FOOD FORETHOUGHT: INTERGENERATIONAL EQUITY AND GLOBAL FOOD SUPPLY—PAST, PRESENT, AND FUTURE

KEITH AOKI*

This Article assesses the treatment of plant genetic resources and crop diversity in light of theories of corrective and distributive justice (utilitarian and deontological) as well as relevant critiques of such theories. It reviews three periods in the treatment of plant genetic resources: the past, the present, and the future, noting that in the present era there are striking levels of vertical and horizontal concentration around the globe. Without denying the central role that intellectual property rights in plant genetic resources have played since the 1980s, this Article argues that we need a renewed regulatory focus on genetically engineered crops, the assertion and construction of a global antitrust regime, and a drastic rethinking of our labor-migration laws to account for the changes in global agriculture.

* Professor, UC-Davis King Hall School of Law. Thanks to Camille Barr, Jordon Browning, Emilio Camacho, Lynn Gatti, Jennifer Maguire, Esmeralda Soria, Lauren Steinhaeuser, Karalyn Downing, and Adrienne Blais. Thanks also to Professors Shubha Ghosh and Deven Desai. All mistakes are my own.

INTRODUCTION: (INTELLECTUAL) PROPERTY RIGHTS AND TIME—LOOKING BACKWARD AND FORWARD

This Article addresses the question of intergenerational equity as it relates to agriculture and global food supply. While the exact date may be in doubt, the era during which human society shifted from a hunter-gatherer culture to a culture that cultivated crops began approximately ten thousand years ago (or approximately two-hundred fifty thousand generations ago).[1] Our major staple food crops during this era were transformed over generations from wild species into domesticated crops such as corn, wheat, millet, rice, and soy. A relatively recent example is the way that maize went from a Central American grass-like crop two thousand years ago to the hundreds of varieties of maize known today.[2] These transformations occurred through human agency, albeit intergenerational and anonymous, as generations of farmers practiced selective breeding and adapted various crops to a variety of climate and soil conditions, as well as through peripatetic diffusion of seeds from centers of origination to distant locations.[3]

The number of hungry persons has increased since the United Nations set their Millennium Development Goals in the 1990s. Unsurprisingly, poverty is the primary cause of hunger. Almost 40 percent of the world's population earns less than $2 per day.[4] Even in the global North, significant parts of the population are food insecure, and government programs aimed at helping hungry families have been implemented. But one question remains: Is an industrialized, consolidated agrifood system the best way to feed hungry people in the global North or the global South?

Marion Nestle says that the U.S. food system produces "3,900 calories per day for every man, woman and child in the country,

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1. KEITH AOKI, SEED WARS: CONTROVERSIES AND CASES ON PLANT GENETIC RESOURCES AND INTELLECTUAL PROPERTY 9 (2008) [hereinafter AOKI, SEED WARS] (providing a brief history of seed cultivation and explaining human development from hunter-gatherers to industrial farmers).

2. *See* STEPHEN B. BRUSH, FARMERS' BOUNTY: LOCATING CROP DIVERSITY IN THE CONTEMPORARY WORLD 28–34 (2004) (explaining how scientists have continuously worked to understand the development of the varieties of maize known today).

3. JACK RALPH KLOPPENBURG, JR., FIRST THE SEED: THE POLITICAL ECONOMY OF PLANT BIOTECHNOLOGY 1492–2000, at 152–57 (2d ed., Univ. Wis. Press 2004) (1988) (analyzing plant genetic resources in the world system).

4. MARY HENDRICKSON ET AL., THE GLOBAL FOOD SYSTEM AND NODES OF POWER 33 (2008); Dan Manternach, *World Ag Forum Still Sees Food Miracle Needed*, DOANE'S AGRIC. REP., May 2005, at 5–6.

whereas the average adult needs only a bit more than half that amount."[5] We are producing too much of the wrong kind of food as diet-based obesity diseases such as diabetes become epidemic in North America and Europe. Hunger, poverty, and vanishing rural livelihoods make rising food prices a sharper and sharper problem. It is clear that food supply matters. However, how we justify and design an equitable system of global food supply is the subject of much controversy.

This Article first reviews justifications for and critiques of arguments that global food supply should be given different treatment in the emerging harmonized intellectual property regimes of the World Trade Organization (WTO). Many of the changes arising from such differential treatment may occasion global redistribution of wealth between countries, institutions, and individuals. These justifications are based upon: (1) national self-interest; (2) utilitarian arguments premised on the notion of diminishing marginal utility—the less an individual has, the greater the benefit they receive from a unit of a particular good/resource; (3) non-utilitarian arguments premised on either contract, deontological or pluralist foundations; and (4) corrective-justice theories, premised on a notion of reparations for past injustice.

This Article has a simple structure. It briefly recounts "The Past" treatment of agricultural-plant genetic diversity with a focus on technological, legal, and economic changes occurring during the twentieth century. It then moves on to consider a snapshot of "The Present," examining tensions between trade and biodiversity treaty regimes represented by the Convention on Biological Diversity (CBD) and the Trade Related Aspects of Intellectual Property (TRIPS) Agreements. In this context it will also consider the shift toward the treatment of plant genetic resources as sovereign national property, a shift which was embodied by the 2001 International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR/FA), which also contained sections addressing "Farmers' Rights." The work of Professors William Heffernan, Mary Hendrickson, and Robert Gronski are also discussed, detailing the striking levels of vertical and horizontal concentration occurring in the food system, in particular how vertical concentration involves food production from seed and genetic modifications, to transport and processing, to wholesale and retail. While intellectual property rights play a part in securing a return on investment with regard to genetically modified organisms, there is much to be concerned with in terms of national regulatory fragmentation and the lack of a coherent global competition/antitrust

5. MARION NESTLE, WHAT TO EAT 11 (2006).

framework regarding the genetically modified products of this concentrated global food system.

Finally, this Article concludes with a snapshot of "The Future." This Part suggests that we have intergenerational responsibilities to the future to help create a sustainable, appropriately decentralized food production system. Such a system should conserve genetic diversity and pay greater attention to distributional issues with regards to the potential bounties produced by human agriculture in terms of access to knowledge, information, and techniques that should be considered "common heritage of humankind," subject to re-imagined antitrust and immigration laws.

I. DEFINING INTERGENERATIONAL EQUITY

Intergenerational equity is both a simple and complex idea. It captures the concept that our contemporary society has a relationship with both past and future generations and raises the question of how these relationships should influence our decision-making today. Arguably, private property is an institution with salutary effects on future generations because it supposedly forces contemporary owners to internalize externalities, making them not "consume" more than they can afford.[6] However, one might look at clear-cut forest slopes in a state like Oregon and wonder whether private property is really the best way to manage resources for future generations.

At the outset, this Article asks *why* the present generation should recognize the interests of future generations or the corrective-justice claims for remediation of past generations. However, if one takes the argument that the costs/burdens of decisions made by each particular generation are borne/paid for by that particular generation, then (as a libertarian might argue), we do not have to account for questions of intergenerational equity—investment decisions for the future are made (or not made) as long as the costs of such decisions are borne by those making the decisions and not passed on to future generations (which

6. *See e.g.*, Harold Demsetz, *Toward a Theory of Property Rights*, 57 AM. ECON. REV. 347, 348–50 (1967) (noting that the primary function of property rights is to guide incentives to achieve a greater internalization of externalities); Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243, 1243–48 (1968) (arguing that a private property model was better than a commons-based model for governing depletable resources because one had to adjust one's activity/consumption of the resource to only what one owned). *But See* Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986) (offering an argument in the name of common resources).

seems increasingly implausible given phenomena such as anthropogenic climate change or even the U.S. national debt).

In contrast to the libertarian bracketing of intergenerational equity, Professor Edith Brown Weiss has written that:

> [N]o generation knows beforehand when it will be the living generation, how many members it will have, or even how many generations there will ultimately be. It is useful, then, to take the perspective of a generation that is placed somewhere along the spectrum of time, but does not know in advance where it will be located . . . . [and] would want to inherit the earth in at least as good condition as it has been in for any previous generation . . . . This requires each generation to pass the planet on in no worse condition than that in which it received it and to provide equitable access to its resources and benefits.[7]

"Natural resources" such as air, water, and soil seem to present a relatively inviting case—for example, there are legal ideas such as a duty of present owners not to "waste" property running to future possessors, although this idea has not been clearly crystallized legally. Plant genetic resources present a conundrum—they are partially the result of thousands of years of human intervention via selective breeding and domestication of particular crops, as well as fairly characterizable as natural resources. Clearly plant genetic resources have and will continue to play pivotal roles in human history. Over the past three decades, as our knowledge of molecular biology has made possible the transgenic manipulation of plant genetic resources and as emerging legal treatment of such resources has moved toward treating them as intellectual property, the problem of conferring upon the "creators/intervenors" a superior right in such resources has developed.

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7. Edith Brown Weiss, *Intergenerational Equity: Toward an International Legal Framework*, *in* GLOBAL ACCORD: ENVIRONMENTAL CHALLENGES AND INTERNATIONAL RESPONSES 333, 335–36 (Nazli Choucri ed., 1993). For a critique of the abstract nature of the phrase "future generations" in Weiss' formulation see Graham Mayeda, *Where Should Johannesburg Take Us? Ethical and Legal Approaches to Sustainable Development in the Context of International Environmental Law*, 15 COLO. J. INT'L ENVTL. L. & POL'Y 29, 45 (2004) ("One cannot owe an obligation to such abstract entities. This problem shows our intuition that ethics must be about an actual relationship between two or more people. Ethical responsibility for the future thus cannot be derived from a concept of obligation to an abstract future generation."), and Brett M. Frischmann, *Some Thoughts on Shortsightedness and Intergenerational Equity*, 35 LOY. U. CHI. L.J. 457 (2002).

This is in part because of labor and investment in transforming such resources from "raw" to "cooked,"[8] natural to human-made.

When compensation via intellectual property is conferred upon contemporary breeders and plant scientists who receive patents for their "inventions," a problem arises as to the credit due to all those who came before. In the ten thousand years or so since humans began domesticating crops, the selective breeding and intervention of weeds and land races produced the portfolio of staple crops we depend on today to feed the human race. Under a corrective-justice rationale, discussed below, some argue that there should be some type of recognition/compensation for these invaluable contributions.

There is also a problem of intergenerational equity when considering the future. Unlike land, air, and water, the genetic makeup of crops is dynamic. Thus, conservation and stewardship acquire additional meaning, in part because of the pervasiveness of human agency (as in traditional selective breeders or molecular biologists manipulating gene sequences) in the very genetic composition of agricultural crops. What distributive-justice rationales might be useful when considering and planning for global food supply and distribution, not only in the present but into the future? The importance of a sound justification becomes even more important when considering the interests of people and generations not yet born, but whose welfare will depend on the sound (or unsound) decisions we make in the present.

The following Sections will review the retrospective corrective-justice rationales that may support the idea of "Farmers' Rights," and then proceed to examine the utilitarian and non-utilitarian teleological rationales for prospective consideration of distributive issues bearing on plant genetic resources and global food supply.

A. Corrective Justice: (Intellectual) Property and Time

Arguments for differential treatment of plant genetic resources used for food and agriculture depend in part on the salience of historical (in)equity rooted in relations between what we currently call the developed world and the developing world, or sometimes as the global North and the global South. They are not premised on the claims of global social welfare, distributive justice or the duty to assist. The core claim is that the present-day impoverishment of the countries and

8. *Cf.* 1 CLAUDE LEVI-STRAUSS, THE RAW AND THE COOKED: MYTHOLOGIQUES (John Weightman & Doreen Weightman trans., Harper & Row 1969) (1964) (using the terms "raw" and "cooked" to discuss the dichotomy between things classified as "natural" (raw) and the product of civilization (cooked)).

peoples of the developing world is the result (at least in part) of interactions between the developed and developing world for at least a half-millennia that give rise to a reparations-like remedial claim.

These claims could encompass the idea that those who benefited from ill-gotten gains after centuries of imperialist and colonial relations should have a duty to disgorge or remediate/repair those regions that have been imperiled or impoverished by such long-standing historical relations. Robert Nozick has referred to a "principle of rectification" that might apply in situations where one has imperiled another and therefore is under a duty to rescue or repatriate that which was taken without permission.[9]

An argument from historical equity is that the nations that benefited from unjustified violence committed in the past including coercion, domination, extraction, and exploitation have a duty to remedy injustices that yield effects possibly tied to their present holdings. While this is normatively controversial, it may lead to a duty to pay reparations for past harms inflicted.[10]

There are two periods of modern history that relate to the contemporary distribution of plant genetic resources. The first is the period from approximately 1500 to 1990, four hundred years during which European and later American countries engaged in coerced trade, conquest, imperial rule, and colonization around the globe. The second period is the era following World War II: an international system purportedly premised on formal equality of nations but characterized by unequal political, commercial, and military power. In this analysis, underdevelopment in the developing nations is related to four elements: (1) extraction by the developed nations of wealth such as resources and cheap labor;[11] (2) stunted local industry to stifle competition with

9. ROBERT NOZICK, ANARCHY, STATE AND UTOPIA 152–53 (1974) ("[The] principle of rectification . . . uses historical information about previous situations and injustices done in them (as defined by the first two principles of justice and rights against interference), and information about the actual course of events that flowed from these injustices, until the present, and it yields a description (or descriptions) of holdings in our society. The principle of rectification presumably will make use of its best estimate of subjunctive information about what would have occurred (or a probability distribution over what might have occurred, using the expected value) if the injustice had not taken place.").

10. See *infra* Parts I.A, I.B for a discussion of corrective justice and reparations theory.

11. On causal factors behind the "rise of the West" from 1500 to the 1800s, see generally THE BRENNER DEBATE: AGRARIAN CLASS STRUCTURE AND ECONOMIC DEVELOPMENT IN PRE-INDUSTRIAL EUROPE (T.H. Aston & C.H.E. Philpin eds., 1985); JARED DIAMOND, GUNS, GERMS, AND STEEL: THE FATES OF HUMAN SOCIETIES (1997); DAVID S. LANDES, THE WEALTH AND POVERTY OF NATIONS: WHY SOME ARE SO RICH

industry in the developed nations;[12] (3) discouragement of autonomous national development efforts and encouragement of uni-linear development efforts supported by the developed nations;[13] and (4) integration into the global economy on unfavorable terms of trade and debt.[14]

The general claim that much of the impoverishment of developing nations is a result of how those countries were treated by nations that are currently wealthy is used to justify an obligation of the developed nations to help developing nations in the context of plant genetic resources.[15] For example, during colonization, extraction states such as

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AND SOME SO POOR (1998); DOUGLASS C. NORTH & ROBERT PAUL THOMAS, THE RISE OF THE WESTERN WORLD: A NEW ECONOMIC HISTORY (1973); KENNETH POMERANZ, THE GREAT DIVERGENCE: EUROPE, CHINA, AND THE MAKING OF THE MODERN WORLD ECONOMY (2000); Robert Brenner, *Agrarian Class Structure and Economic Development in Pre-Industrial Europe*, PAST & PRESENT, Feb. 1976, at 30. On whether colonial spoils and relations were beneficial to the development of the West, see generally IMMANUEL WALLERSTEIN, THE MODERN WORLD-SYSTEM: CAPITALIST AGRICULTURE AND THE ORIGINS OF THE EUROPEAN WORLD-ECONOMY IN THE SIXTEENTH CENTURY (1974); Robert Brenner, *The Origins of Capitalist Development: A Critique of Neo-Smithian Marxism*, NEW LEFT REV., July-Aug. 1977, at 25; Immanuel Wallerstein, *The West, Capitalism, and the Modern World-System*, 15 REVIEW 561 (1992). On what may have been the crucial factors behind Western ascendance during this period, see generally TONY SMITH, THE PATTERN OF IMPERIALISM: THE UNITED STATES, GREAT BRITAIN, AND THE LATE-INDUSTRIALIZING WORLD SINCE 1815 (1981); Patrick Wolfe, *Imperialism and History: A Century of Theory, from Marx to Postcolonialism*, 102 AM. HIST. REV. 388 (1997).

12. *See generally* FERNANDO HENRIQUE CARDOSO & ENZO FALETTO, DEPENDENCY AND DEVELOPMENT IN LATIN AMERICA (1979); Andre Gunder Frank, *The Development of Underdevelopment*, MONTHLY REV., Sept. 1966, at 17, 18.

13. *See generally* AMIYA KUMAR BAGCHI, THE POLITICAL ECONOMY OF UNDERDEVELOPMENT (1982); JAMES M. CYPHER & JAMES L. DIETZ, THE PROCESS OF ECONOMIC DEVELOPMENT 66–100 (2d ed. 2004).

14. *See generally* BRANKO MILANOVIC, WORLDS APART: INTERNATIONAL AND GLOBAL INEQUITY 61–81 (2005); KEVIN WATKINS & PENNY FOWLER, RIGGED RULES AND DOUBLE STANDARDS: TRADE, GLOBALIZATION, AND THE FIGHT AGAINST POVERTY (2002); H.W. Singer, *The Distribution of Gains Between Investing and Borrowing Countries*, 40 AM. ECON. REV. 473 (1950); Robert Wade, *Choking the South*, 38 New LEFT REV. 115, 122–27 (2006). For documentation of ongoing and increasing gaps between nations, see generally Roberto Patricio Korzeniewicz & Timothy Patrick Moran, *World-Economic Trends in the Distribution of Income, 1965-1992*, 102 AM. J. SOC. 1000 (1997); Lant Pritchett, *Divergence, Big Time*, J. ECON. PERSP., Summer 1997, at 3; Charles C. Ragin & York W. Bradshaw, *International Economic Dependence and Human Misery, 1938-1980: A Global Perspective*, 35 SOC. PERSP. 217 (1992).

15. *Cf.* William W. Fisher & Talha Syed, *Global Justice in Healthcare: Developing Drugs for the Developing World*, 40 U.C. DAVIS L. REV. 581, 598 (2007). While Fisher and Syed discuss disparities between the developed and developing worlds in terms of access to pharmaceuticals and healthcare, parts of their argument may be

the Belgian Congo had minimal legal protection for private property, no checks against state expropriation, and pervasive transfers of wealth and resources from the colonized population to the colonizers. This same history also includes "Neo-Europes" such as the United States, Canada, and Australia, where private property was accorded legal protection and various checks on state abuse of power were developed.[16] The former colony/metropole distinction needs a finer metric to distinguish this spectrum of former colonies.

Additionally, the corrective-justice rationale becomes weaker when those who inflicted the damage/harm are no longer living; members of the current generation have no meaningful way to "opt out," and there may be serious difficulties in identifying what ill-gotten gains should be disgorged (and in what form). While not impossible, if we extend the analysis to neo-colonialism in the post World War II era, the task of determining causation and who owes what and why becomes much more difficult.

At its core, corrective justice requires a showing of how historical colonial relations are tied to contemporary poverty and underdevelopment in the developing world *and* also how they are linked to the prosperity of the developed world. While "Farmers' Rights" in a general sense partakes of this sentiment, it declines to stake its claims in a corrective-justice rationale.

Modern concepts of (intellectual) property relate to time.[17] Generally, property rights are conceived of in positivist and utilitarian modes, although certain types of property and ownership may be conceived of as possessing traces, or echoes, of natural rights.[18]

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adopted to disparities between such nations with regard to plant genetic resources and the role that the transfer of such resources has played in placing certain countries higher or lower in the hierarchy of the contemporary world-economy.

16. *Id.* at 599-600. ("The debate concerning why some parts of the world are rich and others are poor will undoubtedly continue for some time. . . . Sufficient for our purposes is a rough generalization . . . [that] a significant portion of the poverty of developing countries today results from the manner in which those countries were treated by countries that today are prosperous.")

17. *See* Sarah Harding, *Justifying Repatriation of Native American Cultural Property*, 72 IND. L.J. 723, 741 (1997) (noting the critical role that 'time' plays in asserting property rights); Sarah Harding, *Perpetual Property*, 61 FLA. L. REV. 285, 287 (2009) (discussing temporal limitations in property law).

18. *See generally* LAWRENCE BECKER, PROPERTY RIGHTS: PHILOSOPHICAL FOUNDATIONS (photo. reprint 1980) (1977); PERSPECTIVES ON PROPERTY LAW (Robert C. Ellickson, Carol M. Rose & Bruce A. Ackerman eds., 2d ed. 1995); JOSEPH WILLIAM SINGER, ENTITLEMENT: THE PARADOXES OF PROPERTY (2000); LAURA S. UNDERKUFFLER, THE IDEA OF PROPERTY: ITS MEANING AND POWER (2003). *But see* Margaret Jane Radin, *Market-Inalienability*, 100 HARV. L. REV. 1849, 1904–09 (1987)

Traditional property law doctrines such as the Rule Against Perpetuities, Adverse Possession, Prescriptive Easements, Landlord-Tenant Law and Termination of Covenants because of Changed Circumstances, are examples of ways that property ownership accommodates and even allows termination of ownership as conditions change over time. The millennium-long shift in Anglo-American conceptions of property—from land infused with inalienable control of the sovereign to fungible property exchanged via market—represents some of the contingency and capacity of the idea of property to adapt to changing social and economic circumstances.

There have been some relatively recent challenges to the actual and potential temporal limitations on property: recent extensions of copyright term;[19] the recent popularity of conservation easements;[20] the assertion that cultural patrimony claims are not subject to statutes of limitations;[21] and the relatively recent instantiation of "Farmers'

(noting that certain types of property are suffused or mingled with an owner's personhood and as such should be shielded from complete commodification).

19. *Eldred v. Ashcroft*, 537 U.S. 186 (2003); *see also* 144 CONG. REC. H9952 (daily ed. Oct. 7, 1998) (noting a statement of Rep. Bono where she advances Jack Valenti's proposal for copyright protection term to last "forever less one day"); Justin Hughes, *Fair Use Across Time*, 50 UCLA L. REV. 775, 784 (2003) ("Ms. Bono and Mr. Valenti carry on the legacy of many nineteenth-century U.S. authors who were advocates of perpetual copyright protection."). *But see* Dennis S. Karjala, *Statement of Copyright and Intellectual Property Law Professors in Opposition to H.R. 604, H.R. 2589, and S.505* (1998), OPPOSING COPYRIGHT EXTENSION (JAN. 28, 1998), http://h9omepages.law.asu/~dkarjala/OpposingCopyrightExtension/legmats/1998statement.html (showing a statement submitted to the Committees on the Judiciary, where 58 law professors, "who spend a heavy proportion of their professional lives thinking about, teaching, and conducting research in intellectual property law," expressed their belief that "extending the term of copyright protection would impose substantial costs on the United States general public without supplying any public benefit. The extension bills represent a fundamental departure from the United States philosophy that intellectual property legislation serve a *public* purpose. This legislation moves strongly and misguidedly in the direction of so-called 'natural rights' theory, in contradiction to the Constitution and two centuries of Supreme Court interpretation").

20. *See* Gerald Korngold, *Solving the Contentious Issues of Private Conservation Easements: Promoting Flexibility for the Future and Engaging the Public Land Use Process*, 2007 UTAH L. REV. 1039, 1044–48 (discussing the history of conservation easements); Christopher Serkin, *Entrenching Environmentalism: Private Conservation Easements over Public Land*, 77 U. CHI. L. REV. 341, 342 (2010) (analyzing how local governments use private law mechanisms, such as conservation easements, to entrench policy in ways that circumvent typical legal limitations). Conservation easements have the advantage of being "private" and "voluntary" market transactions (as opposed to governmental legislation), although local governments may in some cases be the owners of such easements.

