

GENETICALLY MODIFIED ORGANISMS IN THE UNITED KINGDOM: A PROPOSAL FOR MODERATE GMO REGULATIONS POST-BREXIT AND AN OPPORTUNITY IN GENETICALLY MODIFIED WHEAT

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ABSTRACT

The use of Genetically Modified Organisms is a contentious topic internationally, with the stringency of regulations varying widely between countries. While the United States has chosen to adopt more permissive regulations, the European Union, in contrast, has enacted some of the strictest regulations in the world. With the passage of the referendum authorizing the British exit from the European Union, the United Kingdom has the chance to create more permissive regulations than those it was previously required to adopt due to membership in the European Union. While the United Kingdom should not completely deregulate its existing framework, it should adopt more moderate rules than the European Union. The moderate rules would allow the United Kingdom to take advantage of the growing genetically modified crop market—in particular the newly emerging genetically modified wheat market—without compromising public safety. More specifically, these moderate regulations call for an expansion of the evidentiary threshold for the precautionary rule, maintenance of labeling requirements, and the creation of a public awareness campaign to increase public knowledge about Genetically Modified Organisms.

I. INTRODUCTION

On March 29, 2017, the United Kingdom (UK) formally began the process to leave the European Union (EU).¹ The British Exit from the EU (Brexit) has provided the UK with an opportunity to reform its policy regarding genetically modified organisms (GMOs) and open itself to new trade opportunities with the United States and other countries, particularly in terms of genetically modified (GM) wheat.

1. Angela Dewan & Bryony Jones, *Brexit Begins: UK Triggers Article 50 to Begin EU Divorce*, CNN (Mar. 29, 2017, 2:42 PM), <https://perma.cc/Y95M-ZN28>.

GMOs are defined as “organisms . . . in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination.”² The EU, and by extension the UK, has adopted extensive regulations on GMOs to protect individuals and the environment from any potential adverse effects stemming from the release of GMOs.³ Through enactment of these regulations, the EU and UK have two of the strictest GMO regulatory schemes in the world.⁴ In contrast, the U.S. has few regulations on GMOs, involving minimal oversight by government agencies and less stringent mandatory labeling provisions.⁵ Therefore, if the UK chooses to deregulate its GMO rules, it could take advantage of the growing international and domestic markets for GM products, particularly for GM wheat.

The use of GM products is controversial in the UK; although public perception of GMOs is changing, there would likely be some hesitation amongst the scientific community within the country to deregulate GMOs.⁶ Any change in GMO regulations should be mindful of this controversy. The UK should enact a modest deregulation, thereby protecting consumer safety and consumer peace of mind, while also allowing the country to take advantage of the emerging market for GM wheat. This may be accomplished by: (1) limiting the precautionary rule, thus requiring a greater showing of scientific evidence that a potential GM product poses a threat; (2) maintaining labeling requirements so the public can identify GM products in food; and (3) launching a public awareness campaigns to separate fact from fiction in the debate about GMOs.

This Article argues the UK has an astounding opportunity to expand the economic market of its largest agricultural product—wheat—through the aforementioned moderate governmental actions. This Article will address GM crops and their benefits, provide an overview of GMO regulation in the U.S., EU, and UK, and discuss the overall impact and opportunities created by Brexit.

II. GENETICALLY MODIFIED ORGANISMS

In order to understand why the UK should consider moderate deregulation

2. World Health Org., *Frequently Asked Questions on Genetically Modified Foods*, FOOD SAFETY (May 2014), <https://perma.cc/DE52-WVXK> [hereinafter World Health Org.].

3. Theresa Papademetriou, *Restrictions on Genetically Modified Organisms: European Union*, LIBRARY CONG., <https://perma.cc/8BHB-SU2P> (last updated June 9, 2015).

4. *Id.*; see also Clare Feikert-Ahalt, *Restrictions on Genetically Modified Organisms: England and Wales*, LIBRARY CONG., perma.cc/A4DY-BBU8 (last updated June 9, 2015).

5. Luis Acosta, *Restrictions on Genetically Modified Organisms: United States*, LIBRARY CONG., perma.cc/P3BN-S45S (last updated June 9, 2015).

6. See Nirvana Abou-Gabal, *Understanding the Controversy and Science of GMOs*, HUFFINGTON POST (July 28, 2015, 11:11 AM), <https://perma.cc/43QN-Y85L>.

of GMOs and why this task may be controversial, it is important to first understand the relative benefits and concerns of GM products. This Article will not attempt to settle the debate about the safety of GMOs,⁷ but rather, to describe the current landscape of consumer and scientific views of GM products. The term GMO refers to an organism whose DNA has been unnaturally altered.⁸ Although gene modification occurs naturally over time, GMOs allow the process to occur in a faster, more direct, and more controlled manner.⁹

For present purposes, the term GMO will primarily refer to genetically modified crops and foods containing genetically modified products. Many key crops, widely consumed and used as the basis for many food products, have been subject to genetic modification.¹⁰ For example, Monsanto currently produces GM soybeans (also known as Roundup Ready soybeans), which are more tolerant of glyphosate, a herbicide which “is highly effective against the majority of annual and perennial grasses and broad-leaved weeds.”¹¹ These genetic modifications allow spraying of glyphosate in order to kill weeds, and because the soybeans have greater resistance, they are not damaged when the surrounding weeds are sprayed.¹² Additionally, both rice and corn have been genetically modified to contain specific insecticidal proteins, making them insect resistant.¹³

A. Benefits of GMOs

GMOs offer two main benefits: increased productivity and environmental sustainability.¹⁴ Productivity refers to both a higher volume of crop production and

7. It is important to note, however, that multiple scientific studies have found GM products pose no threat to human health. See, e.g., Elizabeth Weise, *Academies of Science Finds GMOs Not Harmful to Human Health*, USA TODAY (May 17, 2016, 11:32 AM), <http://perma.cc/SW4V-857V>.

8. World Health Org., *supra* note 2.

9. Leighton Jones, *Science, Medicine, and the Future: Genetically Modified Foods*, 318 BRIT. MED. J. 581, 581 (1999).

10. Food & Agric. Org. of the United Nations, *Genetically Modified Crops*, in FAO STATISTICAL YEARBOOK 2012, at 312, 315 (2012). The FAO report refers to a table entitled “Chart 119,” from “Global Status of Commercialized Biotech and GM Crops: 2010” by the International Service for the Acquisition of Agibiotech Applications (ISAAA).

11. S. R. Padgett et al., *Development, Identification, and Characterization of a Glyphosate-Tolerant Soybean Line*, 35 CROP SCI. 1451, 1451 (1995).

12. *Id.*

13. Lanzhi Han et al., *Potential Resistance Management for the Sustainable Use of Insect-Resistant Genetically Modified Corn and Rice in China*, 15 CURRENT OPINION INSECT SCI. 139, 139 (2016).

