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The Swedish media debate on GMO 1994-2017

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1. Introduction

Genetically modified organisms (GMO)[1] have long been a source of controversy and media attention. It is a topic most people know at least something about. While medical applications of biotechnology have generally been less controversial, over the years, GM food products have recieved significant, often negative public attention (Frewer et al., 2002). This report is directed to students, researchers and policy makers with an interest in understanding Swedish public perception and media debate on GMO.

A considerable amount of the information on science and technology that the general public receive once they have left school comes from, and thus is also shaped by, the mass media, such as daily newspapers, television and radio. More recently, social media such as Facebook and Twitter have emerged and become increasingly important, while various niche media disseminate information over the internet. So far, however, conventional mass media such as daily newspapers have retained an important role in the dissemination of information to the general public (Retzbach and Maier, 2015). Mass media are thus recognised as a suitable data source for studying public perception (Olofsson, 2002).

Media attention on GMO exploded in Sweden in the mid-1990s (Olofsson, 2002) at around the same time as the wider public debate on GMO intensified in the EU. The media debate is associated with several events that occurred in the wider society as well as technological breakthroughs and political changes. The report presents the results of a study into how media reporting about GMO in relation to food and agriculture changed in intensity and content in the period from 1994 up to and including 2017. The report thus aims to contribute some answers to how the Swedish media debate and wider public perception on GMO has changed over time and which factors that have impacted this change. We present the content, intensity and views communicated in media reporting on GMO over time, and discuss how and why public perception on GMO in Sweden changed in this period. To understand patterns in media reporting, it is relevant to study events in the surrounding political and economic landscape (Hess et al., 2011). Therefore, this report commences with an overview of key events, controversies and policy changes relating to GMO over time with the focus on Europe and Sweden.

[1]There are many different terms used for GMO in the public debate (Appendix 1). In this report, we have chosen to use the terms GMO (genetically modified organism), GM (genetically modified), genetic engineering and biotechnology. We have judged these to be common terms that reflect a neutral tone towards the technology.

2. Background factors playing a possible role in the GMO media debate

The first GM food products emerged on the market in the 1990s and several scientific breakthroughs were made public, stemming from increased scientific understanding about DNA and the possibility of manipulating it. The public debate on GMO really took off in the late 1990s (Olofsson, 2002).

Events that received considerable media attention include the launch of the human genome project in 1990, the cloning of the first sheep, Dolly, in 1996, and the decoding of the first human chromosome in 1999 (Zhang et al., 2016). Several influential reports were also published during this period, reviewing the scientific evidence and ethical issues emerging around the possibility of genetically modifying living organisms (e.g. Royal Society of London, 2000, Nuffield Council on Bioethics, 1999).

1994 saw the first GMO launched on the American food market: the "Flavr Savr" tomato modified by Calgene to stay ripe for longer without softening. The Flavr Savr tomato was initially popular, but its production costs were too high for it to be profitable. In 1996, Zeneca introduced tomato paste using tomatoes developed by the same technology, sold under the house brands of Sainsbury and Safeway stores in the UK and clearly labelled as GMO. The paste was sold at a cheaper price than similar non-GMO products and the product was initially popular and profitable (Bruening and Lyons, 2000).

Lobbying against GMO

In 1996, Greenpeace launched highly publicised campaigns to block the import of GMO soya to the EU (Giorgi et al., 2006). The organisation also encouraged consumers to report products that were labelled as containing GMO, and consequently managed to force several large food producers, including Nestlé, to publicly state that they would no longer sell products containing GMO on the European market (Krenzler and MacGregor, 2000). In 1998 (and on several subsequent occasions), Prince Charles engaged in the debate on GMO, being critical of the technology and its promotion by the biotech industry. The late 1990s also saw activists destroying trial plantations of GMO in several European countries and the United States (Frewer et al., 2002). GMO encountered resistance owing to concerns over several aspects of its technology, including risk perception (Wynne, 2007, Jasanoff, 2000), ideas of naturalness (Siipi, 2008), and worries that scientists and governments were not taking the risks seriously (Wynne, 2001). Another key tenet of the controversy surrounding GMO since the mid-1990s, played out in the global arena in particular in the debate

Golden Rice was developed by Ingo Potrykus and his colleagues with initial funding from the Rockefeller Foundation.

between NGOs/social scientists and natural scientists, has concerned its use to reduce poverty and ensure food security (Fischer et al., 2015a, Fischer and Eriksson, 2016, Glover, 2010, Whitty et al., 2013). Golden Rice caused one of the key controversies in this debate. Golden Rice was (and remains) an attempt to develop a GMO to directly address an issue of relevance to the poor. The rice was developed by the researcher Ingo Potrykus and his colleagues with initial funding from the Rockefeller Foundation. Motivated by vitamin-A deficiency being a significant problem for those who do not have access to a sufficiently varied diet, and a cause of blindness in children, Potrykus and his colleagues set out to develop a rice fortified with vitamin A. The rice was both heralded as an important solution to poverty-induced blindness (Potrykus, 2001) and critiqued as a technical quick fix that does not solve the underlying problem of why people do not have access to a sufficiently varied diet. The Indian activist Vandana Shiva has been a vocal opponent of Golden Rice, and GM crops more generally, as well as of the dominance of multinationals (particularly Monsanto) in the agricultural sector and how intellectual property rights are used to take control of biotechnologies (Shiva, 2000). With similar arguments, Greenpeace has also been vocal in its critique of Golden Rice (Potrykus, 2001). While the Golden Rice project was an attempt to develop a crop that benefits the poor without any ties to intellectual property, herbicide-tolerant and insect-resistant crops developed to simplify large-scale commercial farming have also been heavily promoted as pro-poor technology. The fact that these crops were being promoted by the private sector and public-private partnerships to smallholders in developing countries provoked strong resistance in civil society. Glover (2010) reports on how Monsanto in the mid-1990s emphasised a rhetoric about GM crops being a key tool for sustainable food production in developing countries, made significant investments in

various smallholder programmes, and simultaneously acquired interests in seed companies all over the world. In summary, the 'GM crops for the poor' debate can be seen to concern and involve actors such as the scientists developing GMO and ag-biotech companies on the one side and environmental and social justice activists and some social scientists on the other. Key arguments in the controversy have been that GMO make a positive and important contribution to food security or conversely that they represent a technical quick fix where the argument of 'benefits to the poor' is just a rhetoric to gain access to new markets while expensive and patented GMO seeds and inputs get farmers into debt.

Associated with the debate on farmers' indebtedness is the debate about 'sterile seed', 'terminator technology' and genetic use restriction technology (GURT) (Glover, 2010), a biological switch mechanism that aims to prevent organisms from reproducing. This technology was developed for the purpose of securing companies' revenue by having control over seed, but could, for example, also be of use in preventing the spread of plants to places where they are not wanted. Several patents were filed in the mid-1990s. In 1994 both DuPont and Zeneca were granted patents for these kinds of technologies. In 1998 Delta & Pine Land Company and the US Department of Agriculture were issued with a similar patent. The technologies and patents garnered significant negative media attention and considerable opposition from NGOs and farmers around the world, with the ETC group, an NGO working on environmental and social justice issues, coining the term 'terminator technology' (Lombardo, 2014). Responding to vocal opposition, Zeneca announced in 1999 that it would not use this technology in its commercial products (Lombardo, 2014). Later that same year, Monsanto, which had recently announced its intention to acquire Delta & Pine Land Company (but did not yet have access to its patent because the purchase only went through in 2007), publicly pledged not to make use of GURT. Also in 1999, adopting a precautionary approach, the UN Convention on Biological Diversity (CBD) recommended that the technology should not be used. In the CBD meeting in 2000, a de facto moratorium on the use of GURT was imposed, which has been upheld ever since (Lombardo, 2014). While GURT has not thus far been used commercially, it is related to the issue of patents on GM technology, which in many countries makes it illegal (even though biologically possible) for farmers to collect seeds from their GM crops. This is discussed in the next section.

Some activists have also suggested that seemingly 'good' GMO or not-for profit causes have been used as a 'Trojan horse' to introduce and commercialise GM crops broadly, while scientists have accused activists of blocking poor people's access to a way out of poverty. One example of this, apart from the Golden Rice controversy, is when Zambia in 2002 rejected US food aid containing GM maize, which sparked a heated debate (Zerbe, 2004, Mwale, 2006).

The dominance of multinational companies and the role of patents

One important dimension in the controversy touched on in the previous section about GMO in relation to food security and poverty reduction is that the different legal mechanisms attached to GM seed prevent their free use and that a few multinational companies completely dominate the seed sector. Over the years, there has been a global trend of increased private-sector spending on crop research and development. This has gone hand in hand with the expansion and global harmonisation of plant breeders' rights (PBR) and the extension of intellectual property (IP) rights to agriculture, which includes the possibility of patenting living organisms (Tansey, 2011). Today, 74 countries in the world are members of the International Union for the Protection of New Varieties of Plants (UPOV), an intergovernmental organisation and associated convention that has developed common guidelines for plant breeders' rights. These rights serve to ensure that the developers of new plant varieties receive recognition and economic compensation for their invention. This means that a farmer who purchases a plant protected by plant breeders' rights (which most commercial certified varieties are) is not allowed to commercially reproduce or share seed from that plant with other farmers. However, plant breeders' rights allow farmers to take seeds for their own use. In contrast, GM crops can also be protected today in the sense that

Different legal mechanisms attached to GM seed prevent their free use and a few multinational companies completely dominate the seed sector.

companies can patent the introduction of a specific gene in a plant, such as genes coding for herbicide tolerance or insect resistance. Patent protection is stricter than plant breeders' rights and also makes it illegal for farmers to take their own seed (von Bothmer et al., 2015). In many countries where GM crops are grown, companies also make farmers sign what are known as 'technology licensing agreements' where the farmer legally commits not to share or save seed (Jacobson, 2013). This stronger protection of GM crops, and associated restrictions on use, has caused significant controversy around GMO because although 'sterile seeds' are not used, in effect the regulation has the same outcome as if the seeds were sterile.

An associated controversy is the dominance of a few multinational companies over the technology. Although the seed sector can be seen as an ant among giants when looking at companies across the food value chain, within the seed sector in recent decades there has been a significant concentration, facilitated by the possibility of increased control over intellectual property that comes with GMO. In the early 2000s, significant upscaling and concentration had already occurred and it was common to speak about 'the big six' agrochemical giants: Bayer, Monsanto, DuPont, Syngenta, BASF and Dow (Bonny, 2014). In 2018, Bayer acquired Monsanto and consequently this company now controls one quarter of the global seed and pesticide market (Kumar, 2019).

Science and public skepticism about GMO

In 1999, sales of GMO tomato paste, which had initially been popular with UK consumers, were stopped and stores announced that they would no longer use GMO ingredients in their products. The reason for this was a significant drop in sales in autumn 1998 following a public statement in the British media by Dr Arpad Pusztai that genetic modification had unintended biological effects in rats fed with GMO potatoes (Bruening and Lyons, 2000). However Pusztai's statement alone did not cause this shift from an initially positive public opinion to the strong negative perceptions of GMO emerging in Europe. The outbreak of BSE (also known as mad cow disease) in the UK in 1980s and associated human deaths from a variant of Creutzfeldt-Jakob disease during the 1990s, when any connection was initially refuted and subsequently acknowledged by the British government, has also been widely acknowledged as leading to public distrust in government authorities. This chain of events has been acknowledged as an important trigger for emerging negative public perceptions of GMO in Europe towards the end of the 1990s (Ansell, 2006, Stephan, 2012).

Apart from Pusztai's public statement about GMO-fed rats, there were also a number of other publications that caused controversy at around the same time. In 2001, *Nature* published evidence that transgenic DNA had entered traditional maize seeds in Mexico, a country that at the time did not allow GM maize to be planted (Quist and Chapela, 2001). The publication sparked heated debate within and beyond the journal. Later studies have both detected and not detected transgenes in local maize varieties in the same region (Pinero-Nelson et al., 2009, Ortiz-García et al., 2005). One year earlier, the same journal

announced that a controlled feeding study showed toxicity of pollen from insect resistant GM maize (Bt maize) in Monarch butterflies (Losey et al., 1999), attracting significant media attention and triggering a lively discussion about what this would mean under natural conditions, whether or not Monarchs were threatened, and the general toxicity of the Bt toxin (Shelton and Sears, 2001).

It seems that after this initial period and up to the mid-2000s, with political controversy and several highly publicised contentious events, the issue of GM crops waned for about a decade. However, more recent events seem to have brought the spotlight back onto GMO again. In 2012, a couple of publications announced the discovery of the gene-editing technology CRISPR/Cas9 (clustered regularly interspaced palindromic repeat/CRISPR-associated protein 9) (Jinek et al., 2012, Gasiunas et al., 2012, Doudna and Charpentier, 2014). This technology is described by Doudna and Charpentier (2014: 1258096) as bringing *"a new era in which genomic manipulation is no longer a bottleneck to experiments, paving the way toward fundamental discoveries in biology, with applications in all branches of biotechnology"*. It was heralded by scientists as being faster, cheaper and more precise than previous genetic modification technologies. In Europe, scientists hoped that modifications made with CRISPR technology would not be regulated as GMO since it is not possible to prove that an organism has been modified by CRISPR to the same extent as is the case with traditional GMO. In 2014 a Swedish scientist, Stefan Jansson, a asked Sweden's competent authority, the Swedish Board of Agriculture, if he would have to ask for permission for a field trial for plants developed with CRISPR/Cas9 but without foreign DNA remaining in the plant. He did so to push the regulatory authorities to deal with this issue. The answer he finally received by the Swedish authorities was that since no foreign DNA would remain in the plant they would not judge it as a GMO and he did not need to seek permission for field trials. He subsequently engaged in public debates and interviews in the media to draw attention to the issue, most notably when he in 2016 was interviewed in Swedish radio while cooking and eating his home-grown CRISPR-developed kale (Jansson, 2018). On 25 July 2018, the Court of Justice of the European Union (CJEU) ruled that gene-editing technology such as CRISPR will be regulated under the same regulation as conventional GMO. The ruling generated a lot of media attention and disappointment among many European scientists (Callaway, 2018).

Also in 2012, the French scientist Gilles-Éric Séralini and co-authors published a controversial study claiming a correlation between cancer tumours in mice and genetically-modified maize tolerant to the herbicide Roundup (Séralini et al., 2012). The study was highly criticised by the wider scientific community for its inappropriate study design and far-fetched conclusions. The study was retracted from the journal in which it had initially been published and was republished in another journal. In 2011, Greenpeace activists destroyed trial plantations of GMO wheat run by a government authority in Australia, and of BASFs GM potatoes with modified starch in northern Sweden. In 2013 activists

In Europe, scientists hoped that modifications made with CRISPR technology would not be regulated as GMO.

uprooted trial plantations of Golden Rice planted by the public plant breeding institute IRRI in the Philippines (Zhang et al., 2016). There was a significant public response to this from scientists around the world and on 29 June 2016, 145 Nobel Laureates published an official letter in which they asked Greenpeace and their supporters to *"recognize the findings of authoritative scientific bodies and regulatory agencies, and abandon their campaign against "GMOs" in general and Golden Rice in particular"* (Support Precision Agriculture, 2016). The letter ends with the following statement: *"How many poor people in the world must die before we consider this a "crime against humanity"?* This statement is characteristic of the ongoing controversy surrounding GM crops and its role in poverty reduction and food security.

Responses in regulation and policy

As a reaction to global public concern about the safety of GMOs, the topic was discussed during the Rio 1992 CBD. The Cartagena Protocol on Biosafety was negotiated under the convention for the purpose of providing a broad-based global agreement about how to safely handle international movements of GMO (referred to as living modified organisms (LMO) in the protocol). The precautionary principle is central to the convention and gives the exporting country responsibility for labelling and risk assessment (Lieberman and Gray, 2008). This precautionary principle has been adopted in Europe and has been a central tenet in discussions on GMO.

In 1997, Monsanto's genetically-modified insect-resistant Bt maize (MON810) was approved for planting in the EU. It is still the only GM crop approved for commercial planting in the

EU to date. Following this approval, Austria and then Luxembourg declared that they would not allow the maize to be grown in their territories (Krenzler and MacGregor, 2000). In 1998, nine GMOs for planting or import had been approved by the EU and subsequently banned by its member states France, Germany, Greece, Italy and Luxembourg in their countries (Carson and Lee, 2005). In 1999, the EU instated a de facto moratorium on further acceptance of GMO products until new legislation had been developed (Krenzler and MacGregor, 2000).

