Rivista FORMAZIONE LAVORO PERSONA

Anno V– Numero 14

The GM Food debate within responsible innovation.

Il dibattito sugli OGM all'interno di un'innovazione responsabile.

JONATHAN HANKINS

In the present and recent past, the debate around the genetic modification of foodstuffs for both human and animal consumption has become so polarized that it is difficult even to refer to it as a debate any more.
The aim of this essay is to analyze the debate in terms of its importance for the rapidly expanding field of Responsible Innovation. Issues surrounding the development of this (GM) issue are often cited in responsible innovation literature, as rightly or wrongly the current position is seen as non productive for all sides. This has lead to the GM case often being taken as an example of how an RI approach could improve stakeholder representation within scientific development.

This essay presents the argument that the polarization of positions has created a vicious and self replenishing cycle. Information is primarily published by interested parties, for example companies promoting GM as a good for society, or organizations opposed to the development of the technology on moral or ethical grounds. This systematic tit for tat propaganda approach has left little or no space for debate. There are few sites of real exchange, leading to a strengthening of polarized positions, and away from a constructive discussion about the pros and cons of such technology.

An introduction to GM foods

The following is a brief review of information garnered from various websites that describe what genetic modification actually is. This I believe is the starting point for many lay people's interest in the matter. The texts are all aimed at a non scientific audience.
In relation to the biggest GM crops, soybean, cotton and corn, there are 2 distinctly different approaches. The first is herbicide tolerance (HT) and the second insect resistance (Bt). In other cases nutritional changes have been made, but the major cash crops are based around the following approaches.

Herbicide-tolerant (HT) crops are developed to survive application of specific herbicides that previously would have destroyed the crop along with the targeted weeds. So farmers can plant seeds and spray a herbicide that kills everything apart from the desired crop.
Herbicides target key enzymes in the plant's metabolic pathway, which disrupt plant food production and eventually kill it. Genetic modification creates a degree of tolerance to the broad-spectrum herbicides – in particular glyphosate and glufosinate – which will control most other green plants.

1. Glyphosate-tolerant crops Glyphosate herbicide kills plants by blocking the EPSPS enzyme, an enzyme involved in the biosynthesis of aromatic amino acids, vitamins and many secondary plant metabolites. There are several ways by which crops can be modified to be glyphosate-tolerant. One strategy is to incorporate a soil bacterium gene that produces a glyphosate-tolerant form of EPSPS. Another way is to incorporate a different soil bacterium gene that produces a glyphosate degrading enzyme.
2. Glufosinate-tolerant crops Glufosinate herbicides contain the active ingredient phosphinothricin, which kills plants by blocking the enzyme

responsible for nitrogen metabolism and for detoxifying ammonia, a by-product of plant metabolism. Crops modified to tolerate glufosinate contain a bacterial gene that produces an enzyme that detoxifies phosphonothricin and prevents it from doing damage.

The developers argue that use of this type of seeds cuts fuel usage and tilling as there are fewer weeds, (tilling leads to top soil loss as it is blown in the wind). They also argue that GM production has led to less herbicide use, but that may not be the case for long (if at all).

Unfortunately one effect of this mass usage seems to be the development of 'superweeds', that are becoming resistant to theses herbicides. Farmers have had to address this problem by using more and different types of herbicide as I will later describe.

Insect-resistant crops containing the gene from the soil bacterium Bt (Bacillus thuringiensis) have been available for corn and cotton since 1996. These bacteria produce a protein that is toxic to specific insects. Instead of the insecticide being sprayed, the plants produce the bacteria so insects eating the plant die.

There are risks associated with this approach as well as the advantage that farm workers are not exposed to spraying insecticides.

Invasiveness – Genetic modifications, through traditional breeding or by genetic engineering can potentially change the organism to become invasive. Few introduced organisms become invasive, yet it's a concern for the users.

Resistance to *Bt* – The biggest potential risk to using *Bt*-crops is resistance. Farmers have taken many steps to help prevent resistance but as in the previous case it is a potentially serious problem.

Cross-contamination of genes, genes from GM crops can potentially introduce the new genes to native species.

Much of the recent dramatic growth in GM usage can be attributed to the development of plants that offer both of these systems.

An Introduction to Responsible innovation

Responsible Innovation (RI) is a rapidly developing field of both action and study. Previously virtually unheard of, now definitions abound, and there is a rapidly expanding body of literature both from academic and non-academic sources[1]. One of the most commonly cited definitions is that of Rene' Von Schomberg:

> Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)[2].

