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ARTICLE

A Window of Opportunity for GMO Regulation: Achieving Food Integrity Through Cap-and-Trade Models from Climate Policy for GMO Regulation

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Apathy can be overcome by enthusiasm, and enthusiasm can only be aroused by two things: first, an ideal, which takes the imagination by storm, and second, a definite intelligible plan for carrying that ideal into practice.
- Arnold J. Toynbee

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I. INTRODUCTION

American-patented commodity crops have taken the European market by storm. With an increase of GMO imports, genetically engineered (GE) corn, rice, wheat, and soy have flooded the European Union (EU). GMOs are difficult to detect once introduced into ecosystems,[1] and they become inextricably intertwined with local biodiversity. In deliberations about approving GE crops, policy makers chose to ban GMOs in order to protect the European

1. *Reliable, Standardised, Specific, Quantitative Detection of Genetically Modified Food, in* A DECADE OF EU-FUNDED GMO RESEARCH (2001-2010), at 150 (2010), https://web.archive.org/web/20130805192627/http://ec.europa.eu/research/biosociety/pdf/a_decade_of_eu-funded_gmo_research.pdf [https://perma.cc/5954-V2AB].

food system and its ecosystem until GMOs are proven safe.[2] European experts have given equal weight to the food safety and environmental impact of genetically engineered organisms (GMOs),[3] urging legislators to take sustainability, benefits, and impact on society into account. This balance of priorities is a clash between the prolific commercialization of GMOs and the free trade position of the US, and the precautionary and protectionist approach of the EU and its member states, wary of the risks that GMOs bring along. However, international trade pressures the EU to open its gates to even more GMO imports and possibly to cultivation of GE crops.[4] How could the EU fight back?

Changing US law on GMO approvals along with the confounding and shared regulation of the executive branch's agencies is beyond realistic, permitting uncountable GMOs to be farmed and exported to the EU. However, a cap-and-trade model borrowed from climate change policy may help the EU to protect its member states from GMOs and the associated food safety and environmental risks by slightly altering trade. Essentially, if you can alter the trade, you can alter the practice,[5] as the World Trade Organization (WTO) has shown.[6] The reverse is also true and evident from the proliferation of GMOs in commodity crop agriculture, representing the practice, altered by the potential to export and, thereby, trade GMOs widely.[7] The goal of this paper is to explore and contextualize potential regulatory mechanisms

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2. *Transboundary Movements*, EUR. COMM'N, http://ec.europa.eu/food/plant/gmo/transboundary_en [https://perma.cc/XJR8-2JMG] ("Regulation (EC) 1946/2003 regulates transboundary movements of GMOs and transposes the Cartagena Protocol on Biosafety into EU law.").

3. *European Network on Safety Assessment of Genetically Modified Food Crops, in* A DECADE OF EU-FUNDED GMO RESEARCH (2001-2010), *supra* note 1, at 142, 148.

4. Gabriela Steier, *Trivialization Through Proliferation: Genetically Engineered Food, Urban Agriculture, and Climate Change Mitigation for Improved Food Security in EU-US Trade* (forthcoming).

5. The author thanks Professor Pamela Vesilind for extracting this essential insight and for her support and guidance with this paper.

6. Steier, *supra* note 4; *see also What is the Role of the Multilateral Trading System on World Food Prices?*, WORLD TRADE ORG. (2009), https://www.wto.org/english/forums_e/debates_e/debate18_e.htm [https://perma.cc/RFF7-9DZG].

7. *Recent Trends in GE Adoption*, U.S. DEP'T OF AGRIC. ECON. RES. SERV., http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption/ [https://perma.cc/X73L-SY83] (last updated Nov. 3, 2016).

borrowed from climate change policy to examine conceivable regulatory controls of the spread of Genetically Modified (GM) crops as a safeguard of environmental integrity and food "integrity."[8] Food systems can benefit from borrowing a cap-and-trade scheme from climate change regulation for a bottom-up market-based (as opposed to government top-down) regulation of GMOs to make room for crop diversification, thereby triggering a positive ripple effect for agro-ecosystems, food safety and security, and food policy in the US.

A. GMOs as Links of a Centralized Food System

GMOs are the links of our centralized food system, largely dependent on international trade. The Agricultural Market Information System, a network to which most large food-producing countries subscribe, uses the GE commodity crops of corn, wheat, soy, and rice as key market indicators,[9] providing data to umbrella organizations that determine global policy, such as the WTO and the Food and Agriculture Organization of the United Nations (FAO).[10] Moreover, the well-known Cornucopia Institute's diagram based on Michigan State's Professor Phil Howard's research visualizes that the seeds are ultimately owned by the major plant patent holders, Monsanto, DuPont, Bayer, Syngenta, Dow, and BASF.[11] These multi-national agricultural companies (hereinafter BigAg), dominate both markets and agriculture lobbies, thereby exerting tremendous pressure on legislators and policy holders to eliminate market barriers, maintain trade paths that allow these companies to grow bigger, and boost their bottom lines.[12] Recently,

8. Food integrity shall be defined as the measure of environmental sustainability and climate change resilience, combined with food safety, security, and sovereignty for the farm-to-fork production and distribution of any food product.

9. *Supply & Demand*, AGRIC. MKT. INFO. SYS., http://www.amis-outlook.org/amis-monitoring/supply-demand/overview/en/ [https://perma.cc/AE63-SY2H].

10. *Food Security*, WORLD TRADE ORG., https://www.wto.org/english/tratop_e/agric_e/food_security_e.htm#amis [https://perma.cc/D2QQ-ALUE].

11. Phil Howard, *Seed Industry Structure 1996-2013*, CORNUCOPIA INST., https://www.cornucopia.org/wp-content/uploads/2013/09/seedindustry.pdf [https://perma.cc/L2Q9-7T9B]; *see infra* Figure 1.

12. Amy Mayer, *Why You Should Care About 'Big Ag' Companies Getting Bigger*, CIVIL EATS (Oct. 31, 2016), http://civileats.com/2016/10/31/why-you-should-care-about-big-ag-companies-getting-bigger/ [https://perma.cc/6YML-HQKS].

these companies have come together to form even larger conglomerates, creating power distortions that may, as reports warn, "trigger structural changes to the foundations of our food system and impact all Americans, whether or not they buy seeds, fertilizer or herbicides."[13] As such, the consolidation of food systems, owned by BigAg and scrutinized by trade-oriented bodies such as the WTO, leave barely any room for considerations of food safety, consumer protection, environmental integrity, and overall food integrity. Here, food integrity shall be coined as a measure of environmental sustainability and climate change resilience, combined with food safety, security, and sovereignty for the farm-to-fork production and distribution of any food product.

The quantity of GMO production and export are key indicators that commodity crops have become an economy of scale – a scale that goes beyond country borders,[14] across jurisdictions,[15] above and beyond international treaties,[16] and past the planet's capacity, depleting its resources and work force.[17] As biotechnology has drastically changed American agriculture,[18] the necessary regulations have not kept up. An estimated 70 percent of food sold at grocery stores contains GM ingredients.[19] Although 88 million acres of GM crops are being cultivated in the US, their environmental, public health, and economic implications remain

13. *Id.*

14. *See generally* WORLD TRADE ORG., PRICE VOLATILITY IN FOOD AND AGRICULTURAL MARKETS: POLICY RESPONSES (2011), https://www.wto.org/english/news_e/news11_e/igo_10jun11_report_e.pdf [https://perma.cc/XT8E-XSMM].

15. *See* National Bioengineered Food Disclosure Standard Act of 2016, Pub. L. No. 114-216, § 764, 130 Stat. 834 (2016) (also called the DARK Act); *see also* Michal Addady, *President Obama Signed This GMO Labeling Bill*, FORTUNE (July 31, 2016), http://fortune.com/2016/07/31/gmo-labeling-bill/ [https://perma.cc/PVN2-YXFP].

