(Mis)information and the politicization of food security

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Implications

• With 20 years of genetically modified crop production, data supporting their benefits and safety abound yet the social battle regarding GM crops has not abated and, in fact, seems to have become even more vociferous.
• Environmental non-governmental organizations have effectively boxed themselves into a corner as they find themselves unable to acknowledge the science-based evidence of benefits and remain firmly committed in their opposition, contributing to campaigns of misinformation.
• Improved food security is being jeopardized given the rejection of science by the environmental movements, resulting in food security becoming a political issue.

Key words: biotechnology, communications, developing countries, environmental non-governmental organizations, food labeling, genetically modified crops

Introduction

Agricultural biotechnology, particularly the introduction of genetically modified (GM) crops continues to be controversial more than two decades after they were introduced. For a technology that is now so widely adopted around the world, why is this so? Among the many explanations that have been offered, one focuses on the way that differing perspectives on new technology introductions become entrenched, whether or not they are warranted by the available evidence. Genetically modified crops have experienced a long tradition of entrenched and polarized views, commencing with an insalubrious exchange between Richard Dawkins and Prince Charles on the occasion of the latter’s 2000 Reith Lecture (Ruse and Castle, 2002). More recently in late 2016, the New York Times claimed it had conducted an “extensive examination” of GM crops and found their benefits to be lacking, a claim that was vociferously challenged by scientists and farmers alike, some of whom wrote a pointed rebuttal (Hakim, 2016; Giddings, 2016). The rebuttal gives references to several reviews and analyses of the benefits—and it should be added, the limitations—of GM crops, particularly in the United States and Canada, and other GM crop adopting nations. No one has claimed that GM crop technologies are the “silver bullet” to effective yield gain and pesticide reduction (Scott, 2016), but the record of evidence suggests there have been substantial benefits for consumers, farmers, human health, the environment, and sustainable development.

Despite research dating back 15 yr reporting the benefits of GM crops, and acknowledgment of their limitations, critics of GM crops (and biotechnology more generally) continue to dismiss this information and ignore the multitude of benefits resulting from their adoption. Critics go as far as insinuating that the biotechnology industry has co-opted academic researchers and is paying academics to mislead the public in the quantification of the benefits of biotech crops, as is evidenced by the US Right to Know campaign’s request for freedom-of-information access to the emails of more than 40 leading American academics (Kloor, 2015). These opponents suggest that the distribution of benefits is not equal (benefit distribution is not equal for any technology), causes farmers to commit suicide, and is polluting the land (Adams, 2014). Much of this misleading information was captured in the 2013 report released by the United Nations Conference on Trade and Development (UNCTAD) entitled, “Trade and Environmental Review 2013: Wake Up Before It Is Too Late” (United Nations Conference on Trade and Development, 2013). While containing contributions from more than 60 experts, no single expert in biotechnology or GM crops was listed in the table of contents. On the contrary, many of the contributors listed have been longstanding critics of biotechnology and GM crops. The essential message of this lengthy report was that for food security to exist over the remainder of this century, agriculture in developing countries needs to return to largely organic, small-scale farming practices.

Despite evidence to the contrary, deeply entrenched positions persist much as they have for the last two decades. In response, this article begins with a concise summary of the documented benefits from GM crops from around the world, before turning to a discussion of how environmental non-governmental organizations (eNGOs) have developed a stance on GM crops that presents them with a dilemma: accept some of the evidence and lose political ground or hold the ground and deny all evidence. As that dilemma continues for eNGOs and there is no resolution in sight, we turn in the third section to discuss some of the avenues for continuing and improving communication about the benefits and risks of adopting GM crop technologies. Our conclusion is that the selective use of information or denial of the existence of evidence about the benefits of GM crops politicizes food security in ways that make many millions of hungry people vulnerable.

