

Harvey, Mark

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# **Genetically Modified Food: A Suitable Case for an Economic Sociology Treatment**

by

Mark Harvey

Senior Research Fellow, ESRC Centre for Research in Innovation and Competition

University of Manchester and UMIST

[Msrpsmh@fsl.ec.man.ac.uk](mailto:Msrpsmh@fsl.ec.man.ac.uk)

## **Introduction**

There can be little doubt that the unfolding potential of recombinant DNA science and technology on food and agriculture has a revolutionary significance, whose contours are as yet difficult to discern (Rifkin, 1998; Bonanno et al, 1994; Busch et al, 1991; Harvey 1999a, b). Both the nature of the food we eat and agricultural production is open to radical transformation. Food products can be modified in ways heretofore impossible in terms of their nutrient, pharmaceutical, and aesthetic (taste, colour, shape, density) properties. Likewise, modes and locations of cultivation, some of which have endured for centuries, can be fundamentally changed in terms both of the currently dominant agro-chemical practice, and of crops raised.

In the current hysteria, it is important to be clear about the agricultural significance of genetic modification, especially given Greenpeace's website banner headline of 'NO GENETIC MANIPULATION OF NATURE'. First, there has been effectively no 'natural' natural selection involved in agriculture for as long ago as the first domestication of cultivated crops many millennia ago. Genetic modification is succeeding scientific hybridisation, now also using recombinant DNA technology, and not replacing 'natural' species. Second, what is radically new compared with hybridisation is that plant properties can be transformed which allow crops to grow in hitherto hostile climates and soils<sup>2</sup>. Third, it is replacing a dominant agro-chemical based agriculture, with either a more targeted use of pesticides, or potentially pest-resistant strains which promise a high technology route to eco-sustainable agriculture. Again, genetic modification cultivation is not replacing a more 'natural' method of farming. The 'organic' option remains a marginal activity in advanced agricultural economies with consumers who have high levels of disposable income.

## **The Challenge for Economic Sociology**

If we stand at the threshold of a GM revolution in food and agriculture – or even if, as its opponents dream, we witness its suppression – the story so far presents a challenge to social analysis and invites an integrated and synthetic approach afforded by economic sociology. For it is clear that the forces shaping both the development of science and technology, and the markets, firms and products are diverse. Volatile share value fluctuations, a flurry of mergers and acquisitions, the restructuring of many major companies, demonstrate the significance of the economic dimensions. The evolution of often conflicting regulatory frameworks, disputes over market rules on segregation and labelling, skirmishes in the WTO, all manifest the

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<sup>2</sup> The work of the Mexican scientist Luis Estrella has developed plants tolerant to soils with high aluminium content which affect 40% of the cultivated land in the tropics and sub-tropics, and which currently reduce yield by up to 80%.

formal institutional role as a major shaping force. Governmental policy, political alliances, consumer organisations, supermarkets outcompeting each other in claims to being more ‘natural’ than thou, disparate interest groups from Prince Charles to Genetix Snowball, exert ‘political’ influence. Last, but not least, plants themselves have a ‘voice’. The biological has to be a central part of the picture given the way that GM is changing the interface between cultivated and non-cultivated nature. Moreover, GM is modifying plants (and animals), not modifying the laws of nature. Despite the hyperbole of infinite malleability – on either side of the divide over GM – GM products must be biologically viable and in terrestrial environmental conditions. So an adequate explanation of these historic changes has to embrace very diverse shaping forces – economic, institutional, political, and ecological. That is the challenge.

The approach adopted here is that of ‘instituted economic process’ (IEP)<sup>3</sup>, first enunciated by Polanyi (1957, 1944). Two key components of this type of analysis can serve our purposes here. The first is one of how distinctively *economic* processes become instituted. Perhaps the most important instances of this relevant here are how biological entities, specifically genetically modified ones, become tradable goods; and how ‘economies of knowledge’ are established which distinguish public knowledge from tradable knowledge. How will the divide be made between public or privately owned genomic knowledge? This first aspect thus concerns ‘the study of the shifting place occupied by the economy in society’ (Polanyi, 1957, 250). The second key component is one of how, once instituted as economic, those economic processes and markets for GM crops and foods develop. Here, central issues concern how biotechnology companies have split so separating pharmaceutically-oriented from agricultural- and food-oriented genetic modification economic activity, and how markets and tradable GM goods co-evolve in different ways in different parts of the globe. These two key analytical components of how the economic is institutionally separated from the non-economic, and how processes are instituted within the economic, are quite ‘dialectical’, in the sense that the latter economic processes are clearly affected by how and where the separation between economic and non-economic occurs. Thus, for example, what goes on within the market for tradable GM goods is affected by where the boundary is set for tradable and non-tradable bio-informatics.

