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GE Plants and Animals Report

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Report Highlights:
The United Kingdom's potential exit from the European Union (Brexit) will not change policy or trade in genetically engineered plants or animals in the short to medium term. Longer-term modifications could be possible, depending on the legal basis that the United Kingdom (UK) may or may not leave the EU. The UK represents 10-15 percent of EU imports of soy, corn, and other animal feed products likely to be derived from genetic engineering. Soybean meal is the largest import, mainly from Argentina, with the United States the major supplier of Distiller's Dried Grains with Solubles (DDGS). Livestock industries remain protein-deficient and timely European Union approvals of new GE crops is key. The UK intends to retain its leadership in both GE plant and animal research, and increase applied science and knowledge exchange.

EXECUTIVE SUMMARY

Brexit has the potential to change many policy areas, including agricultural biotechnology. However, in the short to medium term, the current landscape for cultivation and importation of GE products is not expected to alter. The UK will always be mindful of European Union import requirements and approvals when setting their own. Senior UK politicians have consistently spoke out in favor of simple genome editing throughout 2018. However, in light of the European Court of Justice ruling on New Plant Breeding Techniques, a mechanism where the UK could legally deviate from the EU regulation is not yet clear.

Scotland, Wales and Northern Ireland have "opted-out" of cultivating GE crops that are currently approved or in the pipeline under EU legislation. In theory, this opt-out is on a case-by-case basis. However, it is very unlikely that any of the large multi-national seed technology companies would invest in near-market research and commercialization of a crop that could only be marketed in England, unless perhaps it was wheat. Even if developers submitted a cultivation application for a GE product for England only, it is hard to gauge whether farmers would ultimately get the chance to plant GE crops. Successful introduction in the UK will depend on the type of product being engineered, the trait benefits, and the intended benefactors.

Brexit has stirred consumer interest and a national pride in supporting and sourcing British products, particularly meat/poultry/dairy products. However, this is not always followed at the point of sale when price is factored into the equation. GE animal feed is not an issue for most consumers since products from such animals are not labeled as GE, and there is no genetically engineered material found in finished meat and dairy products. Still, in more upscale outlets where the buyer is less price-conscious, there is a trend to remove GE feed where possible.

When comparing UK imports of soy, corn, and other animal feed products (likely to be derived from genetic engineering) against EU- 28 imports, the UK typically represents 10-15 percent of the existing EU import market (this assumes that all products are of non-EU origin). The UK derives most of its soybean meal from Argentina and its DDGS from the United States. In 2017/2018, the UK accounted for 58 percent of the total amount of DDGS shipped to the EU. These figures have been derived using UK and EU import data.

Research is the main focus for animal biotechnology in the UK. Many object to cloning and GE animals on ethical grounds, and there are sensitivities relating to perceived animal welfare issues associated with the technologies. Opinions vary with the intended use, with medical applications (improved medicines) being the most accepted. The UK has imported embryo progeny of clones or embryos of clone progeny as well as bovine semen which may have come from clones or their progeny.

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Reporting Notes:

1. The United Kingdom (UK) is a member of the European Union (EU) and this report should be read in conjunction with the EU-28 Agricultural Biotechnology Annual report available here: FAS/USDA GAIN Report Database

2. The term "agricultural biotechnology" refers to an evolving continuum of technologies. It is a broadly applied term that may or may not refer to crops developed through recombinant DNA technologies. Commonly used terms are: plant (or animal) biotechnology, transgenic, biotech, bioengineered, and genetically engineered (GE).

3. The U.S. government uses the term genetically engineered (GE) in addressing this topic. However, the EU legislation and Member State implementing regulations use Genetically Modified (GM) food and feed and Genetically Modified Organisms (GMO). These terms are used in parentheses in this report when discussing EU legislation and UK implementation.

CHAPTER 1: PLANT BIOTECHNOLOGY

PART A: PRODUCTION AND TRADE

a) PRODUCT DEVELOPMENT

The private sector's interest in developing varieties of GE plants suitable for UK and wider EU cultivation has waned. Almost all of the 60 or so GE crop trials conducted in the UK since 2000 have been subject to vandalism. This, together with the uncertainty and delays that are characteristic of the EU approval process, amounts to an unattractive investment environment. While the UK and EU continue to publicly-fund laboratory and fieldwork on plant biotechnology, it is unlikely that any of the current or recent research, including those below, will be brought forward for commercialization in the UK within the next five years.

