Agricultural Biotechnology and the Public Good

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By way of introduction I want to explain that the Rural Advancement Foundation International (RAFI) is a private, nonprofit organization that works on the interrelated issues of agricultural biodiversity and biotechnology. We are an international research and advocacy organization with offices in North Carolina, USA and in Ottawa, Canada. Since 1986, my own work has focused on the social and economic impacts of emerging biotechnologies, particularly as they affect poor farmers and rural communities—especially in the developing world.

I come here today as an activist and as a critic of biotechnology. But I want to stress that I am not against biotechnology or genetic engineering. I think it is impossible to assign labels such as "good" or "bad" to a new technology. The more fundamental issue is who will *control* these technologies and who will *benefit* from them.

I cannot think of a more appropriate or important theme than *Biotechnology and the Public Good* for this sixth annual meeting of NABC. It seems to me that the format of the workshops scheduled today and tomorrow will allow for an interesting discussion of many topics—whether it be under the title of structure of agriculture, global interdependence or environmental stewardship. Today, I would like to make some brief comments on each of these three general topics.

GLOBAL INTERDEPENDENCE

The theme of global interdependence is especially relevant to the topic of biotechnology and the public good. It is virtually impossible to talk about biotechnology without looking at the global dimensions and without an appreciation for the interdependence of all nations. One of the common denominators, of course, is our genetic interdependence. Access to biological resources is the lifeblood of agricultural biotechnology. The genes from plants, animals and microorganisms of the developing world, in particular, are the "strategic raw materials" for the development of new food, pharmaceutical and industrial products. But these genes are seldom "raw materials" in the traditional sense because they have been selected, nurtured and improved by untold numbers of farmers and indigenous peoples over thousands of years.

All major food crops, the staple crops grown and consumed by the vast majority of the world's population, have their origins and centers of diversity in the tropics and subtropics of Asia, Africa and Latin America. Over the past 12,000 years, Third World farmers selected and domesticated all major food crops on which humankind survives today. Fresh infusions of exotic germplasm are vital for the ongoing maintenance and improvement of agriculture.

Whether they are used in traditional farming systems, conventional breeding or modern biotechnology, genetic resources are a global asset of incalculable value—now and in the future. As genetic diversity erodes, our capacity to maintain and enhance agricultural productivity decreases along with the ability to respond to ever changing needs and conditions. If we are to adapt food production systems to rapidly changing climatic conditions in the next century, plant and animal genetic resources will offer the single most critical resource for doing so. Biological resources are the key to increasing food security and environmental stability, and to improving the human condition.

But I want to stress that the knowledge of farmers and indigenous peoples and their role in conserving and developing biodiversity is *not* ancient history. Today, for example, the Ifugao of the Philippine island of Luzon can name more than 200 varieties of sweet potato. Jivaro farmers in one Amazonian community grow over 100 varieties of manioc. In one Liberian village, Kpelle women maintain over 112 varieties of upland rice.

These plant genetic resources reflect the ingenuity, inventiveness and sophistication of what we call "informal innovation systems." There is increasing recognition worldwide that the indigenous knowledge of thousands of human cultures is of utmost importance in understanding, utilizing and conserving biological diversity for agriculture and sustainable development. The subject of biodiversity assumes utmost urgency today because we are losing biological resources at an unprecedented rate. A great deal of progress has been made in bringing the issue of biodiversity to the global policy arena. In late 1993, the Convention on Biological Diversity gave us the first legally-binding framework for conservation and sustainable use of biodiversity.

Life Patenting

Unfortunately, international cooperation to conserve biodiversity and to ensure its equitable and sustainable use is jeopardized by the efforts of some industrialized countries to obtain exclusive monopoly control over genes, plants, animals and other living organisms—including human genetic material. With the advent of genetic engineering, the biotechnology industry has successfully promoted the extension of industrial patenting regimes to *all* biological products and processes. It has happened in less than 15 years. Many of you are familiar with the landmark decisions, but let me review them quickly:

—In 1980, the U.S. Supreme Court ruled in the groundbreaking case of Diamond vs. Chakrabarty that genetically engineered microorganisms are patentable.