14. Michael Stebbins, *How GMOs Can Help the Environment*, BIOTECHNOW (Dec. 9, 2016), <https://perma.cc/49D4-C4HE>.

also decreased cost to grow those crops.¹⁵ GMOs allow for a higher yield, primarily due to breeding and the introduction of beneficial genetic traits.¹⁶ Breeding techniques improve the germplasm—the fundamental genetic package of a given seed—for optimal characteristics (i.e., larger, more resilient) over time.¹⁷ For GMOs, breeding techniques are combined with genetic manipulation, which allow producers to incorporate beneficial traits directly into the germplasm that would otherwise be difficult to achieve through breeding alone.¹⁸ Often, this manipulation involves herbicide tolerance and insect resistance.¹⁹ These beneficial traits—whether acquired through breeding, genetic manipulation, or a combination of the two—lead to lessened crop destruction, and thus, a higher yield.²⁰ Overall, GMO products account for a 22% higher yield.²¹

These same traits, particularly herbicide and insect resistance, reduce the overall costs required to grow crops because, for example, herbicide-resistant and insect-resistant crops require fewer chemical sprays.²² Therefore, they demand a less costly maintenance,²³ which translates to a decrease in the real cost of food.²⁴ For instance, without the presence of GMOs on the market, corn-based and soybean-based products would cost 6% and 10% more, respectively.²⁵

In addition to higher yields, GMOs are also more environmentally sustainable than traditional agricultural products.²⁶ While serious concerns exist about the

15. Michael Stebbins, *3 Ways GMOs Keep the Cost of Food Down*, FORBES (Apr. 29, 2016, 4:10 PM), <https://perma.cc/2AJK-6V4S>.

16. *Do GM Crops Increase Yield?*, MONSANTO, <https://perma.cc/8Y8E-2QT9> (last updated Nov. 26, 2012) [hereinafter *Do GM Crops Increase Yield?*].

17. *Id.*

18. *Id.*

19. *Id.*

20. *Id.*

21. Wilhelm Klümper & Matin Qaim, *A Meta-Analysis of the Impacts of Genetically Modified Crops*, PLoS ONE, Nov. 3, 2014, at 1, 1.

22. Graham Brookes & Peter Barfoot, *The Income and Production Effects of Biotech Crops Globally 1996–2010*, 3 *GM CROPS & FOOD* 265, 270 (2012); *Do GM Crops Increase Yield?*, *supra* note 16; Stebbins, *supra* note 15.

23. Brookes & Barfoot, *supra* note 22, at 270; *Do GM Crops Increase Yield?*, *supra* note 16; Stebbins, *supra* note 15.

24. Stebbins, *supra* note 15.

25. Brookes & Barfoot, *supra* note 22, at 267.

26. Stebbins, *supra* note 15; *6 Ways GMOs Make Agriculture More Environmentally Friendly*, GMO ANSWERS (Mar. 28, 2017), <https://perma.cc/GY5R-D8LP>.

toxicity of insecticides and herbicides, both for humans (and vertebrates more generally)²⁷ and the environment,²⁸ GMOs reduce producers' reliance on these chemicals.²⁹ Thus, GMOs reduce the environmental impact of insecticides and herbicides overall as explained by the Committee on the Impact of Biotechnology on Farm-Level Economics and Sustainability.³⁰ This committee is supported by the National Research Council and was created to study the impact, challenges, and opportunities of genetically engineered (GE) crops, "[a]s pressure mounts to expand the use of GE crops for energy, food security, environmental improvement, and other purposes."³¹

Additionally, GMOs reduce the harmful environmental effects of tillage.³² Tillage is a technique—traditionally used to control weeds—that also reduces soil quality and magnifies the effects of erosion.³³ Glyphosate-resistant crops allow farmers to reduce tillage, and thus, minimize environmental damage.³⁴

B. Concerns About GMOs

Skeptics of GMOs point to two main concerns related to GMO consumption: food safety and antibiotic resistance. Beyond these two identified concerns, many opposed to GMOs cite the danger of unintended effects as well. Each deserves to be addressed individually.

27. See, e.g., John Peterson Myers et al., *Concerns over use of Glyphosate-Based Herbicides and Risks Associated with Exposures: A Consensus Statement*, 15 ENVTL. HEALTH 1, 2 (2014) (expressing concern about the impact of glyphosate and glyphosate-based herbicides on human health). See generally Robin Mesnage et al., *Major Pesticides are More Toxic to Human Cells Than Their Declared Active Principles*, BIOMED RES. INT'L, Feb. 26, 2014, at 1 (discussing how major pesticides are toxic to humans).

28. See, e.g., Md. Wasim Aktar et al., *Impact of Pesticides Use in Agriculture: Their Benefits and Hazards*, 2 INTERDISC. TOXICOLOGY 1, 3 (2009) (reviewing the environmental harm caused by agricultural pesticides); Robert Annett et al., *Impact of Glyphosate and Glyphosate-Based Herbicides on the Freshwater Environment*, 34 J. APPLIED TOXICOLOGY 458, 458-59 (2014) (discussing the negative impact of glyphosate and glyphosate-based herbicides on the environment, particularly freshwater environments).

29. Brookes & Barfoot, *supra* note 22; *Do GM Crops Increase Yield?*, *supra* note 16.

30. NAT'L RESEARCH COUNCIL ET AL., *THE IMPACT OF GENETICALLY ENGINEERED CROPS ON FARM SUSTAINABILITY IN THE UNITED STATES* 6–8 (2010).

31. *Id.* at vii-viii.

32. *Do GM Crops Increase Yield?*, *supra* note 16.

33. NAT'L RESEARCH COUNCIL ET AL., *supra* note 30, at 5-6.

34. *Id.*

1. Food Safety

Critics of GMOs argue primarily against the safety of the new proteins introduced in GM products and the resulting potential for allergens.³⁵ For example, Bt proteins from *Bacillus thuringiensis* are often introduced to both corn and rice to function as an insecticide.³⁶ These proteins may be toxic to humans and require extensive studies related to toxicity, exposure, and modification of the protein structure as it is metabolized.³⁷

Additionally, these proteins often come from sources with an unknown allergenic history.³⁸ For example, new genes may come from bacteria, and as such, may not have been evaluated fully for their allergenic properties.³⁹ One such product is corn, where the condensed Cry9C protein is expressed.⁴⁰ This product is only allowed for animal feed because the protein contains some strains of known food allergens for humans.⁴¹

2. Antibiotic Resistance

When a gene of interest is transferred to, in this case, a plant, it is transferred not on its own, but as part of a construct.⁴² There is a marker on the construct that confers some resistance to antibiotics, as antibiotic resistance is used as a marker system for gene uptake.⁴³ The resistance is typically not for significant diseases, but on occasion, some clinical antibiotic resistant markers are used.⁴⁴ This leads to the concern that the antibiotic resistant gene could interfere with antibiotic function should that gene, once ingested, cause an infection.⁴⁵

3. Unintended Effects

As previously described, GMO production involves the insertion of a completely new DNA sequence into a plant's gene sequence.⁴⁶ Generally, mutations to

35. Harry A. Kuiper et al., *Assessment of the Food Safety Issues Related to Genetically Modified Foods*, 27 PLANT J. 503, 504, 512 (2001).

36. *Id.* at 510.

37. *Id.* at 506, 510.

38. *Id.* at 505, 512.

39. *Id.* at 511.

40. *Id.* at 513.

41. *Id.* at 513-14.