Crop	**Research Facility**
Various camelina modifications	Rothamsted Research [2018-2022]
Omega-3 oil camelina	Rothamsted Research [2014-2018]
Yield/photosynthesis enhanced wheat	Rothamsted Research [2017 and 2018]
Multi-enhanced potatoes	The Sainsbury Laboratory and partners [2016-2019]

(Late blight resistance, nematode resistance, reduced bruising, reduced acrylamide on cooking)

In addition to the above, a trial with GE Camelina oil (from the Rothamsted crop) will be conducted by the Stirling Institute of Aquaculture in 2018-2019. The study will involve supplementing the diet of farmed fish with oil from the GE camelina to ascertain whether high levels of beneficial fatty acids, such as omega-3, will come through into the final product.

Innovative biotechnologies, such as CRISPR-Cas9, are increasingly used in UK research projects. In the 2018 growing season, Rothamsted Research conducted the UK's first field trial of genome-edited Camelina plants with two lines aimed at improving understanding of lipid metabolism related to the omega-3 work. To safeguard this study, it was conducted within Rothamsted's secure field site. BRACT (Biotechnology Resources for Arable Crop Transformation) at the John Innes Centre has increased its capacity to provide the research community with targeted gene knock-outs in cereals (particularly barley) and *Brassica oleracea* using RNA-guided Cas9.

The UK was the first country to permit researchers from the Francis Crick Institute to edit the genomes of human embryos using CRISPR-Cas9 to snip out defective genes and replace them with

healthy ones. In addition, the UK government launched an Industrial Strategy Challenge Fund in March 2017 to explore new ways of manufacturing or delivering medicines, including synthetic biology and the full suite of biotechnologies.

The UK's historic strength in science lies in curiosity-driven or basic research. However, there are several government initiatives underway to improve the link between the lab and the field. Applied research is increasingly encouraged on a public-private partnership basis. The Agri-Tech Strategy is an example of a funding stream that aims to improve the translation of research into practice: "*This strategy is about better integrating the UK's progressive food and farming businesses, and world class science base, with the government's support for trade, investment and international development.*"

b) COMMERCIAL PRODUCTION

Despite being a supporter of the science, the UK has never planted a commercial GE crop and has no crops under development. The limited portfolios of GE plant products that are approved for cultivation in the EU are not well-suited to UK growing conditions.

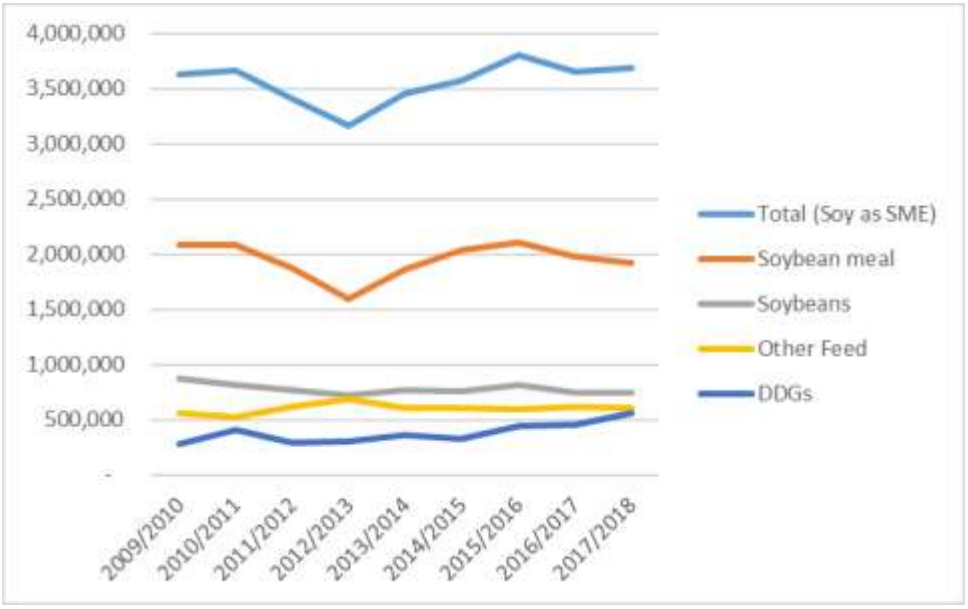
c) EXPORTS

The UK does not export genetically engineered crops or products to the United States or any other country.