—In 1985, the U.S. Patent Office ruled that plants could be patented under industrial patent laws.

—In 1987, the U.S. Patent Office ruled that genetically engineered animals are also patentable.

As a result of these decisions, virtually all living organisms in the U.S.—including human genetic material—became patentable subject matter just like toasters or light bulbs. Genes, plants, animals and microorganisms—whether simply discovered in nature or manipulated by genetic engineers—could be rendered the intellectual property of private interests.

The biotechnology industry is lobbying vigorously, and quite successfully, to see minimum standards of intellectual property enforced worldwide. The European Parliament is currently debating the "Directive on the Legal Protection of Biotechnological Inventions" which proposes to extend life patenting in Europe. The recently concluded General Agreements on Tariffs and Trade and Trade-Related Aspects of Intellectual Property Rights (GATT-TRIPs) agreement will obligate signatory states to adopt intellectual property laws covering both microbial materials and plant varieties. This means that many developing nations will be forced to adopt plant intellectual property rights under the threat of trade sanctions. In many cases, these laws may be entirely inappropriate for some nations' needs and level of development.

Proponents of patenting argue that it stimulates innovation by rewarding patent holders and enables companies to recoup their research investment. But for farmers and consumers of the developing world, in particular, this means having to pay royalties on products which are based on their own biological resources and knowledge. Let me give three brief examples of what we call "Biopiracy."

The first example is the case of thaumatin, the super-sweet protein derived from a West African plant. Genetic engineers from Lucky Biotech Corporation and the University of California recently received U.S. and world patents for any plants that are genetically engineered to express super-sweet natural proteins derived from thaumatin.[1] The thaumatin plant protein is the sweetest substance known to humankind—scientists say it is 100,000 times sweeter than sugar. (For background on thaumatin, see Shand 1987a.) It grows in the humid tropical forests of West Africa where local people have used it for centuries as a sweetener and flavor enhancer. Imagine the potential commercial market for a low-calorie, natural sweetener that can be inserted into the genetic makeup of any fruit or vegetable! (In the U.S. alone, the market for low-calorie sweeteners is $900 million per annum, but West African people will have rights to none of it.)

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[1] International Patent, Publication Number WO 92/01790, dated February 6, 1992 and U.S. Patent Number 5,234,834.

The second example is the U.S. patent on genetically engineered or transgenic cotton.[2] (For a complete analysis, see Shand 1993a.) Even biotechnology industry representatives were shocked in late 1992 when Agracetus, Inc., a biotechnology subsidiary of W.R. Grace Corporation, received a patent for *all* genetically engineered cotton varieties. The first-ever "species patent" gives this company the right to decide when and if it chooses to license its technology—for how much and under what conditions—until the year 2008. In other words, transgenic cotton varieties cannot enter the commercial marketplace without payment of royalties to Agracetus. But the impact of this patent is not limited to the U.S. Agracetus applied for similar patents in India, China, Brazil and Europe, hoping to gain monopoly control over transgenic cotton in areas accounting for 60 percent of the world's cotton production. Cotton was first domesticated and improved by farmers in Central and South America. The notion that Agracetus "invented" transgenic cotton is offensive and unjust. Modern plant breeders and genetic engineers are literally building on the accumulated success of generations of anonymous farmers. Under the industrial patent system, however, it will be *illegal* for farmers to save seed from transgenic cotton plants without payment of royalties. In addition, utility (industrial) patents do not automatically give permission to researchers to use protected plant varieties for research purposes or to develop new commercial varieties.

