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**Agricultural Patenting:
A Case Study of Monsanto**

Shannon Moran

Introduction

Between 1996 and 2012, worldwide biotechnology crops expanded from 1.7 million hectares to 170.3 million hectares (“Beyond Promises,” 2012). With the global population expected to reach almost eight billion by 2025 (United Nations, 2004), the ability of transgenic crops to provide additional nutrients and higher yields leads organizations such as the Consultative Group on International Agricultural Research (CGIAR) to push for the use of genetically modified (GM) plants (Pinstrup-Andersen and Cohen, 2000). However, for policy advocates such as Greenpeace, the risk of “genetic pollution” and negative human-health impacts are not worth the enhanced properties of GM crops (“Genetic Engineering”). For Greenpeace, the poverty alleviation aspects that biotechnology companies promote are merely a public relations move to make their profits from their GM products more palatable for consumers (Greenpeace International, 2014).

In the spotlight of these accusations is Monsanto, one of the largest seed companies in the world. Its estimated market dominance of over 20 percent of global seed sales (ETC Group, 2013) and presence in 68 countries exemplifies the company’s reach and scope. Monsanto’s authority is even more concentrated within the U.S., where in 2009 its seeds produced 90% of the soybean crop and 80% of both cotton and corn crops (Langreth and Herper, 2009). In 2011, corn and soybeans represented the two largest harvested crops in the United States, and with the

cotton crop these three commodities brought in almost \$110 billion in sales (United States Environmental Protection Agency, 2013). Further, its 144 legal claims against U.S. farmers since 1997 (Gillam, 2012) demonstrates its aggressive enforcement of patents rights and legal prowess in the agricultural market. Its immense position and the estimated two million protesters worldwide against GM products in May 2013 (“No More GMO,” 2013) allow Monsanto to provide a case study for the consequences of patents in agriculture.

American patent policy in biotechnology gives innovators in this field a unique advantage compared with other patentable areas. In GM horticulture, scientists can acquire both a plant patent and a utility patent on their discoveries. A plant patent gives individuals protection against others duplicating their breed asexually, selling the plant in whole or in part, or importing the variety from a foreign country. Meanwhile, a utility patent covers not only the plant itself and its descendants, but also its method of production and the uses of the plant. This has a much broader scope than the plant patent and strong sway over follow-on technology and research. While the requirements for a utility patent are stricter, both types of patents last for 20 years in this rapidly changing field. Though this timeframe is the same as other industries under intellectual property (IP) protection by the U.S. Patent and Trademark Office (USPTO), biotechnology’s lightning pace and social impact means that shutting out competition for two decades can limit the innovation within a specific technology before the next methods dominate the field.

Yet this argument does not mean that IP rights are useless and that all discoveries should be open to the public from their moment of inception. Without patents, innovators would keep trade secrets to monopolize their techniques and this limits the dissemination of knowledge. By guaranteeing IP rights, an inventor feels comfortable publishing the details of how their discovery operates, what components it includes, and how to construct it. Other scientists then

can learn about a novel approach to a problem or a unique functionality of previous techniques. Further, without a monopoly period for recovering research and development (R&D) costs, expensive industries such as pharmaceuticals and biotechnology could instead find their competitors profiting from their efforts. Therefore, instead of merely vilifying the rewards provided to innovators through patents, this report identifies the contradictions that IP policy raises in biotechnology in terms of social welfare. Balancing the commercial needs of innovators and public interest is a complex challenge facing policymakers, and this report seeks to apply economic theories on biotechnology patents and to offer recommendations that could alleviate the cost to society.

Therefore, while the societal benefits or harms of biotechnology form a part of the policy discussion of this paper, the patent system that supports the biotechnology industry is the main motivation of its analysis. The findings are that patent law and court rulings on the IP rights over basic life forms created incentives for monopolistic and obstructionist behavior.