As we see, this definition (like many others in use today), seems to view innovation as involving science, technology, or industrial production. It involves distribution and supply process, and an end product. This very much reflects the route that current RI investment and research is taking. Current research includes placing social scientists into laboratories to enhance the scientist's own understanding of the complex consequences and ripple-effects of their innovations, as well as suggestions for ethical frameworks to bring RI considerations to bear onto both the funding and research practice areas.

The specific criticism that this article will address relates not only to the definition above but also to one of the tenants of RI as laid out in the Rome Declaration on Responsible Research and Innovation[3], which is itself very much influenced by the literature cited above.

The declaration states that

> RRI requires that all stakeholders including civil society are responsive to each other and take shared responsibility for the processes and outcomes of research and innovation. This means working together in: science education; the definition of research agendas; the conduct of research; the access to research results; and the application of new knowledge in society- in full respect of gender equality, the gender dimension in research and ethics considerations.

A central part of working towards the goals stated above involves stakeholder involvement[4]. In the case of the GM debate, as with many other topics currently forming the RI debate, I would argue that one of the major stakeholders must be seen as the general public. This is due to the irreversible nature of the technology, its possible widespread but almost unseen use, and the often cited rights of consumers to know what they are consuming.
If as argued in much RI literature[5] stakeholder involvement must begin while projects are in their planning stage, it is plain to see that the clock cannot be turned back to create a different scenario, and as a result the GM project cannot be seen as an example of RI. It does however fit some of the criteria offered in the literature[6] in that the project itself is aimed at some form of betterment for human society (or at least can be justified as such). Genetic modification of plant material for bio-fuels production is often offered as an example of how genetic engineering is necessary in the search for a more sustainable fuel production system. It is interesting to note that polarization of positions within this debate is much less fixed than in the use of GM techniques for human (or animal) foodstuff provisioning.

Public Involvement

In the case of GM as noted above) the general public could be seen as a major stakeholder. The problem of GM acceptance is extremely visible in Europe and if constantly under debate regarding legislation[7]. Much of the information presented to the public is available online, a fact that as I argue above contributes to the polarized positioning due to the nature of the hosting partners. Almost all information freely available to the general public (with the exception of academic literature) is hosted on websites that have already well defined views on the topic. The information they choose to share and the style and slant are primarily aimed at influencing the reader's opinion, as I will go on to demonstrate below with some examples.

The Case studies

All of the parties involved in the experimentation and production of GM foodstuffs have high quality glossy websites. Examining them in terms of content is beyond the scope of this essay, but they all argue that GM foods will improve the lives of large populations on Earth. The only mentions of safety are positive, in terms of the safety of their operations, and neither dissenters or the general public at large appear.
Therefore in the following section I would like to review a small section of the more critically worded materials that are freely available online. Although there is a great deal of academic literature available on the Internet, I choose to exclude it for this analysis as I am interested in a general readership perspective, so have conducted my search using Google rather that Google Scholar. As noted above publications from within the industry have also been excluded.
I would first like to present some general Information regarding GM production: If we look at the statistics that the US Department of Agriculture publish as reported by the Organic Consumers Association website[8], we find the following:

93% of soybeans grown in the USA are GM
90% of all corn produced in the US is GM
95% of US sugar beat is GM
40% of all cropland in the US is used for Monsanto (the largest GM seed producer) production
40% of all global GM crops are produced in the US
35% of all the corn grown in the world is GM
81% of all the soybeans grown in the world are GM

The statistics chosen are impressive in their impact factor, but the link between the current situation and the percentages is not developed. The reader can know little about the geographic distribution, amount, uses or type of modification, leading to a skewed communication (I would argue that taken as they are presented, the reader would have difficulty in positively reading these "findings").

If we look at other "news" style presentations we find a journalistic approach to providing information, including the use of inflammatory headlines. In an article entitled *Mexico Confirms GM Maize contamination*[9], an unnamed author writing on SciDev.net states:

> The Mexican government has confirmed earlier reports that transgenic maize is growing within the country's borders and has apparently contaminated wild varieties, despite a national ban on the cultivation of (GM) crops. A government-commissioned study has shown that as many as 95 per cent of maize fields in the Mexican states of Oaxaca and Pueblo contain evidence of GM 'contamination'— the highest level yet recorded.