21. *See* JOHN HENRY MERRYMAN & ALBERT E. ELSEN, LAW, ETHICS, AND THE VISUAL ARTS 23 (4th ed. 2002) (discussing the longstanding dispute over the Elgin

Rights" in the International Treaty on Plant Genetic Resources for Food and Agriculture (2001).[22] What these four examples of temporally expanded property rights share is a claim that the subject matter they cover is privileged and transcendent of time in certain ways. Copyright term extension, often in the name of honoring a deceased creator by extending economic rights over her work to her heirs, is at odds with the time-restricted nature of intellectual property.[23] Conservation

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Marbles between the governments of Greece and England); SUSAN SCAFIDI, WHO OWNS CULTURE? APPROPRIATION AND AUTHENTICITY IN AMERICAN LAW 51 (2005) (distinguishing intellectual property from cultural property by stating that "intellectual property protects the new and innovative; cultural property protects the old and venerated"); Patty Gerstenblith, *Identity and Cultural Property: The Protection of Cultural Property in the United States*, 75 B.U. L. REV. 559, 591–601 (1995) (discussing statutory treatment of objects of cultural patrimony); Harding, *supra* note 17, at 740–41 (discussing different sorts of cultural property claims); Sarah K. Mann, *What's a Survivor to Do? An Inquiry into Various Options and Outcomes for Individuals Seeking Recovery of Nazi-Looted Art*, 5 LOYOLA U. CHI. INT'L L. REV. 191, 195–96 (2008) (examining the issues a private party wishing to reclaim a piece of art stolen by the Nazis during World War II faces in both international and domestic legal arenas); Jessica Grimes, Comment, *Forgotten Prisoners of War: Returning Nazi-Looted Art by Relaxing the National Stolen Property Act*, 15 ROGER WILLIAMS U. L. REV. 521, 526 (2010) ("Additionally, claimants face complex international laws, intricate and unfavorable statutes of limitations, and national confidentiality regulations blocking access to 'private' information.").

22. *See* AOKI, SEED WARS, *supra* note 1, at 85–86; Keith Aoki, "*Free Seeds, Not Free Beer": Participatory Plant Breeding, Open Source Seeds, and Acknowledging User Innovation in Agriculture*, 77 FORDHAM L. REV. 2275, 2286 (2009) ("The ITPGR reaffirms the commitment to farmers' rights as protecting traditional knowledge relevant to PGR, recognizing a right to equitable benefit sharing, and recognizing the right to participate in decision making at national levels on matters related to conservation and use of PGR."); Daniel Benoliel & Bruno Salama, *Towards an Intellectual Property Bargaining Theory: The Post-WTO Era*, 32 U. PA. J. INT'L L. 265, 284 (2010) ("Farmers' rights, to be sure, are integral to a regime of open access to genetic resources in ex situ public seed banks. The International Treaty on Plant Genetic Resources for Food and Agriculture ('ITPGRFA') regulates them."); Laurence R. Helfer, *Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking*, 29 YALE J. INT'L L. 1, 37 (2004) (discussing "Farmers' Rights" in the context of the International Treaty on Plant Genetic Resources for Food and Agriculture).

23. Olufunmilayo B. Arewa, *Copyright on Catfish Row: Musical Borrowing,* Porgy and Bess*, and Unfair Use*, 37 RUTGERS L.J. 277, 237, 284 (2006) (detailing how George Gershwin and his heirs lobbied for a Copyright Term extension which gave certain Gershwin compositions, such as "Rhapsody in Blue," an additional nineteen years of copyright protection and noting how, subsequently, Gershwin's heirs received approximately $500,000 in royalties for use of "Rhapsody in Blue" in United Airlines commercials). Another example of the economic benefits of the 1998 Copyright Term Extension is the additional nineteen years of protection that the Disney Corporation's character Mickey Mouse received, giving rise to the cry by opponents of the Copyright Term Extension to "Free the Mouse!" *See* FREE EXPRESSION POLICY PROJECT, "THE

easements are an attempt to fix a particular property's natural state in a way not subject to legislative vicissitudes, but perhaps vulnerable to the policies underlying the Rule Against Perpetuities. Claims of patrimony over cultural artifacts such as the Elgin Marbles represent an exception to the idea that statutes of limitations and policies underlying the adverse possession doctrine quiet claims of ownership unsupported by current possession. Finally, "Farmers' Rights" are not intellectual property rights per se; such rights do not expire but give rise to claims stretching back into the mists of time—while not reparations in a traditional sense, they speak the language of compensation due for benefits created and conferred by generations of farmers.

B. Distributive Justice

1. SOCIAL UTILITY

Distributive justice premised on the idea of the greatest good for the greatest number provides a justification for a roughly egalitarian redistribution of access to basic goods such as the benefits of plant genetic resources.[24] The utilitarian argument depends on a weak but plausible assumption regarding diminishing marginal utility. Diminishing marginal utility involves a presumption that the less a

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PROGRESS OF SCIENCE AND USEFUL ARTS:" WHY COPYRIGHT TODAY THREATENS INTELLECTUAL FREEDOM 15 (2d ed. 2003) (noting the aggressive campaign by Disney, among other companies, promoting term extension); Douglas A. Hedenkamp, *Free Mickey Mouse: Copyright Notice, Derivative Works, and the Copyright Act of 1909*, 2 VA. SPORTS & ENT. L.J. 254, 255 (2003) (advancing the argument that Disney's Mickey Mouse copyrights are void on account of Disney's failure to meet copyright notice requirements applicable at the time of publication); Christina N. Gifford, Note, *The Sonny Bono Copyright Term Extension Act*, 30 U. MEM. L. REV. 363, 385 (2000) (explaining how Michael Eisner personally lobbied for passage of the CTEA); Dennis Harney, Note, *Mickey Mousing the Copyright Clause of the U.S. Constitution:* Eldred v. Reno, 27 U. DAYTON L. REV. 291, 291 (2002) (noting that Mickey Mouse's entrance to the public domain would take place in 2024 instead of 2004 as a result of the CTEA); Phyllis Schlafly, *Why Disney Has Clout with the Republican Congress*, EAGLE FORUM (Nov. 25, 1998), http://www.eagleforum.org/column/1998/nov98/98-11-25.html (noting that the following Disney copyrights were soon to expire without the CTEA, including Mickey Mouse (2003), Pluto (2005), Goofy (2007) and Donald Duck (2009), making the CTEA worth billions to Disney).

24. *See generally* JOHN STUART MILL, UTILITARIANISM (George Sher ed., Hacket Publ'g Co. 1979) (1861); Amartya Sen, *Utilitarianism and Welfarism*, 76 J. PHIL. 463, 463–64, 468, 471 (1979).

particular individual or group has, the more benefit they receive from an additional unit of a particular resource/good.[25]

This implicates the question of who should pay for research and development (R&D)—a question in the agricultural-resources area that has had its center of gravity shift greatly over the past century. A century ago it was premised on taxpayer-supported research into selective breeding and plant improvement. This began shifting with the rise of commercial hybrid varieties in the 1920s[26] and changed decisively after the U.S. Supreme Court case *Diamond v. Chakrabarty* in 1980.[27] Also implicated in the research dilemma were questions about how much should be spent and how it should be allocated and by whom. These decisions have been moving from legislatures and public land-grant agricultural-research universities to private boardrooms, begging the question whether this serves the greatest good for the greatest number.

The assumption underlying the idea of diminishing marginal utility is that everyone is assumed to have roughly the same utility function. However, critics point out that individuals and groups vary widely in utility functions, thus there is little basis for using this idea to justify transferring resources from one individual to another.[28] Consider the debate on who should bear the costs of agricultural R&D: The public sector? The private sector? An additional consideration when the private sector bears these costs is the idea that, in the private sector, there will be no investment in R&D of agricultural technology unless there is a meaningful ability to recoup such costs. Relevant to a shift

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25. Fisher & Syed, *supra* note 15, at 604; *see also* JEREMY BENTHAM, AN INTRODUCTION TO THE PRINCIPLES OF MORALS AND LEGISLATION (J.H. Burns & H.L.A. Hart eds., Clarendon Press 1996) (1970); Robert Shackleton, *The Greatest Happiness of the Greatest Number: The History of Bentham's Phrase*, *in* 90 STUDIES ON VOLTAIRE AND THE EIGHTEENTH CENTURY 1461, 1475 (Theodore Besterman ed., 1972); W.R. Sorely, *Bentham and the Early Utilitarians*, *in* 11 THE CAMBRIDGE HISTORY OF ENGLISH LITERATURE: THE PERIOD OF THE FRENCH REVOLUTION 63, 73–74 (A.W. Ward & A.R. Waller eds., 1914). *Compare* R.M. Hare, *Justice and Equality*, *in* JUSTICE AND ECONOMIC DISTRIBUTION 118, 126 (John Arthur & William H. Shaw eds., 2d ed. 1991), *with* RICHARD B. BRANDT, A THEORY OF THE GOOD AND THE RIGHT 311 (1979).

26. *See* CARY FOWLER, UNNATURAL SELECTION: TECHNOLOGY, POLITICS, AND PLANT EVOLUTION 51–52 (1994); KLOPPENBURG, *supra* note 3, at 79–81.

27. *Diamond v. Chakrabarty*, 447 U.S. 303, 309–10 (1980) (explaining that although natural laws, physical phenomena, abstract ideas, or newly discovered minerals are not patentable, a live artificially engineered microorganism is different and patentable).

28. *See* RICHARD POSNER, ECONOMIC ANALYSIS OF LAW 216 (1972); Allen Feldman, *Pareto Optimality*, in 3 THE NEW PALGRAVE DICTIONARY OF ECONOMICS AND THE LAW 5–9 (Peter Newman ed., 1998).

from public to private in the agricultural technology sector is the allocation of agricultural R&D resources—for example, whether there should be increasing resources on industrial and proprietary genetically engineered (GE) crop systems, which, while possessing characteristics such as a higher yield and drought-and-pest resistance, are also more expensive. Such GE crops carry risks of genetic vulnerability as a monoculture to unforeseen pests, blights, and other diseases and disasters.

2. NON-UTILITARIAN DEONTOLOGICAL OR TELEOLOGICAL THEORIES

There are distributive prospective-looking theories that are premised on the teleological idea that the "right" is prior to the "good"—which proceed from concepts of individual liberty and essential human dignity. There are Rawlsians who believe that an equitable system for dealing with plant genetic resources and global food supply should be designed along the contractarian lines of what a free person would agree to in a reasonable system of consensus.[29] There are also libertarians who might argue that as long as contemporary economic holdings are procedurally legitimate, then there is no normative basis to alter their distribution.[30] However, this Article focuses on the purposive pluralism as articulated by Michael Walzer[31]

29. *See* JOHN RAWLS, POLITICAL LIBERALISM 385–95 (expanded ed. 2005) (arguing for a "political" solution to the "fact of reasonable pluralism" in the realm of morals, and urging that when debating core issues of social life, efforts be made to seek an "overlapping consensus" about the "fair terms of social cooperation," by creation of a common vocabulary of public reason); JOHN RAWLS, A THEORY OF JUSTICE (rev. ed. 1999).

30. *See, e.g.*, 2 FRIEDRICH A. HAYEK, LAW, LEGISLATION AND LIBERTY: THE MIRAGE OF SOCIAL JUSTICE 67–100 (1976); NOZICK, *supra* note 9, at 150–60. To Fisher and Syed, "the contention that a transfer of wealth from *A* to *B* not justified by *A*'s misconduct in the past illegitimately interferes with *A*'s liberty, neglects the fact that the exercise of individual liberties, including many so-called 'negative' ones, is often socially enabled and negotiated, and is best preserved not by ignoring the constraints each person faces, but by confronting, evaluating, and then reforming or affirming them." Fisher & Syed, *supra* note 15 at 621.

31. MICHAEL WALZER, SPHERES OF JUSTICE: A DEFENSE OF PLURALISM AND EQUALITY (1983); *see also* JOHN RAWLS, THE LAW OF PEOPLES (1999); Michael Blake, *Distributive Justice, State Coercion, and Autonomy*, 30 PHIL. & PUB. AFF. 257 (2001); David Miller, *The Limits of Cosmopolitan Justice*, *in* INTERNATIONAL SOCIETY: DIVERSE ETHICAL PERSPECTIVES 164 (David R. Mapel & Terry Nardin eds., 1998).

and the "thick vague theory of the good," or Human Capabilities theories articulated by Martha Nussbaum[32] and Amartya Sen.[33]

Michael Walzer has argued that distributive goals must have a fit between their purposes and the relevant institutions.[34] This requires consideration of what is required by the norms, customs, and practices of a particular community.[35] However, one problem is how to prioritize between food and other closely linked claims such as health and income. Walzer has argued that a way to deal with the problem of incommensurability between various goods is to use "lexical hierarchies."[36]

In slightly different but nonetheless teleological[37] ways, Martha Nussbaum and Amartya Sen would ask: What are the attributes of a flourishing human life? Some of the questions related to this inquiry are: What functions are central? What human capabilities are necessary to achieve those functions?[38] Then the central question becomes how we can achieve a distribution of goods/resources to make such a life universally available—including how to determine and rectify differences in social situations that create deviations from such universally basic human capabilities.[39]

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32. MARTHA C. NUSSBAUM, WOMEN AND HUMAN DEVELOPMENT: THE CAPABILITIES APPROACH (2000); Martha C. Nussbaum, *Capabilities as Fundamental Entitlements: Sen and Social Justice*, 9 FEMINIST ECON. 33 (2003).

33. AMARTYA SEN, INEQUALITY REEXAMINED (1992).

34. ALASDAIR MACINTYRE, AFTER VIRTUE: A STUDY IN MORAL THEORY 220–21 (2d ed. 1984) ("I inherit from the past of my family, my city, my tribe, my nation, a variety of debts, inheritances, rightful expectations and obligations. . . . What I am, therefore, is in key part what I inherit, a specific past that is present to some degree in my present. I find myself part of a history and that is generally to say, whether I like it or not, whether I recognize it or not, one of the bearers of a tradition."); *see also* MICHAEL J. SANDEL, LIBERALISM AND THE LIMITS OF JUSTICE 149–52, 172–73 (2d ed. 1998).

35. SANDEL, *supra* note 34, at 160–61 (discussing the encumbered self).

36. *Compare* WALZER, supra note 31, at 95–103, *with* RAWLS, A THEORY OF JUSTICE, *supra* note 29, at 37–38 (proposing lexical hierarchies to make sure that particular fundamental interests were protected from aggregate interests and other, non-fundamental individual interests), *and* Fisher & Syed, *supra* note 15, at 637–38.

37. This Article uses the terms "utilitarian," "deontological" and "teleological" in certain ways. "Utilitarianism" is seen as a subset of "welfarist," or consequentialist theories; "deontological" theories posit that the "right" is prior to the "good;" and "teleological" theories seek to achieve the right "ends." *See* Fisher & Syed, *supra* note 15, at 637.

38. Nussbaum, *supra* note 32, at 40–50.

39. Fisher & Syed, *supra* note 15, at 639–40.

C. Critiques of Theories of Corrective and Distributive Justice

There are at least three critiques or objections to the above mentioned justifications for redistributions of plant genetic resources and the wealth/benefits arising from them. They are: (1) the difficulty of expanding jurisdiction beyond the current boundaries of nation-states; (2) the idea that interfering with national intellectual property law as a way to address global inequities (agricultural and otherwise) is inappropriate at best and dangerous at worse; and (3) that states should not interfere with pervasive private ordering occurring through market decisions, both domestic and international.

1. TERRITORIAL JURISDICTION

The first objection regarding the limits of national jurisdiction arises from the way that the traditionally conceived Westphalian nation-states only have extremely limited duties (and virtually no duty with regard to distributive justice except as adumbrated in treaties).[40] Under international law, nation-states have duties of non-aggression, rights of self-defense, and obligations under treaties. There may be additional duties to lend assistance or mutual aid. Finally, under the traditional Westphalian model, nation-states have a duty of non-interference in the internal affairs of other nation-states. This duty has been qualified since the end of World War II to include an obligation under certain circumstances to intervene in the internal affairs of non-democratic peoples in the name of human rights.

However, Charles Beitz[41] and Thomas Pogge[42] argue that any theory of a just international order must take into account the arbitrariness of the location of the world's resources, and the contingencies of territorial sovereignty must articulate a theory of equitable distribution of such "natural" resources.[43] Furthermore, they argue that by the early twenty-first century there is sufficient

40. *See* RAWLS, THE LAW OF PEOPLES, *supra* note 31, at 37–38, 93–94; *see also* David A. Reidy, *Rawls on International Justice: A Defense*, 32 POL. THEORY 291, 291–92 (2004).

41. CHARLES R. BEITZ, POLITICAL THEORY AND INTERNATIONAL RELATIONS 198–214 (1999); Charles R. Beitz, *Rawls's Law of Peoples*, 110 ETHICS 669, 688–94 (2000).

42. Thomas W. Pogge, *An Egalitarian Law of Peoples*, 23 PHIL. & PUB. AFF. 195, 195–99 (1994).

43. THOMAS W. POGGE, WORLD POVERTY AND HUMAN RIGHTS: COSMOPOLITAN RESPONSIBILITIES AND REFORMS 247 n.264 (2002); Charles R. Beitz, *Justice and International Relations*, 4 PHIL. & PUB. AFF. 360, 367–68 (1975).

interdependence arising from the intertwining of multilateral and bilateral treaties and institutions such as the World Bank and International Monetary Fund that a de facto global cooperative system has emerged which makes possible weak distributive claims and makes reform of the legal treatment of plant genetic resources justifiable, if not probable.

Beitz argues that the fact of the arbitrary distribution of natural resources plus the emergence of a web of interrelated treaties/contracts means that there are deep and lasting consequences for domestic politics and economics arising from a particular nation's integration into the global economy, including dependence on foreign capital markets, vulnerability to international financial institutions, and international trade relations.[44] This means that at least on a functional level, there is increasingly less and less of an intelligible distinction that can be made between international and domestic law.[45] Furthermore this interlocked meshing of the global and the domestic in terms of division of labor means that there is a duty of governments to refrain from doing harm and to ensure that international institutions do not jeopardize the access of individuals to basic goods.[46]

In particular with regard to international trade and intellectual property (with particular reference to agriculture), there may be two ways that institutions such as the WTO may do the harm that Beitz decries. First, it is arguable that the WTO, since 1995, has reproduced massive impoverishment by placing burdens and costs on developing countries that advantage developed counties.[47] Second, it could be

44. *See* Beitz, *Justice and International Relations*, *supra* note 43, at 373–74 ("The system of interdependence imposes burdens on poor and economically weak countries that they cannot practically avoid.").

45. Fisher & Syed, *supra* note 15, at 657–58.

46. *Id.* at 659.

47. *See generally* Agreement on Trade-Related Aspects of Intellectual Property Rights, Including Trade in Counterfeit Goods, Dec. 15, 1993, 33 I.L.M. 81, 84 [hereinafter TRIPS]; Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, Apr. 15, 1994, 1867 U.N.T.S. 14. This agreement was meant to clarify the results of the negotiations since the Round was launched in Punta del Esta, Uruguay, in September 1986. *See* DANIEL GERVAIS, THE TRIPS AGREEMENT: DRAFTING HISTORY AND ANALYSIS 10–25 (1998). A summary of the Final Act of the Uruguay Round is available online at the WTO website. *A Summary of the Final Act of the Uruguay Round*, WTO, http://www.wto.org/english/docs_e/legal_e/ursum_e.htm#nAgreement (last visited Feb. 27, 2011). For a comprehensive analysis of the TRIPS agreement and its history, see generally GERVAIS, *supra*; INTELLECTUAL PROPERTY AND INTERNATIONAL TRADE: THE TRIPS AGREEMENT (Carlos M. Correa & Abdulqawi A. Yusuf eds., 1998); JAYASHREE WATAL, INTELLECTUAL PROPERTY RIGHTS IN THE WTO AND DEVELOPING COUNTRIES 11–47 (2001); Graeme B.

argued that governments of developed countries took advantage of the bargaining process to insure that they benefited and that the nations of the developing world were disadvantaged.[48]

William Fisher and Talha Syed argue (with reference to pharmaceuticals) that it may be possible (though not easy) to reform the WTO to eliminate unjustifiable harm to residents of the developing nations.[49] Furthermore, Fisher and Syed argue that this is explicitly not a duty to help, but a duty to address injustices arising from the global system of interdependence for which the industrialized countries of the developed global North are largely responsible.[50] Such reforms would address the distribution, both historical and contemporary, of natural resources (including plant genetic diversity), ways that relations between the developed and developing nations have been affected by

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Dinwoodie & Rochelle C. Dreyfuss, *TRIPS and the Dynamics of Intellectual Property Lawmaking*, 36 CASE W. RES. J. INT'L L. 95 (2004).

48. A flaw in this argument is that the developing countries are partially responsible for their own underdevelopment and impoverishment through corruption and fraud in their own governmental systems. Fisher & Syed, *supra* note 15, at 661.

49. *Id.* at 662.

50. *Id.*; *See also* KRISTINA HUBBARD, OUT OF HAND: FARMERS FACE THE CONSEQUENCES OF A CONSOLIDATED SEED INDUSTRY (2009); William Neuman, *A Growing Discontent*, N.Y. TIMES, Mar. 12, 2010 ("The price increases have not only irritated many farmers, they have caught the attention of the Obama administration. The Justice Department began an antitrust investigation of the seed industry last year, with an apparent focus on Monsanto, which controls much of the market for the expensive bioengineered traits that make crops resistant to insect pests and herbicids."); Jack Kaskey & William McQuillen, *Monsanto's Seed Patents May Trump Antitrust Claims (Update 2)*, BLOOMBERG (Mar. 12, 2010), http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aXnemqNlsotQ ("Monsanto Co., facing antitrust probes into its genetically modified seeds, may benefit from previous court rulings in which intellectual property rights trumped competition concerns, antitrust lawyers say. The Department of Justice and seven state attorneys general are investigating whether the world's largest seed company is using gene licenses to keep competing technologies off the market. At issue is how the St. Louis-based company sells and licenses its patented trait that allows farmers to kill weeds with Roundup herbicide while leaving their crops unharmed. The company's Roundup Ready gene was in 93 percent of U.S. soybeans last year."); Christopher Leonard, *Food Giant's Power Tactics: Confidential Agreements Show Tough Terms for Smaller Companies*, SALON.COM (Dec. 13, 2009), http://www.salon.com/food/2009/12/13/us_seed_giant/print.html; GianCarlo Moschini, *Competition Issues in the Seed Industry and the Role of Intellectual Property*, 25 CHOICES (2010), http://www.choicesmagazine.org/magazine/issue.php; Lynda Waddington, *Monsanto, Big Ag has 'Troubling' Control over Seed Market, Report Finds*, IOWA INDEPENDENT (Dec. 29, 2009), http://iowaindependent.com/24537/monsanto-big-ag-has-troubling-control-over-seed-market-report-finds.

treaties and international institutions, and pervasive ways that cross-national socioeconomic structure affects the welfare of all persons.[51]

2. LEAVE INTELLECTUAL PROPERTY LAW ALONE

The second objection centers on the misuse of intellectual property laws, and patent laws in particular, to further distributive motives other than the express purpose of such law, to provide necessary and important incentives for investing in invention and innovation. This utilitarian rationale assumes that patents and other intellectual property rights increase social welfare by inducing the creation and implementation of new innovations in agricultural systems that outweigh the monopoly costs of protecting patentees from competition for the duration of their patent. The rationale is supplemented by the related argument that the agrochemical firms deserve the huge financial returns safeguarded by patent law because they have invested large amounts of time and money (and risk) in research and development in areas such as GEs, which they argue are socially valuable innovations. An implicit claim is that unless we continue to allow agrochemical companies to earn monopoly rents from their innovations, they will stop innovating in those areas and move on to a more lucrative areas of endeavor—the result of which could be further impoverishment and hunger in the developing world.

Fisher and Syed (in the pharmaceutical area) contend that we need to know two things to respond: (1) the magnitude of profits that agrochemical firms are currently making (which is hard to know, because the firms jealously guard such information), and (2) the degree to which reform of the patent system would erode the magnitude of those profits such that they would simply shift to other areas of business. Fisher and Syed point out that "the specific set of entitlements that comprise any property rights granted over the fruits of one's value-adding labor; the justification of such rights cannot, without circularity, be founded on the market value of that labor."[52] In other words, the

51. Fisher and Syed, *supra* note 15, at 661; *cf.* DAVID C. MOWERY ET AL., IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT (2004).