Biotechnological innovation in the United States is unique since innovators in agriculture can acquire both a plant patent and a utility patent on their discoveries. This gives the patent owner vast authority over not only the licensing of the technology, but also over any follow-on experimentation leveraging the knowledge contained within the patent. The nature of agricultural patents and Monsanto's behemoth position in the market provide policy analysts with insight into the perils of granting monopolistic power over innovation in a vital industry. By evaluating the current corporate and patent environment, we can search for policies that will improve not only the technological landscape but which also maximize the return to the public.

The structure of this paper is as follows. The report will begin with a literature review of agricultural and biotechnological patent history before exploring recent Supreme Court rulings

that reflect the intellectual property debate. The next section will consist of the empirical work of this analysis on the patent system, relying on Monsanto as a case study of its potential downfalls. We will leverage three concepts in economic theory: barriers to entry in the agricultural market, the tragedy of the anti-commons in licensing, and game theory on litigation strategies. Within each of these tools, we will have case studies referencing Monsanto and other patent-holding companies as well as the Golden Rice project, an initiative to provide beta-carotene to vitamin A deficient children in Asia. Following the analytical work, we will explain the economic implications of intellectual property policies and finally conclude with some policy recommendations to improve the system to work for not only innovators but also for the public.

Literature Review

The laws that grant Monsanto its power over the agriculture industry began in the 1930s with the Plant Protection Act. Originally meant to encourage breeders to pursue pest and fungi resistance after the devastating peach and chestnut crop failures in the late-1920s, it also provided intellectual property rights for asexually reproduced plants (*New Developments*). The peach yellows in the mid-1880s had spread to 15 states in the East, Midwest, and South (Lelong, 1891), while the chestnut blight discovered in 1907 spread at a pace of 20 to 50 miles per year and essentially wiped out the American chestnut by 1950 (Patel). This control over transgenic innovation was further solidified in the court rulings of *Diamond v. Chakrabarty* (1980) and *Ex parte Hibberd* (1985). The former Supreme Court case concluded with the famed perspective that “anything under the sun that is made by man” was patentable, including manipulated microorganisms. The latter ruling applied this principle to agriculture, permitting patent protection to genetically modified plants and their parts. Without this established legal history,

Monsanto may not have achieved its dominance without additional challenges from competitors or follow-on products.

However, agricultural policy experts are beginning to find fault with the court's decisions. Altering a small part of DNA can drastically and unpredictably change a plant's functions, which does not even address the potential mutations of the organism resulting from the insertion of a foreign gene. As patents for gene sequences in plants are given without the full understanding of the results to the host, the patent can conflict with future researchers revealing a commercial property of the plant unrecognized by the patent-holder (Jackson, 2000).

Furthermore, the patent may cover a sequence with few or no substitutes, which inhibits innovation in that genetic code. As an example, according to the National Human Genome Institute, patents control about one-fifth of the human genome ("Intellectual Property and Genomics," 2013). A search within the U.S. Patent Trade Office database reveals that since 1930, their staff issued over 20,000 plant patents as of January 2014. These characteristics of IP laws and of plant adaptability mean that patents give the patent holder power over both their competition in a specific field and the innovation process in that area entirely.

Biotechnology patents are distinct from other patents due to the nature of the innovation they encompass. IP policy in this industry faces not only the ethical dilemma of giving individuals ownership over basic building blocks of nature, but also of granting patents over the sustenance of humanity. Monopoly prices could threaten hungry communities around the globe that could benefit from hardier, GM crops or nutritionally-altered products. Further, the ability of nature to mutate creates circumstances whereby farms or breeders could find themselves possessing a patented life form they did not manipulate to attain. The self-replication and transformative properties of organisms also makes maintaining ownership more difficult, and

pushes inventors to pursue damages to scare individuals from coming into any possible contact with their product. The ethical and logistical questions around patenting in biotechnology presents a conundrum unique from other patents that is not quickly solved, and forces policies to determine the trade-off between entrepreneurship and humanitarianism.

