Available online at www.sciencedirect.com
ScienceDirect
Food Policy 31 (2006) 570–591
FOOD POLICY

FDA's regulation of genetically engineered foods: Scientific, legal and political dimensions

David L. Pelletier *

Division of Nutritional Sciences, Cornell University, 378 MVR Hall, Ithaca, NY 14853, United States

Abstract

The controversy over genetically engineered (GE) food during the southern Africa drought in 2002/03 raised questions concerning the safety of GE foods and the basis for the safety assurances issued by national and international agencies. In the case of foods grown in the US, these assurances must be interpreted in relation to the Food and Drug Administration's (FDA) 1992 policy, which remains in effect today. This paper provides a detailed examination of the roles of scientific, legal and political considerations in the development of that policy.

This paper reveals that the FDA responded to political pressure for a permissive regulatory approach by exploiting gaps in scientific knowledge, creatively interpreting existing food law and limiting public involvement in the policy's development. Common statements by the government and other proponents concerning sound science, rigorous testing, no evidence of harm and "as safe as conventional foods" are found to be misleading unless the scientific, legal and political basis for the US policy is taken into account.

While this paper finds that the evidence for the safety of GE foods has been exaggerated by government agencies and other parties, nothing in this paper suggests that GE foods currently on the market are harmful to human health. To the contrary, the situation is one of great uncertainty. Repeated recommendations that this issue be the topic of a major public research effort have yet to be acted upon.

Keywords: Biotechnology; Risks; Benefits; Food safety; Scientific evidence; Developing countries

* Tel.: +1 607 255 1086; fax: +1 607 255 0178.
E-mail address: Dlp5@cornell.edu.

Introduction

Agricultural biotechnology has the potential to address many of the agricultural, environmental, economic and nutritional problems of developing countries (Persley and Lantin, 2000; Food and Agriculture Organization (FAO), 2003). This includes the potential to address production constraints such as drought, salinity and pests; to reduce or eliminate the need for pesticides and other agricultural chemicals; to increase yields and reduce post-harvest losses and production costs in small- and large-scale agriculture; and to improve micronutrient content, bioavailability and other nutritional properties of important staple crops. For this reason, agricultural biotechnology is becoming an important element of international and national agricultural research and policy (Biotech Watch, 2004; Cohen, 2005).

While these potential benefits are widely acknowledged, this new technology also has raised a number of concerns. These include concerns related to food safety, unintended environmental impacts, biodiversity in agriculture, trade and the ownership and control of seeds, intellectual property and global food production (Altieri and Rosset, 1999; Paarlberg, 2001).

The sheer breadth of these concerns create serious difficulties for developing countries to develop national policies that are well-informed and consistent with their own goals and policies regarding agriculture, trade, environment, nutrition and the protection of human health. A further complication is that major foreign assistance and trading partners, notably the US and the EU, each have their own vested interests in maintaining, justifying and promoting either a supportive or precautionary stance toward these new technologies and their regulation.

These difficulties were illustrated in a vivid fashion during the controversy in 2002/03 over GE food aid during the southern African drought, when African policy makers were faced with conflicting views concerning the safety of GE maize for human consumption.[1] During that crisis the US, FAO, WHO and WFP sought to reassure African governments that GE food is as safe as conventional food, on the basis of scientific evidence and rigorous food safety standards (United Nations (UN), 2003; United States Department of State, 2003). Among the statements made at that time are the following:

> ''With respect to GM maize, soy flour and other commodities containing GMO's, FAO and WHO are confident that the principal country of origin [the US] has applied its established national food safety risk assessment procedures. [ ] The organizations confirm that to date they are not aware of scientifically documented cases in which the consumption of these foods has had negative human health effects.'' (United Nations (UN), 2003)
>
> ''All of the bio-engineered crops that are currently planted in the United States have been rigorously reviewed for environmental and food safety by all relevant regulatory agencies [ ]. To-date, scientific evidence demonstrates that these commercially available bio-engineered commodities and processed foods are as safe as their conventional counterparts. The food safety assessments were conducted to evaluate

[1] GE (genetic engineering) is the particular form of genetic modification (GM) and agricultural biotechnology that involves the inter-generic transfer of genetic material across life forms and is the primary focus of public controversy. GE is the technology examined in this paper.

potential risks for the multi-ethnic US population, and the United States is not aware of any reason to suggest that these foods would be unsafe for populations in other countries." (United States Department of State, 2003)

As the potential humanitarian crisis continued to unfold and some African countries remained undecided whether to accept the GE food aid, the following reassurances of safety were issued from the highest level of the US government:

"Overwhelming scientific research shows that biotech foods are safe and healthy – a conclusion that the EU's own Directorate-General for Research reached two years ago." (Robert Zoellick, US Trade Representative, in Wall Street Journal, 2003)
"Yet our partners in Europe are impeding this [relief] effort. [ ] They have blocked all new bio-crops because of unfounded, unscientific fears." (President Bush, in New York Times, 2003)

Despite the reassuring reference to *scientific evidence and rigorous safety assessments*, as seen in these and other statements, the reality is that these statements cannot be properly interpreted without understanding the *legal standards and procedures* for food safety determinations in the US and the ways in which these were adapted to the case of GE foods.

In an effort to assist policy participants in the US and other countries in interpreting such statements and the actual basis for US policy, this paper describes how scientific, legal and political considerations were co-mingled when the US Food and Drug Administration (FDA) developed its Statement of Policy regarding GE foods in 1992.

Because of the focus on legal considerations and political claims made concerning the safety of GE foods, direct quotes are used as a primary source of data in this paper. This paper is the third in a series on this topic and begins with a summary of key findings from the first two papers. Readers are encouraged to consult the other papers for further details (Pelletier, 2005a,b).

It is important to note that, despite the reference to the southern African controversy above, this paper is *not* an examination of the safety of the particular commodities being used in US food aid at that time, nor is it an examination of the appropriateness of the decisions made by African governments in the region. Rather, this paper adopts the longer-term perspective that GE foods are likely to become an increasingly prominent part of world food supplies in coming decades, with literally hundreds of genetic transformations introduced in order to produce crops with desirable agricultural, environmental and/or nutritional properties. It is within this context that this paper seeks to clarify the scientific, legal and political basis for FDA's 1992 policy on GE foods and the ways in which this policy may or may not be adequate for assuring the safety of this wide variety of GE foods in coming decades. The implications of these considerations for Southern Africa itself are examined elsewhere (Pelletier, 2005c).

Scientific considerations, evidence and uncertainty

From a scientific perspective the safety of GE foods involves two distinct questions: First, does the *inserted* DNA and/or its *intended* expression product or *intended* compositional changes raise concerns for nutritional content, toxicity or allergenicity. Second, does the *insertion* of DNA cause any *unintended* changes in nutritional content, toxicity or allegenicity by disrupting or altering the function of non-target genes (insertional

mutagenesis) or altering the chemical composition of food via interdependent metabolic pathways (pleiotropy). In its Statement Policy, FDA considered both of these as scientifically plausible and provided a series of decision trees to guide developers of GE foods in their pre-market safety assessments (FDA, 1992).

