Agricultural Biotechnology: Why It Can Save the Environment and Developing Nations, But May Never Get a Chance

Mary Lynne Kupchella

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AGRICULTURAL BIOTECHNOLOGY: WHY IT CAN SAVE THE ENVIRONMENT AND DEVELOPING NATIONS, BUT MAY NEVER GET A CHANCE

MARY LYNN KUPCHELLA*

I. INTRODUCTION

Commercial biotechnology is perhaps one of the most important developments of the last century. Agricultural biotechnology has the potential to solve many of the most daunting environmental problems facing the world, such as a decrease in biodiversity and shortages of food. With proper regulation, biotechnology can save biodiversity and solve numerous other environmental concerns. One expert has noted,

The tools of biotechnology are going to be essential if crop-yield ceilings are to be raised, the environment preserved through reduction of pesticide use, the nutrient value of basic foods increased and farmers on less-favored lands provided with varieties better able to tolerate drought, salinity and lack of soil nutrients.

Unlike the United States, the European Union (EU) does not welcome agricultural biotechnology. Its unfounded resistance threatens

* Ms. Kupchella received her B.A. in Biology from Franklin & Marshall College in 1998 and expects to receive her J.D. from the College of William & Mary School of Law in 2001.
1 The U.S. Dep’t of State defines “agricultural biotechnology” as “a collection of scientific techniques, including genetic engineering, used to create, improve, or modify plants, animals, and microorganisms.” U.S. Dep’t of State, Biotech Basics, at http://usinfo.state.gov/topical/global/biotech/99120101.htm (Dec. 1, 1999).
3 Gordon Conway, Biotech Can Feed the World, or Divide It, PLAIN DEALER (Cleveland, OH), Oct. 19, 1999, at 9B.
4 See Glickman, supra note 2.
the realization of the full potential of biotechnology.\footnote{5} While there are potential risks to agricultural biotechnology, and the long-term effects are unknown, the benefits of this technology are immense.\footnote{6} If these benefits are to be realized, a worldwide effort is required. Many issues threaten to impede the potential of biotechnology, but none are insurmountable.\footnote{7}

This paper will outline some of the major issues surrounding the agricultural biotechnology debate. Part I will discuss the benefits and potential risks of this technology in order to show what immense potential exists for biotechnology to solve many environmental problems. Much of the dispute concerning this subject exists because of the differing views of the United States and the EU. In Part II, the U.S. regulatory network for biotechnology will be compared to that of the EU to provide a background for these differences. Part III will briefly discuss the effects of the biotechnology debate on international trade. Intellectual-property rights play a large part in this equation and represent another area where the EU and United States tend to differ. The policies and systems of the developing and developed nations do not agree on intellectual-property issues either. Part IV will discuss the Convention on Biological Diversity\footnote{8} (Convention), the most recent attempt at an international agreement to solve the foregoing issues. The Convention seems to be a general step in the right direction; however, most are not confident that an agreement will ever be reached between the member nations. Through this treaty, nations of the world have recognized that maintaining biological diversity is an issue that must be addressed. However, it steps in the wrong direction by attempting to erode intellectual-property rights. Its goals can be accomplished by other means.

Finally, in Part V, this paper concludes that agricultural biotechnology can, with the cooperation of every nation, solve serious environmental issues. If those countries with opposing views are further polarized, however, biotechnology cannot reach its potential. Currently, developing nations are in desperate need of aid from the developed nations. Agricultural biotechnology will solve many of their problems, but can only do so effectively with support from the EU. Differences must be set aside, as must political influences, to aid those less fortunate.

\footnote{6} See Conway, supra note 3, at 9B.
\footnote{7} See id.
third-world nations are currently the most in need, the entire world's population relies on the biodiversity found mainly in the developing nations. Even if the EU is unwilling to accept agricultural biotechnology for its citizens, it must realize the good it can do in other areas of the world.

II. THE BACKGROUND OF AGRICULTURAL BIOTECHNOLOGY

Biotechnology is defined by the United Nations as "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use."9 The most commonly known biotechnology techniques are those of recombinant DNA technology, which the public refers to as "genetic engineering."10 The genetic material that is derived from the world's diverse resources is a basic source for biotechnology.11 At the same time, however, biotechnological products affect the biodiversity within the ecosystems into which they are introduced.12 Many believe that as the use of biotechnology has risen, a related loss of biodiversity has occurred.13 Seeds have been historically transferred around the world, most commonly from the genetically rich, less-developed countries into the genetically poor, developed countries.14

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9 Id. art. 2, at 823.
10 Dan L. Burk, *A Biotechnology Primer*, 55 U. PIT. L. REV. 611, 616 (1994). Bacterial enzymes called nucleases cut a chain of DNA at a previously defined base-pair sequence. Additional enzymes known as ligases then reconnect the cut DNA strands. By using this basic technique, DNA can be formed into new sequences. This recombinant DNA must then be transferred into a host cell where it can express itself. DNA is often introduced through a "vector." See id. at 616-617.
12 See id.
13 Klaus Bosselmann, *Plants and Politics: The International Legal Regime Concerning Biotechnology and Biodiversity*, 7 COLO. J. INT'L ENVTL. L. & POL'Y 111, 111 (1996). The term "biodiversity" refers to the diversity of life on Earth. This concept can refer to the diversity of species, the diversity within species, and the diversity of ecosystems. Biodiversity can be lost through deforestation as well as gene erosion and gene uniformity. See id. at 112-114.
14 Id. at 116.
A. The Benefits of Agricultural Biotechnology

In order to understand the implications of agricultural biotechnology, one must understand its principal benefits and risks. Many environmental and health benefits may be realized through the use of agricultural biotechnology. In agriculture, the targets for increased control are resistances to weeds, insects, disease, temperature fluctuations, and instability of the water supply.\(^\text{15}\) The use of biotechnology has grown steadily in the United States.\(^\text{16}\) In 1998, genetically engineered crops accounted for 25% of corn acreage planted in the United States, 38% of soy bean acreage, and 45% of cotton acreage, for a total of 45 million acres, an increase of 250% from 1997.\(^\text{17}\) In 1999, “biotechnology plantings in the U.S. increased to 62 million acres . . . .”\(^\text{18}\)

The production of crops which exhibit herbicide resistance is one of the more “controversial applications of biotechnology to agriculture.”\(^\text{19}\) Herbicide-resistant crops are most attractive to industry, however, as herbicide expenditures have risen steadily over the past fifteen years.\(^\text{20}\) Plants exhibit various levels of tolerance to herbicides and some can be damaged or even killed by very low doses.\(^\text{21}\) The use of herbicide-resistant crops will likely cause a reduction in the quantities of herbicides used.\(^\text{22}\) Herbicides may be applicable in stronger doses and multiple herbicide treatments may be replaced by the use of a single herbicide, resulting in a reduction in the number of applications and quantity used.\(^\text{23}\) Additionally, herbicide-resistant crops may be able to promote integrated management of weeds by causing a shift to a total post-emergence approach to weed control.\(^\text{24}\) Proponents of resistant crops also believe that


\(^{16}\) See U.S. Dep’t of State, supra note 1.