The patenting of a major industrial crop is disturbing enough, but in March 1994, the same company, W.R. Grace Corporation, received a European patent on *all* transgenic soybean.[3] (For further details, see Mooney and Shand 1994.) RAFI is officially challenging this patent on a major food crop, for we view the patent as a threat to world food security. Geoffrey Hawtin, Director-General of the International Plant Genetic Resources Institute based in Rome, refers to the species-wide patents claimed by Agracetus as "economic highjacking." He states:

> The granting of patents covering all genetically engineered varieties of a species, irrespective of the genes concerned or how they were transferred, puts in the hands of a single inventor the possibility to control what we grow on our farms and in our gardens. At a stroke of a pen the research of countless farmers and scientists has potentially been negated in a single, legal act of economic high jack.[4]

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[2] U.S. Patent Number 5,159,135, dated October 27, 1992. Title: Genetic Engineering of Cotton Plant and Lines.

[3] European Patent Office Publicaton Number 0 301 749 Bl, dated March 2, 1994.

[4] Quoted in RAFI Press release, ***Food Patent Challenged,*** dated March 30, 1994.

Patenting the Human Cell Lines of Indigenous Peoples

The third and perhaps most disturbing example of biopiracy involves patent applications by the U.S. government on the human cell lines of indigenous peoples. A year ago, RAFI discovered that the U.S. government had applied for U.S. and international patents on the human cell line of a 26-year old Guaymi Indian woman from Panama (Shand 1994). A blood sample was taken from this woman by a National Institutes of Health (NIH) researcher, who then established a cell line—this refers to cells that are capable of sustaining continuous, long-term growth in cultures, i.e., they can live indefinitely under artificial conditions. The sample was of interest because some Guaymi people carry a unique virus, and its antibodies could prove useful in AIDS and leukemia research. The scientist who took the DNA sample from the Guaymi woman followed the standard regulations for what is known as "oral informed consent." But informed consent does not require that you tell the research subject that you intend to patent genetic material derived from their DNA, or that someone stands to profit *if* a commercial product should someday be developed from the patented cell line.

Representatives from the Guaymi Congress in Panama were shocked to learn that the U.S. government could apply for patents on the human genetic material, let alone the cell line of a foreign national. The Guaymi Indians do not object to medical research or to making contributions that will improve the human condition, but they were morally outraged that the U.S. government would seek monopoly control over human cell lines and potentially profit from the genes of poor people. Isidro Acosta, President of the Guaymi General Congress, made this statement at a press conference in Geneva last October:

> I never imagined people would patent plants and animals. It is fundamentally immoral, contrary to the Guaymi view of nature, and our place in it. To patent human material...to take human DNA and patent its products...that violates the integrity of life itself, and our deepest sense of morality.[5]

As a result of protests by the Guaymi Congress, other indigenous peoples' organizations, nongovernment organizations (NGOs) and the European Parliament, the U.S. government silently withdrew its patent claim late last year.[6] But the issue is far from being resolved. In January, 1994, two more patent applications, again in the name of the U.S. government, were pending in Europe.

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[5] Translated from Spanish. Quoted in RAFI press release ***Indigenous People Protest U.S. Secretary of Commerce Patent Claim on Guaymi Indian Cell Line,*** dated October 26, 1993.

[6] Express Abandonment Pursuant to 37 C.F.R. Sec. 1.138, for Human T Lymphotropic Virus Type 2, from Guaymi Indians in Panama. Letter dated November 1, 1993 from the Office of Technology Transfer, NIH to the Commissioner of Patents and Trademarks. Letter submitted by Susan S. Rucker, Attorney.

This time the cell lines come from citizens of the Solomon Islands and Papua New Guinea.[7] The cell lines are now on deposit at the American Type Culture Collection in Washington, DC. But since patent claims are still pending, access to these materials is restricted—even to the governments of Papua New Guinea and the Solomon Islands.

Private ownership of human biological materials raises many profound social, ethical and political issues. The patenting of human cell lines of indigenous peoples is clearly a violation of fundamental human rights—some have dubbed it a new form of "bio-colonialism." If these cell lines, or products derived from them, should someday result in commercial products, U.S. courts have ruled that the people from whom the genetic material is taken do not have rights of ownership over their own cells after they have been removed from their bodies[8] (see Annas 1993). According to corporate interpretations of the Biodiversity Convention, signatory states are obliged to recognize the ownership of genetic materials by countries or companies, but there is no mechanism to compensate the individuals or communities from whom the DNA samples were taken.