For the *intended* changes, FDA's decision trees recommend that developers test for changes in macro or micronutrient levels, known anti-nutrients (e.g., phytates), known toxicants or known allergens. For the *unintended* changes, however, FDA acknowledged that there are no methods currently available to test for the presence of novel allergens and no practical methods for assessing whether a GE food contains any novel toxicants. The agency asserted that these are expected to be relatively rare occurrences and that long-established practices of plant breeders (gross morphological inspection, yield, taste testing) may prove useful in identifying GE foods containing unknown toxicants. The agency did not offer evidence for the presumed rarity of unintended changes nor for the suggestion that these crude "established practices" are effective in detecting more subtle but potentially harmful changes in chemical composition of plants.

Although FDA acknowledged that GE could produce potentially harmful changes in food, *a central scientific question with enormous policy implications was (and remains) whether this happens with greater frequency or different functional consequences in GE versus conventional plant breeding.* There was no empirical evidence to answer this question at the time and this remains the case today (Pelletier, 2005b). Absent such evidence, FDA treated GE foods (as a class) with the *legal presumption of being as safe as conventional foods* and urged GE developers to use the decision trees to assess safety on a case-by-case basis. The weakness in this approach is that the decision trees focus primarily on *intended* changes and/or the possible presence of known toxicants or allergens, but do not adequately address the possibility of novel or unintended allergens or toxicants.

It bears emphasizing that the presumption of being as safe as conventional foods is a statement of the legal status of GE foods, in FDA's view, but this phrase has been widely and erroneously cited as though it is a scientific conclusion (as seen in the quotes earlier in this paper).

Internal FDA documents reveal that a number of FDA scientists and scientific administrators were concerned that the draft Statement of Policy did not adequately address these weaknesses in scientific evidence and testing methods (Pelletier, 2005b). Similarly, a report from a committee of the National Research Council (an arm of the National Academies of Science) raised numerous questions concerning the adequacy of the existing regulations for GE foods (NRC, 2000). These expressions of concern are in addition to the much broader criticisms and concerns expressed by scientists, scientific panels and non-governmental organizations (EU-US Biotechnology Consultative Forum, 2000; Consumer's Federation of America, 2001; Consumers Union, 2001; Royal Society of Canada, 2001; Schubert, 2002).

Despite the awareness of these critical gaps in scientific knowledge, and the enormous policy implications of these questions, as of 2002 the USDA-funded research programs still had not mounted a significant research effort to address them. A recent committee report from another arm of the National Academies of Science (Institute of Medicine, 2004) has recommended that a vigorous program of research be initiated to address gaps in scientific knowledge. In the meantime, FDA's policy remains the same as that articulated in 1992.

Overview of US food safety regulations

In the mid-1980s FDA asserted that it had sufficient legal authority to regulate GE foods either under the adulteration clause (section 402(a)(1) of the Federal Food, Drug and Cosmetic Act, or FDCA) or the food additives clause (section 409) (OSTP, 1986). This meant it was not necessary to involve the US Congress in decisions concerning this new technology.

FDA normally applies the adulteration clause to regulate the safety of whole foods and it normally applies the food additive clause to regulate the safety of chemical substances (or processes, such as irradiation) added to food to achieve an intended effect. However, GE foods pose a challenge to this binary choice because they are whole foods *and* they have been altered to achieve an intended effect through the ''addition'' of new segments of DNA and, indirectly, the intended expression product(s). In resolving this issue FDA had to proceed carefully because the choice would have profound implications for the level and type of pre-market testing required, the strictness of the legal safety standard, labeling, the burden of proof placed on developers versus FDA, the administrative burden on FDA and, ultimately, the pace with which GE foods would enter the marketplace. It is relevant to note that these policies were developed throughout the 1980s and early 1990s, when deregulation and international competitiveness were dominant themes in federal politics and policy-making.

The food additive clause (section 409) mandates that producers file a Food Additive Petition with FDA before marketing foods containing an additive and requires that producers perform extensive safety testing. The relevant safety standard, as used by FDA, is ''reasonable certainty of no harm.'' when the additive is used as intended (21 CFR 170.3). If successful, this petition results in a formal rule issued by FDA and published in the Federal Register stating that the food additive has been approved for its intended use. Foods containing food additives must be labeled as such, on the ingredient section of the food label. Some added substances can be exempted from the food additive petition process under the GRAS clause (Generally Recognized as Safe), if they have a long history of safe use (e.g., spices, vinegar, natural flavors) or have been determined to be GRAS on the basis of publicly available evidence and in the judgment of qualified experts.

The adulteration clause is the authority under which FDA normally regulates whole foods to guard against unintended microbiological, chemical or physical contamination. FDA's 1992 policy states that the adulteration clause '' will be applied to any substance that occurs unexpectedly in the food at a level that may be injurious to health. [...] It is the responsibility of the producer of a new food to evaluate the safety of the food and assure that the safety requirement of section 401(a)(1) is met.'' (FDA, 1992, 22990). Unlike the food additive clause, there is no mandate for pre-market testing nor *ex ante* demonstration that the food is not adulterated. Instead, because these substances occur unexpectedly, by definition, a problem with the food typically might be revealed through post-marketing testing, surveillance, adverse event reports, and/or outbreaks of illness. FDA does not have the authority to mandate a recall, but the implicit threat of regulatory action, liability and adverse publicity has proven sufficient to trigger voluntary recalls by food companies (Roberts, 2004).

Thus, the food additive clause generally provides greater *ex ante* assurance of safety for new substances but is more burdensome for producers and for FDA, while the adulteration clause generally relies upon good manufacturing practices and post-marketing

detection and recall authority to protect public health. In its 1992 policy FDA avoided exclusive use of either the food additive clause or the adulteration clause. Instead, FDA opted for an amplified version of the adulteration clause as a type of ''regulatory middle-ground'' which, from a strictly legal perspective, treats GE foods no differently than conventional foods (Noah and Merrill, 1998). The legal strategy used to implement this decision is described in a later section.

Regulatory history

The coordinated framework for the regulation of biotechnology

In 1984 the Reagan Administration formed an inter-agency Working Group on Biotechnology, managed under the Office of Science and Technology Policy (OSTP) in the White House, to develop a coordinated approach to regulations across FDA, EPA and USDA (OSTP, 1984).

During the same period the interagency Biotechnology Science Coordinating Committee (BSCC) was established to develop common definition of the GE organisms that are subject to review and comparable standards for scientific review of GE products across the regulatory agencies. The creation of this body was said to be inspired by the positive experiences a decade earlier, in which distinguished scientists played a leading role in developing regulations for rDNA research through the NIH's Recombinant DNA Advisory Committee (RAC). In contrast to the RAC, however, the BSCC consisted of *senior policy officials* (i.e., senior career civil servants as well as political appointees) of the relevant agencies rather than distinguished national scientists or senior agency scientists. Both the Working Group and the BSCC continued to be managed by OSTP during the 1984–1986 period, but oversight of the Working Group was later transferred to the White House Domestic Policy Council.

A central issue in the GE food policy debates is whether GE foods should be regulated any differently than conventional foods. The Coordinated Framework defined two broad categories of organisms as coming under the scope of enhanced regulation (OSTP, 1986): (1) intergeneric organisms formed by the deliberate combination of genetic material from sources in different genera; and (2) organisms that belong to pathogenic species or that contain genetic material from sources organisms that are pathogenic. Note that the first category implies a *process-based* criterion (or ''trigger'') for regulation, which would carry important legal implications, and which differs from the *product-based* criterion subsequently adopted by OSTP and the agencies in 1992.