This EU moratorium led to a long-lasting trade dispute between Europe and GMO-exporting countries, with the EU-US dispute in particular receiving significant attention (Krenzler and MacGregor, 2000, Pollack and Shaffer, 2000). The three major GMO-exporting countries – the US, Argentina and Canada – took the case to the World Trade Organization (WTO) (Lieberman and Gray, 2008). In 2004, the EU lifted its moratorium after it deemed that sufficient legislation was in place. The EU regulation on GMO centres on the 'Deliberate Release Directive' (2001/18/EC) and the 'Food and Feed Regulation' (1829/2003/EC) (Paskalev, 2012). Central to the EU legislation is that it is processed-based, meaning that it is the technology (genetic modification) in the product's development, rather than the final product itself, that is the focus of legislation. Contrasting with this is US and Canadian legislation, for example, which focuses on the features of the final product and whether the product is 'substantially equivalent' or not to existing products) (Zetterberg and Björnberg, 2017). With this comes the relevance of separating and labelling products containing GMO and regulating the co-existence of farmers who grow and do not grow GMO. The topic of co-existence has received significant attention in European

academic publications on GMO, whereas it has received much less attention elsewhere in the world (Fischer and Eriksson, 2016, Tillie et al., 2016, Punt et al., 2017, Venus et al., 2017, Schenkelaars and Wesseler, 2016). In contrast to US and Canadian legislation for example, the precautionary principle that preventive action can be taken in the absence of full scientific evidence of risk has also become central to EU policymaking on GMO (Grabner et al., 1996). In 2006, the WTO ruling judged partly, but not completely, in favour of the exporting countries (Lieberman and Gray, 2006). Despite having legislation in place, the stalemate regarding GMO in the EU did not change. In 2009, discussions began on legislation to allow member states to say no to GMO approved at EU level, and in 2015 the directive (Directive 2015/412) came into force. The hope was that the possibility for individual member countries to say no to GMO would stop them blocking approvals at EU level of products that the European Food Safety Authority (EFSA) has concluded are safe. Developments after 2015, however, reveal that this is not the case. Countries who voted against them before continue to block approvals at EU level (Eriksson et al., 2018b).

In this chapter, we have looked at reactions within regulation and policy to public scepticism about GMO. However, it is also helpful to examine the wider policy environment to understand negativity to GMO in the EU. When GMOs were introduced on the global market, the EU had recently undergone a shift in its Common Agricultural Policy away from food security (steering production towards maximised output) to focusing on quality, niche products and rewarding farmers for their work beyond food production (Kurzer and Cooper, 2007). The focus on values other than maximising production aligned well with an anti-GMO sentiment, and not so well with being positive about new GM crops that facilitated the upscaling and rationalisation of farming. Kurzer and Cooper (2007) show that in EU countries where the environmental movement managed to join forces with organic or smallholder farmer movements against GMO, for example in France and Italy, the impact they have made has been particularly effective.

GMO in Sweden

Sweden was one of the first countries to undertake research on GM crops, with the first field trials of a GM rapeseed approved back in 1989. Indeed, Sweden's approach to GMO has remained progressive and one of the EU countries comparatively often running trial plantations of GMO for research purposes (Eriksson et al., 2018a). In contrast, the Swedish public is comparatively sceptical about GMO. The 1996 Eurobarometer showed that Swedes were knowledgeable about GM technology, but more sceptical than the average EU citizen (Gaskell et al., 2000). The Eurobarometer from 2010 on biotechnology, surveying just over 1000 Swedish citizens, indicates that the Swedes are much more sceptical overall about GMO than the average EU citizen (Eurobarometer, 2010).

While there has been no Eurobarometer on biotechnology published since 2010, a Swedish study of 1074 Swedish citizens (aged 18-79, 50 percent men and 50 percent women) by the

Sweden was one of the first countries to undertake research on GM crops, with the first field trials of a GM rapeseed approved back in 1989.

Stockholm Consumer Cooperative Society (Konsumentföreningen Stockholm in Swedish) in 2018 indicated that Swedish consumers are less negative about GMO today than in the past (the association has surveyed Swedes' attitudes to GMO since 1998). Slightly over 50 percent of Swedes are still concerned about the environmental effects of GMO, and just under 50 percent are concerned about the dominance of a few multinational companies over what is grown and about the negative effects on health. The report also showed that men and younger citizens are significantly more positive about GMO than the general public (Konsumentföreningen Stockholm, 2018). This confirms findings from earlier studies (Koivisto Hursti et al., 2002). In summary, the above-mentioned studies show that the key aspects explaining the negativity felt by Swedish citizens are, in no particular order, ethical aspects, worries about unforeseen consequences on health and the environment, that it is unnatural, that it is unnecessary, and scepticism about multinational companies. The studies also show that the type of genetic modification, and its purpose, affect how people judge it.

The early field trials in Sweden and the public negativity reflect the difference in attitudes to the technology: optimism in the scientific community and private sector contrasting with scepticism among general citizens. Kurzer and Cooper (2007) show how Sweden is unique because although Swedish citizens were more negative about GMO than the average European citizen, in parliament the Swedish government still voted in favour of it at every opportunity. The authors explain this by Sweden having a comparatively strong biotech industry for a population of its size, and indicate that governments of countries with a strong biotech industry (such as Sweden, Finland and Germany) have voted in favour of GMO more often than average, whereas countries with a particularly strong environmental-farmer coalition against GMO have voted against it more often than average. Mühlböck and Tosun (2018) studied the voting behaviour of EU member states in relation to GMO between 2004 and 2014 and found that Sweden, the UK, Spain, Finland and the Czech Republic were the only member states that had never voted against GMO applications. The Swedish government's relatively positive view of GMO is also indicated by its recently developed National Food Strategy (Swedish Government, 2016) which states that novel plant breeding techniques are an important tool for meeting sustainability challenges in agriculture.

In the 1990s, Swedish plant breeding companies experienced a drop in profits and increased competition due to the emergence of GM crops in other parts of the world. In 1999, the Swedish company SW Seed entered into a collaboration and co-ownership with BASF to be able to enter the GM crop market (von Bothmer et al., 2015). The company subsequently developed and obtained EU approval for the GM potato Amflora, which has a modified starch composition, in 2010. This was the first EU approval of a GM crop for planting since the approval of Monsanto's MON 810 GM maize in 1998, and it attracted significant media attention (Ryffel, 2010). The potato had been cultivated in trial plantations in Sweden since 1994, and in 2010 and 2011 it was grown in Sweden, Germany and the Czech Republic. In 2010, a GM potato approved for trial plantations in Sweden since 2005, but not approved for commercial plantation, was found in the Amflora fields. In 2012, BASF announced its

decision to stop all activity on GM crops in Europe and move those parts of the company outside the EU. Subsequently, in 2013 the EU's approval of Amflora was withdrawn following a lengthy process that started when Hungary declared in 2010 that the European Commission had made a procedural error in granting approval for the potato (Paskalev, 2012). In response to that, Monsanto also announced in 2013 that it was withdrawing all its applications for approval of GMO for planting in the EU (von Bothmer et al., 2015).

Unlike many other EU countries, and despite Sweden's otherwise comparatively progressive stance towards GMO, the Swedish fodder market remains free of GMO. Fodder importers have so far deemed the cost of segregation on the comparatively small Swedish market to be greater than the economic benefits (for importers) of importing GM feed (Eriksson et al., 2018c). Yet GMO fodder is typically estimated to be somewhat cheaper for farmers than conventionally produced fodder (estimations by Eriksson et al. (2018c) suggest that GM fodder would be approximately 15 percent cheaper than conventional fodder). Thus the issue of allowing GMO fodder imports into Sweden is regularly raised by some farmers and farmer organisations.

There have been few noteworthy studies of the media debate in Sweden on GMO. Ideland (2002) studied how Swedish mass media talked about biotechnology. However, her study focuses on medical applications of biotechnology and is not directly relevant for this report. Olofsson, studied how gene technology was portrayed in one of the major Swedish Newspapers, Dagens Nyheter (DN) between 1973 and 1996. She identifies four periods (that she refer to as waves) representing different focus of the debate. In the 1970s key attention was to issues of risk and safety, this shifted over to a focus on ethics in the early 1980s and in the late 1980s to regulation. During the 1990s, during the period when GMO started to appear on the market, applications of gene technology were in focus. She points out that real-world events are important for the shift in attention in the debate. It is also towards the mid-1990s that the number of newspaper articles increase drastically, which corresponds with that GMOs were starting to appear on the markets. Overall, Olofsson (2002) concludes that the articles published in Dagens Nyheter in the period studied were mostly neutral about the technology and that the topic was not controversial or a focus of media attention, but that debate articles and editorials were more negative than other types of articles. She concludes that the former type of articles might correspond better with the public debate in Sweden because in that period Sweden had a more negative attitude overall to the technology than elsewhere in the world.

Summary of background factors

As shown above, GMO has caused significant controversy in Sweden, as well as elsewhere in Europe and the world. The nature of this controversy, the actors engaged and the topics in focus have shifted with time and place, but the literature indicates some clear trends. At an early stage, the controversy focused significantly on the perceived risks or concerns about unknown risks to human health and the environment. This was related to distrust in the governance of GMO (reflected in the debate on GMO in Europe during much of the 1990s and to some extent is still the case today). A little later, most of the focus was on poverty, food security, rights issues and distribution, with one key controversy being whether we need more food (which, it is argued, could be achieved with the help of genetic modification) or whether we need to focus on the distribution of existing resources. To a large extent, this debate has continued to be between scientists developing GMOs on the one hand and social scientists and environmental and social justice movements on the other, mainly played out in the global arena in academic papers, NGO websites and media campaigns. A parallel controversy that has attracted less attention overall is the debate on 'naturalness', i.e. whether GMOs are natural or unnatural, whether genetic modification is going too far in our manipulation of nature, and about 'playing God' (Siipi, 2008). Overall, farmers seem to be fairly absent from the debate, either as actors or subjects, particularly in the developed world (including most countries in Europe, but with some notable exceptions such as France) (Fischer and Eriksson, 2016).

A history of GMO in the public debate

1986 The outbreak of BSE (also known as mad cow disease) in the UK

1989 Swedish field trials on GM rape seed

1990 The launch of the Human genome project

1994 The first GMO launched on the American food market: the "Flavr Savr" tomato modified for longer shelf life

DuPont and Zeneca are granted patents for Genetic Use Restriction Technologies- GURT ('terminator technology' related to debates on patents, farmers' indebtedness etc)

1996 The cloning of the first sheep, Dolly

The suspected (and later confirmed) connection between that the first human death of a variant of Creutzfeldt-Jakob Disease in the UK in 1995 and the earlier outbreaks of BSE in cows is made public. A long and infected public debate, and widespread public distrust in the governance of food safety follows in the UK

Greenpeace launches highly publicised campaigns to block the import of GMO soya to the EU, and consumer awareness campaigns

Eurobarometer indicates that Swedish citizens are knowledgeable about but sceptical to GMO

1997 Monsanto's genetically-modified insect-resistant Bt maize (MON810) is approved for planting in the EU

1998 Prince Charles is officially sceptical of GMO (naturalness)

Delta & Pine Land Company and the US Department of Agriculture are issued GURT patent

Dr Arpad Pusztai makes a public statement about genetic modification having unintended biological effects in rats fed with GMO potatoes

Nine GMOs for planting or import are approved by the EU and subsequently banned in France, Germany, Greece, Italy and Luxembourg

1999 The decoding of the first human chromosome

Monsanto publicly pledges not to make use of GURT

Zeneca states publicly it will not use GURT

UK supermarkets stop selling GM tomato paste

Nature publication showing toxicity of Bt maize pollen in Monarch butterflies (Losey et al., 1999).

EU instates a de facto moratorium on further acceptance of GMO products, awaiting new legislation

2000 Golden Rice publication in Science (vitamin A fortified, long standing debate, technical quick fix vs solution to major poverty related problem, Vandana Shiva,Greenpeace, Ingo Potrykus)

UN Convention on Biological Diversity (CBD) meeting in 2000, a de facto moratorium on the use of GURT (has been upheld ever since)

2001 Nature publication 2001, transgenic DNA had entered traditional maize seeds in Mexico (Quist and Chapela, 2001)

2002 Zambia rejects US food aid containing GM maize

2004 EU lifts moratorium

2010 Eurobarometer indicates that the Swedes are much more sceptical overall about GMO than the average EU citizen

BASFs GM potato Amflora approved for planting in the EU

2011 Greenpeace activists destroy trial plantations of GMO wheat run by a government authority in Australia, and seed potatoes of BASFs Amflora potatoes grown in northern Sweden

2012 Publications announce the discovery of the gene-editing technology CRISPR/Cas9 (Jinek et al., 2012, Gasiunas et al., 2012, Doudna and Charpentier, 2014)

French scientist Gilles-Éric Séralini and co-authors published a controversial (later retracted) study claiming a correlation between cancer tumours in mice and genetically-modified maize tolerant to the herbicide Roundup

BASF announces its decision to stop all activity on GM crops in Europe

2013 Activists uproot trial plantations of Golden Rice planted by the public plant breeding institute IRRI in the Philippines

EU's approval of Amflora potato is withdrawn following a procedural error

Monsanto announces that it withdraws all its applications for approval of GMO for planting in the EU

2015 EU Directive 2015/412 allowing member states to say no to GMO accepted at EU level in their countries 2016

145 Nobel Laureates publish an official letter asking Greenpeace and their supporters to "*recognize the findings of authoritative scientific bodies and regulatory agencies, and abandon their campaign against "GMOs" in general and Golden Rice in particular*".

2016 Stefan Jansson eats Crispr Kale grown in his garden

2018 The Court of Justice of the European Union (CJEU) rules that gene-editing technology such as CRISPR will be regulated under the same regulation as conventional GMO

3. How the Swedish media debate on GMO was analysed in this study

Search design

Newspaper articles were retrieved from the Retriever Research (Mediearkivet) Database through a search of titles and introductory paragraphs. The search period was set as 1 January 1994 to 2 January 2018 because our key informants, who had worked with GMO and agriculture-related issues in Sweden in research, policymaking or private sector for the past 20 years, identified 1995 as the year in which the GMO debate in Sweden started (which is also indicated by Olofsson (2002)). The end date is the date on which the search was performed. The newspapers were selected based on their readership and press type. We chose the eight Swedish newspapers with the largest readership: four daily newspapers and four evening newspapers (Hedström, 2016). It can be expected that these press types target slightly different groups of readers, with the evening press traditionally directed more at the working class (Cook, 2004). The daily press was represented by Dagens Nyheter (liberal) and Svenska Dagbladet (liberal-conservative), which are national newspapers, and Göteborgs-Posten (liberal) and Sydsvenskan (liberal), which are the largest newspapers in western and southern Sweden respectively. The evening press was represented by Aftonbladet (social democrat) and Expressen (liberal), which are national newspapers, and GT and Kvällsposten (both liberal), which are regional versions of Expressen in western and southern Sweden. It should be noted that most of the largest daily and evening newspapers in Sweden class themselves as liberal. In order to capture the GMO debate within the agricultural sector, we also included three major Swedish agricultural newspapers: ATL, Jordbruksaktuellt and Land Lantbruk. Both print and web-based articles from the selected sources were included. While the daily and evening newspapers have been available in the Retriever media archive since the early 1990s, the agricultural newspapers were only included in it in 1999 (Table 1).

The words included in the search were selected after consulting relevant literature on the topic (Fischer et al., 2015b, Wales and Mythen, 2002, Herrick, 2005, Cook, 2004) and discussions with the key informants. The search design aimed to cover all articles about GMO in farming or food. The final search was designed as follows: (GMO OR genmodifier* OR genteknik OR bioteknik OR genmanipul* OR "genetisk* modifier*" OR "genetisk* manipulera*" OR "GM gröd*" OR genförändr* OR CRISPR) AND (Jordbruk* OR lantbruk* OR bonde OR bönder OR mat OR livsmedel OR äta OR foder).

The search resulted in 1644 articles (730 in print newspapers and 914 in online newspapers), of which 1602 articles had full texts accessible. 136 duplications were removed and 1466 full text articles downloaded into a Word document. Another 67 articles were manually removed during the analysis because they were not about GMO. Only articles that did not in any way relate to GMO were removed. This resulted in a final number of 1399 articles for analysis. The article background data (newspaper source, date and title) was saved in an Excel file and all the articles were assigned a random number. The purpose of this randomisation was to be able to draw conclusions about the whole dataset even if there were insufficient time to analyse all the articles within the limited timeframe (the time turned out to be sufficient and all 1399 articles were analysed). Coding the articles in a non-chronological order also limited assumptions being made about their content based on their publication date, which was particularly important when coding more abstract variables such as a positive/negative tone towards GMO.

Table 1. Readership, availability and press type categories of the selected newspaper sources. Retriever (2018)

Newspaper	**Readership** (Printed press and web)	**Available in Retriever media archive since** (Printed press or web)	**Press type**
Aftonbladet	1 271 972 (2017)	1994-09-01	Evening press
Dagens Nyheter	822 000 (2017)	1991-11-13	Daily press
Expressen	781 700 (2016, 2017)	1990-01-02	Evening press
Svenska Dagbladet	564 400 (2017, 2018)	1995-01-01	Daily press
Göteborgs-Posten	438 991 (2017)	1994-01-02	Daily press
Sydsvenskan	238 000 (2017)	1998-10-27	Daily press
Land Lantbruk	217 900 (2016, 2017)	2002-01-01	Agricultural press
GT	199 700 (2016, 2017)	2000-01-16	Evening press
Kvällsposten	194 200 (2016, 2017)	1998-10-16	Evening press
ATL	131 800 (2016, 2017)	1999-11-12	Agricultural press
Jordbruksaktuellt	No data	2004-10-18	Agricultural press

Design of the content analysis

We analysed the material using a semi-deductive content analysis in which we combined the search for particular words and phrases with the identification and interpretation of normative judgements about GMO, as described below. Events in society have an effect on what is presented in the media and how. Likewise, how people in society talk about GMO both affects, and is affected by, what is written in the media. One important aspect in understanding the changes in media was thus to study the wider societal changes over time

from 1995 to the present day, which is presented in the Background section. The analysis then related the changes found in the texts analysed to events in wider society during the corresponding time periods.