\(^{17}\) Id. Worldwide, 69 million acres of genetically engineered crops were planted in 1998.

\(^{18}\) Id.

\(^{19}\) David Barboza, Redesigning Nature: In the Heartland, Genetic Promises, N.Y. TIMES, Mar. 17, 2000, at Cl.


\(^{21}\) Id. at 30-31.

\(^{22}\) See id. at 33-34.

\(^{23}\) See id. at 41.

\(^{24}\) See id. at 42. Herbicides are most often applied to fields before the crops begin to grow. Treating crops “post emergence” is difficult to do effectively without harming the crop. If herbicide-resistant crops are effective, herbicides would potentially be needed
they will allow older, more toxic and generally more harmful herbicides to be replaced with ones which are more environmentally favorable.\textsuperscript{25}

Those who oppose the use of herbicide-resistant crops generally hold the opinion that herbicides have detrimental effects on the environment.\textsuperscript{26} While many effects of herbicides may be yet unknown, they do possess well-demonstrated benefits.\textsuperscript{27} The most serious concern, however, is that weeds will rapidly develop a resistance to the few herbicides currently relied upon.\textsuperscript{28} Also, herbicide-resistant crops are not being designed to solve problems in the areas of the world where they are most greatly needed.\textsuperscript{29} Many of the products being developed are not necessarily relevant to agriculture in developing countries. Developing countries will have to integrate modern biotechnology with their own research.\textsuperscript{30}

Aside from greater environmental benefits, agricultural biotechnology provides much hope for many problems faced by developing or third-world nations. In developing countries, an increase in the quality and volume of agricultural production is greatly needed.\textsuperscript{31} The potential of biotechnology in allowing the rapid development of new crop

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\textsuperscript{25} See KRIMSKY & WRUBEL, supra note 19, at 44.

\textsuperscript{26} See id. at 45.

\textsuperscript{27} See id. at 44. Prior to the widespread use of herbicides, weeds were controlled through the frequent cultivation of the soil. Such activity compacts the soil and causes high amounts of erosion. See id.

\textsuperscript{28} See id. at 46; see also Stephen O. Duke, Weed Management: Implications of Herbicide Resistant Crops, Paper Presented at the Workshop on Ecological Effects of Pest Resistance Genes in Managed Ecosystems, at http://www.nbiap.vt.edu (Jan. 31 to Feb. 3, 1998) ("[E]nvironmentalists are concerned with the potential impacts of gene flow from transgenic crops to wild relatives [however] herbicide resistance transgenes confer no fitness advantage outside of fields treated with the herbicide.").

\textsuperscript{29} See KRIMSKY & WRUBEL, supra note 19, at 50. The crops that are being genetically engineered are those which are most profitable in developed nations. A great need exists to control weed problems in third-world nations where weeds can "yield losses of up to fifty percent." Id. "Genetically modified plants have the potential to resist killer weeds that are, literally, starving people in Africa and other parts of the developing world." Glickman, supra note 2.


varieties and hybrids that are resistant to stresses such as soil salinity and
drought could be an important step towards meeting the needs of
subsistence farmers. Such farmers are largely unable to afford the costly
inputs on which past advances in agriculture have been based, so their
crops have until quite recently been neglected by research. Africa
particularly needs agricultural biotechnology to improve food production
as well as its agricultural problems. Biotechnology will also be able to
solve nutritional deficiencies in developing nations. Approximately 400
million women suffer from iron deficiency in third-world nations where
the staple diet is rice. A new variety of rice containing iron and vitamin
A will be able to decrease this number. However, the availability of
biotechnology to third-world nations, while highly desirable and
necessary, is subject to intellectual property and production concerns,
which will be addressed in Part III.

The economic benefits of “more efficient, higher yielding, higher
quality, disease- and stress-resistant crops and livestock are evident.”
Crops that exhibit disease resistance have an enormous potential as the
annual worldwide loss from plant disease is estimated at ninety billion
dollars. The most obvious environmental benefit of resistant plants
would be a reduction in fungicides. By reducing the amount of crops
lost each year to disease, fewer acres may need to be planted, thus

32 See Florence Wambugu, Why Africa Needs Agricultural Biotech, NATURE, July 1,
1999, at 15-16. “On about half the arable land in the tropics, acid soils cut yields by up to
eighty percent.” Avery, supra note 5. However, acid-soil crops provide normal yields in
spite of soil acidity. Id.
33 See, e.g., Wambugu, supra note 32, at 15.
34 See id. (stating that “Africa’s crop production per unit area of land is the lowest in the
world”). Africa also needs biotechnology to solve environmental problems. For
example, “[i]n Kenya the demand for tree seedlings reaches 14 million per year” and “the
country can only supply 3 million.” Id. at 16. Tissue-culture and cloning techniques are
desperately needed to “curb deforestation and boost reforestation using indigenous
species threatened with extinction.” Id.
35 Today, in developed nations, supplements are routinely added to the diets of animals
such as chicken to provide nutrients such as methionine or lysine. See Watrud, supra
note 24, at 173.
36 Conway, supra note 3.
37 Id.
38 See Purnell, supra note 15, at 1197-1199.
39 Id. at 1192.
40 See KRIMSKY & WRUBELO, supra note 19, at 87.
41 See id. at 89.
providing the benefits associated with a reduction in agriculture. The possibility exists that disease resistant plants may pose environmental risks; however, such risks are only potential and even the Environmental Protection Agency (EPA) does not regard them as significant.

The production of insect-resistant crops will have similar advantages. Transgenic plants that produce insect toxins are environmentally friendly because they will not have to be sprayed with insecticides. The problems caused by insecticides are well known and include toxicity to humans and animals. Crops are also currently being developed which can be grown in poor soil conditions and which will require less water. “Stress-tolerant plants” are also being developed which have the capability to extend “agricultural possibilities to marginal lands,” providing a “powerful benefit to poor farmers.”

Higher-yielding crops are yet another way in which biotechnology will aid agricultural output. By the year 2050, the world will need almost three times the amount of grain per year as it uses today. Crop yields have ceased to grow as rapidly as needed to keep pace with population increases. Additionally, the percentage of the population working in agriculture has steadily declined. If higher-yielding crops are not used, wild lands will have to be used for agriculture. On the other hand, if the same product can be produced with less cultivated land, then more land can be returned to a natural habitat.

42 See id. “Increased yields in third world countries would help achieve food self-sufficiency and improve the standard of living, gaining many indirect environmental benefits.” Id.
43 See id. at 95. “[T]he Environmental Protection Agency does not regard the risks associated with the development of genetically engineered crops resistant to viruses as significant.” Id. A high likelihood exists, however, that virus strains will develop to circumvent any genetically engineered resistance and that new diseases will be created when viruses replicate in transgenic plants. See id. at 89-94.
44 See id. at 61.
45 See id. at 55. Secondary pest outbreaks, which may cause disruptions in the food chain, are often caused by the killing of beneficial insects. Id. The widespread use of insecticides has also caused a strong selection pressure for the evolution of insecticide resistance in insects. Id. at 63.
46 See Purnell, supra note 15, at 1192.
47 Glickman, supra note 2.
48 See Avery, supra note 5.
49 See id.
50 See KRIMSKY & WRUBEL, supra note 19, at 213.
51 See Avery, supra note 5.
52 See KRIMSKY & WRUBEL, supra note 19, at 237.
result in land that needs less tilling, benefiting the environment through decreased erosion and soil infertility.  