52. Fisher & Syed, *supra* note 15, at 671–672. There is no simple, uncontroversial pro-political metric to apply when determining both when compensation is due to an IP holder as well as how much. The questions that come up in the copyright context are regarding fair use: Is fair use a subsidy flowing from the public to authors (to which the public reserves certain uses) or is copyright a pre-political right that any qualification of change is an unjustified "tax" on authors to benefit readers/the public? Generally, most scholars would say the answer is the latter.

solipsistic question—"is something valuable because it's legally protected, or is it legally protected because it's valuable?"—is begged. The value added to products, such as cultivated crops, is not a question with a clear, self-evident answer, but a thorny political, social, economic, and historical question at the very least.

3. DON'T INTERFERE WITH MARKETS

The third critique of reforms in laws that relate to the creation and distribution of agricultural innovation is the illegitimate interference with markets that reflects and incorporates the choices of private firms and individuals. Some of these reforms include instantiation of a global antitrust regime addressing both vertical and horizontal concentration,[53] consolidated governmental and intergovernmental evaluation of GEs on health and environmental grounds,[54] and increased public support for public plant-breeding research, both domestically and internationally, as well as in the United States—an amendment to Bayh-Dole[55] that would carve out an exemption for not patenting certain types of agricultural research and innovations.

The initial response to libertarian critics of such reforms is the Legal Realist-based argument that the state is already heavily implicated in creating and maintaining markets, including markets for agricultural innovation. All supposed market transactions occur within a legal-

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53. *See* Conference on Trade & Dev., Fourth Review Conference, Sept. 25–29, 2000, *Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices*, U.N. Doc. No. TD/RBP/CONF/10/Rev.2 (2001) (only multilaterally agreed set of antitrust principles in the world); Ana María Alvarez, Julian Clarke & Veronica Silva, *Lessons From the Negotiation and Enforcement of Competition Provisions in South-South and North-South RTAs*, *in* COMPETITION PROVISIONS IN REGIONAL TRADE AGREEMENTS: HOW TO ASSURE DEVELOPMENT GAINS 123, 125 , U.N. No. UNCTAD/DITC/CLP/2005/1 (Philippe Brusick, Ana María Alvarex & Lucian Cernat eds., 2005) (describing regional trade and competition agreements).

54. Keith Aoki, *Seeds of Dispute: Intellectual-Property Rights and Agricultural Biodiversity*, 3 GOLDEN GATE U. ENVTL. L.J. 79, 144–47 (2009). *See generally*, Gregory N. Mandel, *Gaps, Inexperience, Inconsistencies, and Overlaps: Crisis in the Regulation of Genetically Modified Plants and Animals*, 45 WM. & MARY L.REV 2167 (2004).

55. Bayh-Dole Act, Pub. L. No. 96–517, § 6(a), 94 Stat. 3015, 3018–27 (1980) (codified at 35 U.S.C. §§ 200–12 (2006)). For a discussion on the impact of the Bayh-Dole Act on University-based research in the scientific realm, see generally MOWERY ET AL., *supra* note 51; Sara Boettiger & Alan B. Bennett, *Bayh-Dole: If We Knew Then What We Know Now*, 24 NATURE BIOTECHNOLOGY 320 (2006); Sara Boettiger & Alan Bennett, *The Bayh-Dole Act: Implications for Developing Countries*, 46 IDEA 261 (2006); Arti K. Rai & Rebecca S. Eisenberg, *Bayh-Dole Reform and the Progress of Biomedicine*, 66 LAW & CONTEMP. PROBS. 289 (2003).

institutional structural framework that influences the bargaining power of market players as well as the distribution of goods within those markets. Additionally, Fisher and Syed critically point out that:

> The legal concepts underpinning markets such as "property," "contract," "harm," and so forth, and the rules pertaining thereto, are in many concrete settings highly under-determinate (sometimes containing internal antinomies), and hence their elaboration requires a number of subsequent political-ethical choices in order to select which among many detailed entitlement packages the law should enforce;
> . . .
> . . . [C]hoices, being made once the system is up and running, often have some discernibly patterned distributive effects, for which the choosers must acknowledge responsibility.[56]

4. NOTE ON CONTEMPORARY INTELLECTUAL PROPERTY ANALYTICS

Within the U.S. legal academy, law and economics has been the dominant method for analyzing the relationship between intellectual property and innovation.[57] As Madhavi Sunder observes:

> [O]ver the last few decades law and economics scholars have reimagined intellectual property law, portraying it as solely an instrumental mechanism to incentivize creativity (copyright), invention (patents), and industry (trademarks). Because information is assumed by its nature to be nonrivalrous and nonexcludable, the concern is that free-riding will eliminate any incentive to produce information. . . .
> . . . Intellectual property laws bear considerably upon central features of human flourishing. . . .
> . . . marching into all corners of our lives and to the most destitute corners of the world.... [The expansion of intellectual property] has . . . exposed the fragility of its economic foundations while amplifying law's social and cultural effects. . . .
> . . . I offer three critiques of the narrow intellectual property-as-incentives understanding: (1) it fails descriptively as a

56. Fisher & Syed, *supra* note 15, at 676.

57. *See, e.g.*, ROBERT P. MERGES, PETER S. MENELL & MARK A. LEMLEY, INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE (2d rev. ed. 2007).

> comprehensive account of extant legal doctrine; (2) it fails prescriptively as the exclusive basis for deciding the important intellectual property conflicts of the day; and (3) it fails to capture fully the dynamics of cultural creation and circulation.[58]

Copyrights and patents have been reframed as "public goods" and trademarks have been characterized as information proxies that reduce search costs to consumers. Even critics of the dominant law-and-economics understanding of intellectual property, such as Yochai Benkler, Larry Lessig, Pam Samuelson and James Boyle, couch their critical counter-arguments in the language and framework of law and economics.[59] However, scholars such as Madhavi Sunder have made the cogent point that law and economics alone may be ill-equipped to analyze effectively both monetary and moral questions that plague intellectual property. Indeed, the entire field, domestically and internationally, may be much more fraught than mere utilitarianism can capture. Indeed, a post-utilitarian intellectual property analysis has not yet fully crystallized, but as mentioned above, some of the distributive issues raised by deontological scholars such as Rawls, or teleological issues raised by Amartya Sen and Martha Nussbaum, challenge a single-minded focus on incentive theory as the sole heuristic appropriate for intellectual property questions.

Post-colonial theory may help us to supplement a utilitarian- or incentives-based analysis by foregrounding issues related to the persistent asymmetrical access to resources seen under a system of formal equality.[60] Do critiques of expansive intellectual property within

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58. MADHAVI SUNDER, IP (forthcoming 2011) (manuscript at 2–3, 6).

59. YOCHAI BENKLER, THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOMS (2006); JAMES BOYLE, SHAMANS, SOFTWARE, AND SPLEENS: LAW AND THE CONSTRUCTION OF THE INFORMATION SOCIETY (1996); LAWRENCE LESSIG, CODE AND OTHER LAWS OF CYBERSPACE (1999); Pamela Samuelson, *The Law and Economics of Reverse Engineering*, 111 YALE L.J. 1575 (2002). *See generally* C. Edwin Baker, *The Ideology of the Economic Analysis of Law*, 5 PHIL. & PUB. AFF. 3 (1975); Partha Dasgupta, *What Do Economists Analyze and Why: Values or Facts?*, 21 ECON. & PHIL. 221 (2005); Ronald M. Dworkin, *Is Wealth a Value?*, 9 J. LEGAL STUD. 191 (1980); Duncan Kennedy, *Cost-Benefit Analysis of Entitlement Problems: A Critique*, 33 STAN. L. REV. 387 (1981); Duncan Kennedy & Frank Michelman, *Are Property and Contract Efficient?*, 8 HOFSTRA L. REV. 711 (1980).

60. *See, e.g.*, DIPESH CHAKRABARTY, PROVINCIALIZING EUROPE: POSTCOLONIAL THOUGHT AND HISTORICAL DIFFERENCE (2000); BJORN HETTNE, DEVELOPMENT THEORY AND THE THREE WORLDS: TOWARD AN INTERNATIONAL POLITICAL ECONOMY OF DEVELOPMENT (2d ed. 1995); Johan Galtung, *A Structural Theory of Imperialism*, 8 J. PEACE RES. 81 (1971).

the developed countries transfer to the cultures and economics of developing societies? As Anupam Chander and Madhavi Sunder have trenchantly pointed out: the freedom to access information does not presuppose the capability or ability to realistically utilize such "free" information. It may in fact perpetuate inequalities between individuals, groups, regions, and nations.[61]

It is clear that when contemplating issues such as global food supply and the role that intellectual property in plant genetic resources plays in the conservation of such resources, more rather than less interdisciplinary approaches should not only be welcomed but are desperately needed.

A law-and-economics-incentives analysis is not the only heuristic to analyze distributive questions regarding benefits arising from generations of crop breeding. Indeed, if past, present, and future contributors to the development of agricultural crops are dropped out of the equations because incentive-based reasoning finds their claims too spectral and hard to quantify, then perhaps it may be time to discount the "if the bed's too long for the body, cut the body's legs off to fit the bed" analytic to find a more chastened heuristic.

With the above discussion of intergenerational equity and various justifications for retrospective corrective-justice or prospective distributive-justice redistributions of the value arising from plant genetic resources, the next Part moves on to a more detailed consideration of some of the dynamic factors at play on both the national and international levels with regard to their legal treatment. First, there is a review of their past treatment, which moves into a discussion of ways that intellectual property in plant genetic resources has created the cornerstone for vertical and horizontal concentration in global food. Then it considers the Convention on Biological Diversity and its relationship to the international intellectual property regime under the WTO.

II. THE PAST: COMMON HERITAGE OF HUMANKIND TO SOVEREIGN NATIONAL PROPERTY

A. *Common Heritage*

To begin, it is helpful to define "biodiversity" as it relates to agricultural productivity—insofar as productivity depends on biodiversity for developing new cultivars. As used in this Article,

61. *See generally* Anupam Chander & Madhavi Sunder, *The Romance of the Public Domain*, 92 CALIF. L. REV. 1331, 1339–61 (2004).

"biodiversity" is the "sum of genetic and phenotypic differences existing in living organisms . . . at the molecular, individual, population, and ecosystem levels."[62]

Up until the 1970s, with some exceptions, "biodiversity" (including plant genetic resources) was legally treated as a resource which was the "common heritage of humankind."[63] Under this "common heritage" regime, access to and diffusion of plant genetic resources were treated as not belonging to any individual, group or nation. Under the common-heritage principle, crop resources were diffused from centers of domestication, exchanged by farmers, and introduced into new continents in the so-called "Columbian Exchange" following 1492.[64] In the twentieth century, the idea of "common heritage" underlaid the creation of international and national gene banks and was crystallized in international conventions in the early 1970s.[65] Under this principle, particular natural resources, including plant genetic resources, should be freely available and free of national sovereign-property or private-property claims. Furthermore, the "common heritage" principle provided that plant genetic resources should be freely available for scientific research, used exclusively for peaceful purposes, and managed for the benefit of humanity as a whole.

An important point about common-heritage treatment of plant genetic resources is that there is a norm of reciprocity regarding access to such resources among farmers and plant breeders across national borders.[66] Furthermore, Professor Stephen Brush argues that common-heritage treatment of plant genetic resources is a logical outgrowth in farming communities where land, water, and other resources are treated as communally owned or managed through a commons system of governance.[67] He argues that such treatment may be efficient when invention and innovation are collective and anonymous, when provenance of genetic materials and traits is ambiguous, and when past

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62. Paul Gepts, *Who Owns Biodiversity, and How Should the Owners Be Compensated?*, 134 PLANT PHYSIOLOGY 1295, 1295 (2004).

63. AOKI, SEED WARS, *supra* note 1, at 67–68.

64. *Id.* at 123–24; FOWLER, *supra* note 26, at 241–42; KLOPPENBURG, *supra* note 3, at 155.

65. *See generally* United Nations Convention on the Law of the Sea, art. 136, *opened for signature* Dec. 10, 1982, 1833 U.N.T.S. 397; Convention Concerning the Protection of World Cultural and Natural Heritage, art. 2, Nov. 23, 1972, 27 U.S.T. 39; Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies art. 1, Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347.

66. BRUSH, *supra* note 2, at 222.

67. *Id.*; *see also* Rose, *supra* note 6, at 739–49.

and present processes of natural and artificial breeding and selection are intermingled.[68] Indeed, given the costs of proprietary management and the delimitation of intellectual property rights in such contexts, "common heritage" may be an optimal way to manage the need to manage frequent change and adaptation and to ensure genetic diversity in certain agricultural contexts.

As mentioned above, there have been historical exceptions to common-heritage management and open access to plant genetic resources. Professor Paul Gepts mentions, for example:

> [R]estrictions by countries to the export of planting materials (e.g. Cinchona by Peru and Bolivia in the 19th century and coffee [Coffea arabica] by Ethiopia in the 20th century) or attempts by colonial powers to monopolize certain resources (e.g. nutmeg [Myristica fragrans] by England, The Netherlands, and Portugal in the 17th century).[69]

However, until the last third of the twentieth century, these examples remained exceptions to the regime of common-heritage treatment for plant genetic resources. This shifted dramatically in the late twentieth century because of a convergence of technology (molecular biology in particular),[70] politics, and international and national law. By the beginning of the twenty-first century, plant genetic resources were treated as "sovereign national property" and, despite its long-standing historical utility on many levels, common-heritage treatment of such resources was being abandoned.[71]

B. Intellectual Property Rights, Plant Genetic Resources, and Farmers' Agricultural Knowledge

This Section considers a tension between three agreements that have emerged in the past thirty years. The two regimes are a trade

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68. BRUSH, *supra* note 2, at 223–24.

69. *See* Gepts, *supra* note 62, at 1295.

70. In the area of molecular biology, since the 1980s, tools to manipulate or engineer DNA, such as restriction enzymes, high-throughput sequencing, and cloning vectors, have allowed scientists to isolate and characterize many genetic sequences in an increasing variety of organisms. This ability has led, in turn, to the development of transgenic organisms and plants that have been used as sources of genetic diversity in crop improvement programs. *See id.* at 1295–96. *See generally* T. Erik Mirkov, *The Molecular Basis of Genetic Modification and Improvement of Crops*, *in* PLANTS, GENES AND CROP BIOTECHNOLOGY 124–51 (Maarten J. Chrispeels & David E. Sadava eds., 2d ed. 2003).

71. *See* BRUSH, *supra* note 2, at 231–33.

regime encompassing intellectual property rights represented by the TRIPS multilateral agreement in 1994. The second regime is a biodiversity regime (with effects on trade) represented by 1992's CBD. The third multilateral treaty in this area is the 2001 ITPGR/FA (effective in 2004), which attempts to partially reconcile the intellectual property resources approach toward PGRs taken by TRIPS and the "sovereign national property" approach taken by the CBD (which is not antithetical to intellectual property) by placing a limited list of crops and forages into what has been called a "limited commons" under the ITPGR/FA.

1. TRADE RELATED ASPECTS OF INTELLECTUAL PROPERTY

a. U.S. patent system and plant genetic resources

Within the United States, a number of methods exist for the intellectual property protection of plants. Since 1985, the genetic level and cultivar level have been protected via a general utility patent.[72] The phenotype (entire plant) for asexually reproduced plants is protected under the 1930 Plant Patent Act (PPA), and the 1970 Plant Variety Protection Act (PVPA) protects varieties that are stable, distinct, and uniform.[73] From 1930 up until 1970, state trade secret law was also an avenue employed to legally protect the use of F_1 generation of hybrid seeds and has been used to maintain exclusivity in the hybrid-corn industry for decades.[74] In addition, other legislative and cultural protections have developed.

With regard to utility patents, the development of the ability to isolate a gene sequence, apart from its existence within a particular organism, confronted the U.S. Patent and Trademark Office (PTO) with two lines of cases. These GE plants have genetic material bearing a desirable trait from another species inserted into their own DNA. The inserted material signals to the host species to produce desirable proteins. These proteins can cause the host species to express a number of traits, and for food crops these organisms commonly produce their own pesticides or a resistance to certain herbicides, or take longer to ripen to allow for longer storage and transport. Organisms bearing

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72. *See Ex parte Hibberd*, 227 U.S.P.Q (BNA) 443, 444 (1985).

73. *J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred Int'l, Inc.*, 534 U.S. 124, 140 (2001).

74. *See* FOWLER, *supra* note 26, at 51–52; KLOPPENBURG, *supra* note 3, at 91–93.

these modified genes are also referred to as "genetically modified" or "transgenic."[75]

The first line of cases arose from the 1912 U.S. Supreme Court case *Parke-Davis v. Mulford*,[76] which upheld a patent granted to an applicant on purified adrenaline.[77] In this case isolated DNA was considered to be a "purified" form of a "natural" form of adrenaline existing within a living organism. Another line of cases was represented by the 1948 Supreme Court case *Funk Bros. v. Kalo Innoculant*,[78] where the Court refused to uphold a patent on a nitrogen-fixing bacteria on the basis that it was a "product of nature."[79]

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75. Gregory N. Mandel, Gaps, *Inexperience, Inconsistencies, and Overlaps: Crisis in the Regulations of Genetically Modified Plants and Animals*, 45 WM. & MARY L. REV. 2167, 2175 (2004).

76. *See Parke-Davis & Co. v. H.K. Mulford & Co.*, 196 F. 496 (2d Cir. 1912); *see also* Lauren M. Dunne, *"Come, Let Us Return To Reason":* Association of Molecular Pathology v. USPTO, 20 DEPAUL J. ART, TECH. & INTELL. PROP. L. 473, 494 (2010) (noting that *Parke-Davis* became the first case to articulate the idea that isolation of a product from its natural surroundings constituted human intervention sufficient to transform a natural compound into a new and useful product that was now worthy of patent eligibility); Ryan Hagglund, *Patentability of Cloned Extinct Animals*, 15 GEO. MASON L. REV. 381, 396 (2008) (explaining how courts have used *Parke-Davis* to permit patents for purified forms of natural products if sufficiently different from the non-purified or natural form as to otherwise meet the requirements for patentability).

77. *Parke-Davis*, 196 F. at 500.

78. Note that *Parke-Davis* turned on the patentability of an isolated compound. *Funk Bros.* was relevant to the four dissenters in the *Charkabarty* case who thought that living organisms, even the genetically altered bacteria at issue in *Chakrabarty*, remained unpatentable "products of nature." Of course, the *Chakrabarty* majority followed the *Parke-Davis* line of cases to hold patentable "anything under the sun made by man" that met the U.S. utility patent statute's requirements. *See Funk Bros. Seed Co. v. Kalo Inoculant Co.*, 333 U.S. 127 (1948); Hagglund, *supra* note 76, at 388–89 (quoting *Funk Bros.*, 333 U.S. at 130) (explaining how the *Funk Bros.* court "reasoned that products of nature, such as naturally-occurring living things, are 'manifestations of laws of nature' and as such are 'free to all men and reserved exclusively to none'"); Michael Meehan, *The Handiwork of Nature: Patentable Subject Matter and* Laboratory Corporation v. Metabolite Labs, 16 ALB. L.J. SCI. & TECH. 311, 334–36 (2006) (discussing *Funk Bros.*'s notion of the "handiwork of nature" in the context of patent law); Philip McGarrigle & Vern Norviel, *Laws of Nature and the Business of Biotechnology*, 24 SANTA CLARA COMPUTER & HIGH TECH. L.J. 275, 281 (2008) ("[T]he United States Supreme Court used the law of nature doctrine for the first time as an early underpinning for the biotechnology field. Kalo Inoculant sued Funk Brothers for infringement of U.S. Patent No. 2,200,532 [filed Aug. 24, 1938] which had claims to the product and process of making a mixed culture of root nodule bacteria for inoculating leguminous plants.").

79. *See Funk Bros.*, 333 U.S. at 131 (discussing the product-of-nature doctrine).

In 1980, the Supreme Court, in *Diamond v. Chakrabarty*,[80] a five-four decision, followed the *Parke-Davis v. Mulford* line of reasoning in upholding a patent on a genetically engineered form of oil-eating bacteria (*Pseudomonas bacterium*), reasoning that a U.S. utility patent could be granted to "anything under the sun that is made by man," including a living organism that had been altered via inventive human agency.[81] While it was argued that gene sequences were naturally occurring materials, the specific information sequenced by the researcher was viewed by the Supreme Court as producing something which did not occur in nature.

Chakrabarty, in addition to giving the legal go-ahead to the nascent biotechnology industry in the United States, also ushered in a period where the PTO issued utility patents for crop cultivars and plants. This trend was exemplified by the *Ex Parte Hibberd* decision, where the PTO issued a utility patent for a new variety of maize.[82] *Chakrabarty* greatly increased the patenting of plant varieties and genetically engineered crops above that allowed by the 1930 PPA[83] and the 1970 PVPA.[84] For example, in *J.E.M. Ag Supply, Inc. v. Pioneer Hi-Bred International, Inc.*, the Supreme Court, citing *Chakrabarty*, upheld the patentability of inbred- and hybrid-corn varieties that were not patentable under the PPA or PVPA.[85] This confirmed the availability of the utility patent as an avenue for patenting plant materials in addition

80. *See Diamond v. Chakrabarty*, 447 U.S. 303 (1980) (holding that a live, human-made microorganism is patentable subject matter under statute providing for issuance of patent to a person who invents or discovers "any" new or useful "manufacture" or "composition of matter"); *see also* GRAHAM DUTFIELD, INTELLECTUAL PROPERTY RIGHTS AND THE LIFE SCIENCE INDUSTRIES: A TWENTIETH CENTURY HISTORY 154–58, 166–68 (2003) (discussing the rise of the U.S. industry dating from the Court's decision to *Chakrabarty*, allowing microorganisms to be patented, and charting several examples of how the biotechnology industry has worked to clarify and change patent rules in ways that suited the interest of specific biotechnology companies and even discouraged later innovation by other potential competitors); *Bilski v. Kappos*, 130 S. Ct. 3218 (2010) (dealing with the issue of copyrightability of algorithms in business methods incorporating a component computer program and issuing a narrow opinion that the machine-or-transformation test is not the sole test for determining the patent eligibility of a process, but rather "'a useful and important clue, an investigative tool, for determining whether some claimed inventions are processes under § 101.'"); Tun-Jen Chiang, *The Rules and Standards of Patentable Subject Matter*, 2010 WIS. L. REV. 1353 (analyzing the role of categorical exclusions on patentable subject matter under § 101).

81. *See Chakrabarty*, 447 U.S. at 309.

82. 227 U.S.P.Q. (BNA) 443, 443–44 (1985).

83. 35 U.S.C. § 161 (1952).

84. 7 U.S.C. § 2402(a) (1970).

85. 534 U.S. 124, 132–39 (2001).

to the PPA and PVPA, greatly increasing the value of rights to plant genetic materials developed and held by seed companies.