We developed a survey in the Netigate online tool containing the words, phrases and normative judgements we wanted to study. When developing the survey, themes were drawn from the background information in order to identify words and topics, including particular controversial issues that emerged in the GM crops debate during the period studied (see Background section). The survey was piloted by all three authors during a two-week trial when some new survey questions were added in response to topics emerging from the dataset that had not been expected based on the background literature. The questions were also discussed and adapted to ensure valid and reliable answers, and a sufficiently similar coding between the report authors. Subsequently, the second and third authors coded all 1399 articles with support from the first author. The survey is included in Appendix 1.

The media outlet (referred to as 'source' in the survey) and the author of the article were expected to have a significant impact on the article content. The author categories were identified during discussions with professionals in the field and existing research about who engages in the debate (Fischer et al., 2015a, Tourangeau, 2018, Domenec, 2014, Fischer and Eriksson, 2016, FOE International, 2005, Glover, 2010, Cook, 2004). The same applied to the subject positions, i.e. the actors mentioned in the articles (see Appendix 1). The term used for GMO has shifted over time and in particular there was a greater variety of terms used early on in the debate. The choice of the term used says something about the tone of how GMO is presented to the reader, with some terms having particularly positive or negative connotations. For example, the term 'genetically manipulated' has come to be understood as having negative connotations, whereas 'genetically changed' is frequently used as an active stance to give a more positive connotation of the technology. Other terms simplify people's understanding of the technology, such as the use of the prefix 'gene' to genetically modified food, e.g. 'gene-potato'. Selection of the type of organism and type of modification included in the survey was based on existing GM organisms (maize, soy, rapeseed, cotton, other plant, animal or undefined/other), and what has frequently appeared in the debate as noted by others (Fischer and Eriksson, 2016, Fischer et al., 2015a). The code 'type of modification' distinguished GMOs into eight different groups. The code 'changed for production benefits' included all types of modifications for the purposes of making farming easier or 'better', including the commercially dominant GMOs today improved for insect resistance or herbicide tolerance, but also including saline tolerance, drought tolerance or general talk about increased harvest. We also had separate codes for insect-resistant (Bt) and herbicide-tolerant (Ht) crops to indicate something of the specificity with which GMO was discussed. As the answers were multiple choice, an article in which the author is talking about Bt maize could be coded both as 'changed for production benefits', and 'insect tolerant/ e.g. Bt'. We also included a code for the 'purpose of modification' where

we distinguished feed from food as there has been extensive debate about whether or not Swedish farm animals should be given GM fodder (Eriksson et al., 2018c).

The selection of geographical markers was made to include the countries and regions expected to appear within the articles, while keeping the numbers sufficiently limited to facilitate manual categorisation. Since agriculture policies, including GMO regulation, for Sweden are enacted at an EU level, we expected the EU or Europe to appear frequently as a geographical marker. As there has historically been a conflict between EU and US policymaking on GMO, including the 'trade war' during the 1990s, we also expected the US to appear frequently (Pollack and Shaffer, 2000). Data on the top five GMO cultivators in the world shows that the US comes top, followed by Brazil, Argentina, Canada and India (ISAAA, 2017). We therefore included these countries in the search. We also added China due to its size, the general focus on China today in global trade-related discussions, and the fact that China is the eighth largest GMO producer in the world (ISAAA, 2017). Finally, we added Africa (including a general mention of Africa or specific African countries), as research indicates that a large portion of the debate about GM crops in Europe has concerned the extent to which GM crops can contribute to reducing hunger and poverty, with a particular focus on the African continent (Fischer and Eriksson, 2016, Fischer et al., 2015a, Whitty et al., 2013, Zerbe, 2004).

Other issues included in the survey, indicated as relevant from the background research, were for example labelling, co-existence and science, but we also included farmers' perspectives as an issue of interest, which we did not expect would appear frequently. This category was included to be able to identify whether farmers' perspectives are discussed to any extent outside the agricultural press.

Each article was also coded for a number of normative statements and whether they were giving readers a positive, negative or neutral impression of GMO overall. Thus, articles promoting or rejecting GMO in an argumentative tone, and articles with a more neutral tone but reporting events that readers could interpret as positive or negative, were grouped together as respectively positive or negative. As this part of the analysis clearly relied more on the interpretation of the authors of this report, we took particular care with the coding here. The analysis was largely guided by the overall argument or impression given when reading the full piece, but was supported by looking for adjectives and nouns with negative or positive connotations that were used in relation to GMO. Words in negatively-coded articles included 'against', 'warning', 'stop', 'dangerous' and 'complicated', whereas positively-coded articles had words such as 'for', 'good' and 'increased harvest'. Articles without a clear positive or negative tone or without positively or negatively charged words, or where the two sides were perceived as balancing each other out, were coded as having a neutral tone. Articles that one author of this report found difficult to classify were read by the other two authors so that a judgment could be reached.

Statistical analysis

Survey responses were retrieved as a data file and exported to Statistical Package for the Social Sciences (SPSS) for further analysis. The statistical analysis focused on an investigation of how the GMO media debate changed over time from 1994 to 2017, including how particular words or topics were connected in positive or negative ways to GMO, and how the debate differed across the different media sources studied.

The results from the statistical analysis were interpreted in relation to information on GMO policy and debate in Sweden and Europe, as introduced in the Background chapter. This background information also allowed conclusions to be drawn about what was mentioned in the articles.

4. Results and discussion of the media-analysis

This chapter presents and discusses the results of the statistical analysis of Swedish news media articles on GMO from 1994 to 2017. We begin with some general information about the trend in the number of articles published over the years before discussing the data under the following four sub-themes: the level of detail in the debate, the actors mentioned and issues of interest, attitudes reflected in news media, and an in-depth qualitative analysis of specific years which proved to be of particular interest.

Figure 1 shows how many articles on GMO were published in total in the analysed sources, and how this changed between 1994 and 2017. It shows that the highest total number of

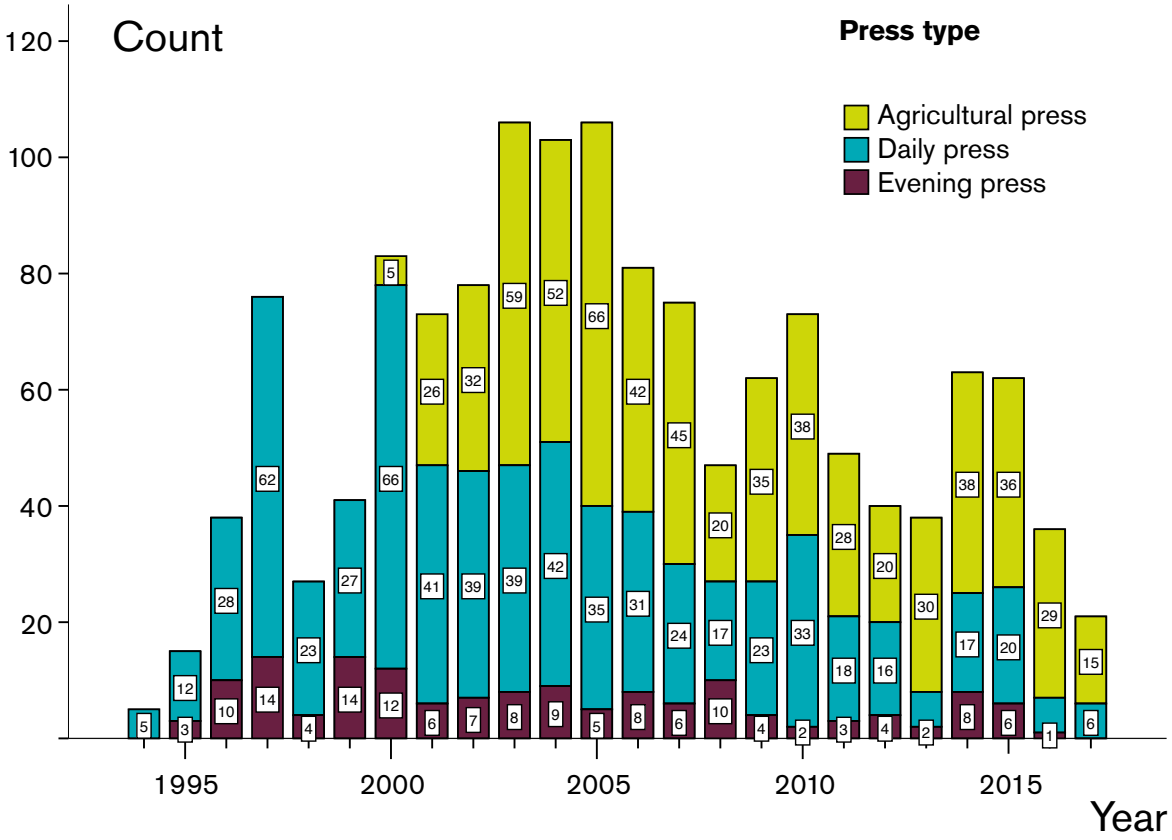

Figure 1. Total number of publications on GMO in the Swedish press per year and press type

publications on GMO were between 2003 and 2005. When dividing this into press types, however, it is important to note that none of the agricultural press sources were available in the Retriever media archive before November 1999. The peak of the agricultural press matches with the overall peak (2003-2005), whereas the daily and evening newspapers more clearly peaked in 1997 and 2000. Major events concerning GMO around these peak years that might have influenced the increased reporting on the issue were the commercialisation of GMO in the US and the EU moratorium on GMO between 1999 and 2003 (Krenzler and MacGregor, 2000, Paskalev, 2012). Looking at the titles of publications in the daily press in 1997, it was clear that the main topics discussed were GMO for food, whether Swedes were willing to eat GMO, and the labelling of GMO food ingredients. This debate can be traced to the consumer awareness campaign launched in Europe in 1996 (Krenzler and MacGregor, 2000). Looking at the titles from 2003, it was clear that the attention remained on food labelling and whether consumers considered GMO safe to eat, but the debate had also broadened to include a significant number of publications on EU regulations and EU negotiations on GMO. The environmental movement and farmers also emerged in the daily newspapers, as did a few articles on the role of GMO in Africa. Figure 1 also reveals that the evening press had relatively few publications overall but more constant reporting of GMO over time, with a peak of just 14 publications in 1997 and 1999.

Looking at the accumulated number of publications for different press types, it can be seen that the agriculture category and daily press in total have quite an equal amount of reporting

on GMO for the years studied (44 % and 45 % respectively of all articles; Fig. 2). Within the agricultural press, the agricultural business journal ATL had the highest number of published articles on GMO with 25 % of total publications. The evening press featured just 10 % of all articles (Fig. 2).

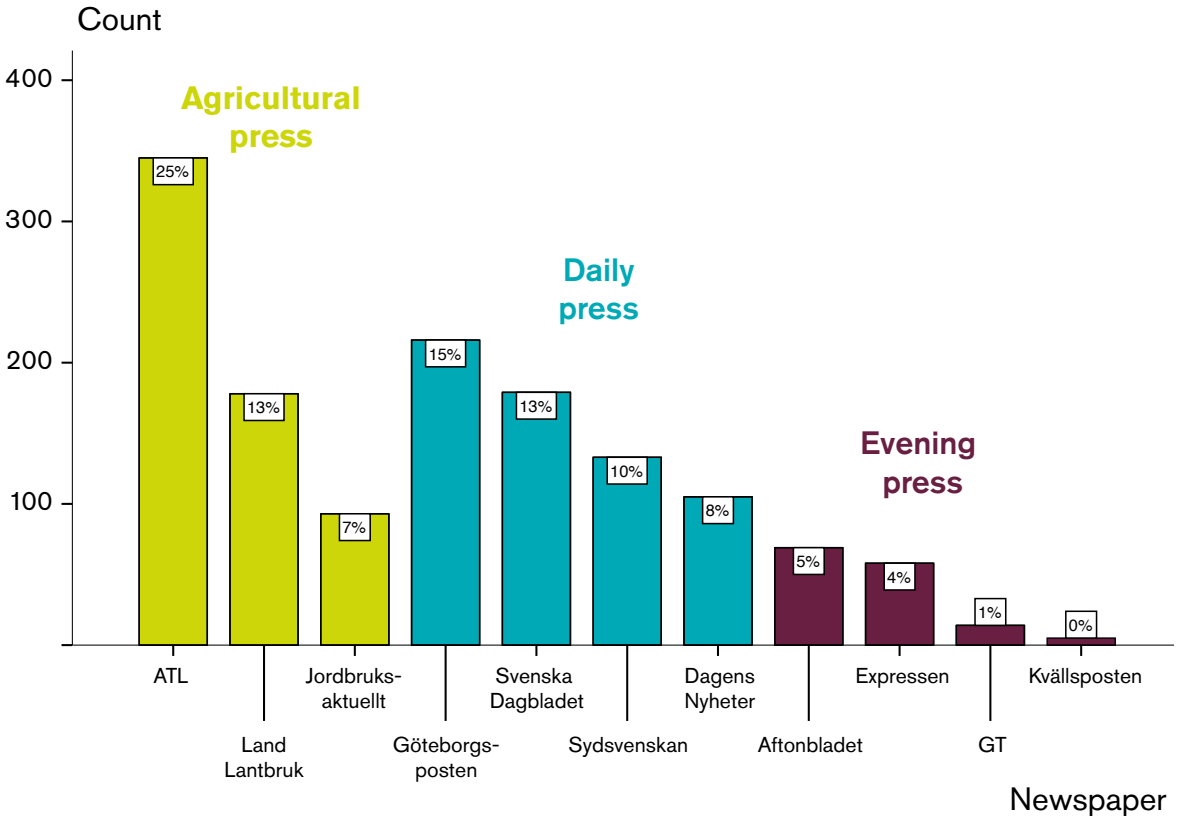

Figure 2. Percentage of articles in the agricultural, daily and evening press

How specific or general has the debate on GMO been?

The term used for GMO might say something about the underlying perspectives of the person writing the article, the broader debate, and the level of detail given to the issue. Articles were coded according to a predefined list of terms appearing in texts on GMO (see Appendix 1). The most commonly used term across all years was 'GMO' (genetically-modified organism), a term that we interpret as being perceived as neutral. This term was used in 86 percent of the articles. The next most frequent term, 'genetically manipulated' (19 percent), was interpreted as having negative connotations. We interpreted the term 'genetically changed' (19 percent) as often being used by proponents of the technology, frequently with the purpose of moving away from its negative associations, particularly linked to the term 'manipulated', but also sometimes as an alternative to and more positive term than 'modified'. The use of the term 'gene' (17 percent) peaked in 1999 and virtually died out in 2013 (Fig. 3). The term was used in the media as a shorthand version of longer phrases such as genetically modified, e.g. gene-potato instead of genetically-modified

potato. Use of this term has been criticised by scientists who point out that it can create misunderstandings about what genetic modification is by implying that only genetically-modified organisms contain genes. The term 'biotechnology' (seven percent) is judged here to be neutral. 'CRISPR/Cas9', 'genetically edited', 'transgene' and other terms each appeared in less than one percent of the articles and were not analysed further. There were no major differences in the terms used in the agricultural, daily and evening press, although evening newspapers used the more negatively connoted term 'genetically manipulated' more than the other two newspaper categories.

Figure 3 shows how the terminology changed between 1994 and 2017 in relation to the four most frequently used terms. It shows that 'genetically manipulated' was the most common term in the Swedish press when the public debate on GMO emerged in the mid-to-late 1990s. The negative connotation of the word 'manipulation' offers an indication of the general attitude towards GMO in the media at this time. In 1998, there was a drastic decline in the total number of articles on GMO and, interestingly, the terminology changed when the media coverage started to increase again in 1999. Thereafter, 'GMO' was the most commonly used term by far, and from 2016 onwards no other terms were used.