B. Potential Risks of Agricultural Biotechnology

While the benefits of biotechnology are numerous and promising, risks are also evident. Most concerns exist, however, because of the unknown consequences of biotechnology.\textsuperscript{54} Historically, problems have existed when non-native species were artificially introduced into ecosystems.\textsuperscript{55} Some fear that biotechnology may be too successful and will lead to an over-production of key crops.\textsuperscript{56} It is also possible that newly introduced traits, such as pest or pathogen resistance, could confer added fitness to a crop, and as a result, the crop could gain weedy characteristics.\textsuperscript{57} Yet unknown is what types of interactions genetically modified plants will have with other species. There is a fear that genetically altered organisms will become agricultural pests or colonize natural ecosystems, disturbing balances, especially where characteristics would allow it to compete successfully.\textsuperscript{58} It is possible that these new organisms will hybridize with a related wild species thereby producing hybrid progeny that are harder to control.\textsuperscript{59} Even plants which are unlikely to escape into the wild can potentially change populations of microorganisms in the soil and the types and numbers of insects and other animals in surrounding areas.\textsuperscript{60}

\textsuperscript{53} See Donna U. Vogt & Mickey Parish, Food Biotechnology in the United States: Science, Regulation, and Issues, at http://usinfo.state.gov/topical/global/biotech/crsfood.htm (June 2, 1999) (stating that industries contend that the U.S. regulations are more than adequate to ensure human safety and health).
\textsuperscript{54} See Purnell, supra note 15, at 1193.
\textsuperscript{55} See id.
\textsuperscript{56} See Al Gore, Planning a New Biotechnology Policy, 5 HARV. J.L. & TECH., Fall 1991, at 19, 28-29.
\textsuperscript{58} See David J. Earp, Comment, The Regulation of Genetically Engineered Plants: Is Peter Rabbit Safe in Mr. McGregor’s Transgenic Vegetable Patch?, 24 ENVTL. L. 1633, 1653-54 (1994).
\textsuperscript{59} See id. at 1654. At least seven groups of crops being engineered for pest resistance are known to have sexually compatible relatives. See Westwood & Traynor, supra note 57.
\textsuperscript{60} See Watrud et al., supra note 24, at 178.
Crops engineered to be pest resistant will be ineffective if the insects develop a resistance to the toxin in the plant. However, with cooperation between growers and regulatory agencies, potential problems such as this need not become issues. Some researchers are also concerned about potential virus resistance of modified plants and fear that hybrid viruses may be formed.

A substantial concern exists over the potential loss of biological diversity. Biotechnology research relies heavily on biodiversity, and as such this diversity needs to be preserved. Biodiversity is lost through deforestation as well as through gene erosion and gene uniformity. The greatest threat to biodiversity is loss of habitat to "nonsustainable and/or

61 In 1999, around thirty percent of corn grown in the United States was Bt (Bacillus thuringiensis) corn, which contains bacteria that kill the European corn borer. The EPA is now requiring farmers to plant a minimum of twenty percent of conventional corn in most areas, and fifty percent in places where cotton is grown. Planting conventional crops beside Bt crops will allow the non-Bt plants to attract pests so they will not develop resistance. The pests will then interbreed and thus reduce the likelihood that resistance to the Bt plants will develop. Companies will also be required to expand monitoring to determine where insect resistance may be occurring. See Philip Brasher, New Restrictions on Biotech Corn, The ADVOCATE (Baton Rouge, La.), Jan. 17, 2000, at 9-A.

62 See Earp, supra note 58, at 1655. Plants which are made "resistant to certain virus types by transformation with viral coat protein genes may provide an environment for interactions between the introduced genes and other virus types." Id.

63 Purnell, supra note 15, at 1194; see Convention, supra note 8, at 823 (defining biological diversity 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"); see also Michele A. Powers, Comment, The United Nations Framework Convention on Biological Diversity: Will Biodiversity Preservation Be Enhanced through Its Provisions Concerning Biotechnology Intellectual Property Rights?, 12 WIS. INT’L L.J. 103, 103 (1993) (stating that studies estimate that a ten percent reduction in biodiversity will occur in the next twenty-five years).

64 See Purnell, supra note 15, at 1195; see generally Peter H. Raven & Jeffrey A. McNeely, Biological Extinction: Its Scope and Meaning for Us, in PROTECTION OF GLOBAL BIODIVERSITY 13, 26-28 (Lakshman D. Guruswamy & Jeffrey A. McNeely, eds., 1998) (discussing the ecological reasons that people should be "concerned with the loss of biodiversity").

65 See Bosselmann, supra note 13, at 113-114. Some believe that monocropping ("planting a uniform type of crop across a large area") could cause a reduction in genetic diversity. Purnell, supra note 15, at 1194. Farmers tend to "choose the most productive varieties," thus resulting in a decline in the overall number of varieties used. However, such a result is not caused by genetic engineering, but by the desire of the farmer to produce the greatest amount possible. See id.
low productivity agriculture." By increasing net agricultural productivity, biotechnology will aid in protecting natural habitats.

This paper argues that the potential risks are minimal in comparison to the extreme benefits that agricultural biotechnology can provide. One of the strongest arguments for the regulation of transgenic food concerns the spread of allergenicity throughout the food supply. However, such concerns are more prominent in the EU than in the United States and will be discussed in greater detail in Part II.

Those opposed to agricultural biotechnology are drawn from several different fields, but include three primary sources: the agricultural community, environmentalists and the moral opposition. Many environmentalists are obviously opposed and have been waging war with the biotech companies for quite some time. Some farmers are also opposed to biotechnology. They believe they cannot afford to utilize agricultural biotechnology and that expensive products will drive small farmers out of business. They also believe that enhanced crop production will saturate the market, thereby causing profits to decline. Additionally, there is a moral opposition not only to agricultural biotechnology, but to any form of biotechnology whatsoever.

III. REGULATION OF BIOTECHNOLOGY

A. Regulation in the United States

No statutes exist in the United States that address biotechnology specifically. However, there is a very comprehensive process to evaluate genetically modified products for risks to human, animal, and plant health.

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66 Robert B. Horsch & Robert T. Fraley, Biotechnology Can Help Reduce the Loss of Biodiversity, in PROTECTION OF GLOBAL BIODIVERSITY, supra note 64, at 49.
67 See id. at 50. But see Laura L. Jackson, Agricultural Industrialization and the Loss of Biodiversity, in PROTECTION OF GLOBAL BIODIVERSITY, supra note 64, at 66 (arguing that biotechnology products will endanger remaining biodiversity).
69 See id.
70 See Purnell, supra note 15, at 1197.
71 See id.
72 See id.
Agricultural biotechnology and for environmental safety. The U.S. Department of Agriculture (USDA) and the EPA are primarily responsible for regulating the release of transgenic plants. The EPA regulates the minority of engineered plants which may have pesticidal properties as defined by the Federal Insecticide, Fungicide, and Rodenticide Act. The USDA's authority comes from the Federal Plant Pest Act and the Plant Quarantine Act. By this statutory authority and through the Animal and Plant Health Inspection Service (APHIS), the USDA is able to regulate the "introduction of genetically modified organisms."

