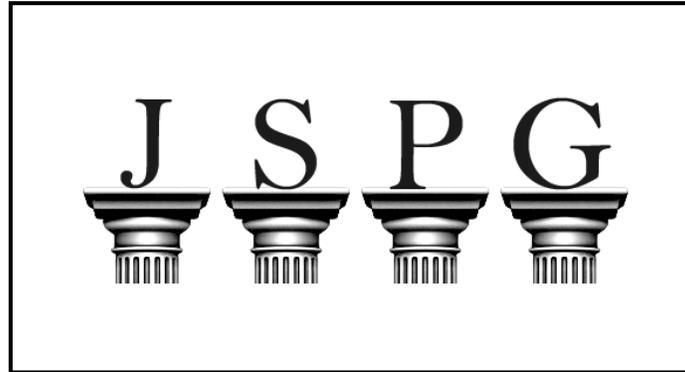


The Journal of Science Policy & Governance



Policy Analysis:

CONSUMER KNOWLEDGE OF GENETICALLY ENGINEERED ORGANISMS

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EXECUTIVE SUMMARY

Genetically engineered organisms (GEOs) and their derivative food products are a topic of significant debate among the scientific community, the biotechnology industry, farmers, consumers, and regulatory bodies. This paper addresses the lack of reliable and balanced information that reaches the average consumer. Consumers are bombarded by an array of information and marketing that is either too simplified or too technical, and fails to address their questions and concerns. The ultimate effect of this problem is a persistent lack of understanding about GEOs among consumers in the United States, as well as a lack of understanding of consumer concerns by stakeholders such as the biotechnology industry and regulatory agencies. This has led to distrust of the regulatory bodies and biotechnology industry by many consumers, which is consequential for effective policy-making. With ever-increasing expectations of public involvement in the policy-making process, the need to increase consumer knowledge is critically apparent. A Pew Research Center study found 26% of Americans believed they had consumed genetically engineered food (Mellman, 2006). In a 2010 survey by the International Food Information council, only 28% of respondents knew genetically engineered foods were sold in stores (International, 2010). Although consumers may not be aware of their intake of food products made from genetically engineered crops, the USDA ERS has found genetically engineered crops are used in approximately 70% of all American processed foods (Byrne, 2010), making this policy problem both relevant and far-reaching in importance.

This brief seeks to provide policy alternatives for effectively educating and communicating with the general public concerning GEOs in consumer products in hopes of improving the quality of GEO policy in the United States. Regulatory activity related to GEOs within the federal government has historically been directed by Office of Science and

Technology Policy. Three alternatives are analyzed in this paper beyond the status quo. These include the creation of a federal sub-agency, whose responsibilities include GEO regulation and education; development of federal nation-wide panels conducted in a town-hall fashion to address the concerns of consumers; and the Federal implementation of an online forum to generate greater consumer participation around a conversation on GE products. The recommendation made is based on five criteria: public trust in quality of information provided, effectiveness in maintaining rights of stakeholders, equality of information gain, political feasibility, and cost and is a combination of two alternatives. Combining federal nation-wide panels and public forums provides the best way to engage the most consumers with the least cost while maintaining stakeholder rights and trust.

BACKGROUND

Gatherers, farmers, and naturalists have been saving seeds found in nature to plant new crops for millions of years (History, 2012). This practice led to the domestication of many plants that are now considered staple crops. Natural hybrids were created as early as 1900 when farmers and naturalists bred plants with certain desired characteristics with other plants in the same or similar species that contained undesired characteristics.

Plant breeding changed with the discovery of DNA by Watson and Crick in 1953, (History, 2012) eventually leading to the ability to splice genes from the DNA of one organism into the DNA of a different organism. In 1973, the first successful recombinant DNA organism was created by Herbert Boyer and Stanley Cohen. This success called into question whether recombinant organisms could be patented. In 1980, the U.S. Supreme Court ruled in that they could. In *Diamond v. Chakrabarty*, the court ruled 5-4 that the bacterium modified by Ananda

Chakrabarty to assist in oil spill clean-up was “a live, human-made micro-organism... [was] patentable subject matter under 35 U.S.C. § 101. Respondent's micro-organism constitutes a ‘manufacture’ or ‘composition of matter’ within that statute” (Diamond v. Chakrabarty, 1980). Subsequently, other companies began to alter organisms and patent them. Two years later, in 1982, the U.S. Food and Drug Administration (FDA) approved the first genetically engineered (GE) drug called Humulin, a human insulin produced by engineered bacteria (History, 2012).

In 1986, the first field tests of GE plants were conducted with tobacco in Belgium, and in 1987 GE tobacco and tomato plants were the first in the United States. In 1992, the first GE food was ruled “not inherently dangerous” by the FDA and the ‘Flavr Savr’ tomato was allowed to be commercially produced by the U.S. Department of Agriculture (USDA). Despite this early governmental acceptance not all groups were comfortable with genetic engineering and in January 2000, the Convention on Biological Diversity in Montreal, Canada allowed concerned parties to voice their opinions (Convention, 2012). From this forum, the Cartagena Protocol on Biosafety was developed, which takes a precautionary approach to handling GE organisms.

The U.S. regulatory system for GEOs is governed by three agencies based on contentious interpretation of legislation created as early as 1908. The USDA evaluates risk to agriculture, the FDA assesses food safety hazards when GEOs are voluntarily submitted by their creators, and the Environmental Protection Agency (EPA) reviews GEOs with pesticidal properties, with specific concern for human and environmental health (McHugen & Smyth, 2008; OSTP 1986).