Due to the negative consumer response leading to the restriction of GM products in countries such as Austria, France, and Germany, economists are also weighing in on the debate. According to a field study in New Zealand, the market share discrepancy between organic and labeled spray-free GM fruits was two-to-one, illustrating the customers' preference for unmodified produce (Knight et al., 2005). This rejection of GM crops by certain consumers makes contamination costly for the industry; in 2011, Bayer paid 11,000 U.S. rice farmers \$750 million to compensate for lost exports after its herbicide-resistant variety was found in as much as 30 percent of U.S. rice plots (Harris and Beasley, 2011). The national economy can suffer as well, since in May 2013 Japan halted imports of western-white wheat and canceled an order of nearly 25 metric tons of the crop after a farm in Oregon discovered an unauthorized GM strain in its plot (Takada, 2013). On the other hand, 20 percent of children around the globe number are estimated to be nutrition-deficient and underweight, so the higher yields from pest-resistance and vitamins GM crops can provide could offer a solution to the crisis at the local level (Paul et al, 2003). Even the farmers benefit, considering worldwide farmers' incomes are estimated to have increased overall by almost \$100 billion between 1996 and 2011 due to bioengineering, according to a study by PG Economics ("Global Economic Benefits," 2013).

Patent enforcement and fears of GM plant infestation in organic or conventional crops add another level of controversy to the debate. In 2004, the Supreme Court of Canada ruled in favor of Monsanto's patent rights in *Monsanto Canada Inc. v. Schmeiser* for unlicensed use of its

GM seeds. While there Monsanto could not prove that Schmeiser profited from the transgenic seeds on his property, the ruling gave Monsanto unprecedented authority in that country to pursue farmers whose crops may have inadvertently been infected with genetically modified pollen or seeds. Since Canadian patent laws are similar to those in America, they could provide persuasive precedents for U.S. agricultural disputes (Rose, 2011). However, the real risk of contamination comes into question, since López (2003) notes that pollen and seed spread is fairly narrow depending on the phenotype of the plant. Yet Lopez also extrapolates that the court's decision could apply to a plant that naturally mutates to assume the patented gene.

Economic Analysis

Barriers to Entry

A major public concern with Monsanto is its control over the market, which it has partially achieved by gaining broad patents in genetic technology. In 2001, Monsanto was awarded US Patent 6174724 B1 on a genetic tracker for antibiotic resistance. This gene allows a researcher to use negative selection to test if another gene successfully transferred into a cell. By injecting both the gene of interest and Monsanto's patented gene into a series of cells, the scientist can then expose them to a toxic level of antibiotics. Those cells that survive, therefore, contain the gene of interest to the scientist. Monsanto's patented gene and another held by Syngenta are the primary options for gene transfer testing. With a patent on all uses of the antibiotic-resistant gene, researchers could avoid licensing fees only by relying on a much riskier and potentially less effective method. The additional effort to work around the patent is inefficient, and could deter researchers from the devoting their resources in that field altogether.

The identification of gene sequence is also far less difficult than determining their application according to Jackson (2003), indicating that Monsanto's efforts of discovery is far

less than that necessary to find a use for the gene. Furthermore, if a scientist did figure out a purpose for the gene Monsanto may lay claim to its commercialization. Monsanto's authority in this case is known as "reach-through," whereby the patent holders have rights to all uses of their technology even if the original application failed to identify the follow-on uses in the patent claims. Reach-through presents a difficult circumstance for innovators, since others can fully profit from their hard work. This reduces the incentive to participate in highly-patented fields, and adds additional risk of reduced revenue in those ventures.

Monsanto also has other means to control innovation, such as through contracts with farmers. As of 1999, the use of "terminator seeds" or infertile seeds ended for Monsanto ("Monsanto Sells Terminator Seeds," 2013) due to the outcry over its potential stranglehold over the agriculture industry. With this restriction, Monsanto now requires buyers to not save seeds produced from the patented plants and instead purchase what they need for the next season. The *Monsanto Canada Inc. v. Schmeiser* case upheld this practice, even when a farmer may not be aware of GM crops on their property. Any use of the patented gene requires a licensing fee to Monsanto, and therefore farmers fear visits from Monsanto investigators who test the edges of their land for Roundup-resistant soybeans.