Technologies classed as GMO can be used to modify living organisms for a multitude of purposes and with a range of outcomes. Thus, just talking about GMO without specifying

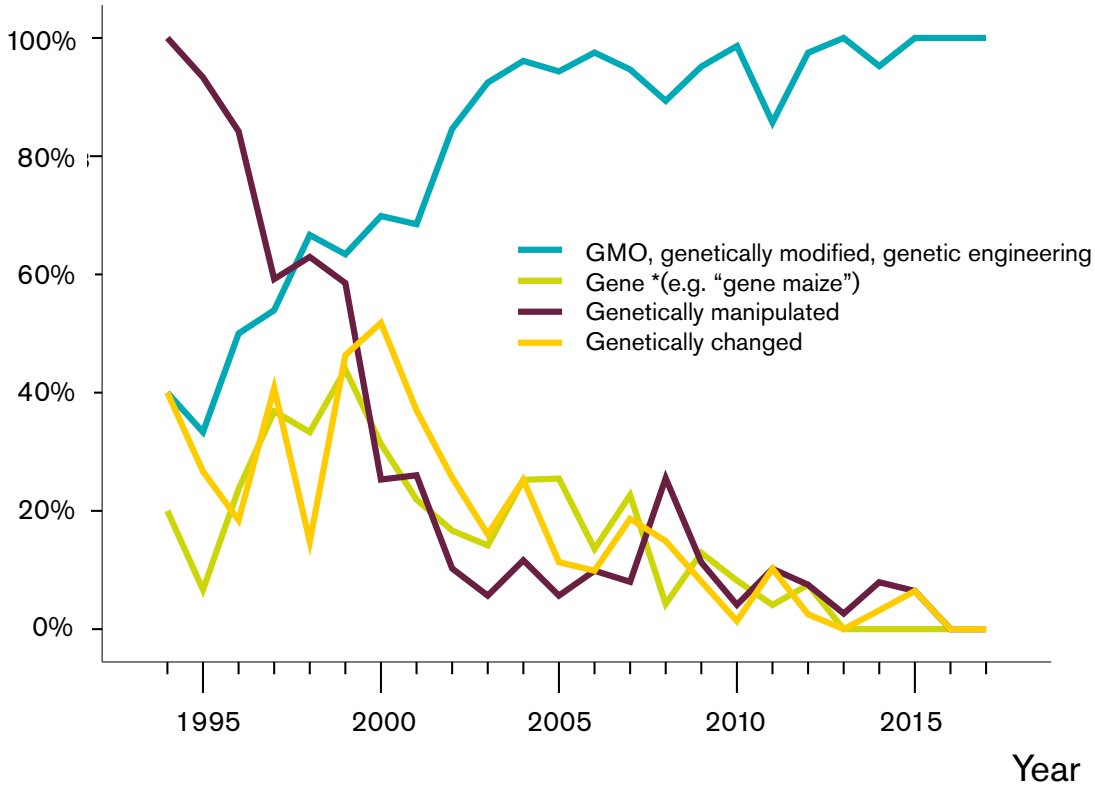

Figure 3. Usage of the four most common terms for GMO in the Swedish press over time

more clearly what is meant gives very little information about the product. Therefore, it is interesting to investigate how much and what kind of detail readers are given when GMO appears in the news.

Figure 4 shows the extent to which different press types report on whether or not the GMO discussed is modified for the purposes of food, feed, other (medicine, fuel, etc.) or not defined. Modifications for the purpose of producing food were most commonly reported on in the daily and evening press (54 percent and 59 percent respectively). However, the agricultural press stood out because it tended to write about GMO in more general terms without specifying the purpose. As seen in Figure 4, 29 percent (227 articles) of articles in the agricultural press did not define the purpose of modification. This lack of detail regarding GMO discussed in the agricultural press was initially quite surprising because the agricultural press, dealing more specifically with food and agriculture issues, could actually be expected to be more rather than less precise in its reporting on GMO. One explanation that we found plausible was that the agricultural press might focus to a larger extent than the other press types on issues regarding markets and regulation, which directly affect farmers' possibilities of growing and selling their produce. However, as seen in Figure 5, this was seemingly not the case. From the data obtained, we were unable to explain this discrepancy between the agricultural press and other press types, and it would have required an in-depth content analysis.

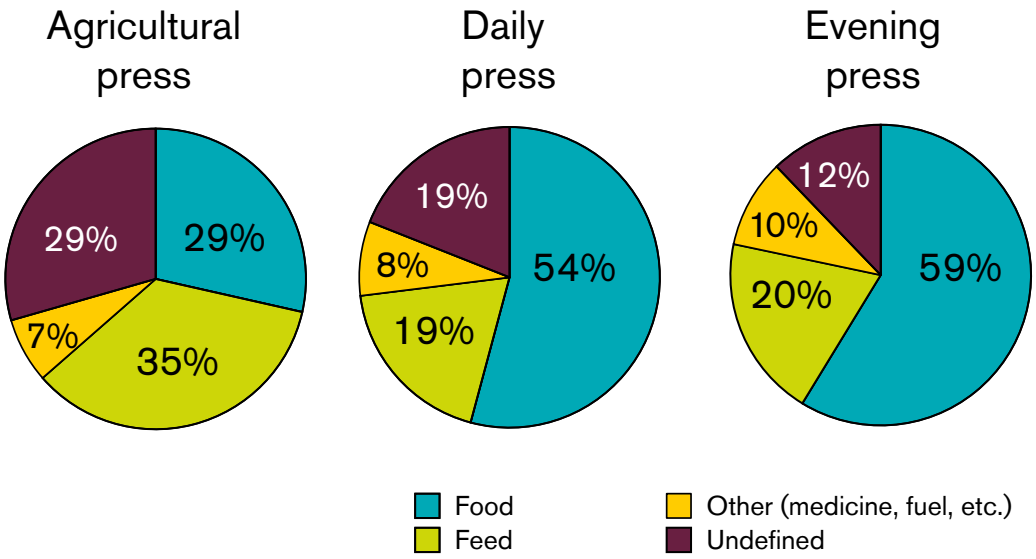

Figure 4. Purpose of modification reported in different types of press

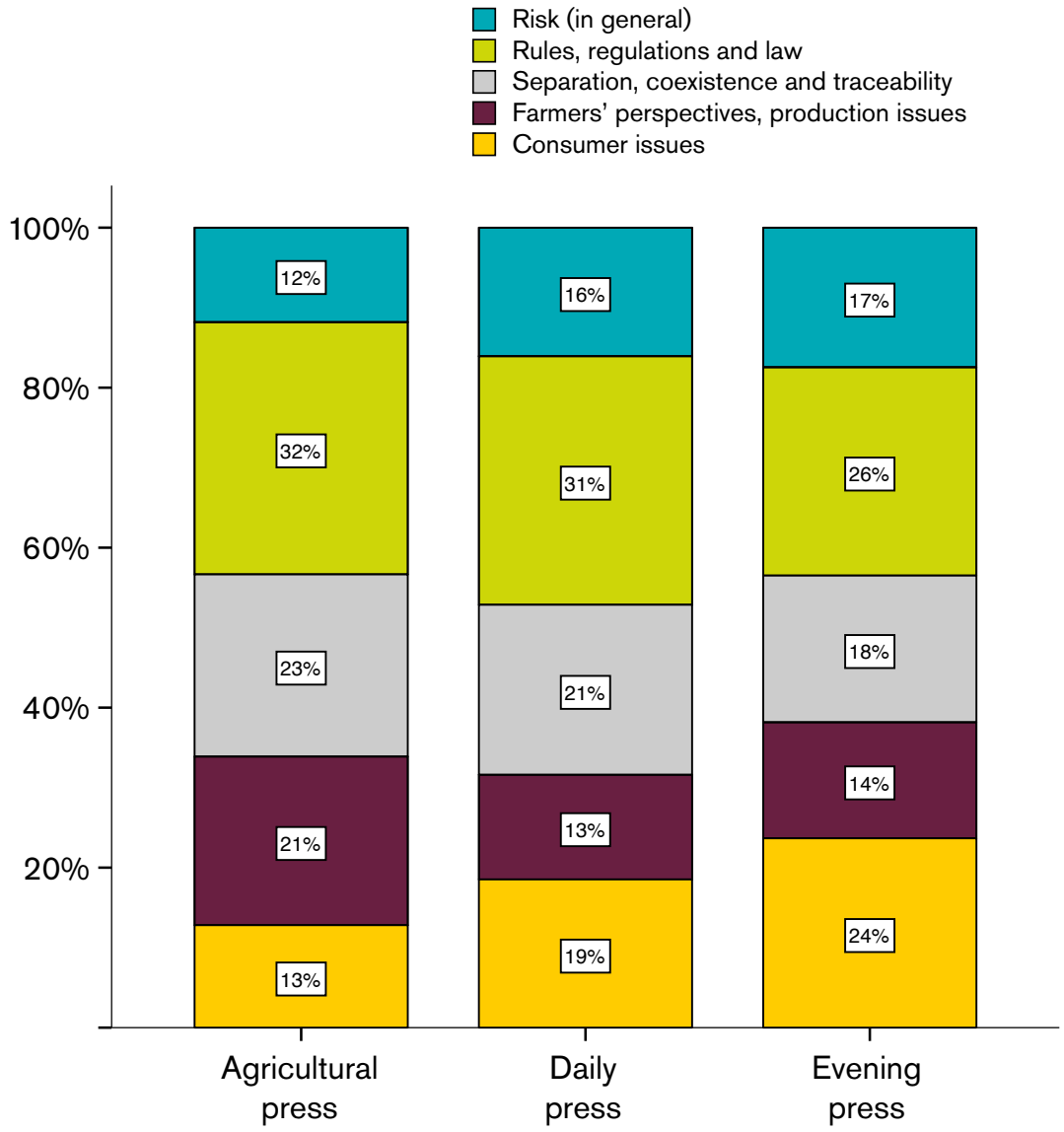

Figure 5. The seven most common issues of interest in different types of press

Figure 6 shows the percentage of articles in which the writers mentioned different purposes (food, feed or not specified) of modification, and how this has changed over time (here all press types are pooled together). GMO for food was by far the most commonly reported purpose in Swedish media in the first 10 years explored in this study (1994-2004). This corresponds with how the wider European debate and events at the time focused greatly on GMO for human consumption, e.g. the introduction and removal of GMO tomato paste in the UK, Árpád Pusztai's public statement about the unintended biological effects on rats fed with GMO potatoes (Bruening and Lyons, 2000), and Greenpeace's consumer awareness campaign (Krenzler and MacGregor, 2000). In the mid-2000s, articles about GMO in general, without specifying its purpose, became more common, as seen in how the category 'undefined' increased at this point in time. As mentioned above with the agricultural press, this tendency might result from greater reporting on regulation and EU negotiations on GMO. More recently, references made to unspecified GMO have decreased. The graph shows an increase in articles about feed since 2012, peaking in around 2014-2016. This

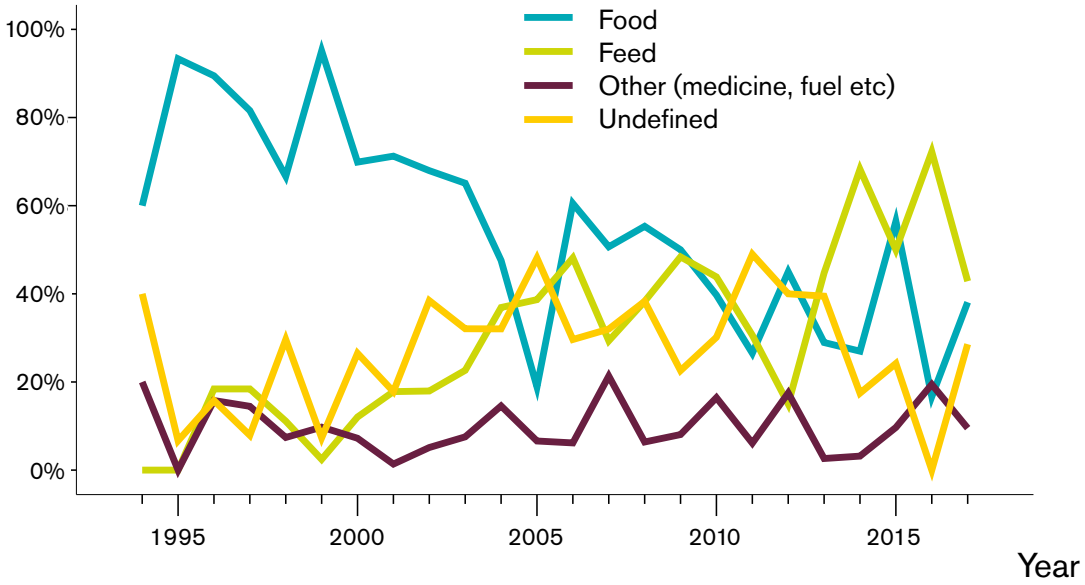

Figure 6. Purpose of GMO and how it has changed over time (1994-2017)

might be related to statements from the Federation of Swedish Farmers (LRF) concerning considerations about dropping its non-GMO fodder policy in 2014.

Figure 7 shows what kinds of GMO are discussed. The options available were the most commonly modified food crops (maize, soybean, rapeseed and cotton (ISAAA, 2017)), other or undefined plants, animals and other/undefined. Most common, at 33 percent, was

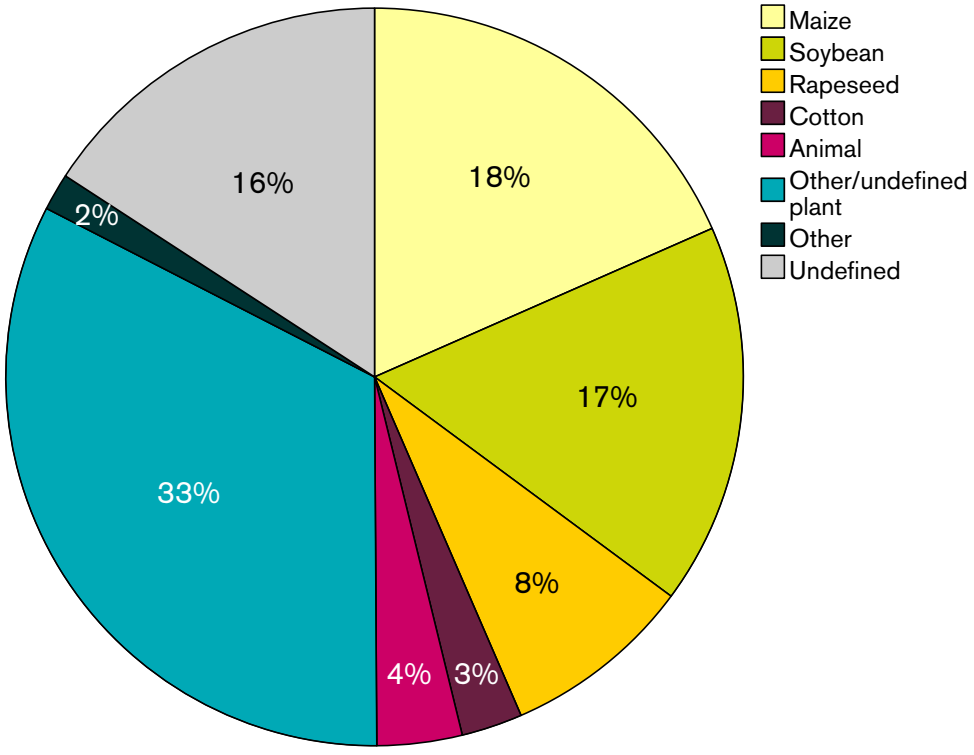

Figure 7. Modified organisms reported on in the Swedish press

the category 'other/undefined plant' (i.e. the article was about GMO plants in general or about a plant not listed as an option in the survey). This might reflect the fact that most of the debate was about GM crops and not animals, and (as regards being non-specific) that there was more focus overall in the press on consumer issues (where GMO was talked about generally like any other food ingredient) and on regulation (which was the same irrespective of the type of plant) than on farm-level issues (for which the type of crop planted is clearly relevant). When plants are specified, maize and soybeans were the most common organisms written about (18 percent and 17 percent respectively). On a global level, 50 percent of all genetically-modified crops planted are soybeans and only 30 percent are maize. No GM soybean variety has been approved in the EU, but import of GMO soya is allowed and makes up a large share of imported animal fodder to the EU (although not to Sweden), while GM maize is cultivated on a small scale in a few EU countries (mainly Spain) (ISAAA, 2017). This might explain the relatively large focus on maize and other organisms in the Swedish press.

There were only minor differences between the agricultural, daily and evening press in terms of the organisms featured in the articles. However, the evening press tended to write more about genetically-modified animals (8 percent) than the other two press types (0.4 percent for the agricultural press and 4 percent for the daily press). Furthermore, the agricultural press had a few more articles on soybeans than the other press types, which probably related to their greater focus on feed crops in general, as shown in Figure 4.

