peoples and their utilization of tropical plants." Mark J. Plotkin, *The Healing Forest: The Search for New Jungle Medicines*, *FUTURIST*, Jan.-Feb. 1990, at 12. Approximately seventy-five percent of the plant-derived constituents currently used in drugs were discovered through the study of plants used by indigenous populations. Peterson, *supra* note 44, at 283. The use of ethnobotany presents an additional intellectual property issue, however, because the "cultural knowledge of an indigenous group and even the secrets of healers within a group are not [patentable], since they are considered to be public, common knowledge." *Id.* at 285.

<sup>165</sup> *Rainforest Pharmaceuticals*, *supra* note 35, at 17.

<sup>166</sup> Hanellin, *supra* note 8, at n.21. Shaman's Vice President, Stephen King, cites one example of the benefits of traditional healers. A Brazilian plant called *pilocarpus jaborandi* is the basis for a drug long used to treat glaucoma; only recently has it been prescribed for dry mouth. This benefit could have been available much sooner had someone "checked the plant's native use. Jaborandi is a Tupi Indian word that means 'slobber-mouth.'" McFarling, *supra* note 18, at 29.

As rain forests are destroyed, not only are species pushed into distinction, but so too are indigenous tribes. For example, in 1900, one million indigenous peoples lived in the Brazilian rain forests; by 1980, only 100,000 such Indians remained in Brazil. McGee & Zimmerman, *supra* note 2, at 517. This poses a serious threat to ethnobotany since knowledge of plants with medicinal use is generally an oral tradition. Peterson, *supra* note 44, at 284-85. As one ethnobotanist stated, "[e]very time one of the healers dies, it's like having a library burned." *Ethnobotanist Seeks New Cures*, *AIDS WEEKLY*, July 4, 1994, at 7 (quoting Paul Alan Cox, a Brigham Young University professor who works with Samoan healers to find a cure for AIDS).

<sup>167</sup> *Rainforest Pharmaceuticals*, *supra* note 35, at 17.

<sup>168</sup> *Id.*

<sup>169</sup> Linda Killian, *Jungle Fervor*, *FORBES*, July 22, 1991, at 315.

<sup>170</sup> *Rainforest Pharmaceuticals*, *supra* note 35, at 17.

<sup>171</sup> *Id.*

In addition to pharmaceutical success as a result of its ethnobotanical techniques, Shaman professes to be environmentally successful in its drive towards biodiversity preservation. The company compensates the shamans who help identify plants with medicinal potential, as well as people from the local communities who help harvest the plants when large quantities are required.<sup>172</sup> By enabling the locals to make a living by collecting samples, Shaman hopes to create the necessary economic alternative to deforestation.<sup>173</sup> Further, the founder of Shaman Pharmaceuticals also established the Healing Forest Conservancy, a nonprofit organization to which a percentage of Shaman's profits are devoted for the preservation of the rain forest and assistance of indigenous people.<sup>174</sup>

Although the method of pharmaceutical research employed by Shaman Pharmaceuticals may be beneficial, the company faces substantial hurdles that may prevent this private model of pharmaceutical research from ultimately succeeding. The biggest barrier Shaman faces is that of adequate financing. Five years after its founding and tens of millions of dollars later, the company's sole source of operating revenue was a research contract with Eli Lilly, a major U.S. pharmaceutical company.<sup>175</sup> However, in October 1994, Eli Lilly discontinued financing Shaman's development of drugs produced from tropical plant specimens.<sup>176</sup> Since Shaman has yet to develop a marketable product, the company's future depends on "clinical trials of two antiviral drugs that look promising but are still a long, costly way from regulatory approval."<sup>177</sup> Thus, Shaman's lofty goal of preserving biodiversity through ethnobotany may be thwarted by the extremely high price tag associated with developing plant-based and animal-based pharmaceuticals.<sup>178</sup> This factor alone indicates a major weakness in this model's attempt to halt the loss of bio-diversity: preservation of genetic resources may simply be beyond the reach of start-up biotechnology companies.

An additional problem with Shaman's approach is that although it provides an economic benefit to the indigenous population on a local scale, the company ignores a major player in the problem of rain forest destruction: the government. An arrangement must be profitable for the country as a whole in order for the developing nation's government to be a willing participant in rain forest protection. Without a financial benefit for the government, Shaman's program seems to help their plant-based and animal-based research while providing little deterrence for the impoverished governments to continue exploiting their nations' natural resources. Shaman pledged to contribute royalties to both the government and the native community home to the successful plant,<sup>179</sup> yet the effectiveness of this pledge is questionable since it lacks a binding contractual agreement with either party.