42. Jones, *supra* note 9, at 583.

43. *Id.*

44. *Id.*

45. *See id.*

46. Kuiper et al., *supra* note 35, at 515.

even one or two nucleotides can have a disastrous impact on the health and integrity of the organism in which they occur.⁴⁷ For example, Huntington's disease and Cystic Fibrosis are two examples of single gene disorders—that is, diseases caused by mutation to a single gene.⁴⁸ While the ingestion of GMO products does not cause any health defects—and certainly nothing as serious as existing single gene diseases—the concern is that ingestion of products containing gene mutations may cause some unforeseeable harm.⁴⁹ The concern in this case is somewhat ambiguous and primarily based on concern that unintended and unknown effects may stem from GMO consumption. These effects are uncertain simply because the down-the-line impact of GMOs has not been studied effectively.⁵⁰

III. GMO REGULATIONS IN THE UNITED STATES

In addition to recognizing how potential optimism and pessimism surrounding GMOs will influence the UK's decision to deregulate GM products, it is also important to consider how the UK's regulations compare to other countries that rely heavily on GM products. The U.S. is a prime example, where regulations are relatively lax compared to other countries, particularly as compared to the EU.⁵¹ U.S. regulations have historically been very permissive, placing more emphasis on the quality of the final product rather than the process by which the food has been made.⁵² Modern U.S. regulations have reemphasized this commitment to the ultimate product, with administrative attention on labeling as a primary means of regulation.⁵³

A. A History of GMO Regulation in the United States

The first step toward GMO regulation in the U.S. began when the National Institutes of Health (NIH) introduced laboratory regulation for experiments on recombinant DNA (rDNA).⁵⁴ A few years later, the Supreme Court determined GMOs could qualify as patent-eligible subject matter.⁵⁵ Subsequently, in 1986 the

47. See *Single Gene Disorders*, GENETIC SCI. LEARNING CTR., <https://perma.cc/L4HG-AXLG> (archived Sept. 2, 2017).

48. *Id.*

49. See Kuiper et al., *supra* note 35, at 504, 512.

50. *Id.* at 515.

51. See generally DIAHANNA LYNCH & DAVID VOGEL, COUNCIL ON FOREIGN RELATIONS, *THE REGULATION OF GMOs IN EUROPE AND THE UNITED STATES: A CASE-STUDY OF CONTEMPORARY EUROPEAN REGULATORY POLITICS* (2001).

52. *Id.* at 4-7.

53. *Id.* at 6.

54. *Id.* at 4.

55. See *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980).

Environmental Protection Agency (EPA), Food and Drug Administration (FDA), and United States Department of Agriculture (USDA) took primary responsibility for regulating agricultural biotechnology, including GMOs.⁵⁶

Significantly, in 1989 the National Research Council (NRC), a non-governmental organization that functions as the research arm of the National Academies of Sciences, Engineering, and Medicine (NASEM), released a report on agricultural biotechnology products.⁵⁷ This report placed emphasis on the final product rather than the regulatory project, noting “the *product* of genetic modification and selection should be the primary focus for making decisions about the environmental introduction of a plant or microorganism and not the *process* by which the products were obtained.”⁵⁸ The report further stated, “the nature of the process is not a useful criterion for determining whether the product requires less or more oversight.”⁵⁹

B. Current GMO Regulations in the United States

Based on the relatively permissive foundations established in the late 1970s and throughout the 1980s, current regulations in the U.S. remain minimal, although subject to more procedural steps.⁶⁰ The FDA, USDA, and EPA continue to regulate and evaluate GM crops.⁶¹ These administrative agencies evaluate the impact of GM products on both human and animal health, along with any potential environmental and agricultural concerns stemming from the release of GMOs.⁶² There is, however, “no comprehensive federal legislation specifically addressing GMOs.”⁶³

1. The USDA

Each U.S. agency devoted to regulating GMOs has specific roles. The

56. Coordinated Framework for Regulation of Biotechnology, 51 Fed. Reg. 23302, 23303 (June 26, 1986); see *How the Federal Government Regulates Biotech Plants*, USDA, <https://perma.cc/3XJM-FB8F> (last updated Jan. 20, 2015).

57. See generally NAT’L RESEARCH COUNCIL, FIELD TESTING GENETICALLY MODIFIED ORGANISMS: FRAMEWORK FOR DECISIONS (1989).

58. *Id.* at 14.

59. *Id.* at 15.

60. LYNCH & VOGEL, *supra* note 51, at 4-7.

61. Katharine Gostek, Comment, *Genetically Modified Organisms: How the United States’ and the European Union’s Regulations Affect the Economy*, 24 MICH. ST. INT’L L. REV. 761, 768 (2016); Alan McHughen, *Plant Genetic Engineering and Regulation in the United States*, 8178 ANR PUBL’N 1, 2 (2006).

62. See Gostek, *supra* note 61, at 768; McHughen, *supra* note 61, at 2.

63. Acosta, *supra* note 5.

USDA's Animal and Plant Health Inspection Service (APHIS) regulations describe the notification requirements for the introduction of GMOs into the market and corresponding permits.⁶⁴ An article is eligible for introduction under a simpler notification procedure if (1) the "genetic material is 'stably integrated' in the plant genome,"⁶⁵ (2) "[t]he function of the introduced genetic material is known and its expression . . . does not result in plant disease,"⁶⁶ (3) the introduced genetic material is not toxic or does not lead to an infectious entity,⁶⁷ or (4) the genetic sequences do not contain a pathogen or virus.⁶⁸ If the appropriate criteria are met, then APHIS must only be notified of the introduction.⁶⁹

Alternatively, if a GM article does not meet the criteria for the notification procedure, an entity must apply for a permit.⁷⁰ The permit application is more formal and requires greater advance notice than the notification.⁷¹ The permit requires an applicant to provide information concerning the "expression of the altered genetic material,"⁷² "[a] detailed description of the purpose for the introduction of the regulated article,"⁷³ and "[a] detailed description of the proposed procedures, processes, and safeguards which will be used to prevent escape and dissemination of the regulated article,"⁷⁴ among other things.

2. The FDA

The FDA regulates food products, particularly through the Federal Food, Drug, and Cosmetic Act.⁷⁵ Relevant to discussion here is the FDA regulation of adulterated food, which includes both foods containing "any poisonous or deleterious substance which may render it injurious to health"⁷⁶ and those with an absence, substitution, or addition of constituents,⁷⁷ among other things. A food additive is:

64. *Permits, Notifications, and Petitions*, USDA, <https://perma.cc/CH6K-KGDH> (last updated Mar. 16, 2016); see 7 C.F.R. §§ 340.3–6 (2017).

65. 7 C.F.R. § 340.3(b)(2) (2017).

66. 7 C.F.R. § 340.3(b)(3) (2017).

67. 7 C.F.R. § 340.3(b)(4)(i)–(ii) (2017).

68. 7 C.F.R. § 340.3(b)(5)–(6) (2017).

69. 7 C.F.R. § 340.3(b) (2017).

70. 7 C.F.R. § 340.3(a) (2017).

71. Compare 7 C.F.R. § 340.3(d) (2017), with 7 C.F.R. § 340.4(c) (2017).

72. 7 C.F.R. § 340.4(b)(5) (2017).

73. 7 C.F.R. § 340.4(b)(8) (2017).

74. 7 C.F.R. § 340.4(b)(12) (2017).

75. See generally Federal Food, Drug, and Cosmetic Act, 21 U.S.C. §§ 301–399h (2012).

76. 21 U.S.C. § 342(a) (2012).