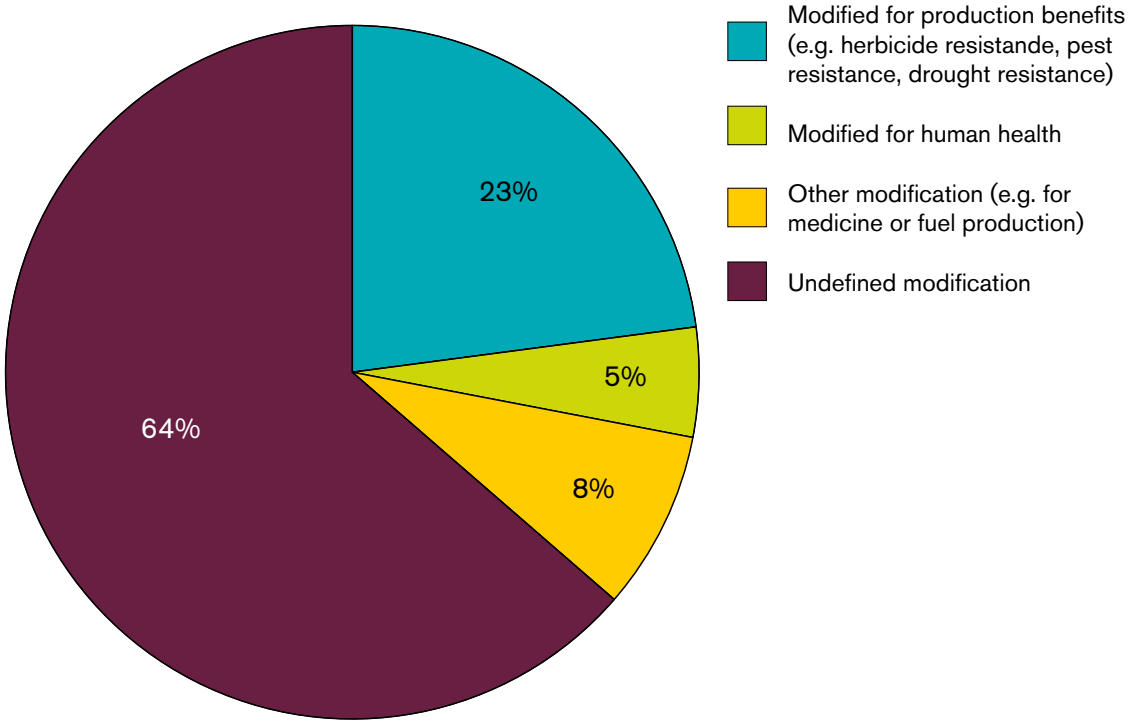

Figure 8. Type of modification reported on in the Swedish press

Figure 8 shows what type of modifications are being reported on in the Swedish press, i.e. whether the organism is modified for production benefits (e.g. resistance to herbicides, pest insects or drought), human health (e.g. vitamin-enriched or modified oil compositions), other modifications (e.g. for medicine or fuel production), or an undefined modification. It is clear from Figure 8 that the type of modification was rarely specified. This was the case for all press types, although less so in the evening press where only 49 percet of the articles were on undefined modifications, the type of modification was not specified in 72 percent of articles in the agricultural press. We cannot find any clear explanation to why the agricultural press is less specific regarding this aspect.

Figure 9 shows the percentage of articles about different types of modifications and how this changed over time from 1994 to 2017. As discussed above, the Swedish press tends to write about GMO in rather general terms without giving the reader much detail about the type of modification. However, an interesting point in time was 2012, when the percentage of articles about modifications for production benefits suddenly exceeded the number of articles on undefined modifications (for more information on this, see page 45-46).

The geographical context of articles on GMO within the different press types is shown in Figure 10. Sweden is the most common geographical marker within the daily and evening press. However, within the agricultural press, articles about the EU/Europe exceeded those about Sweden (although by less than 1 percentage point), which might indicate that the focus in the agricultural press is on the market and EU regulation because Swedish

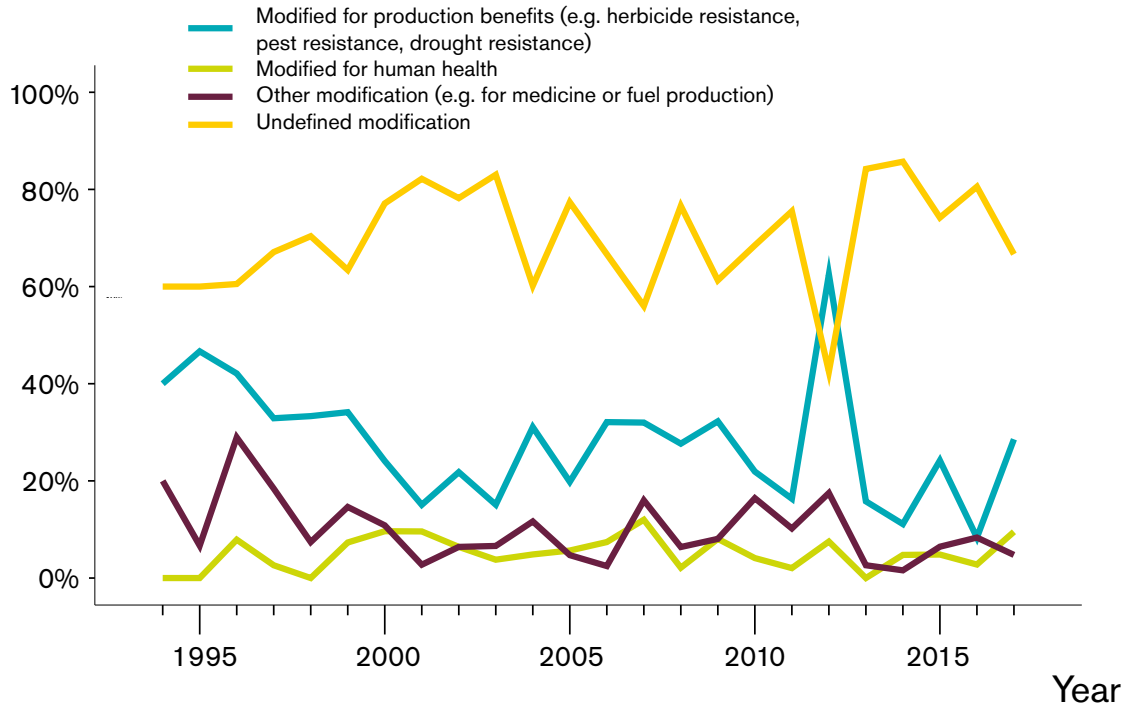

Figure 9. Type of modification reported on over time

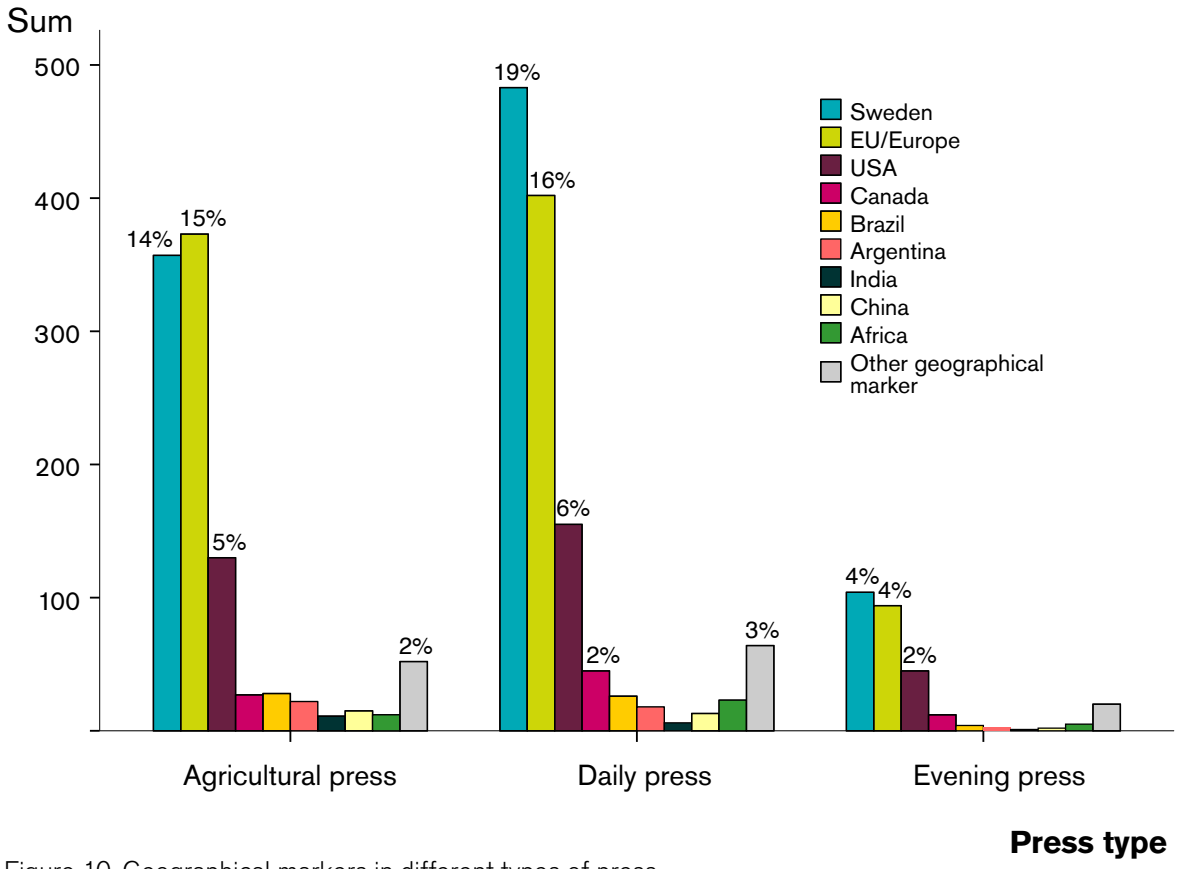

Figure 10. Geographical markers in different types of press

agriculture is largely governed by what happens at EU level. Besides Sweden and the EU/Europe, the most common geographical markers within all press types was the US, followed by Brazil and Canada. These are among the top-producing countries of GM crops in the world in terms of cultivated area (ISAAA, 2017). The focus on the US can also be attributed to the longstanding trade war between the EU and the US with regards to GMO (which also included Canada) (Krenzler and MacGregor, 2000). The spotlight on Brazil is connected with its large soya production. Although Argentina is actually a larger producer of GM crops than Canada (number 3 globally), the limited mention of Argentina might be related to a significant part of the public debate on soy production having to do with competition over land between soy plantation and the Amazon rainforest, which largely is located in Brazil but not at all in Argentina (Schouten et al., 2012), and that both Brazil and Canada are larger trading partners with Sweden than Argentina (Statistics Sweden, 2019).

There were very few news articles about GMO in the Global South in general, and in Africa in particular, which is surprising given the strong focus on the Global South in the academic literature, civil society's focus on GMO (Fischer et al., 2015a), and the fact that most GM crops are grown in developing countries (ISAAA, 2017).

In summary, we have shown that the Swedish press usually provided some contextual information, such as geographical markers and the broader purpose of the modification (e.g. produced for food, feed or something else (Fig. 4), while omitting other possibly

relevant information. For example, the type of organism was often not specified (Fig. 7) and the articles rarely mentioned the type of modification, i.e. whether it was for production benefits, human health improvements or something else (Fig. 8).

Actors mentioned and issues discussed

This section takes a closer look at who and what was mentioned in articles on GMO in the Swedish press. The actors (or subject positions) were consolidated into groups that we saw as representing similar interests or sectors in society (see Appendix 1). Table 2 shows how frequently different actors/actor groups were mentioned in the articles. For each article, all the different actors were noted, but each actor was only noted once even if multiple references were made. The group 'Government and other government bodies' was mentioned in 73 percent of all articles, which made it the most frequently mentioned actor category by far. This corresponded well with the overall focus on what was going on in the EU with regard to GMO, and indeed mention of the EU contributed greatly to the frequency with which this actor group was mentioned, with 45 percent of the total share. However, actors classed as 'Government and other government bodies' also included Swedish government bodies such as the Swedish Board of Agriculture and the Swedish Food Agency. Although farmers were mentioned in 36 percent of the articles, organic farmers, who were specified as a separate category, were the actor group mentioned least (4 percent), just below smallholders, poor or starving people who were only mentioned in 5 percent of the

Table 2. Frequencies of all actor groups in articles about GMO between 1994 and 2017.

Actor groups	Number of articles	Percent of articles
Government and other government bodies (incl. EU)	1018	73%
EU	627	45%
Media	506	36%
Farmer or farmer organisation	506	36%
Other company in the food chain (not Biotech)	463	33%
Biotech company	438	31%
Consumer or consumer organisation	424	30%
The public, people or society	339	24%
Scientist or academic institution	270	19%
Environmental NGO	269	19%
Other	161	12%
Other NGO	69	5%
Smallholder, poor or starving people	64	5%
Organic farmer	56	4%

articles. This was interesting given that much of the international debate has been about the role of GMO for smallholders and poverty reduction (Fischer and Eriksson, 2016, Glover, 2010). It indicates that the Swedish media debate focused more on farmers in Sweden and Europe, but also that organic farmers and farming received limited attention in the debate despite organic food products representing about 20 percent of total food sales in Sweden (Thøgersen, 2010) and the organic movement being a key opponent of GM crops.

Figure 11 shows the six most frequently mentioned actors/actor groups over time, plus the actor group 'Scientist or academic institution'. The reason the latter was added was that despite being mentioned comparatively rarely, it was relevant to the discussion on shifts in the debate (see page 45-46). Government and other government bodies (including the EU) were the most frequently mentioned actor group between 1994 and 2013. From mid-2013 there was a greater variety of actors and actor groups mentioned, and 'other company in the food chain', 'farmer or farmer organisation', 'media' and 'consumer or consumer organisation' in some periods since mid-2013 appeared more frequently than 'Government and other government bodies'. Despite rarely being the main actor groups, farmers and farmer organisations, other company in the food chain (such as supermarkets and processing industry), consumers and the media were all mentioned relatively often in the articles. Between 1994 and 2017, the mentioning of these actors seldom fell below 20 percent. Scientists or academic institutions were mentioned fairly infrequently in the articles, except

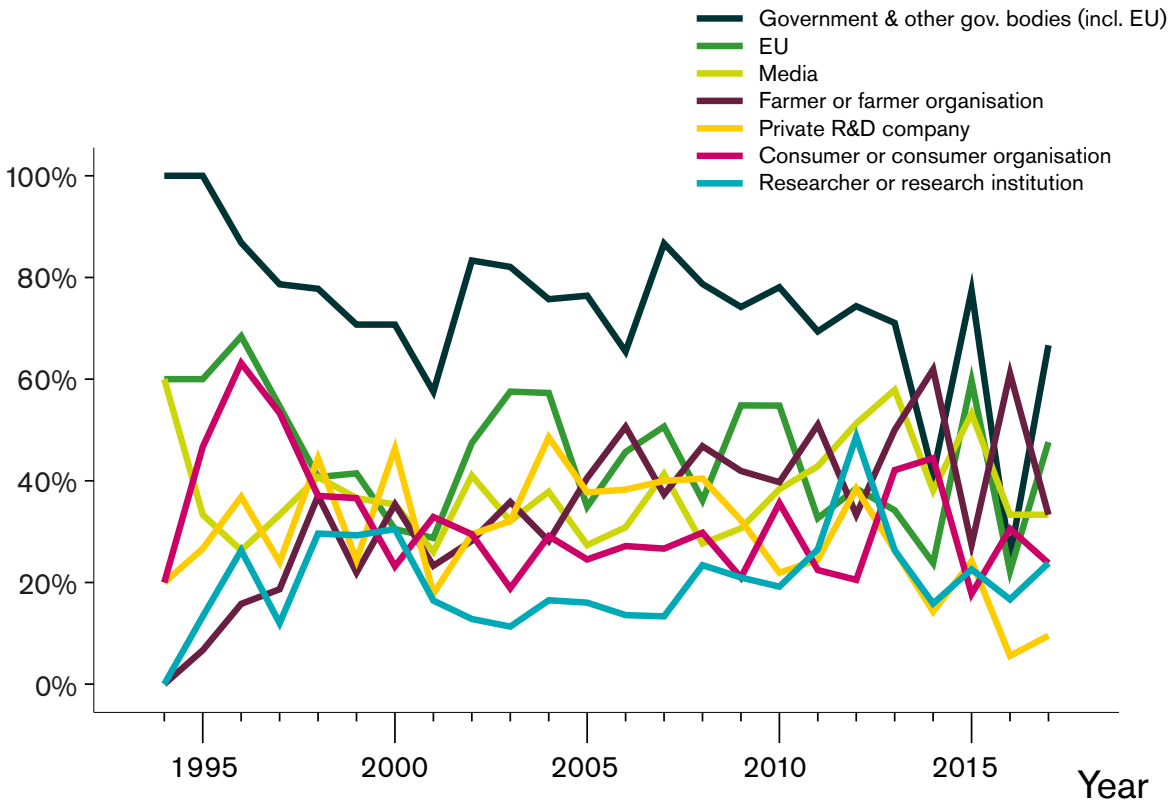

Figure 11. Actor groups in articles about GMO between 1994 and 2017

for the year 2012 when this actor group was mentioned in nearly half of all articles. This is discussed further in the section on shifts in the debate.

Table 3 shows the total number and percentage of articles that mention the different issues of interest examined in this study (a total of 16). The most common theme was 'rules, regulations and law' mentioned in 71 percent of all articles, followed by 'separation, coexistence and traceability' and 'market and trade' mentioned in half of all articles (50 percent and 48 percent respectively). It should be noted that a discussion on these topics does not often make it necessary or even relevant to talk about which type of organism or type of modification is concerned, which might explain some of the seemingly imprecise reporting with regard to the type of organism and modification being referred to (Fig. 6 and Fig. 7).

Table 3. Issues of interests in articles about GMO between 1994 and 2018.