Well, some of you may be wondering what patenting of human genetic material has to do with agriculture. 1 mention this case because it clearly has a great deal to do with biotechnology and the issue of life patenting, and it clearly relates to the public good. The point I want to make is that there is enormous controversy and debate over the ownership of genetic resources. We do not hear as much about it here in the U.S., but it is an extremely hot topic in the rest of the world. And it is a subject we cannot ignore (Khor 1993). The ultimate danger is that the exchange of genetic material and information which is so vital for food security will be severely constricted, undermining efforts to conserve biodiversity and guarantee access to it. Under this scenario, everyone loses.

I will return to the issue of intellectual property rights, but I want to comment briefly on structural changes in agricultural production and trade, particularly in the developing world.

BIOTECHNOLOGY-STRUCTURAL CHANGES IN AG RI CULT URAL PRO DUCT I ON AND TRADE

There is little doubt that in the near future biotechnologies will profoundly shape our economic and social structures and our natural environment. In agriculture, biotechnology will change not only *where* our food is produced, but *how* it is produced and by whom. Although commercial biotech-

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[7] WO93/03759 and WO/92/15325-A. Information on these patent applications came from Miges Baumann, SWISS AID, a development NGO based in Bern, Switzerland, dated January 14, 1994.

[8] Moore vs. Regents of the University of California, 793 P2d 479, 271 *Cal. Rptr.* 146 (1990).

nologies are being developed primarily by food, agrochemical and pharmaceutical corporations in the industrialized world, farmers and consumers of the developing world will be profoundly affected. Early in the next century we will see dramatic changes in global agricultural production and trade—with many negative implications for the Third World.

One very real threat is the transfer of production. The ability to produce high-value tropical products in the laboratory will ultimately transfer production out of farmers' fields into industrial bioreactors. This could mean massive displacement of agricultural workers and disruption of Third World economies.

Vanilla

One classic example is the case of vanilla. In California, a biotechnology company called Escagenetics is now producing natural vanilla in the laboratory using a cell culture technique. (For details see Shand 1991.) Instead of cultivating the vanilla orchid which produces the vanilla bean, this company is growing cells from the vanilla plant and getting those cells to secrete the natural vanilla flavor. No need for soil, sunlight or farmers.

Natural vanilla flavor is, traditionally, an expensive flavoring that can only be grown commercially in a few developing countries. Three-quarters of the world's vanilla bean production comes from the island of Madagascar, the Comoros and other small islands off the East Coast of Africa where about 100,000 small farmers are engaged in production of this high-value crop.

It is no exaggeration to say that, i/commercially successful, biosynthetic vanilla has the potential to displace vanilla bean exports on a massive scale. The last report that I am aware of is that a division of the Unilever Corporation, Quest International, had entered into an agreement with Escagenetics to determine the potential for scaling up the production of biosynthetic vanilla.

Of course, I am not suggesting that these islands should continue to be dependent on export crops like vanilla. But it takes time to diversify economically and it takes a great deal of planning. Remember, too, that the germplasm that makes possible the biosynthetic production of vanilla in the laboratory originated in the developing world.

I want to stress that vanilla is just the tip of the iceberg; it represents only one of thousands of plant-derived substances and primary export commodities which may be future targets of biotechnology. Other tropical products like coffee, cacao, pyrethrum and rubber are among the commodities now being targeted.

Biotechnology will also make it possible to *substitute* one raw material for another in modern food processing; the food industry calls this "multiple sourcing." The potential is especially dramatic in genetic modification of oils and fats. The industry's goal is to reduce reliance on high-priced, imported oils. Several companies are pursuing the goal of converting cheap oils such as palm or soybean into high-quality cocoa butter (Shand 1987b). One California-

based company, Genencor Company, has patented a process to convert palm oil into expensive cocoa butter. Fuji Oil Co. of Japan has a patented process to develop cocoa butter substitutes from olive, safflower and palm oil. This is good news for food processors, and perhaps for consumers as well, but extraordinarily bad news for Third World cacao producers whose annual cocoa butter exports are valued at approximately $540 million.