The Coordinated Framework identified a number of intergeneric organisms to be excluded from these two categories (and, thus, exempt from regulatory oversight), but *foods produced through rDNA technology would not have been eligible for exclusion.* This became the basis for deep disagreements among the regulatory agencies, and parties outside the agencies, as described below.

Proposed scope principles

A number of significant events took place after the 1986 Coordinated Framework was published. According to the Federal Register accounts, the two definitions of organisms subject to regulation were deemed inadequate by public commenters and the agencies experienced unanticipated difficulties ''operationalizing'' these definitions. Accordingly,

the agencies and the BSCC attempted to reconcile these disagreements after the 1986 Coordinated Framework had been issued and identified four different options for doing so, but could not reach consensus in choosing among them. This led to a significant change in institutional responsibility for the policy, when the Director of OSTP orwarded the draft scope document to the Vice-President's Council on Competitiveness [CoC]. The CoC is an interagency policy body comprised of senior representatives of the Federal agencies. The CoC review led to the Proposed Principles of Scope of Oversight (OSTP, 1990, 31119–31120).

Several key features of the subsequent policies were resolved by the CoC and not by the scientific body (BSCC). Among these is the principle that it is the product, not the process, that should be regulated. Related to this, the policy document recommended the use of a broad and all-inclusive term ("organisms with deliberately modified hereditary traits") for all forms of plant breeding to imply that rDNA techniques are a non-problematic extension of other techniques. The rationale given for using this broad and all-inclusive term is:

> "The term ["organisms with deliberately modified hereditary traits"] includes organisms resulting from any process or technique. One reason for using this term is to avoid the incorrect implication that the use of any particular genetic modification process per se makes a modified organism of greater risk than its unmodified parent[...] Such a misconception could inadvertently tend to retard research and the beneficial development of the biotechnology industry." (OSTP, 1990, 31120)

Importantly, the overwhelming focus of the 1990 (and 1992) scope document (as well as in the scientific reports from the NAS and NRC in the 1980s) is the release of new organisms into the environment, with primary implications for USDA and EPA's policies. It appears that the principles or "doctrines" identified in these documents were assumed to apply equally well to food safety, in the interest of developing *common principles* of oversight rather, than by a careful consideration of the scientific reasons why food safety issues may differ from environmental issues.

Final scope principles

In 1992 OSTP published the final scope document, essentially affirming and amplifying its proposed scope principles published in 1990. However, the 1992 OSTP publication went far beyond these issues and introduced a powerful new set of principles and directives that sought to influence how FDA, EPA and USDA should use their discretion in developing and/or implementing their final policies. The preamble states:

> "[ ], several important policy developments have occurred since the issuance of the Proposed Scope, which have been taken into account in developing the current final statement on Scope. These developments include a decision by the President to approve [CoC-derived] Principles for Regulatory Review for Biotechnology, and an EPA report endorsing the risk-based approach to environmental policy." (OSTP, 1992, 6755)

The four principles approved by the President are: (1) regulations should focus on the product, not the process; (2) regulatory burdens should be reduced to the greatest extent possible, as permitted by each agency's legislative statutes; (3) regulations should accommodate rapid advances in technology; and (4) regulations should use performance

standards (e.g., a specific, measurable margin of safety or tolerance level) rather than specify rigid controls or specific designs for compliance. Related principles articulated in The Final Scope Principles are (from the EPA report) that scarce agency resources should be directed to the issues of greatest concern and (from a CoC Fact Sheet) that "Regulations should be issued only on evidence that their potential benefits exceed their potential costs." (OSTP, 1992, 6761).

As a result of these considerations, The Final Statement on Scope states: "Within the scope of authority provided by statute, federal agencies shall exercise oversight of planned introductions of biotechnology products into the environment *only upon evidence that the risk posed by the introduction is unreasonable*. A risk is unreasonable where the full value of the reduction in risk obtained by the oversight exceeds the full cost of the oversight measure. (OSTP, 1992, 6757) (emphasis added).

These directives are significant for two reasons. First, they suggest that agencies should perform cost-benefit analyses before deciding whether/how to issue regulations. This is in conflict with FDA's general food safety standard based only on risk considerations (21CFR170.3(i)). Second, they would put the burden of proof for such analyses on regulators (as opposed to developers) to demonstrate there are actual risks. This is in conflict with FDA's regulation of food additives which require that developers produce evidence of "reasonable certainty of no harm" (21CFR348).

Political context

The integrity of the US regulatory system depends in large part on the ability of agency professionals, scientists and advisory committees to carry out their statutory mandates as provided by Congress, and to be insulated from direct interference related to national or interest group politics. Institutionalized mechanisms have been created for public input and scientific advice, including official public comment periods on proposed regulations, public meetings, and a wide variety of scientific and stakeholder advisory committees. The integrity also requires a high level of transparency, forthright communication to/with the public, and accountability for decisions. These basic principles are well-known, widely accepted in principle and are the basis for legitimacy and public trust.

The public record, statements by public officials close to the situation, and journalistic investigations suggest that these principles were violated in the development of the agencies' regulatory frameworks for agricultural biotechnology. The documents published in the Federal Register (reviewed above) reveal that *the policy formulation process was removed further and further from agency professionals and scientists throughout the critical period from 1984 to 1992, despite the later claims that the US policies are based on scientific considerations.* Further insights on the interaction between the scientific and political inputs into this policy are provided here.

As noted, the documents published by OSTP in the Federal Register express a desire to model the development of biotechnology regulations on the process used by NIH's rDNA Advisory Committee (RAC) formed in 1976. However, the RAC included distinguished scientists with diverse views on the safety of rDNA research, took a precautionary stance while hundreds of experiments were being performed to investigate the most urgent safety concerns, dealt with transgenic bacteria as opposed to food and higher organisms, and focused on the most appropriate barrier and containment methods to ensure the safety

of laboratory research. As a result, by the early 1980s a strong, evidence-based scientific consensus had been achieved concerning the safety of transgenic bacterial experiments and the safety measures required in laboratories.

In contrast, the agencies charged with developing regulations for GE agriculture did not have the benefit of new research to answer their most urgent questions; they were dealing with higher organisms to be deliberately released into the environment and foods to be introduced into the entire food supply; they were working with much closer involvement and oversight from political appointees in the agencies and in the White House; and they were within an administration defined in large part by its commitment to reduce regulatory burdens on industry. These agencies initially attempted to take a moderately cautious approach in defining the frameworks and scope of regulations (as revealed in the 1986 Coordinated Framework) but responsibility for critical decisions was given to the Vice-President's Council on Competitiveness after these cautious proposals met with industry opposition and disagreements among the agencies.

The Federal Register documents state that the Biotechnology Working Group on the Council on Competitiveness includes representatives from the regulatory agencies, but it does not discuss the highly controversial relationship between this Council and industry stakeholders. This relationship was extensively covered in the mass media at the time as revealed by selected quotes shown in Table 1.