<sup>172</sup> Blum, *supra* note 20, at 42.

<sup>173</sup> *Id.* at 43.

<sup>174</sup> *Id.* at 42-43.

<sup>175</sup> Richard Phalon, *Keep Your Eye on the Ball*, FORBES, Apr. 11, 1994, at 78.

<sup>176</sup> Eli Lilly cited a shift in its research priorities as the reason for the withdrawal of its financial backing. John Eckhouse, *Eli Lilly Ends Investment in Shaman*, S.F. CHRON., Oct. 13, 1994, at D1. Because Shaman received \$42 million in its 1993 public stock offering, Phalon, *supra* note 175, at 78, Eli Lilly's withdrawal of financial support in itself does not signal Shaman's demise. Eckhouse, *supra*, at D1. However, in the initial public offering, Shaman's stock was offered at \$15 a share. Phalon, *supra* note 175, at 78. On October 12, 1994, Shaman stock closed at 6 after having hit a 52-week low of 5 1/2 earlier in the day. Eckhouse, *supra*, at D1.

<sup>177</sup> Phalon, *supra* note 175, at 78.

<sup>178</sup> See *supra* notes 36-38 and accompanying text.

<sup>179</sup> Gary Stix, *Back to Roots: Drug Companies Forage for New Treatments*, SCI. AM., Jan. 1993, at 143.

## B. THE MERCK/INBIO AGREEMENT

A second private arrangement between Merck & Co. and Costa Rica's Instituto Nacional de Biodiversidad ("INBio") represents an alternative model for preserving biodiversity and maintaining the storehouse of genetic material currently residing in the global rain forests. In the late 1980s, Daniel Janzen, a tropical biologist at the University of Pennsylvania, and Rodrigo Gámez, a plant virologist at the University of Costa Rica, acted on recommendations of the Costa Rican government<sup>180</sup> and created INBio out of their desire to preserve Costa Rica's biodiversity by finding nondamaging methods of using it.<sup>181</sup>

INBio developed as a nonprofit scientific organization aimed at rain forest research and preservation.<sup>182</sup> Its mission is to "identify and classify the diverse biological species found in the rain forests and protected areas of Costa Rica and to disseminate that information to potential users in a manner beneficial to society."<sup>183</sup> In furtherance of this mission, INBio began to create a complete catalogue of Costa Rica's plants, animals, and insects.<sup>184</sup> The inventory was to be achieved through "training parataxonomists—bus drivers, teachers, housewives, students—in the art of collecting and identifying species."<sup>185</sup>

Cornell University chemical ecologist Thomas Eisner recognized INBio to be the perfect partner for a pharmaceutical company interested in the exploration of rain forest species for medicinal potential.<sup>186</sup> This process, also known as chemical prospecting, "involves the collection of many samples of organisms and microorganisms in order to study them to determine whether their chemical composition can be useful in some respect, either medically or agriculturally."<sup>187</sup> Eisner arranged a meeting between Merck & Co., the largest pharmaceutical company in the United States,<sup>188</sup> and INBio; a mutually beneficial partnership developed. Under the resulting 1991 agreement, Merck provided INBio one million dollars up front, in exchange for which INBio is to supply Merck with rain forest samples over a two-year period.<sup>189</sup> In addition, Merck donated equipment and the use of scientists to INBio in order to set up a lab and train scientists in Costa Rica.<sup>190</sup> Crucial to the agreement is the royalty provision, whereby Merck agreed to pay INBio a percentage of any royalties earned from any drug Merck markets as a result of the Costa Rican samples.<sup>191</sup> INBio will then split the royalties equally with the Costa Rican Ministry of Natural Resources, which will dedicate its portion of the income to

<sup>180</sup> Paul Roberts, *supra* note 20, at 328-29.

<sup>181</sup> Leslie Roberts, *supra* note 20, at 1142.

<sup>182</sup> Paul Roberts, *supra* note 20, at 328.

<sup>183</sup> *Id.*, at 329 (quoting MERCK & CO., INC., *INBio of Costa Rica and Merck Enter into Innovative Agreement to Collect Biological Samples While Protecting the Rain Forest* 2 (Sept. 19, 1991) (Company News Release)).

<sup>184</sup> Leslie Roberts, *supra* note 20, at 1142.