Issues of interest	Number of articles	Percent of articles
Rules, regulations and law	988	71%
Separation, coexistence, traceability	694	50%
Market and trade	675	48%
Farmers' perspectives, production issues	537	39%
Consumer issues	532	38%
Risk (in general)	462	33%
Science, research, scientific evidence	422	30%
Labelling	403	29%
Risk for health	285	20%
Risk for environment	273	20%
Pesticides, herbicides	254	18%
Increased production	111	8%
Risk for economy	89	6%
Food security, poverty, starvation	87	6%
Glyphosate, Roundup (specifically mentioned)	77	6%
Patent and IPR	72	5%

Figure 12 shows the six most frequently mentioned issues of interest in the years 1994 to 2017. From this graph, it is clear that the most common theme over time was 'rules, regulations and law', although there was a decrease in such articles in 2001 when the most frequently reported issues were 'separation, coexistence and traceability' and 'consumer issues'. In 2001, the EU's 'Deliberate Release Directive' (2001/18/EC), which includes the issue of co-existence, i.e. how farmers growing GMO and farmers not growing

GMO should be able to exist together, included issues of separation and traceability. It is up to individual member states to decide more precisely how co-existence should be implemented and therefore the increased Swedish media attention on the topic during this time corresponded to the debate in Sweden on how to handle coexistence (Jacobson and Wahlberg, 2006).

It is also clear from Figure 12 that in most years the theme 'market and trade' shifted in intensity over time in a similar way to 'rules, regulations and law', but with a lower level of reporting. However, in 2013 this trend was reversed and 'market and trade' increased while 'rules, regulations and law' decreased, with the former reported on more frequently than the latter for the first time. After 2013, similar trends were found in both topics again, but in 2016 'rules, regulations and law' drops significantly and for the first time since 2001 was overtaken by 'separation, coexistence and traceability'. The titles of publications in 2016 show that this year included considerable debate about the dairy company Arla considering allowing Swedish cows to have fodder containing GMO. This spurred a debate about GMO-free fodder. In this year too, 'farmers' perspectives and production issues' overtook 'rules, regulations and law', which was also linked to the debate on allowing GMO in fodder given to farm animals in Sweden.

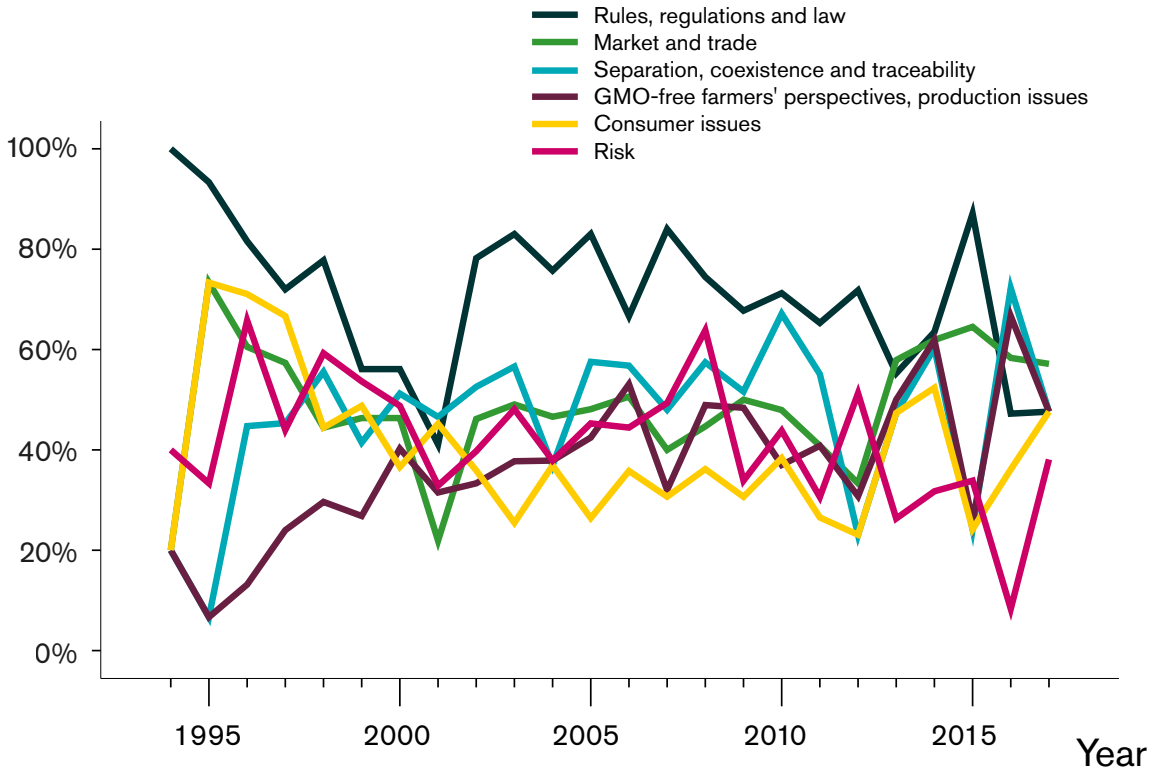

Figure 12. Issues of interest in articles about GMO between 1994 and 2017

Attitudes reflected in the news media

The attitude towards GMO in the Swedish press was investigated by categorising each article as providing a positive, negative or neutral image of genetic engineering. Figure 13 shows how the attitude, or tone, towards GMO has changed over time. Negative articles were given a value of -1, positive articles a value of +1 and neutral articles a value of 0. Figure 13 shows the accumulated value of all articles per year and separated by press type, where a higher value indicates a larger number of positive articles. The numbers on the y-axis are the mean values of the total sum of positive, negative and neutral articles within one press type for one year. For example, in 1994 there were five articles (all in the daily press) where two were negative and three neutral, which gave -2 as the total sum for that year. When this number was divided by the total number of publications within that press type for that year (five in this example), the value of -0.4 was obtained.

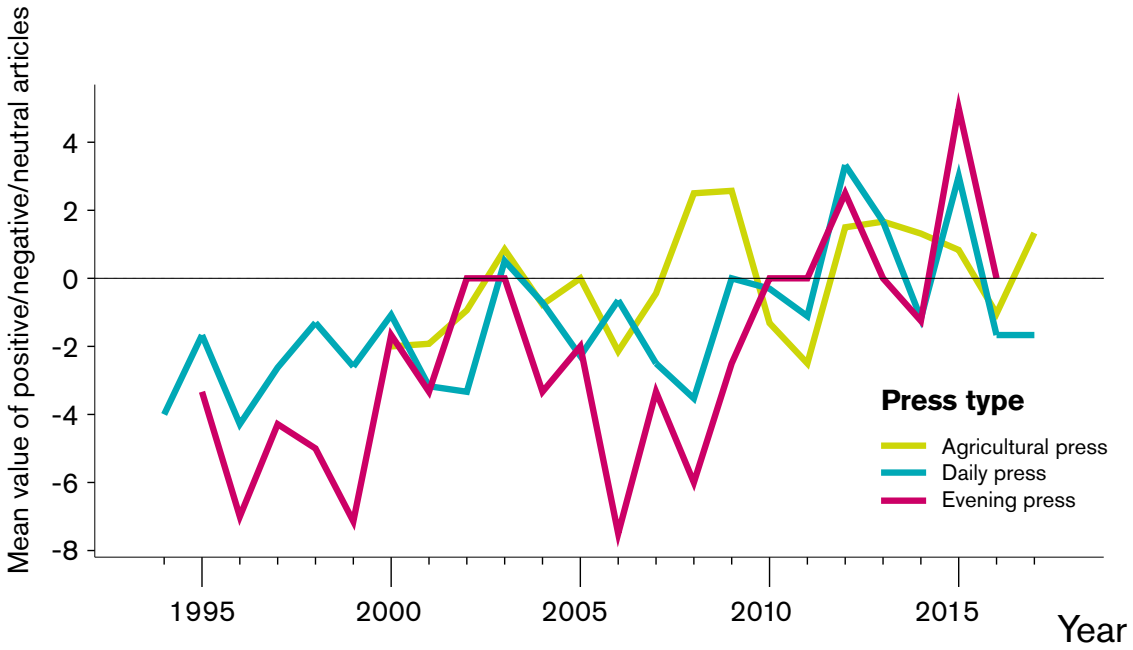

Figure 13. Articles that mention GMO as positive/negative/neutral divided into press type categories and shown over time

Figure 13 indicates that there was a shift in how GMO was represented in the media, from a predominantly negative tone in 1994 towards a more a positive one in 2017. While we do not have information on how views on GMO have changed from year to year among the general public in Sweden, we can note that in 1996 and 2010 Swedes were more sceptical about GMO than the average EU citizen (Eurobarometer, 2010), whereas figures from 2018 indicate that although Swedes remain slightly negative overall, they are less negative than in the past (Konsumentföreningen Stockholm, 2018). This indicates that overall the press leads rather than follows public perception on this topic. The attitude towards GMO clearly changed from negative to positive within all press categories over the years. However, this development was particularly clear within the evening press, where both the lowest value (-0.75 in 2006) and highest value (0.5 in 2015) are found. The larger variance within

the evening press could be related to the evening press in general tending to be more sensationalist in its reporting. The fact that the evening press represents a small sample (146 articles, compared to 616 in the agricultural press and 633 in the daily press) might however also contribute to the larger variations seen.

Figure 14 shows how often an actor/actor group was mentioned in a positive, negative or neutral article, and how this has changed over time, and thus indicating how the tone of the article in part was affected by which actors were discussed in the article. For example, researchers tended to be mentioned more frequently in positive articles overall than farmers and consumers. While a trend in reporting from negative to more positive towards GMO overall (Figure 13) can also clearly be seen in the trend concerning the actors reported on, Figure 14 indicates that this particularly applied to the actor group 'government and other government bodies (including EU)'. This group shifted from most strongly negative to clearly positive towards the end of the study period, which seems to indicate that the government/government bodies were reported on in the same tone as the overall tone for GMO. As described in the background, public opinion in Europe was very sceptical about GMO in the 1990s and there was a lack of trust amongst the general public with regard to governance of GMO, stemming from the earlier BSE outbreak in the UK and vocal NGO campaigns against GMO for example (Stephan, 2012, Giorgi et al., 2006). Thus, negativity towards GMO was strongly associated with views on its governance. Our study shows that this also seemed to be the case in Sweden. In our analysed material, the articles about government bodies during the 1990s emphasised the need to hold the government/EU responsible and the arguments within the EU, and communicated a sense that the governing

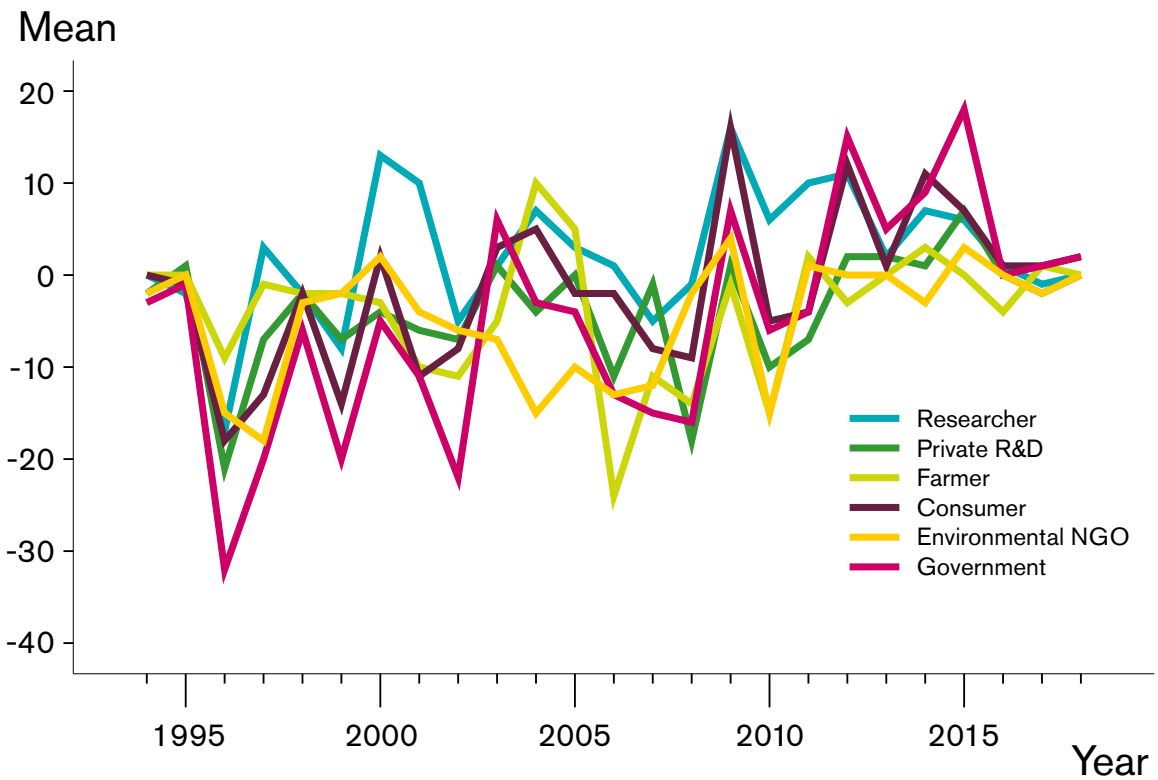

Figure 14. Articles that mention GMO as positive/negative in relation to a particular actor group

authorities did not have control of the situation and/or did not know how to handle it, especially with regard to tracing and labelling GMO. Moving into the 2000s, there was less of a sense of a lack of control, but many articles still reported on arguments within the EU. There were also more articles on governance of field trials than during the 1990s, and thus a slight shift to a greater focus on GMO in the environment as compared to the 1990s when articles concerning food and human health clearly dominated. The mention of government bodies in articles that were negative to GMO could stem from this general tendency. When reading the full articles that mentioned the actor group [government, parliament, government agency, municipality] from 2012 onwards, it was not clear why there was a shift in the attitude communicated by the media, but a greater focus on Sweden and less on the EU in the articles was noted. There was also quite a lot of attention given to the debate about whether to allow GMO fodder to be given to farm animals in Sweden.

In summary, the media outlets analysed seemed to have shifted to more positive reporting before the general public shifted its opinion (to a less negative but still not positive one), and that reporting on government authorities in particular followed this general trend, indicating that media reporting on GMO was strongly associated with its articles on its governance.

For all the articles, we also noted whether they mentioned GMO in positive or negative ways relating to the environment, health and/or the economy, and if they generally spoke about GMO being positive or negative. As seen in Figure 15, GMO was often mentioned in unspecified negative terms in the Swedish press. Positive mentions of GMO are mainly

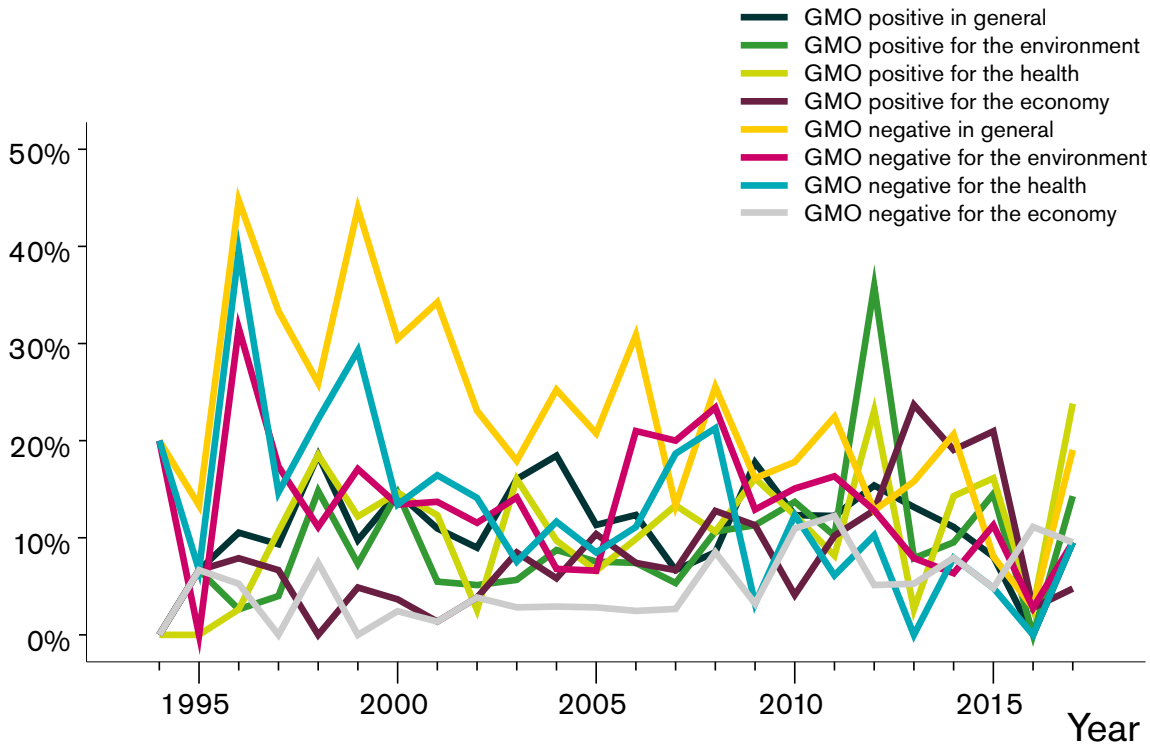

Figure 15. Articles that mention GMO as positive/negative/neutral in general and in relation to the environment, health and the economy between 1994 and 2017

unspecific, except in 2012 when positive arguments regarding environmental effects suddenly peaked and appeared in about 35 percent of the articles.