With regard to asexually reproduced varieties, while U.S. patent law has traditionally required an "inventive step,"[86] the PPA[87] provided that a newly discovered variety of plant that was "new" and "distinct" that was asexually produced—such as ornamentals and potatoes—could be eligible for patent protection.[88] Then, in 1970, the United States adopted the PVPA, which falls within the International Union for the Protection of New Varieties of Plants (UPOV) and provides another avenue for plant breeders to protect cultivars that are distinct, uniform, and stable.[89] Additionally, the PVPA prohibits cultivars that are "essentially derived"—produced from pre-existing cultivars with minor modifications—from receiving a PVP certificate.[90] In the 1995 *Asgrow Seed, Inc. v. Winterboer*[91] case, the Supreme Court significantly narrowed the farmer's exemption, which allowed farmers using PVP protected seed from saving or reselling seeds in a subsequent season.[92]

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86. *See* 1952 U.S. Patent Act, 35 U.S.C. §§ 101, 102, 103 (2006) (requiring that in order for a patent to be issued, an invention must be novel—not made, used or sold more than one year prior to a patent application—useful, and non-obviousness); *see also KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007) (reaffirming the *John Deere* standard); *Graham v. John Deere Co.*, 383 U.S. 1, 24–26 (1966) (the first Supreme Court case interpreting non-obviousness); Rebecca Greendyke, *No Patent for You!: How* KSR v. Teleflex's *Nonobviousness Test Conflicts with the Scientific Method and Removes the Incentive to Innovate*, 35 U. DAYTON L. REV. 413, 430–35 (2010) (noting that the *KSR* decision raised the bar for patentability unnecessarily high and failed to provide clear guidance as to what level of inventiveness will satisfy the nonobviousness requirement); Katherine M.L. Hayes, *Three Years Post-*KSR*: A Practitioner's Guide to "Winning" Arguments on Obviousness and a Look at What May Lay Ahead*, 9 NW. J. TECH. & INTELL. PROP. 243, 248–60 (2010) (analyzing how the lower courts have approached obviousness post- *KSR*).

87. The 1930 Plant Patent Act applied only to asexually reproduced plants, that is, plants that were propagated through grafting and cloning. 35 U.S.C. § 31 (1934).

88. *See* DANIEL J. KEVLES, A HISTORY OF PATENTING LIFE IN THE UNITED STATES WITH COMPARATIVE ATTENTION TO EUROPE AND CANADA 4–10 (2002) (noting how the U.S. nursery industry in the 1920s and 1930s was the industry benefiting from the 1930 PPA and discussing how the delicious apple came from a tree discovered in an orchard in the late nineteenth century, which was reproduced widely by grafting).

89. 7 U.S.C. §§ 2321–2401 (1970).

90. 7 U.S.C. § 2541(c) (1994).

91. 513 U.S. 179 (1995).

92. *Id.* at 190–92; *see also* NUNO PIRES DE CARVALHO, THE TRIPS REGIME OF PATENT RIGHTS 181–84 (2002) (noting how additional policy narrowed the farmers' seed saving exemption and the plant breeders' exemption); Claudio Chiarolla, *FAO International Treaty on Plant Genetic Resources and Farmers' Rights*, UNITED NATIONS UNIVERSITY, http://www.ias.unu.edu/sub_page.aspx?catID=35&ddlID=191 (last visited Feb. 25, 2011) ("Historically, plant breeders' rights laws implementing UPOV

On the legislative front, in an effort to promote the United States' development of biotechnology and the public access of publicly funded research through the commercialization of technologies, Senators Birch Bayh and Bob Dole passed legislation (the Bayh-Dole Act, or the University and Small Business Patent Procedures Act) that gave U.S. universities and small businesses patent rights over federally funded research.[93] In fact, not only were these institutions given any patent rights, but they were encouraged to seek patent protection and attempt to commercialize technologies developed using federal funding.[94] If the government deemed that sufficient action was not taken to protect these rights, the government reserved the right to "march in" and license the technologies itself.[95] The result of the Bayh-Dole Act was a tremendous surge in the patenting of technologies and their movement to the private sector. In 1979, prior to the Act, only around twelve hundred government-owned patented technologies were licensed; for comparison, in 2003 alone, 3,933 technologies were licensed from just 167 universities.[96]

A widely criticized result of the Bayh-Dole Act is decreased public access to technologies developed from public funding, the opposite of one of the stated goals of the Act.[97] This has come about through several avenues that are direct effects of the Act. First, universities have often been locked out of using their own technologies once they are licensed, especially after the Federal Circuit ruling in *Madey v. Duke University*[98] narrowed the research exemption of licenses for university research.[99] Second, by requiring the licensing of technologies developed with federal funds (which at many universities is greater than 50 percent[100]), many more technologies have been patented, resulting in

provided for broad breeders' exemptions necessary to preserve open access to breeding materials. On the contrary, the research exemption in patent statutes is rather narrow, and when patent and plant variety right protection cover the same subject matter (i.e. the same genetic material), the breeders' exemption cannot be normally invoked as a defense against the infringement of biotechnological patents.").

93. 35 U.S.C. §§ 200–11 (1982).

94. § 202(c)(3).

95. § 203; *see also* 37 C.F.R. § 401.1(b), (c) (1987).

96. *See* BAYHDOLE25, INC., THE BAYH-DOYLE ACT AT 25, at 24 (2006); *see also* U.S. GEN. ACCOUNTING OFFICE, REPORT TO CONGRESSIONAL COMMITTEES GAO/RCED-98-126, TECHNOLOGY TRANSFER: ADMINISTRATION OF THE BAYH-DOLE ACT BY RESEARCH UNIVERSITIES app. XVI at 77 (1998) (numbers from Association of University Technology Managers).

97. Boettiger & Bennett, *supra* note 55, at 321.

98. 307 F.3d 1351 (Fed. Cir. 2002).

99. *Id.* at 1361–63.

100. *See* BAYHDOLE25, INC., *supra* note 96, at 10.

what has been coined an "anticommons" effect in which important technological tools become locked up across multiple private groups, leading to the underutilization of the technologies and the stifling of research.[101] Third, because private patent or license holders are generally only interested in using or developing their technologies for lucrative applications, e.g., major crops such as corn and soybeans, those technologies never become developed in less lucrative but still largely important applications from a humanitarian perspective.

Another way of protecting crops is related to the development of hybrid crops, particularly corn, in the first third of the twentieth century. This was achieved through the use of state trade secret law to protect the parent lines used to create hybrid corn. The increased yield of hybrid corn does not continue with further generations. Thus, if the parental lines are concealed as a proprietary trade secret, farmers (or competitors) seeking to produce hybrid corn must either do so independently (because trade secret law does not protect against independent discovery/creation) or gain access to the parental lines.[102] Note that while the PPA protected asexually reproduced plants such as ornamentals, it did not protect sexually reproduced crops such as corn. Protection for those crops was not extended until the 1970 PVPA.

A more recent method of protecting proprietary interests in seed germplasm is self-help. Such self-help has taken the form of restrictive licenses for proprietary seed systems used by companies such as Monsanto. It has also taken the form of technological self-help, such as transgenic Genetic Use Restriction Technology (GURTs) and Varietal Genetic Use Restriction Technology (V-GURTs), which rely on transgenetically engineered inviability, or sterility, of proprietary seeds. These seeds either won't reproduce or require use of other patented technologies in order to "switch on" particular characteristics, such as pest or weed resistance or particular nutritional characteristics.[103]

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101. Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCIENCE 698 (1998).

102. KLOPPENBURG, *supra* note 3, at 6–13 (noting the rise of Pioneer Hi-Bred and high-yield hybrid corn from the 1930s onward).

103. *See* Richard Caplan, *The Ongoing Debate over Terminator Technology*, 19 GEO. INT'L ENVTL. L. REV. 751, 751, 757–58 (2007) (providing a history of the evolution of genetically engineered crops and arguing that "[g]enetically engineered crops present unique and significant risks to human health and the environment, and compound[] the potential for harm with a technology that may exacerbate the problem would be a serious mistake); Sina Muscati, *Terminator Technology: Protection of Patents or a Threat to the Patent System?*, 45 IDEA 477, 477, 500 (2005) (explaining how Terminator Technology works and discussing critiques of the use of such technology); Debra M. Strauss, *Defying Nature: The Ethical Implications of Genetically Modified Plants*, 3 J. FOOD L. & POL'Y 1, 3, 35 (2007) (analyzing how

There were tensions in the international arena regarding intellectual property claims in plant genetic resources arising in part from the common-heritage treatment of plant genetic resources that crystallized in the 1970s and the roughly contemporaneous crystallizing national intellectual property treatment of "worked" plant genetic resources ("worked" either through selective breeding or genetic engineering).[104] By the mid-1980s, the United States had allowed utility patents for appropriately "worked" plant genetic material that many other developed countries were granting Plant Breeder's Rights, or PVP protection to plant varieties. However, some activists, plant breeders, researchers and administrators, and policymakers running international seed banks were urging that ALL plant genetic material be legally treated as common-heritage of humankind,[105] and as such be

terminator technology functions and stating that "the problem is not that this technology exists, but how that technology is being used"); Jason A. Barron, Note, *Genetic Use Restriction Technologies: Do the Potential Environmental Harms Outweigh the Economic Benefits?*, 20 GEO. INT'L ENVTL. L. REV. 271, 272 (2008) ("[A]n introduction to the modern agricultural methods developed by scientists to inhibit second generation seeds from reproducing, collectively known as genetic use restriction technologies ('GURTs')."); *Genetic Use Restriction Technologies (GURTs)*, CONVENTION ON BIOLOGICAL DIVERSITY, http://www.cbd.int/agro/gurts.shtml (last visited Feb. 28, 2011).

104. *See* AOKI, SEED WARS, *supra* note 1, at 103–04; FOWLER, *supra* note 26, at 196–97; Thomas Cottier & Marion Panizzon, *Legal Perspectives on Traditional Knowledge: The Case for Intellectual Property Protection*, 7 J. INT'L ECON. L. 371, 377–78 (2004). ITPGRS art. 12.3 is opposed to the extension of intellectual property rights to traditional knowledge and on plant genetic resources used for food or agriculture. However, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) permitted plant breeders who utilized genetic materials from the CGIAR gene banks to obtain proprietary rights. Arts. 12.3(f) and (g) do not preclude private plant breeders or public institutions "from claiming [intellectual property rights] on modifications of plant genetic materials;" once protection is extended, "only the patent holder can release control over it." *Id.*; *see also* KEYSTONE CTR., FINAL CONSENSUS REPORT OF THE KEYSTONE INTERNATIONAL DIALOGUE SERIES ON PLANT GENETIC RESOURCES: MADRAS PLENARY SESSION 13–15 (1990); Keith Aoki & Kennedy Luvai, *Reclaiming "Common Heritage" Treatment in the International Plant Genetic Resources Regime Complex*, 2007 MICH. ST. L. REV. 35, 37 ("[E]xamin[ing] how the tension between the intellectual property regimes such as TRIPS, and equity/conservation regimes such as the International Treat [sic] for Plant Genetic Resources . . . and the Convention of Biological Diversity . . . produced an overlapping inter-national regime complex addressing PGRs."); Susan K. Sell, *Post-TRIPS Developments: The Tension Between Commercial and Social Agendas in the Context of Intellectual Property*, 14 FLA. J. INT'L L. 193, 193 (2002).

105. *See* Food and Agriculture Organization Res. 8/83 of the FAO Conference, 22d Sess., Nov. 5–23, 1983 [hereinafter IUPGR] (declaring that all plant genetic resources, including cultivars protected by various forms of intellectual property by the laws of the developed countries, were to be accorded legal treatment as "common heritage"). The IUPGR was strongly opposed by the United States and other countries

available for farmers and breeders without intellectual property licenses. Alternately, other activists criticized common-heritage treatment for plant genetic resources because it allowed for the uncompensated expropriation and exploitation of plant genetic resources from the countries of the global South by the industrial countries of the global North. They demanded sovereignty over plant genetic resources within their borders (resulting in compensation for use of national plant genetic resources).[106] Finally, developed countries such as the United States simultaneously insisted on protection of patented and PVP-protected "worked" plant genetic material and the free availability of "raw," or unworked plant genetic resources arising from wild and weedy relatives of domesticated varieties and farmers' landraces.[107]

b. Minimum standards under TRIPS

In part, the rapid intellectual propertization of plant genetic resources revolved around the territorial definition of patent and other intellectual property rights, which were only legally valid in the jurisdiction that granted such protection to plants or plant genetic materials. If patent protection was sought on a broader geographic basis, patent applications had to be filed in the countries where protection was sought, which could be problematic because of widely uneven levels of intellectual protection and enforcement between different countries. During the 1980s and early 1990s, the international trade regime that began with the 1948 General Agreement on Trade and Tariffs[108] started to focus on the importance of developing countries providing "minimum levels" of intellectual property protection. This focus eventually became the Trade Related Aspects of International

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who did not want to see patented and PVP-protected cultivars treated under an open access "common heritage" regime. *See* FOWLER, *supra* note 26, at 188; KLOPPENBURG, *supra* note 3, at 173–74; Neil D. Hamilton, *Who Owns Dinner: Evolving Legal Mechanisms for Ownership of Plant Genetic Resources*, 28 TULSA L.J. 587, 603–05 (1993).

106. Jack R. Kloppenburg, Jr. & Daniel Lee Kleinman, *Seeds of Controversy: National Property Versus Common Heritage*, *in* SEEDS AND SOVEREIGNTY: THE USE AND CONTROL OF PLANT GENETIC RESOURCES 173 (Jack R. Kloppenburg, Jr. & Daniel Lee Klienman eds., 1988).

107. *See* FOWLER, *supra* note 26, at 109; KLOPPENBURG, *supra* note 3, at 46, 130.

108. FOWLER, *supra* note 26, at 161; Keith Aoki, *Distributive and Syncretic Motives in Intellectual Property Law (with Special Reference to Coercion, Agency, and Development)*, 40 U.C. DAVIS L. REV. 717, 774 (2007).

Property (TRIPS), which was signed in 1994 in Marrakech and came into force, under the aegis of the WTO, on January 1, 1995.[109]

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109. Frederick M. Abbott, *Public Policy and Global Technological Integration: An Introduction*, 72 CHI.-KENT L. REV. 345, 346 (1996); TRIPS, *supra* note 47; *Agreement on Trade-Related Aspects of Intellectual Property Rights*, WORLD TRADE ORGANIZATION, http://www.wto.org/english/traop_etrips_e/t_agm0_e.htm (last visited Feb. 27, 2011). TRIPS was meant to clarify the results of the negotiations since the Round was launched in Punta del Este, Uruguay, in 1986. *See* BAYHDOLE25, INC., *supra* note 96, at 35; *see also A Summary of the Final Act of the Uruguay Round*, *supra* note 47. For a comprehensive analysis of the TRIPS agreement and its history, see generally GERVAIS, *supra* note 47. For more information on the TRIPS agreement, see also WATAL, *supra* note 47, at 11–47; Andrew Beckerman-Rodau, *The Problem with Intellectual Property Rights: Subject Matter Expansion*, 13 YALE J.L. & TECH. 35 (2010) ("[O]verprotection of intellectual property in the form of overlaps which allow multiple bodies of intellectual property law to simultaneously protect the same subject matter . . . is problematic because it interferes with the carefully developed doctrines that have evolved over time to balance the private property rights in intellectual creations against public access to such creations."); Robert S. Chaloupka, *International Aspects of Copyright Law*, 15 No. 4 INT'L HR J. ART 3 (2006) (on the structure and objectives of TRIPS); Kerstin Mechlem, *Agricultural Biotechnologies, Transgenic Crops and the Poor: Opportunities and Challenges*, 10 HUM. RTS. L. REV. 749, 763–64 (2010) ("Agricultural biotechnologies, including transgenic crops, entail important present and future opportunities but also significant risks. They can contribute to meeting the need to increase food production by 70% . . . [and] 'shape the future of sustainable food security.' However, while increases in productivity have been realised in temperate-zone environments, the development and use of agricultural biotechnologies has bypassed the needs of most developing countries, and in particular of their smallholder farmers, and consequently missed the goals of contributing towards reducing hunger and poverty, and improving the realisation of human rights. In particular with respect to transgenic crops, smallholder farmers in developing countries have neither benefited from scientific progress and its applications, nor from improved methods of production by making full use of technical and scientific knowledge in order to fulfil [sic] the right to food. Instead, the introduction of transgenic crops in developing countries has had negative effects in many instances."); Greg K. Venbrux, *When Two Worlds Collide: Ownership of Genetic Resources Under the Convention on Biological Diversity and the Agreement on Trade-Related Aspects of Intellectual Property Rights*, 6 J. TECH. L. & POL'Y, 4 (2005), http://tlp.law.pitt.edu/wp-content/uploads/2011/02/vol-vi-venbrux.pdf (discussing the disagreements between industrialized countries and developing countries in protection of indigenous IP); Maria "Tess" Barker, Note, *The Use of Universities' Intellectual Property to Address Humanitarian Concerns in Developing Nations*, 19 TRANSNAT'L L. & CONTEMP. PROBS. 923, 934 (2011) (arguing that developing countries do not have effective IP regimes for a variety of reasons: "[f]irst, developing nations lack the institutional stability or capacity to develop these systems[;] [s]econd, developing countries lack effective IP regimes because of cultural perspectives that are suspicious of strong regulatory schemes[;] [s]pecifically, developing countries are suspicious of those regulations that provide greater benefits for multinational corporations at the expense of local companies or farmers[;] [and,] [h]aving recognized this, developing frameworks that assist these nations through the international IP regime is an important humanitarian cause"); and Yuqin Jin, Note, *Necessity: Enacting Laws to Protect Indigenous*

TRIPS represented a partial compromise on intellectual property rights between the developed industrial nations of the global North and the bio-resource rich but undeveloped or developing countries of the global South. The developed countries received a commitment from the signatory developing countries that they would work to implement national intellectual property systems that met the "minimum standards" of TRIPS. However, member nations were allowed to exclude plants, animals, and "essential" biological processes from patents as long as they had "sui generis" protection available[110] or some combination of patents and a system for crop cultivars.[111]

2. CONVENTION ON BIOLOGICAL DIVERSITY

a. Plant genetic resources as sovereign national property

The CBD was signed in 1992 and its objectives are (1) conserving biological resources,[112] (2) promoting the sustainable use of components

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Intellectual Property Rights in the United States, 19 TRANSNAT'L L. & CONTEMP. PROBS. 950, 976 (2011) ("It is necessary for the United States to enact indigenous IP laws for the protection of indigenous IP rights and the advancement of science and technology. . . . or at least require[] that applicants disclose the sources of biomaterial and associated knowledge.").

110. *See supra* note 47.

111. *See* TRIPS, *supra* note 47, at 94. Article 27(3)(b) requires that "Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or any combination thereof." *Id.*; s*ee also* WATAL, *supra* note 47, at 135–65 (discussing the array of possible intellectual-property regimes applicable to plants that are permissible under the WTO). Note that "members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect public order or morality, including to protect . . . human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by domestic law. . . . Members may also exclude from patentability: (a) diagnostic, therapeutic and surgical methods for the treatment of humans or animals; (b) plants and animals other than microorganisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, Members shall provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof. The provisions of this sub-paragraph shall be reviewed four years after the entry into force of the Agreement Establishing the MTO." TRIPS, *supra* note 47, at 94.

112. Convention on Biological Diversity art. 1, June 5 1992, 31 I.L.M. 818, 823 ("The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.").

of such biodiversity,[113] (3) fair and equitable benefit sharing arising from use of biological resources,[114] and (4) facilitating the appropriate transfer of resources and related technologies.[115] The CBD states in Article 15 that plant genetic resources are the sovereign national property of member states and the collection of biodiversity (including plant genetic resources) within such states requires prior informed consent.[116] Both equitable benefit sharing and prior informed consent are meant to give rise to a system of decentralized contracting between states and private parties regarding collection and exploitation of such resources.[117] The CBD represented a reversal of the position taken by the International Undertaking on Plant Genetic Resources (IUPGR)[118] in 1983 with regard to the treatment of plant genetic resources—in less than a decade the legal treatment of such resources had shifted from a regime of "common heritage" to a regime of "sovereign [] property."[119]

An important contrast between the CBD and TRIPS is that while TRIPS uses internationally standardized "minimum standards" of intellectual property protection, the CBD treats plant genetic resources as tangible goods, owned by the sovereign nation, which according to the traditional view is free to instantiate private intellectual property or place other conditions on the use of materials.[120] A key part of the CBD is to weakly provide that technology transfers occur from the country acquiring the plant genetic resources to the country providing access to such resources.[121]

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113. *Id.*

114. *Id.*

115. *Id.*

116. *See* Convention on Biological Diversity, *supra* note 112, at 828 ("Recognizing the sovereign rights of States over their natural resources, the authority to determine access to genetic resources rests with the national governments and is subject to national legislation.").

117. JANAK RANA GHOSE, BENEFIT SHARING OF GENETIC RESOURCES: THE CONVENTION ON BIODIVERSITY, THE BONN GUIDELINES AND EMERGING ABS FRAMEWORKS 1–5 (2004); *see also* AOKI, SEED WARS, *supra* note 1, at 91.

118. AOKI, SEED WARS, *supra* note 1, at 90–91.

119. *Id.* at 91; *see also* BRUSH, *supra* note 2, at 221–32.

120. *See generally* Roderick Lawrence, *Policy Research Brief: Property Rights and Fairness*, *in* ENVIRONMENTAL VALUATION IN EUROPE 10–11 (Pol'y Res. Brief No. 6, 2000); Rockefeller Found. Global Inclusion Program, Intellectual Property Strategic Opportunity Assessment Presentation (Aug. 2001).

121. AOKI, SEED WARS, *supra* note 1, at 80–92.

b. Decentralized bilateral contracts

The contribution of indigenous and local communities to sustainable use and conservation of plant genetic resources is also recognized by the CBD, and traditional knowledge is accorded legal status and is entitled to some form of recognition as intellectual property.[122] An important feature of the CBD is the way that it facilitates the privatization of plant genetic resources via decentralized agreements between states and private individuals. While the CBD does not address intellectual property rights in plant genetic resources, it goes without saying that the intellectual property rights are an essential component in drafting equitable benefit-sharing agreements as stipulated by the CBD. While the CBD is focused on addressing the conservation of biodiversity, its use of decentralized contractual agreements presupposes the presence of intellectual property rights as part of the valuation process, whether at the beginning of the informed consent/access stage or in the exploitation/commercialization stage when equitable benefits are to be shared.

The CBD is a framework agreement, and as such it lays out policies, purposes, and principles for the treatment of plant genetic resources and provides for subsequent Conferences of the Parties at which protocols and decisions are to be worked out in greater detail.[123] A protocol undertaken subsequent to the CBD is the Cartagena Protocol,[124] which attempts to address methods for the release, transfer, and handling of transgenic organisms.[125]

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122. Several scholars have questioned the commodification of traditional knowledge and critiqued arguments equating traditional knowledge with intellectual property rights, particularly given the different social and cultural assumptions that underlie each system. *See generally* INDIGENOUS HERITAGE AND INTELLECTUAL PROPERTY: GENETIC RESOURCES, TRADITIONAL KNOWLEDGE AND FOLKLORE (Silke von Lewinski ed., 2004); INTELLECTUAL PROPERTY RIGHTS FOR INDIGENOUS PEOPLES: A SOURCEBOOK (Tom Greaves ed., 1994); INTELLECTUAL PROPERTY AND HUMAN DEVELOPMENT: CURRENT TRENDS AND FUTURE SCENARIOS (Tzen Wond & Graham Dutfield eds., 2011).

123. *See Conference of the Parties*, CONVENTION ON BIOLOGICAL DIVERSITY, http://www.cbd.int/convention/cops.shtml (last visited Feb. 23, 2011); *see also* SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, BONN GUIDELINES ON ACCESS TO GENETIC RESOURCES AND FAIR AND EQUITABLE SHARING OF THE BENEFITS ARISING OUT OF THEIR UTILIZATION 3–4 (2002).

