Pollen Drift: Reframing the Biotechnology Liability Debate

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Abstract

The advent of genetic engineering and its application to agriculture has transformed the rural landscape at a microscopic level. A cursory glance of current production fails to reveal the underlying legal tensions at work in post-modern agriculture. The seemingly natural and necessary event of drifting, sexually viable pollen, however, implicates legal rights and responsibilities at the farm level with a ripple effect felt throughout the international commodity food and feed supply chain. Despite the ubiquitous nature of agricultural biotechnology, disputes arising from simple pollen drift lack a clear legal doctrine to define the multitude of subjects implicated, including tort liability, contracts, and administrative law.

Although others have discussed the limits of traditional tort doctrine as applied to pollen drift events, to enhance the accuracy of the debate, this Article evaluates actual cost and return data from GM and non-GM farmers to highlight the true nature of the assignment of burden and benefit these legal doctrines impose. We argue that social welfare maximization requires, in the instance of pollen drift, legislative assistance in the design of efficient liability rules. We further suggest that, with respect to liability rules, care must be taken to distinguish unilateral and bilateral accidents, with the ultimate goal of minimizing the total costs of preventive action of both parties in light of the expected damage. This could be done on the premises of negligence and the least-cost avoider theory, a result that shares the liability burden amongst conventional and GM farmers alike.

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I. INTRODUCTION

In addition to irritating allergy sufferers, pollen is an essential aspect of agricultural production. Without pollen, food in its current form would cease to exist as we would be reduced to harvesting delicacies such as algae for dinner. A single stalk of corn will release on average 25 million grains of pollen, drifting in the wind in search of a mate to produce a kernel of corn.[1] With a projected 90 million acres of corn[2] in the United States alone, the amount of pollen floating about is staggering. Pollen, unfortunately, does not observe artificial boundary lines and the formalized rules of property law such as trespass or nuisance. Rather, viable pollen is captive to the capriciousness of the

1. Martin Bohn, Pollen Drift and Its Impact on Gene Flow Between GMO and Non-GMO Cultivars 5 (2003) (on file with authors) (citing JEAN EMBERLIN, THE DISPERSAL OF MAIZE POLLEN (1999)).

2. ECON. RESEARCH SERV., U.S. DEP'T OF AGRIC., USDA AGRICULTURAL PROJECTIONS TO 2016, at 21 (2007), *available at* http://www.ers.usda.gov/ersDownloadHandler.ashx?file=/media/197549/oce20071_1_.pdf (projecting corn acreage to reach 90 million by 2010).

wind and other atmospheric conditions.[3] This freedom of movement, important in a biological sense for genetic diversity, nonetheless presents a problem for the farmer seeking to plant and harvest a crop free of genetically modified ("GM") organisms and the attendant food/feed supply chain attempting to coexist with a commodity-based, international grain market.[4]

The farm gate economic value[5] of these pollinated corn plants exceeds 30 billion dollars annually.[6] Identity preserved corn (i.e., corn that must be protected from cross-pollination with other varieties), such as organic, constitutes approximately seven percent of U.S. corn acres.[7] Although relatively small in acreage, the identity preserved corn harvest commands a significant price premium to account for the difficulties and risk entailed in producing a genetically pure product.[8] The price premium enjoyed by organic crops is an important factor offsetting lower yields, a relationship that will be explored with empirical data later in the paper. As adoption of genetically engineered corn varieties expands, the potential for unwanted commingling and difficulty of producing a non-

3. F. Di-Giovanni & P.G. Kevan, *Factors Affecting Pollen Dynamics and Its Importance to Pollen Contamination: A Review*, 21 CAN. J. FOREST RES. 1155, 1158 (1991).

4. The most commonly accepted working definition of "coexistence" is from the Commission of the European Communities: "Coexistence refers to the ability of farmers to make a practical choice between conventional, organic and GM-crop production, in compliance with the legal obligations for labeling and/or purity standards." Commission Recommendation 2003/556, on Guidelines for the Development of National Strategies and Best Practices to Ensure the Coexistence of Genetically Modified Crops with Conventional and Organic Farming, Annex, 2003 O.J. (L189) 36, 39; *see also* A. Bryan Endres, *Coexistence Strategies in a Biotech World: Exploring Statutory Grower Protections*, 13 MO. ENVTL. L. & POL'Y REV. 206, 206–10 (2006) (discussing coexistence concepts in production agriculture).

5. The farm gate value is the pricing point of the product available at the farm, without the added costs of transport and delivery charges. *Glossary of Statistical Terms, Farm Gate Price*, ORG. FOR ECON. CO-OPERATION & DEV., http://stats.oecd.org/glossary/detail.asp?ID=940 (last visited May 7, 2014).

6. ALLEN BAKER & EDWARD ALLEN, U.S. DEP'T OF AGRIC., FEED SITUATION AND OUTLOOK YEARBOOK, at iii (2007), *available at* http://usda01.library.cornell.edu/usda/ers/FDS-yearbook//2000s/2007/FDS-yearbook-05-10-2007.pdf (noting the most recent yield of 10.5 billion bushels of corn with an average price of between $3.00 and $3.20 per bushel).

7. AZIZ ELBEHRI, U.S. DEP'T OF AGRIC., THE CHANGING FACE OF THE U.S. GRAIN SYSTEM 2 (2007), *available at* http://www.ers.usda.gov/ersDownloadHandler.ashx?file=/media/201679/err35_1_.pdf (noting the rise in identity preserved corn acres from 3% in 1995 to 7.2% in 2003).

8. *Id.* at 3. Some difficulties at the farmer level include a yield drag associated with a specialty variety, as well as additional production or segregation costs. *Id.* From the demand perspective, food processors and others are willing to pay a premium over conventional grain prices for trait-specific products to improve production and processing efficiency, enhance product value, or provide "credence" goods such as organically certified products. *Id.*

GM product likewise increase,[9] transforming the simple act of pollen drift into a liability inducing event with financial implications.

These issues have recently come into the international spotlight in a case that is the first of its kind. A farmer in Western Australia, Steve Marsh, is suing his neighbor, Michael Baxter, for financial damages and allegations of negligence and nuisance after nearly 70 percent of his 478 hectare farm lost its organic certification after it became contaminated with Baxter's GM canola material.[10] Baxter, on the other hand, claims that Australia's organic certifying body standards are unreasonable, and that he is farming on his land legally and should not have to compensate Marsh for his decertification.[11] At the heart of this case are two neighbors with conflicting land uses relying on an ill-equipped tort system to decide who should be responsible because they cannot sort out the issue between themselves.[12]

Although the above example is from Australia, the same scenario could just as easily occur in the United States. This Article seeks to demonstrate why the United States' tort system is not the most efficient way to decide similar cases of GM pollen contamination between farmers who share a common boundary, and why, using economic principles, the legislature is in the best position to regulate this type of conflict. In Part II, we place the liability problem of pollen drift into perspective by explaining how such instances occur and further explore its impact on the agricultural supply chain. We also examine the actual costs and returns of conventional (GM) and organic corn to help determine the true impact of different liability regimes and establish which liability regime best addresses the issue of pollen drift. Within the liability context, several commentators have addressed the intersection between modern biotechnology's application to agriculture and both tort and patent infringement liability from a doctrinal approach. In Part III we review and critique these proposed liability regimes. Our goal is to demonstrate the limits of traditional tort doctrines in pollen drift events. Part IV seeks to integrate principles of law and economics into the traditional analysis. In Part V we argue that social welfare maximization

9. A. Bryan Endres, Revising Seed Purity Laws to Account for the Adventitious Presence of Genetically Modified Varieties: A First Step Toward Coexistence, 1 J. FOOD L. & POL'Y 131, 131 (2005).

10. Colin Bettles, *Landmark GM Case Kicks Off*, FARM WEEKLY (Feb. 10, 2014, 1:00 AM), http://www.farmweekly.com.au/news/agriculture/cropping/general-news/landmark-gm-case-kicks-off/2687345.aspx.

11. *Australia Genetically Modified Crops Row Goes to Court*, BRIT. BROADCASTING CORP (Feb. 11, 2014, 3:46 AM), http://www.bbc.co.uk/news/world-asia-26116628.

12. Damien Carrick, *GM Contamination Test Case*, AUSTL. BROADCASTING CORP. (Feb. 4, 2014, 5:30 PM), http://www.abc.net.au/radionational/programs/lawreport/gm-case/5233804#transcript.

requires, in the instance of pollen drift, legislative assistance in the design of efficient liability rules modeled on the fence-in rule for division fences amongst neighboring landowners where one owner has livestock and the other does not.

II. THE SCIENCE AND ECONOMICS OF GM CROPS

A. GM Crops and Biotechnologies

It may be useful, at this stage, to introduce the main biotechnologies applied to agriculture. According to the Food and Agriculture Organization of the United Nations ("FAO"), there are three types of genetic modification methods:

> 1. "tweaking," in which genes already present in a plant's genome are manipulated to change the level or pattern of expression;
>
> 2. "close transfer," in which genes are transferred from one species to another of the same kingdom; and
>
> 3. "distant transfer," in which genes belonging to a species of another kingdom are transferred into a plant (e.g., bacteria genes into plants).[13]

The third method, perhaps, is the most prevalent genetic modification used in commercial agricultural production.[14] GM corn and cotton often are engineered to incorporate the *Bacillus thuringiensis* (Bt) bacterium—a species of another kingdom.[15] This bacterium, capable of producing specific proteins called δ-endotoxines, instills insecticidal properties within the plant, reducing, and often eliminating, the need for the application of additional insecticides. Another frequent

13. U.N. FOOD & AGRIC. ORG., THE STATE OF FOOD AND AGRICULTURE 2003–04, at 16 (2004), *available at* ftp://ftp.fao.org/docrep/fao/006/y5160e/y5160e.pdf.

14. *See id.* at 35. In 2004, the FAO observed:

> Almost two-thirds of the field trials in industrialized countries and three-quarters of those in developing countries focus on two traits: herbicide tolerance and insect resistance or a combination of the two traits together. Although insect resistance is an important trait for developing countries, herbicide resistance may be less relevant in areas where farm labour is abundant. In contrast, agronomic traits of particular importance to developing countries and marginal production areas, such as potential yields and abiotic stress tolerance (e.g. drought and salinity), are the subject of very few field trials in industrialized countries and even fewer in developing countries.

Id. (citation omitted).

15. Numerous patents have been filed, first for the use of the bacterium in topical sprays for pest control, and later for its introduction into genetically engineered plants such as maize, cotton, or rice.

biotechnology application is the introduction of genes conferring resistance to broad spectrum herbicides such as glyphosate or glufosinate. Some experts, however, argue that the introduction and widespread, indiscriminate use of Bt, glyhposate, or glufosinate is likely to hasten pest and herbicide resistance.[16] Although perhaps the most controversial genetic modification, and not currently used in commercial agriculture,[17] the insertion of Genetic Use Restriction Technologies (GURTs),[18] would most likely belong to the FAO's first category of genetic engineering—"tweaking." GURTs prevent the germination of second generation seed and thus serve as a "built in" prevention to seed saving and the attending violation of intellectual property rules.

B. Area Planted with GM Crops Worldwide

Genetically modified seeds are grown in more than 20 countries, on five continents, by 10.3 million farmers.[19] The total area planted with GM seeds has increased steadily from 80 million hectares ("ha") in 2004, to 175.2 million ha in 2013, up 5 million ha from 2012, indicating a three percent growth rate.[20] Since the initial introduction of GM crops in 1996, the United States has devoted more acreage to GM production than

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16. *See generally* Geertson Seed Farms v. Johanns, 2007 WL 518624, at *9–11 (N.D. Cal. Feb. 13, 2007) (discussing commentators' allegations of glyphosate herbicide resistance and ordering the agency to review the subject in its Environmental Impact Statement). Several articles discuss pest and herbicide resistance. *See* Ian Heap, *International Survey of Herbicide Resistant Weeds*, WEED SCI., http://www.weedscience.org/summary/home.aspx (last updated May 12, 2014) (tracking scientific studies of herbicide resistant weeds). To manage pest resistance to Bt technologies, the Environmental Protection Agency imposes permit restrictions on the seed developers, which are passed onto farmers, to plant non-Bt refuges to slow pest resistance to Bt. Compliance, however, can be a problem. Kay Shipman, *Refuge Compliance Down; Push Made to Reach Growers*, FARMWEEK, Jan. 14, 2008, at 1–2. With respect to herbicide resistance, researchers have documented several instances of weed resistance to Roundup, the trade name for glyphosate. *See* Heap, *supra*.

17. Richard Caplan, *The Ongoing Debate over Terminator Technology*, 19 GEO. INT'L ENVTL. L. REV. 751, 751 (2007) (noting that GURTs would, for instance, make seed saving nearly impossible).

18. GURTs can be split into two categories: V-GURTs, which are "restriction technologies at the variety level where the seed produced from the crop is sterile," and T-GURTs, which consist of "restriction technologies at the trait level where the seed produced from the crop is fertile and only expression of a high added-value trait requires a special treatment." *Position Paper of the International Seed Federation on Genetic Use Technologies (GURTs)*, SEEDQUEST (July 10, 2003), http://www.seedquest.com/News/releases/2003/july/6168.htm.