Global Benefits of GM Crops

Although the first commercial GM crop was planted in 1994 (tomatoes), 1996 was the first year in which a significant area of crops containing GM
traits were planted (1.66 million ha). Since then, there has been a dramatic increase in plantings; by 2015, the global planted area reached more than 180 million ha (ISAAA, 2016). Genetically modified traits have largely been adopted in four main crops—canola, corn, cotton, and soybeans—although small areas of GM crops in sugarbeet (adopted in the USA and Canada since 2008), papaya (in the USA since 1999 and China since 2008), and squash (in the USA since 2004) have also been planted. In 2015, 28 countries planted GM crops, and more than half were developing nations. Six countries accounted for 92% of total production: US, Brazil, Argentina, India, Canada, and China (in declining order of area). Two traits dominate: herbicide-tolerant crops account for 65% of the total GM area while insect-resistant crops account for 35% of global plantings. Genetically modified seeds account for 88% of the global soybean acreage, with 57% for corn and 32% for canola. In those countries adopting GM varieties, GM seed market share has risen above 80%. Genetically modified crops have also been pro-trade in that adoption and production is concentrated in leading export nations. Brookes (2014) estimates that biotechnology producers account for between 72% of cotton and 95% of soybean global trade.

The biggest GM crop in Canada is canola, used both for consumer food and livestock feed. Research shows economic benefits to Canadians of Can$350–400 million per year (Gusta et al., 2011). While much of this has gone to farmers through higher yields and lower production costs, consumers have also benefitted through low prices for margarine and healthier cooking oils. The other huge beneficiary is the environment due to major reductions in pesticide use (down 35%), soil tillage, soil erosion, fossil energy usage, and greenhouse gas emissions—all directly related to GM canola. The overall environmental impact of canola production has been estimated to have dropped by 53% (Smyth et al., 2011).

Hutchison et al. (2010) led a study on the economic benefits of GM corn adoption in the US, finding that GM corn created $6.8 billion in extra value, with 60% going to non-adopters due to lower insect pressures. This means that non-GM corn farmers are making fewer pesticide applications to their corn fields due to the spillover benefits from GM corn fields to non-GM corn fields.

One of the most successful GM crops that often gets overlooked is that of insect-resistant GM papaya in Hawaii. In the early 1990s, ring spot virus had infected virtually all of Hawaii’s papaya production, causing output to drop from 58 million lb in 1993 to 35 million lb just 5 yr later (Gonsalves and Gonsalves 2014). This production decline was estimated to have been worth US$17 million per year. Genetically modified virus-resistant papaya allowed Hawaiian production to return to normal, as nearly all papaya producers adopted GM papaya.

One of the most significant economic benefits identified from GM crop commercialization has been the adoption of GM cotton in India. Farm families there, living on less than US$2 per day, have seen their household incomes rise by 134% (Qaim, 2016). In China, GM cotton increased farmers’ annual income by US$500/ha (Pray et al., 2002). In Burkina Faso, GM cotton farmers received US$80/ha more than non-GM cotton farmers (Vitale et al., 2014). In the Philippines, GM corn farmers have annual net incomes of US$600 versus US$400 for non-GM corn farmers (Yorobe and Smale, 2012).

Environmental benefits from GM crops come from reduced chemical applications. In India, cotton farmers lose 50 to 60% of yield due to insect infestations. Those growing GM cotton have reduced pesticides to control insects by 41% (Qaim, 2016). Cotton farmers in China used to spray fields as often as 30 times per season to control insects. That usage is down by about 90% with GM crops (Huang et al., 2010).

Human health has also experienced enormous benefits following the adoption of GM crops. Most chemical applications in developing countries are done by farmers walking through fields wearing short-sleeved shirts, sometimes barefoot, spraying chemicals from a backpack. A study of chemical use with GM cotton farmers in India found that cases of pesticide poisoning dropped by 2.4 to 9 million cases per year (Kouser and Qaim, 2011). Similar results were observed in Burkina Faso where it is estimated that GM cotton results in 30,000 fewer cases of pesticide poisoning annually (Vitale et al., 2014). A study on GM corn adoption in South Africa found that women farmers are the dominant adopters, and they spend 10 to 12 fewer days a season hoeing and hand-weeding under the hot sun (Gouse, 2013).