These examples offer a glimpse of some long-term structural change in global food and agricultural systems with unintended, though very negative, consequences for many developing countries. New, natural substitutes as well as novel production processes will alter, reduce or eliminate the need for traditional cultivation of major food and industrial crops. At stake are not only foreign exchange earnings but the livelihoods of literally millions of agricultural workers who currently produce these products.

These examples are particularly important in light of the fact that the biotechnology industry so readily promises that genetic engineering will solve problems of hunger in the developing world. And, it is usually the promise of technology transfer that is so often mentioned as the reward for developing nations who make available their biological resources. Despite what other presenters indicated, I do not believe that commercial biotechnology is about feeding hungry people.

While new biotechnologies do have potential to address food and agricultural problems in the developing world, it is critically important to look at the social and economic as well as ecological risks associated with the introduction of these new technologies.

Of course, I do not mean to imply that U.S. farmers will be immune from these trends. As I mentioned earlier, under the industrial patent system it becomes illegal for farmers to save seed from patented varieties, or to sell offspring from patented livestock, without payment of royalties. This is just one example of how the role of farmers in society is changing and will be dramatically affected by emerging biotechnologies. Way back in 1986, Roger Salquist, the outspoken president and CEO of Calgene, made an important prediction about the impact of commercial biotechnology on agriculture (Salquist 1986). He said:

> The major thing that's going to happen in terms of biotechnology in agriculture, I believe, the single most startling thing is a strategic restructuring of the industry to vertical integration...Historically the processors of products from agriculture have purchased them on the commodity markets. What's going to happen with biotechnology is that you're creating *proprietary* products out of commodities.

Mr. Salquist was right. The biotechnology industry of the future will control a product from raw material to the point of consumption. As biotechnology firms gain control over every phase of production, processing and marketing—

from "seed to supermarket" as they say—the role of the farmer is reduced to that of a worker who grows crops and livestock under contract. In the development of new transgenic crops, for example, the trend is toward the development of "use-tailored, identity-preserved" seed varieties that are genetically tailored to meet specific needs—*not of the farmer,* but of the food processor (Wheat 1991, Wheat 1992). Under this scenario, the American farmer becomes a "renter of germplasm," rather than an independent, owner/operator. The trend is not new, but it will likely accelerate with the commercialization of transgenic plants and livestock. Agricultural economists such as Michael Boehlje (1992) predict that up to 40 percent of U.S. farmers will be growing "value-added" crops under contract by the year 2000.

ENVIRONMENTAL CONCERNS

Well, what about environmental stewardship? Will the biotechnology industry deliver on its promise to bring us a more environmentally friendly agriculture? Will new biotechnologies promote sustainable agriculture? These are issues that have been the subject of intense debate over the past years.

I am not an expert on the environmental impacts of biotechnology, nor is it the area I focus on day to day, but we *do* have concerns about the potential ecological risks involved with genetic engineering. RAFI and many other farm advocacy organizations continue to question whether or not the biotechnology industry will deliver on its promises to bring us a more sustainable system of agriculture. Several years ago, I coauthored a report entitled *Bitter Harvest: Herbicide Tolerant Crops and the Threat to Sustainable Agriculture* (Goldburg et al. 1990). This report is four years old, but our basic analysis remains the same. The bottom line is that agrichemical corporations are not developing herbicide-tolerant varieties because they want to clean up the environment, but because they are interested in selling more herbicides. Rather than moving us away from chemical dependence in agriculture, herbicide-resistant crops will entrench our reliance on toxic chemical weedkillers.