Negative articles peaked in 1996 and 1999. In 1998 and 2004, the number of positive articles was higher than usual, but were still fewer overall than negative articles. However, in 2009 articles reporting about GMO as positive in general exceeded articles talking about GMO in a negative way for the first time. In 2012, articles arguing that GMO is positive for the environment suddenly increased considerably and this was also the first time that the number of articles reporting positively about GMO clearly exceeded the number of negative articles. Overall, GMO was mentioned more frequently as positive for the economy (and less frequently as negative) in comparison with the environment and health, where negative articles dominated in most years. Between 2013 and 2015, there were considerably more articles on GMO being positive for the economy than in other years. This might be related to the quite significant attention during this period to the issue of whether to allow GMO fodder in Sweden because it would be expected to be cheaper and therefore have economic benefits for most farmers (Eriksson et al., 2018c).

Attitudes towards GMO in the news media were also reflected in its coverage of topics related to risks. Table 3 shows that risks (in general) were mentioned in 33 percent of all articles, and risks to health and the environment in 20 percent of all articles. Risks to the economy were only mentioned in 6 percent of all articles. Figure 16 shows the reporting on risks over time and within the different types of press. Here, all risk categories have been pooled into one variable. The evening press mentioned risks related to GMO in every single article published in 1996 and in 2010. However, in 2009, none of the articles on GMO in the evening press mentioned risks. This changeability was in line with how overall more extremes were found in the evening press reports than in the two other press types (which could partly be explained by the smaller number of articles in the evening press, and not necessarily only by the more sensationalist writing style). Articles on risks in the daily and agricultural press were more evenly distributed over the years. The daily press mentioned risks in about 50 percent of all articles on GMO in most years, however in 2016 no articles appeared in the daily press that mentioned risks.

The overall trend seemed to be that within all press types there was less reporting on risks related to GMO from 2009 onwards, which could indicate a more relaxed attitude towards GMO in the Swedish press. Interpreting these results together with the number of positive, negative and neutral articles over the years, as shown in Figures 13 and 14, further reinforces this image of an increasingly positive media debate on GMO.

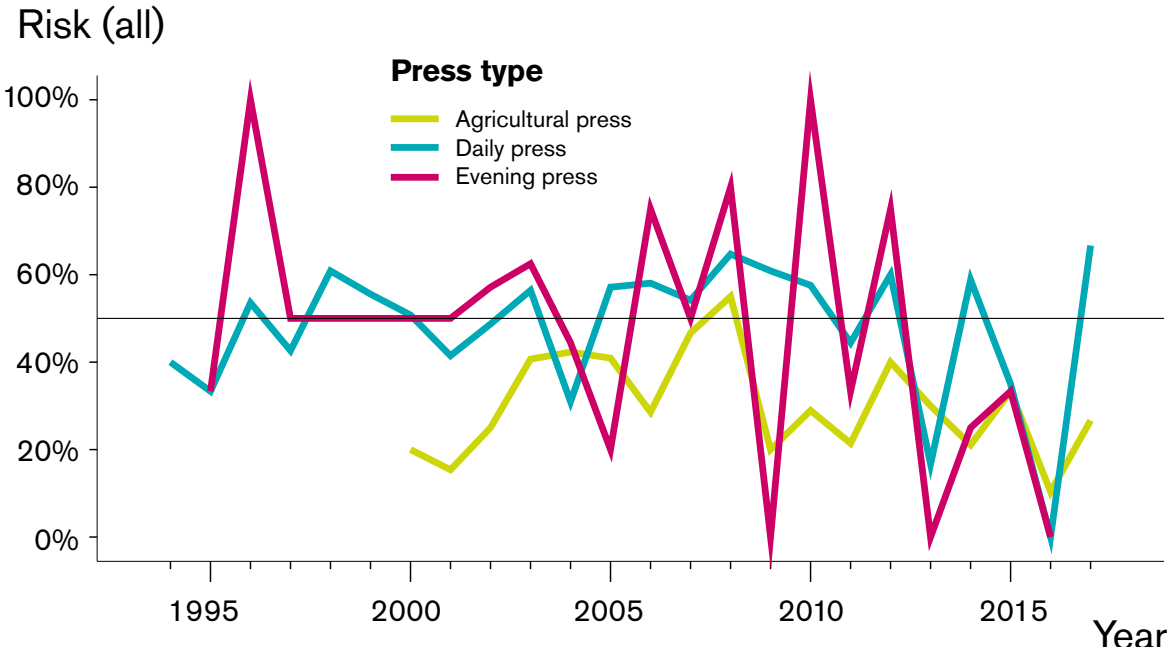

Figure 16. Articles mentioning risks in different press types over time

Shifts in the debate

This section takes a closer look at two years that from the statistical analysis appear to be of particular interest. A qualitative review of the content of news articles from years that stand out statistically aims to provide some explanations for interesting shifts in the media debate on GMO.

2008

In 2008 an unusual amount of positive articles appeared in the agricultural press, while the daily and evening press were negative (Fig. 13). This year marks the time when the overall debate, when studied quantitatively, turned from being mainly negative within all press categories to predominantly positive in later years, with the agricultural press leading the way.

Researchers and environmental NGOs were mentioned in more positive articles than any other subject positions in 2008 (Fig. 14) and rules and regulations were the most common issue of interest by far (Fig. 12). This goes hand in hand with government agencies being mentioned in almost 80 percent of all articles from 2008 (Fig. 11). However, we can also see that the EU as a subject position dips in that year, indicating that the focus of articles was on domestic rules, regulations and government agencies, and that something might have happened on a governmental level in Sweden in 2008.

A closer look at the articles from 2008 revealed that several events occurred that year which might have affected the debate. New Swedish rules regarding the cultivation of GM crops entered into force in September 2008, stating the distance required between different types of conventional and GM crops, and that neighbours within 100 metres of a GMO cultivation must be notified (ATL, 2008-06-27). The first genetically-modified potatoes were also planted and harvested in Sweden in that year, only intended for industrial papermaking (Jordbruksaktuellt, 2008-09-30). Environmental NGOs mentioned in several GMO-positive articles during that year might be related to major organisations such as Greenpeace Sweden and The Swedish Society for Nature Conservation (Naturskyddsföreningen) taking a more nuanced approach to GMO for the first time, with both organisations saying that the technology could be acceptable if it contributed to sustainable agriculture (Svenska Dagbladet, 2008-11-30). However, Greenpeace Sweden also arranged a protest action against GMO that year (Svenska Dagbladet, 2008-11-21).

The Swedish Minister of Agriculture at the time, Eskil Erlandsson, made headlines in 2008 for his positive stance on GMO, particularly after his statement during a live TV debate in which he said that "we are one hundred percent sure that there are no risks when we approve a GMO product" (our translation, GT, 2008-09-29). The president of the Federation of Swedish Farmers (LRF) was also criticised for changing his opinion on GMO fodder in favour of importing it into Sweden, with critics blaming the LRF for being the "driving force for GMO" (Sydsvenskan, 2008-07-23), although there were actually different opinions on this issue within the organisation (Land Lantbruk, 2008-05-28). While the debate became more positive in the agricultural press in 2008, it is interesting to note the cause of the remaining negativity found in the daily and evening press. An examination of the authorship of the 49 articles published in 2008 revealed that the opposition was in fact not as great as might at first appear. Eight of the 22 negative articles from 2008 were actually written by one person, Rune Lanestrand, who was also the founder and editor of "Småbrukaren" (the magazine published by the Swedish Smallholder Association), and one additional article concerned his protests against GMO. This means that 18 percent of all articles from 2008 were either written by or were about Lanestrand, and 70 percent of all news articles in the evening press from 2008 were actually debate articles he wrote. All of these articles were categorised as negative towards GMO. The attention that Lanestrand managed to obtain in the media in 2008 indicated the capability of individuals or organisations to influence the public debate, or at least to find ways to publicly voice their concerns in Sweden. It is difficult in this study to draw any conclusions about the extent to which Lanestrand managed to affect the wider public debate with his articles. It should be noted that the agricultural press did not publish Lanestand's opinion pieces.

Undoubtedly, 2008 was the year in which several major players in the GMO debate changed their opinions, or at least expressed them publicly, sparking controversy among GMO critics. It is also clear that there was a greater focus on Sweden in articles that year than had previously been the case.

2012

The year 2012 stands out in the statistical analysis in several ways. Most significantly, Figure 9 shows a sudden increase in articles in 2012 that mentioned genetic modification for production benefits (i.e. modified for herbicide/pest/drought resistance). This was the only year in which a specified type of modification surpassed the category "undefined modification". 2012 was also when the media reporting turned from predominantly negative to overall positive towards GMO within all press categories (Fig. 13). Figure 15 also shows a sharp peak in articles that mentioned GMO as good for the environment in 2012. These reversals in trend were difficult to explain statistically, and therefore all 40 articles from 2012 were examined more closely to see what news might have contributed to this turnaround in the media debate.

One of the biggest news stories about GMO in Sweden in 2012 was that the Swedish Board of Agriculture gave approval to the multinational agribusiness corporation Monsanto to perform field trials with a herbicide-tolerant sugar beet in southern Sweden (Dagens Nyheter, 2012-04-17). Seven articles, or 18 percent of all publications in 2012, were about this event, and an additional three articles were about approvals of new GM crops in the EU or US. Another common theme in articles from 2012 was researchers who promoted genetic engineering, mainly for its environmental benefits, with 23 percent (nine articles) of all publications from this year. It started with a debate article in Svenska Dagbladet (2012-03-23) in which Swedish researchers wrote about the many benefits of genetic engineering and what they saw as the public's 'unnecessary' scepticism about the technology. This was followed by a rather intense media debate on GMO in which a member of the European Parliament, Carl Schlyter (the Swedish Green Party), argued against the debate article (Svenska Dagbladet, 2012-03-26), which the researchers went on to call "infantile scaremongering" (Svenska Dagbladet, 2012-03-27). Later the same year, another constellation of researchers wrote a debate article in Dagens Nyheter (2012-06-02) in which the environmental movement was accused of "demonising genetic engineering", which revived the media debate. This explains the increase in researchers or research institutions as subject positions in 2012, as shown in Figure 11, and also the peak in articles that mentioned GMO as good for the environment (Fig. 15). The many articles about experiments with new GM crops and researchers promoting the benefits of GMO might also explain the sudden increase in articles that mentioned the production benefits of GMO, as seen in Figure 9.

Interestingly, it seems that the researchers who promoted GMO for its environmental benefits emerged as the winners in the media debate because 2012 can be seen as the year in which the Swedish news media adopted a positive stance overall towards GMO (Fig. 13). This interpretation is also reinforced by an article in Jordbruksaktuellt (2012-07-17) that reported on a survey conducted by the Stockholm Consumer Cooperative Society with the Swedish general public, which stated that the proportion of people negative about GMO decreased from 76 percent in 1998 to 46 percent in 2012.

Looking at the background literature, it is evident that there were several events around 2012 that might have brought about this shift. The article by Séralini on rats with tumours (Séralini et al., 2012) was published and then retracted and strongly criticised by the wider research community, and Nobel Laureates wrote an open letter to Greenpeace asking them not to destroy any more field trials and emphasising the importance of modern biotechnology for sustainable agriculture, which is likely to have stimulated the debate articles by Swedish researchers the same year using similar arguments. The new technology CRISPR/Cas9 was also made public and heralded by the scientific community for being faster, cheaper and more precise than older genetic modification technologies (Doudna and Charpentier, 2014, Baltimore et al., 2015).

5. Summarising conclusions

In summary, it is clear that in the 1990s the debate on GMO in Sweden, like that elsewhere in Europe, was biased towards consumer issues including food, health risks and labelling, underpinned by the concern that the governing bodies were not in control or not taking sufficient responsibility. Over time, the topics discussed in the media broadened, although labelling, health risks and food remained frequently reported topics, and environmental issues seemed to have made less of an impact on the Swedish debate than in Europe over all. There was a notable discrepancy between the quite narrow dominant focus on consumer aspects of GMO in the media and the broader concerns of the Swedish general public, including ethical aspects, unforeseen consequences for the environment, GMO being unnatural and unnecessary, and overall scepticism about multinational companies (Koivisto Hursti et al., 2002, Gaskell et al., 2000, Konsumentföreningen Stockholm, 2018).

The geographical focus also shifted over time in media reporting, with a strong focus on the EU in the early years of the debate towards a greater focus on Sweden in later years. In contrast to the academic literature and the wider societal debate internationally on GMO which focused on agriculture in the Global South along with issues about food security, poverty and farmers' rights (Fischer and Eriksson, 2016), our study indicates that these issues were almost completely absent in the Swedish media. Overall, the Swedish media debate has mainly been concerned with Sweden and the EU, and to a lesser extent with the US, Brazil and Canada. It was also noted that in general researchers participated in the media debate to a limited extent overall, but that when they did become involved (in 2012) they actually seemed to have had an impact on the debate becoming more positive, which followed the trend of researchers' increased public visibility in wider society. It should be noted that the general public does not yet appear to have shifted towards having a more positive view of GMO overall (Konsumentföreningen Stockholm, 2018). Thus, it remains to be seen whether the media can lead the way in changing public opinion.

References to news articles

ATL, *Svenska gmo-regler börjar gälla i september.* 2008-06-27.

Dagens Nyheter, *Populistisk miljörörelse demoniserar gentekniken*. 2012-06-02.

Dagens Nyheter, *Välkommen*. 2012-04-17.

GT, *Dags att ta tag i GMO-debatten*. 2008-09-29.

Jordbruksaktuellt, *Delade meningar om första Gmo-potatisen*. 2008-09-30.

Jordbruksaktuellt, *Färre tycker att GMO är negativt*. 2012-07-17.

Land Lantbruk*, Styrelsen vann GMO-debatt*. 2008-05-28.

Svenska Dagbladet, *Greenpeace tände Stadshuset*. 2008-11-21.

Svenska Dagbladet, *Fredstravare i genkriget*. 2008-11-30.

Svenska Dagbladet, *Infantil skrämselpropaganda om växtförädling*. 2012-03-27.

Svenska Dagbladet, *Genmanipulation ger inte ett uthålligt jordbruk*. 2012-03-26.

Svenska Dagbladet, *Onödig skepsis mot genmodifierat*. 2012-03-23.

Sydsvenskan, *Nonchalant och okunnigt om GMO.* 2008-07-23.

References

Ansell, C. 2006. What's the beef?: the contested governance of European food safety, MIT Press.

Baltimore, D., Berg, P., Botchan, M., Carroll, D., Charo, R. A., Church, G., Corn, J. E., Daley, G. Q., Doudna, J. A., Fenner, M., Greely, H. T., Jinek, M., Martin, G. S., Penhoet, E., Puck, J., Sternberg, S. H., Weissman, J. S. & Yamamoto, K. R. 2015. A prudent path forward for genomic engineering and germline gene modification. Science, 348, 36-38.

Bonny, S. 2014. Taking stock of the genetically modified seed sector worldwide: market, stakeholders, and prices. Food Security, 6, 525-540.

Bruening, G. & Lyons, J. 2000. The case of the FLAVR SAVR tomato. California Agriculture, 54, 6-7.

Callaway, E. 2018. CRISPR plants now subject to tough GM laws in European Union. Nature, 560, 16-17.

Carson, L. & Lee, R. 2005. Consumer sovereignty and the regulatory history of the European market for genetically modified foods. Environmental Law Review, 7, 173-189.

Cook, G. 2004. Genetically modified language: the discourse of arguments for GM crops and food, New York and Oxon, Routledge.

Domenec, F. 2014. Monsanto's and Chevron's home pages in the US and the UK: Corporate discourse as a reflection of social trends? Iberica, 27, 51-76.

Doudna, J. A. & Charpentier, E. 2014. The new frontier of genome engineering with CRISPR-Cas9. Science, 346, 1258096.

Eriksson, D., Brinch-Pedersen, H., Chawade, A., Holme, I. B., Hvoslef-Eide, T. A., Ritala, A., Teeri, T. H. & Thorstensen, T. 2018a. Scandinavian perspectives on plant gene technology: applications, policies and progress. Physiologia plantarum, 162, 219-238.

Eriksson, D., De Andrade, E., Bohanec, B., Chatzopolou, S., Defez, R., Eriksson, N. L., Van Der Meer, P., Van Der Meulen, B., Ritala, A. & Sági, L. 2018b. Why the European Union needs a national GMO opt-in mechanism. Nature biotechnology, 36, 18.

Eriksson, M., Ghosh, R., Hansson, E., Basnet, S. & Lagerkvist, C.-J. 2018c. Environmental consequences of introducing genetically modified soy feed in Sweden. Journal of Cleaner Production, 176, 46-53.

Eurobarometer 2010. Eurobarometer 73.1 Biotechnology. Brussels: TNS Opinion & Social on request of European Commission,.

Fischer, K., Ekener-Petersen, E., Rydhmer, L. & Björnberg, K. E. 2015a. Social Impacts of GM Crops in Agriculture: A Systematic Literature Review. Sustainability, 7, 8598-8620.

Fischer, K., Ekener-Petersen, E., Rydhmer, L. & Edvardsson Björnberg, K. 2015b. Social impacts of GM crops in agriculture: A systematic literature review. Sustainability (Switzerland), 7, 8598-8620.