124. The Cartagena Protocol, an agreement that promotes trade in biotechnology products that are environmentally safe, offers some, albeit little, comfort to those still opposed to the unbridled entry of genetically altered foods and food products, in that it mandates that shipment of such products clearly identify that they may contain living modified organisms. Cartagena Protocol on Biosafety to the Convention on Biological Diversity art. 18, Jan. 29, 2000, 39 I.L.M. 1027, 1035;

3. INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

The ITPGR was signed by 140 countries in 2001 and came into force on June 29, 2004—ninety days after forty governments had ratified it.[126] The ITPGR is a major revision of the 1983 IUPGR promulgated by the Food and Agriculture Organization (which conspicuously lacked the United States as a signatory).[127] An important goal of the ITPGR was to reconcile differences between the 1983 IUPGR and the CBD, particularly regarding the legal treatment of plant genetic resources. The IUPGR treated all plant genetic resources as open-access common-heritage resources, whereas the CBD characterized genetic resources as "sovereign national property."[128] The "sovereign national property" characterization contemplates "facilitated access" to governments or "legal persons" in member states to the crops and forages listed on the ITPGR's "Annex I."[129] Under the ITPGR, the parties receiving facilitated access to the Annex I crops and forages are to pay an equitable share of benefits arising from those

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HOWARD MANN, THE CARTAGENA PROTOCOL ON BIOSAFETY: AN ANALYSIS (2000). However, this labeling requirement is only required for transportation purposes and does not necessarily extend to subsequent consumer retailing. *See* MANN, *supra*, at 9. Two months before the Protocol went into effect, a relatively obscure U.N. agency, the Codex Alimentarius Commission, with the backing of all 168 member states, produced the first set of international guidelines for assessing and managing health risks posed by GM foods. The most significant guideline called for safety assessments of all GM foods prior to their approval for commercial sale. Phil Bereano & Eliott Peacock, *Harmony or Havoc: Can the WTO, Biosafety Protocol and Codex Alimentarius Work Together?*, SCIDEV NET (Jan. 1, 2005), http://www.scidev.net/dossiers/index.cfm?fuseaction=policybrief&dossier=6&policy=54. *See generally FAQs – General Questions*, CODEX ALIMENTARIUS, http://www.codexalimentarius.net/web/index_en.jsp (last visited Feb. 19, 2011).

125. *The Cartagena Protocol on Biosafety*, CONVENTION ON BIOLOGICAL DIVERSITY (Feb. 18, 2011), http://bch.cbd.int/protocol/; *see also* AARON COSBEY & STAS BURGIEL, THE CARTAGENA PROTOCOL ON BIOSAFETY: AN ANALYSIS OF RESULTS (2000).

126. *See id.*; *see also* Gepts, *supra* note 62, at 1297.

127. AOKI, SEED WARS, *supra* note 1, at 85–90. The United States has signed, but not ratified, the ITPGR. *See International Treaty on Plant Genetic Resources for Food and Agriculture*, LEGAL OFFICE TREATIES, http://www.fao.org/Legal/treaties/033s-e.htm (last visited May 2, 2011).

128. *Id.* at 86, 91.

129. *Id.* at 120; BRUSH, *supra* note 2, at 248; Gepts, *supra* note 62, at 1297. The list of crops and forages on Annex I of the ITPGR include rice, maize, wheat, potato, banana, and common bean. Crops not on the annex and not subject to "facilitated access" include tomato, soybean, sugarcane, cocoa, coffee, oil palm, and rubber. *Id.*

resources that are protected by intellectual property rights into a "Global Crop Diversity Trust."[130] The Global Crop Diversity Trust will use its funds to create and maintain programs dedicated to conserve crop germplasm and capacity building as directed by the ITPGR's governing body.[131]

The transformation since the early 1990s in the legal treatment of plant genetic resources has meant that rather than the open access/exchange rule, access to such resources must be obtained by patent licenses, technology-uses contracts, material-transfer agreements, and bag-label agreements. DNA fingerprinting provides intellectual property rights holders with an important tool to detect the provenance of plant genetic resources as an aid in enforcing licenses and terms of use.[132] As Gepts has noted:

> [A] system of biodiversity ownership is now being put into place that consists of three mutually reinforcing components—molecular biology, IPRs, and international treaties. . . .[That] is leading to an increased commoditization of biodiversity and allows inventions, including those based on living organisms or biodiversity and crop cultivars, to receive intellectual protection and be distributed throughout the world.[133]

III. THE PRESENT

A. The Shift from Public to Private Agricultural Research

One of the problems driving the expansion of intellectual property rights in agricultural crops has been the shift over the past thirty years from public research that was freely accessible to private research by firms. Jack Kloppenburg has detailed the success of the U.S. land-grant university system from the late nineteenth to the mid-twentieth century.[134]

In the nineteenth and early twentieth centuries, the U.S. government was heavily involved in plant collecting and "plant improvement," and was also actively involved in freely spreading seed germplasm and information as widely as possible among U.S. farmers.

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130. Gepts, *supra* note 62, at 1297.

131. *Id.*

132. Sunil Archack, *Plant DNA Fingerprinting: An Overview*, AGBIOTECHNET, April 2000, at 1.

133. Gepts, *supra* note 62, at 1298.

134. KLOPPENBURG, *supra* note 3, at 12–14.

Thus, the U.S. government laid the foundation for expanded commercial agriculture in the twentieth century.[135] In the United States, from the 1860s onward, land-grant universities played a major role in disseminating agricultural information and germplasm by breeding plants tailored to local soil, climate, and pest contexts.[136] During the early twentieth century, U.S. agriculture became increasingly rationalized and industrialized, a trend that continues to date. Specifically, during the early twentieth century, many farmers stopped saving seed and began producing for a commercial marketplace that favored crop uniformity and higher yields—marking the beginning of a shift toward purchased seed stock.

In particular, patent and para-patent laws applicable to plants emerged roughly during the first three decades of the twentieth century. These laws, however, are imperfect and incomplete in their tracking of technological plant-breeding advances such as hybridization. These laws did not arise because of new technologies, but in large part

135. The United States may have been a latecomer in the colonial posturing for plant resources, but this does not mean that it did not participate. Early political leaders including Thomas Jefferson, George Washington, and Benjamin Franklin were enthusiastic importers of exotic plant material into the country. Jefferson is often quoted as noting that "[t]he greatest service which can be rendered to any country is to add a useful plant to its culture." FOWLER, *supra* note 26, at 14. Most of the original seed stocks in the United States were either brought into the country by immigrant families or imported by the U.S. government. Later, in the early part of the nineteenth century, the U.S. government played an active role in obtaining crop diversity and facilitating its testing and adaptation as a means of commercially expanding agriculture. By 1878, the U.S Department of Agriculture, created sixteen years earlier, was spending a third of its budget on germplasm collection and distribution. This distribution entailed handing farmers enough seed to facilitate experimentation, but not enough to supply commercial farming needs. The U.S. government thus encouraged the individual farmer to be a selector, breeder, and multiplier of seed. *See id.* at 14–18.

136. In 1862, the Morrill Act led to the creation of public land-grant universities on the premise that states should create centers of education that teach "agriculture and the mechanic arts." See James Stuart, Comment, *The Academic-Industrial Complex: A Warning to Universities*, 75 U. COLO. L. REV. 1011, 1023 (2004). Federal funds were disbursed to the various states based on the number of each state's congressional representatives providing each state with an endowment to form at least one university, hence the term "land grant university." *Id.* at 1023–24. In 1890, a second Morrill Act provided funding to support seventeen land-grant institutions created especially to serve African Americans in southern states. As of 1994, when the Equity in Educational Land Grant Status created twenty-nine Native American colleges in the western and plains states, the total number of land-grant universities had peaked in excess of 100. *Id.* at 1024. These state-supported land-grant universities were part of the government's undertaking in the task of plant improvement. At the time, it was apparent that a productive agricultural sector was contingent upon the development of improved crop varieties. Since private capital was lacking, it became evident that social capital was needed to accomplish this development. KLOPPENBURG, *supra* note 3, at 12.

because of political pressure from nursery companies trying to protect their market share in asexually reproduced (cloned) trees produced through cuttings and grafting, and because of deep structural changes in markets for agricultural produce. The 1930 Plant Patent Act[137] was followed and expanded by the Plant Variety Protection Act of 1970,[138] the 1980 Plant Variety Protection Act amendments,[139] and judicial decisions regarding the patent scope in terms of living organisms.[140] Against the backdrop of these legal developments, the Green Revolution occurred globally and the trend toward industrialized, mass-commercial agriculture which is highly dependent on chemical inputs such as fertilizers, pesticides, and herbicides continued.[141] At the core of these developments was the attempt to create legal mechanisms for the economic control of plants, plant varieties, and ultimately, plant genes that express particular traits.

This same mid-twentieth century period also brought changes in the division of labor in the agricultural sector, both nationally and internationally. Land-grant universities, which had encouraged and trained public plant breeders from the late nineteenth century onward, had their mission redefined.[142]

This redefinition involved characterizing their role as one of basic scientific-agricultural research, as opposed to being in the business of producing public plant breeds that were in competition with breeds and hybrids produced by increasingly powerful private-sector companies such as Pioneer Hi-Bred, Garst Seeds, and Cargill.[143] This displacement

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137. Plant Patent Act of 1930, Pub. L. No. 245, 46 Stat. 376 (codified at 35 U.S.C. §§ 161–64 (2006)).

138. 7 U.S.C. §§ 2321-2583 (1970).

139. Pub. L. 96-574, § 20, 94 Stat. 3350–52.

140. *See* discussion *infra* Part III.C.2.b.

141. Michael R. Taylor & Jerry Cayford, *American Patent Policy, Biotechnology, and African Agriculture: The Case for Policy Change,* 17 HARV. J.L. & TECH. 321, 328 & n.19 (2004).

142. The public agricultural research system had been the target of critics who questioned the quality of its work. The land-grant universities along with the U.S. Department of Agriculture were accused of parochialism, bureaucratic inefficiency, and inability or unwillingness to support critical research. A report issued jointly by the Rockefeller Foundation and the White House Office of Science and Technology Policy, which came to be known as the Winrock Report, warned that unless the current situation was improved, the nation would not be in a position to harness the benefits of newly emerging advances in biotechnology. *See* KLOPPENBURG, *supra* note 3, at 235.

143. The Winrock Report provided a template for reforming public agricultural research along lines more amenable to the needs of capital. This reform would be accomplished in three ways. First, the highly decentralized system that existed previously would be streamlined; part of this streamlining process involved creating a competitive grant system by which institutions outside the land-grant system

of public plant breeding from a central to a marginal position not only cleared the way for the privatization of seed production, but also meant the displacement of the model of *plant improvement* that emphasized free exchange of seed germplasm, breeding techniques, and information. These plant-improvement practices had the effect of maintaining and enlarging plant genetic diversity. Public plant breeds were replaced with hybrids developed from closed proprietary lines—heralding a move towards asserting legally protected rights in new plant varieties and away from enlarging plant genetic diversity.[144]

By the late 1970s, North American and European agricultural activists and authors began voicing concerns that "the genetic base of the world's food supply was quickly disappearing and that restrictive legislation was making it possible for agribusiness to gain control of this vital segment of the total food system."[145] These comments were the genesis of arguments arising from newly emerging NGOs that were severely critical of the spread of high-input industrialized agriculture in the so-called third world[146] with a particular focus on plant breeding and crop improvement.[147]

NGOs advanced their cause by employing several arguments. First, they argued that crop development policies and practices were effectively destroying the genetic base essential to plant breeding.[148] Because the Green Revolution drove the spread of new, high-yielding, uniform varieties (which were replacing traditional farmer landraces and their wild and weedy relatives), industrialized agriculture was

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could access funds administered by the USDA. Second, research and the associated funding would be redirected to basic scientific research. Third, industry would have a greater opportunity in determining social division of labor in agricultural research. KLOPPENBURG, *supra* note 3, 235–36.

144. *See generally* Keith Aoki, *Weeds, Seeds & Deeds: Recent Skirmishes in the Seed Wars*, 11 CARDOZO J. INT'L & COMP. L. 247, 278–86 (2003). The nineteenth and early twentieth centuries provided ample genetic diversity for both public and private plant breeders to introduce new traits into the cultivated varieties. However, this process has now become a booming market through which proprietary varieties are introduced with the accompanying genetic uniformity. *Id.*

145. ROBIN PISTORIUS & JEROEN VAN WIJK, THE EXPLOITATION OF PLANT GENETIC INFORMATION: POLITICAL STRATEGIES IN CROP DEVELOPMENT 8 (1999). Meeting in Canada under the aegis of the International Coalition for Development Action (ICDA), these authors and activists expressed concern about crop development and the world food supply in general and seed in particular. The book, *Seeds of the Earth*, authored by Pat Mooney, resulted from this conference. The concerns vocalized in the conference and articulated in *Seeds of the Earth* were developed further by other authors. *Id.*

146. *See id.*

147. *Id.* at 8–10.

148. *Id.* at 9.

accelerating the global erosion of plant genetic diversity. Second, the NGOs argued that there was a serious South-North appropriation of plant genetic diversity that went uncompensated because such resources were treated legally as the "common heritage of [h]umankind."[149] Third, they observed that throughout the last third of the twentieth century, the multinational chemical, pharmaceutical, and food-processing corporations acquired control of smaller seed-supply companies, thereby producing a striking economic concentration in the seed sector.[150] These corporations acquired smaller companies, gained control and access to unique seed and/or gene libraries, converted them into proprietary resources, and used the libraries to create new plant varieties suited to industrialized agriculture. In many instances, the proprietary resources were protected by plant breeders' rights or patents, meaning that these seeds could not be legally reproduced by farmers beyond the first sale.[151] The final set of claims centered on the concern that the rise of intellectual property rights in PGR for food and agriculture had slowed down or stopped the transfer of new crop development technology to farmers in the developing world. The technology contained in seeds and chemicals was protected by intellectual property rights that farmers risked infringing if they used such seeds and chemicals.[152] However, if they did not, they risked being driven out of their markets by farmers employing the technologies.[153] Additionally, such intellectual property rights were seen as creating a dependence on agrochemical companies and leading to a striking decline in traditional subsistence farming practices in the developing world, such as seed saving by farmers.[154]

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149. *Id.*

150. *Id.* at 9.

151. *Id.* at 10.

152. While these new varieties were developed using genetic resources acquired from developing nations, these poorer nations are precluded from exploiting the new varieties without the consent of the respective developers. This situation has been seen by some as not only being unfair, but also a hindrance to agricultural development in these poorer countries. *Id.* at 10.

153. This is just one of the criticisms leveled against the technology transfer provisions under TRIPS from the perspective of the developing world. *See supra* Part I.C.2; *supra* notes 108–10 and accompanying text; *see also* Donald P. Harris, *TRIPS' Rebound: An Historical Analysis of How the TRIPS Agreement Can Ricochet Back Against the United States,* 25 NW. J. INT'L L. & BUS. 99, 108–09 (2004) (stating that while the long-term positive effects of TRIPS's technology transfer provisions are yet to come to fruition in addition to being questionable, the short-term negative effects are fully apparent).

154. The extension of intellectual property rights to plant genetic resources threatens to eliminate farming as it has been practiced over the last ten millennia. For

B. Global Concentration: Privatization of Governance, Intellectual Property, and Logistics/Labor

Historically, American agriculture has been a mixture of capitalist and subsistence forms. American farms produced enough for farm families, although many raw materials (given variations in local economies and geographies) found their way to Europe to help fuel the Industrial Revolution. The American Industrial Revolution required farms to produce agricultural products for an increasingly urban population.[155] Mechanized industrial agricultural technology such as tractors, combines, hybrid seeds, and fertilizers expanded U.S. labor productivity in agriculture—many of such developments, such as hybrid seeds, were the product of public- and private-sector cooperation and research. Agricultural economists focused narrowly on increasing labor productivity (with the assumption that labor is a scarce resource and a concomitant assumption that natural resources are abundant) and relied on a narrow definition of "efficiency."

When analyzing industrialized agriculture at the end of the first decade of the twenty-first century, two modes of understanding changes have emerged. The first is commodity-chain analysis, which examines the dynamic emergence and changes of interdisciplinary, but hierarchically organized, industrialized, agricultural-production spaces created from the successful transformation of agriculture into formal manufactured products.[156] The second mode of analysis has focused on the emergence of networks.[157] In the context of global industrial

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instance, patents protecting Terminator Technology—technology which renders seeds infertile—have led to the dependence on the ever-expensive modified seed and chemical inputs from a handful of global biotechnology companies at the expense of farmers' ability to save and share the seed. As a consequence, family and indigenous farmers risk being driven off the land owing to the march toward bioserfdom whereby farmers have no choice but to license, or conceivably lease, the crops they wish to cultivate from the conglomerates. *See* RONNIE CUMMINS & BEN LILLISTON, GENETICALLY ENGINEERED FOOD: A SELF-DEFENSE GUIDE FOR CONSUMERS 88–89 (2d rev. ed. 2004).

155. *See generally* KARL KAUTSKY, THE AGRARIAN QUESTION (Peter Burgess trans., Zwan Publ'ns 1988) (1899); ERIC T. FREYFOGLE, THE NEW AGRARIANISM: LAND, CULTURE, AND THE COMMUNITY OF LIFE (2001).

156. HENDRICKSON ET AL., *supra* note 4, at 5–6; Gary Gereffi, Miguel Korzeniewicz & Roberto P. Korzeniewicz, *Introduction* to COMMODITY CHAINS AND GLOBAL CAPITALISM 1, 1–13 (Gary Gereffo & Miguel Korzeniewicz eds., 1994).

157. *See, e.g.*, JACK GOLDSMITH & TIM WU, WHO CONTROLS THE INTERNET? ILLUSIONS OF A BORDERLESS WORLD (2006); MICHAEL STORPER, THE REGIONAL WORLD: TERRITORIAL DEVELOPMENT IN A GLOBAL ECONOMY (1997); Anupam Chander, *Trade 2.0*, 34 YALE J. INT'L L. 281, 282–84 (2009) (discussing how advancement of telecommunication technologies is impacting the delivery of services and trade markets); Sergio G. Lazzarini, Fabio R. Chaddad & Michael L. Cook, *Integrating*

agricultural production, these two modes of analysis provide supplementary, if sometimes contradictory analyses.

Under commodity-chain analysis, economic actors at key points in the chain exercise power. This power may be exercised within a particular segment of a commodity chain through horizontal concentration, or power may be exercised up and/or down a particular production chain by technological means (such as through intellectual property rights) or through changes affecting buyer/consumer preferences. There has tended to be a concentration of inputs (seeds, fertilizers, herbicides, pesticides) and processing within particular firms. The important thing to observe is that industrial agriculture has become a supply-driven system with power being exercised by particular firms both upstream (i.e., machinery and chemical inputs) and downstream (i.e., processing, trading, and retail food products).

There has been a partial rupture in the consolidating commodity food chain caused by retail consolidation that has had to deal with both differentiation and segmentation of the consumer food market. Differentiation has been driven by three factors: (1) increasing prevalence of food branding (including identity-preserved commodities) and their vulnerability; (2) retail strategies driven in part by and aimed at particular consumer segments, (i.e., organics); and (3) civil society consumer activism/mobilization organized around food safety and quality. Taken together, these three factors tend to strengthen weaker links in the food-commodity chain: small farmers, traditional communities, and environmental activists.

Examples of networks affecting the food-commodity chain are the movement against transgenic foods over the past decade and the increasing presence of NGOs advocating particular policies in the global agrifood system.[158] Many of these policies focused on the emergence of alternate production and consumption chains, such as organic and fair-trade networks.

Supply Chain and Network Analyses: The Study of Netchains, 1 J. ON CHAIN & NETWORK SCI. 7 (2001) (discussing the concept of netchain analysis); Dan Jerker B. Svantesson, *Borders On, or Border Around—The Future of the Internet*, 16 ALBANY L.J. SCI. & TECH. 343 (2006); David R. Johnson & David Post, *Law and Borders—The Rise of Law in Cyberspace*, 48 STAN. L. REV. 1367 (1996).

158. On the idea of regime shifting in the global regulatory environment in the twenty-first century, see generally AOKI, SEED WARS, *supra* note 1, at 99-109, Helfer, *supra* note 22, Kal Raustiala & David G. Victor, *The Regime Complex for Plant Genetic Resources*, 58 INT'L ORG. 277 (2004), and Peter K. Yu, *TRIPs and Its Discontents*, 10 MARQ. INTELL. PROP. L. REV. 369, 401–02 (2006). On opposition to transgenic foods, see the Erosion, Technology, and Concentration Group's campaign against Monsato's Terminator gene. News Release, ETC Group, Terminating Food Sovereignty in Ecuador? President Opens Door to Terminator Seeds (Apr. 17, 2009).

The emergence of global food production networks, existing in tension with the food-commodity chain is notable over the past decade. Such networks are not reducible to ownership/possession by particular actors, yet such networks have had influence on input and output decisions; have differential geographic and territorial dimensions; and have managed to situate themselves to varying degrees within the institutional/regulatory complex. [159]

The tension between commodity-chain production and networks draws a focus to nodes of control over the vertical organization of agricultural food systems. At issue at these nodes is the control of key resources—land, water, infrastructure, and inputs. For example, the movement against transgenic foods is a network, and the increasing activism of NGOs in different aspects of the agrifood system are pushing for alternate food production in areas such as the organic and fair-trade certification movements.[160]

While some scholars identify up to eight nodes in the global agrifood system, there are at least three interrelated "super"-nodes. First, governance includes shifts from public regulation to private-sector self-regulation (including standard-setting), and a shift from the public sector to the private sector in terms of decision-making, as well as access to markets (for inputs, such as seeds, fertilizers and other chemical inputs) and to commodities (grain, livestock, etc.) that are related to access to capital. Second, the intellectual property node (including patent, trademark, copyright, geographical indicators, and trade secrets) confers significant control over production, marketing, and distribution of genetic resources and food supply. Third, logistics

159. *See generally* Douglas A. Kysar, *Preferences for Processes: The Process/Product Distinction and the Regulation of Consumer Choice*, 118 HARV. L. REV. 525, 550, 558–62 (2004) (discussing the application of the Agreement on Sanitary and Phytosanitary Measures on the international level, and the Food and Drug Administration and the U.S. Department of Agriculture jurisdiction over genetically modified organisms and organic food at the national level); Gabriel Marceau & Joel P. Trachtman, *The Technical Barriers to Trade Agreement, the Sanitary and Phytosanitary Measures Agreement, and the General Agreement on Tariffs and Trade: A Map of the World Trade Organization Law of Domestic Regulation of Goods*, 36 J. WORLD TRADE, 811 (2002).

160. Margaret Chon, *Marks of Rectitude*, 77 FORDHAM L. REV. 2311, 2311 (2009) ("[T]rademarks, service marks, collective marks, and certification marks (CMs) (collectively, marks) denote sustainability standards of some sort, such as fair trade."); Daniele Giovannucci, *How New Agrifood Standards are Affecting Trade*, *in* WORLD EXPORT DEV. FORUM, TRADE—WHAT IF? NEW CHALLENGES IN EXPORT DEVELOPMENT: CONSUMERS, ETHICS AND ENVIRONMENT 99, 104–05 (2008): Errol Meidinger, *Multi-Interest Self-Governance Through Global Product Certification Programmes*, *in* RESPONSIBLE BUSINESS: SELF-GOVERNANCE AND LAW IN TRANSACTIONAL ECONOMIC TRANSACTIONS 259 (Olaf Dilling, Martin Herberg & Gerd Winter eds., 2008).

and labor include transport, storage, handling and packaging systems, and "races to the bottom" regarding cheap, non-unionized, and undocumented agricultural labor.

1. PRIVATIZATION OF GOVERNANCE AND POTENTIAL PUSH-BACK: STANDARD-SETTING AND CERTIFICATION MARKS

While there has been a turn toward privatized governance over the past two decades, the WTO via treaties, the creation of institutions, and the promulgation of rules has created a global space for standard-setting in the global food system. In the name of reducing consumer confusion and transaction costs, this system makes possible a turn towards defining 'quality'—arguably embodying a shift from the "economics of quantities to the economy of qualities"[161]—the rise of "niche" markets, and more publicly negotiated standards.[162] However, the rise of standards and standard-setting organizations[163] may create barriers to entry if the number of supermarkets and retailers shrinks, as it has

161. Maki Hatanaka, Carmen Bain & Lawrence Busch, *Differentiated Standardization, Standardized Differentiation: The Complexity of the Global Agrifood System*, *in* BETWEEN THE LOCAL AND THE GLOBAL: CONFRONTING COMPLEXITY IN THE CONTEMPORARY AGRI-FOOD SECTOR: RESEARCH IN RURAL SOCIOLOGY AND DEVELOPMENT 39, 44 (Res. in Rural Sociology & Dev., vol. 12, Terry Marsden and Jonathan Murdoch eds., 2006).