19. CLIVE JAMES, EXECUTIVE SUMMARY, BRIEF 46, GLOBAL STATUS OF COMMERCIALIZED BIOTECH/GM CROPS (2013), *available at* http://isaaa.org/resources/publications/briefs/46/executivesummary/pdf/Brief%2046%20-%20Executive%20Summary%20-%20English.pdf.

20. *Id.*

any other country (70.1 million ha in 2013),[21] followed by Brazil (40.3 million ha), Argentina (24.4), India (11.0), Canada (10.8), and China (4.2).[22] Brazil, although second worldwide in GM crop acreage, has witnessed the fastest growth over the first decade of biotech commercialization,[23] whereas India has shown the largest proportional (almost three-fold) increase from 2005 to 2006, surpassing China.[24]

The 102 million ha planted with genetically engineered crops in 2006, however, amounts to only 7.6 percent of the world's cropland.[25] Serious debate persists regarding the cost-benefit calculus of agricultural biotechnology, balancing scientific advancement with the political realities of each nation.[26] For example, despite their relatively advanced technological status, member states of the European Union (EU) grow only small amounts of GM plants. Indeed, from 1998 to 2003, the EU imposed a general moratorium on approval of new agro-biotech products, which eventually led to the establishment of a World Trade Organization Dispute Settlement Panel.[27]

As exemplified by the European experience, many sectors of the global food/feed supply chain demand segregation of product into GM/GM-free pipelines. As a result, coexistence strategies, from farm to fork, have been adopted along the supply chain to ensure delivery of

21. *Id.* at 4 fig.1.

22. *Id.*

23. *Id.* at 5.

24. *Id.*

25. *See* R. Lal & J.P. Bruce, *The Potential of World Cropland Soils to Sequester C and Mitigate the Greenhouse Effect*, 2 ENVTL. SCI. & POL'Y 177, 177 (1999) (noting total world cropland at 1338 million hectares).

26. Gordon Conway outlined many of the issues surrounding this debate in an address to the Organization for Economic Co-operation and Development, noting that the balancing of the benefits and risks of genetic engineering lies solely in the political arena. Gordon Conway, President, Rockefeller Found., Crop Biotechnology: Benefits, Risks and Ownership (Mar. 28, 2000), *available at* http://www.agbioworld.org/biotech-info/articles/biotech-art/conwayspeech.html. Although scientists can provide evidence of the likely benefits and hazards and the probability of occurrence, "in the end, politicians needs to decide . . . what each country's policy should be." *Id.*

27. On September 29, 2006, the Dispute Settlement Body issued the long-expected panel decision in disputes DS291, DS292, and DS293 opposing the EU to the United States, Canada, and Argentina. Panel Report, *European Communities—Measures Affecting the Approval and Marketing of Biotech Products*, WT/DS291/R, WT/DS292/R, WT/DS293/R (Sept. 29, 2006). Plaintiffs, the United States, Canada, and Argentina, asserted that the moratorium, applied by the EU since October 1998, improperly restricted imports of agricultural and food products from plaintiffs. These countries also contended that several EU Member States maintained national bans on import and marketing of biotechnological products despite EU-level approval of those products. The Dispute Settlement Panel concluded that the general de facto moratorium resulted in a failure to complete individual approval procedures without undue delay, giving rise to an inconsistency with Article 8 (control, inspection, and approval procedures) of the WTO Agreement on Sanitary and Phytosanitary Measures. *Id.* ¶¶ 7.1567–.1570.

product meeting the required genetic purity standards. Along this route, however, there are threats from several sources of commingling—any one of which could produce a liability event.

Similar to the growth in GM plantings, organic food rapidly has emerged as an important food industry in the United States.[28] Underlying motivations for this expansion are often traced to consumer concerns with food safety and environmental quality, including concerns about the use of pesticides, food additives, and the spread of GM food ingredients throughout the food supply.[29] In one study, nearly 64 percent of the respondents had purchased organic food,[30] and consumers may be willing to pay up to 20 percent more for organically grown food.[31] From a retail perspective, "the average unit margin for organic products exceeds that of conventional products by 4.2 cents."[32] Willingness to pay higher prices can be considered a valid measure of the value consumers attach to food.[33] However, it is not just consumers who are recognizing the demand for organic food. Many Cooperative Extension offices are offering classes to farmers on organic production and certification as a means to capture the price premiums for organically grown foods.[34]

28. Press Release, U.S. Dep't of Agric., USDA Announces Growth of U.S. Organic Industry and Additional USDA Support Available with New Farm Bill (Mar. 20, 2014), *available at* http://www.usda.gov/wps/portal/usda/usdahome?contentid=2014/03/0043.xml&navid=NEWS_RELEASE&navtype=RT&parentnav=LATEST_RELEASES&edeployment_action=retrievecontent.

29. Leila Hamzaoui-Essoussi & Mehdi Zahaf, *Canadian Organic Food Consumers' Profile and Their Willingness to Pay Premium Prices*, 24 J. INT'L FOOD & AGRIBUSINESS MARKETING 1, 1 (2012); Qingbin Wang et al., *Consumer Preferences and Willingness to Pay for Locally Grown Organic Apples: Evidence from a Conjoint Study*, 45 HORTSCIENCE 376, 376 (2010).

30. Wang et al., *supra* note 29, at 380.

31. *See* Hamzaoui-Essoussi & Zahaf, *supra* note 29, at 6.

32. Jenny van Doorn & Peter C. Verhoef, *Willingness to Pay for Organic Products: Differences Between Virtue and Vice Foods*, 28 INT'L J. RES. MARKETING 167, 167 (2011).

33. *See* Hamzaoui-Essoussi & Zahaf, *supra* note 29, at 1.

34. *See* Christopher Cumo, *High Prices Pique Interest in Organic Corn*, DAKOTAFIRE http://dakotafire.net/farms/high-prices-pique-interest-in-organic-corn/3410/ (last visited May 11, 2014) (explaining the demand for North Dakota State University's Extension Center to provide classes on organic corn); Tim Thornberry, *Growing Corn Organically Could Prove to be Financially Rewarding for Kentucky Farmers*, KYFORWARD (Jan. 11, 2013), http://www.kyforward.com/2013/01/growing-corn-organically-could-prove-to-be-financially-rewarding-for-kentucky-farmers/ (explaining demand for University of Kentucky Cooperative Extension Service to offer classes on producing organic corn).

C. The Dollars and Cents of Conventional (GM) and Organic (Non-GM) Corn

One key factor affecting the applicability of the different liability regimes is the economic reality of the conventional and organic crop market. Commentators have theorized that the reportedly lower yields of organic crops render them a less profitable, and therefore a niche alternative to conventional crops. If organic crops are less economically efficient, that fact has bearing in the allocation of liability. A crop that is less profitable *and* produces less food is arguably contributing less to social welfare and should bear the burden of its inefficient existence. This section reviews empirical studies and data to determine whether organic crops are the lower yield, lower profit alternative. Many will suspect that at least the first proposition is true, but several studies have found that under proper management organic crops produce yields equal to or higher than their conventional counterparts. According to available data, organic crops are also consistently more profitable per acre than conventional crops. The authors compared conventional and organic corn yields and profits due to the fact that corn is an exemplar crop for pollen drift.[35]

The U.S. Department of Agriculture ("USDA") has been collecting average yield and revenue figures for conventional corn since the 1970s.[36] However, no such figures have been maintained for organic crops. The USDA did collect equivalent figures for organic soybeans in 2006 and wheat in 2009,[37] but the agency has not made any other organic crop information available to the public.[38] The fact that USDA has some organic data sets indicates that the agency could track organic crops in the same way it tracks conventional crops, but has chosen not to perform this service. If the USDA provided equivalent figures for organic crops, farmers and the general public could more easily compare organic and conventional crops and assess the economic differences.

In the absence of USDA data, the authors conducted a literature review to compile production and price data capable of comparison with data collected by USDA. Our research found that although yield per acre of organic corn varies across studies, so does the yield per acre of

35. However, the reported cost-profit ratios were similar for other conventional and organic commodity crops in the studies reviewed.

36. *See Documentation*, *Commodity Costs and Returns*, U.S. DEP'T OF AGRIC., http://www.ers.usda.gov/data-products/commodity-costs-and-returns/documentation.aspx#.U2-MhK1dWDQ (last updated May 1, 2014).

37. *Organic Costs and Returns*, *Commodity Costs and Returns*, U.S. DEP'T OF AGRIC. , http://www.ers.usda.gov/data-products/commodity-costs-and-returns/organic-costs-and-returns.aspx#.U2-NZ61dWDQ (last updated May 1, 2013).

38. Organic dairy information is also available for the year 2010. *Id.*

conventionally grown corn. This variability reflects the unavoidable differences in management techniques, soil quality, weather and other inputs.[39]

Kathleen Delate and her colleagues at Iowa State University conducted a four-year study of conventional and organic commodity crops to compare yields under different crop rotations.[40] Delate and her colleagues found that while conventional yields were significantly higher, the rotation of crops mattered. A full year of alfalfa before planting corn gave the organic corn a yield only four and a half percent lower than conventional corn.[41] The lowest organic corn yield was just over ten percent lower than conventional corn yield.[42] Interestingly, the organic corn did not show significantly more pests or weeds than the conventional counterpart.[43] In an extended version of this study, Delate and her colleagues found that organic farming was a competitive economic enterprise as long as compost costs were less than 20 dollars per ton.[44] If compost costs rose higher than 20 dollars per ton, an alfalfa rotation was necessary to keep the organic corn competitive.[45] As long as this requirement was met, the financial per acre returns for both of the studied organic rotations were significantly greater than the conventional rotation.[46]

Catherine Badgley and a team from the University of Michigan also concluded that organic yields were competitive with conventional yield.[47] Badgley conducted a metastudy of 293 data sets, the majority of which were peer-reviewed publications, along with some conference presentations and research station websites.[48] Some of the data sets represented one growing season while others included 20 years of observation.[49] The observations were made in both the developed and

39. *See* Verena Seufert et al., *Comparing the Yields of Organic and Conventional Agriculture*, 485 NATURE 229, 229 (2012).

40. KATHLEEN DELATE ET AL., COMPARISON OF ORGANIC AND CONVENTIONAL CROPS AT THE NEELY-KINYON LONG-TERM AGROECOLOGICAL RESEARCH (LTAR) SITE 1 (2002), *available at* http://extension.agron.iastate.edu/organicag/researchreports/nk02ltar.pdf.

41. *Id.* at 2 tbl.1.

42. *Id.*

43. *Id.* at 2 tbl.2.

44. Kathleen Delate et al., An Economic Comparison of Organic and Conventional Grain Crops in a Long-Term Agroecological Research (LTAR) Site in Iowa 9 (2002), *available at* http://extension.agron.iastate.edu/organicag/researchreports/orgeconomics.pdf.

45. *Id.* at 9–10.

46. *Id.* at 2.

47. Catherine Badgley et al., *Organic Agriculture and the Global Food Supply*, 22 RENEWABLE AGRIC. & FOOD SYSTEMS 86, 86 (2007), *available at* http://www.organicvalley.coop/fileadmin/pdf/organics_can_feed_world.pdf.

48. *Id.* at 87.

49. *Id.*

developing world with no attempt to skew the sample towards organic growers.[50] Badgley's research showed that organic corn[51] yields in developed countries ranged from 84 percent[52] to 130 percent[53] of conventional yields. The average organic corn yield in developed countries was 97.6 percent of conventional corn yield.[54] In developing countries, the situation is even more promising for organic corn. The lowest organic yield Badgley's team observed in developing countries was 109 percent of conventional yield,[55] and the highest was 371 percent of conventional yield.[56] The average organic corn yield in developing countries was 205 percent of conventional yields.[57] Of course, some of the yield differentials found in developing counties may be due to the absence of the highest-yielding, new seed varieties.

U.S. yield data are more modest, but nonetheless far from the epic economic failure often reported. Researchers with the USDA's Sustainable Agricultural Systems Laboratory found organic corn yields to be 76 percent of conventional yields, and organic yields could be increased by 30 percent with improved crop rotation.[58] The Rodale Institute also found that organic and conventional corn yields were nearly equal in typical years,[59] and organic yields were actually 30 percent higher than conventional yields in years of drought.[60] Organic corn was also considerably more profitable per acre, with organic corn seeing a return of 558 dollars per acre versus conventional corn's 190 dollars.[61]

Rodale is not alone in reporting data indicating organic corn as the more profitable alternative to conventional corn. The preceding discussion illustrates that the yield difference between conventional and organic corn varies, with organic corn typically somewhat lower than conventional. However, yield is not the only factor. Price per bushel also must be considered in order to compare per acre profit scenarios for

50. *Id.*
51. Only the figures for commodity corn were used; sweet corn figures were excluded.
52. Observed in South Dakota. Badgley et al., *supra* note 47, at 98 tbl.A1.
53. Observed in Ohio. *Id.*
54. Math conducted by the authors based on figures reported by Badgley et al. *Id.* at 97–98 tbl.A1.
55. Observed in China. *Id.* at 103 tbl.A1.
56. Observed in Guatemala. *Id.*
57. Math performed by authors.
58. *Organic Corn: Increasing Rotation Complexity Increases Yields Substantially*, SCIENCEDAILY (June 1, 2008), http://www.sciencedaily.com/releases/2008/05/080528102904.htm.
59. RODALE INST., THE FARMING SYSTEMS TRIAL: CELEBRATING 30 YEARS 9 (2011), *available at* http://66.147.244.123/~rodalein/wp-content/uploads/2012/12/FSTbookletFINAL.pdf.
60. *Id.* at 10.
61. *Id.* at 14.

organic versus conventional corn. For conventional corn, the authors used the USDA's 2011 data for return and yield per acre[62] to reach the profit per bushel result in Table 1. The USDA data is used to achieve a "returns per acre" calculation for conventional corn in Delate's study. As noted above, the USDA does not have equivalent data for organic corn. Therefore, we used an organic corn budget prepared by Iowa State University—a leading agricultural research institution.[63] This budget, with returns per 150 bushels, was used to calculate the profit per bushel outlined in Table 1. While the organic data is an estimate, it is nonetheless grounded in empirical research.