16. *See* Marrakesh Agreement Establishing the World Trade Organization, Apr. 15, 1994, 1867 U.N.T.S. 154 [hereinafter Marrakesh Agreement].

17. Fredrik Moberg, et al., *How to Feed Nine Billion within the Planet's Boundaries: The Need for an Agroecological Approach*, SWEDISH INT'L AGRIC. NETWORK INITIATIVE (Mar. 2015), http://www.siani.se/sites/clients.codepositive.com/files/document/siani_agroecology_brief_march_4.pdf [https://perma.cc/R35V-4CFU].

18. Jason J. Czarnezki & Emily Montgomery, *Genetically Modified Organisms and the Environment, in* FOOD, AGRICULTURE AND ENVIRONMENTAL LAW 93, 93 (Mary Jane Angelo et al. eds., 2013).

19. *Id.*

uncertain at best.[20] Capping the ever-growing trade of GE crops might be a viable solution to interrupt the flux of environmentally harmful and risky foods along the trade lines of commodity crops. This paper proposes such a cap-and-trade model and explores the environmental repercussions of the widespread GM crop agriculture. The goal of this paper is to explore regulatory mechanisms borrowed from climate change policy to examine potential regulatory controls of the spread of GM crops as a safeguard of environmental integrity.[21]

B. GMO Regulation Under a Climate Change Regulatory Model

Food systems can benefit from borrowing a cap-and-trade scheme from climate change regulation for a bottom-up market-based regulation of GMOs to make room for crop diversification to promote food integrity. The novelty of this idea lies in the inward-pointing regulatory approach where international policy may help the US catch up with domestic food policy. Although, the regulation of GMOs is an issue that many have written about before,[22] putting GMO regulation under a climate change regulatory approach in the context of capping international trade of the most traded GMO commodity crops, is a new twist that combines both problems into a proactive solution.

The proposed solution, despite the vast amount of literature on point, is non-obvious. In climate change regulation, cap-and-trade schemes are well-known, but their applicability to agro-ecosystems, however, has barely been covered in the literature and

20. *Id.*

21. Although GM crops are closely related to GM animals in agriculture, GM animals are beyond the scope of this paper.

22. *See, e.g.,* A. Bryan Endres & Lisa Schlessinger, *Pollen Drift: Reframing the Biotechnology Liability Debate*, 118 PENN ST. L. REV. 815 (2014); Bernd van der Meulen & Neshe Yusuf, *One-Door-One-Key Principle: Observations Regarding Integration of GM Authorization Procedures in the EU*, 118 PENN ST. L. REV. 877 (2014); Gregory Shaffer, *A Structural Theory of WTO Dispute Settlement: Why Institutional Choice Lies at the Center of the GMO Case*, 41 N.Y.U. J. INT'L L. & POL'Y. 1 (2008); Cara V. Coburn, Comment, *Out of the Petri Dish and Back to the People: A Cultural Approach to GMO Policy*, 23 WIS. INT'L L.J. 283 (2005); Elizabeth G. Hill, Comment, *Nature's Harvest or Man's Profit: Environmental Shortcuts in the Deregulation of Genetically Modified Crops*, 44 TEX. TECH L. REV. 353 (2012).

certainly not from a legal point of view. Borrowing climate change regulation for food systems is a practical idea because agriculture should not be separated (through agricultural exceptionalism as explained below) from environmental considerations and, thereby, climate change considerations. Thus, agro-ecology is the sustainable counterpart to industrial monocultures and GE cropping.

Finally, considering how a cap-and-trade system might apply to food systems is a useful start for policy makers and supplies a basis for further discourse. This paper takes issues left open—h ow GMOs and climate change should be regulated—in legal literature, and combines them by zooming in on one particular tangent, namely food trade. Correspondingly, food trade regulation could be a powerful tool to unleash or disrupt the centralized food system by capping commodity crop trade, and thereby discouraging unsustainable GE cropping, thus redistributing resources and opening trade routes for agro-ecologically produced alternatives to commodity crops. This ripple effect may serve to decentralize food systems and invigorate local supply chains, which has predictably positive environmental outcomes, such as reduced food miles, less fossil fuel dependence, improved crop diversity, and even a more varied food supply produced at greater transparency to improve food safety and security in the best case scenarios.[23]

C. Trans-Atlantic Comparison: US-American Free Trade and European Precautionary Protectionism

This paper takes a comparative law approach, borrowing from climate change policy on the one hand, and from related legal systems, on the other. The functionality principle from modern comparative law[24] informs the methodology in this paper by examining the concrete problem of how GMOs can be regulated in international trade. Comparing the EU to the US approaches serves to juxtapose two extremes: the free trade (US) and the protectionist (EU) approach of GMO trade regulation.

23. *See* Moberg et al., *supra* note 17; Gabriela Steier, *Small Farmers Cool the Planet- The Case for Rights-Based International Agroecological Law*, 4(2) GRONINGEN J. INT'L. L. 1 (2016).

24. KONRAD ZWEIGERT & HEINRICH KÖTZ, AN INTRODUCTION TO COMPARATIVE LAW 34-35 (Tony Weir trans., Oxford University Press 3d ed. 2011).

Additionally, in borrowing the cap-and-trade model from climate change policy, this policy proposes mechanisms to close some loopholes established through agricultural exceptionalism from a food law approach, as explained in Part 3. Resulting from this climate change policy extension to agricultural trade, food systems may find more sustainable and environmentally friendly alternatives that decentralize and open-up trade on a global scale.

The structure of US law has not yielded a GMO regulatory framework as sustainable and environmentally friendly as in the EU, despite extensive regulation of the food and agricultural sector. States have started to require labeling of GMOs as a consumer protection scheme,[25] but the BigAg lobby continues to be so powerful that additional legislation may be obsolete. Thus, assuming that additional GMO regulation on a federal level is a solution beyond the scope of this paper, one may envision trying the market-based approach, capping the amount of GMOs that can be traded. Zooming further in on the GMO market, commodity crops compose the primary traded crops[26] and, therefore, lend themselves to being a test group for such a cap-and trade scheme. In 2016-2017, according to USDA-FAS data, the US alone dominates world production with 386.7 million metric tonnes of corn (nearly 60 percent globally), 474 of milled rice (98.5 percent globally), and 688.4 of wheat (about 91.6 percent globally).[27] The EU imports large quantities of oilseeds, animal feedstuffs, and rice, according to the WTO's tariffs and duty regulations.[28] Competing with the US, "wheat is by far the most popular cereal grown in the EU, making up nearly half the total[,]" with corn and barley each making up another third.[29] As such, comparing the US and EU

25. For a list of states requiring GMO labeling, see *GMO Labeling Isn't Dead: See Which States Are Leading the Fight*, JUST LABEL IT!, http://www.justlabelit.org/press-center/press-items/gmo-labeling-isnt-dead-see-which-states-are-leading-the-fight [https://perma.cc/Z53S-5N3Y].

26. Jeff Daniels, *Agriculture Commodity Traders See a Good 2017, Despite Possible Demand Risks*, CNBC (Jan. 3, 2017, 4:07 PM), http://www.cnbc.com/2017/01/03/agriculture-commodity-traders-see-a-good-2017-despite-possible-demand-risks.html [https://perma.cc/5ELC-K93Y].

27. Estimated calculation based on FOREIGN AGRIC. SERV., *All Grain Summary Comparison*, *in* GRAIN: WORLD MARKETS AND TRADE 3 (2017), https://apps.fas.usda.gov/psdonline/circulars/grain.pdf [https://perma.cc/DT4W-HFVH].

28. *Cereals, Oilseeds and Protein Crops, Rice*, EUR. COMM'N, https://ec.europa.eu/agriculture/cereals_en [https://perma.cc/DQ5T-M6VK].