Fischer, K. & Eriksson, C. 2016. Social Science Studies on European and African Agriculture Compared: Bringing Together Different Strands of Academic Debate on GM Crops. Sustainability, 8, 865.

Foe International 2005. Who benefits from gm crops? Monsanto and the corporate-driven genetically modified crop revolution. Amsterdam: FOE Internetional.

Frewer, L. J., Miles, S. & Marsh, R. 2002. The media and genetically modified foods: evidence in support of social amplification of risk. Risk Analysis: An International Journal, 22, 701-711.

Gasiunas, G., Barrangou, R., Horvath, P. & Siksnys, V. 2012. Cas9–crRNA ribonucleoprotein complex mediates specific DNA cleavage for adaptive immunity in bacteria. Proceedings of the National Academy of Sciences, 109, E2579-E2586.

Gaskell, G., Allum, N., Bauer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., De Cheveigné, S., Fjaestad, B. & Gutteling, J. M. 2000. Biotechnology and the European public. Nature biotechnology, 18, 935.

Giorgi, L., Von Homeyer, I. & Parsons, W. 2006. Democracy in the European Union: towards the emergence of a public sphere, Routledge.

Glover, D. 2010. The corporate shaping of GM crops as a technology for the poor. Journal of Peasant Studies, 37, 67-90.

Grabner, P., Hampel, J., Lindsey, N. & Torgensen, H. 1996. Biopolitical diversity: The challenge of multilevel policy-making. In: GASKELL, G. & BAUER, M. (eds.) Biotechnology 1996-2000 the years of controversy. London: Science Museum.

Hedström, T. 2016. Svenska Mediehus 2015/2016 - Fakta om marknad och medier. TU Medier i Sverige.

Herrick, C. B. 2005. 'Cultures of GM': Discourses of risk and labelling of GMOs in the UK and EU. Area, 37, 286-294.

Hess, S., Von Cramon-Taubadel, S., Zschache, U., Theuvsen, L. & Kleinschmit, D. 2011. Explaining the puzzling persistence of restrictions on seasonal farm labour in Germany. European Review of Agricultural Economics, 39, 707-728.

Ideland, M. 2002. Dagens Gennyheter. Hur massmedier berättar om genetik och genteknik, Lund, Nordic Academic Press.

ISAAA 2017. Global Status of Commercialized Biotech/GM Crops in 2017: Biotech Crop Adoption Surges as Economic Benefits Accumulate in 22 Years. In: JAMES, C. (ed.) ISAAA brief. Ithaca, New York: ISAAA.

Jacobson, K. 2013. From Betterment to Bt maize: : Agricultural Development and the Introduction of Genetically Modified Maize to South African Smallholders PhD Doctoral theisis, Swedish University of Agricultural Sciences.

Jacobson, K. & Wahlberg, K. 2006. Lantbruk på lika villkor- om samexistensen mellan GMO-fritt lantbruk och lantbruk som använder GMO. Uppsala: Centrum för Uthålligt Lantbruk.

Jansson, S. 2018. Gene-edited plants on the plate: the 'CRISPR cabbage story'. Physiologia plantarum, 164, 396-405.

Jasanoff, S. 2000. Between risk and precaution–reassessing the future of GM crops. Journal of Risk Research, 3, 277-282.

Jinek, M., Chylinski, K., Fonfara, I., Hauer, M., Doudna, J. A. & Charpentier, E. 2012. A programmable dual-RNA–guided DNA endonuclease in adaptive bacterial immunity. science, 337, 816-821.

Koivisto Hursti, U.-K., Magnusson, M. K. & Algers, A. 2002. Swedish consumers' opinions about gene technology. British Food Journal, 104, 860-872.

Konsumentföreningen Stockholm 2018. Svenskarnas Attityder kring GMO och Genteknik. Stockholm: Konsumentföreningen Stockholm, the Consumer association Stockholm,.

Krenzler, H. G. & Macgregor, A. 2000. GM food: The next major transatlantic trade war? European Foreign Affairs Review, 5, 287-316.

Kumar, B. R. 2019. Bayer's acquisition of Monsanto. Wealth Creation in the World's Largest Mergers and Acquisitions. Springer.

Kurzer, P. & Cooper, A. 2007. What's for dinner? European farming and food traditions confront American biotechnology. Comparative Political Studies, 40, 1035-1058.

Lieberman, S. & Gray, T. 2006. The so-called 'moratorium' on the licensing of new genetically modified (GM) products by the European Union 1998–2004: a study in ambiguity. Environmental Politics, 15, 592-609.

Lieberman, S. & Gray, T. 2008. The World Trade Organization's Report on the EU's Moratorium on Biotech Products: The Wisdom of the US Challenge to the EU in the WTO. Global Environmental Politics, 8, 33-52.

Lombardo, L. 2014. Genetic use restriction technologies: a review. Plant Biotechnology Journal, 12, 995-1005.

Losey, J. E., Rayor, L. S. & Carter, M. E. 1999. Transgenic pollen harms monarch larvae. Nature, 399, 214.

Mwale, P. N. 2006. Societal deliberation on genetically modified maize in southern Africa: The debateness and publicness of the Zambian national consultation on genetically modified maize food aid in 2002. Public Understanding of Science, 15, 89-102.

Mühlböck, M. & Tosun, J. 2018. Responsiveness to different national interests: Voting behaviour on genetically modified organisms in the council of the European Union. JCMS: Journal of Common Market Studies, 56, 385-402.

Nuffield Council On Bioethics. 1999. Genetically Modified Crops: the Ethical and Social Issues.

Olofsson, A. 2002. Waves of controversy: gene technology in Dagens nyheter 1973-96. Umeå universitet.

Ortiz-García, S., Ezcurra, E., Schoel, B., Acevedo, F., Soberón, J. & Snow, A. A. 2005. Absence of detectable transgenes in local landraces of maize in Oaxaca, Mexico (2003–2004). Proceedings of the National Academy of Sciences, 102, 12338-12343.

Paskalev, V. 2012. Can science tame politics: The collapse of the new GMO regime in the EU. European Journal of Risk Regulation, 3, 190-201.

Pinero-Nelson, A., Van Heerwaarden, J., Perales, H. R., Serratos-Hernandez, J. A., Rangel, A., Hufford, M. B., Gepts, P., Garay-Arroyo, A., Rivera-Bustamante, R. & Álvarez-Buylla, E. R. 2009. Transgenes in Mexican maize: molecular evidence and methodological considerations for GMO detection in landrace populations. Molecular ecology, 18, 750-761.

Pollack, M. A. & Shaffer, G. C. 2000. Biotechnology: the next transatlantic trade war? Washington quarterly, 23, 41-54.

Potrykus, I. 2001. The 'golden rice'tale. In Vitro Cellular & Developmental Biology-Plant, 37, 93-100.

Punt, M. J., Venus, T. J. & Wesseler, J. 2017. The costs of coexistence on farms in Germany. AgBioForum, 20, 24-36.

Quist, D. & Chapela, I. H. 2001. Transgenic DNA introgressed into traditional maize landraces in Oaxaca, Mexico. Nature, 414, 541-543.

Retzbach, A. & Maier, M. 2015. Communicating scientific uncertainty: Media effects on public engagement with science. Communication Research, 42, 429-456.

Royal Society Of London 2000. Transgenic plants and world agriculture, Washington DC,, National Academy Press.

Ryffel, G. U. 2010. Making the most of GM potatoes. Nature Biotechnology, 28, 318-318.

Schenkelaars, P. & Wesseler, J. 2016. Farm-level GM Coexistence Policies in the EU: Context, Concepts and Developments. EuroChoices, 15, 5-11.

Schouten, G., Leroy, P. & Glasbergen, P. 2012. On the deliberative capacity of private multi-stakeholder governance: The Roundtables on Responsible Soy and Sustainable Palm Oil. Ecological Economics, 83, 42-50.

Séralini, G.-E., Clair, E., Mesnage, R., Gress, S., Defarge, N., Malatesta, M., Hennequin, D. & De Vendômois, J. S. 2012. Retracted: Long term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize. Elsevier.

Shelton, A. M. & Sears, M. K. 2001. The monarch butterfly controversy: scientific interpretations of a phenomenon. The Plant Journal, 27, 483-488.

Shiva, V. 2000. Stolen harvest: The hijacking of the global food supply, Zed Books.

Siipi, H. 2008. Dimensions of naturalness. Ethics and the Environment, 71-103.

Statistics Sweden (SCB) 2019. Exports and Imports by countries: The Swedish export and import of goods by countries (SEK million) https://www.scb.se/en/finding-statistics/statistics-by-subject-area/trade-in-goods-and-services/foreign-trade/foreign-trade---exports-and-imports-of-goods/pong/tables-and-graphs/exports-and-imports-of-goods-by-countries/ [07-10-2019]

Stephan, H. R. 2012. Revisiting the transatlantic divergence over GMOs: Toward a cultural-political analysis. Global Environmental Politics, 12, 104-124.

Swedish Government 2016. Regeringens proposition 2016/17:104 En livsmedelsstrategi för Sverige – fler jobb och hållbar tillväxt i hela landet. In: Innovation, M. O. E. A. (ed.). Stockholm.

Support Precision Agriculture. 2016. Laureates Letter Supporting Precision Agriculture (GMOs). https://www.supportprecisionagriculture.org/nobel-laureate-gmo-letter_rjr.html [04-12-2019]

Tansey, G. 2011. Whose Power to Control? Some Reflections on Seed Systems and Food Security in a Changing World. IDS Bulletin, 42, 111-120.

Thøgersen, J. 2010. Country Differences in Sustainable Consumption: The Case of Organic Food. Journal of Macromarketing, 30, 171-185.

Tillie, P., Dillen, K. & Rodríguez-Cerezo, E. 2016. Perception of Coexistence Measures by Farmers in Five European Union Member States. EuroChoices, 15, 17-23.

Tourangeau, W. 2018. Power, discourse, and news media: Examining Canada's GM alfalfa protests. Geoforum, 91, 117-126.

Wales, C. & Mythen, G. 2002. Risky discourses: The politics of GM foods. Environmental Politics, 11, 121-144.

Venus, T. J., Dillen, K., Punt, M. J. & Wesseler, J. H. H. 2017. The Costs of Coexistence Measures for Genetically Modified Maize in Germany. Journal of Agricultural Economics, 68, 407-426.

Whitty, C. J. M., Jones, M., Tollervey, A. & Wheeler, T. 2013. Biotechnology: Africa and Asia need a rational debate on GM crops. Nature, 497, 31-33.

Von Bothmer, R., Fagerström, T. & Jansson, S. 2015. Bortom GMO: vetenskap och växtförädling för ett hållbart jordbruk, Fri Tanke förlag.

Wynne, B. 2001. Creating public alienation: expert cultures of risk and ethics on GMOs. Science as culture, 10, 445-481.

Wynne, B. 2007. Risky delusions: misunderstanding science and misperforming publics in the GE crops issue.

Zerbe, N. 2004. Feeding the famine? American food aid and the GMO debate in Southern Africa. Food Policy, 29, 593-608.

Zetterberg, C. & Björnberg, K. E. 2017. Time for a New EU Regulatory Framework for GM Crops? Journal of Agricultural and Environmental Ethics, 30, 325-347.

Zhang, C., Wohlhueter, R. & Zhang, H. 2016. Genetically modified foods: A critical review of their promise and problems. Food Science and Human Wellness, 5, 116-123.

Appendix 1: Survey questionnaire

Questionnaire used for coding articles.

Survey question	Response alternatives (words combined in brackets were grouped as one alternative because they were considered to have roughly the same meaning)	Comments on response type and interpretation
Article id-number	The randomised code assigned to each individual article	
Date of publication	Year-month-date	
Headline of article	Free text	
Newspaper source	ATL, Jordbruksaktuellt, Dagens Nyheter, Land Lantbruk, Svenska Dagbladet, Aftonbladet, Expressen, GT, Kvällsposten	Only one response
Author of article	Media, researcher, private R&D biotech, environmental organisation, agricultural organisation, consumer organisation, other private actors in the food chain (food or feed producer), other (free text)	Multiple responses. In all cases where an article did not have an author, 'media' was noted as the response.
Term for GMO	[GMO, genteknik, genetiskt modifierad, genmodifierad, GM], gen, [genetiskt manipulerad, genmanipulerad], [genändrad, genförändrad, genetiskt förändrad], transgen(a), genredigerad, [CRISP, CRISPR/CAS], [bioteknik, biotekniskt modifierad, modifierad med bioteknik, biotech], other (free text);	Multiple responses. All terms for GMO were listed, based on discussion with key informants. Terms that mean essentially the same thing were coded together, noted with brackets here. GMO terms are written in Swedish here so as not to introduce confusion in this key part of the analysis.
Geographical markers	Sweden, [EU, Europe, European countries], US, Brazil, Argentina, Canada, India, China, Africa [including specific African countries], other geographical marker	Multiple responses. Named European or African countries were coded as Europe or Africa because these geographical areas were of particular interest for this study. Reference to other continents was coded as "other geographical marker".
Purpose of GMO	Food, feed, other (medicine, fuel, etc.), not defined	Multiple responses. Food is interpreted as also including drinks for human consumption.
Type of organism	Maize, soy, rapeseed, cotton, other plant (including other specific plants, or "plants" in general), animal, other (anything else), not defined	Multiple responses. "Animal" was coded only when the animal was modified, not when the animal was eating GMO feed. Unidentified plants were coded as "other plant".

Type of modification	Changed for production benefits (including insect resistance, herbicide tolerance, drought resistance, salt resistance, increased harvest, etc.), insect resistance (e.g. Bt), herbicide tolerance (e.g. Roundup ready, glyphosate tolerance), changed for human health, vitamin enriched (e.g. Golden Rice, vitamin A enriched, iron enriched, changed oil composition), other modification (e.g. produce fuel, medicine, etc.), not defined	Multiple responses
Actor group	Media, [researcher, research institute], [private R&D research, biotech, seed producer], [farmer, farmer organisation], organic farmer, [small farmer, poor, starving people], [the public, people, citizens], [consumers, consumer's organization, customers], [government, parliament, government agency, municipality], other actors in the food supply chain (stores, grocery stores, food producer, fodder producer), EU, environmental organisation, NGO other, other	Multiple responses Actor or role talked about in the third person
Issues of interest 1 of 2 –	[scientific proof, scientific advancement, technical development, proven, research support], [pesticide, plant protection], [glyphosate, roundup, glufosinate-ammonium], [farmer's perspective, producer issues, agricultural issues], [consumers issues, food prices, consumers resistance, options in the store etc.], labelling, [separation, co-existence, tracing GMO in food/nature, contamination, GMO-free], increased production, [food security, poverty, starvation], risk (in general), environmental risk, health risk, economical risk, [market, trade between countries, competition, profit, export, import, commercial opportunities], [rules, laws, conventions, regulations, permission, prohibition], [patent, intellectual property rights, the possibility to use your own seeds, property rights over natural resources, use GMO seeds several years, terminator technology, terminator genes]	Multiple responses. However, for each issue, the article can only be coded as "not mentioned in text", "mentioned in text" or "main focus in text".
Issues of interest 2 of 2	[GMO good, GMO good without specifying how, GMO good in other than environmental, health or economical terms, lack of proof that GMO is bad, GMO-free is bad], [GMO bad, GMO bad without specifying how, GMO bad in other than environmental, health, or economical terms, "against GMO", "no to GMO", GMO-free is good], [GMO good for the environment, GMO has no negative effect on the environment, GMO decreases use of pesticides, GMO safe for the environment, GMO-free is bad for the environment], [GMO bad for the environment, GMO increases use of pesticides, more monoculture from GMO, negative risk with GMO spreading, GMO-free is good for the environment], [GMO good for health, GMO has no negative effect on health, GMO inventions good for health, GMO-free is bad for health], [GMO bad for health, there might be health risks with GMO, unsure if there are health risks, cancer, allergy, GMO-free is good for health], [GMO good for the economy, GMO has no negative effect, GMO-free is bad for the economy], [GMO is bad for the economy, GMO has no positive economic effect, GMO-free is good for the economy]	Multiple responses. However, for each issue, the article can only be coded as either "not mentioned in text", "mentioned in text", or "main focus in text".

GMO tone	Positive, negative, neutral	The tone of the article was coded according to the feeling towards GMO it was interpreted to induce in the reader. As positive, negative or neutral. The analysis was largely guided by how adjectives and nouns were used in relation to GMO and if they had negative or positive connotations, creating an overall “tone”. Words in negatively coded articles were for example ‘against’, ‘warning’, ‘stop’, ‘dangerous’ and ‘complicated’, whereas positively coded articles had words such as ‘for’, ‘good’, ‘increased harvest’ and ‘approved’. Articles without positive or negative words or where the two sides were perceived as balancing out the argument were coded as having a neutral tone. One exception was articles with a clear negative or positive argumentation but where the overall tone of the article conflicted with the argumentative intention of the piece, leading us to code the article as neutral.

SLU Future Food is a platform for research and collaboration at the Swedish University of Agricultural Sciences aimed at ensuring that the entire food system is characterized by economic, ecological and social sustainability.

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