62. *Overview, Commodity Costs and Returns*, U.S. DEP'T OF AGRIC., http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx (last updated May 1, 2014) (select "Recent Costs and Returns: Corn" from the "Data" drop-down menu; then click on Excel file titled "U.S.: 1996–2000, 2001–04, 2005–09, 2010–13").

63. Craig Chase et al., *Organic Crop Production Enterprise Budgets*, IOWA ST. U., http://www.extension.iastate.edu/AGDM/crops/html/a1-18.html (last updated July 2011).

	Yield as Percentage of Conventional	Bushels per Acre[64]	Profit per Acre[65]
USDA Conventional	N/A	145	$269.70
DELATE ET AL.			
• **Conventional**	N/A	179	$332.94
• **Organic 1**	95.5%	171	$1,126.89
• **Organic 2**	89.9%	161	$1,060.99
Badgley et al.			
• **Highest**	130%	188	$1,182.25
• **Lowest**	84%	122	$763.91
• **Average**	97.6%	141	$887.59
SCIENCEDAILY	76%	110	$691.16

Table 1. Yields and Profit Estimates of Studies

A more recent meta-analysis of 66 studies on crop yield comparisons, including the studies discussed above, illustrated that the average organic-to-conventional ratio for corn was .86 (meaning organic corn yields are only 14 percent lower than conventional corn yields.[66] This ratio is based off of 74 observations from 19 different studies; 69 of the 74 observations were from U.S. fields.[67]

The empirical data collected by the preceding studies and summarized in Table 1 demonstrates that organic corn, despite

64. The USDA conventional figure is an average of the last seven years of yield. *Commodity Costs and Returns: Data*, USDA/ERS (June 4, 2012), http://www.ers.usda.gov/data/costsandreturns/testpick.htm. To achieve the bushels per acre figure for Badgley and ScienceDaily, the authors multiplied the USDA's bushels per acre for conventional corn (145) against the percentage figures given by the respective articles. Thus, the exact figures would likely change from year to year and even field to field. However, the ratios would remain the same. All figures were rounded to the nearest whole number.

65. The profit per acre amount was reached by multiplying the bushels per acre figure times a profit per bushel figure. Conventional and organic corn have different profit per bushel figures. The conventional figure was achieved by using the average of the USDA's figures for return per acre for the last seven years ($270.56) and dividing it by the average of the USDA's figures for bushels per acre for the last seven years (145). *Id.* This math resulted in a profit per bushel for conventional corn of $1.86. The organic profit per bushel figure was reached by taking Iowa State's estimate of $987.77 for 150 bushels and dividing the dollar amount by the 150. Chase et al., *supra* note 63. These figures were rounded to the nearest whole cent. Obviously, costs—and therefore returns per bushel—will vary depending on the price of multiple inputs. Thus, these figures can be seen only as estimates, but estimates based in research and actual returns.

66. Seufert et al., *supra* note 39.

67. *Id.* at 229 fig.1(c); Interview with Verena Seufert, Dep't of Geography & Global Envtl. & Climate Change Ctr., McGill Univ. (Feb. 28, 2014).

sometimes lower yields, can be more profitable per acre than its conventional counterpart. We qualify our conclusions with "can be" because the USDA data for conventional crops cannot account for the inherent variability in agricultural production across regions. Additionally, the USDA profit per bushel figure does not include subsidy payments and other government incentives in place for conventional commodity production, ranging from international marketing programs to university extension assistance.

While the data uncertainty makes predictions difficult, the aggregate of research shows that organic corn should not be considered inherently less economically efficient than conventional corn, even when subsidies are considered. This finding has implications for allocating liability and the burden of segregation.

III. LIABILITY ISSUES ARISING FROM POLLEN DRIFTS: THE CURRENT TORT REGIME

Agricultural production starts and ends with the seed. As noted sociologist Jack Kloppenburg stated, seeds are "the irreducible core of crop production on the farm and the most fundamental agricultural input."[68] Other commentators noted, "Nothing is more fundamental to agriculture and our food supply than seeds. Whether eaten directly or processed through animals, seeds are the ultimate source of human nutrition. The variety, abundance, and safety of foods are all dependent on the availability and quality of seeds."[69] Commingling at the seed production stage sets in motion a disruptive chain of events rippling through the agricultural system.[70] For example, a study published by the Canola Council of Canada noted that even a small amount of GM seed, as low as one-fourth of a percent, may result in as many as 1,500 off-type plants per acre.[71]

68. Jack Ralph Kloppenburg, Jr., First the Seed: The Political Economy of Plant Biotechnology, 1492–2000, at 4 (1988).

69. Margaret Mellon & Jane Rissler, Union of Concerned Scientists, Gone to Seed: Transgenic Contaminants in the Traditional Seed Supply 1 (2004), *available at* http://www.ucsusa.org/assets/documents/food_and_agriculture/seedreport_fullreport.pdf.

70. A recent example of the potential economic devastation resulting from genetic contamination of seed supplies is the trouble experienced by the rice industry in 2006. A regulated and unapproved-for-export genetically engineered rice variety contaminated the foundation seed supply for rice, resulting in the halt of export shipments and extensive genetic testing. For a full discussion of the issue and resulting class action litigation, see A. Bryan Endres, *Coexistence Strategies, the Common Law of Biotechnology and Economic Liabilty Risks*, 13 Drake J. Agric. L. 115, 132–35 & nn. 107–21 (2008).

71. Eric Johnson et al., Canola Council of Can., Ecology and Management of Volunteer Canola 3, *available at* http://ws373847.websoon.com/uploads/managing_vol_canola.pdf. *See generally* Endres,

Other potential sources of admixture include pollen drift between neighboring fields, commingling during harvest or post-harvest activities (such as transportation or storage) and volunteer plants[72] from previous growing seasons. As our focus in this paper is a critique of the liability system arising from pollen drift, we will not discuss the latter sources of potential genetic impurity.

Because pollen tends to ignore field boundaries, conventional open-pollinating crops may be pollinated by genetically modified plants. Several studies have investigated the incidence of pollen drift for various crops. A literature review conducted by the extension service of the University of Illinois noted that the distance pollen can be carried varies according to the crop[73] and the wind patterns observed.[74] Other factors

supra note 9, at 134 (discussing the need for revised seed purity laws to better manage coexistence efforts in light of the increased use of genetically engineered seeds).

72. Volunteers are plants that grow spontaneously, without human intervention, as a result of some tubers or seeds remaining in the soil after harvest. They can occur with conventional as well as GM plants. For instance, in a field planted with canola, volunteer wheat and barley, at 7 to 8 plants/m2, can reduce canola yield by 10 to 13%. Weed Management, Canola Council Can., http://www.canolacouncil.org/canola-encyclopedia/weeds/weed-management/ (last updated Apr. 17, 2014). In the genetic engineering context, the most famous, and troubling, case of unwanted volunteers involved the commingling of non-regulated soybeans with corn genetically engineered to produce pharmaceuticals. Volunteer corn plants from a field trial were harvested the following year along with the soybean crop and commingled in a grain elevator with 500,000 bushels of other soybeans, resulting in the forced destruction of the elevator's contents. ProdiGene, Inc., the company responsible for the field tests, entered into a consent agreement with the USDA and the Food and Drug Administration ("FDA") in which it paid a civil penalty of $250,000 and agreed to reimburse the government for its costs in securing approximately 500,000 bushels of soybeans in storage. Press Release, U.S. Dep't of Agric., USDA Announces Actions Regarding Plant Protection Act Violations Involving ProdiGene, Inc. (Dec. 6, 2002), available at http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2002/12/0498.html.

73. *See* Mike Gray, *Pollen Drift and Refuge-Management Considerations for Transgenic Hybrids*, Bulletin (April 17, 2003), http://bulletin.ipm.illinois.edu/pastpest/articles/200304e.html. For example, a Canadian study of canola pollen drift found that, in "field studies conducted in Saskatchewan where Polish canola was grown beside an herbicide-resistant Argentine canola field, hybrids were detected at frequencies of 0.11% at 40 m and dropped below 0.01% at distances of 60 to 250 m from the edge of the Argentine canola field." Johnson et al., *supra* note 71, at 2. In a 1950 study, well before the era of genetic engineering, Professors Jones and Brooks measured the average level of cross-pollination in corn as up to 25.4% in immediately adjacent rows, dropping to 1.6% at 200 meters and 0.2% at 200 meters. *See* M.D. Jones & J.S. Brooks, *Effectiveness of Distance and Border Rows in Preventing Outcrossing in Corn*, Okla. Agric. Experiment Station Technical Bull. T-38 (1950); *see also* Graham Brookes et al., GM Maize: Pollen Movement and Crop Co-Existence 6–8 (2004), *available at* http://www.pgeconomics.co.uk/pdf/Maizepollennov2004final.pdf (reviewing the scientific literature of pollen dispersal); Bohn, *supra* note 1, at 5–6 (reviewing scientific literature of cross pollination in corn). On the other hand, farmers planting self-pollinating crops, such as soybeans and rice, for the most part need not take coexistence measures related to pollen drift. *See* Endres, *supra* note 9, at 148–51

include temperature, humidity,[75] and even the size and shape of the field.[76]

When considering pollen drift, notions of open and closed ranges, a legal doctrine developed to establish liability rules for livestock, come to mind. Like livestock, pollen tends to wander. Unlike livestock, the fine particles of pollen are impossible to control with traditional fences. Thus, the following sections will address application of various established liability regimes in the unfamiliar context of drifting pollen.

We focus here on four torts, namely trespass, nuisance, strict liability, and negligence. Each common law cause of action has unique elements potentially applicable within the context of pollen drift. On the other hand, each tort suffers from certain limitations that hinder straightforward application to this specific agricultural situation. Accordingly, in the following sections we will review and critique these liability regimes with a goal of demonstrating their limits with respect to pollen drift events and justifying our subsequent recommendations for a new law and economic based approach to liability described in Part V.

A. The Original Environmental and Land Use Torts: Trespass and Nuisance

Although the difference between trespass and nuisance may be murky in some situations, and are in fact derived from similar language—*trespass* and *trespass on the case* (now referred to as nuisance)—one clear distinction between the two hinges on the nature of property right infringed. As summarized in *Martin v. Reynolds Metals Co.*,[77] "an actionable invasion of a possessor's interest in the *exclusive possession of land* is a trespass; an actionable invasion of a possessor's interest in the *use and enjoyment of his land* is a nuisance."[78] With this admittedly simple construct, we proceed to analyze the respective tort

(discussing an EU proposal for varying levels of seed purity depending upon whether the plant is cross- or self-pollinating).

74. *See* Gray, *supra* note 73.

75. Neil E. Harl, Biotechnology Policy: Global Economic and Legal Issues 12 (paper presented at a conference sponsored by the Lundberg Family Farms, Woodland, CA, Jan. 28, 2004), *available at* http://www.econ.iastate.edu/~harl/BiotecnologyPolicy_California.pdf.

76. Large rectangular fields result in pollen travelling farther than small circular fields due to higher pollen concentrations. Moreover, the depth of a field, in relation to wind direction, may be more important than the overall acreage of a particular field. Brookes et al., *supra* note 73, at 6.

77. Martin v. Reynolds Metals Co., 342 P.2d 790 (Or. 1959).

78. *Id.* at 792 (emphasis added); *see also* Fagerlie v. City of Willmar, 435 N.W.2d 641, 644 n.2 (Minn. Ct. App. 1989); W. PAGE KEETON ET AL., PROSSER & KEETON ON THE LAW OF TORTS 622 (5th ed. 1984).

claims to conceptualize application in the event of damage from pollen drift.