The biotechnology industry assures us that herbicide-tolerant crops will be engineered to resist only newer, less toxic herbicides. We reject that claim (Shand 1993b). The U.S. Department of Agriculture's (USDA) recent approval of Calgene's bromoxynil-resistant cotton is a case in point.[9] Bromoxynil is a known cause of birth defects in laboratory animals and is highly toxic to both fish and wildlife. With commercial sale of bromoxynil-resistant cotton, farmers can use a post-emergent herbicide on cotton for the first time. Here we see biotechnology being used to create new uses for a dangerous herbicide. It is a far cry from environmentally benign. Worldwide, herbicide tolerance is the trait most commonly tested in transgenic crops. In the U.S. approximately 40 percent of the field test applications for transgenic plants have been for herbicide tolerance.

[9] USDA/APHIS approved Calgene's petition for its bromoxynil-resistant cotton varieties for nonregulated status under USDA regulations on February 15, 1994.

Overall, we think it is important to acknowledge that genetic engineering of plants and microorganisms *is* new and still untested on a large scale. With genetic engineering the species barrier has been broken—allowing scientists to fashion new organisms that are not found in nature or in traditionally bred organisms. At this point, we have very limited experience with the use and behavior of novel transgenic plants, animals and microorganisms.

Of course, there is a great deal of important research being done in the area of biological insecticides as well as plants genetically engineered for beneficial traits such as insect and virus resistance. But published reports in the past few weeks remind me of how little we know, even in those cases where the end products are deemed the most socially beneficial and environmentally benign.

In March 1994, for example, scientists at Michigan State University published their findings that genetic engineering of plants to resist existing viruses may actually stimulate the evolution of new viruses (Greene and Allison 1994). While some scientists believe that the risk of creating new and harmful viruses is practically nil, the findings of Richard Allison and Ann Greene signal the need for further research on genetically engineered virus-resistance in plants. After all, approximately 18 percent of the field tests approved by USDA are for crops genetically engineered to resist viral diseases. Given the fact that the next step is commercialization of these crops, it is prudent to continue research designed to carefully assess the potential risks.

In the May 1993 issue of *Bio/Technology* magazine, there is an interesting editorial by Bernard Dixon, entitled *Keeping an Eye on* Bacillus thuringiensis (Dixon 1993). He begins his commentary by quoting scientists who describe *Bt* as "totally safe" and "nontoxic," an agent of biological insect control that could never pose a threat to human health. But he goes on to describe recent reports in the literature that suggest, *not conclusively,* that "nonpathogenic" members of the genus *Bacillus* can trigger human disease, especially among immunocompromised individuals under special circumstances. Based on these reports, he suggests that there may be particular grounds for concern about the dissemination of *B. thuringiensis* in areas of Africa with a high prevalence of immunosuppressive infections such as childhood measles in, malaria and AIDS.

I am *not* suggesting that we should discontinue research on genetically engineered virus-resistant plants or that Bt is harmful to human health. But these examples illustrate, I think, how little is known about the possible adverse impacts of introducing genetically engineered plants and microorganisms into the environment—*even* for those products that are considered the most environmentally benign and that clearly offer tremendous benefits for agriculture and human health.

In case you have not seen it, I urge you to take a look at the Union of Concerned Scientists' recent report entitled *Perils Amidst the Promise: Ecological Risks of Transgenic Crops in a Global Market* (Rissler and Mellon 1993). The report describes many of the potential ecological risks of transgenic plants and

offers an innovative approach for scientifically assessing two aspects of risk—weediness potential and gene flow. The report calls on the U.S. to establish a strong federal program to assess and minimize the risks of transgenic crops before they are commercialized. It does a particularly good job, I think, of describing the potential threat to centers of crop genetic diversity, both in the U.S. and in the developing world.

In light of these risks, I find it particularly disturbing that the Biotechnology Industry Organization (BIO), a trade group, is lobbying the Clinton Administration to oppose the development of an international biosafety protocol under the Convention on Biological Diversity (Feldbaum 1994).

CONCLUSION

So, what can be done to address the issues of biopiracy and inequities that may result from the development of new biotechnologies that are based on both genetic material and informal innovation of the South (i.e., southern hemisphere)? I want to mention a few areas of policy reform that we think are important.

First, the whole notion of intellectual property rights over living materials needs broad societal review. New biotechnologies are being developed at a rate far faster than responsible social policies can be devised to guide them, or legal systems can evolve to adequately address them. Public debate has lagged far behind.