29. *Id.*

commodity crop trade schemes may be quite revealing as globally dominant forces with international impact on the agricultural sector.

From the onset, however, the clashes of the US-American and European legal systems must be accounted for from a comparativist perspective. Following the negative aspect of the functionality principle[30] in this comparative analysis, "sources of law" are "whatever molds or affects the living law in [the] chosen system."[31] Simply put, the author strives to think creatively, eradicating the preconception and investigating the positive aspects of the European and US-American legal systems compared herein, to find an analogy to the solution of interest, i.e. the forced diversification of crops to weaken GMO proliferation through US exports.[32] The premise for this methodology is that of Ernst Rabel, an internationally renowned comparativist, finding that "social, economic and legal fields interact[]" to shape political and legal ideals.[33] Here, the ideals point toward more sustainable and resilient food production of diversified crops. Underlying this approach is a simple premise: for sustainable agricultural systems to feed future populations, GMOs must be heavily regulated and stopped from flooding the international crop markets. Diversifying the crop trade of the major producers and importers, the US and the EU respectively, illustrates which legal tools can be targeted to achieve these goals. Using cap-and-trade methods from greenhouse gas (GHG) trading models in climate change policy provides an imaginable upstream regulatory model. Finally, choosing a comparison of the EU and the US systems is merely a trans-Atlantic geographical limitation to deepen the analysis of the US - from where many GMOs originate, on the one hand, and the EU - of the most resistant governments to GMOs, on the other hand. Then, an explanation of the clash between free trade and protectionist perceptions create a basis for the subsequent context of international GMO trade, as well as its environmental and food safety risks.

In Part 1, the pertinent risks of genetically engineered crops are contrasted to conventionally bred counterparts, clarifying

30. ZWEIGERT & KÖTZ, *supra* note 24, at 35.
31. *Id.*
32. *Id.*
33. *Id.* (citations omitted).

common misconceptions and highlighting the need for improved regulation. Concepts of food policy and macroeconomics, such as free trade and protectionism, are briefly introduced by way of background information for the following legal analysis. Then, Part 2 identifies the problematic risks of GMO under-regulation, namely uncontrolled environmental harm and food insecurity. Explaining how agricultural exceptionalism enables the US-American free-trade approach to GMO regulation, prioritizes profitability of agriculture over other important considerations, such as public health, socio-economic and direct and indirect environmental effects. Part 3 proposes a solution, a cap-and-trade upstream regulation of GMOs borrowed from climate change policy. The applicability to the US is explored in context of paragon directives from the EU on GMO regulation. Notably, in conceding that the US GMO regulatory policy does not exist in a vacuum, this paper takes a comparative law approach, contrasting the US free trade against the EU protectionism and precautionary models, evaluating both with the goal to extract a cap-and-trade model suitable for the US and concludes with an evaluation of the proposed model.

II. SETTING UP THE MODEL: MISCONCEPTIONS AND KNOWLEDGE GAPS

A. Genetically Engineered Versus Conventionally Bred Crops

To clarify common misconceptions from the onset, genetically engineered crops do not occur in nature and are inherently "unnatural" because they cross species barriers and are designed to be mass-produced in industrial agricultural schemes. Genetically Modified Organisms (GMOs), also known as Genetically Engineered (GE) or Genetically Modified (GM) crops are widely understood to be modified to give desired traits through biotechnology of recombinant deoxyribonucleic acid (rDNA).[34] In contrast, conventional breeding includes other methods, such as selective breeding, crossing, and interspecies hybridization.[35] The

34. NEIL D. FORTIN, FOOD REGULATION: LAW, SCIENCE, POLICY, AND PRACTICE 277 (Wiley & Sons eds., 2d ed. 2016).

35. *Id.*

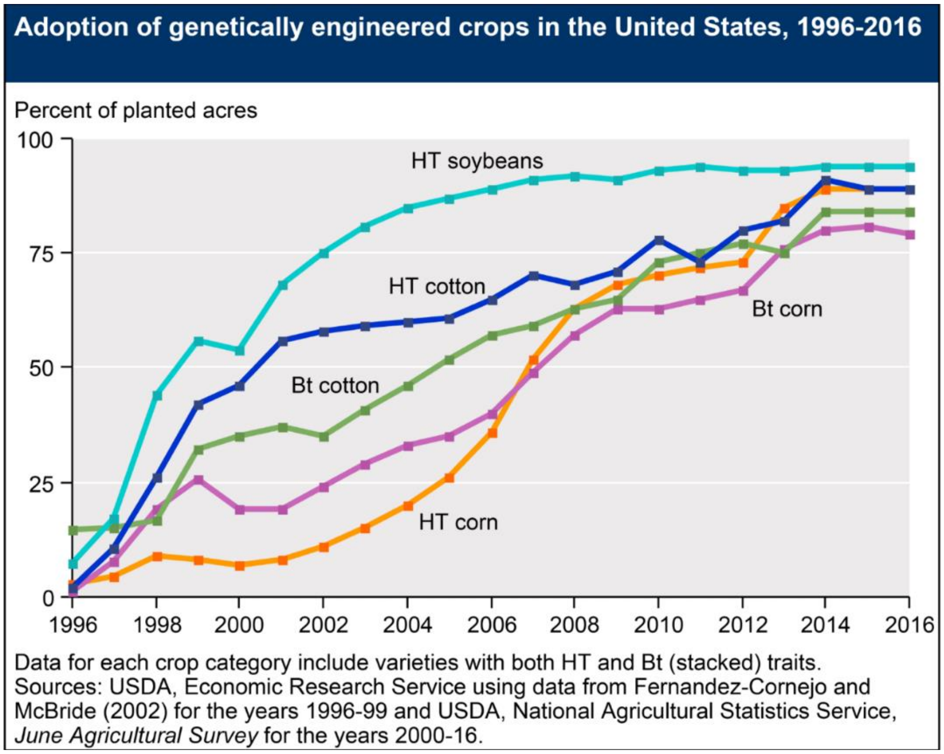
relevant difference between genetic engineering and conventional breeding for this paper is that GE plants are specifically engineered to industrial agriculture, cultivation in monocultures, and thereby, highly resource-intensive and environmentally harmful practices.[36]

There are several types of GE crops, such as, among others, herbicide resistant (HT) and insect resistant (Bt) varieties, which are abundant in the US.[37] According to the US Department of Agriculture (USDA), HT crops have been "developed to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds."[38] Their alleged benefit is that they "provide farmers with a broader variety of options for effective weed control."[39] The other common type of GE crops are insect-resistant crops, defined by the USDA as those crops "containing the gene from the soil bacterium Bt (*Bacillus thuringiensis*)," which "produce a protein that is toxic to specific insects, protecting the plant over its entire life."[40]

Projected spread for GE Crop Cultivation in the US is usually measured by acreages planted with these crops.[41] So-called "stacked" varieties of cotton and corn, which have both HT and Bt traits, have accelerated in recent years, with stacked corn accounting for up 76 percent of corn acres in 2016.[42] According to the USDA-ERS, "GE soybean adoption rates reached 94 percent in 2016 (soybeans have only HT varieties). Adoption of all GE corn accounted for 92 percent of corn acreage in 2016."[43] A European multi-disciplinary investigation of the possible negative effects on the biodiversity of non-target insects in and around fields of Bt crops that have fuelled growing public and political concerns, found that pollinator, predator, and other arthropod biodiversity were affected.[44]

36. *See generally* Czarnezki & Montgomery, *supra* note 18.
37. *Recent Trends in GE Adoption*, *supra* note 7.
38. *Id.*
39. *Id.*
40. *Id.*
41. *Id.* The spread of GE crops is rising. *See infra* Figure 1.
42. *Id.*
43. *Id.*
44. *Effects and Mechanisms of* Bt *Transgenes on Biodiversity of Non-Target Insects: Pollinators, Herbivores and Their Natural Enemies*, *in* A DECADE OF EU-FUNDED GMO RESEARCH (2001-2010), *supra* note 1, at 52.