It should be noted that this approach facilitates the entry of the biological into the overall analysis, and allows us to operate beyond a simple nature-culture dualism which distorts so much of current debate around GM. Much biological diversity (notably all directly cultivated species) is ‘economically instituted’ bio-diversity. Many species either could not or do not reproduce themselves by ‘natural’ sexual reproduction without human assistance. Most currently cultivated species exist biologically only in relation to the specific products for which they are destined. For example, hybridisation has successively created different varieties of tomato each dedicated for tomato ketchup since the 1870s, the latest being patented by Heinz in 1994, the H9382 ketchup tomato, using recombinant DNA markers<sup>4</sup>. In

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<sup>3</sup> In Polanyi much was unclear about how this approach of instituted economic process related to the much more commonly referred to concept of embeddedness. In my view, IEP is much the most radical view because it allows all economic processes, capital accumulation, labour, price, supply, demand, markets, etc. to be viewed as instituted, and hence socially and historically variable. This contrasts with an ‘embeddedness’ approach where the social is seen as contextualising (Granovetter, 1985) the economic, or even dissolving the economic (Callon, 1998). An IEP approach takes the economic as economic, but no less instituted for that, even, and indeed especially, when ‘dis-embedded’.

<sup>4</sup> To avoid confusion, it should be stressed that this is using recombinant DNA technology for hybridisation and *not* genetic modification.

this context, therefore, GM varieties constitute a new range of economically instituted biodiversity.

### **Genetic Modification as a Bio-socio-economic Process**

The analysis below arose out of a case study<sup>5</sup> of the emergence of a particular GM product, genetically modified tomato purée, and the correlative formation of a distinctive market, followed by the disappearance of that product, and the collapse of a carefully constructed market. Unavoidably, the analysis involved consideration of other, perhaps more typical, broad acre crops, and consequently a central part of the story necessarily has to consider two very different strategies, and their ensuing conflict: Zeneca with its tomato purée and Monsanto with its RoundUp Ready GM soya bean. Here only some of the broad results of the study are summarised in order to illustrate the kind of explanation generated by it.

### **The Rise of GM Tomato Purée**

Let us begin with some simple ‘economic’ facts. In 1996 Sainsbury and Safeway supermarkets began selling, in clearly labelled and advertised cans, genetically modified tomato purée. It can be said to be the world’s first – and as yet only – genetically modified product where the aim of the modification was to improve the final product as well as facilitating food processing, as against modification whose primary aim is directed towards agribusiness and cultivation regimes. Before it was banished from supermarket shelves in 1999, it sold two million cans, at 15% lower price, and was chosen in preference by consumers whose only complaint, according to company commissioned surveys, was that the purée was in cans not tubes.

But the appearance of a standardised can, with clear labelling, under the own label colours of major supermarkets, was the outcome of a highly contingent, complex, and long term process which was initiated over 20 years previously. Here, four major aspects determining this trajectory are noted.

- *Production cultures and plants.* Like Monsanto, Zeneca as a biotechnology company also involved in the production of agrochemicals, spent a lot of capital during the 1980s purchasing seed companies for broad acre crops. But the tomato was already genetically particularly well known from hybridisation experience, and in its developmental pattern peculiarly lent itself to fundamental experimentation. Consequently, Zeneca in 1975 began a collaboration with Don Grierson at Nottingham University, to explore genetically modified tomato. At the same time Calgene (later acquired by Monsanto) in the US was also interested in developing the same technology. The technology involved modifying and slowing the ripening process. In the US, distinctive varieties of tomato had already long been developed for an industry based on mechanical harvesting of semi-ripe fruit. In Northern Europe, tomatoes are grown horticulturally, under glass, and are hand picked when ripe. These can be seen as two quite distinctly instituted production cultures, growing distinctive instituted biological varieties. In 1984, Zeneca and Calgene cut a deal in which Calgene would develop the GM technology for fresh

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<sup>5</sup> The full version can be found in my (1999b). The research involved in-depth interviews with key strategic players, the scientists in universities and companies, the biotechnology companies, supermarkets, and seed companies, as well as food manufacturers and processors. The research on the GM tomato is part of a much bigger project which used the ‘tomato’ as an empirical probe to analyse major transformations of production, distribution, retail and consumption over the past century, and was conducted together with my colleagues Huw Beynon and Steve Quilley (Harvey et al, forthcoming.)

tomatoes (the Flavr Savr) which suited US production culture, and Zeneca would use it for processed tomato. Both plant and production cultures fundamentally affected the economic deal which separated the markets for two distinct GM products.