Intellectual property laws are designed to promote innovation, but it is clear that the system is out of control in regard to biological products and processes. Patents are a legal monopoly given by government in exchange for societal benefits. I would argue that there is *no* benefit for society when a single company is given exclusive monopoly control over an entire agricultural species. Patents are clearly an important marketing tool for biotechnology firms. Instead of promoting innovation, however, they may be stifling the free flow of information and genetic resources that are so vital to the biotechnology industry, public researchers and agricultural development worldwide.

We believe that there is an urgent need for the U.S. Congress to reevaluate the role of intellectual property rights as it affects agriculture and the public good. Unfortunately, every time in recent history that plant intellectual property rights have been amended, it has been to strengthen the rights of industry at the expense of farmers and society. The seed industry is lobbying very hard to take away the right of farmers to save and sell proprietary seed. And they want the U.S. government to ratify an international convention that makes it *optional* for signatories to allow farmers to save seed harvested on their own land.[10]

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[10] Amendments to the Plant Variety Protection Act, H.R. 2927. Hearing held before the House Agriculture Subcommittee on Department Operations and Nutrition. May 24, 1994.

Secondly, there are two major shortcomings in the Biodiversity Convention that need to be addressed by contracting parties in future negotiations: 1. *ex situ* gene bank material; and 2. farmers' rights.

The Biodiversity Convention specifically excludes *ex situ* gene bank material collected before the enactment of the Convention. This means that the comparatively huge stockpile of agricultural germplasm held in gene banks around the world, most of it gathered from tropical and subtropical countries, remains outside the agreement. Two-thirds of gene bank collections are controlled by the North (i.e., developed countries in the northern hemisphere). Well over four-fifths of livestock and microbial collections are also controlled by the North. Because it is usually inventoried and catalogued, this is generally considered to be material of most immediate value. There is concern that germplasm provided freely by the International Agricultural Research Centre (IARC) gene banks could become subject to exclusive monopoly, and this, in turn, could constrain free exchange of germplasm.

There are some positive developments in this area. Last year, IARCs of the Consultative Group on International Agricultural Research (CGIAR) initiated discussions to place IARC gene banks under the auspices of the Food and Agriculture Organization (FAO) of the United Nations (UN). This move is intended to guarantee that genebank samples cannot be subjected to exclusive monopoly control under an intellectual property system.

There is also an urgent need for an international funding mechanism, under the auspices of the UN, that will recognize, reward and protect the innovations of farmers, indigenous peoples and their communities. FAO made important progress in this respect by recognizing the principle of farmers' rights. Basically, farmers' rights recognizes that farmers—past, present and future—have contributed greatly to the conservation, use and development of plant genetic resources, and that they should be recognized and rewarded for those contributions. The principle of farmers' rights has not been implemented in any meaningful way, but it could be strengthened and implemented as a protocol to the Biodiversity Convention.

Many NGOs, as well as governments, support the creation of a sustained international fund, provided for by governments via the standard UN formula and administered through a UN agency governed on the basis of one nation, one vote. Such a fund would not make payments to individual farmers or communities, but would direct practical support of specific programs and projects, such as training of plant breeders, construction of gene banks, etc., to bring about rural development and to conserve and enhance agricultural genetic resources.

Ultimately, the goal of such a fund is to enable all countries to share the rights and responsibilities of conserving and using biodiversity. The aim is to allow even the poorest countries to develop indigenous capacity to exploit their own genetic resources and to develop greater self-reliance in food production.

Similar resolution is needed on the issue of patenting of human genetic material. We believe that the contracting parties to the Biodiversity Convention should respond to the requests of indigenous peoples' organizations for protection from patent claims.

The U.S. government should drop all claims to the human cell lines of foreign nationals, and repatriate the materials to the indigenous communities or national governments involved.

Finally, international protocols should be developed by the appropriate UN bodies for protecting and broadening the rights of human subjects from commercial exploitation and patent claims.

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