1. Trespass

A trespass traditionally consists of a voluntary and intentional or negligent[79] act of unauthorized entry upon, or physical contact of an object with, another's land.[80] Modern constructions of the tort reduce the claim to three elements: invasion, causation, and harm.[81] One potential difficulty with the traditional application of the tort in the event of non-negligent pollen drift is establishing the intention of the trespasser. Moreover, the traditional definition of intentional trespass requires the invasion to be direct and the injury immediate.[82] In light of these requirements, Professors Heald and Smith argue that the traditional approach to trespass would most likely not apply to pollen drift situations for two reasons.[83] First, for pollen drifts to occur, a carrier (i.e., the wind) must be at work, making the entry less direct.[84] Second, the injury is not immediate, as crops need time to grow post-pollination.[85] Unlike the learned opinions of Professor Heald and Smith, these purported difficulties with a trespass claim, in our view, are relatively minor under both the traditional and modern applications of the tort.[86]

Although an intentional tort, a trespasser does not have to intend or even expect the damaging consequences of the trespass.[87] Rather, the plaintiff only must establish that the trespasser intended the act which

79. Phillips v. Sun Oil Co., 121 N.E.2d 249, 250–51 (N.Y. 1954).

80. *See* Hoffman v. Monsanto Canada Inc., 2005 SKQB 225, para. 127 (Can.). It must be noted here that the analogy between pollen drifts and stray bulls (that we used in introduction, not specifically with respect to trespass) was rejected by the Canadian court. The court argues that "[t]hese are not trespasses cases. The imposition of strict liability for the consequences of stray bulls is clearly a policy decision intended to place a heavy onus on the owners and possessors of bulls to keep these animals confined and under control." *Id.* para. 132.

81. Paul J. Heald & James Charles Smith, *The Problem of Social Cost in a Genetically Modified Age*, 58 HASTINGS L.J. 87, 136 (2006) (citing Richard A. Repp, Comment, *Biotech Pollution: Assessing Liability for Genetically Modified Crop Production and Genetic Drift*, 36 IDAHO L. REV. 585, 600 (2000)).

82. Baumann v. Snider, 532 S.E.2d 468, 472 n.4 (Ga. Ct. App. 2000).

83. Heald & Smith, *supra* note 81, at 135.

84. *See id.*

85. *See id.*

86. Professors Heald and Smith do acknowledge that, under the modern view of trespass, liability could be found by some courts. *Id.* at 135 (citing RESTATEMENT (SECOND) OF TORTS § 158 cmt. i (1965); Adams v. Cleveland-Cliffs Iron Co., 602 N.W.2d 215, 224 (Mich. Ct. App. 1999); Lunda v. Matthews, 613 P.2d 63, 66 (Or. Ct. App. 1980)).

87. Phillips v. Sun Oil Co., 121 N.E.2d 249, 250–51 (N.Y. 1954).

amounted to or produced the entry onto the plaintiff's land.[88] It is axiomatic that the farmer cultivating genetically engineered corn intended to plant the crop. Corn is an annual rather than a perennial species, and thus requires seeding each growing season. Moreover, although every farmer may not be an expert in plant science, even the most inexperienced farmer knows that corn is a cross-pollinating crop that produces extensive amounts of pollen—an essential element of corn production and thus an inevitable and intended consequence of growing corn. Although there may be no specific intent or even desire to have the pollen drift in the wind beyond the farm's borders, the undoubtedly intentional act of planting and growing corn produced the ultimate entry onto the land of another.[89]

With respect to the traditional trespass elements of direct and immediate harm, a careful reading leads us to conclude that the terms refer more to the concept of the proximity of the harm rather than its temporal nature. As one court noted, "the intrusion must at least be the immediate or *inevitable* consequence of what [the trespasser] willfully does."[90] Inevitability refers to the likelihood of a consequence rather than timing. Pollination is an inevitable consequence of planting corn. Likewise, wind capable of transporting the pollen is an inevitable feature of nature and an event the corn plant has relied upon for reproductive evolution since its creation. Narrowly defining "directness" and "immediacy" of the invasion without consideration of the environment's natural forces and inevitable consequences of the corn grower's actions fails to consider the harm's proximity.

Several jurisdictions applying the modern elements of trespass—invasion, causation, and harm—have imposed liability for airborne pollutants[91] without the separate establishment of "direct" and "immediate." As noted by Heald and Smith, those jurisdictions "obviously will be predisposed to apply the same rule for bystanding farmers whose crops are damaged by GMO pollen."[92] Causation, often cited by commentators as a potentially difficult element to satisfy,

88. *Id.* at 251.

89. *See* Margaret Rosso Grossman, *Biotechnology, Property Rights and the Environment*, 50 AM. J. COMP. L. 215, 235–36 (2002) (discussing application of trespass to pollen drift); *see also* Heald & Smith, *supra* note 81, at 118.

90. *Phillips*, 121 N.E.2d at 251 (emphasis added); *see also* Merlino v. City of Atlanta, 657 S.E.2d 859, 862–63 (Ga. 2008) (holding that although the act itself may not have been wrongful, the consequences of the act could constitute a trespass).

91. See Borland v. Sanders Lead Co., 369 So. 2d 523, 529 (Ala. 1979); Martin v. Reynolds Metals Co., 342 P.2d 790, 794 (Or. 1959); Thomas P. Redick & Christina G. Bernstein, *Nuisance Law and the Prevention of "Genetic Pollution": Declining a Dinner Date With Damocles*, 30 ENVTL. L. REP. NEWS & ANALYSIS 10328, 10336 (2000).

92. Heald & Smith, *supra* note 81, at 136.

especially if the plaintiff's contaminated field is surrounded by several fields of genetically modified plants,[93] actually may be a relatively simple element to prove. The same technology responsible for creating the genetically engineered plant endows the plant with a unique genetic construct capable of determination through DNA testing. As *Monsanto Canada Inc. v. Schmeiser*[94] has shown, DNA fingerprinting can be conducted in most instances. Similar DNA testing is conducted with most identity preserved grain shipments and even international commodity shipments to destinations with restrictive genetic engineering policies.[95] In sum, the process of DNA testing is straightforward and should simplify the causation analysis. One potential complication could occur if all the surrounding farmers planted a variety with the identical genetic modification. In those instances, principles of joint and several liability could apply.[96]

The final element in modern trespass jurisdiction—harm—has some unique attributes in the agricultural sector. For example, in *Martin v. Reynolds Metals Co.*, the plaintiff's land was held unfit for livestock grazing after contamination by microscopic fluoride particles emitted by the defendant's plant.[97] In the organic context, it is possible that repeated contamination from pollen drift could result in the land losing organic certification and thus not only the price premium applied to "organically certified" land, but also the higher value of crops produced on organically certified land in compliance with organic production methods.[98]

93. *Id.* at 114–15.

94. Monsanto Canada Inc. v. Schmeiser, 2004 SCC 34, [2004] 1 S.C.R. 902 (Can.); *see infra* Part V.

95. Thomas P. Redick & A. Bryan Endres, *Jury Verdict Against Bayer for Liberty Link Rice Breaks New Ground in Biotech Liability*, 26 AGRIC. L. UPDATE (Am. Agric. L. Ass'n, Kelso, WA), Nov.–Dec. 2009, at 2, 3–4., *available at* http://nationalaglawcenter.org/wp-content/uploads/assets/aala/11+12-09.pdf.

96. Grossman, *supra* note 89, at 233 (citing Repp, *supra* note 81, at 607).

97. Harl, *supra* note 75, at 16. Harl cites (along with *Martin v. Reynolds Metals Co.*, 342 P.2d 790 (Or. 1959)) *Hall v. De Weld Mica Corp.*, 93 S.E.2d 56 (N.C. 1956), in which a cloud of silicon dust was found likely to create damage; and *Stevenson et al. v. E.I. DuPont de Nemours & Co.*, 327 F.3d 400 (5th Cir. 2003), in which Texas law was construed to allow trespass claims for land contamination caused by airborne emissions. See also Heald & Smith, *supra* note 81, at 138, for a discussion of a Texas case, *Schronk v. Gilliam*, 380 S.W.2d 743 (Tex. Civ. App. 1964), in which the plaintiff's crops were damaged by pesticides dropped from an airplane. The court upheld the trespass claim, although such instances are generally considered to be in the remit of negligence. *Id.* at 745.

98. *See* Heald & Smith, *supra* note 81, at 129; Transcript of Proceedings, Marsh v. Baxter, No. CIV 1561 (W. Austl. Feb. 12, 2014), *available at* http://www.supremecourt.wa.gov.au/_files/Marsh%20v%20Baxter%2012%20Feb%2020 14%20CIV%201561%20of%202012.pdf.

Even in the non-organic context, Christopher Rodgers notes that in England, "[u]ntil severed from the soil, crops are part of the land to which they are attached, and an alteration in the genetic makeup of one's crops would, in principle, constitute damage to property in the same terms."[99] In the United States, perennial crops (e.g., alfalfa) are *fructus naturales* and thus considered a fixture of the land.[100] Accordingly, genetically engineered pollen drift could alter the nature of the non-GM alfalfa, and thus the land itself. The property status (personality or realty) of annual crops is a function of their maturity (growing verses ready to harvest) as well as the law of the particular state. In some jurisdictions, annual crops are *fructus industrales* at all stages of development, and thus personal property.[101] In Illinois and several other states, immature crops not yet ready to harvest are considered realty.[102] In those jurisdictions, pollen drift altering the genetics of growing crops would be a harm to real property and thus fit within the trespass construct.

2. Nuisance

Several commentators have discussed the concept of nuisance, including the distinction between public and private nuisances.[103]

> [A] public nuisance is a nuisance which is so widespread or so indiscriminate in its effects that it would not be reasonable to expect one person to take proceedings on his own responsibility to put a stop

99. Christopher P. Rodgers, *Liability for the Release of GMOs into the Environment: Exploring the Boundaries of Nuisance*, 62 CAMBRIDGE L.J. 371, 385 (2003) (citing Law of Property Act 1925, § 205).

100. *See* Triggs v. Kahn, 167 A.D.2d 680, 681–82 (N.Y. App. Div. 1990) (holding that perennial five-year alfalfa is part of the realty).

101. *See* Spauldin v. Spauldin, 945 S.W.2d 665, 668 (Mo. Ct. App. 1997) (holding that annual crops are personal chattels, independent and distinct from land); Heinold v. Siecke, 598 N.W.2d 58, 63 (Neb. 1999) (holding that growing crops are personal property); *see also* Heald & Smith, *supra* note 81, at 138 (referencing the general point of personal property and referring to *StarLink Corn Products*).

102. Loepker v. Wesselman, 569 N.E.2d 321, 322 (Ill. App. Ct. 1991) (holding that growing or standing crops are part of realty until severed); *see also* Balla v. Ireland, 196 P.2d 445, 449 (Or. 1948) (holding that beans and squashes (annual crops) are real property until severed from the land); Williams v. State, 209 S.W.2d 29, 31 (Tenn. 1948) (holding that stalk of growing corn is part of the soil and thus realty and is not personal property until severed); Woody v. Wagner, 154 P. 819, 820 (Wash. 1916) (holding that crops, whether growing or ready for harvest, are part of real property until severed).

103. *See* A. Bryan Endres, *"GMO:" Genetically Modified Organism or Gigantic Monetary Obligation? The Liability Schemes for GMO Damage in the United States and the European Union*, 22 LOY. L.A. INT'L & COMP. L. REV. 453, 491–94 (2000); Grossman, *supra* note 89, at 230–35; Repp, *supra* note 81, at 605–07.

> to it, but that it should be taken on the responsibility of the community at large.[104]

"Private individuals may maintain a public nuisance only if they 'have suffered harm of a kind different from that suffered by other member of the public . . . .'"[105]

Courts generally limit application of public nuisance to unreasonable conduct that (a) significantly interferes with public health, safety, peace, or comfort; (b) is illegal; or (c) is of a continuing nature that has a significant, long-lasting effect upon the public.[106] Although pollen drift potentially could rise to the level of a public nuisance, in a simple cross-pollination scenario between neighboring farms, the general public does not suffer an unreasonable interference. The harm in this case is confined to the farmer with the contaminated crops and the doctrine of public nuisance may not be applicable.[107]

Conversely, the doctrine of private nuisance may provide pollen drift plaintiffs with a slightly more viable opportunity for recovery.[108] "A private nuisance is a civil wrong, based on the disturbance of rights in land,"[109] specifically the unreasonable interference with the individual's use and enjoyment of his or her property.[110] As noted by Professor Rodgers, "[w]ere the courts to refuse a remedy for the unconsented genetic alteration of a claimant's produce by cross-pollination from nearby GM crops, this would render his property right contingent."[111]

The complaint in a private nuisance action is either the creation of an unreasonable physical harm to the plaintiff's property, or an unreasonable interference with plaintiff's use of her land.[112] Stated another way, nuisance refers to the condition created by the defendant

104. John Wightman, *Nuisance—The Environmental Tort?* Hunter v. Canary Wharf *in the House of Lords*, 61 MOD. L. REV. 870, 884 (1998) (quoting Attorney-General v. P.Y.A. Quarries Ltd., [1957] 2 Q.B. 169, 191 (Can.)); *see also* RESTATEMENT (SECOND) OF TORTS § 821C(2) (1979).