<sup>185</sup> *Id.*

<sup>186</sup> *Id.*

<sup>187</sup> Paul Roberts, *supra* note 20, at 329.

<sup>188</sup> Thernstrom, *supra* note 6, at 13. Other sources state that Merck is the largest pharmaceutical company in the world. See, e.g., Johnson, *supra* note 26, at 1A.

<sup>189</sup> Johnson, *supra* note 26, at 1A; Leslie Roberts, *supra* note 20, at 1142; Thernstrom, *supra* note 6, at 13.

<sup>190</sup> The estimated value of this equipment ranges from \$135,000, Leslie Roberts, *supra* note 20, at 1142, to \$180,000, Thernstrom, *supra* note 6, at 12.

<sup>191</sup> Though undisclosed, these royalties are thought to range between one to three percent. Leslie Roberts, *supra* note 20, at 1143.

environmental preservation.<sup>192</sup> INBio may form similar agreements with other companies, but Merck retains the right of first refusal to samples collected by INBio parataxonomists.<sup>193</sup>

The Merck/INBio agreement may be the best chance yet at staving off further global rain forest depletion, because in theory it provides sufficient financial incentive for a developing country to leave its forests intact, thereby preserving the biodiversity necessary for pharmaceutical companies to continue pursuing plant-based and animal-based research.<sup>194</sup> In addition to the up-front fee and the technology transfer,<sup>195</sup> "if INBio receives two percent of the royalties from the sale of twenty products based on its samples, INBio would receive more money than Costa Rica does from the sale of coffee and bananas, two prime exports."<sup>196</sup>

This royalty fee addresses a serious problem typified by the Madagascar rosy periwinkle,<sup>197</sup> where Eli Lilly has profited in the hundreds of millions, while Madagascar has yet to receive any remuneration.<sup>198</sup> Developing countries now recognize the medicinal potential of their natural resources and will not repeat the lesson of the rosy periwinkle.<sup>199</sup> Consequently, any pharmaceutical company making an arrangement involving the use of a developing nation's natural resources must adequately compensate that country; the Merck/INBio agreement appears to succeed on this point.<sup>200</sup> Further, Merck retains all patents to any products resulting from the agreement, thereby resolving the intellectual property concerns voiced by the pharmaceutical industry in pressuring the Bush Administration to forgo signing the Earth Summit's Biodiversity Convention.<sup>201</sup>

While the Merck/INBio contract appears to be a solution to the current loss of biodiversity, the agreement is not without potential problems. It is conceivable that Merck (or another drug company in a similar agreement) could find fruitful biological specimens in other nations with which it does not have a contractual agreement to provide royalties. As a result, Costa Rica would lose the royalties that provide the necessary financial incentive for the country to protect its biodiversity.

An additional weakness in the Merck/INBio model lies in the possibility that if a useful specimen also exists in a country other than Costa Rica, it would thus be available to Merck's competitors.<sup>202</sup> If so, Merck may lose the competitive edge

<sup>192</sup> Blum, *supra* note 20, at 20.

<sup>193</sup> *Id.* But see Kadidal, *supra* note 20, at 233 (arguing that Merck's "exclusive" right to the plant samples "can be undercut . . . [o]nce Merck's product reaches the market" and other companies determine the active chemical ingredient makeup of the drug).

<sup>194</sup> Leslie Roberts, *supra* note 20, at 1142.

<sup>195</sup> Merck was able to avoid the technology transfer dilemma that stalemated the Biodiversity Treaty by giving INBio valuable technology, but not technology that would allow INBio to replicate Merck's drugs. Coughlin, *supra* note 34, at 359. The Biodiversity Treaty, on the other hand, did not distinguish between types of technology. *Id.* at 360. For a discussion on the three identifiable classes of technology, see *id.* at 358-59.

<sup>196</sup> Blum, *supra* note 20, at 34.

<sup>197</sup> See *supra* notes 20-26 and accompanying text.

<sup>198</sup> Thernstrom, *supra* note 6, at 12.

<sup>199</sup> Johnson, *supra* note 26, at 1A.

<sup>200</sup> But see Kadidal, *supra* note 20, at 235 (calling the Merck/INBio agreement "one-sided as . . . the result of a severe imbalance of bargaining power: the enormous wealth of a multinational corporation matched against the enormous financial need of a developing nation . . .").

<sup>201</sup> See *supra* notes 146-56 and accompanying text.

<sup>202</sup> Peterson, *supra* note 44, at 289.

necessary to produce a lucrative product, and INBio will lose out on potential royalties, thus removing significant financial incentive to conserve its natural resources.