d) IMPORTS

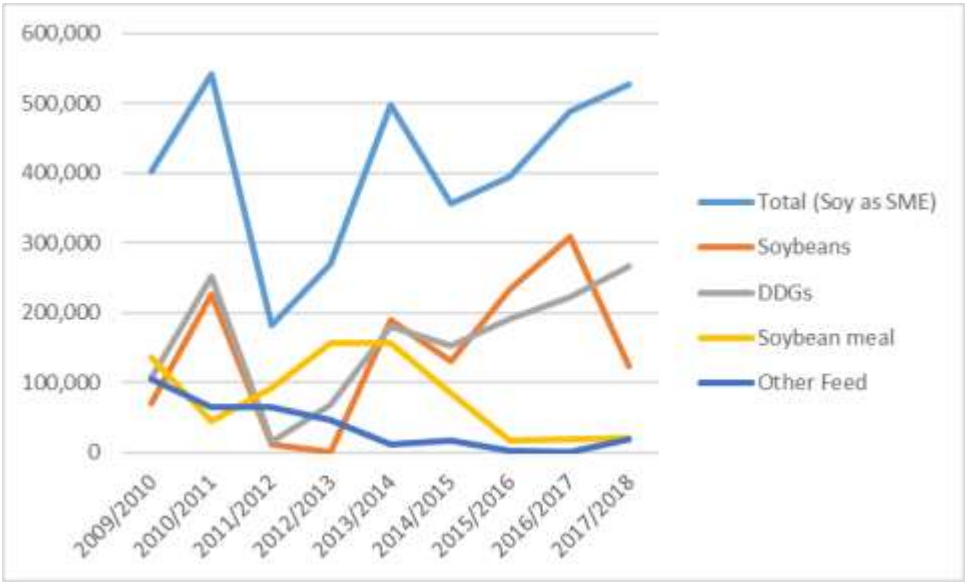
Like EU counterparts, the UK is a protein-deficient market that needs to import grain and oilseed derivatives to feed livestock. Imports of animal feed products are influenced by animal stocking levels and domestic production of grains and oilseeds. The charts below show UK imports of animal feed commodities that are predominantly derived from GE crops, and those that the United States may export to the UK when conditions are favorable.

UK Imports from the World: Soybeans, Soybean Meal, DDGS, and Other Animal Feed (metric tons)



SME = Soybean Meal Equivalent
Source: Global Trade Atlas/UK Her Majesty's Revenue and Customs (HMRC)

UK Imports from the United States: Soybeans, Soybean Meal, DDGS, and Other Animal Feed (metric tons)



SME = Soybean Meal Equivalent; Source: Global Trade Atlas/UK HMRC

Confidence to purchase from a particular country is dependent on whether there is EU approval (for food and feed) for new GE crops cultivated there. The main supplier countries are located outside of the EU and include Argentina, Brazil and the United States. Low Level Presence (LLP) of unapproved GE events in bulk shipments remains a concern that dominates trade decisions. The threshold for unapproved events found in animal feed is very low at 0.1 percent (and only for traits already in the EU approval pipeline). There continues to be zero tolerance for unapproved GE events found in the food supply chain.

There is a marked difference between the stability of trade shown in the world imports chart above and the chart showing UK trade with the United States in animal feed commodities. It demonstrates that trade is affected by asynchronous approval timelines when a GE trait is commercially grown in the United States ahead of EU approval. Of course, trade is also dependent on many other things such as the fortunes of long term supply chain investments for soy meal in South America, availability of supply, demand, exchange rates, etc. However, it is clear that short-term changes in sourcing patterns by UK importers can arise due to issues associated with plant genetic engineering.

As can be seen in the chart below, many UK imports arrive via other EU destinations, particularly from the Netherlands port of Rotterdam. Ireland is also a key trans-shipment country for animal feed materials ultimately destined for the UK. This routing through other EU Member States makes it difficult to say definitively what proportion of UK imports can be attributed to the original country, such as the United States, Brazil, Argentina, etc. However, it is clear that the vast majority of these commodities are from outside the EU as neither the Netherlands nor Ireland grows soy or corn in commercial quantities.

Comparing UK imports of soy, corn and other animal feed products likely to be derived from genetic engineering against EU- 28 imports in the last five years, the UK typically represents 10 - 15 percent of the existing EU import market (this assumes that all products are of non-EU origin). Since the UK only has one soybean crushing facility it imports significantly less (around 5 percent of EU total) soybeans than other major EU Member States. The UK particularly looks to the United States for DDGS, each year typically sourcing over 70 percent of total imports from the United States when trans-shipment from Ireland and other Member States are taken into account. In 2017/18, the UK accounted for 58 percent of the total amount of Distillers Dried Grains shipped to the EU.

Imports of Selected Animal Feed Tariff Lines during MY 2017-2018

	Total EU Imports from All Origins MMT	US % Market Share of EU Imports	UK Imports from All Origins MMT	UK Imports from USA as % Market Share
Soybeans (1201)	14.6	16	0.7	17
Soybean meal (2304)	18.4	4	1.9	1
DDGS (230330)	1	85	0.6	47
Other Feed (2308)	1.8	5	0.6	3

MMT = Million Metric Tons
Source: Global Trade Atlas/UK HMRC

UK Imports of Selected Animal Feed Tariff Lines during MY 2017-2018

	UK Intra-EU Imports MMT	UK Imports from Third Countries MMT	Top Source Countries for UK Imports
Soybeans (1201)	0.0	0.8	Brazil, United States, Canada
Soybean meal (2304)	0.3	1.1	Argentina, Netherlands, Paraguay, Canada
DDGS (230330)	0.3	0.3	United States, Ireland, Netherlands, Sweden
Other Feed (2308)	0.0	0.6	Argentina, Russia, Ireland, Germany