Figure 1: Adoption of GE crops in the US.[45]



The USDA's Economic Research Service (ERS) reports that "HT soybeans went from 17 percent of U.S. soybean acreage in 1997 to . . . 94 percent in 2014, 2015, and 2016. Plantings of HT cotton expanded from about 10 percent of U.S. acreage in 1997 to . . . 89 percent in 2015 and 2016."[46] Moreover, "[p]lantings of Bt corn grew from about 8 percent of U.S. corn acreage in 1997 to . . . 79 percent in 2016. . . . Plantings of Bt cotton also expanded rapidly, from 15 percent of U.S. cotton acreage in 1997 to . . . 84 percent in 2014, 2015, and 2016."[47]

45. Figure reprinted from *Recent Trends in GE Adoption*, *supra* note 7.
46. *Id.*
47. *Id.*

B. Risks of GMO Under-Regulation of GMOs

Under-Regulation of GMOs, favoring the alleged free-trade view, prioritizes profitability of agriculture over other important considerations, such as public health, socio-economic, and direct and indirect environmental effects. In fact, a 2015 review study published in *Agriculture, Ecosystems & Environment* examined "the direct and indirect trait-specific effects of GM plants, microbes, and animals on ecosystem processes" and concluded "that most of the effects of genetically modified organisms (GMOs) on ecosystem processes are indirect and are the result of associated changes in management strategy rather than a direct effect of the GMOs."[48] The researchers from the Swedish University of Agricultural Sciences explain that "manipulated traits may introduce unforeseen effects on ecological processes, and there is a possibility of trade-offs at the genetic, physiological or ecological level that constrain the opportunities for improving resource-use management using modern biotechnology."[49] They also found that "the adoption of novel transgenic plants, animals, and microbes in agricultural systems globally may have potentially large impacts at [the] ecosystem level."[50] Those impacts mainly affect net production, nutrient cycling, greenhouse gas fluxes, biodiversity, and crop-weed and trophic interactions.[51] Thus, "knowledge of their sustainable use and environmental impact is crucial," but for HT and Bt crops, the most studied GM crops' "direct effects of GM traits are rare and effects on ecosystem processes have seldom been documented."[52]

Most of the effects of GMOs on ecosystem processes that have been reported to date are indirect, appearing to rely on complex, multi-trophic interactions, and are primarily a consequence of changes in agricultural practices associated with, for example, the

48. Anna-Karin Kolseth et al., *Influence of Genetically Modified Organisms on Agro-Ecosystem Processes*, 214 AGRIC., ECOSYSTEMS & ENV'T 96, 96 (2015), https://www.researchgate.net/publication/281559358_Influence_of_genetically_modified_organisms_on_agro-ecosystem_processes [https://perma.cc/GJ6M-UN93].

49. *Id.* at 97 (citation omitted).

50. *Id.*

51. *Id.*

52. *Id.* at 102.

use of HT and insect-resistant crops.[53] The Swedish researchers identified knowledge gaps and highlighted the "urgent need for basic ecological and agronomic research on the impacts of traits (modified with conventional methods or GM) on ecosystem processes in order to evaluate the possible effects of GMOs in an appropriate setting."[54] Precisely this knowledge gap lies between the European precautionary and the US-American biotechnology approaches in regulating GE crops. In short, the US evaluates risks from GMOs as products and asks "what is made?" while the EU's approval process of GMOs is process-oriented, asking "how is it made?" The resulting dissonance is at the heart of the solution proposed herein, respecting both approaches and suggesting a bridge to allow both to coexist.

In the US, GMOs are regulated under the Coordinated Framework for Regulation of Biotechnology, which "was promulgated by the White House Office of Science and Technology Policy in 1986 to address the budding biotechnology industry."[55] The Framework was designed to institute a "comprehensive federal regulatory policy" for GM research and products, and specified that GM products would be regulated under then-existing laws and regulations instead of developing new laws to address the new technology.[56] The basis for this policy was the government's conclusion that GM products are not fundamentally different from non-GM products or inherently risky, and thus the final product of

53. It should also be noted that,

> many of the published reports on the effects of GMOs are descriptive and lack functional-mechanistic analyses aiming at the causal relationships between organismal traits and relevant ecosystem processes in agro-ecosystems or of importance for natural resource management. The focus of most investigations is on risk assessment at species level without considering an ecosystem perspective. There are also numerous conflicting results on the performance and environmental effects of GM crops, especially with regard to effects on crop yield and impacts on non-target organisms. It has previously been pointed out that this type of data is inconclusive or contradictory and that any discussion on the potential of GM crops needs to take these complex results into account.

Id. (citation omitted).

54. *Id.* at 102.

55. Czarnezki & Montgomery, *supra* note 18, at 99.

56. *Id.*

biotechnology should be regulated, rather than the process of creating GM products.[57]

The three agencies responsible for GMO regulation under the Framework are the Food and Drug Administration (FDA), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Agriculture (USDA).[58] In short, the FDA oversees what is safe to eat, the USDA oversees what is safe to grow, and the EPA oversees what is safe for the environment. Notably, the USDA has primary authority over all GE plants "except those that are pest-protected" and "oversees the interstate movement, import, field testing . . . and generally ensures that they are safe to grow."[59] USDA's Animal and Plant Health Inspection Service (APHIS), under the authority of the Plant Protection Act (PPA), mandates that USDA's APHIS oversights prevents the release and spread of "plant pests," broadly defined as organisms "that can injure or cause disease or damage (directly or indirectly) in or to any plants or plant parts,"[60] commonly known as "weeds." None of the agencies directly address questions of food issues with climate change, nor do they help streamline and decentralize the system as a whole.

Environmental scholars have repeatedly lamented that, "[a]s a result of the policy set out in the Framework, no single law directly addresses GM plants or GM products in general. Instead, as many as 12 statutes, a myriad of regulations, and five different agencies and services play a role in governing GM products."[61] All of the regulatory oversight in the cracks and crevices left behind an ever-stronger Biotech and BigAg lobby yields several risks that remain unaccounted for from the regulatory and legal point of view. Environmental risks from GE crops include the possibility that GM plants or traits give rise to superweeds resistant to herbicides, that insects become resistant to Bt crops or pesticides used in synchrony with GM crops, reduced biodiversity, the effects of GM crops and the associated chemicals on non-target organisms,[62] i.e other wildlife and plants, monoculture cultivation

57. Czarnezki & Montgomery, *supra* note 18.
58. *Id.*
59. *Id.* at 99-100.
60. *Id.* at 100 (citing 7 U.S.C. § 2402 (2012)).
61. *Id.* at 99.
62. *Id.* at 97.

and the land use, soil depletion, freshwater waste for irrigation, and fossil-fuel-dependent intensive agriculture associated with GM cropping. The cumulative effects of these policies lack in convergence.

C. Free Trade Versus Protectionism

This paper seeks to examine the nuances between the two opposing views of free trade versus protectionism in international food trade,[63] specifically focusing on the problem of GMO regulation, where BigAg has benefitted from the tension of these competing regulatory views and consolidated food systems. On the one hand, as Professor Michael Roberts from UCLA Law School explains, the free trade view expects that "the expansion of food trade is good for consumers, farmers, and the United States as a whole," and "that consumers have come to expect the world food system to provide them with a wide choice of products and that changes in consumer taste have encouraged the emergence of global markets and added to the significance of trade."[64] Moreover, subscribers to the free trade view "posit[] that trade enables farmers to build markets for surplus food and has helped maintain in the United States a competitive domestic food market" and base their opinion "on a market model in which food trade between the United States and other countries flows without restrictions imposed by government."[65]

The expansion of GMOs and the underlying trade have, however, undermined this view in creating trade distortions, which, in turn "create more universal problems, such as food insecurity, social unrest, unsustainable food production, environmentally harmful farming, and political uncertainty."[66] As a result of distorted trade of GE crops, specifically of commodity crops, global food distribution has become ineffective.[67] Through Regional Trade Agreements (RTAs), which are "deep integration

63. *See* MICHAEL ROBERTS, FOOD LAW IN THE UNITED STATES 57 (Cambridge Univ. Press 2016).