The United States' regulations are not without criticism. Most would agree, however, that the present regulatory framework is a "sound risk-based regulation that both fosters technological development and protects the environment against known risks."

B. Regulation in the European Union

While agricultural biotechnology is widespread and accepted by consumers in the United States, the EU has a far different perspective.

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74 See Earp, supra note 58, at 1640 n.36. The USDA, EPA, the Food and Drug Administration (FDA), the National Science Foundation (NSF), the National Institute of Health (NIH), and the Occupational Safety and Health Administration (OSHA) all have jurisdiction over products produced by genetic engineering. See id.

75 See id. at 1637.


79 Arnold S. Foudin & Cyril G. Gay, Introduction of Genetically Engineered Microorganisms into the Environment: Review under USDA, APHIS Regulatory Authority, in ENGINEERED ORGANISMS IN ENVIRONMENTAL SETTINGS, supra note 23, at 85, 86; see also Stewart & Johanson, supra note 73, at 249-250. APHIS primarily regulates genetically modified organisms (GMOs) that may become plant pests. If APHIS determines that a genetically modified organism is not a plant pest, it will deregulate it and thus allow it to be planted. See id.

80 See Earp, supra note 58, at 1671; see Vogt & Parish, supra note 53.

81 See Carol K. Yoon, Redesigning Nature: A Special Report; Squash With Altered Genes Raises Fears of 'Superweeds,' N.Y. TIMES, Nov. 3, 1999, at A1 (stating that the USDA has not rejected a single application for a genetically engineered crop).


83 The member countries of the European Union are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands,
For example, of the thirty-five million hectares planted in 1998 of genetically modified crops, eighty-eight percent were planted in North America, and less than one percent was planted in Europe.\textsuperscript{84} There are many factors that attempt to account for such a large discrepancy, many having to do with issues unrelated to biotechnology.\textsuperscript{85} In Europe, cultures vary drastically from country to country and matter greatly, while in the United States, variations in culture and behavior among regions is less distinct.\textsuperscript{86} United States industry is much more research oriented than that of the EU.\textsuperscript{87} The U.S. government funds a great deal of biotech research through several agencies, and this funding helps to support a “highly competitive industrial and regulatory structure.”\textsuperscript{88} In contrast, government funding and support in the EU is more bureaucratic and exists on a much smaller scale.\textsuperscript{89}

The structure of the EU’s legislature influences its laws relating to agricultural biotechnology.\textsuperscript{90} The European Commission “acts as the executive body for the laws . . . of the European Union.”\textsuperscript{91} The Council of Ministers is composed of representatives of the member states who work on behalf of their respective governments.\textsuperscript{92} Essentially, the Commission proposes legislation and the Council determines whether it will be adopted.\textsuperscript{93} The European Parliament is the only directly elected body of government in the EU. Its primary role, however, is an advisory one, as its legislative power is generally weak.\textsuperscript{94}

The EU has two major laws directed at biotechnology. The first, Council Directive 90/220/EEC, “concerns the placing in the market of

\textsuperscript{84} B. Zechendorf, \textit{Agricultural Biotechnology: Why Do Europeans Have Difficulty Accepting It?}, 1 AGBIOFORUM 3, ¶2 (Summer 1998), at http://www.agbioforum.org/archives.htm.
\textsuperscript{85} See id. at ¶ 3.
\textsuperscript{86} See id. at ¶ 5.
\textsuperscript{87} See Ashworth, \textit{supra} note 83, at 88 (the United States devotes 23.4% of its workforce to research and development while the EU devotes only 13.4%).
\textsuperscript{88} Id. at 92; see also \textit{supra} text accompanying note 74.
\textsuperscript{89} See Ashworth, \textit{supra} note 83, at 92. A consequence of these differences is that many large corporations have established laboratories in the United States. See id.
\textsuperscript{90} See Stewart & Johanson, \textit{supra} note 69, at 252.
\textsuperscript{91} Id. The twenty members are to act independently of their national governments to further the interests of the EU. See id.
\textsuperscript{92} See id. at 253.
\textsuperscript{93} See id.
\textsuperscript{94} See id.
GMO products that may be described as raw materials." Under this Directive, there is a notification process for placing a genetically modified organism (GMO) on the market. It requires notification of the manufacture or importation of a GMO. The Directive also contains labeling amendments. 90/220 has essentially broken down, as "[f]or over two years, no products have been approved."

Regulation No. 258/97 applies to placing novel foods on the market, including foods containing GMOs. This Regulation specifies that food containing GMOs, as well as foods that were produced by genetic techniques, must be labeled accordingly. Despite regulatory attempts by the EU, member nations have individually prohibited the use of GMOs that had been approved by the Commission. In fact, Directive 90/220 allows a member state to "provisionally restrict" a product it has justification to believe causes risks to health or the environment. In contrast with the United States, companies introducing foods derived through biotechnology in the EU must obtain approval.

The EU has been extremely slow to match scientific advances with the necessary related policy and regulatory adjustments. Transgenic

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95 Id. at 256. A Directive obligates the legislatures of each member state to conform their laws to objectives established by the EU. Id. at 255. This regulation also requires notification before placing a GMO on the market. The Commission evaluates potential risks and decides if the GMO is authorized. See Raymond O’Rourke, Genetically Modified Foods, 147 NEW L.J. 1578, 1578 (1997).

96 A dossier must be submitted to the Commission which decides on the application following an evaluation of the risks involved in placing the GMO on the market. When the GMO is authorized, it can be freely circulated in the EU. However, it can be temporarily prohibited if a member state believes that it is a possible danger to public health or the environment. As of October 1998, five of the EU member states had imposed bans on some form(s) of GMOs. See Pierre-Benoit Joly & Stéphane Lemarié, Industry Consolidation, Public Attitude and the Future of Plant Biotechnology in Europe, 1 AGBIOFORUM 10, ¶2 (Fall 1998), at http://www.agbioforum.org/archives.htm.


98 See Stewart & Johanson, supra note 73, at 256. A regulation applies throughout the entire EU as soon as adopted. Thus, each nation does not have to individually implement the legislation. See id. at 255-56.

99 See O’Rourke, supra note 95, at 1579. Foods must be labeled if, after scientific assessment, it is shown that they are no longer equivalent to traditional foods.

100 See, e.g., Stewart & Johanson, supra note 73, at 266-67 (discussing the banning of Bt-Maize by Austria and Luxembourg).