105. Endres, *supra* note 103, at 492 (quoting RESTATEMENT (SECOND) OF TORTS § 821C(1) (1965)).

106. *Id.* (citing Restatement (Second) of Torts § 821B(2)(a)–(c) (1965)); *see also* Grossman, *supra* note 89, at 231–32 (citing Amended Complaint, Higg[i]nbotham v. Monsanto Co., No. 1:99cv03337 (D.D.C. Feb. 1, 2000)) (discussing potential public nuisance actions brought against the seed developer rather than the farmer).

107. Endres, *supra* note 103, at 492.

108. Heald & Smith, *supra* note 81, at 115; *see also In re* StarLink Corn Prods. Liab. Litig., 212 F. Supp. 2d 828, 845 (N.D. Ill. 2002) ("We agree that drifting pollen can constitute an invasion, and that contaminating neighbors' crops interferes with their enjoyment of the land.").

109. Harl, *supra* note 75, at 18.

110. RESTATEMENT (SECOND) OF TORTS § 821D (1979).

111. Rodgers, *supra* note 99, at 380.

112. RESTATEMENT (SECOND) OF TORTS § 821D (1979).

rather than the harm-causing conduct of the defendant.[113] Although the initial characterization of the nuisance concerns the type of harm, courts will assess conduct in order to assign liability. At this point, a distinction is made between intentional and negligent nuisance. Liability for intentional nuisance requires conduct causing an invasion that is both intentional and unreasonable.[114] In contrast, liability for negligent nuisance may arise from unintentional conduct that nonetheless may be actionable under the rules for negligent or reckless conduct, or involvement of abnormally dangerous conditions/activities.[115]

Unlike the intentional element of a trespass claim—which only examines whether the actor intended to conduct the act, and not the intention to inflict harm[116]—the intentional invasion of another's interest element of an intentional nuisance claim requires the actor to act for the purpose of causing the invasion or with the knowledge that the invasion is substantially certain to occur.[117] The American Law Institute ("ALI") considered the distinction between intentional and unintentional in two illustrations discussed in the comments of the Restatement (Second) of Torts. In the first scenario, A owns a factory and neighboring landowner B operates a poultry farm.[118] There is a small stream that flows from A's land to B's land, which B uses for his poultry farm.[119] A, with knowledge that B uses the stream and that dumping would interfere with B's use—but with no desire to harm B—dumps ten barrels of waste from the factory into the stream and fouls the water in such a way that it is a substantial interference with B's poultry farm.[120] The ALI found that this scenario is an example of A's intentional invasion of B's interest in the use of his land.[121] On the other hand, the ALI provides an example of an unintentional invasion of a nuisance claim when the stream is replaced by a ground well on B's land, and A dumps the waste into a hole on his land that then, unknowingly to A, seeps into the groundwater and

113. 4 J.D. LEE & BARRY LINDAHL, MODERN TORT LAW: LIABILITY AND LITIGATION § 35:7 (2d ed. 2008) (citing Sletten v. Ramsey Cnty., 675 N.W.2d 291 (Minn. 2004); Guzman v. Des Moines Hotel Partners, Ltd. P'ship, 489 N.W.2d 7 (Iowa 1992)), *available at* Westlaw MTLLL (last updated 2013); *id.* § 35:1 ("[M]uch of the confusion in nuisance law is because of the failure to recognize that nuisance refers to the interest invaded and not to the type of conduct that subjects the defendant to liability." (citing Milwaukee Metro. Sewerage Dist. v. City of Milwaukee, 691 N.W.2d 658 (Wis. 2005))).

114. *Id.* § 35:7; *see also* Grossman, *supra* note 89, at 233.

115. LEE & LINDAHL, *supra* note 113, § 35:7; *see also* Grossman, *supra* note 89, at 233.

116. *See supra* notes 87–89 and accompanying text.

117. RESTATEMENT (SECOND) OF TORTS § 825 cmt. c (1979).

118. RESTATEMENT (SECOND) OF TORTS § 825 cmt. d, illus. 2 (1979).

119. *Id.*

120. *Id.*

121. *Id.*

contaminates B's well so that he is unable to use the water for his poultry farm.[122] Thus an intentional invasion may be difficult to prove in a GM pollen drift contamination case; unless the plaintiff has proof the GM farmer (defendant) knew the organic status of the plaintiff's farm.

The "unreasonableness" analysis in both intentional and negligent nuisance claims relates to the invasion—the interference with the property right—not the conduct of the defendant,[123] and is perhaps where much of the confusion lies with regard to providing a precise definition of the tort. The unreasonableness analysis is a utility balancing exercise in which the court will weigh the gravity of the harm with the utility to society of the defendant's conduct.[124]

This balancing of factors renders nuisance a flexible approach, which subjects the doctrine to both praise as a factor of adaptability in an evolving society, and vilification as a source of legal uncertainty.[125] The tort's evolutionary flexibility renders it susceptible to frequent test cases seeking to broaden legal boundaries and is therefore a likely candidate for biotechnology litigation (or any transformative technology released into the environment).

An additional element taken into account by the Restatement is the relative sensitivity of the plaintiff's land use. It is a well-established principle of private nuisance that "a man cannot increase the liabilities of his neighbour by applying his own property to special uses, whether for business or pleasure."[126] Professor Rodgers notes that "[a]lthough the 'hypersensitive land use' principle was not directly at issue in *R.* v.

122. *Id.* § 825 cmt. d, illus. 3.

123. *See* LEE & LINDAHL, *supra* note 113, § 35:9 (noting that reasonableness when assessing negligent nuisance does not mean "due care" but refers to a balancing of social utility and harm); *id.* § 35:8 (stating test from Restatement (Second) of Torts § 826 for balancing gravity of harm with defendant's utility when considering liability for intentional nuisance).

124. *See* Restatement (Second) of Torts §§ 826–31 (1979). Pursuant to the Restatement (Second) of Torts, the following criteria are taken into account in determining the utility of the defendant's land use: (1) the social value that the law attaches to the primary purpose of the defendant's conduct, (2) the suitability of the conduct to the character of the locality, and (3) the impracticability of preventing or avoiding the invasion. *Id.* § 828. The criteria relating to the appraisal of the harm are defined as follows: (1) the extent of the harm involved, (2) the character of the harm involved, (3) the social value that the law attaches to the type of use or enjoyment invaded, (4) the suitability of the use or enjoyment invaded to the character of the locality, and (5) the burden on the person harmed of avoiding the harm. *Id.* § 827.

125. *See* David Campbell, *Of Coase and Corn: A (Sort of) Defence of Private Nuisance*, 63 MOD. L. REV. 197, 203 (2000); Heald & Smith, *supra* note 81, at 124 n.167; *see also* William L. Prosser, *Nuisance Without Fault*, 20 TEX. L. REV. 399, 410 (1942) (referring to nuisance as a legal garbage can).

126. E. & S. African Tel. Co. v. Cape Town Tramways Cos., [1902] A.C. 381 (P.C.) 393 (appeal taken from Eng.).

Secretary of State ex parte Watson,[[127]] the Court of Appeal discussed the difficulties that would be faced by an organic producer seeking to establish liability" for nuisance as a result of pollen drift.[128] He concluded, however, that "[d]espite the reservations expressed in *ex parte Watson*, there is no logical justification for regarding either organic or 'ordinary' arable cropping practices as hypersensitive land uses for the purposes of the law of private nuisance."[129]

Similarly, the *Hoffman* case pitted organic growers against Monsanto. The growers alleged pollen drift from genetically engineered canola, and the Canadian court held: "The plaintiffs' claim is novel, and there are difficult hurdles to overcome. However, I do not find it plain and obvious that they cannot succeed in showing that the damage or interference they have alleged constitutes a legal nuisance."[130]

Although the Canadian common law, as illustrated in the *Hoffman* case, has adopted a slightly different approach to nuisance, the underlying condition giving rise to a nuisance is similar to the United States' standards.[131] The difference between jurisdictions seems to lie in the court's investigation as to the type of harm resulting from the activity. Where the plaintiff alleges physical harm to her land, the Canadian court need not assess whether the use made by the defendant of her own land was reasonable or not, nor consider the character of the local environment.[132] Such a balancing of circumstances, and in particular the appraisal of the character of the locality in order to determine the standard of comfort the plaintiff may expect, will take

127. Rodgers, *supra* note 99, at 389–90 (explaining that in this case, it was decided that the testing of GM maize in a field adjoining that of the plaintiff's organic maize crop was not unreasonable, insofar as the scientific evaluation had established a likelihood of cross-pollination of one kernel in a thousand if the crops were planted 200 metres apart, while the actual distance between the two crops was two kilometres).

128. *Id.* at 393.

129. *Id.* at 394.

130. Hoffman Canada Inc. v. Monsanto, 2005 SKQB 225, para. 110 (Can.). The "hurdles" alluded to are the fact that, unlike pesticide drifts, adventitious GMO pollen is not inherently harmful to crops, *id.* para. 106, that growing GM canola is not an "unreasonable" use of land in Saskatchewan, and that the "activities of organic farmers are said to raise [an] issue of hypersensitivity." *Id.* para. 107.

131. *Compare* Jane Matthews Glenn, *Footloose: Civil Responsibility for GMO Gene Wandering in Canada*, 43 WASHBURN L.J. 547, 554–55 (2004) (describing nuisance in Canada as "an unreasonable interference with the use or enjoyment of land, causing either physical damage to the land or injury to the health, comfort, or convenience of the occupier"), *with supra* note 110 and accompanying text (describing private nuisance in the United States as "the unreasonable interference with the individual's use and enjoyment of their property.").

132. Glenn, *supra* note 131, at 556.

place only where the claim relates to an interference with use of, rather than harm to, the land.[133]

Where a genetic alteration of plants is not regarded as damage to the land itself,[134] the claim can only be in relation to an interference with land use, and thus the defendant's use and the character of the locality have to be assessed. The "locality" test focuses on the predominant land use in the geographical area concerned. Thus, according to Professor Rodgers, if an area has declared itself "GM free", the introduction of GM technologies on one farm is more likely to constitute an actionable nuisance.[135] This is similar to the discussion of the suitability of an activity to a particular area in § 827(d) of the Restatement (Second) of Torts. As noted in the comment to that section of the Restatement, if a particular use or enjoyment of land is well suited to the locality, an interference with it is more serious than if the use is not suited to the locality.[136] The analysis, therefore, focuses on the condition interfered with (the plaintiff's activity and appropriateness to the locality) rather than the activity of the defendant.[137]

In the United States, the "locality" test is embodied in the various right-to-farm laws enacted by many states with agricultural activities.[138] According to Professor Harl, there are two types of right-to-farm laws. The first codifies the "coming to the nuisance defense" and will protect an agricultural operation only if it predated the "nuisance" or change in the nature of the surrounding area, and if it complied with any state or federal requirements (e.g., permits).[139] "The second type of right-to-farm statute is designed to prevent local and county government from enacting regulations or ordinances that impose restrictions on normal agricultural practices."[140] That is, the second type of right-to-farm laws will ensure that local governments cannot pass local laws that change the requirements for agricultural enterprises. For instance, Texas law states

133. This paragraph draws on *Hoffman Canada Inc. v. Monsanto*, 2005 SKQB 225, para. 100 (Can.) (quoting 1 G.H.L. FRIDMAN, THE LAW OF TORTS IN CANADA 126–30 (1st ed. 1989)).

134. *See* Douglas H. Kenyon & Lionel S. Popkin, *Recent Decisions*, 20 COLUM. L. REV. 612, 615 (1920) (discussing status of growing crops in relation to real versus personal property).

135. Rodgers, *supra* note 99, at 381.

136. RESTATEMENT (SECOND) OF TORTS § 827 cmt. g (1979).

137. *See id.*

138. *See* Grossman, *supra* note 89, at 233–34 (discussing applicability of right-to-farm laws to pollen drift scenario); *see also* Heald & Smith, *supra* note 81, at 121.

139. Harl, *supra* note 75, at 21; *see also* Grossman, *supra* note 89, at 233–34 (discussing right-to-farm laws within the context of genetic engineering).

140. Harl, *supra* note 75, at 21; *see also* A. Bryan Endres, *Coexistence Strategies in a Biotech World: Exploring Statutory Grower Protections*, 13 MO. ENVTL. L. & POL'Y REV. 206 (2006) (discussing state preemption of local initiatives to regulate biotechnology).

that any laws passed by governments other than city and state governments will not affect farms already in existence,[141] and that city government laws will not affect farms outside the corporate boundaries of the city.[142]

Right-to-farm laws, therefore, make nuisance a difficult claim to sustain against a farming operation. Attempting to claim nuisance for pollen drift may be especially difficult. Pollen drifting, after all, is an entirely natural and expected process. It is caused by no unreasonable action of the farmer, and it will happen even if farmers follow all ordinances and regulations currently imposed. Furthermore, the second type of right-to-farm laws would make it difficult to enact local legislation that would make pollen drift a nuisance moving forward. As if right-to-farm laws were not enough of a hurdle, a nuisance suit for pollen drift will also have to contend with the economic loss rule.