77. 21 U.S.C. § 342(b) (2012).

any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food . . . if such substance is not generally recognized, among experts . . . as having been adequately shown . . . to be safe under the conditions of its intended use; . . .⁷⁸

Entities using unsafe food additives are subject to regulations; in particular, they may only be allowed to do business under a conditional market entry upon a showing that their products are safe for use.⁷⁹ Despite the restrictions for food products, many GMOs do not need premarket approval, as they are generally recognized as safe by both the FDA and the USDA.⁸⁰

3. *The EPA*

The EPA primarily has authority over herbicides and pesticides used in conjunction with or as a part of GMOs. In particular, pesticide products must be tested and must be demonstratively safe before they can be registered by the EPA.⁸¹ An application to register a given pesticide must provide a showing of testing, identity of the product, labeling, and other safety-related information.⁸²

4. *Labeling Requirements*

Until very recently, there were no GMO-specific labeling requirements for GM or GM-containing products.⁸³ Previously, the most stringent regulations on those requirements stemmed from the FDA, who could prevent the false and misleading labeling of food.⁸⁴ However, this issue never arose for GM food products unless the product was materially different from its existing counterpart.⁸⁵ In late 2016, however, President Obama signed an act requiring all food labels to declare whether the item contains GM components.⁸⁶ This law is somewhat controversial, as the labeling requirements are less stringent than those adopted by several states.⁸⁷ For example, the law superseded Vermont's stricter labeling laws, which required

78. 21 U.S.C. § 321(s) (2012).

79. *See* 21 U.S.C. § 348(b) (2012).

80. Acosta, *supra* note 5.

81. *See* 40 C.F.R. § 152.50(f)(3) (2017).

82. 40 C.F.R. § 152.50 (2017).

83. *See* Acosta, *supra* note 5.

84. *Id.*

85. *Id.*

86. Ben Popken, *Obama Signs Controversial GMO Food Label Law*, NBC NEWS (Aug. 1, 2016, 9:51 AM), <https://perma.cc/YE33-NYKR>.

87. *See id.*

GM-containing products to display the words “produced with genetic engineering.”⁸⁸ In contrast, the federal law allows companies to use plain words on packaging “or provide a QR code, 1-800 number, or website for consumers to visit for more information.”⁸⁹ Notably, the federal bill was supported by many agriculture groups, including the National Council of Farmer Cooperatives, the National Corn Growers Association, the American Farm Bureau Federation, the American Feed Industry Association, the National Grain and Feed Association, and the American Soybean Association.⁹⁰

IV. GMO REGULATION IN THE EUROPEAN UNION

The EU’s GMO regulations provide the framework for those in the UK. If the UK should choose to even moderately deregulate GMOs, it would be moving from a framework in harmony with the EU to one that is a step closer to the system in the U.S. EU regulations have historically been very cautious of the release of GMOs, and as a result, they have restricted GMO release on the grounds of very minimal evidence.⁹¹ EU regulations have not relaxed despite the growing prevalence of GMO distribution internationally.

A. A History of GMO Regulation in the European Union

The first EU legislation pertaining to GMOs was a Council Directive in 1990 addressing the deliberate release of genetically modified organisms.⁹² This directive was very cautious of GM products.⁹³ Rather than allow the release of GM products, the EU adopted a precautionary principle, which preferred protective action—preventing distribution.⁹⁴ This principle prevented release of a GM product even before there was complete scientific proof of a risk.⁹⁵ This could involve evidence of any risk; indeed, the threshold for triggering the precautionary principle was very low.⁹⁶

88. *Id.*

89. *Id.*

90. David Bennett, *House Passes GMO-Labeling Bill 306 to 117*, DELTA FARM PRESS (July 15, 2016), <https://perma.cc/47AZ-EW6L>.

91. Jessica Lau, *Same Science Difference Policies: Regulating Genetically Modified Foods in the U.S. and Europe*, SCI. NEWS (Aug. 9, 2015), <https://perma.cc/4V7V-NLW7>.

92. See generally Council Directive 90/220/EEC of 23 April 1990 on the Deliberate Release into the Environment of Genetically Modified Organisms, 1990 O.J. (L 117) (EC) [hereinafter Council Directive on the Deliberate Release of Genetically Modified Organisms].

93. See generally *id.*

94. *Communication from the Commission on the Precautionary Principle*, at 2, COM (2000) 0001 final (Feb. 2, 2000).

95. *Id.* at 7, 11.

96. See John N. Hathcock, *The Precautionary Principle—An Impossible Burden of Proof for New Products*, 3 *AGBIOFORUM* 255, 256 (2000).

Beyond the stringent EU-wide regulations, member states have further authority to restrict or prohibit EU-approved GMOs if they believe them to be harmful.⁹⁷

B. Current GMO Regulations in the European Union

Directive 2001/18/EC is one of the major, modern EU legislative documents currently regulating GMOs;⁹⁸ it repealed the earlier Directive 90/220/EEC and was later amended by Directive 2008/27/EC. The current EU regulations on GMOs exist to protect human welfare and the environment⁹⁹ and to ensure the effective circulation of any authorized GM products.¹⁰⁰ These regulations are also very extensive:¹⁰¹ the directives create and clarify a thorough notification and proposal process for GM products.¹⁰² EU authorization through a national, competent authority—generally the EU country from which the applicant is applying—is required before cultivating and distributing a GM product.¹⁰³ Upon application for authorization, the parameters involve a grant for up to ten years, consistent monitoring of the GMO in the market, and public consultation, labeling, and recording of GMO information.¹⁰⁴ The regulations are so strict that few GMOs have been approved since 2001.¹⁰⁵

97. Council Directive on the Deliberate Release of Genetically Modified Organisms, *supra* note 92, at art. 16.

98. *See generally* Directive 2001/18/EC, of the European Parliament and of the Council of 12 March 2001 on the Deliberate Release into the Environment of Genetically Modified Organisms and Repealing Council Directive 90/220/EEC, 2001 O.J. (L 106) [hereinafter Directive Repealing Council Directive 90/220/EEC].

99. Consolidated Version of the Treaty on the Functioning of the European Union arts. 9 & 11, Dec. 13, 2007, 2012 O.J. (C 326) 8.

100. Regulation (EC) No. 1829/2003 of the European Parliament and of the Council of 22 September 2003 on Genetically Modified Food and Feed, art. 1, 2003 O.J. (L 268) 7 [hereinafter Regulation on Genetically Modified Food and Feed].

101. *See, e.g.*, Council Decision of 25 June 2002 Concerning the Conclusion, on Behalf of the European Community, of the Cartagena Protocol on Biosafety 2002/628/EC, 2002 O.J. (L 201) 1; World Trade Organization, WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), Apr. 15, 1994, 1867 U.N.T.S. 493; U.N. Conference on Environment and Development, *Rio Declaration on Environment and Development*, U.N. Doc. A/CONF.151/5/Rev.1, annex 1 (June 3-14, 1992); United Nations Convention on Biological Diversity, *Declarations*, 1760 U.N.T.S. 79 (June 5, 1992); United Nations Framework Convention on Climate Change, *Declarations*, 1771 U.N.T.S. 107 (May 9, 1992).

102. Directive Repealing Council Directive 90/220/EEC, art. 6, *supra* note 98, at 6.

103. *Id.*

104. *GMO Authorizations for Cultivation*, EUROPEAN COMMISSION, <http://perma.cc/6B87-F24N> (last updated Feb. 10, 2017).