Based on this evidence, consumer and political support for GM crops should
be magnitudes above where it presently is. A study released by Health Canada in 2016 found that 78% of Canadians would prefer to have food products labeled for GM ingredients, yet 45% said they rarely or never pay attention to the labels on food products (Health Canada, 2016). If nearly half of Canadian consumers report they seldom look at food labels, then why would more than three-quarters indicate the desire to have these same products labeled for GM content? One answer could be consumer manipulation by eNGOs.

The Politicization of Food Security

Genetically modified crops have been produced in the initial adopting countries for 20 yr. Over this period of time, hundreds of articles and reports have been published by academic journals, government regulatory agencies, and national science organizations on the safety aspects of biotechnology and GM crops. In addition to this, there is a growing body of quantified peer-reviewed literature on the economic and environmental benefits following the adoption of GM crops in both developed and developing countries. Some estimates place the economic benefits in the billions of dollars a year range. In spite of the documentation of these economic and environmental benefits, GM crops face a challenging future. Environmental non-governmental organizations are relentless in their campaigns of misinformation about the dangers and hazards of GM crops. While eNGOs are unable to quantify their claims and accusations, their political and policy influence continues, particularly in Europe and numerous developing nations. The result is regulatory delays for the approval of new GM crops and frequent international commodity trade failures where shipments have been rejected due to the low level presence of a GM crop. Taken in combination, the regulatory and trade challenges facing GM crops are having a detrimental impact on improving food security.

Global food insecurity is one of the top agenda items that governments and institutions are grappling with in the 21st century. After a half a century of advances in technology, productive capacity, and trade liberalization, the absolute and relative incidence of malnutrition and food insecurity was dropping nicely until 2000. But accelerating demand, due to inexorable population and income growth, and slowing productivity growth in yields due to climatic and agronomic change have led in recent years to a rise in absolute and relative food insecurity. New technologies are needed to fill this emerging gap, but they will only work if the resulting produce can be distributed efficiently and effectively to consumers around the world.

To successfully meet the existing and new demands for food products, international trade will be crucial. The United Nations Food and Agriculture Organization estimates that the only countries to unambiguously have the capacity to produce more food than they consume are Argentina, Australia, Burma, Canada, France, India, Russia, Thailand, and the US, along with a few other small countries. Approximately 16% of the global population today relies on imports of food produced elsewhere to meet their basic dietary needs. Fader et al. (2013) undertook a trend analysis, concluding that the exhaustion of farmland, climate change, and uneven population growth will raise the proportion of the world population that depends on international exchange to secure adequate food to 50% by 2050.

Yet despite these growing pressures, new agricultural technologies and trade have become flashpoints. The problem is that the advent of GM food has led to a tangle of new regulatory and trade measures designed to segment markets based on the provenance of food; these new rules affect both GM and traditional trade flows. In the process, the capacity to produce an increasing flow of technological innovations as well as the efficiency of the international trade system are being eroded. Brookes and Barfoot (2016) have estimated that production increases from GM crops have made substantial contributions to improving global food security. Over the 19-yr period of their assessment of GM crop production (1996–2014), an additional 158 million tonnes of soybeans and 322 million tonnes of corn have been produced that would not have been possible with only conventional seeds.

This increased production has resulted in an estimated additional economic benefit from GM crops of US$150 billion over the entire time period.

The debate about coexistence between conventional, GM, and organic forms of agricultural production is about the future of the global food system and its capacity to meet the rapidly growing demand for food and nutrition. After more than 15 yr of slow and largely unsuccessful efforts to design new rules to accommodate the various demands in the marketplace, there may be a new opening for renewed discussion. The revisionist trade agenda for the new Trump administration and the pending Brexit negotiations will inevitably open up and potentially reinvigorate trade negotiations at the World Trade Organization, at related international organizations, and in various bilateral and sectoral fora.

As the rules governing the approval and trade of GM crops have tightened, a multitude of eNGOs have become heavily invested in countering the benefits described above. In 2011, the big six multinational biotechnology development companies spent US$8.6 billion on agriculture research and development (R&D) (Hobbs, 2014). This R&D spending is for all aspects of agricultural innovations, not just for GM crop development. In talking with various technology development firm representatives, it is estimated that 10 to 20% of the total R&D budget would be invested into GM crop research. This figure varies from firm to firm and from year to year, but serves as an estimate of annual investment into GM crop development. This represents an investment of US$860 million to US$1.7 billion.