The economic loss rule is "the prevailing rule in America,"[143] holding that a mere economic loss, absent some harm to property, is insufficient to obtain tort recovery.[144] Nuisance is no exception to this rule. In order for a plaintiff in a nuisance case to recover, he must show that he has suffered some damage other than pure economic loss.[145] These non-economic damages can be fairly broad. In fact, a plaintiff in a nuisance suit "may recover all consequential damages flowing from the injury to the use and enjoyment of his or her person or property."[146] However, non-economic damages must be shown. When considering pollen drift as a potential nuisance, it is important to note that the harm need not be to personal property. The consequential harm in a nuisance claim can be consequential harm to real property.[147] This fact aside, the necessity that a claimant prove consequential, rather than pure economic, damages could be difficult for farmers claiming nuisance for pollen drift. Farmers grow crops to sell as commodities; thus, convincing a court that the farmer has lost anything but a decline in revenue may be challenging in a nuisance claim between two neighboring farmers.

141. TEX. AGRIC. CODE ANN. § 251.005(b)(1)–(2) (West 2009), *available at* http://nationalaglawcenter.org/wp-content/uploads/assets/righttofarm/texas.pdf. If the farm is established after the law is passed, however, then the farm will have to comply. *Id.*

142. *Id.* § 251.005(c). If the farm is later incorporated into city limits, the farm still does not have to comply with the law unless it is "reasonably necessary to protect persons who live in the immediate vicinity." *Id.*

143. *In re* Chi. Flood Litig., 680 N.E.2d 265, 274 (Ill. 1997).

144. *In re* StarLink Corn Prods. Liab. Litig., 212 F. Supp. 2d 828, 838 (N.D. Ill. 2002) ("Physical injuries to persons or property are compensable; solely economic injuries are not.").

145. *In re Chi.*, 680 N.E.2d at 279.

146. *Id.*

147. *Id.* at 277.

However, in two different cases of farmers suing seed companies for nuisance because of pollen drift and GM contamination of the harvest, the courts have found that pollen drift and the resulting commingling of crop types constituted a physical injury sufficient to survive a challenge under the economic loss doctrine.[148] Both cases involved the contamination of the food supply by GM products that were not yet approved by the FDA for general commercial release, a situation unique from a farmer growing approved GM plants that contaminate organic crops.[149] These cases, although not identical to the farmer-versus-farmer contamination situation discussed in this Article, hint at the potential for an organic farmer to successfully prove more than pure economic loss for pollen drift based on the concept that GM contamination is a form of physical injury.

B. *Alternative Causes of Action: The Conduct-Related Torts of Strict Liability and Negligence*

Although traditional land use doctrines of trespass and nuisance provide some insight, strict liability and negligence rules, analyzed in greater detail below, complete the theoretical common law liability landscape for agricultural biotechnology. To frame our discussion of strict liability, we first discuss the rule defined in *Rylands v. Fletcher*.[150] After briefly exploring strict liability, we turn to negligence and the once again important practical distinction of the economic loss rule.

1. *Rylands v. Fletcher*: Still a Strict Liability Rule?

The remit of the rule laid down by the Court of Exchequer and affirmed by the House of Lords in *Rylands v. Fletcher* requires some clarification. According to Judge Blackburn's dictum, the person who collects on his land "anything likely to do mischief if it escapes" must keep it at his peril, as he will be "answerable for *all the damage* which is the natural consequence of its escape."[151]

148. A. Bryan Endres, *An Evolutionary Approach to Agricultural Biotechnology: Litigation Challenges to the Regulatory and Common Law Regimes for Genetically Engineered Plants*, 4 NORTHEASTERN U. L.J. 59, 74 (2012); *In re* Genetically Modified Rice Litig., 666 F. Supp. 2d 1004, 1016–17 (E.D. Mo. 2009); *In re StarLink Corn Prods.*, 212 F. Supp. 2d at 841–43.

149. Endres, *supra* note 148, at 78.

150. Rylands v. Fletcher, (1868) L.R. 3 (H.L.) 330 (appeal taken from Eng.).

151. John Murphy, *The Merits of* Rylands v. Fletcher, 24 OXFORD J. LEGAL STUD. 643, 653 (2004). A discussion of whether this liability regime also applies to cases of personal injury, unlike nuisance originally, or only if the plaintiff has an exclusive proprietary interest in the land he occupies, as Lord Lloyd required in *Hunter v. Canary Warf Ltd*., is beyond the scope of this note.

As noted by John Murphy, the phrase "anything likely to do mischief if it escapes" has largely been supplanted by the word "dangerous."[152] Likewise, Stephen R. Munzer observes that "American courts interpreted the rule of *Rylands v. Fletcher* as applicable mainly to abnormally hazardous things or activities."[153] Judge Posner, in *Indiana Harbor Belt Railroad Co. v. American Cyanamid Co.*,[154] offers a further restriction: "ultrahazardousness or abnormal dangerousness is, in the contemplation of the law at least, a property not of substances, but of activities."

Conversely, as the United Kingdom House of Lords posits in *Transco plc v. Stockport Metropolitan Borough Council*, "many things not ordinarily regarded as sources of mischief or danger may nonetheless be capable of proving to be such if they escape. I do not think this condition can be viewed in complete isolation from the non-natural user condition."[155] The House of Lords points here to a dangerous, uncommon use of the land, rather than to the dangerous nature of the thing stored on it. Moreover, a use of the land might be uncommon without being unreasonable.[156]

The second relevant criterion is whether the damage was reasonably foreseeable, as in nuisance cases. As noted by Lord Hoffmann in *Transco*, deciding that the defendant should nevertheless be held liable where the escape was not reasonably foreseeable is akin to internalizing the costs of an enterprise.[157] Lord Hoffmann then enumerates the limits[158] put to the rule set out in *Rylands v. Fletcher*. In particular, the

152. *Id.* at 662 (noting that the dangerous nature of the thing, or of the use of land—in this case biotechnology—should be assessed).

153. Stephen R. Munzer, *Plants, Torts, and Intellectual Property*, *in* PROPERTIES OF LAW ESSAYS IN HONOUR OF JIM HARRIS 189, 200 (Timothy Endicott, Joshua Getzler, & Edwin Peel eds., 2006).

154. Ind. Harbor Belt R.R. Co. v. Am. Cyanamid Co., 916 F.2d 1174, 1181 (7th Cir. 1990).

155. Transco plc v. Stockport Metropolitan Borough Council, [2003] UKHL 61, [10], [2004] 2 A.C. 1 [10] (appeal taken from Eng.), *available at* http://www.publications.parliament.uk/pa/ld200203/ldjudgmt/jd031119/trans-1.htm.

156. *Id.* at [11] (Lord Bingham of Cornhill).

157. *Id.* at [29] (Lord Hoffmann of Woodborough).

158. Lord Hoffmann explains in *Transco* that: "within a year of the decision of the house of Lords in *Rylands v. Fletcher*, Blackburn J. advised the house that, in the absence of negligence, damage caused by operations authorised by statute is not compensatable unless the statute so provides." *Id.* at [30] (citation omitted). Thus, the rule in *Rylands* does not cover a use of land proper for the general benefit of the community, such as works constructed or conducted under statutory authority; neither does it apply to acts of God (defined as unusual natural events, such as heavy rains, but also a rat gnawing a hole in a wooden gutter box) or acts of a third party, as these were defenses identified by Blackburn J. in *Rylands* (insofar as the defendant does not have any control on these elements), or to really high-risk activities.

rule has been later understood in England and Wales[159] as applying only to cases where the damage is the natural, foreseeable consequence of the escape. This interpretation tends to merge the rule in *Rylands* into the tort of negligence. However, we contend that this assimilation of the two regimes is disputable. What "natural"[160] means when opposed to "consequence of its escape" is that the resulting damage is the unavoidable result of such an escape, and not that it was foreseeable.

The rule in *Rylands*, understood as a strict liability one in Canada, as a regime of liability for highly dangerous activities in the United States, and subsumed within the tort of nuisance in England and Wales, has been "absorbed by the principles of ordinary negligence" in both Australia[161] and Scotland.[162] As aptly criticized by John Murphy:

> [T]o allow the rule in *Rylands v. Fletcher* to be swallowed up by the law of negligence would mean that in some cases claimants would face insurmountable evidentiary burdens, burdens, indeed, that may be thought inappropriate as a matter of policy and justice. . . . [I]t can be seen that the rule in *Rylands v. Fletcher* provides a viable option for redress where a necessarily fault-based law of negligence would not.[163]

Indeed, the plaintiff would need to show a breach of the duty of care owed by the persons in control of the thing that creates damage by escaping, where the very existence of such a duty in the first place would be difficult to establish in some instances. Thus, a stand-alone rule of strict liability, as *Rylands* was intended to be, for land-related damages[164] might still be justified and, as discussed below, potentially apply in scenarios of pollen drift.

159. Cambridge Water Co. v. Eastern Counties Leather Plc, [1994] 2 A.C. 264 (H.L.) 306 (appeal taken from Eng.) (requiring that nuisance claims under *Rylands* be for only foreseeable damages).

160. Conversely, when the use of the land at stake is said to be a "natural" one, natural has to be construed as meaning "common," "ordinary."

161. *Burnie Port Authority v General Jones Pty Ltd.* (1994) 179 CLR 520, 556, *quoted in Transco plc*, [2003] UKHL at [93] (Lord Walker of Gestingthorpe).

162. Scotland has chosen to depart from *Rylands v. Fletcher* by establishing a fault-based rule in *RHM Bakeries (Scotland) Ltd. v. Strathclyde Regional Council*, (1985) S.C.(H.L.) 17 (Scot.), with Lord Fraser of Tullybelton describing the suggestion that the rule in *Rylands* formed part of the law of Scotland as "a heresy which ought to be extirpated." *Id.* .at 41.

163. Murphy, *supra* note 151, at 659–60 (footnotes omitted).

164. This regime of strict liability is distinct from that applying in the field of product liability, which cannot be developed here.

2. Strict Liability

In the United States, the Restatement (Second) of Torts defines the elements of strict liability as: (1) the probability of an accident is great, (2) the harm that would ensue from this accident could be great, (3) the accident could not be prevented by the exercise of due care, (4) the activity is not a matter of common usage, (5) the activity is inappropriate in the place in which it took place, and (6) the value to the community does not offset the costs in the event of an accident.[165]

As Judge Posner, in *Indiana Harbor Belt Railroad Co. v. American Cyanamid Co.*,[166] distinguished, the necessary care standard in negligence is different from the level of care required in strict liability situations. Although this distinction is often blurred, due care, in the negligence sense, requires "average" care. Strict liability is premised on different principles—not average care. Each of the six factors identified in the Restatement "is a different facet of a common question for a proper legal regime to govern accidents that negligence liability cannot adequately control."[167] None of them suffices and the presence of several is required for strict liability to be found in a given situation. Therefore, the exercise of due care to prevent an occurrence is not a determinative factor as it is in negligence litigation because, by definition, strict liability accidents often cannot be prevented by due care.

Prior commentators have discussed the application of strict liability to the pollen drift situation.[168] *Langan v. Valicopters, Inc.*,[169] a Washington Supreme Court case, provides a straightforward analogy. In that case, the court applied the strict liability regime to a case of contamination of an organic farm by airborne particles—in this instance, pesticides. The court did not find it necessary to assess whether the Plaintiff's specialization in the organic food business was abnormally sensitive to the Defendant's conduct. It simply noted that the "same factors that produced a high degree of risk of harm were not possibly eliminated by the use of reasonable care."[170] On the other hand, the court held in *Hoffman v. Monsanto* that GM crops were not unnatural or dangerous per se.[171] Moreover, depending upon the crop, it may be

165. Restatement (Second) of Torts § 520 (1977).
166. Ind. Harbor Belt R.R. Co. v. Am. Cyanamid Co., 916 F.2d 1174, 1180 (7th Cir. 1990).
167. *Id.* at 1177.
168. Endres, *supra* note 103, at 473–75.
169. Langan v. Valicopters, Inc., 567 P.2d 218 (Wash. 1977).
170. *Id.* at 222; Heald & Smith, *supra* note 81, at 129.
171. Hoffman Canada Inc. v. Monsanto, 2005 SKQB 225, para. 100 (Can.).

possible to exercise some amount of care in the agronomic sense to prevent if not the pollen drift, at least the damage from the pollen.[172]

3. How Does Negligence Apply to Pollen Drift Events?

Before trying to apply rules of negligence to such situations, it is worth recalling the economic justification of this regime of liability. Negligence can be construed as the failure to take optimal care to avoid foreseeable accidents.[173] The principle more generally applied has come to be known as the "Hand Formula," announced by Judge Hand in *United States v. Carroll Towing Co*.[174] It consists in determining whether the burden of precaution is less than the costs of the accident multiplied by the probability that such accident occurs. When such is the case, it is negligent not to take precautions to avoid the accident. However, as explained by Judge Posner in *McCarty v. Pheasant Run, Inc.*,[175] "this is a distinction without a substantive difference. . . . The formula translates into economic terms the conventional legal test for negligence."

Clearly, pollen drifts qualify as foreseeable events, insofar as this is precisely what the reproduction of cross-pollinating plants is based upon. The questions that concern us here, in relation to the application of negligence rules to pollen drift events, are how can the injured party show the existence of a duty of care, what would this duty consist of, and who would owe it to whom?