105. *See* MARIA LEE, EU REGULATION OF GMOs: LAW AND DECISION MAKING FOR A NEW TECHNOLOGY 3 (2008).

In addition to the 2001 and 2008 directives, Regulation No. 1829/2003 provided significant updates and changes to the regulations for food that contains, consists of, or is produced from GMOs distributed in the EU market.¹⁰⁶ Overall, the regulation updated procedures for the approval of GM food and the labeling of products made with GM material.¹⁰⁷ In terms of applying for authorization, potential distributors must submit a single application addressing all uses of the GM product, including uses for food, animal feed, and cultivation.¹⁰⁸ After the product is given authorization, all food and feed containing the GM product must be clearly labeled, explicitly denoting that they contain GMOs.¹⁰⁹ Products often used as ingredients must be labeled if they are from a GM source (e.g., flour, oils, glucose syrups, corn products, and beverages containing GM ingredients).¹¹⁰ “Cheese produced with GM enzymes,” however, as well as “meat, milk and eggs from animals fed on GM animal feed” do not need to be labeled.¹¹¹ In addition to labeling requirements, the regulation dictates how long the authorization to release can last. The maximum is ten years and is renewable upon request.¹¹²

C. Regulatory Hurdles

Few GM products are approved because of the regulatory hurdles in the process for release. Within two weeks of the application submission, the competent, national authority informs the European Food and Safety Authority (EFSA) of the application.¹¹³ The EFSA has six months to review the application and decide on a recommendation as to whether the product should be authorized.¹¹⁴ The EFSA then submits the recommendation to the Standing Committee on the Food Chain and Animal Health, who decides whether to accept the application.¹¹⁵ If the committee accepts the application, it is sent directly to the European Commission, who adopts the proposal.¹¹⁶ If the committee does not accept the proposal, the Appeal Committee then reviews the application and ultimately decides whether the commission

106. See generally Regulation on Genetically Modified Food and Feed, *supra* note 100.

107. *Id.* art. 1, at 7.

108. *Id.* art. 27, at 18.

109. *Id.* art. 13, at 12.

110. *Id.* art. 12, at 12.

111. *GM Labelling*, FOOD STANDARDS AGENCY, <https://perma.cc/FZ6S-BUTT> (last updated Jan. 30, 2013).

112. Regulation on Genetically Modified Food and Feed, art. 7, *supra* note 100, at 10.

113. *Id.* art. 5, at 8.

114. *Id.* art. 6, at 9.

115. Francesca Angelilli, *GMOs: The Current Legal Framework and the Latest Proposals for Change*, LEXOLOGY (Dec. 16, 2015), <https://perma.cc/L69G-XCPP>.

116. *Id.*

will adopt it.¹¹⁷ Consider also that in the midst of these reviews, the precautionary principle allows any evidence of harm to be counted as a reason to reject the application. These restrictions help ensure the EU's GMO regulations are among the strictest in the world.

V. GMO REGULATION IN THE UNITED KINGDOM

The UK's GMO regulations closely mirror that of the EU. As a member of the EU, the UK was required to adopt, at a minimum, the regulations created by the EU. Using the EU standards as a framework, member states like the UK are responsible for writing the provisions into law and enacting them using their national administrative or governmental agencies.

A. Pertinent GMO Legislation in the United Kingdom

One of the most significant pieces of UK legislation regulating GMOs is the Environmental Protection Act of 1990.¹¹⁸ The Act broadly regulates environmental contaminants, waste management (both household and industrial),¹¹⁹ air pollution,¹²⁰ radioactive substances,¹²¹ nature conservation,¹²² and GMOs.¹²³ According to the Act, an organism is genetically modified if “any of the genes or other genetic material in the organism—[] have been modified by means of an artificial technique . . . or are inherited or otherwise derived, through any number of replications, from genes or other genetic material (from any source) which were so modified.”¹²⁴ The Act vests authority in the Secretary of State, as well as the Minister of Agriculture, Fisheries and Food to regulate GM products.¹²⁵

In terms of procedure for release and marketing, it is illicit to “import or acquire, release or market,” any GMOs before first carrying out “an assessment of any risks there are . . . of damage to the environment,” and providing notice to the

117. *Communication from the Commission on the Precautionary Principle*, *supra* note 94, at 2.

118. *See generally* Environment Protection Act 1990, c.43 (Eng.), <http://www.legislation.gov.uk/ukpga/1990/43/contents>.

119. *Id.* Part II, IV.

120. *Id.* Part III.

121. *Id.* Part V.

122. *Id.* Part VII.

123. *Id.* Part VI.

124. *Id.* §106(4)(a)-(b).

125. *See, e.g., id.* §§ 107(8), 108(8), 126 (allowing the Secretary of State to provide regulations of GMOs, and allowing the Minister of Agriculture, Fisheries and Food to assist the Secretary of State).

Secretary of State.¹²⁶ After receiving notice, the Secretary of State must give consent before the GM product can be introduced.¹²⁷ Similar prohibitions apply for a person proposing to release GMOs.¹²⁸ It is important to remember this process of approval by the Secretary of State occurs only after the GM product has received approval by the EU in accordance with Regulation No. 1829/2003.¹²⁹

If a GM product is approved for importation, acquisition, release, or marketing, it is placed on a public register.¹³⁰ The register provides information about pending applications, including notices, prohibitions, applications for consents (and any resulting consents), convictions for violations of the GMO provisions, and any other information related to the application.¹³¹ Even where some information is kept confidential for national security or commercial reasons, the register still shows the name of the applicant, a description of the GMO, the purpose for importation, acquisition, marketing, and release, and the results of the risk assessment.¹³²

In instances where a GM product has been approved, labeling requirements turn primarily on equivalency. GM food must be labeled and indicate “any characteristic or food property such as: composition, nutritional value or nutritional effects, intended use of the food, which renders a novel food or food ingredient *no longer equivalent to an existing food or food ingredient.*”¹³³

A product is no longer equivalent when it can be demonstrated “that the characteristics assessed are different in comparison with a conventional food or food ingredient.”¹³⁴ A label containing non-equivalent products must specifically denote the presence of the novel ingredient, “together with the method by which that characteristic or property was obtained.”¹³⁵ This includes a notice to “the final consumer of any characteristic or food property which renders a novel food or food ingredient

126. *Id.* §108(1).

127. *See id.* §§ 111, 112 (describing full consents and limited consents).

128. *Id.* §109(4).

129. *See* Explanatory Memorandum to the Genetically Modified Food (England) Regulation 2004 No. 2335 (Eng.), <http://www.legislation.gov.uk/uksi/2004/2335/memorandum/contents> (describing the adopted regulations are enacted in accordance with Regulation 1829/2003).

130. *Id.*

131. *See generally* Environment Protection Act 1990, c.43 (Eng.), <http://www.legislation.gov.uk/ukpga/1990/43/contents>.

132. *Id.* §§ 123(1)-(7).

133. Regulation (EC) No. 258/97, of the European Parliament and of the Council of 27 January 1997 Concerning Novel Foods and Novel Food Ingredients, art. 8.1(a), 1997 O.J. (L 043) (emphasis added).