MMT = Million Metric Tons
Source: Global Trade Atlas/UK HMRC

e) FOOD AID RECIPIENT COUNTRIES

The UK's Department for International Development (DFID) sends food packages, which do not include GE products, along with medical supplies to countries in need. The UK is not a recipient of Food Aid.

f) TRADE BARRIERS

For two decades, U.S. exports of processed foods and beverages have been constrained by market conditions and EU legislation pertaining to GE food products. As a result of an historically negative

image of agricultural biotechnology, UK supermarkets and food manufacturers formulate their regular grocery products to exclude GE ingredients. Usually the GE element of processed foods is a small component of the overall product, for example, soy lecithin (used as an emulsifier). This means that the additional cost of sourcing non-GE ingredients adds only a small contribution to the finished price of the goods. However, for many U.S. companies, the additional burden to source non-GE ingredients to supply the EU is often too large a hurdle to overcome. This is also increasingly the case for other countries wishing to supply the EU. As approximately 30 countries now produce GE crops it is becoming ever-harder to source non-GE ingredients.
Private standards are increasingly affecting the incorporation of GE feed into animal feed rations. Depending on the product line, high end grocery chains can make it a condition of supply that the animals have been fed a non-GE diet.

PART B: PLANT BIOTECHNOLOGY POLICY

a) REGULATORY FRAMEWORK

While still a Member State, the UK must implement all EU Directives and Regulations since novel foods and processes is an aspect of food law that is harmonized throughout the EU.

Responsible UK authorities

1. The Health and Safety Executive (HSE) regulates genetically modified organisms ("GMOs") in contained use (e.g., in a laboratory). Link to HSE

2. The Department for Environment, Food & Rural Affairs (Defra) is responsible for the control of the deliberate release of GE agricultural products and for national, EU and international policy on the environmental safety of such products. Link to Defra, see Appendix 7, the term used is "GM."

    Defra is the competent authority that implements and enforces Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of GE agricultural products genetically modified organisms. EU Directive 2001/18/EC

    Defra provides the secretariat for the Advisory Committee on Releases to the Environment (ACRE). ACRE is the independent body which reviews applications for field trials of GE agricultural products. Link to Defra/ACRE

3. The Food Standards Agency (FSA) controls the assessment of GE food for human consumption (food and feed), and consumer labeling of GE foods. Link to FSA, term used is "GM."

The FSA is advised on both GE and novel foods by an independent body of experts called the Advisory Committee on Novel Foods and Processes (ACNFP) and on GE animal feed by the Advisory Committee on Animal Feedingstuffs (ACAF). The ACNFP is responsible for assessing the safety of novel and GE food, and ACAF is responsible for assessing the safety of GE feed. There is a proposal to revert risk assessment authority back to these UK committees if and when the UK exits the EU. However, the UK may decide to retain the European Food Safety Authority (EFSA) as its risk assessor since "subscribing" to EFSA is still a possibility for countries outside of the EU.
The United Kingdom is comprised of England, Wales, Scotland and Northern Ireland. The devolved

governments of Northern Ireland, Scotland and Wales have jurisdiction over agriculture, fisheries, and food policy in their regions. These countries have a higher proportion of "Less Favored Areas" for agriculture under EU Common Agricultural Policy definitions than England, and they trade heavily on their 'pristine and natural environment' image.

In 2015, Wales, Scotland and Northern Ireland notified the European Commission that they wished to "opt-out" of cultivation of GE crops. These more rural communities generally believe that growing GE crops may damage the reputation of their produce, and as such, this outweighs any benefits that agricultural biotechnology might bring.

In formulating overall UK agricultural biotechnology policy, the central government (based in London) solicits views from a wide range of stakeholders, including the devolved Parliaments.

b) APPROVALS

The EU approval process distinguishes between the regulatory treatment of the approval for food, feed, processing, and environmental release. For information on EU policy, approval process and pending approvals, please see EU-28 Agricultural Biotechnology Annual report: FAS/USDA GAIN Report Database

c) STACKED or PYRAMIDED EVENT APPROVALS

In the EU the approval process for stacked events is similar to that for single events. For import or cultivation in the UK, these types of GE events must also apply through the EU legislation and approvals system for stacked or pyramided events. Further information on the EU approval process can be found here: European Food Safety Authority, and Page 8 of EFSA Guidance for Risk Assessment Also, for more information, please see EU-28 Agricultural Biotechnology Annual report at: FAS/USDA GAIN Report Database

d) FIELD TESTING

The Department of the Environment, Food and Rural Affairs (Defra) is the lead agency for field testing. However, the devolved administrations of Scotland, Wales, and Northern Ireland have powers over cultivation on their territory.