162. HENDRICKSON ET AL., s*upra* note 4, at 11–12 (describing how global food retailers seek to reduce risk, avoid public controversy, and both standardize with certain types of market differentiation and differentiate with some forms of standardization). By contrast some retailers may become vulnerable to standardization and third party certification by NGOs and food activists using them as education and training tools. Hatanaka, Bain & Busch, *supra* note 161, at 47. Suppliers may be the most impacted by the rise of standards, but have the least substantive participation in their development; however such differentiation may create niche markets and make evaluating product safety more transparent. *Id.* at 47, 55. Finally, third party certifiers use standards competitively and thus may favor retailers/suppliers to maintain competitive advantage. *Id.* at 47.

163. *See* Mark A. Lemley, *Intellectual Property Rights and Standard-Setting Organizations*, 90 CALIF. L. REV. 1889, 1903 (2002); Joseph Scott Miller, *Standard Setting, Patents, and Access Lock-In: RAND Licensing and the Theory of the Firm*, 40 IND. L. REV. 351, 351 (2007); *see also About ISO*, INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, http://www.iso.org/iso/about/discover-iso_isos-name.htm (last visited Feb. 19, 2011). The U.S. representative to the ISO is the American National Standards Institute (ANSI) and ANSI relies on certification marks without elaborating their role in standard-setting. *See* AM. NAT'L STANDARDS INST., NATIONAL CONFORMITY ASSESSMENT PRINCIPLES FOR THE UNITED STATES 8 n.5 (2002); *see also* Naomi Roht-Arriaza, *Shifting the Point of Regulation: The International Organization for Standardization and Global Lawmaking on Trade and the Environment*, 22 ECOLOGY L.Q. 479, 486 (1995).

been.[164] The smaller number of retailers may then collaborate to set standard-reducing market access for suppliers unable to meet those standards.[165]

Additionally, this creates the opportunity for NGOs and other consumer groups to apply not-always-successful public-relations pressure on companies producing transgenic crops.[166] However, Hatanaka, Bain, and Busch warn that "[d]epending on how [third party certification] is used, and by whom, it may reflect and reproduce power relations that already exist in the global agrifood system,"[167] and Hendrickson suggests:

> How standards are used and by whom, and who provides third party certification affects different actors in the global food system in ways that are not easily predicted. . . . NGOs may have certain powerful roles in setting standards, and may become 'complicit' with other retailers or third party certifiers in their quest to help farmers access new markets.[168]

One thing that is clear is that brands are vulnerable and consumer trust and goodwill in corporate brands may be easily broken. Brands may also be capable of creating a certain amount of competition within a food-chain cluster, particularly if local farmers and merchants create a branding strategy based on local production and consumption of foods.

2. GLOBAL VERTICAL AND HORIZONTAL FOOD-SYSTEM CONCENTRATION

A central claim in this Subsection is the argument that we currently have adequate global food-production capacity and that distribution of food is what is problematic.[169] This claim of inegalitarian distribution of

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164. HENDRICKSON ET AL., *supra* note 4, at 9, 14.

165. Maki Hatanaka, Carmen Bain & Lawrence Busch, *Third-Party Certification in the Global Agrifood System*, 30 FOOD POL'Y 354, 359-60 (2005).

166. The anti-"Terminator" campaign by the Action Group on Erosion, Technology, and Concentration (ETC), a group against Monsanto, was an example of a successful campaign. *Support the Campaign to Ban Terminator!*, ETC GROUP (Jan. 5, 2006), http://www.etcgroup.org/en/node/39. However, the increasing prevalence of GE soy, corn and canola in the North American market is an example of a less successful strategy.

167. Hatanaka, Bain & Busch, *supra* note 161, at 46.

168. HENDRICKSON ET AL., *supra* note 4, at 10.

169. *See* KEITH GRIFFIN, ALTERNATIVE STRATEGIES FOR ECONOMIC DEVELOPMENT 144–45, 159-60 (2nd ed. 1999); ANDREW PEARSE, SEEDS OF PLENTY,

global food production and capacity is often countered by neo-Malthusian claims that the demand for increased global food production must be met by ever-escalating levels of biotechnology, including genetic engineering of major food crops.[170] However, the types of vertical and horizontal concentration occurring in the global food system, including but not limited to expanding intellectual property rights in germplasm and genetically engineered crops, are leading to greater, not less, inequality in the global distribution of food.

Since the end of the nineteenth century, in countries such as the United States and the nations of Western Europe, there has been a steady movement toward the industrialization of agriculture, incorporating scientific developments such as the rediscovery of the work of Gregor Mendel and the laws of plant genetics that gave birth to hybrid crops in the first two decades of the twentieth century.[171] At around the same time, chemical companies entered the agricultural

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SEEDS OF WANT: SOCIAL ECONOMIC IMPLICATIONS OF THE GREEN REVOLUTION 216–18 (1980); SEN, *supra* note 33, at 136.

170. Thomas Robert Malthus was an economist from England, almost exclusively known for his influence on Charles Darwin, his interests were mainly centered on social conditions and political economy, with his work on population playing an integral part. Malthus predicted that population would outstrip food supply growth and therefore justified the elimination of public support for the poor. For more on Malthus' life, *see* 9 AM. COUNCIL OF LEARNED SOC'YS, DICTIONARY OF SCIENTIFIC BIOGRAPHY 67–71 (Charles Coulston Gillispie ed., 1974). Modern day "population-bombers," Paul Ehrlich and Garrett Hardin are economists that have used Malthus's analysis to argue for cutting off foreign aid to fight hunger in developing countries. Ehrlich adopted a policy based on the concept of "triage" in military medicine first suggested by William and Paul Paddock. This concept classifies underdeveloped nations as: (1) those that will undergo a transition to self-sufficiency without food aid, (2) those that will achieve self-sufficiency only with food aid, and (3) those that are so far behind in the population-food game that there is little hope that food aid will result in later self-sufficiency. According to this policy, the finite assistance available should only be targeted towards the second group of nations, rather than those that can either survive without, or not be saved in spite of, such aid. *See* PAUL R. EHRLICH, THE POPULATION BOMB 146–47 (rev. ed. 1971). Hardin contends that the markedly higher population growth in poor nations makes it unsustainable for rich nations to offer food aid in the long-term. Against this backdrop, he argues that food aid would only benefit select corporate entities in rich nations while serving as a disincentive for poor nations to implement policies that would foster food security. Because the population growth in poor countries may go unchecked, resulting in a limitless increase in the need for food aid, Hardin urges the denial of such aid. This denial, according to Hardin, would have the positive effect of checking the rapid population growth in poor nations, thus eventually stabilizing the proportion of poor to rich populations. *See* Garrett Hardin, *Life Boat Ethics, The Case Against Helping the Poor*, PSYCHOL. TODAY, Sept., 1974, at 38–43, 123–26.

171. CARY FOWLER & PAT MOONEY, SHATTERING: FOOD, POLITICS, AND THE LOSS OF GENETIC DIVERSITY 45–46 (1990); KLOPPENBURG, *supra* note 3, at 61–62, 68–69.

sector, producing commercial fertilizers, pesticides, herbicides, and other chemical inputs into farming.[172] Also, farm equipment was becoming motorized and larger and larger, allowing fewer and fewer farmers to use increasingly mechanized techniques to farm increasing acreage.

During this same period, there were large increases in the number of confined animals being raised for food, and decisions regarding the production of food animals shifted from the level of the family farm to firms that provided food inputs as well as markets for processing the animals. For example, in broiler chicken production, firms provided both the birds and the feed to farmers, as well as mandating major decisions such as building design, schedule for chick delivery, and when broilers would be slaughtered. Farmers provided land, money, and labor, but firms "owned" the broilers and paid farmers on a piece rate (usually between three and four cents per pound).[173] On crop farms during this period, the composition of the labor force shifted from family to non-family labor. By the beginning of the twenty-first century, farming in the United States largely consisted of approximately thirty thousand farms producing oil crops, feed grain, and animals for a global, industrialized food system.[174]

As Heffernan, Hendrickson, and Gronski have detailed, markets for agricultural inputs such as seeds, fertilizers, herbicides, and other chemicals and commodities such as livestock and grain have become increasingly economically concentrated. This concentration has been dominated by transnational food retailers who dictate farm-level decisions that shape input markets as well as output agricultural-commodity markets. They write that:

> [E]xtreme amounts of concentration exist in many markets for both commodities and inputs in the U.S., Brazil and other places in the world. Markets are particularly concentrated in grain processing, meat slaughter, and food retail. . . . [M]any of the same firms are operating in different locations around

172. RAOUL A. ROBINSON, RETURN TO RESISTANCE: BREEDING CROPS TO REDUCE PESTICIDE DEPENDENCE 102–03 (1996); *see also* FOWLER & MOONEY, *supra* note 171.

173. HENDRICKSON ET AL., *supra* note 4, at 27; *see also* Dan Cunningham, *Contract Boiler Production: Questions and Answers*, THEPOULTRYSITE.COM (2004), http://www.thepoultrysite.com/articles/147/contract-broiler-production-questions-and-answers#7.

174. WILLIAM HEFFERNAN, MARY HENDRICKSON & ROBERT GRONSKI, REPORT TO THE NATIONAL FARMERS UNION: CONSOLIDATION IN THE FOOD AND AGRICULTURE SYSTEM 13 (1999).

> the world and in different commodity sectors (e.g. Cargill processes beef in the U.S., is a major grain trader and meat producer in Brazil, sells fertilizers in Brazil, and operates in China). Many of these firms have developed into food chain clusters that operate around the world. . . . [T]he key is to source wherever inputs are the cheapest and sell where your products can command the higher price.[175]

The basic input for agriculture—land—is becoming unaffordable, particularly on the urban fringe where agriculture must compete with high-demand suburban development. Transnational investment funds,

> including the giant BlackRock fund group in New York, are separately planning to invest hundreds of millions of dollars in agriculture, chiefly farmland, from sub-Saharan Africa to the English countryside. . . . Brad Cole, president of Cole Partners Asset Management in Chicago, which runs a fund of hedge funds focused on natural resources [said,] "There is considerable interest in what we call 'owning structure' -- like United States farmland, Argentine farmland, English farmland -- wherever the profit picture is improving."[176]

a. Emerging food-chain clusters

Heffernan, Hendrickson, and Gronski point out that until recently, most of the non-global grain firms were operated and run by family operations, occupying one or two stages of the food system and few commodities.[177] By contrast, the contemporary system has become much more complex. This complexity begins with biotechnology involvement in the fields (seeds and inputs), extending through food procession, production, and transportation and ending with highly processed food available to consumers on supermarket shelves.[178]

The structure has changed. Acquisition, mergers, joint ventures, partnerships, and contracts have given rise to what Heffernan, Hendrickson, and Gronski have called a "foodchain cluster" to refer to these new economic arrangements. In a food-chain cluster, the food is moved from stage to stage, but ownership does not change and neither does the decision-making locus. The food-chain cluster system is still

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175. *Id.* at 1–4; *See also* HENDRICKSON ET AL., *supra* note 4, at 12.

176. Diana B. Henriques, *Food Is Gold, and Investors Pour Billions into Farming*, N.Y. TIMES, June 5, 2008, at A1.

177. HEFFERNAN, HENDRICKSON & GRONSKI, *supra* note 174, at 3.

178. *Id.*

evolving. At the global level—where there are virtually no antitrust regulations—oligopolies, not monopolies, and oligopsonies have formed and they predict that four or five food-chain clusters will emerge.[179]

b. Government-regulated competition policy

The extremely high cost of biotechnological R&D in the agricultural sector, coupled with utility-patent rights following the 1980 Supreme Court case, *Chakrabarty*,[180] has helped create the foundation of a global oligopoly. Heffernan writes that the "constraining of competition in the food system on the input side of agricultural production . . . [is] at least as great and quite possibly greater than the constraints of a few dominant firms at the processing stage."[181]

As a source of power in the global agrifood system, intellectual property rights are connected with the specialization and standardization processes of industrialized agriculture. Since the *Chakrabarty* case in 1980, intellectual property laws have regulated innovations in living organisms—allowing companies holding patents in crops to charge rents and license fees for organisms that would otherwise be freely reproducible (or at least very difficult to control reproduction).

Competition made early forms of capitalism effective—stimulating innovation and bringing about price discipline to market actors. However, as capitalism matures, capital has tendencies to concentrate as a particular buyer or seller (or small group of buyers or sellers) gains sufficient market share to influence other buyers and sellers and the ability of competitive markets to regulate supply and demand vanishes. Since the early twentieth century in the United States, congressional legislation such as the Sherman Antitrust Act, the Clayton Antitrust Act, and the Packers and Stockyards Act of 1921 have sought to regulate agricultural competition, with jurisdiction spread between the U.S. Department of Justice (DOJ), the U.S. Department of Agriculture (USDA), and the Federal Trade Commission (FTC).

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179. *Id.* at 3–4.

180. 447 U.S. 308 (1980); *see also* Lauren M. Nowierski, *A Defense of Patenting Human Gene Sequences Under U.S. Law: Support for the Patenting of Isolated and Purified Substances*, 26 CARDOZO ARTS & ENT. L.J. 473, 489-90, 507 (2008).

181. William D. Heffernan, Plenary Lecture, *Biotechnology and Mature Capitalism*, *in* WORLD FOOD SECURITY AND SUSTAINABILITY: THE IMPACTS OF BIOTECHNOLOGY AND INDUSTRIAL CONSOLIDATION 127 (NABC report No. 11, Donald P. Weeks, Jane Baker Segelken & Ralph W.F. Hardy eds., 1999).

U.S. antitrust laws generally do a better job of addressing horizontal concentration rather than vertical integration, which tends to turn the focus of U.S. antitrust enforcement on consumer harm. In particular, since the Reagan era, competition has been narrowly interpreted in agriculture, with the seeming acceptance of markets where one buyer may possess a 30 percent market share.[182]

On the global level, the U.N. Conference on Trade and Development provides that the model law on competition's goal is "[t]o control or eliminate restrictive agreements or arrangements among enterprises, or mergers and acquisitions or abuse of dominant positions of market power, which limit access to markets or otherwise unduly restrain competition, adversely affecting domestic or international trade or economic development."[183]

On both national and international levels, increased focus on producer harm, new approaches to analyzing vertical integration, and an analytical focus on abuses of buyer power are important ways to address concentration in rapidly globalizing agricultural markets.[184] Agricultural inputs such as seeds, fertilizers, herbicides, insecticides, and other chemicals are economically concentrated. Hendrickson and her colleagues write that:

> [T]wo firms (Mosaic, Yara) provide most of the fertilizer used today in North America, one firm has a 25% market share for fertilizers in Europe and Bunge recently made moves in Brazil to strengthen its fertilizer business that will place it in fourth place globally. . . .
>
> Ownership of global seed and agrochemical firms has also converged in the last 15 years[, helping] "to better control and market proprietary lines of chemicals, genetic technologies and seeds, often sold in a single-bundled package." . . . [This] reduces flexibility of on-farm strategies

182. For example, Smithfield has, at one point, controlled over 40 percent of the buying power in pork. HEFFERNAN, HENDRICKSON & GRONSKI, *supra* note 174, at 17; *see also* Peter C. Carstensen, Statement at the Workshop on Merger Enforcement: Buyer Power and Merger Analysis–The Need for Different Metrics 28–30 (Feb. 17, 2004), *available at* www.ftc.gov/bc/mergerenforce/presentations/040217carstensen.pdf.

183. United Nations Conference on Trade and Development, *Model Law on Competition*, U.N. Doc. TD/RBP/CONF.5/7/Rev.3, 3 (2007) [hereinafter UCTAD, *Model Law on Competition*].

184. An important effort to document concentration in the agrifood system may be seen at Professor William Heffernan's website. William Heffernan & Mary Hendrickson, Report at the Agribusiness Accountability Initiative Conference on Corporate Power in the Global Food System: The Global Food System: A Research Agenda 2–3 (2005), *available at* http://www.foodcircles.missouri.edu/global.pdf.

> for pests and weeds . . . and increases reliance on purchased inputs [that] becomes even more apparent with the stacking of more and more traits into the seeds that are available (herbicide tolerance or insect resistance).[185]

They further observe that:

> [T]he U.S. seed industry . . . is the most heavily commercialized seed sector in the world, and it started with hybrid maize, a significant innovation as it made farmers return to the seed company year after year. Between 1970 and 2000, small private seed firms essentially vanished, with more than 50 acquisitions of seed companies by pharmaceutical and chemical firms. By the 1980s, the maize seed market was dominated by two firms and by the late 1990s, over 90% of cotton seed, 69% of maize seed and nearly half of soybean seeds were sold by the four largest firms in each crop. This transformation could not have taken place without important developments in intellectual property regimes. . . .
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> . . . [T]here are four firms that dominate a third of the seed industry globally. . . . [and they] captured their dominant position after the refinement of IPR and as products of biotechnology were becoming commercially available. From the outset it was obvious that only the most highly capitalized firms, which included pharmaceutical firms, could afford such expensive research. Since research leading to the introduction of biotechnology was perceived as the future of crop breeding and production, experts predicted a grim future for seed firms without access to biotechnology. . . . prompt[ing] smaller firms without such access to capital – or even large firms like Cargill – to literally run to one of the five firms emerging as dominant and ask to be bought.[186]

In emerging oligopolistic, food-system clusters of firms, Heffernan has found that each cluster that includes a firm with access to biotechnology holding "government-granted patent rights" will be a

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185. HENDRICKSON ET AL., *supra* note 4, at 13 (quoting United Nations Conference on Trade & Dev., *Tracking the Trend Towards Market Concentration: The Case of the Agricultural Input Industry*, 7, U.N. Doc. UNCTAD/DITC/COM/2005/16 (Apr. 20, 2006)).

186. *Id.* at 16–17.

dominating firm in each food system cluster.[187] Heffernan observes that:

> [N]umerous "alliances" in each cluster lead to what is often called a "seamless system" which describes the emerging, fully-integrated food system from the gene to the supermarket shelf. Within this emerging system there will be no markets and thus no "price discovery" . . . The first time the price of any input in the food system will be public information will be at the supermarket. . . . [E]ven the price of animal feed and its ingredients, such as the corn, will not be known to the public, because like today's broilers, the product will not be sold. The firm owns the chick and sends it to their processing facility from which it emerges, perhaps as a TV dinner. In a food system cluster, the food product is passed along from stage to stage. Technically ownership may change, but the location of the key decision-makers does not change. Starting with the intellectual property rights that governments give to the biotechnology firms, the food product always remains the property of a firm or cluster of firms with close working relationships. The farmer becomes a grower, providing the labor and often some of the capital, but never having clear title to the product as it moves through the food system and never making the major decisions.[188]

In the context of seed technology systems, the largest firms receive patents or acquire firms that hold valuable agricultural patents. Heffernan points out that "[e]ven a firm as large as Cargill felt it was better to sell the global seed business to Monsanto and form a joint venture with them than it was to try [to] enter the biotechnology field on its own."[189] Monsanto and Cargill announced their joint venture in 1998;[190] Cargill had been one of the largest seed companies in the world and sold its international seed operations to Monsanto and its domestic U.S. operations to AgrEvo (a joint venture between Hoescht and Schering).[191]

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187. William D. Heffernan, Presentation at the 11th Annual Meeting of the National Agricultural Biotechnology Council: Biotechnology and Mature Capitalism 5 (June 6–8, 2009), *available at* http://www.foodcircles.missouri.edu/biotech.pdf.

188. *Id.* at 6.

189. *Id.* at 7.

190. HEFFERNAN, HENDRICKSON & GRONSKI, *supra* note 174, at 4.

191. *Id.*

Intellectual property laws provide the backdrop against which farmers are asked to sign end-user agreements in which they consent to unannounced field testing of crops and agree not to save seed from season to season. These end-user agreements also deprive the farmers growing these seeds of any type of ownership of the genetically modified seeds, and thus their own crops. The result of these agreements is that farmers are now more like renters of seed than owners and producers. Each year farmers must buy seed anew.

The rise of intellectual property rights in agriculture raises questions and constrains what choices farmers may make. Because of the market dominance of hybrid corn and glyphosate-tolerant crops, farmers become reliant on the few firms supplying seeds and thus the rough substitutability among competing types of genetically engineered and non-genetically engineered crops disappears. Hendrickson and her colleagues note:

> In the U.S., there is virtually no open-pollinated corn seed available except in very limited farmer to farmer sharing networks. Given that over 90% of Midwestern soybeans are Round-up Ready, sourcing non-RR soybeans is virtually impossible – it has all the stresses and inconveniences of sourcing specialty crop seed without any of the benefits of specialty crop premiums. Virtually all new soybeans genetics (even those achieved through conventional breeding) contain patented RR technology.[192]

They also note:

> The continued planting of conventional seeds was made particularly difficult because farmers bore the cost of analysis to prove that their grains were conventional. Thus, there was no premium for planting non-transgenic soy, no infrastructure

192. HENDRICKSON ET AL., *supra* note 4, at 17. Greenpeace won an appeal in Brazil to prevent RR marketing until an Environmental Impact Statement (EIS) was undertaken. GE crops were barred legally but farmers in the State of Rio Grande So Sul planted RR seeds smuggled in from Argentina, as they were convinced that RR soy would lower costs. Monsanto argued that it had not stimulated the illegal diffusion but decided to charge royalties. Brazil's federal government legalized the planting of RR soy but included a clause that royalties could only be charged against receipts for purchases of the RR seeds. Monsanto levied a fine amounting to 1 percent of the value per sack of the marketed grain, because the seeds were clandestinely traded, and demanded that the fine be collected by traders such as Cargill and ADM under threat that RR soy would not be unloaded in ports where Monsanto's patent was recognized (Japan and Europe). *Id.* at 18.

> for ensuring its post-harvest segregation, and to boot, the farmers had to pay for the tests to confirm that the soy was conventional. . . .
>
> . . . Upstream the multipliers apply and collect Monsanto's royalties, while downstream the global traders collect its fines, both bearing the logistical and administrative costs this entails. The farmers, largely accepting the legitimacy of technology rights, for the most part defensively negotiate levels of payments while those who resist must pay to prove that they have not benefited from the technology on offer.[193]

The current state of global food supply is dynamic for at least two reasons. New technologies, but also political interventions and public opinion, may have destabilizing effects on the structure of a particular food-system cluster. Additionally companies such as Monsanto, DuPont, Novartis, and Cargill are able to find new partners who can take advantage of the dynamic state of the food system, and those partners are more likely than not to be dominant players in their particular niche of the food system.

C. The Rise of Genetically Engineered Crops

1. GENETICALLY ENGINEERED CROPS PLUSES AND MINUSES

GE crops were developed because they offered a number of methodological advantages over traditional crop breeding. First, genetic engineering using recombinant DNA (rDNA) allows for the isolation and insertion of a precisely identified single gene or sequence of DNA in one generation. This comes in contrast to the process of introgressing desired genes through traditional breeding methods which takes many generations, is less precise, and involves complicated and costly procedures such as marker-assisted selection.[194] Second, rDNA technologies allow for the insertion of genes from organisms that are reproductively isolated and not available for the hybrid crosses necessary for traditional breeding. For example, a corn gene coding for a protein that increases photosynthetic output was inserted into rice,[195] a

193. *Id.* at 19.

194. Peggy G. Lemaux, *Genetically Engineered Plants and Foods: A Scientist's Analysis of the Issues (Part I)*, 59 ANN. REV. PLANT BIOLOGY 771, 774–75 (2008).