There is also an explanation of the controversial withdrawal of the claim, but the headline nature of the reporting leaves an overwhelming and lasting impression.
Other articles do report scientific journal articles, the online publication of the journal Nature being one example. In *A Hard Look at GM Crops*[10], Natasha Gilbert argues that one effect of the mass usage of insect resistant GM crops seems to be the development of 'superweeds' that are becoming resistant to theses herbicides (as noted above). Farmers have had to address this problem by using more and different types of spray herbicide, according to a cited Pennsylvania State University research article.
The author describes the academic article's findings stating that pesticide use will increase dramatically in the very near future as a result, questioning the sustainability of the process, with resulting problems similar to the present antibiotics resistance problem that we are seeing in the human population. She also argues that it should also be noted that the use of broad spectrum herbicides has grown as GM usage has grown, as its ease of application using the new seeds has made it more widespread, even though it only needs to be applied once under a GM regime.

Experts and regulation

Issues surrounding regulation and expert involvement are widely available online, and they tend to be extremely critical of the GM industry and regulatory bodies as a whole. In the following section I outline several cases as reported through various websites. The following information is taken from the IVN website[11].
In the USA the Federal Drug Administration is responsible for regulating the safety of GM crops that are eaten by humans or animals. According to a policy established in 1992, FDA considers most GM crops as "substantially equivalent" to non-GM crops. In such cases, GM crops are designated as "Generally Recognized as Safe" under the Federal Food, Drug, and Cosmetic Act (FFDCA) and do not require pre-market approval.
According to the IVN article, over the last decade at least 7 high ranking FDA officials have also held high positions in Monsanto, the largest producer of GM seeds in the world. This is accepted and known as the revolving door in the USA, but it is worthy of exploration.
The website states that

> at the forefront of this controversy is Michael R. Taylor, currently the deputy commissioner of the Office of Foods. He was also the deputy commissioner for Policy within the FDA in the mid '90s. However, between that position and his current FDA position, Mr. Taylor was employed by Monsanto as Vice President of Public Policy. Other Monsanto alumni include Arthur Hayes, commissioner of the FDA from 1981 to 1983, and consultant to Searle's public relations firm, which later merged with Monsanto. Michael A. Friedman, former acting commissioner of the FDA, later went on to become senior Vice President for Clinical Affairs at Searle, which is now a pharmaceutical division of Monsanto (incidentally Donald Rumsfeld ex Secretary of Defense was also on the Board of Directors). Virginia Weldon became a member of the FDA's Endocrinologic and Metabolic Drugs Advisory Committee, after retiring as Vice President for Public Policy at Monsanto.

Another controversy surrounded the appointment of Margaret Miller. The following is taken from Red Ice Creations website[12]:

> In order for the FDA to determine if Monsanto's growth hormones were safe or not, Monsanto was required to submit a scientific report on that topic. Margaret Miller, one of Monsanto's researchers put the report together. Shortly before the report submission, Miller left Monsanto and was hired by the FDA. Her first job for the

> FDA was to determine whether or not to approve the report she wrote for Monsanto. In short, Monsanto approved its own report. Assisting Miller was another former Monsanto researcher, Susan Sechen.

The article states that

> Monsanto received copies of the position papers of the EC Director General for Agriculture and Fisheries prior to a February 1998 meeting that approved milk from cows treated with BST. Notes jotted down by a Canadian government researcher during a November 1997 phone call from Monsanto's regulatory chief indicate that the company 'received the [documents] package from Dr Nick Weber', a researcher with the US Food and Drug Administration (FDA). Sources noted that Weber's supervisor at the US FDA is Dr Margaret Mitchell who, before joining the agency, directed a Monsanto laboratory working on the hormone.

The question of who should or could actually regulate GM research is however never raised, and no alternative to the system offered, although the language used is extremely accusatory.

New Developments, The Nanomaterials in Food Debate

Recently a similar debate has been developing surrounding the use of nanomaterials in foodstuffs. The forum is very similar to that described above however, with online authors offering one-sided arguments.
Friends of the Earth US have recently published a report entitled *Tiny Ingredients, Big Risks*[13]. The report states that:
There has been a ten fold increase in unregulated and unlabeled nanofoods over the last 6 years; nanomaterials are found in a broad array of everyday food (cheese, chocolate, breakfast cereals etc); major food companies are investing billions in nanofood and packaging; an increasingly large body of peer reviewed evidence indicates that nanomaterials may harm human health and the environment; nano agrochemicals are now being used on farms so entering the environment; US regulation is wholly inadequate; public involvement in decision-making regarding these problems is necessary.