Specific evidence of how the White House (presumably reflecting input from the CoC, though this is not clear from the memo) exerted a powerful influence on FDA's 1992 policy statement is provided in a memo from the Director of the Office of Information and Regulatory Affairs (James MacRae, Jr.) to C. Boyden Gray, White House Counsel to President Bush. In the memo MacRae provided comments on FDA's draft policy statement, the final version of which was published in the Federal Register eight days later. MacRae suggested changes related to four key issues:

> ''First, the title of the Notice should be shortened to 'Statement of Policy: Foods Derived from New Plant Varieties.' Referencing 'plants developed by [rDNA]' in the title inappropriately suggests that the document focuses on rDNA techniques.''
> ''Second, the policy statement needs to clearly state that method of production is irrelevant unless it directly affects the safety of food.''
> ''Third, the policy statement needs to stress the role of decentralized safety reviews by producers; with informal FDA consultation only if significant safety or nutritional concerns arise.''
> ''Finally, the Notice should state that newer techniques actually may produce safer foods. I suggest the following sentence be added to the bottom of page 13: 'Since these techniques are more precise, they increase the potential for safe, better characterized, and more predictable foods.''' (MacRae, 1992)

All of these suggestions were followed and most were incorporated verbatim into FDA's final policy statement. In contrast, strong concerns from FDA's scientists and administrators (cf. Pelletier, 2005b) were not incorporated into the final policy.

Finally, while the above sources clearly reveal the extent to which industry was involved in shaping its own regulations, a consistent narrative from agency officials, elected officials and industry representatives when seeking to build public trust during post-1996 controversy has been that these policies are based on sound science and insulation from undue industry influence. This is illustrated in Table 2 by quotes from

Table 1
Statements concerning the Council on Competitiveness and the industry's influence over biotechnology regulations

"The Council [on Competitiveness] wants to be a super-regulatory body, but it refuses to comply with the laws and rules that all federal regulators must live by. Although the council regularly invites industry lobbyists to voice their objections to agency regulations, those messages remain private, in violation of the principles of open government. This secrecy breeds all of the problems that our administrative and ethics laws were designed to overcome – conflict of interest, political favoritism and lawlessness. In a recent subcommittee hearing, four of the nation's leading legal experts agreed that the council was illegally trampling on important laws and procedures. [ ] Finally, the council's secret meetings, ex parte contacts with dissatisfied private interests and refusal to keep any records are an illegal intrusion into the regulatory process. The council's conduct goes far beyond anything in the Keating Five scandal; it doesn't merely advocate special-interest fixes, it dictates them." (Waxman, 1992)
(US Congressman (D) from California)

"It is profoundly frustrating to an EPA Administrator to go through all of the careful control processes of arriving at a regulatory decision or proposal and to respect all of the rules against *ex parte* contact – make sure any contact with the regulated community is recorded, noted, memorialized, public, on the record – and then to have it go to the White House and see many of the same parties engaged in influencing other people who have influence over such decisions without any public record, without any acknowledgment that this is going on. The secrecy that characterized that process, I think, is a source of great mistrust and, potentially, of corruption. Corruption in the sense that it violates process, not that it involves anyone taking any money." (Reilly, 1995)
(William Reilly was President Bush's appointee as Administrator of EPA from 1989 to 1993)

"In the weeks and months that followed, the White House complied, working behind the scenes to help Monsanto – long a political power with deep connections in Washington – get the regulations it wanted. It was an outcome that would be repeated, again and again, through three administrations. What Monsanto wished for from Washington, Monsanto – and, by extension, the biotechnology industry – got. [. . .] Even longtime Washington hands said that the control this nascent industry exerted over its own regulatory destiny – through the [EPA, USDA and ultimately FDA] – was astonishing. 'In this area, the US government agencies have done exactly what big business has asked them to do" said Dr. Henry Miller, a research fellow at the Hoover Institution, who was responsible for biotechnology issues at the FDA from 1979 to1994." (New York Times, 2001)
This excerpt refers to events following a meeting between four Monsanto executives and then-Vice President Bush in late-1986.

several key political figures. These statements suggest that scientific evidence, rigorous testing and arms-length regulatory procedures have symbolic value for politicians and agencies, but the evidence presented in this paper depicts a process completely at odds with these symbols.

While the above evidence reveals the White House took an active interest in shaping key aspects of FDA's policy, even to the extent of overriding the views of agency scientists, FDA still faced some difficult legal dilemmas in implementing these directives. The next section describes these dilemmas and how FDA addressed them.

FDA's legal strategies

The record reviewed above suggests that political pressures emerging from the White House sought to minimize regulatory interference with the emerging agricultural biotechnology industry. In pursuing this objective, FDA had to remain within the authority delegated to it by Congress in the Food, Drug and Cosmetics Act (FDCA), remain within the boundaries of discretion afforded by the Administrative Procedures Act, and be capable of surviving potential lawsuits from industry, consumer interest groups, states or other

Table 2
Government statements concerning regulation of GE foods

"The US regulatory approach to agricultural biotechnology applies principles of sound science to ensure that there are no unacceptable human health and environmental risks associated with the use of these crops and that they are safe to enter into commerce. This system, encompassing the food safety and environmental regulations of the Department of Agriculture, Food and Drug Administration, and Environmental Protection Agency, has resulted in rigorous scientific review of products, while providing a predictable regulatory environment that fosters scientific advancement and product innovation." (Office of the White House Press Secretary, May 3, 2000)
"Not only must the food Americans eat be safe, but consumers must have confidence in its safety, and confidence in the government's role in ensuring safety. Policies that are grounded in science, that are developed through open and transparent processes, and that are implemented rigorously and communicated effectively are what have assured consumers' confidence in an agency that has served the nation for nearly 100 years." (Jane Henney, Commissioner of FDA, quoted in Thompson 2000:23)
"With all that biotechnology has to offer, it is nothing if it's not accepted. This boils down to trust. Trust in the science behind the process, but particularly trust in the regulatory process that ensures review – including complete and open public involvement. The process must stay at arm's length from any entity that has a vested interest in the outcome. By and large, the American people have trust and confidence in the food safety efforts of USDA, the FDA, EPA, CDC and others because these agencies are competent and independent from the industries they regulate, and are viewed as such. That kind of independence and confidence will be required as we deal with biotechnology. The US regulatory path for testing and commercializing biotechnology products as they move from lab to field to marketplace is over a decade old. We base decisions on rigorous analysis and sound scientific principles." (Glickman, 1999) (USDA Secretary)
"Overwhelming scientific research shows that biotech foods are safe and healthy – a conclusion that the EU's own Directorate – General for Research reached two years ago.[ ] Some claim that we are "forcing" biotech foods on European consumers. Yet all we ask is for consumers to have the right to make their own decisions, a right they are now denied because the EU is blocking access to foods that EU regulators and scientific associations acknowledge are safe. The legal case for biotechnology is clear, the science overwhelming, and the humanitarian call to action compelling." (US Trade Representative Robert Zoellick, in Wall Street Journal, 2003)

entities. This section describes some of the basic principles related to delegation and discretion in regulatory agencies and the ways in which FDA has been able to meet the above challenges.

Delegation, discretion and deference

The regulation of new technologies poses challenges to the US political system because they can introduce broad and significant changes in society that normally should be debated at a political level, but the highly complex and technical character of technological issues can pose obstacles to well-informed debate in legislative settings and in the broader public arena. A pragmatic response over the previous century has been for Congress to delegate authority to a wide range of regulatory agencies for the analysis and management of risks related to health, safety and the environment. These agencies maintain a considerable body of in-house scientific and technical expertise and are able to augment this through scientific advisory committees, NAS committees and other mechanisms.