To counter this investment in GM crop R&D, the European Union (EU) and its eNGOs spend billions annually to prevent GM crops from being adopted in developing countries. In 2015, it is estimated that the anti-GM movement spent US$10 billion fighting biotech around the globe (J. Byrne, Griffith School of Environment, unpublished). If one were to take an average of US$1.5 billion in GM crop R&D, then those opposed to an innovation that improves production and profitability, therefore lowering food insecurity, are outspending the technology developers by a ratio...
of 6.7 to 1. This imbalance is the crux of the food insecurity debate that is presently raging around the world, and nowhere is this better represented than in the recent actions of the European Parliament.

In the spring of 2016, the European Parliament completely abandoned a previous G7 commitment to improving food security. In 2012, the G7 group of countries launched the New Alliance for Food Security and Nutrition program in an effort to lift 50 million people out of poverty. In June 2016, Members of the European Parliament called on developing countries to reject the program, calling it “a mistake.” Members of the European Parliament demanded “that the G7 abandon its commitment to GMOs in this public–private partnership,” arguing this type of farming practice “destroys family farming and reduces biodiversity” (Barbière, 2016).

The future of global food security now resides in the outcome of a political debate. Science is similarly under attack from many different viewpoints, not the least of which is at the political governance level. The eNGO movement is seemingly no longer interested in, or willing to accept, the peer-reviewed evidence of the environmental benefits offered through the production of GM crops, choosing instead to focus on campaigns of misinformation and fear about GM crops. Clearly, opposing GM crop production is a profitable business to be in these days. These diverging tracks are not sustainable, or promising, for the future of food security. How does, can, or will the science of agricultural innovations compete to inform parliamentarians, regulators, and consumers about the benefits of GM crops in the face of emotional arguments advanced by critics of the technology? What solutions are potentially available to those involved in advancing the discussions that support adoption and production of GM crops? We now turn to a discussion of deconstruction of food security impediments.

**Paving the Road to Improved Food Security**

Knowledge about iterative and transformative technologies, such as the recent technological changes in agriculture, accumulates incrementally over many years. Articles in the early to mid-1980s described the process of how one might genetically transform plants. These scientific publications have continued, providing more information and greater details about how to insert or activate new traits into plants. By the mid to late-1990s, new articles began to appear that attempted to estimate the effects of this technology on consumers, producers, and industry, both in developed and developing nations. This was matched by a flurry of work on consumer responses, intellectual property, regulatory frameworks, international trade impacts, bio-safety assessments, and adoption benefits and many other topics.

The current narrow set of metrics for the assessment of innovation and the resulting social and economic benefits from agricultural biotechnology research is incomplete and often misleading. These measures simply define the tip of the innovation iceberg; most of the critical processes, outcomes, and impacts remain uncharacterized or ignored. The methods and models that have been developed and tested must ultimately be grounded in measures that better capture social causes and effects of innovation. The advent of boundary-crossing science and technology that destabilizes the regulatory environment, together with awareness of the far-reaching social and environmental effects of innovation, increases the demand for meaningful measures of innovation (Phillips et al., 2012).

**Improved communication clarity**

While it is possible to argue that we have evolved from finger painting on cave walls, the reality is that we have not evolved a great deal. Almost all of the communication by academics remains between themselves through the publication of peer-reviewed journal articles and academic books and book chapters. Essentially, academics talk among themselves and little of the information contained within the research articles is communicated with the broader public. Oblivious to the change in communication from print media to social media, present day academics struggle to find ways to meaningfully engage with the public about the impacts and benefits of science and agriculture. All the while, critics of biotechnology have masterfully managed the use of the communication mediums to manipulate the public.