Farmers who decide to buy genetically modified seed enter into a contract with the seed company (which generally has applied for or obtained a patent to protect its seeds), either directly or through a "shrink-wrap" license affixed or printed on the bag containing the seeds.[176] The primary purpose of these contracts is to reserve the seed breeder's intellectual property rights.[177] A secondary purpose is to provide notice of some agronomic or marketing restrictions. These could include the mandatory planting of non-genetically engineered (or

172. *See* Heald & Smith, *supra* note 81, at 111 (discussing buffer zones).
173. Richard A. Posner, *A Theory of Negligence*, 1 J. LEGAL STUD. 29, 32–34 (1972).
174. United States v. Carroll Towing Co., 159 F.2d 169 (2d Cir. 1947).
175. McCarty v. Pheasant Run, Inc., 826 F.2d 1554, 1557 (7th Cir. 1987) (citations omitted).
176. *See generally* Heald & Smith, *supra* note 81, at 114–15.
177. A. Bryan Endres, *State Authorized Seed Saving: Political Pressures and Constitutional Restraints*, 9 DRAKE J. AGRIC. L. 323, 325 (2004); Keith Aoki, *Weeds, Seeds & Deeds: Recent Skirmishes in the Seed Wars*, 11 CARDOZO J. INT'L & COMP. L. 247, 255 (2003).

engineered with a different trait) seeds to manage resistance pressures[178] or even a notice to sell the harvested crop in approved marketing (e.g., domestic only) channels.[179]

Seed company license agreements could, but as a general rule do not, include a notice given by the seed company to the GM farmer concerning some drift prevention measures:

- Fencing (with pollen barriers),
- Where possible (depending on the number of neighboring farmers and on the crops they plant) adopting a crop rotation system or minimum time intervals between the cultivation of GM and non-GM crops of the same species. This would require consultation between GM, conventional and organic farmers in the area and use of crop varieties with different flowering times,
- Cover tassels with bags in order to avoid cross-pollination with other farmers' crops of the same species (although possible in theory, this measure would be particularly cumbersome and costly in practice).

In sum, several alternative strategies are available to minimize or even prevent the impact of pollen drift. Thus there is some argument that taking these measures is an aspect of due care. However, use of negligence as a cause of action for pollen drift is complicated by a familiar issue: the economic loss rule. The economic loss rule, discussed more thoroughly above, states that a claimant is not entitled to recovery in a tort proceeding unless he can show he has suffered more than mere economic losses.[180] Negligence, like nuisance, requires a showing of physical damage.[181] Thus, farmers who choose negligence as their cause of action against pollen drift face the same problem as farmers who choose nuisance; they must prove that the loss of their crops is more than a pure economic loss.

Where the GM seed company has given notice to the GM farmers, and these farmers have not implemented the measures required in order to avoid contaminating neighboring fields, the GM farmers failing to

178. *See* MONSANTO, 2014 TECHNOLOGY USE GUIDE 4–5 (2013), *available at* http://www.monsanto.com/sitecollectiondocuments/technology-use-guide.pdf (discussing restrictions on the use of GM seeds in order to prevent insect resistance).

179. *Know Before You Grow*, NAT'L CORN GROWERS ASS'N, http://www.ncga.com/for-farmers/know-before-you-grow (last visited May 12, 2014) (providing recommendations for farmers to select seeds that have approval for export markets).

180. *See supra* notes 143–47 and accompanying text.

181. *In re* Chi. Flood Litig., 680 N.E.2d 265, 274 (Ill. 1997)..

implement such measures could be held liable for negligence. Another possibility would be to shift the liability burden on the non-GM farmer should he be the least-cost avoider. This would lead to a no-liability result where the non-GM farmer failed to take necessary precautionary measures and contamination of his field resulted.

Another solution would consist in enticing all operators involved to share the costs of prevention of pollen drifts, and the liability burden. Presumably each party assuming responsibility for contamination prevention measures where they are the least-cost avoider. For example, the GM farmer may have lower costs for installing fencing, establishing a buffer zone, or assuming cleanup costs of "decontamination" of non-GM farmers' fields. Similarly, non-GM farmers would implement those measures for which they are least-cost avoiders, lest the compensation for the loss of their premium resulting from the adventitious presence of GM plants in their fields would be reduced due to their contributory negligence.

Overall, non-GM farmers will be willing to take measures to avoid adventitious presence of GM plants, or pay compensation to GM farmers for them to take such measures or to abandon cultivation of GM crops, so long as the premium farmers receive for their non-GM produce exceeds the costs of precautionary measures or compensation paid to GM farmers.[182] Similarly, GM farmers will stop growing GM seeds if the costs of isolation (fencing, buffer zones) or the amount of damages paid to conventional farmers exceed the benefits derived from higher yields resulting from GM crop production.[183]

We contend the economically efficient allocation is to place the burden of precautionary measures regarding pollen drift on the GM producer. First, the developer of GM seeds (and thus the farmer-customers of these products) are in the best position to evaluate the risk of pollen drift due to greater access to information than other farmers. Thus, these market participants may more aptly internalize the cost of risk in their prices. Secondly, and relatedly, it can be argued that users of GM seeds may present the greatest risk. The theory of reciprocal risks states that the party that creates "a risk greater in degree and different in order" from the other party or parties has created a nonreciprocal risk for

182. This analysis is an application of the Coase Theorem, as discussed in R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

183. *See generally* VOLKER BECKMANN, CLAUDIO SOREGAROLI & JUSTUS WESSELER, GOVERNING THE CO-EXISTENCE OF GM CROPS: EX-ANTE REGULATION AND EX-POST LIABILITY UNDER UNCERTAINTY AND IRREVERSIBILITY (Volker Beckmann & Konrad Hagedorn eds., 2006), *available at* http://www.ssoar.info/ssoar/handle/document/12618 (ICAR Discussion Papers).

which that party should be held responsible.[184] GM companies are creating synthetic crops which pose a far greater risk to non-GM growers than users of non-GM growers impose on their neighbors. Thirdly, owing to higher prices, consumers (here, GM farmers) are more likely to buy the exact amount they need, rather than too much of seed, as might be the case under a negligence rule applied upstream onto the GM seed companies. This is all the more true as seed prices are most likely rather elastic, because substitutes to GM seeds exist, i.e., conventional seeds for the same species. This could encourage GM farmers to plant buffers of non-GM crops along field borders.

As this section has illustrated, perhaps neither trespass, nuisance, traditional strict liability nor negligence are ideal causes of actions for dealing with conflicting land uses that on their face are not more intensive or better suited to the land than the conflicting use. But if we reframe these traditional tort doctrines under a theory of social welfare maximization, there is greater clarity on how the law may evolve to better resolve the farmer versus farmer scenario.

IV. SOCIAL WELFARE MAXIMIZATION, THE LEAST-COST AVOIDER, AND THE COEXISTENCE APPROACHES

The proceeding sections are meant to illustrate the risks of organic farming in the United States. Not only is there the ever-present danger of commingling and pollen drift from neighboring GM farms that can jeopardize an organic farmer's return on investment; the contamination might be enough to cause the organic farmer to lose organic certification on the land, which is a costly and time consuming process.[185] However, as we address below, society values organic food and is willing to pay a premium for the benefits that organic food provides.[186] Yet under the current tort regime, there is no predictable protection or redress for an organic farmer to shield their investment and livelihood should a GM farmer start farming on neighboring land. This may have the perverse effect of causing organic farmers to switch to conventional farming to avoid unprotected economic losses, despite society's demand for organic food. Of course, absent some special circumstances, the GM farmer is also using his land in a productive and legal way, even though it conflicts and potentially harms his neighbor's use. When faced with two conflicting land uses that are both legal, how does the law decide who to favor? The following section contemplates allocation of liability using

184. George P. Fletcher, *Fairness and Utility in Tort Theory*, 85 HARV. L. REV. 537, 542 (1972).
185. *See supra* Part II.
186. Wang et al., *supra* note 29, at 376.

economic principles to show that implementing a coexistence regulatory system is a better, more predictable model than relying on the current tort system.

As we have discussed throughout this Article, the current tort system is not set up to predictably or efficiently decide who should be held liable for the burden of preventing pollen drift between an organic and GM farmer, and may even exclude such cases entirely based on right-to-farm statutes.[187] In his now famous paper, *The Problem of Social Cost*, R.H. Coase considered how to allocate liability when there was no clear wrongdoer and the damaging business is not liable for any of the damage it causes, situations that he identified as an example of the reciprocal nature of harm.[188] In such situations, the real task for the decision maker is deciding whether A should be allowed to harm B or if B should be allowed to harm A?[189] If society establishes rules to prevent pollen drift (harm) to the organic farmer by placing the burden of the underlying prevention measures on the GM farmer, then the GM farmer is harmed because he cannot plant as much GM crop on his land. Coase explains that the only way to determine who society chooses to harm is to know the value of what is obtained in comparison to the value of what is sacrificed to obtain it.[190] Once we know the value, Coase claims that the proper procedure for deciding which side to favor is comparing the total social product yielded by these different arrangements—looking to see which side maximizes social welfare by being able to "fix" the harm at a lower social cost.[191]

If an accident can be avoided by only one person, absolute liability is sufficient to create incentives for this person to avoid such an accident, insofar as the costs incurred by this liability do exceed the costs of precautionary measures.[192] However, where several persons could avoid the accident, some might tend to free-ride on the others' efforts, which results in a sub-optimal level of precaution. In the now classic model devised by Calabresi and Hirschoff, liability rests on the "least-cost avoider", i.e., the person who could avoid an accident at the lowest cost, irrespective of the level of care taken by this person.[193]

"Calabresi and Hirschoff structured the cheapest cost-avoider test in a peculiar way: they defined the cheapest cost-avoider as the person best

187. *See supra* Part III.
188. Coase, *supra* note 182, at 2.
189. *Id.*
190. *Id.*
191. *Id.* at 43–44.
192. Guido Calabresi & Jon T. Hirschoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055, 1060 (1972).
193. Stephen G. Gilles, *Negligence, Strict Liability, and the Cheapest Cost-Avoider*, 78 VA. L. REV. 1291, 1306 (1992).

suited (1) to carry out a cost-benefit analysis of a particular accident risk, and then (2) to act on that analysis."[194] These authors specified, however, that the party in the best position to make the cost-benefit analysis might not always be in the best position to act upon it; in such a case, the decision would require weighing comparative advantages.[195] A more general formulation of the least-cost avoider principle "simply asks which party could, at lowest overall cost, have avoided the accident"[196], irrespective of the applicable liability regime.[197] The general position of Stephen Gilles is that the costs fall on the victim, who supports the burden of liability in a negligence regime, unless the injurer is shown to be the least-cost avoider. Guido Calabresi and Alvin Klerovick,[198] quoted by Stephen Gilles, prefer to reverse this rule, so that the costs would be borne by the injurer, unless the victim is shown to be the least-cost avoider, leading to a situation of no-liability.[199] In situations where several persons can take precautions in order to prevent damage from occurring, in other terms, in joint-care problems identified by William Landes and Richard Posner (1987),[200] the test becomes "what *additional* precautions by each party could have avoided the accident at least cost,"[201] i.e., a marginal least-cost avoider analysis. This creates incentives for all parties involved to take care.

Overall, the least-cost avoider test is the most efficient allocation of liabilities in situations where transaction costs would be prohibitive for conventional, organic, and GM-farmers to contract (on crop rotation or on sharing fencing costs for instance), because there are numerous, not always easily identifiable, parties involved (for example multiple borders with multiple combinations of GM and organic farmers). Additionally, the least-cost avoider test is more efficient than waiting for a full cost-benefit analysis by the courts, because trials are time- and resource-consuming for society. According to Landes and Posner, where transaction costs are high enough to hinder bargaining, property rights or liabilities must be assigned so as to minimize transaction costs.[202] Thus, property rights or entitlements are vested on the party who values them

194. *Id.*
195. *Id.* at 1307 n.47.
196. *Id.* at 1308.
197. The phrase "least-cost avoider" is often replaced with that of "best-cost avoider". The two expressions are equivalent, and mean that persons who can avoid an accident at the lowest cost should have liability imposed on them.
198. Guido Calabresi & Alvin K. Klevorick, *Four Tests for Liability in Torts*, 14 J. LEGAL STUD. 585, 588–89 (1985).
199. Gilles, *supra* note 193, at 1308 n.48.
200. WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF TORT LAW 190 (1987).
201. Gilles, *supra* note 193, at 1310.
202. LANDES & POSNER, *supra* note 200, at 85–88.

the most, saving the cost of a transaction. Following this logic of welfare-maximization, the least-cost avoider analysis should be conducted by legislators when allocating liabilities in events of pollen drifts under a regulatory regime.[203]

Borrowing from the economics literature, social welfare maximization is an economic principle championed by consequentialists.[204] Concerned with society's overall welfare, consequentialists believe that public policy decisions should be based on the likely outcomes of the different choices, and that regulators should always choose the policy that results in a better outcome.[205] Determining the better outcome depends on what social welfare function is used.[206] Historically, social welfare has been defined as the maximization of society's wealth, meaning "the sum total of the value of goods and services available as measured by people's willingness to pay for them."[207] Accordingly, if price serves as an accurate representation of consumers' willingness to pay, then the measure of what all people are willing to pay for an outcome of a certain policy decision is a reflection of the wellbeing produced by that decision.[208] Further using wealth maximization as a way to measure overall social welfare is useful with the understanding that people are willing to pay more for an outcome if it means they are better off.[209]

Much of the discussion of social welfare maximization in terms of organic versus conventional farming has focused on the total yield; the standard assumption is that organic agriculture has lower yields, and therefore needs more land to produce the same amount of food as a conventional farmer, making organic farming a more costly and less efficient option.[210] The traditional thinking is that the higher yield from conventional farming translates to more food, which in turn translates to more revenue for the farmer and is thus better for society's general welfare.[211] However, as discussed in Part III of this Article, comparing only the yields of organic and conventional farms is an inaccurate analysis of social welfare because of the steep price differential between

203. *Id.*; Gilles, *supra* note 193, at 1298.
204. Michael B. Dorff, *Why Welfare Depends on Fairness: A Reply to Kaplow and Shavell*, 75 S. CAL. L. REV. 847, 851 (2002).
205. *Id.*
206. *Id.* at 853.
207. *Id.* at 873–74.
208. *Id.* at 874.
209. *Id.*, at 876.
210. Seufert et al., *supra* note 39, at 229.
211. Eric F. Lambin & Patrick Meyfroidt, *Global Land Use Change, Economic Globalization, and the Looming Land Scarcity*, 108 PROC. NAT'L ACAD. SCIENCES 3465, 3465 (2011).

organic and conventional products.[212] A more accurate way to assess social welfare is to include society's value of the product as indicated by its price, and not simply yield. In other words the profit per acre provides a clearer picture of which farming operation contributes more to total social welfare.