The authority of regulatory agencies is not absolute, but is constrained in certain key respects by Congress. An important case in point is that FDA's authority requires it to regulate food additives and adulterated foods based purely on public health considerations, while EPA's authority requires that decisions be based on a *balancing of the benefits and costs* of potential regulations (Meier and Garman, 1995). A number of authors have noted that, from a larger policy perspective, a strict application of purely risk-based standards by FDA could not only become a serious impediment to innovation and economic growth, it also could harm public health, safety and the environment if they prevent potentially useful and efficient new technologies from being developed or marketed (Breyer, 1993; Graham and Wiener, 1995; Viscusi, 1998). This tension between a strict application of FDA's food safety authority and the use of a broader public policy perspective is illustrated forcefully in the GE foods case by the directives contained in the Final Scope Principles as described earlier. In effect, these urged regulatory agencies to adopt a broader public policy perspective (OSTP, 1992). The challenge for FDA was to find a workable legal strategy for doing so, given that this was not explicitly permitted by its legal authority.

While the delegation of authority to regulatory agencies helps to address the complexity and high technical content of technology-based policy decisions, simultaneously it has the potential to create problems for procedural and democratic concerns related to openness, transparency, inclusiveness and accountability. The Administrative Procedures Act (Administrative Procedures Act (APA), 1946) seeks to address these concerns by requiring agencies to publish proposed regulations in the Federal Register, provide public comment periods and respond to public comments when publishing the final regulations in the Federal Register. The agencies also have the option of creating scientific advisory committees and/or more broadly constituted public advisory committees, under the Federal Advisory Committee Act. Finally, members of the public can use the courts to challenge the legality of how an agency interprets and applies its statutes and/or they can seek to change those statutes via Congress.

Specific strategies

While APA requirements and other institutional mechanisms, in principle, provide some measure of openness, transparency, inclusiveness and accountability in agency decision-making, the GE foods case reveals several ways in which FDA appears (at face value) to have stretched its discretionary authority. Specifically:

1. FDA did not publish a proposed version of the policy in advance nor seek public comments. Therefore, it could not ascertain and address public concerns (of a scientific or extra-scientific nature) in the final policy.
2. FDA used neither a scientific advisory committee nor a public advisory committee in developing its 1992 policy statement.
3. FDA's final policy statement did not respond to the strong concerns expressed by some of its own scientists and senior administrators.
4. FDA granted the presumption of GRAS status for GE foods, which could be overturned only if the specifics of individual cases suggested otherwise. From a legal perspective this is the same status granted to conventional whole foods, but the granting of this status to GE foods appears inconsistent with the novelty of GE foods, the

plausible scientific basis for expecting that unintended compositional changes may arise (which FDA acknowledged) and the limited methods available to test for compositional changes (which FDA acknowledged).

5. By virtue of the GRAS presumption, independent GRAS determinations by producers were not subjected to public notice-and-comment procedures that are required for food additive petitions and used (though not legally required) for GRAS petitions/affirmations (Noah and Merrill, 1998). Instead, private, voluntary consultations between FDA staff and food developers are the primary means to agree upon testing methods and for drawing conclusions from the test results. Thus, open, transparent and public procedures for challenging or confirming GRAS status were replaced with closed and non-transparent procedures that precluded challenge by outside parties (GAO, 2002; NRC, 2000).
6. The use of closed, private and voluntary procedures for industry to make independent GRAS determinations deprived FDA and the public of an important mechanism for demonstrating the ''general recognition'' requirement. Litigation since the 1970s has identified three criteria, any one of which, will lead to a determination that a substance is not considered GRAS (FDLI, 1996):
   - a genuine dispute among qualified experts as to whether a substance is GRAS;
   - a lack of data and studies upon which to base general recognition; or
   - even if data exists, it is not publicly available.

   In light of the novelty of GE foods, FDA's acknowledgment of the potential for unintended compositional changes, and the limited public research or published research on these topics, it is likely that a large number of GE foods would have failed to meet one or more of these criteria. This would have created ''regulatory interference'' which the White House sought to avoid and, thus, it was necessary for FDA to adopt a strategy that would avoid this outcome. The *presumption of GRAS status* for GE foods was a central element of this strategy.
7. FDA decided not to impose mandatory labeling on GE foods, despite the acknowledged potential for unintended compositional changes and the limitations of existing testing methods. FDA based this decision on a narrow legal analysis of whether GE status is ''material information'' that should be provided to consumers. In addition, FDA apparently did not give weight to three broader public policy considerations with respect to labeling:
   - the lack of labeling severely limits the ability of the public, the FDA and/or other state or federal agencies to identify unintended health effects, because prospective and retrospective studies would be limited in their ability to assess exposure to GE foods;
   - the lack of labeling limits the ability of FDA and/or the public to hold industry legally accountable for any damages to specific consumers and to seek changes in the regulations and/or statutes; and
   - both of the above considerations weaken the incentives for developers to perform thorough safety evaluation before marketing GE foods.

   Although the above examples seem to suggest that FDA violated some of the FDCA statutes regarding GRAS determinations and some of the basic principles underlying the APA (e.g., openness, transparency and accountability), the ultimate test of the legality of and agency's actions is based on interpretations and decisions by the courts. The unsuccessful lawsuit brought against FDA concluded that the agency was operating within the legal boundaries of its discretion, as described below.

The regulatory middle ground

Insight into FDA's legal strategy for regulating GE foods is provided in an unauthored "Points to Consider" memo released by FDA as part of the suit brought against it by the Alliance for Bio-Integrity (Anonymous, undated). This memo outlines the advantages and disadvantages of two regulatory options (see Table 3):

Table 3
Two regulatory options initially considered by FDA for GE foods

Option 1. Place GE foods in the food additive/GRAS category but build greater flexibility into the process of making, documenting and informing FDA about independent GRAS determinations by developers	*Option 2*. Place most biotech foods under the adulteration category but strengthen FDA's involvement in assuring compliance within this category
Implications (a) if routine petitions are to be avoided, this would require overt FDA affirmation of the concept of relying on independent GRAS determinations (b) would require promulgation of guidelines for safety evaluation and documenting it to satisfy the "publication" requirement (c) to avoid appearance of self-regulation, would require some process short of a GRAS petition to inform FDA of independent GRAS determinations	*Implications* (a) would require promulgation of guidelines for safety evaluation of new foods and notifying FDA of the basis for judging them safe (b) would preserve the option of moving a food to the food additive/GRAS category if it were determined based on criteria promulgated by FDA the genetic alteration warrants this
Advantages (a) provides FDA the greatest legal authority (b) could be used to compel formal petitions on a routine basis	*Advantages* (a) grounds regulation of GE foods in current law and practice regarding conventional foods (b) preserves FDA's role in setting ground rules for safety evaluation and for keeping informed about new products (c) preserves option of shifting foods to food additive/GRAS category when facts warrant (d) creates appearance of strengthening a regulatory category to address GE foods (e) avoids precedent and resulting resource problems involved with treating GE foods as food additives or GRAS substances
Disadvantages (a) places GE foods in a different category than conventional whole foods (b) treats GE foods as a food additive rather than whole food, undermining the concept of "food" as a regulatory category (c) has the appearance of loosening requirements to fit GE foods (d) is at odds with emerging FDA FDA legal interpretation of what is required to achieve GRAS status, including the "publication" requirement	*Disadvantages* (a) could be criticized as less than the most rigorous regulatory category (b) places somewhat greater legal burden of proof on FDA to enforce against wrongdoers

Adapted from Points to Consider memo (Anonymous, undated).

(1) a ''flexible'' version of the food additive/GRAS clause, in which developers would be allowed to make self-determination of GRAS; and
(2) a strengthened version of the adulteration clause in which FDA would simply issue guidelines for safety evaluation and notification of FDA.