While the UK is still an EU Member State, an application for a field trial is made to Defra under Part B of the EU's Deliberate Release Directive (2001/18/EEC), which covers release for research and development.

Over 60 GE crop trials have been conducted in the UK since 2000, mainly on corn, sugar beet, oilseed rape, wheat and potatoes. See section a) Product Development for further information on current field trials.

e) INNOVATIVE BIOTECHNOLOGIES

Innovative biotechnologies include CRISPR-Cas9, oligonucleotide-directed mutagenesis (ODM), zinc finger nuclease (ZFN), cisgenesis and intragenesis, grafting, agro-infiltration, RNA dependent DNA methylation, reverse breeding and synthetic genomics.

These technologies are evolving rapidly, and are an example of where legislation has not kept up with development. The EU Commission's Modern Biotechnologies Web Page provides the latest status of policy development. In addition, the U.S. Mission to the EU website has a helpful summary.

Throughout 2018, Defra Secretary of State: Michael Gove said that genetic engineering (particularly genome editing) is an area where the UK may diversify from the European Union following possible departure from the bloc. At the time of writing, the details of the UK's future relationship with the EU remain unclear.

f) COEXISTENCE

The UK currently does not have a policy. The basis for any UK coexistence policy is likely to be the extensive work carried out and published by the Supply Chain Initiative on Modified Agricultural Crops (SCIMAC) in 2006. Information on their proposals for coexistence and liability can be found here: SCIMAC

The UK government's policy on coexistence of GE crops with conventional or organic crops states: "*If and when genetically modified crops are grown in England commercially, we will implement pragmatic and proportionate measures to segregate these from conventional and organic crops, so that choice can be exercised and economic interests appropriately protected.*"

g) LABELING

For consumer-ready grocery products, labeling is triggered by the presence of 0.9 percent or more approved "GM" ingredients as a percentage of the individual ingredient. The list of ingredients should contain a reference, for example: "contains soya oil from genetically modified soya." More at: EU Commission Traceability and Labeling

Guidance on labeling GE products, ingredients or processing aids can be found here: Food Standards Agency "GM" Labelling

Also, see the EU-28 Agricultural Biotechnology Annual report for further details on labeling requirements: FAS/USDA GAIN Report Database

Seed Labeling Legislation

In the absence of any EU seed labeling regulation for the adventitious presence of GE seed, the European Commission has advised that any seed lot containing "GM" seed authorized for the cultivation has to be labeled as containing "GMOs." Seed lots containing GE seeds that are not authorized for cultivation cannot be marketed in the EU. In the UK, this is enforced by the GM Inspectorate of the Animal and Plant Health Agency (APHA GM Inspectorate).

h) MONITORING AND TESTING

All UK imports are subject to random or more frequent testing (depending on product) upon border entry. Since it is not a food safety concern, testing for genetically enhanced material is normally randomized testing unless the EU Rapid Alert System has flagged a particular product and origin for additional measures. The food supply chain conducts its own testing to satisfy import specifications, labelling obligations, and customer assurance.

i) LOW LEVEL PRESENCE (LLP) POLICY

The EU has a zero tolerance policy for low-level presence of GE products in food and feed. As the EU's authorization procedures for new agricultural biotechnology varieties tend to be slower than those of other countries, a time-lag known as 'asynchronous authorization' occurs. To deal with the possible presence of unauthorized varieties in imports of commodity crops, the EU has adopted a measure, Regulation 619/2011, which defines "zero" with a "technical solution" level 0.1 percent for varieties that have a valid application for an EU authorization has been made and which fulfill the requirements set out in Article 2 of the Regulation. There is no set technical solution for food. The EU's Joint Research Centre has published guidance on the application of Regulation (EU) No 619/2011.

Above this threshold, the product is not allowed on the EU market. Operators must demonstrate that the presence of "GM" material was adventitious or technically unavoidable. The UK must adhere to the EU's technical solution for unapproved GE traits found in shipments. For more information, please see EU-28 Agricultural Biotechnology Annual report coordinated by FAS/USDA Paris at: FAS/USDA GAIN Report Database

j) ADDITIONAL REGULATORY REQUIREMENTS

The UK has no additional regulatory requirements.

k) INTELLECTUAL PROPERTY RIGHTS (IPR)

The UK has a comprehensive system to address Intellectual Property Rights, including an Intellectual Property Office (IPO) that covers plant breeders' rights. A patent can be granted at a national level through the IPO or through the European Patent Office.