Monsanto's agreement also runs counter to traditional farming methods, where farmers select the best seeds to save for the following year based on the plant's characteristics. Breeding gives farmers a greater understanding of a plant's potential, and they develop basic knowledge which improves the industry. However, if their skills give them an ideal plant only after the use of Monsanto's gene, they would be unable to leverage this hard work in the following season since they would have to destroy the seeds. Single-season crops result in a loss of traditional

agricultural innovation, which although less technologically advanced still furthers the boundaries of science.

The Tragedy of the Anti-Commons

With six companies in possession of 75 percent of U.S. agricultural patents as of 2005 (Dunwell, 2005), there is apparent potential for hold ups in biotechnology. The ability of companies to obtain utility patents without prior knowledge of all the applications of their technology means that any follow-on innovation requires permission from a variety of holders. This is known as the “tragedy of the anti-commons,” a reinterpretation of the tragedy of the commons by Hellen and Eisenberg (1998). Instead of the overutilization of public goods, the tragedy consists of underutilization due to the number of property rights involved in a technological application of patented materials.

Golden Rice is an example of the impediments of an anti-commons situation. Invented by the Swiss Federal Institute of Technology (SFIT) and Ingo Potrykus in the 1990s, the genetically modified rice incorporated beta-carotene, which provides vitamin A. Around eight million children around the world suffer from vitamin A deficiency, and it is particularly common in Asia. Each year, 700,000 children perish and up to half a million are blinded from insufficient beta-carotene consumption (Paul et al, 2003). The Golden Rice project focused on solving this problem, and can provide over half of the recommended daily intake of vitamin A in just 50 grams of grains (Tang, 2012). Although humanitarian in purpose, the production of Golden Rice encountered 32 holders of 70 patents who could each demand a transaction cost for a license (Paul et al, 2003).

A model from Scotchmer (2004) depicts the spiraling costs of negotiating for access to multiple patents. In an ideal case, the intended user would be able to sign agreements with all the

patent holders at once so that each patent holder would receive an equal part of the user's willingness to pay for the licenses. However, separate negotiations are required and each consecutive license becomes more vital to the commerciality of a product such as Golden Rice. Therefore, those patent holders begin to overvalue their technology and charge an additional fee than what is optimal for the user. While the additional cost could be potentially marginal, as the user moves through the 69 other license negotiations these surplus charges add up to a substantial amount. Therefore, the anti-commons property heightens rent-seeking and reduces the social benefit of the application method (Jackson 2003).

This tragedy became actualized in the case of Golden Rice. Although some of the patent holders gave their licenses to the effort for free, the overall costs made it prohibitive for the inventors to move forward. To bring Golden Rice to fruition, Syngenta and Greenovation received exclusive rights to the product in 2000 (Paul et al, 2003). Developing nations protested the change in ownership, believing the inventors sold them out to companies seeking to profit from their plight. The Golden Rice project, however, felt it was the only way to ensure the commercialization of their crop in the wake of such high transaction costs. While Syngenta and Greenovation may seek profits which the SFIT team would have reneged in the endeavor, the companies still face challenges in development. These impediments range from the inability to export to other countries under patent law, the risk of losing their intellectual property in weak regulatory environments, and the need to cross-breed Golden Rice with wild versions of the targeted nations (Paul et al, 2003).