64. *Id.* (internal citations omitted).

65. *Id.*

66. Steier, *supra* note 23, at 1.

67. YING CHEN, TRADE, FOOD SECURITY, AND HUMAN RIGHTS: THE RULES FOR INTERNATIONAL TRADE IN AGRICULTURAL PRODUCTS AND THE EVOLVING WORLD FOOD CRISIS 73 (Routledge 2014).

partnerships between countries or regions with a major share of world trade and foreign direct investments,"[68] highly-productive nations, such as the US, "often fail to address the inequalities of trading partners and miss the important goal of trading governments to ensure food security."[69] As such, the ever-expanding BigAg network spans not only agriculture and trade, but also policy and socio-economic aspects of many nations.

On the other side of the spectrum, competing with the liberal free trade is the notion that uncontrolled "expansion of food trade threatens food safety, food security, farms and food enterprises, the environment, and culture" because unrestricted "food trade encapsulates the inequity between the industrialized nations and the poorer, predominantly rural countries."[70] This protectionist vision for food trade envisions a fair distribution of importing and exporting countries and crops, rather than a centralized and lop-sided BigAg-dominated grid where the haves and haves not, as Ernest Hemingway once put it,[71] compete in one global market to the detriment of the latter. Consequently, while "[t]hose who oppose trade liberalization of food favor restrictions to trade,"[72] as Professor Roberts explains, the problem is more nuanced, as illustrated by the GMO-focus of this paper. Stepping back and simplifying the tension to a mere clash to free trade versus protectionism is an oversimplification prone to misinterpretation and lobbyist abuse in favor of either end of the spectrum. With the BigAg lobby pouring $94,282,881 in 2016 alone[73] to control the discourse and policy, one must steer clear of these pitfalls and traps from logical fallacies so often abused by the industry.[74] Instead of the mere clash between the free trade and protectionist,

68. *Call for Papers: 2016 AgLaw Colloquium*, INST. LAW, POLI. & DEV. (Oct. 20, 2016), http://www.santannapisa.it/it/event/2016-aglaw-colloquium [https://perma.cc/45WL-R4FT],

69. Steier, *supra* note 23, at 2.

70. ROBERTS, *supra* note 63, at 57.

71. ERNEST HEMINGWAY, TO HAVE AND HAVE NOT (1937).

72. *Id.*

73. *Sector Profile, 2016: Annual Lobbying for Agribusiness*, OPENSECRETS, https://www.opensecrets.org/lobby/indus.php?id=A [https://perma.cc/JX7V-T4S9].

74. THE GMO DECEPTION: WHAT YOU NEED TO KNOW ABOUT THE FOOD, CORPORATIONS, AND GOVERNMENT AGENCIES PUTTING OUR FAMILIES AND OUR ENVIRONMENT AT RISK (Sheldon Krimsky & Jeremy Gruber eds., 2014) [hereinafter THE GMO DECEPTION].

the actual subject matter of trade must therefore be considered alongside the public health, socio-economic, and environmental effects to ensure a well-rounded analysis.

D. GMO Regulation in the EU

By comparison to the US, European GMO regulation is largely streamlined and follows the aforementioned precautionary principle through EU Directives on point. "In 1990, the European Council adopted Directive 90/220/EEC on the Deliberate Release of Genetically Modified Organisms," taking "a process rather than product-oriented approach"[75] like the US Framework. Notably, the Directive's language is in stark contrast to the US Framework, where the Directive notes that it is "based on the principle that preventive action should be taken . . . whereas the effects of such releases on the environment may be irreversible" and where "the protection of human health and the environment requires that due attention be given to controlling risks from the deliberate release of genetically modified organisms (GMOs) into the environment."[76] Notably, its preamble already establishes that "case-by-case environmental risk assessment should always be carried out prior to a release,"[77] taking the "better safe than sorry" approach as opposed to the US counterpart's "safe until proven unsafe" dogma.

Other Directives on point are Regulation (EC) 1829/2003 on genetically modified food and feed[78] and Implementing Regulation 503/2013 on applications for authorisation of genetically modified food and feed.[79] Both of these regulations give the European Food Safety Authority (EFSA) authority over GMOs and set forth a rigorous safety assessment, including the procedures for evaluation and authorisation of GM foods and feeds,[80] which are largely banned and barely cultivated in the EU.

In June 2015, EFSA published a new guidance clarifying the data needs for the agronomic and phenotypic characterisation of

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75. *Id.*
76. Council Directive 1990/220, 1990 O.J. (L 117) 15 (EC).
77. *Id.*
78. Commission Regulation 1829/03, 2003 O.J. (L 268) 1 (EU).
79. Commission Regulation 503/13, 2013 O.J. (L 157) 1 (EU).
80. *Genetically Modified Organisms*, EUR. FOOD SAFETY AUTH., https://www.efsa.europa.eu/en/topics/topic/gmo [https://perma.cc/FUM4-V6GW].

GM plants.[81] The document complements existing guidance on data requirements for the risk assessment of GM plants. "It gives applicants seeking market approval for a GM plant in the European Union recommendations on how to generate, analyse and interpret agronomic and phenotypic data of the GM plant."[82] Interestingly, the 2015 "guidance proposes a comprehensive and harmonised approach for the agronomic and phenotypic characterisation of GM plants, which should ensure the best use of agronomic and phenotypic data for the comparative analysis of GM plants and derived food and feed products, and for their food and feed and environmental risk assessment."[83] This guidance alone illustrates that EFSA acknowledges and is aware of the risks that GMOs pose, leading to a near zero-tolerance of GMOs in the European market – a stark contrast to the US approach.

Putting all of this into context, the EU essentially up-regulates GMOs while the US down-regulates GMOs. This divergence is in part due to agricultural exceptionalism in the US and can only be overcome if agriculture is positioned within environmental law and the climate change discussion about resilient food production and food integrity. The reason why the US has historically down- and under-regulated GMOs is a function of its agricultural exceptionalism, the very policy allowing special status for food producers.

E. Agricultural Exceptionalism and GMO Down-Regulation in the US

Agricultural exceptionalism is the point at which food and agriculture law diverge. Agricultural law,[84] rooted in Jeffersonian elitism, has been distorted into a system reminiscent of nepotism from long passed feudal and colonial regimes, based on the societal

81. EFSA Panel on Genetically Modified Organisms, *Guidance on the Agronomic and Phenotypic Characterisation of Genetically Modified Plants*, 13 EFSA J. 44 (2015).