101 See id. at 259-60.

102 See id. at 248.

103 See Vogt & Parish, supra note 53.
crops should undergo rigorous regulations, but if found to be safe, they should be used.\textsuperscript{104} Other nations watch the policies of the United States and the EU with great interest. If the EU begins to influence such nations on biotechnology issues, such influence will only be harmful to global issues.\textsuperscript{105} The EU seems to want a comprehensive regulation, but does not know what such a regulation should be and is hampered by its slowness to change.\textsuperscript{106}

Negative public opinion has had a most harmful effect on the acceptance of agricultural biotechnology in the EU.\textsuperscript{107} The term “Frankenstein food” has been used to describe GMOs in Europe.\textsuperscript{108} Much of the public distrust stems from confusion and lack of education. Such opinion has caused an “over-concentration . . . on the regulation of genetic engineering processes.”\textsuperscript{109} U.S. regulations generally concentrate on the products produced, not the processes.\textsuperscript{110} The commercialization of GMOs arrived in Europe following two major health crises.\textsuperscript{111} These crises have had several longstanding effects. “[T]hey have created distrust of public regulation and expertise” and of public institutions.\textsuperscript{112} European citizens

\textsuperscript{104} In the EU, before a crop can be field tested or released, a license or consent must be obtained from a member government. See id.

\textsuperscript{105} See Genetic Id’s New GMO Tests Can Save U.S. Corn Exports to Japan; Restore Exports to Europe, at http://news.excite.com/news/bw/000323/ia-genetic-id (last modified Mar. 23, 2000) [hereinafter Genetic Id’s].

\textsuperscript{106} See Vogt & Parish, supra note 53.

\textsuperscript{107} See David Barboza, Biotech Companies Take on Critics of Gene-Altered Food, N.Y. TIMES, Nov. 12, 1999, available at http://www.nytimes.com/library/national/science/111299sci-biotech-gm.html (most opponents to this technology believe that not enough research has been done to prove that food made from GMOs is safe); see also Stewart & Johanson, supra note 73, at 246-47. One recent poll in England showed that only one in 100 people thinks that genetically modified products are good for society. See John Micklethwait, Life by Design: Europe’s Profound Fear of Food, N.Y. TIMES, June 7, 1999, at A23.

\textsuperscript{108} See Micklethwait, supra note 107, at A23.

\textsuperscript{109} Ashworth, supra note 83, at 93-94.

\textsuperscript{110} See id. at 94.

\textsuperscript{111} See Joly & Lemarié, supra note 96, at ¶ 14. These health crises were contaminated blood and the outbreak of mad cow disease. See id. “Mad-cow” disease, or bovine spongiform encephalopathy, “is a brain disease that affects beef and dairy cattle.” Ashworth, supra note 83, at 93 n.23. In 1996 nearly every country in the EU imposed bans on importing British beef. Id. at 94 n.23. Later in that year the European Commission imposed a world-wide ban “on the exporting of British beef.” Id. (citing John Darnton, Europe Orders Ban on Exports of British, N.Y. TIMES, Mar. 28, 1996, at A1).

\textsuperscript{112} Joly & Lemarié, supra note 96, at ¶ 14.
do not trust the government to regulate any types of food.\textsuperscript{113} GMOs became a politically risky topic, with most policy makers bypassing the issue.\textsuperscript{114} The public also does not have an accurate understanding of the current state of agriculture and does not understand the utility of new technology.\textsuperscript{115}

In order for government regulations to guarantee public health and environmental safety, they must be science-based and free of political influence.\textsuperscript{116} The EU seems to say that until it can be proven that there will never be a risk from GMOs, they should not be introduced.\textsuperscript{117} That, however, is an extremely unrealistic standard.\textsuperscript{118}

Unfortunately, opposition to GMOs seems to be increasing in the United States.\textsuperscript{119} If fear spreads in the United States, it is likely that an increasing number of companies will move away from genetically altered crops.

IV. TRADE AND INTELLECTUAL PROPERTY ISSUES

A. Trade

"The United States and the European Union share the world's largest trading relationship."\textsuperscript{120} One of the greatest areas of conflict between them is agriculture, particularly agriculture involving biotechnology.\textsuperscript{121} The United States believes that the EU's policies are a barrier to trade. Economically, the EU is at a competitive disadvantage with the U.S. biotechnology industry. Because of the EU's approval system for GMOs, the United States has had great trouble expanding into EU markets.\textsuperscript{122}

\textsuperscript{113} See Aaron, supra note 97.
\textsuperscript{114} See id.
\textsuperscript{115} See id.
\textsuperscript{116} See Scher, supra note 82.
\textsuperscript{117} See id.
\textsuperscript{118} See id.
\textsuperscript{119} Protests are starting to occur in the United States over the safety of genetically modified foods. Some food producers have stated that they will not use biotechnology crops. McCain Foods will not use altered potatoes, Frito-Lay will not use modified corn, and Gerber will not use biotech crops in its baby food. See Barboza, supra note 18, at C6.
\textsuperscript{120} Stewart & Johanson, supra note 73, at 246 (citation omitted).
\textsuperscript{121} See id.
\textsuperscript{122} Some believe that the EU is using this time to build its own biotech industry. See Vogt & Parish, supra note 53. But see Bosselmann, supra note 13, at 128 (stating that
Labeling all products containing GMOs, as desired by the EU, would require "separate distribution systems for GMO and non-GMO products" and be impracticable for exporters. There are also problems for imports as no major trading partners of the EU have the same policies.

Biotechnology products are not directly covered by the World Trade Organization (WTO) agreements, and thus it is not clear which agreements would cover disputes concerning agricultural biotechnology. It is possible that the policies of the EU may not "comport with its obligations under the WTO."

The fear of GMOs in other parts of the world is having a profound impact on the exporters of American agricultural commodities. A new Japanese regulation, to be enforced starting April 1, 2001, bans imports of "unapproved genetically modified corn varieties for human consumption." Japan is currently the largest export market for U.S. corn, a figure that could decrease dramatically with such a regulation of genetically modified corn. GMO regulations in other areas of the world will likely cause the United States major difficulties. The amount of genetically modified crops planted in the United States has increased steadily because of the numerous benefits these provide, but if a market does not exist elsewhere, they will not be profitable.

B. Intellectual Property Concerns

In the nineteenth century, it was thought that biological inventions were not eligible for patent protection. From 1925 to 1934, the Paris Convention was revised to include biotechnological products; however, it did not expressly include plants. It was, however, difficult to obtain

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123 Stewart & Johanson, supra note 73, at 277-78.
124 See id. at 278.
125 See id. at 287.
126 Id. at 293. As an example, the EU has only approved four of eleven GMO corn varieties for import. But the EU has not taken any official action, so the United States cannot yet formally protest under the WTO. See Vogt & Parish, supra note 53.
127 Genetic Id's, supra note 105.
128 See id. Currently Japan buys thirty-one percent of all U.S. corn exported. Corn exports to the EU went from $305 million in 1996 to $1 million in 1999 because of GMO restrictions. See id.
129 See Bosselmann, supra note 13, at 122.
130 See id.
protection for plants, and several countries began to recognize that this protection was necessary. In 1961, the International Convention for the Protection of New Varieties of Plants (UPOV) was adopted in Paris to protect plant breeders' rights (PBRs). The United States passed the Plant Patent Law in 1930 to protect asexually reproduced plants. Forty years later, the Plant Variety Protection Law gave protection to sexually reproduced varieties. "Both of these laws had been passed in the belief that patent law did not extend to living things." However, a series of three landmark cases, beginning with Diamond v. Chakrabarty in 1980, extended patent protection to "biotechnological developments in microorganisms, plants, and higher life forms." Because of these decisions, the United States offers perhaps the most comprehensive coverage to biotech inventions of any nation.