Game Theory on Litigation in Patent Disputes

After the ruling in *Monsanto Canada Inc. v. Schmeiser*, the Organic Seed Growers and Trade Association (OSGATA) and a group of conventional farmers decided to take preemptive

action against the infiltration of patented crops in their property. After being contested in the lower courts, the U.S. Court of Appeals dismissed *OSGATA et al. v. Monsanto* in 2013 due to the extraction of assurances from Monsanto that it will not seek damages for inadvertent transferring of up to one percent of its patented genes into farmers' fields. This therefore gave the plaintiffs no standing to pursue further protection from future lawsuits from Monsanto for infringement. In an appeal to the Supreme Court, the plaintiffs noted that they face risks of contamination far higher than the one percent granted in the binding agreement, which some estimate could be as high as five percent (Hershaw, 2013), and therefore are seeking a covenant not to sue from Monsanto.

As revealed in this legal dispute, the farmers felt that the costs of pursuing court protection against future damages outweighed the potential licensing fees to Monsanto. While it seems counterintuitive to pursue preemptive action when the probability of contamination is so low, the game-theory model below may clarify the motivations of both parties. Consider that Monsanto earns its normal revenues without the additional licensing fees from the OSGATA farmers, and that the farmers earn income from their organic and conventional fields. If Monsanto suspects a patent infringement and brings a suit against the farmers, both parties face litigation costs and the individuals in OSGATA risk paying penalties for inadvertent infringement. Meanwhile, the farmers near GM-using plots fear the cross-pollination or outright contamination of their crops due to the resulting licensing fees.

Table 1: Game Theory Model of Pre-Litigation Decisions of Monsanto and OSGATA

		Monsanto	
		Doesn't pursue damages	Pursue damages
OSGATA Farmers	Don't seek legal protection	Outcome A ($\pi T_x, \pi T_y$)	Outcome B ($\pi T_x - L_F - R, \pi T_y - L_M + R$)**
	Seek legal protection	Outcome C ($\pi T_x - L_F, \pi T_y - L_M$)*	Outcome D ($[P_{WF}(\pi T_x - L_F) - P_{WM}(\pi T_x - L_F - R)],$ $[P_{WM}(\pi T_y - L_M + R) - P_{WF}(\pi T_y - L_M)]$)

*Note: *Assumes $L_F < R$ and $L_M > R$; **Assumes $L_F > R$ and $L_M < R$*

Variables

Monsanto's baseline revenues: πT_y

OSGATA Farmers' baseline revenues: πT_x

Litigation cost for Monsanto: L_M

Litigation cost for grouped farmers: L_F

Royalties collected by Monsanto from farmers for the life of the patent: R

P_{WF} : Probability that the farmers will win in court

P_{WM} : Probability that Monsanto will win in court

In this simplified model, the best outcome for the farmers would be to avoid litigation and to merely earn their normal profits (Outcome A). However, for Monsanto it becomes a bit more complicated depending on the value of the royalties they could extract from the farmers. Depending on the litigation costs and additional factors not taken into account in this exercise, the royalties to Monsanto may outweigh the required legal costs to present their case (Outcome B). For the farmers, the burden of taking Monsanto to court and winning protection could be less than the fees (Outcome C), especially compared with the costs in losing to Monsanto's allegations in the future (Outcome B). With these motivations, society ends up with the worst outcome as both parties have incentives to leverage the legal system (Outcome D). Litigation and high damage rewards further reduce the incentives to innovate since new entrants would see aggressive lawsuits as detrimental to their business. Legal costs therefore not only reduce some of the surplus for society from biotechnological advancements, but also cut back the total

number of industry ventures. Therefore, the public which granted the monopolies in exchange for technological innovation ends up potentially worse off since participants use the resources to seek profits or protection through court rulings.

An intriguing twist on this case would be if the organic farmers banded together to charge Monsanto for their lost business and organic certification whenever they discover GM plants on their property. It is unclear whether the court would side with the patent holder's IP rights or with the damages experienced by the organic farmers, but the United States Department of Agriculture places the responsibility for preventing GM contamination on the organic farmer, not Monsanto. Organic and conventional farmers are expected use options such as setting their crops to flower at a different interval than those of farmers using Roundup Ready plants, deep cleaning shared seed silos, or by designating a section of their crops as a buffer zone that will not be sold as GM-free products (McEvoy, 2013).