Of further detriment to the success of this agreement is the potential for Merck to "discover[] commercial use of specimens from the contracting [country] and attribut[e] those discoveries to substances synthesized in laboratories."<sup>203</sup> Again, this outcome would deprive INBio of the financial gain necessary to guard its natural resources from destruction. However, this possibility does not seem likely given the cooperative nature in which the agreement developed.

Additionally, the success of the partnership depends on the drug company's ability to bring to market a product that is based on specimens provided by Costa Rica; this remains merely a potential, however, since no such drug has yet been marketed.<sup>204</sup> In this regard, the Merck/INBio arrangement overlooks the immediacy of the deforestation problem.<sup>205</sup> It may be ten years before INBio, and thus Costa Rican conservation, receives any royalties from its resources, and in the meanwhile, the globe's rain forests and their species continue to be pushed into extinction.<sup>206</sup> Thus, in the short term, the pharmaceutical industry remains threatened.

Another problem lies in the possibility that Merck may develop a marketable drug from a Costa Rican specimen, but this drug's active ingredients cannot be synthesized.<sup>207</sup> If so, demand for the actual specimen will increase, leading to a plundering of the Costa Rican rain forest for more of that resource, possibly to the point where the region is completely stripped of the specimen. Thus, the creation of a useful and profitable pharmaceutical may actually contribute to the denuding, rather than the preservation, of the region's tropical forests. As a result, biodiversity could suffer, instead of benefiting.

Further, while the Merck/INBio partnership seems to be a possible solution to the raging problem of deforestation, it remains to be seen whether a similar arrangement would be successful in other tropical regions and whether it is truly a global solution instead of merely a localized one.<sup>208</sup> Many characteristics of Costa Rica made it particularly amenable to such an agreement. First, the country is abundantly rife with tropical plant, animal and insect species, containing approximately four percent of the world's biodiversity.<sup>209</sup> On the other hand, another developing nation in serious jeopardy of losing its biodiversity may not be such a

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<sup>203</sup> Paul Roberts, *supra* note 20, at 330-31.

<sup>204</sup> Clifford, *supra* note 37, at 13. See also Weiss, *supra* note 36, at 12 (noting that "despite two and a half years of [collaboration between Merck and INBio], no new drugs have made it into clinical studies.").

<sup>205</sup> Clifford, *supra* note 37, at 13.

<sup>206</sup> *Id.*

<sup>207</sup> *Id.*

<sup>208</sup> Other pharmaceutical companies and developing nations are beginning to form similar partnerships based on sharing pharmaceutical profits with communities that contribute natural resources for analysis. For example, Bristol-Myers Squibb has paired up with Surinam to study the country's medicinal plants. Bristol-Myers Squibb will pay to Surinam's local population royalties for any drugs derived from plants gathered in the Amazonian nation. Additionally, the shamans of Surinam will be eligible to share patent rights to marketable compounds. Weiss, *supra* note 36, at 12. But see Eugene Linden, *Chain Saws Invade Eden*, TIME, Aug. 29, 1994, at 58 (noting that the government of Surinam recently opened huge tracts of forests for logging by timber and trading companies).

<sup>209</sup> Johnson, *supra* note 26, at 1A. See also Paul Roberts, *supra* note 20, at 328 n.145 ("Costa Rica . . . is believed to contain almost five percent of all the species of flora and fauna in the world.").

wealthy, genetic storehouse. Drug companies interested in pursuing chemical prospecting will seek agreements with nations based on their "relative genetic richness."<sup>210</sup> Such a situation could lead to a result where countries "whose biological diversity is the most threatened" receive the least amount of assistance.<sup>211</sup>

Other factors facilitating the Merck/INBio agreement are Costa Rica's well-educated adult population<sup>212</sup> and stable, democratic government committed to conservation.<sup>213</sup> This commitment to preservation allowed the Merck/INBio arrangement to develop in a cooperative atmosphere, unlike the divisiveness which characterized the negotiations of the Biodiversity Treaty.<sup>214</sup> Additionally, INBio presented a unique opportunity, given its ties to the government and its existing scientific expertise prior to the partnership with Merck.<sup>215</sup> While these characteristics facilitated the Merck/INBio partnership, they may not be imperative for similar success in other developing nations, since circumstances seem ideal for the creation of other such agreements as pharmaceutical companies are once again recognizing the irreplaceable benefits of natural resource-based drug research.