82. *Id.*

83. *Id.*

84. "Agricultural law can be defined as the study of the network of laws and policies that apply to the production, marketing, and sale of agricultural products, i.e., the food we eat, the natural fibers we wear, and increasingly, the bio-fuels that run our vehicles." Susan A. Schneider, *A Reconsideration of Agricultural Law: A Call for the Law of Food, Farming, and Sustainability*, 34 WM. & MARY ENVTL. L. & POL'Y REV. 935, 935 (2010).

goal to preserve and protect farms. It is the basis for the conglomerates of multi-national companies—BigAg—which shape the multi-lateral food trade, thereby controlling large aspects of agriculture world-wide. As Professor Roberts explains, "[e]xamples of agricultural exceptionalism via the law include protections afforded to farmers in labor, bankruptcy, and international trade; exceptions to environmental and antitrust regulations; and programs based on subsidies, loans, and education."[85] Scholars have called for a "reconsideration of agricultural law and policy to address the unique aspects of agricultural production, the fragility of the environment, and the fundamental need for healthy food,"[86] but the legislature has not responded to satisfy the demands of food lawyers. Distinguishable from agriculture law, food law is practiced by those learned colleagues exploring the intersection of law and food, in terms of how food sustains life, affects the quality of life, shapes societies, and manifests cultural values.[87] Food lawyers hold the law accountable for the five topics it covers, commerce, safety, marketing, nutrition, and systems,[88] all of which are complex and connected. Thus, while agricultural law largely represents farms and agricultural enterprises, food law concerns itself with the safe and sustainable production of food in a manner that ensures the highest possible quality of life in a more holistic approach, considering food security, food sovereignty, biodiversity, and ecologic systems at large. The point of divergence and friction between agricultural law and food law is simply the premise that exceptionalism should not be a permissible lair of BigAg's externalized costs.[89]

Domestic GMO policy has taken a pro-industry approach, down-regulating the agricultural sector to benefit BigAg's cost externalization practices. As asserted by the FAO and other organizations:

> agricultural biotechnology will be important to meet global nutritional needs in 2050. Many countries have responded to this challenge, allowing agricultural biotechnology innovations to be

85. ROBERTS, *supra* note 63, at 6-7.

86. Schneider, *supra* note 84, at 935.

87. ROBERTS, *supra* note 63, at 2.

88. *Id.*

89. *See* Gabriela Steier, *Externalities in Industrial Food Production: The Costs of Profit*, 9(3) DARTMOUTH L.J. 163 (2011).

> commercialized as part of their strategic response to the FAO challenge. While Argentina, Australia, Brazil, Canada, and the USA have all approved the production of GM crops, few developing countries have followed suit.[90]

Even peer-reviewed scientific journals fall prey to the misunderstandings about GMO safety, criticizing the EU for its progressive, precautionary, and effective approach to ban GMOs.[91] However, even Europe's ban is not absolute. In fact, Monsanto's Maize MON 810 is the only GE crop that has been approved in the EU.[92] Between its approval in 1998 and the expiration of the license in 2013, 150,000 hectares have been planted with MON 810, with 91.3 percent in Spain alone.[93] The *European Parliament News* reported that GMOs are banned in Germany, Austria, Bulgaria, Luxembourg, Poland, Hungary, Greece and Italy, and predicts that "[i]t is possible that other countries could follow suit."[94]

The debate over GMOs on a governance level continues. In fact, "[t]he European Commission is proposing to give member states the power to ban the commercialisation of GMOs on their territory, even if they have already been approved at EU level."[95] However, members of the European parliament rejected the proposal for "fear it could prove unworkable and lead to border controls between countries that disagree on GMOs, which would affect the internal market."[96] The EU imports most of its GE soybeans from the US, Brazil, and Argentina but products containing more than 0.09 percent of GMOs must be labeled in the EU,[97] thereby shifting the risk assessment partially to consumers. Thus, the debate over GMOs centers around the utility versus the need, on the one hand, and the possible risks and reserves, on the

90. Stuart J. Smyth et al., *EU Failing FAO Challenge to Improve Global Food Security*, 34 TRENDS IN BIOTECHNOLOGY 521, 521 (2016).

91. *See generally* THE GMO DECEPTION, *supra* note 74.

92. *Eight Things you Should know About GMOs*, EUR. PARLIAMENT NEWS (Oct. 27, 2015), http://www.europarl.europa.eu/news/en/news-room/20151013STO97392/eight-things-you-should-know-about-gmos [https://perma.cc/KK4S-QYR5].

93. *Id.*

94. *Id.*

95. *Id.*

96. *Id.*

97. *Id.*

other hand.[98] As long as the proliferation of GMOs continues to be trivialized by their mass production, BigAg's business remains guarded under agricultural exceptionalism.

From a European perspective, agricultural exceptionalism resembles an artificial construct:

> [o]ver the years, the boundary between the species is broken and new varieties are introduced, for example, a gene of the pig in a tomato, a firefly gene into a tobacco plant and a human gene into a bull. The killing of the natural boundaries between species, the unpredictability of long-term effects and irreversibility of the potential environmental consequences are among the main risks associated with GMO[s].[99]

Notably, in a telling and suspicious lack of studies on point, "the review articles published in international scientific journals during the current decade did not find . . . references concerning human and animal toxicological/health risks studies on GM foods."[100] "It is therefore important that the legislation on GMOs in the EU and its Member States, in many third countries and in international treaties be based on this reality."[101]

III. THE SOLUTION

A. Cap-and-Trade in Climate Change Policy and GE Commodity Crops

If commodity crops, specifically the most commonly traded GMOs, were regulated under a cap-and-trade scheme borrowed from climate change regulation, a system shift toward improved food integrity might result. In a cap-and-trade regulatory model, a government sets a limit on the quantity of GHG emissions, distributes permits for allowable emissions that add up to the cap, and enables firms to buy and sell the permits after the initial distribution.[102] Regulated sources must pay allowances at the end

98. Margherita Arcieri, *Spread and Potential Risks of Genetically Modified Organisms*, 8 AGRIC. & AGRIC. SCI. PROCEDIA 552, 554 (2016).

99. *Id.*

100. *Id.* (citation omitted).

101. *Id.*

102. HARI M. OSOFSKY & LESLEY K. MCALLISTER, CLIMATE CHANGE LAW AND POLICY 34-35 (2012).

of a given period equal to their emissions,[103] but ultimately strive to stay within the cap. The price for emission allowances (the carbon price) is determined by supply and demand for allowances in an emissions trading market.[104]

Applied to GE crop trades, governments concerned with the environmental and food safety risks of GMOs could cap the quantities of crops that may be distributed, creating an environment similar to the GHG trading model under the Paris Agreement. Briefly, under the United Nations Framework Convention on Climate Change (UNFCCC), GHG emissions are traded like commodities[105] – hence the parallel to the GMO trading proposal. Here, the regulated sources would be easily traceable food conglomerates, such as the major GE seed producing companies and BigAg's main players. At the end of a given period, GMO producers and sellers would essentially have to stay below a certain maximum amount of GMOs that may be traded, thereby either keeping GMOs for domestic use or reducing production overall. The advantage of keeping the GMOs for domestic use puts the brunt of the cap-and-trade scheme on the major producing countries: US, Brazil, and Argentina.[106] As a consequence of the reduced export, price volatility may directly or indirectly enable the second benefit of this scheme, reducing GMO production overall, thereby forcing farmers to diversify their crops. Supply and demand for GMOs would thus dwindle and potentially make room for crop diversification and more sustainable alternatives of agriculture. The commodity crop trading market would consequently become more varied and create opportunities for agro-ecologic farming to push BigAg's market dominance aside, thereby decentralizing the market further.

Refining the commodity-crop cap-and trade scheme further, the upstream alternative, as opposed to the downstream version, lends itself to this scenario. Again, borrowing from climate change policy,

103. *Id.*

104. *Id.*

105. *International Emissions Trading*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/kyoto_protocol/mechanisms/emissions_trading/items/2731.php [https://perma.cc/3BFR-BBED].

106. *Countries Growing GMOs*, GMO COMPASS (Jan. 19, 2007), http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/142.countries_growing_gmos.html [https://perma.cc/J2TL-XPB5].