The Animal and Plant Health Agency (APHA) takes the lead on plant intellectual property and plant

variety rights. See: Guidance on Plant Breeders' Rights

l) CARTEGENA PROTOCOL RATIFICATION

In the context of potentially leaving the EU, the UK is already a stand-alone party to the United Nations' Convention on Biological Diversity, and ratified the Cartagena Protocol on Biosafety. Defra is the contact point.

England implemented EU Council Regulation (EC No. 1946/2003 by way of the Genetically Modified Organisms (Trans-boundary Movements) (England) Regulations 2004. Similar regulations have been implemented in Scotland, Northern Ireland and Wales). These regulations establish a common system of notification and information for transboundary movements of GE organisms and ensures coherent implementation of the provisions of the Cartagena Protocol on Biosafety.

Biological Diversity is an increasing area of work for the UK government, as agricultural innovation seeks to increase production while at the same time reducing environmental and biodiversity impacts. See more at: UK biodiversity indicators

Increasingly, countries with experience of growing GE crops will be asked how they measure the impact of monoculture/short rotation on wildlife, and for hard statistical results.

m) INTERNATIONAL TREATIES/FORUMS

The UK is an active participant in all major plant health and international regulatory forums including the International Plant Protection Convention (IPPC), European Plant Protection Organization (EPPO), Food and Agriculture Organization of the United Nations (FAO), World Trade Organisation (WTO), Codex Alimentarius, and the Organization for Economic Cooperation and Development (OECD). In all forums, the UK consistently takes a pragmatic position based on evidence and science-based risk assessment.

n) RELATED ISSUES

There are no related issues.

PART C: PLANT BIOTECHNOLOGY MARKETING

a) PUBLIC/PRIVATE OPINIONS

The UK has a number of academics that are vocal on both sides of the debate. Most are proponents of responsible use of biotechnology. During any live media debates, relevant experts are invited to speak publicly through the Science Media Centre following requests from journalists for specialist information and comment.

There are a number of organizations actively campaigning against the technologies, including but not limited to GeneWatch, Friends of the Earth, the Soil Association, and Royal Society for the Protection of Birds.

For the majority of the British public, genetic engineering in food is irrelevant. There are very few mainstream grocery products that contain GE as an outright ingredient and, with this invisibility, UK consumers consider the "GM problem" to have gone away.

For those that distrust the technology or have limited knowledge and hold only a sense or a feeling on the subject, many cite the concentration of power over staple food crops by big business as their main concern. An example illustrating that these technologies may be more accepted if derived from publicly funded projects is that of the wheat field trial at Rothamsted Research. Scientists there appealed to the public not to vandalize their work and empathetically communicated the nature and purpose of the trial. The trial reached conclusion, despite involving a food staple, and set the scene for the successful trials that have followed.

b) MARKET ACCEPTANCE/STUDIES

The food price spikes of 2008, and the ensuing debate and focus on how to deliver global food security, while addressing climate change and feeding a burgeoning population, resulted in generally positive media coverage in the UK for agricultural biotechnology. This has never translated into a blanket acceptance for the presence of GE ingredients in the UK food supply.

Deepening economic turmoil over Brexit has meant that the UK government has attempted to highlight and support areas that could create economic growth and skilled labor. The food and drink industry is the UK's largest manufacturing sector. However, in terms of power base within the supply chain, the majority of consumers look to grocery store operators to determine what values are associated with the quality to price ratio, and to rigorously check the safety and traceability of the food they purchase. In turn, the "choice editing" by retailers or foodservice companies determines what is sourced by the supply chain. Experience has shown that unless the sector is up against global shortages that lead to significant price rises, sourcing GE ingredients is a last resort.

As the number and adoption of GE crops worldwide continues to increase exponentially, the availability and cost of sourcing and segregating GE products has become a real issue for the UK supply chain. No single retailer wants to be the first to undo its previous general stance on agricultural biotechnology on any product category. However, movement has been necessary within the animal feed sector as the availability of non-GE has rapidly decreased and the cost increased. In 2010, Asda (Walmart) was the first to accept GE feed for their private label meat and poultry products, Wm Morrisons Supermarkets followed. More recently (April 2013), Tesco, Cooperative Group, Marks & Spencer, and Sainsbury Supermarkets also communicated to their customers that the poultry and livestock supply chains could no longer source sufficient quantities

of non-GE animal feed at a reasonable cost. Organic options are available for those who wish to avoid GE-fed livestock, and the up-scale Waitrose chain (capitalizing on the opportunity to differentiate from its competitors) now states that "No Waitrose food is genetically modified". See more here: Waitrose policy statement

There have been calls by lobby groups to label meat and poultry products from animals fed with GE feed (currently exempt from EU labeling law). Some commentators believe that voluntary labeling will help acceptance of GE feed and food, since the labeling will be become familiar. Others cite concerns that meat and poultry products from animals fed with GE feed will be seen as the option for the poorest in society, while the richest will have alternatives. However, it is more likely, if given the information and a choice, a large majority of UK consumers will vote with price uppermost in mind.