The article states that products containing unlabeled nano-ingredients range from Kraft American Singles to Hershey's chocolate. They are made by major companies including Kraft (KRFT), General Mills (GIS), Hershey (HSY), Nestle (NSRGY), Mars, Unilever (UL), Smucker's (SJM) and Albertsons. But due to a lack of labeling and disclosure, a far greater number of food products with undisclosed nanomaterials are likely currently on the market.
The report documents 85 food and beverage products on the market known to contain nanomaterials — including brand name products, and points out that the nanofood industry will soon be worth $20 billion.
This is a detailed report, it lists many of the the products that have been found to contain these materials, the (reported) health problems associated with ingestion of such materials in animals and calls for action. As we would expect from Friends of the Earth it is a single minded argument however. There is no discussion about why companies are choosing to proceed in this way, or detailed analysis of health risks. It is however convincingly written but with a clear agenda to shock.

Concluding Remarks

In this essay I have argued that without an impartial forum within which GM and other food technology issues can be debated, arguments on both sides will become and remain polarized. Form an RI perspective the need for open public debate is paramount, and many lessons can be learned from the current GM situation.
The current situation regarding the state of the debate is problematic on many levels. The public voice is not heard, almost all information is political in nature and has clear and explicit aims and goals, there is little or no referencing making reports difficult to compare, verify and credible from an academic perspective. Information such as that above about the actual nature of GM processes is much more difficult to find online than the later news style stories, and the language is more difficult to understand, a fact that must influence the level of understanding held by any lay member of the public. The reports are much more visible and are presumably read by people who have little understanding of genetic modification, it's aims, and the

scientific process that underpins it. The aim of this essay is not however to criticize these reports from an academic perspective, but to raise the problem of the polarizing nature of the system as it exists today.

Above I have offered several examples that I see as typical of the issue today. Obviously these examples are not meant to be exhaustive, nor to express criticism regarding the viewpoints represented. The aim is merely to demonstrate the structural form of the current debate, and the problems that it represents for an RI approach.

For those of us working within the RI community, the issue of non political and open debate is fundamental, especially if the GM debate is to become less radicalized and this situation is to be avoided in the future. I argue the need to bring all parties to the debate, in an open and non politicized forum, in which all stakeholders have equal representation.

JONATHAN HANKINKS

jonnyhankins@hotmail.com

Dottorando (Fondazione Bassetti) in Formazione della Persona e Mercato del Lavoro, Università di Bergamo
Ph.D. student (Bassetti Foundation), Human capital formation and labour relations, University of Bergamo

[1] Cfr. R. Owen, J. Bessant, M. Henitz (Eds.), *Responsible innovation: Managing the Responsible Emergence of Science and Innovation in society,* Chichester, Wiley 2013; H. Sutcliffe, *A Report On Responsible Research and Innovation*, Prepared for DG Research and Innovation, European Commission, 2013; X. Pavie, V. Scholten, D. Carthy, *Responsible Innovation: From Concept to Practice*, World Scientific Publishing Company Incorporated, Singapore 2014.

[2] R. Von Schomberg, *Prospects for Technology Assessment in a framework of responsible research and innovation*, in M. Dusseldorp, R. Beecroft (Eds.), T*echnikfolgen abschätzen lehren: Bildungspotenziale transdisziplinärer Methode*, Springer, Wiesbaden 2011, p. 48.

[3] The Rome Declaration on Responsible Research and Innovation in Europe was published under the auspices of the Italian Presidency of the Council of the European Union, 21st November 2014. http://ec.europa.eu/research/swafs/pdf/rome_declaration_RRI_final_21_November.pdf

[4] Cfr. R. Owen, J. Bessant, M. Henitz (Eds.), *Responsible innovation*, cit.

[5] J. Hankins, *A Handbook for Responsible Innovation*. Bassetti Foundation Books, Milan 2012.

[6] V. Sutton, *Hydrogen: A model for Regulating Emerging Technologies in Innovation and Responsibility: Engaging with New and Emerging Technologies*, in C. Coenen, A. Dijkstra, C. Fautz, J. Guivant, K. Konrad, C. Milburn, H. Van Lente (Eds), *Akademische Verlagsgesellschaft,* AKA GmbH, Berlin 2014.

[7] See the European Commission GMO portal for details: http://ec.europa.eu/food/plant/gmo/new/index_en.htm

[8] http://www.organicconsumers.org/articles/article_28059.cfm

[9] http://www.scidev.net/global/gm/news/mexico-confirms-gm-maize-contamination.html

[10] http://www.nature.com/news/case-studies-a-hard-look-at-gm-crops-1.12907

[11] http://ivn.us/2013/02/11/the-revolving-door-fda-and-the-monsanto-company/

[12] http://www.redicecreations.com/specialreports/monsanto.html

[13] http://www.foe.org/news/news-releases/2014-05-new-report-tiny-ingredients-big-risks