134. *Id.*

135. *Id.*

no longer equivalent to an existing food or food ingredient.”¹³⁶

Beyond the Genetically Modified Food Regulations of 2004 (which updated labeling requirements) and the Environmental Protection Act of 1990, the Genetically Modified Organisms Regulations of 2014 regulates the contained use of GMOs.¹³⁷ Additionally, the 2015 Animal Feed Regulations govern the composition, marketing, and use of animal feed containing GM products.¹³⁸

B. The Status of GM Product Use in the United Kingdom

Currently, no GM crops are grown commercially in the UK.¹³⁹ However, the UK does willingly import GM commodities.¹⁴⁰ Interestingly, the UK has been cautious but open to the use of GM products both in animal feed and food products—at least compared to other EU countries.¹⁴¹ For example, Italy has traditionally exhibited significantly more resistance to GM products.¹⁴² Italy initially tried to prevent the importation of any GM products and enacted legislation to ban the use of specific GM products in foods.¹⁴³ In contrast, the UK has been open not only to the importation of GM-based animal feed, but also GM-containing food products.¹⁴⁴ Italy also has more stringent labeling requirements, even beyond those required by the EU, demanding that specific language explicitly identify all ingredients that have been genetically modified.¹⁴⁵ The UK also complies with EU standards, but generally doesn’t require specific language on its products.¹⁴⁶

136. Genetically Modified Food (England) Regulations 2004, SI 2004/2335, art. 9.1, ¶ (b) (Eng.), <http://www.legislation.gov.uk/ukxi/2004/2335/contents/made>.

137. HEALTH & SAFETY EXEC., THE GENETICALLY MODIFIED ORGANISMS (CONTAINED USE) REGULATIONS 2014, at 7 (5th ed. 2014). “Contained use” refers to use of GM products in a contained and structured setting; this can include use in work or research settings, educational settings, and on occasion, use by private individuals.

138. *See generally* The Animal Feed (Composition, Marketing and Use) (England) Regulations 2015, SI 2015/255 (Eng.), <http://www.legislation.gov.uk/ukxi/2015/255/contents/made>.

139. DEP’T FOR ENV’T FOOD & RURAL AFFAIRS, 2010–2015 GOVERNMENT POLICY: FOOD AND FARMING INDUSTRY (2015), Appendix 7 [hereinafter FOOD AND FARMING INDUSTRY] (citations omitted).

140. *See generally id.*

141. *See* Dante Figueroa, *Restrictions on Genetically Modified Organisms: Italy*, LIBRARY CONG. (Mar. 2014), <https://perma.cc/A33B-EVGD>.

142. *Id.*

143. *Id.*

144. FOOD AND FARMING INDUSTRY, *supra* note 139, at 4.

145. DANA BIASETTI, U.S. DEP’T OF AGRIC. FOREIGN AGRIC. SERV., FOOD AND AGRICULTURE IMPORT REGULATIONS AND STANDARDS NARRATIVE: ITALY 12–13 (Dec. 2016).

146. *See* JENNIFER WILSON, U.S. DEP’T OF AGRIC. FOREIGN AGRIC. SERV., FOOD AND AGRICULTURAL IMPORT REGULATIONS AND STANDARDS NARRATIVE: UNITED KINGDOM 8-11 (2016); *GM Labelling*, *supra* note 111.

VI. THE BRITISH EXIT FROM THE EUROPEAN UNION: TIME FOR A CHANGE?

The referendum authorizing Brexit and the formal triggering of Article 50 of the Lisbon Treaty in March 2017 will have significant legal and trade implications over the next two years as the terms of the exit are negotiated.¹⁴⁷ However, Brexit may create opportunities to rework GMO laws, with due consideration given to public opinions about the safety of GM products.

A. The Impact of Brexit

Brexit changes little about GM policy, at least insofar as existing law is concerned. The EU GMO regulations have been adopted into UK legislation and have been enforced for many years.¹⁴⁸ Thus, the UK already has a significant framework in place for regulating the acquisition, importation, release, and marketing of GMOs.¹⁴⁹ In the Great Repeal Bill, the UK will transform EU laws into UK laws, taking the EU GMO regulations with them.¹⁵⁰ The UK has an opportunity to reduce GMO regulations during this transfer.

B. Consumer Attitudes Toward GMOs

It is uncertain whether lenient regulation of GMOs would receive support from citizens of the UK, some of whom believe they are being used as metaphorical guinea pigs when they, perhaps unknowingly, are exposed to GM products in food and in the environment.¹⁵¹ Initially, the UK exhibited opposition to the widespread distribution of GM-based foods. For example, in the late 1990s and early 2000s, food processing companies like J. Sainsbury refused to sell food containing GM products.¹⁵² This opposition culminated in British food retailers issuing “a joint standard on procuring GM-free foods.”¹⁵³ Even members of the royal family joined in the opposition; Prince Charles voiced concerns about the effect GMOs would have on the environment and human health in 1998.¹⁵⁴ The concerns expressed by

147. See Dewan & Jones, *supra* note 1; Alex Hunt & Brian Wheeler, *Brexit: All You Need to Know About the UK Leaving the EU*, BBC NEWS (Aug. 15, 2017), <https://perma.cc/TAJ8-RL6B>. The formal exit was triggered by the invocation of Article 50 of the Lisbon Treaty. After Article 50 is triggered, the Lisbon Treaty gives the exiting country two years to negotiate the terms of the split.

148. See *supra* Part IV.A.

149. See generally FOOD AND FARMING INDUSTRY, *supra* note 139.

150. *The Repeal Bill*, INST. FOR GOV'T, <https://perma.cc/EU8L-UNCJ> (last updated July 13, 2017).

151. LYNCH & VOGEL, *supra* note 51, at 9.

152. *Id.*

153. *Id.*

154. *Id.*

the members of the UK were primarily about food safety and other unintended or unpredictable effects of GMOs.¹⁵⁵

However, since this initial resistance, attitudes towards GMOs are changing in the UK.¹⁵⁶ When surveyed in the early 2000s, consumers noted that GMOs were one of a variety of issues motivating food selection,¹⁵⁷ and thus, opinions concerning GM products is only part of the picture.¹⁵⁸ Consumers also consider factors such as cost, availability of organic food, and other concerns.¹⁵⁹ More recent studies assessing consumer attitudes determined most individuals in the UK would choose GM foods if those foods were more cost-effective.¹⁶⁰ Although some consumers valued non-GM food over GM-food, the majority were “indifferent between GM and non-GM alternatives.”¹⁶¹

VII. AN OPPORTUNITY IN WHEAT?

In the UK, 71% of land is used for farming, and about 19% of that is used for arable crops, including wheat.¹⁶² In particular, cereals generated £3.5 billion for the UK in 2014¹⁶³ and were the fifth largest exported commodity.¹⁶⁴ Between 2014 and 2015, UK wheat yields increased by 2.8%, which is the highest wheat yield in the past twenty-five years.¹⁶⁵ Similarly, UK barley production increased 5.3% between 2014 and 2015.¹⁶⁶ By and large, grain production represents a significant agricultural market—potentially an even more significant economic market overall—for the UK.

155. See *supra* Part III.

156. See Alexa Spence & Ellen Townsend, Comment, *Examining Consumer Behavior Toward Genetically Modified (GM) Food in Britain*, 26 RISK ANALYSIS 657, 668 (2006).

157. See Michael Burton et al., *Consumer Attitudes to Genetically Modified Organisms in Food in the UK*, 28 EUR. REV. AGRIC. ECON. 479, 487-95 (2001).