Today’s youth communicate via Twitter, memes, podcasts, Snapchat and other forms of social media and media on demand. Most of these venues of communication will be hieroglyphics to most academics. Today, information is exchanged in real time, and there is a noticeable absence of the academic voice. The fault is twofold. First, many academics simply have no interest in engaging in communication mechanisms that stray beyond the classical publication of articles, books, and book chapters. Indeed, if nearly 90% of AAAS scientists think GM crops are safe, but fewer than 40% of American people agree, something is amiss (McFadden, 2016). Second, and more importantly, is that academics are not remunerated for this type of engagement, and therefore, there is no incentive for them to do so (Ryan and Doerksen, 2013). The argument that academics are not compensated for engaging is a weak one as ensuring that they do engage is an essential part of self-preservation. User demands are driving the provision of any number of products and services, and in just a matter of a handful of years, students will be demanding more engaged faculty to teach their courses.

**Developing country adopter experiences**

There have been numerous academics based at universities in Europe and North America who have collaborated with academics in developing countries to measure and quantify the impacts and benefits following the adoption of a GM crop, with the results published in academic journals. While this is useful in telling the broader story about the global benefits of GM crop adoption, it comes up short in communicating the personal or farm level benefits of the small landholder that has adopted the GM crop.

It is evident in grocery stores that the retail industry has moved toward greater use of provenance to promote many of the products available on store shelves. Consumers are able to scan signage or labels that provide them with trace back information regarding a steak, pork chop, or chicken breast. This is also possible for fruits, vegetables, and other produce. Consumers are seeking and demanding greater context about where their food has originated and how it has been produced or processed prior to arriving at their particular grocery store. The technology is already in place—all that would need to be done is to have a farmer in a developing country be videotaped highlighting the benefits to his or her farm from adopting a specific GM food crop. Consumers are
Rigorous enforcement of food labeling standards

The food label is a key point of contact between the producer and consumer. The challenge is that there are numerous efforts to mislead consumers through the use of food labels that misinform. Examples such as the application of a verified non-GMO label on products such as cherry tomatoes or wheat cereals made only with wheat are subtly designed to mislead consumers into thinking that there are GM versions of cherry tomatoes or wheat. Neither is available in any market at a global level. Another example is the application of a verified non-GMO label to salt—the president of the company engaged in this misleading labeling has indicated that consumers will pay more for a product that is labeled as non-GMO or GMO-free (Brat, 2015).

Regulators indicate that this is a “gray area” when it comes to complying with domestic labeling legislation as the legislation does not explicitly prevent this. This is, of course true, but by not rigorously enforcing intentional mislabeling of products, regulatory agencies are complicit in the campaign to further misinform consumers about GM food products. Clear, precise regulations and food labeling standards would greatly benefit consumers so that they know exactly what foods have been genetically modified and which have not.

Summary

Twenty years of commercial GM crop production has delivered resounding evidence that the technology benefits small landholder farmers, increases farmer profits, and is environmentally sustainable. The environmental efforts vested against this have boxed themselves into a corner as after decrying and railing against GM crops, they suddenly cannot now acknowledge that there are benefits created by GM crops. In this age of instant communications, any eNGO changing its message would risk instantly losing global credibility, not just on GM crops, foods, and biotechnology, but on their entire environmental portfolio. Trumpeting the dangers and hazards of GM crops is far too lucrative a business for the eNGOs to walk away from.

Wesseler and Zilberman (2014) assess the foregone health benefits from delaying Golden Rice in India. Golden Rice fortifies rice with vitamin A, and its consumption can prevent blindness and even death. Indian government requests to allow field tests for Golden Rice variety cultivation have been denied since 2002. The authors conclude that foregone benefits are at least US$1.7 billion or about US$200 million per year and may have resulted in at least 1.4 million cases of unnecessary blindness. Continued eNGO opposition can now be measured in lives lost due to their political anti-science stance.

To tilt the scales back toward balance, the agriculture and food industry needs to transform how it engages with consumers. If it does not do this, and do this quickly, all of the benefits identified above will be lost as farmers will be forced to return to older technologies that are lower yielding and have higher environmental impacts. The impact for the future of food security of such a radical change in course would simply be devastating.

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