> [a]n upstream cap-and-trade (UCT) system applies to fuel suppliers and requires them to surrender allowances equivalent to the carbon content of fossil fuels they distribute. . . . This option has the advantage of being relatively simple, and it covers the entire economy. Analyses have shown that it would be environmentally efficient, minimize economic costs to the economy, be manageable administratively, and link easily to domestic and international offset programs.[107]

Here, the commodity crop UCT would apply to GE crop producers and their supply chains, including pesticide, herbicide, and chemical fertilizer producers, down to the distributors of fossil-fuel dependent machinery upon which industrial agriculture relies, covering the entire economy. Food lawyers might argue that more environmentally friendly alternatives would ensue if the BigAg system were weakened through such a UCT.

B. An Upstream Cap-and-Trade (UCT) Model for GE Commodity Crops

The premise of the UCT model lies in its simplicity. As long as the goal is to create market forces that those countries following the precautionary approach, such as the EU, need is to shift food systems away from industrial agriculture and toward agroecology, thereby diversifying the commodity crop market by creating opportunities to compete with non-GMO crops, the UCT model is a powerful tool to create opportunities for improvement. Juxtaposing the business-as-usual model (Figure 2) with the market mechanisms and feedback loops of the UCT model (Figure 3) highlights how powerful the simple limitations of the cap are.

107. OSOFSKY & MCCALLISTER, *supra* note 102, at 35.

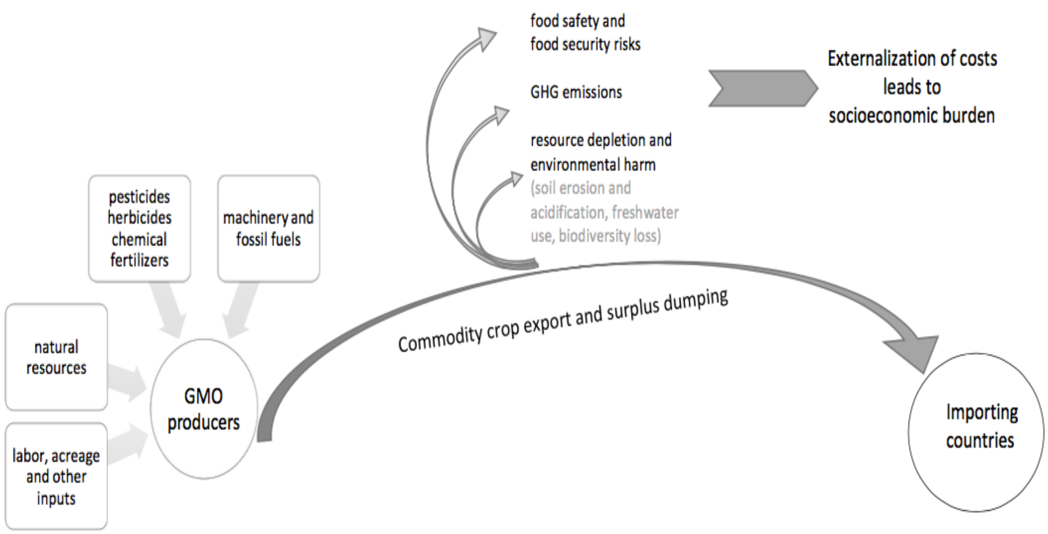

Figure 2: Business as Usual Scenario

The business as usual graph illustrates factors contributing to the centralization of the food system and its relationship to trade in GE commodity crops. From left to right, GMO producers (BigAg) use substantial resources, which appear in boxes on the far left. These inputs include pesticides, herbicides and chemical fertilizers, machinery and fossil fuels, natural resources, labor, land acreage and others. As noted above, the production of GE commodity crops is inextricably intertwined with the industrial agriculture and monocultures, thereby depleting resources and causing environmental harm (see curved arrows in the center). Other side effects of GMO production and processing are greenhouse gas emissions (GHG), which are considered pollution and further environmentally harmful practices. For the reason that the business and usual model illustrates the centralized food system, it also shows the food safety and food security risks, thereby impairing food integrity. Together, the side effects shows through the curved arrows are externalized costs, creating socioeconomic burdens that are borne by the public and aggravated through the environmental harm. Overall, this is how GMO producers can create a profit margin and export commodity crops (see the long horizontal arrow), and dump surplus on importing countries. Notable here is the lack of defenses of importing countries.

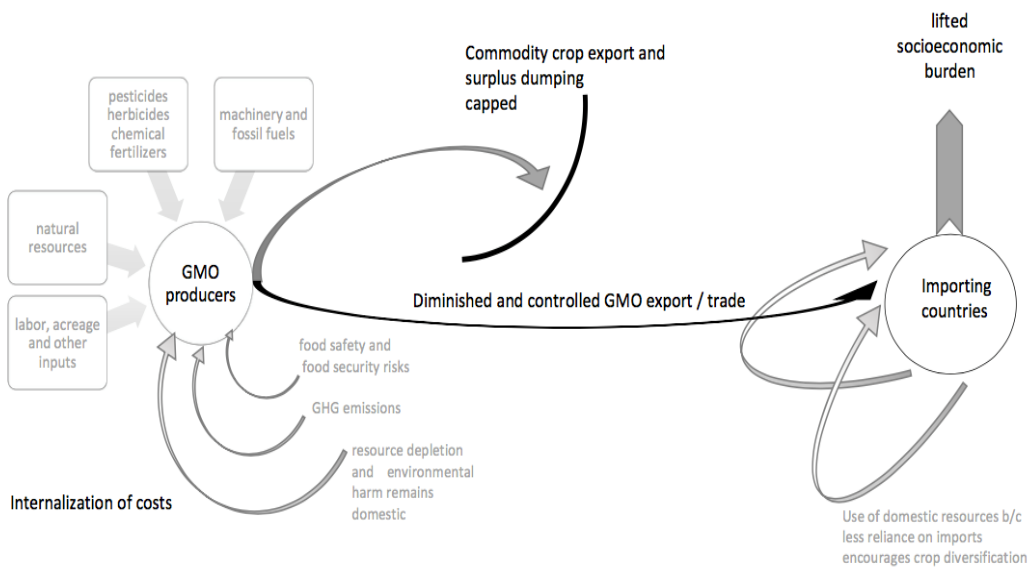

Figure 3: GE Commodity Crop Upstream Cap-and-Trade Model

This is a snapshot illustrating the effects of the upstream cap-and-trade model once the caps, maximum allowances under the caps, have been reached and the positive effects of the limitation accrue. When the curved grey arrow representing GE commodity crop trade hits the cap (shown as a black crescent line in the center), a shift in side effects and trade impacts occurs. In this upstream cap-and-trade model, GMO producers are forced to internalize the costs of production, thereby accounting for all the inputs (boxed terms in the far left). Consequently, the GMO producers have control to mitigate the risks (curved arrows), such as food safety and food security, GHG emissions, resource depletion, and environmental degradation. For the reason that there is only output (long black arrow in the center) if the GMO producers internalize the costs of production, there is diminished and controlled GMO export and trade. A balance of profit and internalization of risk ensues, lifting the socioeconomic burden on the importing countries. The diminished and controlled GMO export and trade creates a window of opportunity to use domestic resources because these importing parties are less reliant on imports, thereby encouraging domestic crop diversification. Notable here is the presence of defenses (crescent line in the center) of importing countries and the beneficial side effects (illustrated through light grey looping arrows in the far right.