158. See *id.* at 495.

159. See *id.*

160. See Spence & Townsend, *supra* note 156, at 668.

161. *Id.*

162. DEP'T FOR ENV'T FOOD & RURAL AFFAIRS, BRITISH FOOD AND FARMING AT A GLANCE 1 (Mar. 2016) [hereinafter BRITISH FOOD & FARMING AT A GLANCE].

163. *Id.* at 1.

164. *Id.* at 3.

165. DEP'T FOR ENV'T FOOD & RURAL AFFAIRS, FARMING STATISTICS: PROVISIONAL 2015 CEREAL AND OILSEED RAPE PRODUCTION ESTIMATES UNITED KINGDOM 1 (Oct. 2015) [hereinafter PROVISIONAL 2015 CEREAL AND OILSEED RAPE PRODUCTION ESTIMATES].

166. *Id.*

A. *The Economic Benefits of Growing GM Cereals*

In the UK, 17.2 million hectares are used for farming.¹⁶⁷ As of 2015, 3100 hectares were used to farm cereals.¹⁶⁸ Wheat is the most prominent grain, both in area and yield.¹⁶⁹ As of 2014, 8.6 tonnes of wheat were grown per hectare.¹⁷⁰ Further, wheat dominates the export cereal market by a significant margin: in 2011, the UK produced 14.88 tonnes of wheat, exporting 2.66 tonnes.¹⁷¹ Ergo, increasing the international competitiveness of wheat produced in the UK by deregulating the use of GMOs could significantly benefit the UK economy.

Currently, wheat is not a commercialized GM product¹⁷² due to market forces and the advocacy of anti-GM wheat special interest groups.¹⁷³ However, much of that resistance has minimized over the years—at least in the sense that the expanding GMO market has significantly grown, creating more possibilities for wheat.¹⁷⁴ Beyond social resistance, part of the difficulty in commercializing wheat is that the technology simply is not developed.¹⁷⁵ In 2016, there were many studies assessing the safety and equivalency of GM wheat.¹⁷⁶ These studies found GM wheat is substantially equivalent to non-GM wheat.¹⁷⁷ Based on these developments, it is estimated that GM wheat, modified for disease resistance and other improvements, will be available as early as 2020.¹⁷⁸

As GM wheat inevitably becomes available in the next few years, the UK is poised to take advantage of this growing market. Genetic modification allows agricultural crops, including wheat, to be grown more economically and with a higher

167. BRITISH FOOD & FARMING AT A GLANCE, *supra* note 162, at 1.

168. PROVISIONAL 2015 CEREAL AND OILSEED RAPE PRODUCTION ESTIMATES, *supra* note 165, at 6.

169. *Id.* at 3-4.

170. *Id.* at 1.

171. AGRIC. & HORTICULTURAL DEV. BD., THE UNITED KINGDOM CEREALS INDUSTRY (June 2012) [hereinafter THE UNITED KINGDOM CEREALS INDUSTRY].

172. Manhong Zhu et al., Why Has Not Genetically Modified Wheat Been Commercialized: A Game Theoretical Perspective 4 (Feb. 4, 2016) (unpublished thesis, University of Florida) (on file with author).

173. *Id.*; see also Tim Barker, *Genetically-Modified Wheat is in the Works Again, But Are We Ready for It?*, ST. LOUIS POST-DISPATCH (Jan. 11, 2015), <http://perma.cc/7EKM-F4V7>.

174. Barker, *supra* note 173.

175. See *id.*

176. See, e.g., M. A. Elfattah et al., *Composition and Rheological Properties of Flour and Dough from Genetically Modified Wheat (Triticum aestivum L.) Hi-Line 111*, 44 CEREAL RES. COMMS. 605, 605 (2016).

177. *Id.* at 610.

178. INT'L SERV. FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS, ISAAA BRIEF 51-2015: EXECUTIVE SUMMARY 10 (2015) [hereinafter ISAAA Brief 51-2015].

yield.¹⁷⁹ GM technology adoption may increase UK farmer profits by 68% overall.¹⁸⁰

B. GM Wheat and International Competitiveness

Production of GM wheat would open the UK to more international trade partners, most significantly the U.S. Currently, there are significant trade obstacles between the U.S. and the EU due to differing regulations.¹⁸¹ The U.S. is the largest producer of GM crops, and thus represents a massive market for GM products.¹⁸² Other potential markets include Argentina, India, Canada, and China.¹⁸³ Regardless of which particular countries the UK would partner with, any partnership would open a new market that could be economically vital for a post-Brexit UK.

The UK wheat industry has already experienced an uplift since the Brexit referendum.¹⁸⁴ The UK can capitalize on this momentum by commercializing GM wheat as soon as is feasible. In order to establish a market foothold post-Brexit, the UK should transform the portion of its grain industry dedicated to wheat exported for industrial and animal feed purposes. Of all the cereals grown in the UK, about 35% are used for human and industrial purposes (including use as biofuel), and approximately 50% of grains are used as animal feed.¹⁸⁵ This is significant because the standards for animal feed and industrially used grains are lower than that for human consumption. If the UK changed its regulations of GMOs and allowed for GM products (especially GM wheat) to be grown, it would only need to ensure that its exported grains met importing countries' standards for industrial and animal uses.¹⁸⁶

The three largest importers of UK cereals are the Netherlands, Spain, and Germany.¹⁸⁷ The Netherlands "imports large quantities of GE crops and derived products" and has taken a pragmatic approach to the presence of these products on

179. Stebbins, *supra* note 15.

180. Klümper & Qaim, *supra* note 21, at 1.

181. Gostek, *supra* note 61, at 786.

182. *See id.* at 761.

183. ISAAA Brief 51-2015, *supra* note 178, at 4.

184. *See* Emiko Terazono, *UK's Wheat Industry Enjoys Brexit Glow*, FIN. TIMES (July 21, 2016), <https://www.ft.com/content/e961c72c-4e7b-11e6-88c5-db83e98a590a>.

185. THE UNITED KINGDOM CEREALS INDUSTRY, *supra* note 171.

186. This is not to preclude an expansion of GM products for human consumption. The UK can certainly transform its land and dedicate portions to growing GM wheat for human consumption; however, special attention here is given to wheat grown for non-human consumption, as this type of wheat represents a significant portion of UK exports, and because the use of GM products for animal and industrial use is less controversial than GMOs in products for humans.

187. THE UNITED KINGDOM CEREALS INDUSTRY, *supra* note 171.

the market.¹⁸⁸ Spain is the largest grower of certain strains of GM corn, and it has “traditionally defended a science-based approach to agricultural biotechnology.”¹⁸⁹ Given this attitude, Spain is a large importer of GM grains.¹⁹⁰

By contrast, Germany has been much more resistant to GMOs.¹⁹¹ The German public has widely rejected the use of GM foods for human consumption.¹⁹² However, the country is home to many international companies that develop and supply GE crops.¹⁹³ Germany is also a major importer of GE crops for use as animal feed.¹⁹⁴ Therefore, if the UK modifies its GM crop regulations, it can still maintain economic ties with its three major importing countries.

With this economic security, if the UK begins to grow GM wheat, the use of GM seeds will allow the UK to decrease cost of production and increase crop volume, all while growing crops in a more environmentally sustainable fashion. The production of GM crops, therefore, will allow the UK to decrease its price for wheat and other grains.