For example, if we look back to Table 1 in Part II of this Article, the traditional analysis, which compares only yields, would show that GM results in 179 bushels per acre, while organic, at its reported lowest yield, brings in 122 bushels per acre. Based on this variable, the organic farm produces 84 percent of the conventional farm and appears to be the less efficient use of the land. However, when we look at the overall return, a different picture of social welfare appears. When examining the returns per acre, a GM farm receives $332.94 per acre, while an organic farm receives $763.91 per acre (again we use the most conservative data for organic profits per acre, yet recall that many of the studies showed higher yields than the 84 percent used in this worst-case example). Using these estimates, on a property with 100 acres, a conventional farmer stands to make a return of $33,294 (100 acres multiplied by the $332.94 profit per acre), while the organic farmer on the same land would receive a return of $76,391 (100 acres multiplied by the $763.91 profit per acre).

This example demonstrates that even though the organic yield is smaller, the returns are greater for the same tract of land. If we alter our social welfare maximization calculation to focus on the overall returns, it is clear that the organic farm is more valued by society because society is willing to pay more for organic food. As mentioned above, social welfare is maximized by society's wealth, and because the organic farmer provides more wealth per acre than the GM farmer, the implication is that organic production is the higher social use of the land. This conclusion leads us to revisit placement of the legal burden to prevent cross-contamination via pollen drift.

As described above, there are several ways to prevent pollen drift; including fencing (with pollen barriers), adopting a crop rotation system, minimum time intervals between the cultivation of GM and non-GM crops, use of crop varieties with different flowering times, and physical covering of tassels.[213] All of these options require placing limitations on the use of the land at a cost to the implementing farmer. As mentioned above, neither the GM nor the organic farmer deserves to pay for this burden in the general sense that one use is bad or wrong. However, in order to avoid costly and unpredictable tort claims, the authors suggest a regulation that decides the issue beforehand. When faced with

212. *See supra* Part III.
213. *See supra* Part IV.

conflicting uses of land, society must have a way to decide which use to favor. From an economic perspective, policy makers should select the use that maximizes social welfare.[214] If one of the two neighboring farmers has to sacrifice five percent of his or her production in order to compensate for the burden of preventing pollen drift, it should come from the land use that is valued less by society. This will increase social welfare by preventing the damage at a lower cost. Following this logic, we should shift the duty of preventing pollen drift onto the GM farmer because it will cost society less than if the burden rests with the organic farmer. This idea of shifting the burden onto the least-cost avoider is discussed in the following section.

V. RECOMMENDATION FOR IMPLEMENTATION OF COEXISTENCE REGULATIONS

Pollen drift is not the first liability allocation issue that emerged from landowners sharing common borders with conflicting uses.[215] For example, farmers have long dealt with how to manage the cost of fencing, either in or out, livestock that are capable of destroying a neighboring farmer's crops.[216]

A "division" fence is simply a fence that divides two adjoining landowners with rules allocating the legal obligation to build and maintain the fence generally outlined via a state statute.[217] There are currently four types of fence cost-sharing provisions in the United States: fence-in; fence-out; mandatory cost-sharing; and equitable cost-sharing.[218] The following section describes each of these models.

The traditional English common law rule is the fence-in option.[219] The operation of this rule is relatively straightforward—to prevent liability from property damage caused by livestock running-at-large, the livestock owner is required to fence-in her property at her own expense.[220] Of course, nothing prohibited adjoining landowners from sharing the burden of building and maintaining a common fence and in practice this is what happened. But if one landowner elected to keep

214. Dorff, *supra* note 204, at 852.

215. A. Bryan Endres & Lisa R. Schlessinger, *A Move Towards a More Fair Division: Envisioning a New Illinois Fence Act*, FARMDOCDAILY (Dec. 13, 2012), http://farmdocdaily.illinois.edu/2012/12/a-move-towards-a-more-fair-division.html.

216. *Id.*

217. Craig R. Heidemann, *Fencing Laws in Missouri: Confusion, Conflict, Ambiguity and a Need for Change*, 63 MO. L. REV. 537, 538–39 (1998).

218. Terence J. Centner, *Reforming Outdated Fence Law Provisions: Good Fences Make Good Neighbors Only if They Are Fair*, 12 J. ENVTL. L. & LITIG. 267, 280–81 (1997).

219. *Id.* at 268.

220. *Id.* at 280.

livestock, and thus build a fence, nothing prohibited the adjacent landowner from later making use of this same fence to restrain his own livestock without compensating for the initial construction costs.

The converse of the English common law rule is fence-out, in which the livestock owner is not responsible for building fences to confine her animals, but rather adjoining neighbors who want to keep straying livestock off their land must bear the burden of paying fence costs.[221] A fence-out policy is more popular in western states where there are large amounts of open grazing land and the cost of fencing-in ones livestock over this vast area would be economically infeasible.[222] Accordingly, the law in these areas developed to place the burden on the small-landholder seeking to keep livestock out of their homestead yard. Although declining in use, perhaps due to development pressure, a few fence-out jurisdictions remain.[223]

Mandatory cost-sharing regimes require adjoining landowners to share the cost of a division fence to control the livestock owner's animals, regardless of the corresponding utility a neighbor may receive from the division fence.[224] In essence, whenever one landowner is willing to pay half the funds to build a fence between the properties, the adjoining landowner is burdened with the other half of the fence costs.[225] From an economic perspective, this rule may be efficient when the majority of landowners in a jurisdiction graze livestock. This prevents the "free-rider" problem of the common law fence-in rule whereby the adjoining landowner can take advantage of the fence erected by the neighbor without compensation. On the other hand, a system that requires payment for an unneeded fence can be burdensome and oppressive to the non-livestock owning landowner.[226]

The equitable cost-sharing model is a hybrid of the original fence-in rule along with mandatory cost-sharing. As in the fence-in rule, livestock owners bear the burden of building and maintaining an adequate fence to restrain their livestock.[227] However, if an adjoining neighbor has livestock, or later decides to acquire livestock, a cost-sharing provision is triggered to ensure that all landowners benefiting from a fence also share in the cost.[228]

221. *Id.* at 269.
222. *Id.* at 268–69.
223. *See* ROBERT C. ELLICKSON, ORDER WITHOUT LAW 43 (1991).
224. Centner, *supra* note 218, at 281.
225. *Id.* at 282.
226. *Id.*; *see also* Sweeny v. Murphy, 334 N.Y.S.2d 239, 242 (App. Div. 1972) (finding a mandatory cost sharing fence law to be oppressive when defendant owned 110 dairy cows and plaintiff neighbor kept no livestock).
227. Centner, *supra* note 218, at 280.
228. *Id.*

Thus far, the default rule for pollen drift buffer zones for crop production has been an informal "fence-out" rule, meaning the organic farmer must cover the cost and land for the buffer zone.[229] However, this approach may not maximize social welfare and rather reflect the economic and political influence of the large agribusiness and chemical/biotechnology industry.[230] In the alternative, a coexistence regulation that codifies and mirrors what state legislators have adopted for fence laws across the United States would provide an improvement to society.

If the farmers each have a 100 acre farm, as previously demonstrated in the social welfare maximization section, above, a GM farmer would receive a return of $33,294 while an organic farmer would receive a return of $76,391. If five acres are required for a buffer zone to minimize pollen drift between the two cornfields, we can calculate the costs of "sacrificing" the five acre buffer zone.[231] If the organic farmer must implement the buffer zone (an application of the fence-out rule), the farmer would lose five percent of his return, a total of $3,849.55. On the other hand, if the GM farmer must implement the buffer zone (an application of the fence-in rule), the GM farmer would lose five percent of his return, a total of $1,664.70, a substantially lower financial loss than the organic farmer.

However, the figures calculated above illustrate only part of the economic story. Even though the organic farmer must segregate the harvest into two supply chains, the farmer can plant organic for the majority of the harvest and conventional-non-GM corn in the five acre strip, which means that 95 acres will fetch the organic rate of return and five acres will bring in a return based on a conventional-non-GM price,[232] resulting in a total loss of $2501.05 (The difference in the cost of 100 acres of organic return and a combined total of 95 acres of organic and five acres of conventional-non-GM corn).[233] But, the organic farmer does so at a risk of commingling non-organic corn with the organic corn, resulting in the entire harvest being designated as commodity grade and losing a greater amount of money because the entire yield of the 100 acres would be calculated at the conventional-non-GM return per acre instead of the organic return per acre.[234]

229. Endres, *supra* note 148, at 64.
230. *Id.* at 74.
231. *Id.* at 67.
232. For the non-GM conventional rate of return we are using the USDA conventional data from Table 1 that has a lower yield than GM farms of 145 per acre and has a rate of return per acre of $269.70.
233. Endres, *supra* note 148, at 67.
234. *Id.*

Conversely, if the GM farmer must implement the buffer zone while taking into account that five acres would bring in the rate of return per acre for conventional-non-GM corn, then the GM farmer would only lose $316.20 if he is unable to plant GM corn on all 100 acres. This application of the rule is less risky than to the organic farmer, because even though the GM farmer must also plant two varieties of corn, at harvest the GM farmer does not risk losing the GM value of the 95 acres like the organic farmer does by planting non-organic seed in the five acre buffer zone.[235]

Based on the above analysis, it is clear that society can maximize total welfare if the GM farmer bears sole responsibility for the buffer zone. Not only does the buffer zone result in less risk for the GM farmer in terms of management costs and return, but the buffer zone costs less overall for the GM farmer to maintain. On the other hand, the organic farmer would suffer a greater actual loss and be at risk of even great loss if the same buffer zone is his responsibility.

An alternative liability allocation of mandatory and equitable cost-sharing modeled on the 50-50 rule for division fence and placing responsibility on each farmer to supply 2.5 acres of the buffer zone on their land would be inefficient because both farmers would incur the management costs.[236] Additionally, it would still be more costly for the organic farmer to sacrifice 2.5 acres of land ($1,250.52)[237] than it costs the GM farmer to cover the entire ten foot buffer zone ($316.2). Such an arrangement would fail to maximize social welfare.

As the calculations have shown, the fence-in rule, allocating the liability to the GM farmer, is the most efficient legislation because it both maximizes social welfare and assigns the burden of prevention on the least-cost avoider. Because of this, the authors recommend that states implement a fence-in rule that places liability for the buffer zone to prevent pollen drift on the GM farmer.

This Article has attempted to show the limitations of traditional torts in resolving pollen drift disputes and the currently vulnerable position of non-GM farmers. We argue that the legislator may best positioned to step in and design specific liability rules that maximize social welfare as opposed to relying on the courts to resolve this issue in a piecemeal fashion. We have suggested that this could be done on the

235. *Id.*

236. *Id.*

237. This figure was calculated by taking 97.5 acres and multiplying it by the rate of return per acre for organic corn ($769.91) and then taking 2.5 acres and multiplying it by the rate of return per acre for conventional-non-GM corn ($269.70). Once these two figures were added together, the total was subtracted from 100 acres of organic corn ($76,991) to come up with the cost of covering half the buffer zone.

premises of the least-cost avoider, with legislation modeled after current division fence laws—an allocation of responsibility and liability that has longstanding acceptance in the agricultural community. Under this model, the liability for pollen drift prevention rests with the GM farmer. This is a shift in the current legal approach, but one that could result in lower costs to obtaining coexistence and thus a net improvement for social welfare.