It is extremely interesting to note that the Chakrabarty patent application was granted by the United Kingdom's patent office without any opposition or controversy, while in the United States the patent was fought to the Supreme Court. Many Europeans believe that the United States grants patents for a much broader scope than is allowed in the EU or in its individual member nations. Since the early 1980s, the controversy surrounding patents for genetically engineered organisms has faded in the United States and has greatly increased in Europe.

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131 See id.
132 See id. at 123. To qualify for protection the new variety had to "be clearly distinguishable by one or more important characteristics" and had to be "sufficiently homogenous in its sexual reproduction." Id. The UPOV did not provide the same protection as traditional patents. PBRs did not actually address whether "biological products" could be patented under traditional laws. Id.
133 See id. at 126.
134 See id.
135 Id.
137 Purnell, supra note 15, at 1195 n.15. Chakrabarty extended protection to microorganisms. Ex parte Hibbard, 227 U.S.P.Q. 443 (1985), held that plants, seeds and tissue cultures are protectable. Finally, Ex parte Allen, 2 U.S.P.Q. 2d 1425, extended coverage to higher organisms leading to the first animal patent on the "Harvard mouse." See id.
138 See Bosselmann, supra note 13, at 126.
139 See Yvonne Cripps, Aspects of Intellectual Property in Biotechnology: Some European Legal Perspectives, in PROTECTION OF GLOBAL BIODIVERSITY, supra note 64, at 316, 318.
140 See Ashworth, supra note 83, at 94.
141 See id. The EPC specifically excludes from protection any inventions that would be contrary to morality if published or exploited. Patents on engineered plants have been
The structure governing patent rights in the EU has much to do with its opposition to biotechnology. In countries that are part of the European Patent Convention (EPC),\(^{142}\) patent applications may be made through a member country’s patent office, or under the EPC. The purpose of the EPC was to enable an applicant seeking patent rights in more than one European nation to achieve such result with only one application.\(^{143}\) When a European patent is granted, its enforceability is determined by the courts of the member countries, and thus is subject to over a dozen degrees of protection.\(^{144}\) Thus, the EPC “accomplishes nothing toward the unification of property rights, which is the most valuable element of a patent convention.”\(^{145}\) The EPC additionally contains a provision that provides an opportunity for the public to challenge applications before they issue as patents.\(^{146}\) Through this means, the public has the ability to delay or impede patents to which they are opposed.\(^{147}\)

Since the 1980s, intellectual property rights have been considered as a “barrier to free trade” by developed nations unless the lesser-developed countries changed their intellectual property legislation to the same level of protection.\(^{148}\) Many underdeveloped nations believe that patents provide a means for developed countries to stay ahead in technology and to prevent the underdeveloped from forming any substantial research and development (R&D) industry.\(^{149}\) The developed nations view patent protection as necessary to allow companies to recoup what they have spent on R&D.\(^{150}\) In the biotechnology industry, large
investments are required for relatively high-risk projects. A market for innovation will not exist if exclusive rights are not granted. Those obtaining patents in the United States cannot use them to prevent others abroad from freely making or using the particular invention. If they wish to protect their invention elsewhere, they will have to apply for a patent in each nation where they desire protection. However, patentable subject matter differs between nations. Enforcing intellectual property rights in foreign nations could reduce the trade deficit by increasing the competitiveness of domestic products overseas.\footnote{151}

Generally, the developing nations, with Mexico and Brazil as exceptions, lack the type of intellectual property protection that is found in the rest of the developed world.\footnote{152} Intellectual rights granted by developed nations are not enforced in the lesser-developed countries because officials there tend to believe that granting monopolies to foreign companies will hurt local economies.\footnote{153}

In the past decade, treaties dealing with intellectual property have been dominated by developed nations' attempts to protect their intellectual property rights in developing countries.\footnote{154} Many believe that the "over-protectionism" of the U.S. patent system has resulted in biopiracy.\footnote{155}

However, the underdeveloped nations contend that the gene-poor developed nations are "robbing the gene-rich" developing nations "of germplasm as a resource for biotechnology and then selling products such as... seeds back to the South for enormous profit."\footnote{156} Third-world nations have few, if any, resources with which to acquire biotechnology. However, access to biotechnology is of crucial importance to these nations.

R&D will likely encourage the development of the most profitable projects. Thus, the development of products desperately needed by third-world nations will necessarily take a back seat. See Purnell, \textit{supra} note 15, at 1201.

\footnote{151} Enforcing IP rights will increase the price of foreign goods to cover royalties that foreign manufacturers must pay and will decrease the quality of foreign goods by denying foreign manufacturers access to protected U.S. technology.\footnote{152} See Powers, \textit{supra} note 63, at 116-17.

\footnote{153} See \textit{id.} at 117.


\footnote{155} "Biopiracy" is the appropriation and privatization, without permission, of the rich resources most commonly found in developing nations. The over-protectionism of the U.S. patent system, where most of the pirated products have been granted a patent, has exacerbated the problem, many believe. Patenting stolen wealth creates a financial incentive for richer nations to pirate third-world biological wealth. See \textit{id.} The failure of foreign countries to enforce U.S. patents results in lost royalties. See Purnell, \textit{supra} note 15, at 1199.

\footnote{156} Bosselmann, \textit{supra} note 13, at 132.
in order to solve the many environmental and health related problems that they face.\textsuperscript{157}

There is a connection between biodiversity and intellectual property law. Some fear that the limited monopolies which are conferred by patents will cause a loss of genetic diversity by encouraging industry to focus on genetically engineered plants and not organisms that offer fewer genetic advantages.\textsuperscript{158} However, genetic diversity may also be enhanced by the patent system because a financial incentive is created to produce new genotypes.\textsuperscript{159} Additionally, to satisfy the patent disclosure requirements, a sample of the biological material must be deposited.\textsuperscript{160} These depositories will save genetic material that may not otherwise exist in the future.\textsuperscript{161}