Over the last twenty years, the existence of GE crops in the marketplace has negatively affected imports of food products containing soy and corn-based products. In addition, products containing glucose or other sugar components of GE sugar beet or oilseed rape (Canola) must be labeled, and by doing so the GE presence is highlighted. Some supply chains may decide that they do not want GE ingredients/labeled products and the product may not be listed or carried in UK inventories. There are a few examples of products overcoming the hurdles, labeling appropriately and achieving sales success. These products are usually those where consumers have a desire for the product or there is a price incentive that counters the presence of GE ingredients, for example, "cult" confectionery, candy bars and low cost cooking oils.

Innovative biotechnologies may have a smoother path to consumer acceptance. This will depend on the nature and purpose of the change that is created, and how any consumer benefits are communicated.

Marketing Studies

There have been many consumer attitude studies conducted over the last two decades. The identity of those having paid for the research tends to color the acceptance, or otherwise, of the data. In general, it is possible to say that over time there has been movement towards greater understanding of the benefits that GE can bring. It is interesting to note that a 2018 Populus poll (carried out for the Agricultural Biotechnology Council), of more than 1,600, 18 to 30 year olds, found that only 20 percent of millennials expressed concerns about gene editing or genetically engineering crops. In addition, it found that two-thirds of under-30s believe technology is a good thing for farming and support futuristic farming techniques.

In 2016, a survey of 2,000 Brits, carried out by Populus for the agrochemical company Bayer Crop Science, found that two thirds of respondents said that they would support GE food so long as it did not harm public health or the environment. Fifty-four per cent said that they agreed with GE crops in principle and a further ten per cent said they were the only way to feed a growing global

population. Twenty-seven per cent said that they were opposed to biotechnology outright.

A YouGov survey of the British public conducted in February 2014 showed that 46 percent of those polled hold negative views on "GM" foods. Thirty-one percent didn't know (whether their views of "GM" foods have become more positive or negative in the preceding 12 months), and only 23 percent held positive a view. YouGov Poll Results

CHAPTER 2: ANIMAL BIOTECHNOLOGY

PART D: PRODUCTION AND TRADE

a) PRODUCT DEVELOPMENT

Research is the main focus for animal biotechnology in the UK. 'Dolly the sheep' was the first mammal in the world to be cloned from an adult cell in 1996. Previously researchers had cloned a sheep from an embryo cell in Cambridge in 1984. No UK cloning research is currently taking place that will result in live farm animals. Genetically Engineered animals, such as those below, are under development but none are expected to be on the market in the UK within the next five years.

Event	**Organization**
GE mosquitoes to control dengue fever, malaria	Oxitec/Intrexon
GE olive fly, medfly, bollworm	Oxitec/Intrexon
GE pest insects	Pirbright Institute
GE insects	Beta Bugs
Suppression of avian influenza transmission in GE chickens	Roslin Institute
Gene-edited (ZFNs and TALENS) Pig 26 (for biomedical research)	Roslin Institute

b) COMMERCIAL PRODUCTION

Genetically Engineered animals (particularly mice) and fish are produced in the UK for research purposes. According to statistics from the UK government's Home Office, genetically engineered

mice accounted for almost fifty per cent of all animals bred for research in 2016. Such usage of GE mice is expected to continue to increase. Figures for UK production are not available. The figures above only reflect total numbers of GE animals used. In 2017, 3.8 million GE animals were reportedly used in mainly human health-related studies (Speaking of Research). In addition, GE invertebrates such as fruit flies and nematode worms are widely used by UK researchers. With regards to products from animal biotechnologies, embryo progeny of clones or embryos of clone progeny have been imported for use in the dairy sector. Bovine semen is also imported, including from U.S. Holstein herds, so it is possible that this has been sourced from clones or their progeny.

c) EXPORTS

The UK exports GE mosquito eggs for development and subsequent release in Brazil and the Cayman Islands. This trade is expected to increase with the announcement of a new mosquito egg production unit, see: Oxitec Press Release Apart from these, the UK does not export GE animals, livestock clones, or products from these animals. Given the aforementioned reference to the beef and dairy sector, it is possible that the UK exports products produced from, and genetics from, the progeny or subsequent generations of clones.

d) IMPORTS

As mentioned above, the UK has imported embryo progeny of clones or embryos of clone progeny as well as bovine semen which may have come from clones or their progeny. No import data is available as these products are not differentiated from other embryos or semen. The UK has not imported GE animals or livestock clones.

e) TRADE BARRIERS

Ethical and welfare concerns exist, but there are no known physical trade barriers in the UK.