The memo suggests that FDA considered both of these to be viable legal options. However, as stated in the memo:

> ''Whole foods are a special and difficult case because there is no established precedent of affirmative FDA regulation but something is needed to assure safety and satisfy the public that it is being protected. For biotech whole foods, some regulatory middle ground is needed between complete reliance on an unamplified 402(a)(1) [adulteration clause] and routine imposition of the food additive/GRAS regime, with its requirement of petitions as the only basis for obtaining any FDA involvement in the task of safety assurances.'' (Anonymous, undated)

The strategy chosen by FDA most closely resembles Option 2. As shown, this options was considered less burdensome on industry and FDA, less complicated to justify legally and more consistent with current law and practice regarding whole foods. In addition this option would permit developers of GE foods to make independent GRAS determinations, while not requiring FDA to make an overt affirmation of the GRAS status for each GE food.

FDA recognized that one major problem with a strict reliance on the adulteration category (Option 2) for GE foods is, strictly speaking, GE foods do meet the legal definition of a food additive. Under the FDCA the term ''food additive''

> ''means any substance the intended use of which results or may reasonably be expected to result, directly or indirectly, in its becoming a component or otherwise affecting the characteristics of any food (including any substance intended for use in producing, manufacturing, packing, processing, preparing, treating, packaging, transporting or holding food; and including any source of radiation intended for any such use), if such substance is not generally regarded, among experts qualified by scientific training and experience to evaluate its safety, as having been adequately shown through scientific procedures (or, in a case of a substance used in food prior to January 1, 1958, through either scientific procedures or experience based on common use in food) to be safe under the conditions of its intended use...'' (FDCA. 201(s), 21 U.S.C.. 321(s)).

In relating this definition to GE foods FDA used two strategies:

(a) it took the position that the transferred DNA and the *intended* expression products could be considered food additives, but any *unintended* changes in the food would be more appropriately regulated under the adulteration clause because, by definition, they are not *intended* changes in the food as specified in the first line of the above quotation.
(b) To avoid subjecting all GE foods to the burdensome food additive petition process, FDA made use of the GRAS clause in the above definition, which holds that a food will not be considered adulterated if its food additives are generally recognized as safe. However, the demonstration that a food or substance is GRAS also has

demanding requirements, as noted earlier, which FDA wished to avoid. Thus, in its 1992 policy statement FDA declared that GE foods would be *presumed* to be GRAS unless the details in a specific case suggested otherwise. It then proposed some decision trees and a voluntary consultation process that developers could use on a case-by-case basis to assure themselves and FDA that the product does not have any characteristics that might contradict the GRAS presumption.

The court documents from the lawsuit, notably FDA's defense arguments and the judge's decision memo, provide much greater insight into the legal strategies available to FDA to implement and defend this "regulatory middle ground." In particular, these documents reveal how a combination of legal and scientific considerations provided FDA with ample discretion to regulate GE foods under *either* of the two options noted above or under the middle ground it proposed. Further background on these and other aspects of food law are available in Pew (2004), Noah and Merrill (1998) and McGarity and Haines (2001).

Summary of FDA's legal strategy

In order for FDA to implement its middle ground to regulating GE foods it:

(a) established that rDNA itself is GRAS;
(b) granted *presumptive* GRAS status to GE whole foods and established the objective characteristics of the intended expression products in GE foods that might call into question their GRAS status and trigger their regulation as food additives;
(c) asserted that GE does not create any unique food safety risks, compared to other forms of plant breeding, and that existing methods of plant breeding and safety evaluation are adequate to detect any (rare) unintended compositional changes;
(d) provided guidance to developers on how they might perform independent GRAS determinations;
(e) suggested a *voluntary* consultation process between FDA and developers as a way for developers to inform FDA of their GRAS determinations and voluntarily notify FDA of new products entering the marketplace, while reminding developers that the ultimate responsibility for assuring the safety of GE foods (as with all whole foods) rests with developers;
(f) articulated a narrow interpretation of what constitutes "material information" concerning any food, based on objective characteristics, which might trigger the need for mandatory labeling; and
(g) in light of the above, declared that the existing statutes provide FDA with all the authority necessary to adequately regulate GE foods, such that an interpretive policy statement could be issued rather than new regulations and thereby avoid public notice and comment requirements.

Many of the above decisions and claims by FDA rest on the premise that, from a scientific perspective, GE foods can be treated in the same manner as foods produced through traditional breeding methods. For instance, this is the basis for granting presumed GRAS status to GE foods (item b above) and for the claim that existing methods of breeding and testing are adequate to assure safety (item c). The scientific basis for this notion

stems directly from the 1987 "white paper" from the NAS (1987), one of the NRC reports (NRC, 1989) and the Final Scope Principles as influenced by the CoC (OSTP, 1992). All of these documents held to the position that there is no evidence of the existence of unique hazards of GE crops compared to those produced by classical breeding techniques. However, all of these documents were primarily concerned with the risks associated with release of GE crops into the environment, as opposed to food safety risks, and neither the NAS/NRC nor the FDA has cited evidence that supports (or refutes) this presumption as it pertains to food safety. To the contrary, FDA's 1992 policy statement identifies a number of reasons (related to pleiotropy and insertional mutagenesis) why GE might lead to unintended compositional and health effects. This was reinforced by statements from FDA scientists and administrators described in an earlier paper (Pelletier, 2005b).

The question arises, therefore, as to how FDA could make these claims and successfully defend them in the lawsuit initiated by the Alliance for Bio-Integrity. The answer appears to relate to the broad discretion granted to FDA by administrative statutes and the courts, as described below.

The court's interpretation

Three of the complaints raised in the lawsuit are of interest in this connection: (a) that FDA's 1992 policy statement was not properly subjected to public notice and comment procedures; (b) that FDA's granting of presumptive GRAS status or GE foods was arbitrary and capricious; and (c) that FDA's decision not to mandate labeling for GE foods is arbitrary and capricious. The plaintiffs based the latter two complaints on the scientific considerations noted above, suggesting that GE might plausibly be expected to create unintended compositional and health effects in some foods. FDA's defense arguments and the court's decision memo reveal that that three interrelated factors were decisive in the decision to dismiss these complaints: the high scientific and technical content of these issues, the legal status of the policy statement as an informal rule, and the FDA's reliance on voluntary rather than mandatory consultation procedures.

FDA clearly announced that the 1992 policy statement is an *interpretive* statement (i.e., an "informal rule" under the APA), as opposed to new or amended regulations (a "formal rule" under APA). By definition, informal rules cannot impose new rights or obligations on the agency or the regulated entities, nor can they constrain the agency from exercising its discretion in any way. In order to meet these tests, it was necessary for FDA to rely upon *voluntary* consultations, to avoid *mandatory* labeling and to grant GE foods the *presumption* of GRAS status. The first and second of these clearly avoid imposing new rights or obligations. With respect to the third, FDA argued and the court agreed, that the policy statement only grants a *rebuttable presumption* that a given GE food is GRAS, such that FDA could still challenge a developer's independent GRAS determination and move the food into the food additive category if the facts of the case warrant.[2]

[2] Neither the court, nor FDA, nor the plaintiffs explored the fact that the presumption of GRAS is rebuttable only if a developer chooses to follow the voluntary consultation process, because that is the only mechanism for FDA knowing of the existence of that GE food. Similarly, the court did not explore the fact that the presumption of GRAS cannot be rebutted if, as acknowledged by FDA, there are no methods available for detecting unintended compositional changes in GE foods.