C. Evaluating a GMO Regulatory Model Borrowed from Climate Change Policy

Escalating food law beyond solely food safety issues quickly delves deeply into the realm of environmental sustainability and, inherently to the environmental discourse, into questions of climate change contributions of the food and agriculture sector. Food production in the US alone accounts for 20% of overall fossil fuel consumption,[108] where it takes 30.3 liters of gas to till one hectare of land today with a 50 horsepower tractor, fossil fuel inputs that are directly linked to the carbon emissions going into the atmosphere.[109] Industrial agriculture and GMO cultivation in monocultures contributes to greenhouse gas (GHG) emissions—and thereby to global temperature rises[110]—as demonstrated by high certainty evidence corroborated by the United Nation's panels of experts—the Intergovernmental Panel on Climate Change (IPCC)—who published these findings in their most recent reports. Specifically, the IPCC found that the agricultural "sector is responsible for just under a quarter (~10–12 $GtCO_2eq$/year) of anthropogenic GHG emissions, mainly from deforestation and agricultural emissions from livestock, soil and nutrient management,"[111] factors overlapping with the inputs highlighted in Figures 2 and 3. Tackling the agricultural sector, however, is particularly promising because, as the IPCC concluded, "the mitigation potential is derived from both an enhancement of removals of greenhouse gases (GHG), as well as reduction of emissions through management of land and livestock."[112] It follows that the links between food production and climate change already exist and that the subject lends itself to comparison to find solution to shared environmental concerns.

The major benefit of the cap-and-trade model is the decentralization of the food system, which would have a positive ripple effect

108. Jason J. Czarnezki & Elisa K. Prescott, *Environmental and Climate Impacts of Food Production, Processing, Packaging, and Distribution*, *in* FOOD, AGRICULTURE AND ENVIRONMENTAL LAW, *supra* note 18, at 115.

109. *Id.* at 117.

110. *Id.*

111. Pete Smith et al., *Agriculture, Forestry and Other Land Use*, *in* CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 816 (2014).

112. *Id.*

on the agricultural sector, allowing agroecology to surge and mitigate some effects of climate change. Under the proposed model, BigAg would only be able to grow and continue to export its products if they diversified their crops, away from the four major GMOs: corn, wheat, soy, and rice. As such, to stay competitive in the free market economy,[113] BigAg would, in theory, shift its focus to other types of crops. A logical consequence of this development would be that BigAg might genetically engineer and patent other types of crops, eventually expanding the centralized food system to more than the four major commodity crops. The problem of the centralized food system would not directly be solved. Nonetheless, indirectly decentralizing food systems by capping GMOs would destabilize the trade paths for a certain period, providing the moment that many existing producers of other crops might need. Thus, gearing up to enter international markets and interrupting existing import and export patterns would create opportunities for non-BigAg producers to seize parts of the food system, thereby decentralizing the system. It is the window of opportunity[114] for the underdogs of the food system to take the long shots of entering a market that is otherwise dominated by BigAg and seemingly impermeable. Through the UCT implementation, an otherwise unattainable opportunity is created that, if used mindfully, forces BigAg to internalize the cost of production along with the associated risks of GMO production, giving others the chance to enter the market and compete with other crops.

Other benefits include policy incentives, where legislators would be empowered to advocate for the underdogs, stripping some lobbying power away from BigAg as soon as the caps are reached. Environmental organizations and concerned members of the public might applaud proactive and well-targeted caps that strengthen

113. *See generally* Chris Seabury, *Free Markets: What's The Cost?,* INVESTOPEDIA, http://www.investopedia.com/articles/economics/08/free-market-regulation.asp?ad=dirN&qo=serpSearchTopBox&qsrc=1&o=40186&lgl=bnull-baseline-below-content [https://perma.cc/SSQ5-MUZZ] (outlining positives and negatives of free market economy system).

114. A window of opportunity is defined as "a short time period during which an otherwise unattainable opportunity exists. After the window of opportunity closes, the opportunity ceases to exist." *Window of Opportunity*, INVESTOPEDIA, http://www.investopedia.com/terms/w/window-of-opportunity.asp#ixzz4VLwSWeDj [https://perma.cc/96Y6-TQ5P].

local economies and force producers to internalize the costs of production rather than externalizing them to the public at large, as depicted in Figure 3.

In practice, any UCT implementation should be incremental, for only staggered momenta can accumulate to the positive effects proposed in this model. Simply put, policy makers should create several caps occurring over an extended period of time, repeating the snapshot illustrated in Figure 3, with the goal to tap the UCT benefits over and over and for various crops. Although the predictions in this paper are speculative and far from all encompassing, the ideas presented will hopefully nudge policy makers in the right direction. In fact, the results might play out in various scenarios, the most beneficial of which would result in weakened margins for the most commonly and widely traded GE commodity crops, bringing the reliance of the industrialized agriculture and GMO monocultures to stagnation. Eventually, resource depletion and environmental degradation could be slowed, creating yet another window of opportunity for agroecology[115] to assume a large role in international food production. In other words, enacting caps and repeating the UCT process visualized in Figure 3 facilitates food integrity improvements on a large scale, relying on agroecology.

Resuming the comparative analysis of the UCT model, taking a precautionary approach has, indeed, risk-aversion potential. For instance, in food systems, the US is taking the biotech principle, which permits food to be marketed until it is proven unsafe.[116] In the EU, however, the precautionary approach only allows foods to be marketed that have been proven safe,[117] as noted above. This illustrates two ends of a spectrum, with a gap between them, where

115. For the purpose of this paper, agroecology is defined as the symbiotic relationship of agriculture and ecology, a harmonious blend of practices that ensure sustainable, environmentally friendly, safe and transparent food production. Agroecology shall be understood to be the opposite of industrial, resource-intensive agriculture and monoculture. This is the author's own definition of agroecology, a definition which she is further developing in her upcoming book AGROBIODIVERSITY AND AGROECOLOGY: ENVIRONMENTAL RESILIENCE IN INTERNATIONAL FOOD LAW.

116. *Biotechnology Frequently Asked Questions (FAQs)*, U.S. DEP'T OF AGRIC., http://www.usda.gov/wps/portal/usda/usdahome?navid=AGRICULTURE&contentid=BiotechnologyFAQs.xml [https://perma.cc/2MXM-7NNQ].

117. *See generally Food Law General Principles*, EUR. COMM'N, http://ec.europa.eu/food/safety/general_food_law/principles/index_en.htm [https://perma.cc/G4TE-BPHT].

certain potentially unsafe foods are marketed in the US, but not in the EU. Although this comparison is highly simplified, it shows how national and regional policy approaches can affect a whole system. For instance, those potentially unsafe foods that are not permitted in the EU may, nonetheless, be imported from the US and, thereby, enter the European market, making it difficult for European legislators and policy makers to prevent this cross-contamination.[118]

The same cross-contamination can happen in climate policy when different nations take incompatible approaches to regulating factors that contribute to climate change, offsetting each other's efforts. However, the efforts to mitigate, combat and adapt to climate change must be priorities in policy approaches around the world and taking a precautionary approach may aid to use the available data are more serious warning signs. According to the European Commission, the precautionary principle established common guidelines and "enables rapid response in the face of a possible danger to human, animal or plant health, or to protect the environment."[119] Thus, this precautionary approach may require that the climate change risks with medium and high levels of scientific certainty become guideposts for policy makers – until and unless any risks to further aggravate climate change can be conclusively discounted (if ever).[120]

IV. CONCLUSION

An upstream regulation of GE commodity crops might decentralize food systems, thereby opening trade up for other crops. The benefits reach along the supply and distribution chains, eventually favoring agroecology approaches over industrial agriculture and monocultures. The UCT model, however, is limited in that it represents a snapshot momentum that creates a window of opportunity for agroecology to compete with BigAg's food trade dominance. If this window of opportunity is not seized, BigAg will simply diversify its supply and thereby control the demand in the

118. The ideas in this paragraph were sparked by assignments in Professor Tracy Bach's Climate Change Policy course at Vermont Law School (Spring 2016).

119. *The Precautionary Principle*, EUR-LEX, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Al32042 [https://perma.cc/VMA4-N346] (last updated Nov. 30, 2016).

120. *See Food Law General Principles*, *supra* note 117.

free market tradition. From the European perspective, the caps on GE commodity crops may validate the precautionary protectionism and relieve some of the pressures posed by the US-dominated free trade and biotechnology dogma. Overall, incremental caps could turn into powerful tools to restore and conserve food integrity.