Economic Implications

The analysis above presents a depressing picture for innovation in the agricultural realm. The patents in existence encompass too much of the technological spectrum and the incentives of IP are to pursue rents rather than a socially-optimal level of licensing. One of the original solutions to the anti-commons consisted of consolidating companies to centralize the necessary patents for applied science. By 1983 in the U.S., large corporations held 70 percent of the market in seeds, and four companies had 50 percent to 60 percent of total sales; by 1997, small firms had only 20 percent market share, demonstrating the rapid merging within this high risk industry (Fernandez-Cornejo, 2004). In comparison, the pharmaceutical industry in 2007 had ten companies in control of around half of the patent protected drug market, with 48 percent held by competitors; this held true in 2012 as well (Gauntlett and Rickwood, 2013). Yet while the consolidation of patent

holders in agriculture may have aided company researchers to gain access to the necessary proprietary material for corporate projects, it also allowed those larger companies to profit from the lucrative ventures of others through licensing agreements and to close off potential competition through patent thickets.

Another implication not discussed in the models is the pursuit of less-desirable industries with the patents at hand. Rommens (2010) argues that affluent consumers would value improvements such as enhanced taste and color. Lucrative markets such as countries within the EU favor organic produce over GM options, although the latter offer higher crop yields and could provide lower prices. The focus on these markets distorts the use of agricultural IP away from those technologies which would help impoverished communities. While the pursuit of profits forms a necessary incentive for corporate undertakings, the broad IP patents limit the opportunities for humanitarian efforts and can give rewards to patent holders far beyond the returns to society.

However, a lack of IP protection, especially in the international arena, has negative consequences. Companies become reluctant to invest in foreign countries with weak patent enforcement and will not allow those who have access to the technology to export it to other regions. Jackson noted in 2000 that WIPO identified 44 countries that did not recognize patents for plants. As of 2011, Brazil, China, and India, currently three of the fastest growing economies in the world, are among those that believe that biological material does not qualify for IP (Chen and Yeh, 2011). Without patent protection, American companies may also be unwilling to maintain manufacturing or research facilities in those countries out of fear of IP theft and local clones of their business. For every \$100 worth of agricultural output, developed nations spend \$5 in research and development while developing countries spend only 66 cents (Phillips, 2004).

This limits the exposure rising nations have to crop technology, and could slow their progress towards advanced agriculture production.

Yet while biotechnology may be able to end hunger and nutritional deficiencies, it also can harm the livelihoods of farmers in developing countries. Exports are one of the fastest ways for those nations to gain wealth, and those countries often leverage their natural resource sector to their competitive advantage. Selling local produce to more lucrative markets abroad can provide jobs for communities, and higher yields from GM crops could expand that part of the economy (Kydd et al, 2000). However, even though drought and pest resistant plants could save a harvest from ruin, many major importing countries refuse to accept GM products. While GM crops would remain an option for solving local hunger, their use could also restrict the export options and leave the farmer with less desirable margins than before. Therefore, even if the farmer can blend the transgenic plant with a local crop to improve their production levels and to feed their neighbors, relying on GM technology could also close the farmer off from the more valuable foreign consumers.

Policy Solutions

After consolidation failed to solve the restrictive nature of agricultural patents, a more recent policy solution is to have non-corporate and non-governmental organizations hold a database of patents that are made available for entrepreneurial companies and researchers. This challenges the monopolistic power of those possessing broad patents, and gives innovation steered towards public welfare a means of achieving society's goals affordably. One such organization is the Public Intellectual Property Resource for Agriculture (PIPRA), which was created by the Rockefeller Foundation in 2004. With more than 50 entities as members, PIPRA's database in 2006 contained more than 6,600 patents and patent applications (*PIPRA Database*, 2006).