The legal status of the policy statement as an informal rule led to the dismissal of the first complaint because such rules are not required to use public notice and comment procedures. It also greatly broadened the legal scope for FDA's discretion and offered greater protection against subsequent intervention by the courts. The APA and substantial case precedent holds that the courts are required to show great deference to the agency's judgment in formal and informal rules alike, unless the language of the statutes provided by Congress limit the agency's discretion on specific substantive matters. However, the legal standard for defining the boundaries of discretion differ for formal and informal rules. Formal rules must be supported by "substantial evidence on the record as a whole" whereas informal rules must simply avoid being "arbitrary and capricious." This latter standard is extremely generous to the agency and is the reason why legal challenges are so seldom mounted against informal rules by FDA and other agencies. The use of informal rules is one of the strategies FDA has used with increasing frequency over the years to accomplish its "creative application of the law" (Bachrach, 2000).

The above distinctions were decisive in the lawsuit as revealed in the following quote from the court's decision memo: "Having examined the record in this case the Court cannot say that FDA's decision to accord genetically modified foods a presumption of GRAS is arbitrary and capricious." The court goes on to quote from FDA's own motion for dismissal, which noted: 'The rationale for deference is particularly strong when the [agency] is evaluating scientific data with its technical expertise. [ ] [I]n an area characterized by scientific and technical uncertainty[,]. . .this court must proceed with particular caution, avoiding all temptation to direct the agency in a choice between rational alternatives." In a similar fashion, the court showed great deference to FDA's decision and arguments related to labeling.

As noted in the above quote, another factor that defines the boundaries of agency discretion is the extent to which the policy issue involves scientific or technical considerations within the agency's expertise. In such cases the courts are reluctant to second-guess the agency's judgments.

Notwithstanding this deference, the court did take up the question of whether the agency's decision to grant GE foods the presumption of GRAS was arbitrary and capricious. Noting that "generally recognized" does not imply unanimity, but that a severe conflict among experts does preclude a finding of general recognition, the court considered the two forms of evidence which the plaintiffs claim demonstrate the existence of a severe scientific conflict. The first was a set of affidavits submitted by scientists citing the basis for safety concerns in GE foods. The court refused to admit this evidence into the record because it was not available to FDA at the time it developed its policy. The second was the set of internal memos from FDA scientists and administrators quoted in an earlier paper (Pelletier, 2005b), including memos from the Director of FDA's Center for Veterinary Medicine, the Director of the Division of Toxicological Review and Evaluation, the Head of FDA's Biological and Organic Chemistry Section and others. With respect to this evidence the court stated:

> "[ ], Plaintiffs, pointing to the critical comments of lower-level FDA officials, insist that even the administrative record reveals a lack of general recognition of safety among qualified experts. [ ] However, low-level comments on a regulation 'do[ ]not invalidate the agency's subsequent application and interpretation of its own regulations. [ ]' Moreover, pointing to a 44,000 page record, FDA notes that Plaintiffs have chosen to highlight a select few comments of FDA employees, which were ultimately addressed in the agency's final policy statement. As a result, Plaintiffs have failed to

> convince the Court that the GRAS presumption is inconsistent with statutory requirements.'' (Memorandum Opinion for Summary Judgment in Bio-Integrity vs. Shalala, dated September 29, 2000)

This quotation is of interest for several reasons. First, the court's dismissal of the critical views expressed by the heads of scientific sections, divisions and centers in FDA, who presumably possess and/or represent the technical expertise of the agency, appears to contradict the very notion that great deference should be granted to such expertise. It suggests that the court actually is more inclined to accord great deference to senior policy officials, who decide the final policy, even when this is at odds with senior scientific administrators. Second, as revealed in this passage and others, the court appears to accept FDA's questionable claims on factual matters that should be readily verifiable by the court. In this case, FDA claimed, and the court accepted the claim on face value, that the concerns of these employees were ultimately addressed in the agency's final policy statement. A simple comparison of the final policy statement with the employees concerns reveals that this is not the case (Pelletier, 2005a).

Conclusions

The evidence presented in this paper reveals that, despite the federal government's stated intention in 1984 to develop agricultural biotechnology regulations based on scientific principles and expert bodies (inspired by the highly successful NIH RAC model in the 1970s), key features of the regulations ultimately were dictated by senior White House officials, the Council on Competitiveness and, indirectly, the agricultural biotechnology industry. OSTP documents from 1990 and 1992 document that these bodies created or reinforced assertions about critically important scientific matters (e.g., that the process of GE does not create any unique hazards relative to traditional methods of plant breeding), which an NRC committee (1989) and a NAS panel (1987) had made in connection with the release of genetically modified organisms into the environment. FDA subsequently applied this doctrine in its 1992 policy to justify its decision to grant GE foods the same legal status as conventional foods (i.e., ''presumed to be GRAS''). This is despite the fact that neither the NRC report nor the NAS white paper addressed food safety issues and FDA acknowledged the scientific basis for potential unintended health effects to arise due to pleiotropy and insertional mutagenesis.

FDA was able to take this position by exploiting critical gaps in scientific knowledge, ''silences'' in the scientific community and creative legal strategies. Gaps in scientific knowledge included the lack of any direct scientific comparison of the nature, frequency and extent of unintended composition changes induced by GE versus classical breeding and significant limitations in methods for safety testing, both of which reflect a long-standing neglect of these issues in the public agricultural research agenda that continues to this day (Pelletier, 2005b). These gaps permitted FDA to frame GE as a simple extension of traditional plant breeding and thereby grant it the presumption of GRAS. This was facilitated further by: the absence of any expression of concern from scientific or professional bodies such as the NAS or professional/scientific societies; the use of a closed policy-making process that effectively precluded input from individual scientists, agency advisory committees or the public; and the ability of senior FDA policy officials to override objections from its own scientists and senior scientific administrators.

A key feature of FDA's legal strategy was to promulgate a *policy statement* in 1992 rather than a formal rule. This allowed FDA to side-step public notice and comment requirements, which could have surfaced troublesome scientific objections to the policy, and it ensured that the agency would enjoy wider discretion and a higher degree of deference from the courts. Finally, FDA, along with other public officials, the biotechnology industry, and scientific and academic organizations have represented the policy in ways that could have the effects of misleading the public, by making reference to sound science, no evidence of harm, the precision of GE compared to traditional breeding and arms-length regulation (Table 2). Regardless of one's particular views regarding GE foods, this case raises grave concerns about public trust and the measures the federal government was willing to use to achieve its political and policy objectives.

This paper, taken together with two earlier papers (Pelletier, 2005a,b), clarifies several issues regarding FDA's regulation of GE foods that deserve to be more widely understood. First, FDA had to make decisions in the face of important gaps in scientific knowledge, concerning the nature, likelihood and consequences of unintended changes arising from GE foods (as a class) versus those known to arise in conventional breeding, and these gaps persist to this day. Second, and following from the first, is that statements to the effect that "there is no evidence that GE foods currently on the market are harmful to human health" must be evaluated in light of the nature and strength of the evidence itself. Specifically, in addition to the gaps in scientific knowledge noted above, there are limitations in current testing methods (especially for assessing the potential health effects of unintended compositional changes) and currently there is no systematic post-marketing monitoring for adverse effects. Third, statements to the effect that "FDA has determined that GE foods currently on the market are as safe as conventional foods" is an accurate statement of the legal status of GE foods in FDA's view (i.e., "presumed to be GRAS"). However, it is not, as widely assumed, based on an extensive body of scientific evidence and rigorous testing methods, especially with regard to unintended compositional changes induced by GE. Finally, and most regrettably, the overall experience suggests that reassurances of safety based on reference to sound science, rigorous testing and/or overwhelming scientific evidence must be interpreted with great caution.