V. CONVENTION ON BIOLOGICAL DIVERSITY

"In 1992, 178 nations met . . . for the Earth Summit," to discuss, among other issues, the conservation of biological diversity.\textsuperscript{162} The United Nations Convention on Biological Diversity (Convention) was one document that resulted from that meeting.\textsuperscript{163} The Convention is an agreement that builds upon earlier treaties and attempts to deal with biodiversity in a more comprehensive manner.\textsuperscript{164} The specific objectives of the Convention are "the conservation of biological diversity, the sustainable use of its components and the [f]air [sic] and equitable sharing of the benefits arising out of the utilization of genetic resources."\textsuperscript{165} Many developed nations had reservations over signing the document and did so stating that they would interpret it individually.\textsuperscript{166} The wording of the Convention is vague and thus it is unknown what the impact will be.\textsuperscript{167}

\begin{itemize}
\item [\textsuperscript{157}] See Purnell, supra note 15, at 1200.
\item [\textsuperscript{158}] See Cripps, supra note 139, at 317.
\item [\textsuperscript{159}] See id.
\item [\textsuperscript{160}] See id.
\item [\textsuperscript{161}] See id.
\item [\textsuperscript{162}] Purnell, supra note 15, at 1202.
\item [\textsuperscript{163}] See Convention, supra note 8. The Convention was adopted on May 22, 1992 and entered into force on Dec. 29, 1993. There are currently 175 parties to the Convention. See Purnell, supra note 15, at 1202.
\item [\textsuperscript{164}] See Daniel M. Bodansky, International Law and the Protection of Biological Diversity, 28 VAND. J. TRANSNAT'L L. 623, 630 (1995).
\item [\textsuperscript{165}] Convention, supra note 8, at art.1.
\item [\textsuperscript{166}] See Bosselmann, supra note 13, at 136-37. The United States signed the Convention on the last day it was open for signature. See id.
\item [\textsuperscript{167}] See id. at 136.
\end{itemize}
This disagreement in interpretation raises concerns that the Convention will not prove useful.\(^{168}\)

One function of the Convention "is to allow countries where biological resources are found to realize or recapture some of the value of those resources."\(^{169}\) The Convention aims to provide payment for genetic resources and to increase the ability of developing countries to develop their own genetic resources.\(^{170}\)

Aside from social and economic considerations, the Convention requires each member to take part in in-situ conservation.\(^{171}\) As per this mandate, the countries with the greatest biological diversity will have the largest economic burden to maintain it.\(^{172}\)

One of the most controversial parts of the Convention is the effect that Articles 15, 16, and 19 may have on intellectual property rights.\(^{173}\) Article 15 governs access to genetic resources.\(^{174}\) It states that "the authority to determine access to genetic resources rests with the national governments and is subject to national legislation."\(^{175}\) Those nations with genetic resources must facilitate access by other nations.\(^{176}\) In return, those countries or private companies seeking to utilize the resources must take measures to share in a "fair and equitable way" the benefits arising from the R&D of those resources.\(^{177}\) Historically, genetic material has been considered to be in the public domain, which is why industrialized countries take genetic resources from third-world countries with no

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\(^{168}\) See id. at 137.

\(^{169}\) Bodansky, supra note 164, at 626-27; see Purnell, supra note 15, at 1203.

\(^{170}\) See Powers, supra note 63, at 104. By providing these incentives, the Convention hopes that the developing nations will preserve their tropical rainforests. See id.

\(^{171}\) ‘In-situ conditions’ means conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. ‘In-situ conservation’ means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

\(^{172}\) See Powers, supra note 63, at 108 n.31 (estimating that the cost of preserving worldwide biological diversity is approximately 50 billion dollars) (citation omitted).

\(^{173}\) See id. at 110.

\(^{174}\) Convention, supra note 8, at art.15.

\(^{175}\) Id.

\(^{176}\) See id. at ¶2.

\(^{177}\) Id. at ¶7.
compensation in return. Article 15 however acknowledges a country’s right to direct compensation for materials taken and to part of the income generated from any resulting products. This is an extremely large change in property rights to naturally occurring species.

Article 16 promotes access to and transfer of technology derived from the research and development of genetic material. The Article states that “both access to and transfer of technology among Contracting Parties are essential elements for the attainment of the objectives of this Convention.” Contracting parties must pass legislation to grant provider countries rights to the technology that makes use of the genetic material. In this way intellectual property rights in the technology in question will not interfere with the transfer of the technology. Article 16 will likely cause complex negotiations in the future.

Article 19 further impacts intellectual property rights in biotechnology by “requiring participating countries to pass legislation guaranteeing that biotech companies share the results and benefits of their research and development with genetic resource provider countries.” Such legislation should serve to include provider countries in the biotechnology research.

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178 See Powers, supra note 63, at 111.
179 See id.
180 See id.
181 See Convention, supra note 8, at art. 16.
182 Id. at art.16, ¶ 1.
183 See id. at art.16, ¶ 3 and 5. Article 16 states:
Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, with the aim that Contracting Parties, in particular those that are developing countries, which provide genetic resources are provided access to and transfer of technology which makes use of those resources, on mutually agreed terms, including technology protected by patents and other intellectual property rights . . .

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

Id. at art.16, ¶¶ 3 and 5.
184 Powers, supra note 63, at 112.
185 See Convention, supra note 8, at art.19, ¶ 1. “Each Contracting Party shall take legislative, administrative or policy measures, as appropriate, to provide for the effective participation in biotechnological research activities by those Contracting Parties,
Full compliance with the convention will essentially mean that a company wanting another country's genetic resources "will have to give up a portion of their intellectual property rights." The United States and the EU nations will likely weaken these articles through interpretation. The difference in economic and technological positions of the developed and underdeveloped nations has caused the split in positions on the intellectual property provisions. Additionally, protection of intellectual property is vastly different between these two sets of countries. The United States' tradition has been to increase the intellectual property rights in biotechnology.

It is not yet clear how intellectual property rights on a global scale may be affected by the Convention. Such effect mainly depends on legislation passed by each individual member nation. Clearly, however, erosion of intellectual property rights will only serve as a disincentive to biotech companies to conduct future research. The particular types of genetically engineered products to be covered by provisions of the Convention are in dispute. The United States and other major agricultural exporters wish to restrict the scope of the Biosafety Protocol to GMOs that would be introduced into the environment, such as seeds. Generally, developing countries seek a broader definition that would include GMOs that are "agricultural commodities or that are used for food, animal feed, or processing." Such rules would radically impede international trade without providing a benefit to the environment. The United States has especially developing countries, which provide the genetic resources for such research...
accused Europe of wanting a treaty which will aid it in erecting trade barriers in order to justify the tight position it has taken on GMOs. The United States also seeks to ensure that the treaty does not take precedence over the WTO rules.\textsuperscript{192}

Negotiations of the Biosafety Protocol, an outgrowth of the Convention, began in 1999 in an effort to regulate the trade of genetically modified foods.\textsuperscript{193} The United States never ratified the Convention but has been able to take part in negotiations.\textsuperscript{194} More than 130 nations adopted the treaty on January 29, 2000 in Montreal.\textsuperscript{195} It will be known as the Cartagena Protocol on Biosafety and allows countries to prohibit the import of GMOs that they believe are a threat to their environment.\textsuperscript{196} Most of the proposed provisions which the United States stringently opposed were diluted or eliminated altogether.\textsuperscript{197} The primary requirement of the treaty is that “exporters must obtain permission in advance from the importing country before the first shipment of a