However, this approach suffers from its own shortcomings because of the insider-outsider paradox. If a new technology that challenges the market share of those within the organization seeks licenses for patents in their portfolio, would the organization grant the developer access to the IP necessary to produce it? Thus even if the purpose of the group is to promote the interests of the public, it can still fall victim to self-interest when presented with a contender to their industrial power. Universities with patents could also feel this pressure, since their reputation and funding are dependent on maintaining a technological edge over their rival science schools. Offering their licenses to groups in the same field could lead to the next step in the biotechnology revolution and hurt their standing with their stakeholders.

In 2011, President Obama signed the America Invents Act (AIA) to align U.S. patent practices with international standards, to ease the application requirements for filers, and to open a patent to post-grant review. While the opposition portion of the AIA alleviates some of the expertise requirements of the USPTO (since industry professionals and interested parties could provide technical critiques), there are still areas that this legislation does not address. Problems from litigation to pursue rents rather than IP justice continue to stifle smaller actors from entering certain areas of research: according to the Federal Trade Commission, a trial over biotechnology can last two to three years and cost as much as \$7 million (“To Promote Innovation”, 2003). Furthermore, in my opinion, if society wishes to alter the incentive structure for biotechnological companies then a narrower scope for an awarded patent would be necessary to prevent reach-through and restrictive licensing practices.

However, to understand the latest technological advancements, patent office staff needs to be more experienced with and aware of this quickly evolving field. The Fee Reserve Fund of this office should be more flexible to allow it to add expertise as necessary to keep up with

industry and to offer competitive salaries. Instead under the current system, it must receive its additional revenues through the appropriations process, a political battle that Congress undertakes annually. This is vital since the staff's choices on claims rights have such extensive consequences to both the developed and developing worlds. Access to food and nutrition are becoming increasingly viewed as public goods due to their significant impacts on health and economic growth at the national level, and therefore politicians may want to be more concerned with the motivations promoted by the current patent system.

Another concern relating to local knowledge and indigenous techniques is also left out of the latest reforms. These cultural and generational insights to a specific species require a novel approach to patent policy to prevent its privatization by a single company. Marinova and Raven (2006) note several partnerships between indigenous communities and corporations that offer economic reimbursements to the groups that harvest or rely upon a plant for their spirituality and livelihood. The authors also point out its sustainability for the plant and national policies that defend the needs of the local communities around profit-worthy flora. Western concepts of ownership over natural species are neither desirable nor enforceable in certain cultures, and therefore the U.S. patent system should seek to provide protections and recourse for groups affected by American privatization in biotechnology. Expanding exemptions from patent infringement to cultural, humanitarian, and research requests could reduce the burdens on socially-oriented development and provide additional innovation in areas that benefit vulnerable populations.

However, additional patent reform would be extremely difficult because of both political and corporate advocates. Biotechnological companies can form a major lobby group for representatives in the government. Yet even if these companies do not necessary contribute to

campaigns, congressmen with large agricultural companies or biotechnology research facilities in their districts will want to promote the jobs these corporate entities can generate. Constituents not only want higher-wage employment but also cheaper food so that they can use their money on other goods. Changing the current patent system could result in a painful transition for some groups of the public, which may backfire on the politicians supporting the policy and cause laws to regress into giving only more power to the rent-seeking interests in biotechnology.

Another possible downside in patent reform would be if the laws removed incentives to pursue research in the field. If the government narrows the scope of corporate patents, it may push IP holders towards more lucrative industries that offer even less public welfare. If the market is rewarding technologies that develop taste- or texture-oriented products, restricting companies to the less profitable, more humanitarian aspects may not have the expected outcome of additional advancements in those areas. Rather, it could lead to an overall loss in innovation as companies such as Monsanto turn to their other options, such as the chemical sector. The purpose of patent reform would be to stimulate innovations in agricultural biotechnology, but it would not be worth sacrificing all technological change to reorient the industry towards only the most pressing needs of the world.

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