VIII. A PROPOSAL FOR MODERATE GMO REGULATIONS IN THE UK

The UK has three options moving forward regarding its approach to GMOs: maintain the status quo, deregulate extensively (leaving few regulations in place), or partially deregulate (adopting moderate regulations). The third option is the most ideal for several reasons. First, while consumer concern about GM products is decreasing in the UK,¹⁹⁵ those concerns still exist. Therefore, extensive deregulation is unlikely to gain widespread public support. Second, because the UK has an extensive regulatory framework already in place, thorough deregulation would require a massive overhaul in UK law. Third, the simplest possible approach to modifying regulations is preferable, as the UK will be extensively negotiating other terms for its exit from the EU and determining its new place in the global society.¹⁹⁶

188. BOB FLACH, U.S. DEP'T OF AGRIC. FOREIGN AGRIC. SERV., AGRICULTURAL BIOTECHNOLOGY ANNUAL: NETHERLANDS 2 (June 2015).

189. MARTA GUERRERO, U.S. DEP'T OF AGRIC. FOREIGN AGRIC. SERV., AGRICULTURAL BIOTECHNOLOGY ANNUAL: SPAIN 1 (June 2015).

190. *Id.* at 3.

191. *See generally* LEIF ERIK REHDER, U.S. DEP'T OF AGRIC. FOREIGN AGRIC. SERV., AGRICULTURAL BIOTECHNOLOGY ANNUAL: GERMANY 2 (May 2015).

192. *Id.*

193. *Id.*

194. *Id.*

195. *Public Concern over GM Food Has Lessened, Survey Shows*, GUARDIAN (Mar. 9, 2012, 1:00 AM), <https://perma.cc/VL2W-K9LS>.

196. *See generally* ROBYN MUNRO, INST. FOR GOV'T, NEGOTIATING BREXIT: BRIEFING PAPER (July 2016).

Based on these reasons, there are three primary proposed tactics to establish a moderate GMO regulatory system that will ensure consumer safety and allow the UK to take advantage of the emerging GMO market: limiting the precautionary rule, maintaining standard EU labeling rules, and promoting a public knowledge campaign.

A. Limiting the Precautionary Rule

As mentioned earlier, the EU's precautionary principle establishes a review standard where any scientific evidence of any health concern related to a GMO is grounds for restriction.¹⁹⁷ This standard is too stringent, and de facto prevents virtually all GM products from being imported or marketed. Not every study establishing a link between a GM product and some risk will be legitimate. Certainly, such an initial study is grounds for further analysis, but if additional research can, on the whole, renounce the alleged threat to health or the environment, the GM product should be allowed. Consequently, the UK should set the evidentiary threshold for its version of the precautionary rule as significant scientific evidence of a risk, either to health or the environment. The new threshold "significant" should mean a quantum of evidence supported by several scientific studies, assessed on a case-by-case basis. The specific quantum of proof necessary would need to be determined by Parliament. It would likely be a standard requiring a greater showing than that needed in the EU, and at the same time, requiring a more extensive risk assessment than is required in the U.S.

Altering the precautionary principle to a more workable standard would allow the UK to better discern which GM products truly pose a risk. The proposed quantum of evidence sits somewhere between the U.S.' presumption of safety (i.e., more emphasis should be placed on the end product, rather than the means to achieve the product—in many cases, only notification rather than authorization is required) and the EU's presumption of risk (i.e., the precautionary principle).

B. Labeling Rules

Labeling rules are standard as a part of EU regulations and are enacted in the UK; they should still remain in force. Based on EU requirements, the UK also adopted its own labeling regulations.¹⁹⁸ As a result, UK consumers are accustomed to seeing GMO labels on products containing GM ingredients.¹⁹⁹ Since some consumer hesitation still exists in the UK, it would be ideal for the UK to maintain

197. Hathcock, *supra* note 96, at 256.

198. LYNCH & VOGEL, *supra* note 51.

199. *See id.*

labeling requirements.²⁰⁰ Requiring labeling—notably labeling without the strict model language—represents a balancing of the consumers’ and corporations’ interests. The corporation, food distributor, farmer, etc., is allowed to produce and sell GM products and take advantage of the agricultural market. Balancing this interest is the interest the consumer has in making knowledgeable decisions about the products they purchase. The consumer has a right to know what exactly is in a given food product—particularly so because the consumer has already come to expect this in the UK.

C. Public Knowledge Campaign

In any discussion where an overlap between public health and scientific terminology occurs, the threat of misinformation is high.²⁰¹ Generally, this arises because such issues receive much attention from major newspapers, and the most accurate and precise language is not always used.²⁰² Because of this information gap, discussion of GMOs is subject to much misinformation.²⁰³ Articles addressing GM food and crops have steadily increased since 1999,²⁰⁴ but the information dissemination shows a “publishing pattern for the lay press [that] does not exactly follow that of science communication.”²⁰⁵

With this communication trend in mind, the UK should launch a public campaign to better connect the public with the actual elements and conclusions of GMO research. Key studies should be summarized clearly, concisely, and in language members of the non-scientific community can easily understand. This information should be readily accessible via a variety of mediums, such as print materials, computers, and smartphones, to name a few. The UK should use this public awareness campaign to reassure people that the eventual decision to permit GM crops did not come at the expense of their safety.

D. An Optional Deregulation for Animal Feed and Industrial Purposes

The modest deregulations proposed should ideally extend to GM wheat grown for all purposes, as this would allow the UK to drop its international price

200. *See supra* Part V.B.

201. *See* Claire McInerney et al., *The Flow of Scientific Knowledge from Lab to the Lay Public: The Case of Genetically Modified Food*, 26 SCI. COMM. 44, 46 (2004).

202. *Id.* at 59.

203. *Id.*

204. *Id.* (noting a decrease in publications in 2001 likely due to the publicity stemming from the threat of terrorism in the U.S.).

205. *Id.* at 60.

of wheat in all respects and thus become more competitive on the market. However, since more than 50% of UK-grown cereals are used for industrial or animal feed purposes,²⁰⁶ the UK could allow the growth of GM products solely for industrial use and animal feed. This would allow UK citizens to consume GMO-free grains, while permitting the UK to become more competitive specifically within the sphere of grain used for purposes other than human consumption.

IX. CONCLUSION

The use of GMOs is a contentious topic internationally, with the stringency of regulations varying widely between countries. While the U.S. has chosen to adopt more permissive regulations, the EU in contrast has enacted some of the strictest regulations in the world; the current regulations have not authorized a GM product since 2001.²⁰⁷ With the passage of the referendum authorizing Brexit, the UK has the chance to create more permissive regulations than those it was previously required to adopt due to membership in the EU. While the UK should not deregulate its existing framework to the level of permissiveness of the U.S., it should adopt more moderate rules than the EU. The moderate rules could allow the UK to take advantage of the growing GM crop market—in particular the newly emerging GM wheat market—without compromising the safety of its citizens. More specifically, moderate regulations could call for an expansion of the evidentiary threshold for the precautionary rule, maintenance of labeling requirements, and the creation of a public awareness campaign to increase common knowledge of GMOs.

206. THE UNITED KINGDOM CEREALS INDUSTRY, *supra* note 171 (noting the use of cereal at 50% for animal feed and 35% for industrial purposes).

207. Papademetriou, *supra* note 3.