\textsuperscript{193} See \textit{U.S., Developing Nations Quarrel over Biotech Pact}, DESERT NEWS (Salt Lake City, UT), Feb. 23, 1999, at A5. The first session of talks on the Biosafety Protocol was held in February 1999 in Cartagena, Columbia, with talks reaching a stalemate over sharp disagreements between the United States and most developing countries. The United States and five other grain exporting nations rejected a proposal that would have required exporters of genetically modified crops to obtain advance permission from the importing nation. \textit{See Report of the 6th Session of the Open Ended Ad Hoc Working Group on Biosafety and the 1st Extraordinary Session of the CBD Conference of the Parties}, \textit{9 EARTH NEGOTIATIONS BULL.} 117. Two informal sessions were held in July and September 1999. Discussions were scheduled to resume on Jan. 20, 2000, in Montreal. \textit{See Fuller, supra} note 190.
\textsuperscript{194} See Pollack, \textit{supra} note 189. The Bush administration opposed the Convention on the grounds that it would undermine the protection granted by the U.S. patent system for biotechnology. \textit{See Krimsky, supra} note 19, at 224. The United States’ allies at the talks are Argentina, Australia, Canada, Chile and Uruguay. Because the United States never ratified the Convention, it cannot be a part of the biosafety protocol. However, the United States will have to comply with its rules when exporting to nations who are parties. \textit{See Pollack, supra} note 192, at A10.
\textsuperscript{195} See Andrew Pollack, \textit{130 Nations Agree on Safety Rules for Biotech Food}, N.Y. TIMES, Jan. 30, 2000, at A1. The treaty will go into effect after being ratified by fifty countries. \textit{See id.}
\textsuperscript{196} \textit{See id.}
\textsuperscript{197} \textit{See id.} (stating that “the treaty requires stating only that the shipment ‘may contain’ genetically modified organisms.”).
particular 'living modified organism’ meant for release into the environment.”

One evident problem with the terms of the protocol is that a nation can bar the import of a GMO even if there is no scientific proof that it is dangerous.

VI. OTHER OPTIONS

Contractual obligations are another way in which third-world nations could be reimbursed for their resources. In one form of contractual agreement the undeveloped nations would essentially sell their germplasm for “payment and/or royalties on future sales.” This income could then be used to conserve areas of biodiversity. Some multinational companies have already made such agreements. The contract between pharmaceutical company Merck and Costa Rica is a model agreement that should be followed by others. Perhaps the most important aspect of the Merck/Costa Rica agreement is that Merck will retain all intellectual rights to any products developed as a part of this research. Additionally important for Costa Rica is that the genetic diversity of their forests will finance their own preservation. This agreement should lead the way in providing compensation for genetic resources.

198 Id. Notice will not be required “for exports of agricultural commodities meant for eating or processing rather than for release into the environment.” Id.

199 See Bodansky, supra note 164, at 630.

200 Bosselmann, supra note 13, at 142.

201 If farmers do not recognize that the forest has value, the outlook for preservation is grim. See Pollack, supra note 195, at A1.

202 In 1991, the pharmaceutical firm Merck entered into a “prospecting” agreement with Costa Rica. Under the agreement, a non-profit organization created by the Costa Rican government was to provide 10,000 germplasm samples to Merck. Merck would in return pay one million dollars, provide equipment, training, and a certain amount of technology transfer, and pay a royalty on the sale of any drugs produced from the samples. The Costa Rican organization was also to contribute to conservation efforts. See id.; see also Powers, supra note 63, at 121.

203 See Powers, supra note 63, at 121.

204 See id. at 122. Merck received environmental achievement awards from the National Wildlife Foundation and the National Environmental Development Association. Id.

205 The market solution, illustrated by the Merck agreement, is not free of possible drawbacks. Infringement could be hard to detect, and even if discovered the costs of bringing an action may be prohibitive. Additionally, not every chemical is valuable and as such the market may not provide adequate compensation to the lesser developed nations. See Bosselmann, supra note 13, at 143-44.
However, the future of these types of contractual agreements is far from predictable. Many developing countries, angry that they have not profited from their own resources, have begun restricting the freedom of scientists to collect samples and are demanding payment for permits to do so. Since the Convention on Biological Diversity established that "nations have sovereignty over their genetic resources," many nations have adopted laws controlling access to such resources. One obstacle is that many nations overestimate the value of their genetic resources. If the developing nations exclude researchers, nobody wins. They must be reasonable in their expectations of compensation and be willing to compromise.

VII. CONCLUSION

A danger exists that ongoing disputes over biotechnology issues will so polarize the interested countries that it will become impossible for developing countries to gain anything from the technology. These nations are most needy of the genetically engineered products produced by both America and multi-national countries, and developed nations need biodiversity to be preserved. If developing nations are to preserve genetic resources, they must have an incentive for doing so. The developed nations have the means to provide such an incentive.

As an increasing number of developing countries are investing resources in biotech research, it is most important to create conditions which will enable them to take full advantage of their opportunities. Many sources of funding exist for biotechnology programs in developing nations. Such relationships must be encouraged and more funding

207 Id.
208 See id. Drug development can cost millions of dollars and span one to two decades. The NIH, for example, has collected 50,000 plants from thirty countries over the last fifteen years and has only one drug in clinical trials. It is thus hard to determine how much money a country should get just because the starting plant for research was taken from its territory. See id.
210 Some sources of funding are national organizations, national agriculture research institutions, universities, private foundations, commercial companies, and bilateral and multilateral aid agencies. See Brenner & Komen, supra note 30, at 24.
GMOs provide much hope for the problems faced by the third-world nations. They will boost nutritional value of crops, reduce the need for pesticides, reduce the need to till soil, improve yields, and increase drought resistance of plants. Concerns continue however that developing countries will be denied free access to modified plants. Only if a worldwide agreement is reached, will biotechnology realize its full potential.

The benefits of agricultural biotechnology are quite impressive. This new technology, like any other, does have risks, but the bulk of fears are fears of the unknown. Careful, but not oppressive, monitoring by regulatory agencies with the cooperation of the companies producing the seeds and the farmers planting them, will keep the known risks from becoming problems. The EU particularly needs to change its regulatory policies and recognize the benefits of agricultural biotechnology.

While the Biodiversity Convention has an important goal, its objectives are not likely to be met in the manner desired by the text. Its potential erosion of the intellectual property rights, which the United States particularly sees as fundamental, will be the cause. The developed countries do need to give back to those nations from which they take genetic resources. However, such reimbursement can occur in ways other than property rights; U.S. companies have already shown that such means do exist.

Biotechnology is not the panacea, but it is perhaps the best tool that is available today. It can aid third-world nations, preserve biodiversity, and increase the food supply for the developed nations. As the world population increases, biotechnology provides the only current answer to solving food shortages. If the EU and other nations of the world do not embrace this technology, they will not be able to feed themselves one day. The unwarranted opposition to GMOs by the EU, and most recently by Japan, because of their trading relationship with the United States, threatens the existence of GMOs on a global scale. If import restrictions become severe and/or widespread, the United States will be prohibited from growing genetically modified crops. If the United States is not growing these crops, U.S. biotech companies will have no incentive

A model relationship exists between Monsanto Chemical Co. and Kenya. Monsanto proposed its idea to the U.S. Agency for International Development (USAID), an organization which funds biotechnology research, who agreed to contribute. Monsanto also provides a royalty-free non-exclusive license and additional funding to the Kenyan Agricultural Research Institute to develop this technology. See id. at 40.
to continue researching and developing GMOs. The outcome of this chain of events will be that the developing nations will be denied the great benefits of genetically altered crops.