195. Maurice S.B. Ku et al., *Introduction of Genes Encoding C4 Photosynthesis Enzymes into Rice Plants: Physiological Consequences*, *in* RICE

process that would not have been possible using traditional breeding methods because corn and rice cannot be bred together. Third, using trait introduction with rDNA and subsequent tissue culture and screening methods allows for the mass production of organisms with the desired traits.

These methodological benefits have resulted in the possibility of generating organisms that contain traits with a wide range of potential benefits. For example, they include the ability to genetically engineer crops with systemic pesticide resistance. This reduces the amount of exogenous pesticides that have to be applied with potential environmental benefits, cost savings to the farmer, and health benefits to the consumer (e.g., expression of Bt in corn reduces earworm attack and subsequent fungal infection which has been linked to elevated rates of liver and/or esophageal cancer in humans[196]). The most widely used of these pesticides are the toxins generated by the bacterium *Bacillus thuringiensis* (Bt) which have been engineered into corn and cotton. Bt was widely sprayed by farmers to resist herbivorous insect damage, but because it breaks down relatively quickly in the environment, it has to be applied frequently to be effective. Systemic production of Bt toxins in the plants themselves can now be delivered exogenously, thus providing greater protection against insect predation.

Another benefit of a widely used GE trait in crop plants is herbicide tolerance (HT). Competition with weeds is a significant factor in crop yield losses, and farmers expend a large amount of resources through herbicide spraying and tilling to eliminate weeds without damaging the crop. The engineering of crop plants with a tolerance to herbicides allows for herbicide spraying at a later stage of crop growth which reduces the number of applications necessary. HT crops also allow for reduced tilling methods with the concomitant benefits of reduced fossil fuel consumption from farm equipment and reduced soil erosion. The first commercially available HT crop was Roundup Ready (RR) soybeans introduced by Monsanto in 1996, a business coup because Monsanto owned the patent both to the soybean and to the glyphosate herbicide Roundup which was then and still is the most widely used herbicide in the world.[197]

BIOTECHNOLOGY: IMPROVING YIELD, STRESS TOLERANCE AND GRAIN QUALITY 100 (Jamie A. Goodie & Derek Chadwick eds., 2001).

196. Felicia Wu, *Mycotoxin Reduction in Bt Corn: Potential Economic, Health, and Regulatory Impacts*, ISB NEWS REP., Sept. 2006, at 8, 8–9.

197. CTR. FOR FOOD SAFETY, GENETICALLY MODIFIED (GM) CROPS AND PESTICIDE USE 4 (2009).

Further benefits of genetic engineering are the ability to engineer crops with traits for increased tolerance to environmental factors, such as drought and salinity,[198] disease resistance,[199] reduced nicotine content,[200] increased nutrient content (e.g., Golden Rice)[201], longer shelf lives,[202] allergy-reducing pollen,[203] improved nutrient uptake which reduces the need for fertilization,[204] and male sterility to increase the ease of hybridization[205]—essentially any trait that is desired.[206] In addition, GE crops can be used as vehicles for the generation of materials unrelated to agriculture such as fuels and drugs,[207] much the way that GE bacteria are used as workhorses to produce the rennin used in the majority of U.S. hard-cheese products and lactase supplements for those with lactose intolerance.[208]

GE crops have drawn widespread criticism, however, from a variety of groups with a variety of concerns. The general concerns about GE crops fall into two categories: environmental effects and food safety. Because many GE crops reproduce in the field, there is the high potential for transgenes to escape from crop fields and introgress into

198. Hong-Xia Zahng et al., *Engineering Salt-Tolerant* Brassica *Plants: Characterization of Yield and Seed Oil Quality in Transgenic Plants with Increased Vacuolar Sodium Accumulation*, 98 PNAS 12832, 12932 (2001).

199. Dennis Gonsalves, *Control of Papaya Ringspot Virus in Papaya: A Case Study*, 36 ANN. REV. PHYTOPATHOLOGY 415, 415–16, 421 (1998).

200. Naruhiro Hibi et al., *Gene Expression in Tobacco Low-Nicotine Mutants*, 6 PLANT CELL 723, 723 (1994).

201. Xudong Ye et al., *Engineering the Provitamin A (ß-Carotene) Biosynthetic Pathway into (Carotenoid-Free) Rice Endosperm*, 287 SCIENCE 303, 303 (2000).

202. BELINDA MARTINEAU, FIRST FRUIT: THE CREATION OF THE FLAVR SAVR™ TOMATO AND THE BIRTH OF GENETICALLY ENGINEERED FOOD 1–5 (2001).

203. V. Niederberger et al., *Vaccination with Genetically Engineered Allergens Prevents Progression of Allergic Disease*, 101 PNAS 14677, 14677 (2004).

204. Suichi Yanagisawa et al., *Metabolic Engineering with Dof1 Transcription Factor in Plants: Improved Nitrogen Assimilation and Growth Under Low-Nitrogen Conditions*, 101 PNAS 7833, 7833 (2004).

205. Eduardo Zabaleta et al., *Transgenic Male-Sterile Plant Induced by an Unedited atp9 Gene is Restored to Fertility by Inhibiting Its Expression with Antisense RNA*, 93 PNAS 11259, 11259 (1996).

206. *See, e.g.*, *Petitions of Nonregulated Status Granted or Pending by APHIS as of August 19, 2010*, USDA ANIMAL AND PLANT HEALTH INSPECTION SERVICE, http://www.aphis.usda.gov/brs/not_reg.html (last visited Feb. 20, 2011) [hereinafter *Petitions of Nonregulated Status*].

207. Yasmin Thanavala et al., *Immunogenicity in Humans of an Edible Vaccine for Hepatitis B*, 102 PNAS 3378, 3378 (2005); *see also* François Torney et al., *Genetic Engineering Approaches to Improve Bioethanol Production from Maize*, 18 CURRENT OPINION BIOTECHNOLOGY 193, 193 (2007).

208. Lemaux, *supra* note 194, at 774.

natural plant populations, especially given that many crop species have weedy relatives.[209] The existence of GE genes in forms readily available to natural species—that is, pollen and ovules—dramatically increases the chance that completely foreign genes can be introduced into native plant populations. The introduction of pesticide or herbicide resistance into wild populations can create "superweeds," which could present a problem to farmers as well as disrupt natural plant community dynamics by potentially resulting in the domination of one plant at the expense of others (as well as many other effects that come from the disruption of finely tuned ecosystems). The escape of transgenes into unintended populations has already been documented by the well-publicized presence of transgenes in Mexican maize landraces in 2001 and then confirmed in 2008.[210] This occurred despite the fact that a moratorium on field testing and commercial planting of GE maize had been in place in Mexico since 1998, and it shows the potentially wide reach of transgenes.

A second issue of concern is the evolution of herbicide and pesticide resistance in weeds and pests as a response to high and lengthy exposure to herbicides and pesticides.[211] This appears to be

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209. Lesley G. Campbell, Allison A. Snow & Caroline E. Ridley, *Weed Evolution After Crop Gene Introgression: Greater Survival and Fecundity of Hybrids in a New Environment*, 9 ECOLOGY LETTERS 1198, 1205–07 (2006).

210. David Quist & Ignacio H. Chapela, *Transgenic DNA Introgressed into Traditional Maize Landraces in Oaxaca, Mexico*, 414 NATURE 541, 542 (2001). But note the controversy over Chapela's research when *Nature* withdrew the article. Chapela was eventually granted tenure at Berkeley, but only after first enduring a prolonged tenure fight. Chapela's pending tenure was complicated by his opposition to Berkeley's acceptance of a $25 million gift from Novartis. *See* Charles Burress, *Berkeley/Embattled UC Teacher is Granted Tenure? Critic of Campus' Ties with Biotech Lost Initial Bid*, SF CHRONICLE, May 21, 2005, http://articles.sfgate.com/2005-05-21/bay-area/17374009_1_tenure-ignacio-chapela-novartis. For more on transgenes in Mexican maize, see also A. Piñeyro-Nelson et al., *Transgenes in Mexican Maize: Molecular Evidence and Methodological Considerations for GMO Detection in Landrace Populations*, 18 MOLECULAR ECOLOGY 750, 751 (2009).

211. For example, Bt is one of the most important pesticides used by conventional and organic growers alike. It functions by killing pest individuals that are susceptible to its chemical structure, and these individuals usually represent the majority of a pest population. However, there are always individuals that possess traits that make them immune to the pesticide. If these individuals then breed with each other, their offspring will all be immune to the pesticide and in a short period of time the pesticide will no longer be effective against that particular pest species. Rebecca Bratspies, *The Illusion of Care: Regulation, Uncertainty, and Genetically Modified Food Crops*, 10 N.Y.U. ENVTL. L.J. 297, 307 (2002). Although Bt spraying has been used for many years and not resulted in this type of pest resistance, the process of embedding Bt into the plant cells creates a much more favorable environment for resistance breeding. Spraying only coats a plant's leaves for a short period of time.

already occurring in the United States with the appearance of Roundup-resistant weeds that may be the result of the increased use of Roundup herbicide given the popularity of RR GE crops.[212] As we have learned with the rise of antibiotic-resistant bacteria, repeated and lengthy exposure to a toxin creates strong selection on organisms to counteract the negative effects of the toxin. With herbicide-resistant weeds, farmers again have to increase their herbicide spraying and tilling, diminishing the profit value of using GE crops.[213]

Another environmental concern is the escape of antibiotic-resistant genes from GE crops into wild plant populations, or to bacteria, creating both an environmental and a human-health hazard. Because the process of recombining transgenes into a target crop has a low probability of success, researchers use a marker-selection screening method to discover the successful transformations. Transgenes are linked to a "marker gene" that has traditionally been an antibiotic-resistant gene. Application of an antibiotic reveals which cells have been transformed and which have not, providing a method for selection for successful transformations. Because the antibiotic-resistant genes are inserted into the target crop along with the desired transgene, the possibility of escape is as high as that of the transgene.

While the severity of these problems if actuated is very high, it should be noted that the research community is actively involved in discovering technological solutions to these problems. For example, a wide range of selectable markers other than antibiotic-resistant genes are being developed to eliminate the problem of antibiotic resistance spreading in plant, human, or bacterial populations.[214] Work is also being done to contain transgenes to male-sterile lines in field plantings, reducing the probability of gene flow through pollen.[215] There are also developments in the works for plants to self-excise selectable

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With plants bred to contain Bt, however, the result is a continuous production of high doses of Bt. *Id.* This increased timeline of exposure to the pesticide can allow a pest species to develop a resistance much faster than it could if it were only exposed to the pesticide for short periods of time.

212. William Neuman & Andrew Pollack, *Rise of the Superweeds*, N.Y. TIMES, May 4, 2010, at B1.

213. *Id.*

214. *See* Isaac Kirubakaran Sundar & Natarajan Sakthivel, *Advances in Selectable Marker Genes for Plant Transformation*, 165 J. PLANT PHYSIOLOGY 1698, 1710–11 (2008).

215. Henry Daniell, *Mollecular Strategies for Gene Containment in Transgenic Crops*, 20 NATURE BIOTECHNOLOGY 581, 583 (2002).

markers,[216] and even the transgenes themselves,[217] from pollen so that any pollen that gets dispersed is transgene-free.

In addition to environmental concerns, there has been concern about the negative effects of transgenes on human health. One concern is the presence of allergens in GE food either through the deliberate introduction of genes coding for allergenic proteins that may be ingested by an unsuspecting consumer or through the unintended expression of a previously unexpressed gene caused by widespread genome-expression effects due to transformation.[218] There is little evidence that GE foods have led to an increase in human allergic reactions; however, the potential remains.

Critics are also concerned about the negative health impacts of chronic exposure to systemically produced pesticides such as Bt in GE crops. Bt has been long used in the United States with little to no adverse human effects,[219] and more recent safety studies have been conducted showing no evidence to suggest allergenic or toxic effects of Bt proteins on humans.[220] Further, because Bt proteins have been shown to be unstable in digestive fluids, the U.S. EPA does not conduct long-term studies on them,[221] though some have called for these.[222]

There is further concern about the downstream effects of transgene-induced metabolic changes such as changes in nutrient content or up-regulation of previously quiescent proteins.[223]

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216. Hong S. Moon et al., *Keeping the Genie in the Bottle: Transgene Biocontainment by Excision in Pollen*, 28 TRENDS BIOTECHNOLOGY 3, 4 (2010).

217. David W. Ow, *GM Maize from Site-Specific Recombination Technology, What Next?*, 18 CURRENT OPINION BIOTECHNOLOGY 115, 115 (2007).

218. *See* Thomas O. McGarity, *Seeds of Distrust: Federal Regulation of Genetically Modified Foods*, 35 U. MICH. J.L. REFORM 403, 419 (2002).

219. NAT'L RESEARCH COUNCIL, GENETICALLY MODIFIED PEST-PROTECTED PLANTS: SCIENCE AND REGULATION 34–36 (2000).

220. Rita Batista et al., *Lack of Detectable Allergenicity of Transgenic Maize and Soya Samples*, 116 J. ALLERGY CLINICAL IMMUNOLOGY 403, 407–08 (2005); Mike Mendelsohn et al., *Are Bt Crops Safe?*, 21 NATURE BIOTECHNOLOGY 1003, 1004–05 (2003).

221. U.S. ENV'T PROT. AGENCY, BIOPESTICIDES REGISTRATION ACTION DOCUMENT: BACILLUS THURINGIENSIS (BT) PLANT-INCORPORATED PROTECTANTS, at IIB2 (2001).

222. McGarity, *supra* note 218, at 418.

223. *Id.* at 420–23.

2. GENETICALLY ENGINEERED CROPS AND REGULATION (OR LACK THEREOF) IN U.S. AGRICULTURE

The rise of GE crops and the patentability of life forms and genetic technologies has further exacerbated the consolidation of agriculture by increasing barriers to the use and development of agricultural biotechnologies by any but the largest companies. This is because of the obvious barriers to use and development that a private patent creates, but also because the development of a GE product requires the use of a large number of technologies, each of which may be patented. Control of these technologies through patent ownership or through licensing often can only be had by the largest companies, such as Monsanto, Syngenta, and Dow.[224]

The regulatory framework for GE crops in the United States has provided little resistance to the patenting of genetic and agricultural resources, largely because oversight is fragmented across the three responsible agencies and because agency attitude has been permissive instead of skeptical. Currently, regulation of GE crops falls to three agencies: the U.S. Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the USDA.[225]

Because of the relatively permissive agency attitude, GE crops have become widely adopted in the United States: 93 percent of soybeans, 86 percent of corn, and 93 percent of cotton planted in the United States in 2010 was genetically modified, and GE canola, squash, papaya, alfalfa, and sugar beet were also widely planted.[226] As of May 12, 2010, seventy-nine GE crops were granted non-regulated status, covering fifteen species and including smaller-volume crops such as beets, chicory, plums, and flax.[227]

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224. *See* Richard C. Atkinson et al., *Public Sector Collaboration for Agricultural IP Management*, 301 SCIENCE 174, 174 (2003).

225. ALAN MCHUGHEN, AGRICULTURAL BIOTECHNOLOGY IN CALIFORNIA SERIES, PUB. NO. 8179, PLANT GENETIC ENGINEERING AND REGULATION IN THE UNITED STATES 1, 2–3 (2006).

226. *Adoption of Genetically Engineered Crops in the U.S.*, USDA ECONOMIC RESEARCH SERVICE, http://www.ers.usda.gov/Data/BiotechCrops/alltables.xls (last updated July 1, 2010); *ISAAA Brief 41-2009: Executive Summary*, INTERNATIONAL SERVICE FOR THE AQUISITION OF AGRI-BIOTECH APPLICATIONS, http://www.isaaa.org/resources/publications/briefs/41/executivesummary/default.asp (last visited Feb. 18, 2011).

227. *Petitions of Nonregulated Status*, *supra* note 206.

a. Regulatory fragmentation regarding genetically engineered crops

A fragmented regulatory system has failed to mitigate similar concentration in the manufacturing of GE crops. The rate at which these GE crops have been adopted into the market is quite remarkable. According to the USDA's Economic Research Service:

> HT [herbicide-tolerant] soybeans expanded to 93 percent of U.S. soybean planted acreage, HT cotton reached 78 percent of cotton acreage, and HT corn expanded to 70 percent of the corn acreage in 2010. Adoption of insect-resistant (Bt) crops, containing the gene from a soil bacterium Bacillus thuringiensis (Bt), has also expanded. Use of Bt cotton reached 73 percent of planted cotton acreage in 2010 and Bt corn use grew from about 1 percent of corn acreage in 1996 to 63 percent in 2010.[228]

The prevalence of these GE crops in our food production markets begs the question: What are the advantages and possible risks of such widespread adoption of this technology? Farmers cite increased yields, less management time, and lower pesticide costs as the top three reasons for using GE crop varieties.[229] There is no doubt that this technology has allowed more food to be available for a lower cost to the American public. Why, then, is there so much controversy about GE crops in the first place? One concern raised by scientists and environmental groups is the risk of creating resistance among pest populations.

When agricultural biotechnology first came onto the scene in 1983 there were no laws to govern its production and distribution. The Reagan administration responded to this issue by commissioning the Coordinated Framework for Regulation of Biotechnology ("Coordinated Framework") in 1986. The Coordinated Framework did not enact any new laws, and instead fit the regulation of GE crops into existing laws and split the responsibility of regulation between the FDA, the EPA, and the USDA.[230] While this type of inter-agency cooperation may sound good in theory, the result has undoubtedly been

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228. *Agricultural Biotechnology: Adoption of Biotechnology and Its Production Impacts*, USDA ECONOMIC RESEARCH SERVICE, http://www.ers.usda.gov/Briefing/Biotechnology/chapter1.htm (last updated July 1, 2010).

229. *Id.*

230. Rebecca Bratspies, *Some Thoughts on the American Approach to Regulating Genetically Modified Organisms*, 16 KAN. J.L. & PUB. POL'Y 393, 405–06 (2007) [hereinafter Bratspies, *Thoughts on the American Approach*].

a piecemeal and all together ineffective regulation of the agricultural biotechnology market.

The Coordinated Framework claimed to seek out a "balance between regulation adequate to ensure health and environmental safety while maintaining sufficient regulatory flexibility to avoid impeding the growth of an infant industry."[231] Its purpose was to ensure that the regulation of GE crops adequately considered the health and environmental safety consequences of biotechnology as it moved from the lab to the marketplace. *Unfortunately the adoption of theories such as "substantial equivalence" and "generally regarded as safe" (GRAS) has led the Coordinated Framework to fail at both of its underlying goals.*

Based on the choice to fit regulation of GE crops into existing law, these delegations make perfect sense, but as experience has shown us the lack of cooperation and coordination between the agencies has led to a system in which no one agency can effectively carry out its purported goal. The following Subsections explain how each agency is currently regulating GE plants and why that regulation is allowing production corporations essentially to operate without limits.

(I) THE FDA

The process begins with the FDA. Under the Federal Food, Drug, and Cosmetics Act, the FDA is charged with protecting the food supply from being adulterated from food that contains "any poisonous or deleterious substance which may render it injurious to health."[232] Additionally the FDA can regulate food additives, which are defined as substances that are intended for use in food that may reasonably be expected to become a component of food, or may otherwise affect the characteristics of food.[233] The FDA must approve food additives before they are used in food, and both the gene inserted into a GE plant and the product itself are food additives under the FDA's definition.[234] While this should allow the FDA to effectively control GE food crops and protect against any harmful effects they may have, in practice it has not.

One of the main problems is that food additives that are GRAS do not require approval before being used in food. The food additive

231. Coordinated Framework for Regulation of Biotechnology, 51 Fed. Reg. 23,302–23,303 (June 26, 1986).

232. 21 U.S.C. § 342(a)(1) (2006).

233. Bratspies, *Thoughts on the American Approach*, *supra* note 230, at 408.

234. Mandel, *supra* note 54, at 2218.

manufacturer, and not the FDA, determines whether an additive is GRAS. Additionally the manufacturer is not required to report a GRAS determination to the FDA, but may choose to do so in order to receive an affirmation that the particular additive is GRAS.[235] The FDA chose to proceed in such a manner based on its own determination that GE food crops are the substantial equivalent of conventional crops, a decision that severely limits the scope of its review of such crops. "Substantial equivalence" categorizes GE food crops as variations of traditional foods with no increased safety risks.[236]

The result of these decisions is a system in which the FDA's regulatory requirements for GE foods are almost entirely voluntary. In 1995, the FDA conducted a safety review of the Flavr Savr tomato, the first GE food product to be commercialized, at the request of the manufacturer. Since then, the FDA has not conducted any safety reviews of the many new GE food products that have entered the market, maintaining instead that they believe manufacturers have voluntarily consulted with it for each of these new products.[237] The FDA has waived regulatory authority over any GE pest-protected plant, so long as it has not been modified to express any non-pesticide proteins. The EPA regulates these types of plants as pesticides.

(II) THE EPA

All pesticides must be registered with the EPA prior to distribution, use, or sale under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).[238] Registration requires a demonstration that the pesticide will not cause an unreasonable adverse risk to man or the environment.[239] The EPA also has the authority to exempt pesticides from registration if they determine them "to be of a character which is unnecessary to be subject to [FIFRA] in order to carry out the purposes of [FIFRA]."[240] The EPA has exempted all plants with pesticidal properties from the requirements of FIFRA, so although they do regulate the inserted genetic material and the product it expresses, they do not regulate the actual plants. The EPA can also regulate pesticides that will leave any residue on food, but they have exempted all FIFRA-

235. *Id.* at 2219.
236. Bratspies, *Thoughts on the American Approach*, *supra* note 230, at 408.
237. Mandel, *supra* note 54, at 2219.
238. 7 U.S.C. § 136a (2006).
239. §§ 136(bb), 136a(c)(5)(C).
240. § 136w(b).

registered, pest-protected plants from this requirement based on the lack of a demonstrated human-health risk.

This regulatory process results in a system where the EPA essentially signs off on pest-protected plants after they have been registered. There is no way for the EPA to track where the crops have been planted or if the plants are causing any unanticipated damage to the environment. Concerns have been raised about the cross-contamination of wild crops and pollen drift affecting riparian areas far from sites where pest-protected crops are actually planted. As discussed earlier, the more exposure insect populations have to certain pesticides, the higher the chance they will develop immunity to the compound. Concerns are not limited to pesticide-protected plants, either. A recent study in North Dakota found that over 80 percent of wild canola tested contained one of two herbicide-resistant genes.[241] These types of studies raise the question of how easily these traits can be passed to wild species and could signal the emergence of superweeds that could prove highly detrimental to local agriculture. The EPA's regulatory authority does not extend to plants without pesticide-like properties, so it would be the job of the USDA to address concerns related to herbicide-resistant plants.

(III) THE USDA

The USDA is responsible for evaluating the risk that a novel organism will pose a plant-pest risk when introduced to the environment or interstate commerce. Under the PPA, the USDA regulates "organisms and products altered or produced through genetic engineering that are plant pests or are believed to be plant pests" through the Animal and Plant Health Inspection Service (APHIS).[242] The USDA has chosen to interpret this regulation narrowly and treats GE crops exactly like conventional crops, evaluating them for the same risks associated with conventional crops. This means that the USDA does not consider whether planting an herbicide-resistant crop is likely to spread the trait of resistance to other species or whether there is a risk of pollen-drift contamination to non-GE crops.[243] Additionally, plant producers do not need permits to field test GE crops but instead need simply to notify the USDA of the tests. Once tested, producers can apply for non-regulated status and approval for commercial sales.

241. Rachel Bernstein, *Genetically Modified Crops Pop Up in the Wild*, L.A. TIMES, Aug. 13, 2010, at A19.

242. 7 C.F.R. §340.0(a)(2) n.1 (2010).