PART E: POLICY

a) REGULATORY FRAMEWORK

As with plant biotechnologies, the UK Government takes a pro-science and generally positive, pragmatic and progressive approach to animal biotechnologies. At present, the UK does not have any country specific legislation or registration requirements on animal biotechnology; it must implement and follow all EU legislation in this area.

Please see FAS USDA's EU-28 Agricultural Biotechnology Report for more information on the EU regulatory framework in the FAS/USDA GAIN Report Database

The Department for Environment, Food, and Rural Affairs (Defra) plays an overarching role in the

implementation of animal biotechnology regulation in the UK. The Health and Safety Executive helps to control the contained use of genetically engineered organisms in the UK to ensure no products or animals are released or exposed to humans without safety inspections and approvals. Further information on Defra's role in the regulation of GE animals and/or livestock clones, is available here

The Farm Animal Genetic Resources Committee (FAnGR) gives advice to the UK government on issues to do with farm animal genetics. See: FAnGR

b) INNOVATIVE BIOTECHNOLOGIES

As covered in the PART A a) - Product Development section above, UK researchers are using innovative biotechnologies in the laboratory.

These technologies are evolving rapidly, and are an example of an area where legislation has not kept up with development. The EU Commission's Modern Biotechnologies Web Page provides the latest status of policy development. In addition, the U.S. Mission to the EU website has a helpful summary.

c) LABELING AND TRACEABILITY

Guidance on labeling GE products, ingredients, or processing aids derived from GE animals or clones can be found here: Food Standards Agency "GM" Labelling

Also, see the EU-28 Agricultural Biotechnology Annual report for further details on labeling requirements: FAS/USDA GAIN Report Database

d) INTELLECTUAL PROPERTY RIGHTS (IPR)

The UK has a comprehensive system to address Intellectual Property Rights, including an Intellectual Property Office (IPO) that covers animal breeders' rights. A patent can be granted at a national level through the IPO or through the European Patent Office. See: Guidelines for Patent Applications relating to Biotechnological Inventions

e) INTERNATIONAL TREATIES AND FORUMS

The UK is a member of Codex Alimentarius in its own right and the direct liaison point is Defra: codex@defra.gsi.gov.uk. While still a member of the EU, the UK only speaks or votes on issues in areas of exclusive or mixed UK/EU competence.

As regards the World Organization for Animal Health (OIE), Defra is the liaison point for Great Britain (England, Scotland, Wales) and the Department of Agriculture, Environment and Rural Affairs (DAERA) represents Northern Ireland in that forum.

PART F: MARKETING

a) PUBLIC/PRIVATE OPINIONS

The UK has a number of organizations, such as the Roslin Institute and the Biotechnology and Biological Science Research Council (BBSRC), active in public, positive engagement on animal biotechnologies. There are also a number of organizations actively campaigning against the technologies, including but not limited to GeneWatch, Friends of the Earth, the Soil Association, and Compassion in World Farming (CIWF).

The UK population has a generally low understanding of the science behind the technologies. Many object to cloning and GE animals on ethical grounds, and there are sensitivities relating to perceived animal welfare issues associated with the technologies. Opinions vary with the intended use, with medical applications (improved medicines) being the most accepted. If consumers' level of awareness regarding the positive animal welfare traits were higher (such as the example of breeding cattle without horns so that they do not have to be de-horned) then it could be expected that this would increase the acceptance of the technologies. However, accepting a product that has animal benefits will always remain secondary to a product that the consumer needs or wants because of inherent benefits to them.

Publicly funded research is more trusted than that undertaken by the private sector, there being an inherent bias towards the acceptance of technology provided free to all as a public good over that perceived to be created for financial reward by private companies. In fact, UK-based breeding companies have distanced themselves from the technologies, preferring to maintain the trust of the public in their other research.

b) MARKET ACCEPTANCE/STUDIES

No independent market research has been undertaken that provides statistics on the potential acceptance of marketing animal biotechnologies in the UK.

Every couple of years a survey is conducted by Ipsos MORI, on behalf of the UK government, that takes a snapshot of current public opinion on the use of animals in medical research. The most recent 2016 survey shows that there continues to be an overall majority support for the use of animals in medical research, although the level of support dropped by three percent since the 2014 survey.

The Farm Animal Welfare Committee (FAWC) is an expert committee of Defra. It provides advice to Defra on the welfare of farmed animals, including farmed animals on agricultural land, at market, in transit and at the place of killing. In November 2012, the Committee published its "Opinion on the welfare implications of breeding and breeding techniques in commercial livestock agriculture."

The detailed report is available here. Among its many conclusions, it is notable that it encourages publicly funded animal biotechnology researchers to "engage closely with the livestock breeding industries to target the research effort better towards traits that are likely to have the greatest impact on animal welfare." Other FAWC reports and advice provided to the UK government can be found here: FAWC publications