## VI. CONCLUSION

In light of the fundamental role biodiversity plays in a successful future for the pharmaceutical industry and the threat deforestation poses to the continued existence of biodiversity, it is imperative that industrialized nations act immediately to halt global rain forest destruction. Since deforestation occurs primarily as a result of developing nations' urgent need for quick finances, the only feasible solution to this crisis is making protection of the rain forests and their species profitable for the countries which host these valuable resources. Indigenous populations and national governments must have sufficient economic incentives to preserve the biodiversity of their nations.

The pharmaceutical industry plays a fundamental role in achieving this end, as the drug industry has finally realized that conservation of the tropical rain forests is in its own best economic interest. The industry, however, must allow developing countries to profit from their natural resources by way of compensation for the removal of tropical plants and animals, and royalties from any drugs produced therefrom. Ultimately, these countries must realize that their tropical forests and unique biodiversity are worth more intact than they are destroyed. If they receive more economic compensation for their valuable resources by maintaining the rain forests, rather than converting them to lumber or cattle grazing areas, these countries will act to preserve these resources. Only through this conservation of resources can the pharmaceutical industry succeed in its current venture of examining natural compounds for their medicinal potential.

The Biodiversity Treaty introduced at the Earth Summit in 1992 still represents a possible model for how the global community can unite in an effort to preserve world-wide biodiversity. However, it is questionable whether the intel-

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<sup>210</sup>Coughlin, *supra* note 34, at 369.

<sup>211</sup>*Id.*

<sup>212</sup>The Costa Rican government estimates adult literacy to be ninety-eight percent. Blum, *supra* note 20, at 39.

<sup>213</sup>Leslie Roberts, *supra* note 20, at 1143.

<sup>214</sup>Coughlin, *supra* note 34, at 357.

<sup>215</sup>Leslie Roberts, *supra* note 20, at 1142.

lectual property concerns which have prevented the U.S. Senate from ratifying the treaty can be overcome so that the United States, with the world's largest pharmaceutical industry, can become a partner to the pact. Without U.S. participation in the Convention, many of the troubling issues concerning biodiversity preservation remain unaddressed. The next Conference of the Parties is scheduled to be held in Indonesia from November 6-17, 1995.<sup>216</sup> If the U.S. Senate has ratified the treaty by that time, the United States must work with the other signatory parties to arrive at a mutually satisfactory agreement on the intellectual property terms that will govern pharmaceutical use of biodiverse resources. In order for this to be successful, the U.S. pharmaceutical industry must be willing to share the financial gains of its plant-based and animal-based successes with the countries that host the natural compounds on which these successes are based.

In the meanwhile, individual pharmaceutical companies should undertake the preservation of biodiversity through private means. While Shaman Pharmaceuticals and its ethnobotanical efforts may succeed at this goal, the massive financial resources required for biotechnology research may prove to be insurmountable for a small, start-up biotechnology firm. If Shaman can produce a marketable drug from its research, however, the company will be able to satisfy the economic needs of its own endeavors while making biodiversity preservation lucrative for the people of the developing countries.

The Merck/INBio partnership may represent the most effective model for preserving biodiversity. The agreement appears to protect the intellectual property rights of the pharmaceutical company, while compensating Costa Rica and its inhabitants for the precious resources within the country. The partnership shows other firms, organizations, and nations how to establish mutually beneficial agreements that provide economic incentives for rain forest preservation while advancing pharmaceutical research. The ultimate success of this partnership, and of other agreements modeled after this relationship, depends on Merck producing a marketable drug from the specimens provided by INBio, in return for which INBio will receive substantial royalties. Only this reward will provide Costa Rica with sufficient financial incentive to protect its natural resources.

Given the extent of the irreversible damage reeked by deforestation, developed countries must take the lead in halting this crisis by promoting economic growth through biodiversity preservation. The three models examined in this Note possess the potential for furthering this goal. Each one, however, requires willingness by the pharmaceutical industry to compensate developing nations for their resources. Each one also depends on involvement of the parties financially affected by deforestation—the pharmaceutical industry, governments of developing nations, and the indigenous populations of these countries. While these three attempts possess potential and are worthy of pursuit, ultimately only time will tell if any of these arrangements is the desperately needed solution to the deforestation crisis that is threatening to destroy the planet's biodiversity.

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<sup>216</sup> *Biodiversity: UNEP Head Cites 'Uncommon Spirit' of Cooperation Demonstrated at Meeting*, *supra* note 160.