243. Bratspies, *Thoughts on the American Approach*, *supra* note 230, at 412.

Non-regulated status ends APHIS' oversight of the crop, and once again there is no way to track or monitor the GE crops that are being planted.[244]

b. Initial judicial responses to regulatory fragmentation

(I) *MONSANTO CO. V. GEERTSON SEED FARMS*

In *Monsanto Co. v. Geertson Seed Farms*,[245] the Supreme Court waded into the regulatory quagmire of GE crops.[246] Monsanto had developed a transgenic alfalfa resistant to their glyphosate herbicide Roundup (creating RR Alfalfa), and had petitioned the USDA to deregulate it so that it could be planted in outdoor trials. The USDA branch in charge of plant pest regulation, APHIS, complied and deregulated the alfalfa. In making its deregulation determination, APHIS is obliged to comply with the National Environmental Policy Act (NEPA),[247] which requires the filing of an environmental impact statement (EIS). However, if a shorter statement, known as an environmental assessment (EA), finds that the action will not have a significant environmental impact, a full EIS need not be completed. This was done in the present case. Conventionally grown alfalfa farmers and environmental groups challenged APHIS' deregulation as a violation of NEPA.

The District Court held for petitioners that APHIS violated NEPA by not completing a full EIS and granted an injunction on the planting of the alfalfa.[248] The Ninth Circuit upheld the lower court's decision.[249] The Supreme Court, however, reversed the permanent injunction, holding that the factors necessary for granting an injunction were not supported, and most importantly that respondents could not show that they would be irreparably harmed if a partial deregulation was enacted until the completion of the EIS. The Supreme Court felt that the remedy of a permanent injunction was overkill, and that impossibility of sale of the alfalfa under a partial deregulation was a sufficient remedy.[250] Thus, while the requirement of a complete EIS for full deregulation of GE

244. Mandel, *supra* note 54, at 2226.

245. 130 S. Ct. 2743 (2010).

246. *Id.* at 2749-50.

247. National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4370f (2006).

248. *Geertson Seed Farms v. Johanns*, No. C-06-01075-CRB, 2007 WL 518624, at *12 (N.D. Cal. Feb. 13, 2007) (unpublished).

249. *Geertson Seed Farms v. Johanns*, 570 F.3d 1130, 1141 (9th Cir. 2008).

250. *Monsanto*, 130 S. Ct. at 2753–54, 2757.

crops was maintained, the general permissive authority of the agencies to regulate such crops was upheld.

(II) *CENTER FOR FOOD SAFETY V. VILSACK*

In the first post-*Geertson* decision dealing with the environmental impact of GE crops and available remedies, a federal district judge in the Northern District of California recently vacated the APHIS decision to deregulate (or approve for planting) genetically modified sugar-beet seeds in *Center for Food Safety v. Vilsack*.[251] The district court's order once again made GE sugar-beet seeds a "regulated" article under the PPA, precluding their planting until APHIS complied with NEPA by preparing a valid EIS or issued permits or other partial deregulation to allow planting of the GE sugar beets.[252]

This case suggests that there may be an emerging judicial willingness to restrict the planting of GE seeds until the environmental impact has been assessed. To the agrichemical companies, this could put in place costly regulatory hurdles for GE seed in the United States. However, the court ruled that *Geertson* precluded them from issuing an injunction placing additional limits on APHIS's ability to regulate the planting of GE seed before completion and submission of an EIS.

Earlier in 2010, the district court ruled that despite the plaintiffs' likely success on the merits and their demonstration that they would likely be irreparably harmed from seed contamination if an injunction was not issued, a preliminary injunction was *not* warranted because of the plaintiffs' five-year delay in seeking an injunction as well as the industry's overwhelming conversion during that period to GE sugar-beet seeds. The court did warn the defendants that its decision on the preliminary injunction was not dispositive on the plaintiffs' request for a permanent injunction and that the defendants should "take all efforts, going forward, to use conventional seed."[253]

Between the denial of the plaintiffs' request for a preliminary injunction and the August 2010 hearing on remedies, the Supreme Court announced its opinion in *Geertson*.[254] In light of the *Geertson* ruling, the district court vacated APHIS's deregulation order and remanded the case back to APHIS for further consideration.[255]

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251. *Ctr. for Food Safety v. Vilsack*, 734 F. Supp. 2d 948, 949 (N.D. Cal. 2010).

252. *Id.* at 950, 955.

253. *Id.* at 950.

254. 130 S. Ct. 2743 (2010).

255. *Ctr. for Food Safety*, 734 F. Supp. 2d at 950.

The district court then held that a permanent injunction preventing the planting of the GE seeds was unnecessary and inappropriate, holding that *Geertson* prevented the issuance of an injunction when a "less drastic remedy" was sufficiently able to redress the plaintiffs' injury.[256] On November 30, 2010, Judge Jeffrey S. White of the U.S. District Court for the Northern District of California issued an injunction ordering the destruction of hundreds of acres of GE sugar beets planted in violation of federal law, suggesting that planting GE crops during pendency of an EIS may have some bite.[257]

In sum, this decision reflects the increasing willingness of courts to require APHIS to prepare a formal EIS in advance of deregulating GM seeds—which could potentially slow down the approval process during the pendency of this review. The next likely skirmish in the GE seed context will probably focus on the question of whether a partial approval for planting from APHIS will protect conventional farmers from exposure to GE crops while required environmental reviews are conducted.

c. Power vacuum as a result of regulatory fragmentation

The failures of the Coordinated Framework are not limited to the shortfalls of each individual regulatory agency in their respective role. As a whole, the Coordinated Framework does not address the reality that GE crops are vastly different from the organisms that existed when the laws currently being used to regulate were created. Many GE products fall into multiple categories that would put them under the review of multiple agencies, and the current system simply ignores these issues. Each agency focuses only on what it needs to regulate and makes decisions without thinking of how it could affect another agency's ability to regulate. All of the agencies involved lack the scientific expertise to grasp the potential risks and adverse effects GE crops could have on the environment, and these concerns are simply never raised. The lack of tracking on every level means that no agency can ensure compliance with even basic regulations, let alone address novel issues as they arise. Lastly, the voluntary nature of participation in some of the regulation creates absolutely no incentive for companies to do additional research or have consistent reporting mechanisms because of the potential for unfavorable data to emerge.

This fragmented regulation brings up an important question: Who has the power here? The short answer is the agrichemical industry. It is

256. *Id.* at 954.

257. *Id.* at 955.

clear from the above discussion that the regulatory agencies have very little control over GE crops, and much of that stems from their own decisions about how to proceed with their own regulatory authority. In most other fields this wouldn't be so alarming. Scientists independently test chemicals and pesticides to fully understand the potential risks and benefits associated with each one. This type of testing does not occur in the GE agriculture industry. Patent protection has given companies such as Monsanto, Pioneer, and Syngenta the power to require that all users of their products sign end-user agreements. These agreements ensure that each company's intellectual property is protected from replication and theft. However, these companies have also used these agreements to forbid the use of any seed for independent research.[258] Any research on GE seeds that is published is at the behest of the company who owns the seed. If experiments reveal undesirable results, they will never be published. If a scientist is perceived as hostile to the industry, they will never be granted permission to conduct any research. The lack of transparency behind the corporate veil is troubling particularly when considering the public's interest in the stability and quality of global food supply.

3. LOGISTICS AND LABOR

a. Logistics

Major technological innovations in transportation and communications enable the movement of vast quantities of agricultural commodities around the globe. The growing dependence on distant food sources has supplanted in many ways considerations of local, regional, or national food supply and security. These emerging global food markets concentrate power in the hands of transnational corporations that make decisions based on the logistics of the corporate bottom line.

> In terms of infrastructure, Cargill is exceptionally adept in the storage, handling and transportation of agricultural goods and food commodities. . . .
>
> Within North America, as illustrated by Cargill over the 20th century, the key to power in transportation is the consolidation of storage (e.g., grain elevators) along major waterways and continental railways. Besides inland storage along the Mississippi River and other rivers leading to the

258. Op-Ed., *A Seedy Practice*, SCI. AM., Aug. 2009, at 28.

> Atlantic and Pacific coasts, the major ports for grain and food exports also are in the hands of very few agribusiness corporations, namely Cargill and ADM. . . .
>
> These firms are reproducing the same infrastructure in South America and East Asia. In Brazil four transnationals control virtually all crushing capacity, an activity which until the '90s had strong national capital participation. In many States these firms hold complete monopoly positions.[259]

What this has meant is that consolidation and rationalization have been applied repeatedly to agricultural transportation infrastructure, resulting in higher costs to governments for road maintenance, higher costs to farms surviving consolidations for transportation, a smaller tax base, and disappearing rural communities.

b. Labor

The transformation of the traditional farmer (peasant, small farmer, or family farmer)—with the assumption that significant labor and management inputs arose from within and were supplied by the family—was accompanied by the loss of input into decisions regarding labor, planting, and management decisions. However, due to many of the transformations discussed in this Article, farmers have been losing power over decision-making with respect to production contracts and bundled arrangements of seeds and chemicals and may not even be in control of the labor of family members. Today these decisions are being made by agro giants who decide the type of crops, the chemical input methods, and the timing of harvest; farmers now merely provide the labor and land.

There have been and continue to be sharp tensions between waged labor, non-waged labor, and family. These tensions are exacerbated when immigrant labor in a country such as the United States is composed of many former small farmers. These workers were forced out of farming in their home countries because of a variety of push-and-pull factors that have structural ties to globalization, including consolidation of former subsistence farms and implementation of industrial agricultural technologies, including genetic engineering.

While the introduction of industrialized farming has reduced labor-intensiveness, there are still labor-intensive agricultural systems, such as those for vegetables which demand large amounts of labor at particular phases of the growing season. Additionally, there are deep

259. HENDRICKSON ET. AL., *supra* note 4, at 24.

and recurrent tensions between organized labor and farmers, making traditional labor organizing hard. The movement away from formalized labor arrangements entails a movement from waged to non-waged arrangements based on piece-work reimbursement and deskilled, non-union jobs.

Reducing labor costs is a key profit strategy in the emerging agrifood system—sourcing labor to the cheapest parts of the globe and exploiting the legally uncertain status of farming and processing workers that prevent them from organizing. There is little protection domestically for agricultural laborers, and even less internationally. Keeping agricultural labor cheap is a classic strategy to deal with the squeeze of declining prices and rising costs.

There are some steps that may be taken to alleviate the structural disadvantage of agricultural laborers. The first may be alliances with labor unions in more powerful positions, such as dockworkers in the United States. Additionally, protection from forced arbitration in production contracts is important. The possibility for protection of agrifood laborers could mark an expansion of fair trade and other consumer-labeling and certification strategies that have had a measure of success in differentiating coffee markets. Finally, and this cannot be stressed too strongly, there must be meaningful and substantive reform of U.S. immigration laws premised on the ability of labor to migrate freely to where work is, removing the stigma born by undocumented agricultural laborers from living and working in the "shadows" and making them vulnerable to exploitation and abuse.

Agricultural economist Herman Daly has argued that we need to fundamentally rethink economic scarcity. Daly suggests that natural resources may be the truly scarce ones and labor may be an abundant resource. Natural resources, phosphate, nitrogen, and other chemicals on which industrialized agriculture depends are being allocated by corporations, as land and water are being purchased by investment funds.[260] Hendrickson and her colleagues depict the price-cost squeeze on farmers thusly:

> In the U.S., projected seed costs per acre will double next year [2009] for corn, and cash rents will skyrocket at a time when Midwestern maize farmers already need $4.50/bushel to break even. Despite recent highs in the futures markets, the

260. *See* Herman E. Daly, *From Empty-World Economics to Full-World Economics: Recognizing an Historical Turning Point in Economic Development*, *in* POPULATION, TECHNOLOGY, AND LIFESTYLE: THE TRANSITION TO SUSTAINABILITY 23, 32 (Robert Goodland, Herman E. Daly & Salah El Serafy eds., 1992).

> fall price for maize will likely be somewhere near $5–$6/bushel – a decent living this year, but perhaps not next year.
>
> . . . The cost of petroleum, in the three major ingredients used in fertilizers, the cost of seed and the cost of highly productive cropland have risen sharply. The cost of fertilizer in the Midwest has more than doubled in the last four years. A recent study . . . indicates that the cost of fertilizer for Illinois corn farmers was $118 per acre. They estimate that the cost for 2009 will rise to $215 . . . [and] estimate that all non-land costs for producing corn in 2008 is $388 per acre. . . . [and] that it will rise to $529 per acre in 2009.[261]

This augurs a global rush that is already underway for buying large tracts of land, water rights, and fertilizer ingredients by firms that have heretofore not been engaged in agriculture, further shifting control of these resources away from the farmers who work the land and grow the crops.

IV. THE FUTURE?

A. Farmers' Rights under the ITPGR/FA

The issue of farmers' rights under the ITPGR/FA squarely raises the issue of the legitimacy of intellectual property rights in agricultural crops. Farmers' rights also questions the benefits reaped historically and contemporaneously by the global North at the expense of the biodiversity of the global South.[262]

The concept of farmers' rights was an idea proposed by a Canadian nongovernmental organization, the Rural Advancement Foundation International (RAFI). It theoretically would allow farmers to receive compensation from an international genetic conservation fund to be administered by the U.N. Food and Agriculture Organization (FAO).[263] In 1985, RAFI's proposal of the concept was meant to embody concerns over genetic erosion and the North-South "gene drain."[264] As envisaged by RAFI, farmers' rights were a new type of

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261. *Id.* at 35.

262. *See supra* Part I.A (discussing corrective justice and the relationship between the developing and developed world).

263. *See* Helfer, *supra* note 22, at 37.

264. *See* Sell, *supra* note 104, at 206 n.50.

collective intellectual property rights, meant to counter plant-breeders' rights (PBRs).

Farmers' rights advocates focused on the following four issues: (1) the right to grow, improve, and market local varieties and their products; (2) the right to access improved plant varieties and use farm-saved seeds of commercial varieties for planting and exchange; (3) the right to be compensated for the use of local varieties in the development of new commercial products by outsiders; and (4) the right to participate in decision-making processes related to acquiring, improving, and using plant genetic resources.[265]

In 1989, the FAO adopted a new interpretation of the 1983 International Undertaking on Plant Genetic Resources that declared that PBRs were compatible with common heritage and also recognized the principle underlying farmers' rights: that most of the world's valuable germplasm came from the developing world, that it was the result of thousands of years of selection by farmers, and that some form of compensation should be paid for its use.[266] However, neither the international fund nor farmers' rights crystallized in the period following 1989, in large part because contributing to the fund was voluntary.

The claim for compensation by proponents of farmers' rights has a dimension of a corrective-justice claim for reparations.[267] However, as Mari Matsuda has pointed out, under the Anglo-American legal system, the further an individual or group's claim for reparations strays from the clearly defined individual plaintiff (or group of plaintiffs) versus a clearly defined defendant (or group of defendants), the harder it becomes to conceive of, let alone argue for, concrete reparations.[268] On

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265. Kirit K. Patel, *Farmers' Rights over Plant Genetic Resources in the South: Challenges and Opportunities*, *in* INTELLECTUAL PROPERTY RIGHTS IN AGRICULTURAL BIOTECHNOLOGY 95, 96 (F.H. Erbisch & K.M. Maredia eds., 2004).

266. Annie Patricia Kameri-Mbote & Philippe Cullet, *The Management of Genetic Resources: Developments in the 1997 Sessions of the Commission on Genetic Resources for Food and Agriculture*, 1997 COLO. J. INT'L ENVTL. L. & POL'Y 78, 83–84 (1997).

267. *See, e.g.*, ERIC K. YAMAMOTO ET AL., RACE RIGHTS AND REPARATION: LAW AND THE JAPANESE AMERICAN INTERNMENT (2001) (discussing the many dimensions of reparations claims); Robert Westley, *Many Billions Gone: Is It Time to Reconsider the Case for Black Reparations?*, 40 B.C. L. REV. 429 (1998) (comparing Japanese American redress claims, claims by survivors of the Jewish Holocaust, and claims made before the South African Truth and Reconciliation Commission).

268. Mari J. Matsuda, *Looking to the Bottom: Critical Legal Studies and Reparations*, 22 HARV. C.R.-C.L. L. REV. 323, 373–76 (1987) (arguing that survivors of the Japanese American Internment seeking redress in the 1980s were well advised to make their claims resemble the corrective-justice "plaintiff v. defendant" model in order to secure redress for the internment). The ongoing and so far unsuccessful claims

an abstract level, it is hard, if not impossible, to deny the creative human agency and labor that went into selecting and breeding the wild species that have become part of the staple crops comprising the human diet.[269] However, on the level of a specific varietal crop, while it may be possible to do a detailed molecular biological map of a crop genome,[270] numerous problems attend the assignation of compensation for any particular trait, not the least of which is the relatively recent rise of the modern nation-state[271] and the peripatetic propensity of individuals and groups to migrate repeatedly, diffusing crops throughout the world.

"Farmers' Rights," as incorporated into the ITPGR/FA, is an attempt to acknowledge the intergenerational dimension of the development, diffusion, and improvement of agricultural crops. However, given economic, social, technological, and legal changes in the treatment of agricultural-plant genetic resources, one may wonder if acknowledgement of farmers' rights in a treaty that places responsibility for recognizing and implementing them (if at all) on the member nations is a sop that closes the barn door long after the animals have escaped from the barn.

However, rather than looking retrospectively under a corrective-justice rubric at farmers' rights, meaningful intergenerational steps may be taken to conserve agricultural-plant genetic diversity by focusing on and critiquing the current state of the global food system, and by taking meaningful prospective steps using a distributive-justice analysis to address the striking levels of horizontal and vertical concentration that have arisen in this area over the past three decades. While intellectual property rights may be a piece of the puzzle, they may not be the

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for reparations by African Americans for slavery demonstrate the difficulty of making corrective justice claims when *both* the wrongdoers and victims of such wrongdoing are no longer living. While not impossible, it is possible to ground such claims in deontological or utilitarian claims. *See generally* YAMAMOTO ET AL., *supra* note 267, at 24–25; Irma Jacqueline Ozer, *Reparations for African Americans,* 41 HOW. L.J. 479, 495 (1998); Eric K. Yamamoto, *Racial Reparations: Japanese American Redress and African American Claims*, 40 B.C. L. REV. 477, 488–90 (1998).

269. *See generally* BRUSH, *supra* note 2; KLOPPENBURG, *supra* note 3; FOWLER & MOONEY, *supra* note 171.

270. Molecular biology gives us strong evidence of varied provenance of modern seeds. However, how this evidence is tied into the issues of the ill-gotten gains from centuries of colonialism is another matter. *See* KLOPPENBURG, *supra* note 3, at 55 n.4.

271. *See* BENEDICT ANDERSON, IMAGINED COMMUNITIES: REFLECTIONS ON THE ORIGIN AND SPREAD OF NATIONALISM 37–46 (rev. ed. 2006) (discussing the rise of the modern nation-state).

pivotal piece in addressing questions of intergenerational equity and conservation of plant genetic diversity in the future.

B. Loss of Food Sovereignty

Decision-making affecting food policy over the past twenty years has increasingly moved from public fora to private boardrooms—where profit maximization is the primary goal. To the extent that government policies were implicated, the federal government got out of mandating supply management for commodities—such as corn production—when it began subsidizing maximum corn production from the 1970s on. Companies like ADM and Cargill had access to an ever-growing supply of cheap, subsidized corn with which they made products like high-fructose corn syrup and flooded the Mexican market, driving subsistence farmers off the land and often northward across the U.S. border searching for jobs.[272]

These changes in the decision-making framework related to global agrifood policy have implications for biodiversity, global rural development, and public health. Over 40 percent of the world's population has a daily income of less than $2 per day (eight hundred dollars a year), and food corporations that are determined to increase profit margins do not focus on the poor because they can cater to the affluent with disposable incomes of tens or hundreds of thousands of dollars to spend.

An important question is whether the global agrifood system is so important that it requires special policies and rules. At the very least, the ITPGR/FA suggests that some special rules and dispensations must be made, as do some implications of the 1992 Rio Biodiversity Treaty. However, these treaties have distinct tensions with multilateral trade agreements such as TRIPS. Brazil and India, leading a group of more than twenty countries, are pushing the WTO to consider how food is different than other commodities exchanged in the world economy. Some of this agitation took place at the 2003 Cancun WTO ministerial, where staunch opposition to U.S. corn-industry subsidies was voiced, particularly in light of the decimation of the Mexican corn industry by subsidized U.S. imports.

Food sovereignty is a crucial issue. However, for the most part the United States has insisted and promoted the idea that the market will be the mechanism that decides the where, what, how, and who of food production. But that idea is under challenge, and criticism by a diverse

272. BILL ONG HING, ETHICAL BORDERS: NAFTA, GLOBALIZATION, AND MEXICAN MIGRATION 12–14 (2010).

number of food movements around the world. These groups view the issue of food sovereignty of farmers as:

> [A]n overarching framework or paradigm employed by civil society groups to reclaim land, territory and human dignity. . . . The call for food sovereignty . . . is also a plan for prioritization of food production for local and national markets through authentic agrarian reform and sustainable, agro-ecological practices. . . . [and] include[s] the recognition and enforcement of the right to food and the right to land; the right of each nation or people to define their own agricultural and food policies, (including) the right of indigenous peoples to their territories and the rights of traditional fisherfolk to fishing areas.[273]

The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)[274] has found that agricultural productivity has increased in such areas of the globe such as North America and Europe. However, the increase in agricultural productivity has brought attendant public-health problems—too much of the wrong types of food are being produced, leading to an epidemic of diet-related diseases. Additionally, by obsessively focusing on agricultural productivity, important issues of rural development, erosion of soil, water quality, biodiversity reduction, or even meaningful immigration law reform are ignored.

The central problem is that farmers and rural communities are currently enmeshed in a global food-production system that has had the tendency to suck capital and natural resources from some areas of the globe and redistribute them in wealthier areas. This means that there is insufficient capital and wages in areas that could be used to reinvigorate rural agricultural communities and economies. However, an industrialized, consolidated, agricultural economy producing for global

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273. HENDRICKSON ET AL., *supra* note 4, at 31 (quoting La Via Campesina et al., *Agrarian Reform in the Context of Food Sovereignty, the Right to Food and Cultural Diversity: "Land, Territory and Dignity," in* INTERNATIONAL CONFERENCE ON AGRARIAN REFORM AND RURAL DEVELOPMENT (Civil Society, Issue Paper No. 5, 2006)).

274. The IAASTD was created and sponsored by the U.N. Environmental Program, UNESCO, WHO, FAO, the World Bank and other global agencies to assess ways that agriculture and agricultural technology could contribute to alleviating poverty, eliminating hunger, and maintaining sustainable rural livelihoods around the globe. *See Overview and Structure*, INTERNATIONAL ASSESSMENT OF AGRICULTURAL KNOWLEDGE, SCIENCE AND TECHNOLOGY FOR DEVELOPMENT, http://www.agassessment.org (last visited Mar. 20, 2011).

markets may not be the best development strategy for rural communities, as North America and Europe demonstrate. In the emergent global agricultural economy, small-owner agriculture is being rapidly replaced by production-contract industrialized agriculture with control, management, and capital residing in distant locations.

CONCLUSION

The contemporary global agrifood system is capital intensive, centralized, and consolidated, sourcing labor and natural resources where they are cheapest and selling where they bring the highest prices. In markets for other goods, if people can't generate a demand, they go without the particular good.

Food is different. Food is needed on a regular basis. There may be pressure points in the emerging food agrifood system where farmers, rural communities, consumers, and activists may be able to leverage more equitable positions. However, it is far from certain that decision-makers will recognize that the food system is different from other commodities and that it needs different policies and rules, ranging from immigration to intellectual property to antitrust, so as to ensure that a modicum of distributive equity is included in decisions affecting food production.

The centralized global food system that is emerging was never a product of democratic deliberation but has been the product of deliberate decisions made by a very few powerful actors. This is not the only system that could emerge. If today is not the time to ask some critical questions about our food system and about what it is in the best interest of this and future generations, then when is?