- *Funding.* The nature and sources of funding of product development and fundamental research in biotechnology is fundamental to the diverse trajectories of GM markets and products. Funding is both critical and a clearly ‘instituted process’ which more or less sharply divides the ‘public’ from the ‘private’ economy. Here a first major point of contrast can be drawn between Zeneca and Monsanto. From the beginning, Zeneca attracted governmental finance, first from the UK and then from the European Commission, and R&D was throughout a process of intense collaboration between public science infrastructure in universities and private research laboratories. Zeneca operated on an ‘open laboratory’ basis with its public sector collaborators. By contrast, Monsanto funded its research exclusively from internally generated profits from its agrochemicals business, and notably from glyphosate, the RoundUp Ready insecticide, which the GM soya bean was designed to tolerate, and whose patent, hence rent generating capacity, is about to expire. In this sense Monsanto’s GM project was much more closely bound up with its agrochemical business. For ‘second generation’ genetic modification, which enhances nutrient or pharmaceutical properties of food (Nutrient Dense Foods), Zeneca acquired European Commission funding, on condition of demonstrable health benefits. It is also worth noting that ‘golden rice’ with enhanced vitamin A was developed by Potrykus with Rockefeller Foundation, EC and Swiss government funding. Thus different trajectories of GM technology can be seen to be affected by the public-private relationship, and related income sources.
- *Regulatory regimes.* The only Californian tomatoes to enter UK supply chains were those grown for Zeneca’s GM purée. One of the major reasons for this was the relative ease, due to lack of complexity as much as to stringency, of the US regulatory system for GM food and cultivation. However, regulatory systems are themselves shifting entities, very much moulded by the economic developments with which they interact. Labelling and segregation of GM food has now become mandatory in UK and other European countries, whereas, for reasons we shall see below, was absent in US food regulation. A further key aspect of regulation has involved differences in patent regimes, where the US have lower levels of prescription in terms of definition of end use of an innovation. This has had fundamental effects in the nature of biotechnology firms and of the goods they trade. The tomato gene construct (for polygalacturanase) was patented without definition of end use in 1987 in the US, and companies hence trade in licenses for its use.
- *Inter-sectoral power relations.* One of the starkest differences between Monsanto and Zeneca is that the latter was engaged with retail supermarkets four years prior to launching their GM product, in a co-operative exercise to construct the rules of the new consumer market, including labelling and segregation of GM material. It is scarcely an exaggeration to say that Monsanto did not even consider consumer markets, but was exclusively oriented to agribusiness. This reflects deep seated, ‘instituted’ differences in power relations between agribusiness, manufacturing,

and food retailing in the US and UK. In the UK, especially in the last 30 years, supermarket retailers have exercised unprecedented power over supply chains. In these circumstances, it is significant but unsurprising that the first GM products appeared in Sainsbury and Safeway livery.

### **The Fall**

If the co-evolution of GM product and markets was a result of a complex interaction between plants and production cultures, revenue flows, regulatory regimes, and sectoral power relations, the disappearance of those markets is equally complex. Again four major heterogeneous aspects can be discerned.

- *Food scares and science.* In the UK, the experience of a succession of food scares, salmonella, listeria, e-coli, and above all BSE created a climate of suspicion. Industrial food systems in which technology seemed to become increasingly 'un-natural', especially making cows into cannibals, provoked a reaction. Conflicting and contradictory scientific advice from various sources fed into a more widespread growth of scepticism towards science, which was easily mobilised by anti-GM propaganda.
- *Political configurations.* Strange alliances emerged between radical eco-warriors, Greenpeace, Prince Charles, the Royal Society for the Protection of Birds, the Church (which holds a lot of land) and the Soil Association. A new form of 'nature fundamentalism' arose which constructed a contingent linkage between defence of nature against human interference and the organic farming lobby. Opportunistically, the power of the supermarkets was reversed from promotion to rejection of GM almost too quickly for them to clear their shelves. Once one supermarket led the stampede, all others had to occupy the same nature-moralistic high ground, coincidentally expanding their organic range of food at much higher profit margins.
- *The clash of regulatory regimes.* Zeneca had decided early on that bringing produce from one regulatory regime into another was likely to be unsustainable. But the clash between regulatory regimes over segregation and labelling created enormous market turbulence. A more profound clash of production cultures, between an agribusiness-oriented Monsanto and a more consumer-oriented Zeneca, however, contributed significantly to the at least temporary destruction of the market for GM produce in the UK.
- *Capital markets and biotechnology companies.* The impact of this multifaceted market disturbance took on its own logic within capital markets, especially when the world's largest bank, Deutsche Bank, advised dis-investment from the biotechnology companies involved in GM, and declared 'GMOs are dead' (August 1999). The consequences for the future of recombinant DNA science and technology have been profound. Pharmaceuticals have been detached from agribusiness and GM foods, and genomics likewise has split into a distinct trading area. Sector restructuring and firm organisation has been fundamentally altered so that these different developments of the same underlying science are now economically instituted in a new corporate division of labour.

### **Conclusion**

The dramatic rise and fall of GM markets in Europe can be seen as a complex and contingent process which involves the interaction of many different causal domains: biology, economics, law, regulation, politics. Complexity and contingency, however, should not stifle the search

for adequate explanation. An IEP approach has been suggested as a way in which the properly economic can be analysed in its interactions with other causal domains, on condition that the economic itself is seen to be variously instituted and as a separate domain with shifting boundaries. Turbulence in Europe and advanced economies may well presage a fundamental shift in the centre of gravity for this biotechnology revolution to China, India, and South America.

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