That said, nothing in this paper should be construed to suggest that GE foods currently on the market are harmful to human health or are more harmful than foods produced through conventional breeding. To the contrary, the overwhelming message from this paper and its companions (Pelletier, 2005a,b) is that deep uncertainties exist because these questions have been systematically neglected in private and public research agendas. Thus, while FDA's policy settles these questions as a legal matter, these questions remain unsettled as a scientific matter.

References

Administrative Procedures Act (APA), 1946. Administrative Procedures Act. 5. 551 et seq. (1994).

Altieri, M., Rosset, P., 1999. Ten reasons why biotechnology will not ensure food security, protect the environment and reduce poverty in the developing world. Available from: <http://www.mindfully.org/GE/Ten-Reasons-Why-Not.htm>.

Anonymous (undated). FDA regulation of food products derived from genetically altered plants: points to consider. FDA document released in the case of Bio-Integrity vs. Shalala, Civil Action No. 98-1300 (CKK). US Court of Appeals for the District of Columbia.

Bachrach, E., 2000. The case for a substantial evidence amendment to the informal rulemaking provision of the Federal Food, Drug, and Cosmetic Act. Food and Drug Law Journal 55, 293–299.
Biotech Watch. 2004. UNEP project helps developing countries develop framework biosafety laws, regimes. Available from: <http://subscript.bna.com/SAMPLES/btb.nsf/>.
Breyer, S., 1993. Breaking the Vicious Cycle: Toward Effective Risk Regulation. Harvard University Press, Cambridge, MA.
Cohen, J., 2005. Poorer nations turn to publicly developed GM crops. Nature Biotechnology 23 (1), 27–33.
Consumer's Federation of America, 2001. Breeding distrust: an assessment and recommendations for improving the regulation of plant derived genetically modified foods. Washington, DC, Consumer's Federation of America.
Consumers Union. 2001. Consumers Union's comments on Docket No. 99N-4282, Biotechnology in the Year 2000 and Beyond. Available from: <http://www.consumersunion.org/food/fdacpi100>.
EU-US Biotechnology Consultative Forum. 2000. Final Report. Available from: <http://europa.eu.int/comm/external_relations/us/biotech/report.pdf>.
Federal Advisory Committee Act (FACA). 5 U.S.C. App 2.
Food and Agriculture Organization (FAO), 2003. FAO statement on biotechnology. Available from: <http://www.fao.org/biotech/stat.asp>.
FDA, 1992. Statement of policy: foods derived from new plant varieties; Notice. Federal Register 57, 22984.
Government Accounting Office (GAO), 2002. Genetically modified foods: experts view regimen of safety tests as adequate, but FDA's evaluation process could be enhanced, Government Accounting Office.
Graham, J., Wiener, J. (Eds.), 1995. Risk versus Risk. Harvard University Press, Cambridge, MA.
Institute of Medicine (IOM), 2004. Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects. National Academies Press, Washington, DC.
MacRae, J., Jr. (Office of Management and Budget), 1992. Subject: FDA Food Biotechnology Policy. Memorandum for C Boyden Gray (White House counsel) 2 pages, May 21 1992.
McGarity, T., Haines, P., 2001. Breeding Distrust: An Assessment and Recommendations for Improving the Regulation of Plant Derived Genetically Modified Foods. Consumer Federation of America Foundation, Washington, DC.
Meier, K., Garman, E., 1995. Regulation and Consumer Protection. Dame Publications, Inc, Houston, TX.
National Academy of Sciences, 1987. Introduction of Recombinant DNA-engineered Organisms into the Environment: Key Issues, National Academies Press.
National Research Council (NRC), 1989. Field Testing of Genetically Modified Organisms: Framework for Decisions. National Academies Press, Washington, DC.
National Research Council (NRC), 2000. Genetically Modified Pest Protected Plants: Science and Regulation. National Academies Press, Washington, DC.
New York Times, 2003. Bush Links Europe's Ban on GM Crops with Hunger. May 22.
Noah, L., Merrill, R., 1998. Starting from Scratch: Reinventing the Food Additive Approval Process. Boston University Law Review 78, 329.
Office of Science and Technology Policy (OSTP), 1984. Proposal for a coordinated framework for regulation of biotechnology; Notice for public comment. Federal Register 49, 50856.
Office of Science and Technology Policy (OSTP), 1990. Principles for federal oversight of biotechnology: planned introduction into the environment of organisms with modified hereditary traits. Announcement of policy, notice for public comment. Federal Register 51, 23302.
Office of Science and Technology Policy (OSTP), 1992. Exercise of federal oversight within scope of statutory authority: planned introduction of biotechnology products into the environment. Announcement of policy. Federal Register 57, 6753.
Office of Science and Technology Policy (OSTP), 1986. Coordinated framework for regulation of biotechnology. Federal Register 51, 23303.
Paarlberg, R., 2001. The Politics of Precaution: Genetically Modified Crops in Developing Countries. Johns Hopkins University Press, Baltimore, MD.
Pelletier, D., 2005a. Science, law and politics in FDA's genetically engineered foods policy: FDA's 1992 policy. Nutrition Reviews (May), 171–181.
Pelletier, D., 2005b. Science, law and politics in FDA's genetically engineered foods policy: scientific concerns and uncertainties. Nutrition Reviews (June), 210–223.
Pelletier, D., 2005c. Food safety and consumer choice policy. In: Omamo, S.W., von Grebmer, K. (Eds.), Biotechnology, Agriculture and Food Security in Southern Africa. International Food Policy Research Institute, Washington, DC.

Persley, G., Lantin, M., 2000. Agricultural Biotechnology and the Poor. Consultative Group on International Agricultural Research, Washington, DC.

Pew, 2004. Issues in the Regulation of Genetically Engineered Plants and Animals. Pew Initiative on Food and Biotechnology. Pew Charitable Trusts, Washington, DC.

Roberts, M., 2004. Anatomy of the Government's role in the recall of unsafe food products. Available from: <www.nationalaglawcenter.org/assets/articles/roberts_recall.pdf>.

Royal Society of Canada, 2001. Elements of precaution: recommendations for the regulation of food biotechnology in Canada. Expert Panel Report prepared for Health Canada, Canadian Food Inspection Agency and Environment Canada. Ottawa, Canada, Royal Society of Canada.

Schubert, D., 2002. A different perspective on GM food. Nature Biotechnology 20, 969.

United Nations (UN), 2003. Statement regarding the use of GM foods as food aid in Southern Africa. Joint statement released on behalf of the Directors-General of FAO, WHO and WFP, by Mr. James T. Morris, UN Secretary-General's Special Envoy for the Humanitarian Crisis in Southern Africa and Executive Director of WFP.

United States Department of State, 2003. Questions and answers on US food aid donations containing bio-engineered crops. Fact Sheet, United States Department of State, International Information Programs.

Viscusi, W., 1998. Rational Risk Policy. Oxford University Press, Oxford, UK.

Wall Street Journal. 2003. Bush steps up attack on EU over its ban on biotech crops, May 21.