EVIDENCE FOR THE PROBLEM

Consumers face significant barriers in understanding GEOs. The risks and advantages of GEO production are debated in a wide range of topics, including advantages to developing countries,

economic issues, environmental impact, ethical and social considerations, public confidence in regulatory procedures for GE crops, and human health” (Magana-Gomez, 2009). The USDA defines “genetic engineering” as “manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA techniques” (USDA, n.d.). The highly technical nature and vast range of subjects within which GEOs are debated limits the ability of the average consumer to understand those issues, thereby excluding much of the general public from participation in the discussion.

A comprehensive review of GEO oversight in the U.S. found that experts see the GEO oversight system as highly complex (Kuzma, 2009). While the study observes that the complexity of oversight may have either positive or negative qualities, the complexity presents a significant challenge for consumers to understand the intricacies of the oversight process. In order to gather comprehensive information on GEOs through the responsible regulatory agencies, consumers must sift through information and regulations provided by all three agencies. Additionally, the FDA, USDA, and EPA have been directed to evaluate GE crops on scientific criteria (OSTP, 1986) that fail to account for many stakeholder concerns and values in GE crop regulation. Instead, regulation is based primarily on discussion between industry stakeholders and the regulatory agencies. This creates a flawed system and encourages distrust of the U.S. regulatory system while failing to encourage education and participation in the democratic system. Further research is needed on the extent and consequences of consumer distrust of regulatory bodies and industry with respect to GEOs.

The media is often the primary source of information to the public when general knowledge of a subject is low (Goya & Gurtoo, 2011). A 2002 study by Frewer, Miles, and Marsh looked into the consumer perception of GEOs after imports of genetically engineered soy began to gain broad media attention in the UK, which took place between 1998 and 1999. When reporting on GE foods was at its highest levels, they found that public perception of risk and other possible negative consequences surrounding GE foods also increased (Frewer et al., 2002). However, as reporting lessened, perception of risk and negative consequences fell. In the U.S., consumers have similarly been found to be highly reliant on the media to understand complex new technologies and the issues that surround them (Ten Eyck, 2005). Highly polarized information available in the media contributes to the lack of general understanding about GMOs. While industry experts insist that GEOs have not been shown to cause harm, an article in *Better Nutrition* argues that the health risks associated with eating GE foods can include infertility, immune system problems, accelerated aging, disruption of insulin and cholesterol regulation, gastrointestinal problems, and organ damage (Smith, 2011). Given the paucity of middle ground between these two opposing viewpoints, consumers are left without a clear idea of which views have merit.

Several studies have examined the views of consumers toward GEOs and their willingness to pay a higher price for non-GEO products (Fernandez-Cornejo & Caswell, 2006). According to industry research, consumers tend to favor GEO products that offer consumer benefits such as increased nutritional value (IFIC, 2012). However, further studies are needed to analyze the correlation between consumer understanding of GEO issues and their views and willingness to pay for GE products.

The most recent forum for public debate on GEOs being used in food is Proposition 37 in California. The initiative sought to require:

labeling on raw or processed food offered for sale to consumers if the food is made from plants or animals with genetic material changed in specified ways; prohibited labeling or advertising such food as ‘natural’; exempted from this requirement foods that are: certified organic; unintentionally produced with genetically engineered material; made from animals fed or injected with genetically engineered material but not genetically engineered themselves; processed with or containing only small amounts of genetically engineered ingredients; administered for treatment of medical conditions; sold for immediate consumption such as in a restaurant; or alcoholic beverages. (California Official Voter Information Guide, 2012)

Prior to the 2012 election, a USC Dornsife/L.A. Times poll reported on September 27th, 2012 found supporters outnumbered foes of Proposition 37 approximately 2 to 1 (Lifscher, 2012). By November 6th, however, the measure was defeated 53% to 47%. Some news sources suggested this change was precipitated late in the election cycle due to the \$46 million spent on advertising, which was given largely from companies such as Monsanto and PepsiCo, especially since these advertisements primarily warned of increased food prices and confusing new rules for farmers and grocers (Baertlein, 2012).

In a survey conducted in 2012 by the campaign group “Just Label it!,” which represents a variety of organic farming interests, 91% of Americans said the FDA should require “foods which have been genetically engineered or containing genetically engineered ingredients be labeled to indicate that” (Mellman, 2012). However, a survey conducted by the International Food Information Council, a non-profit supported by the food and agricultural industries, but

which does not lobby for legislative action, found in their 2012 survey that only 24% of the 750 people surveyed could think of additional information they would like to see on food labels (IFIC, 2012). This small percentage could be related to the small number of consumers that are aware of GE foods in the market already, and without this base of knowledge cannot be expected to anticipate necessary labeling. Although the percentage of skeptics of GE crops in the United States is unclear, skepticism of the utilization of GE crops in foods is not limited to the U.S. Fifty countries currently require labels on GEO food products, and Peru passed a law restricting the growth of GE crops until 2021 (Boderke, 2011; Westervelt, 2012).

At the heart of this issue is the concept of “freedom of choice” and the ability to obtain information necessary to make this choice. As noted in the publication *Freedom of Choice: Concept and Content*, this idea is at least as old as Aristotle and is still at the heart of many nations’ core beliefs (Sen, 1987). The United States has traditionally valued the idea of “freedom of choice” as it correlates with the general ideals of a democracy. Just, as the people in a democratic society have a voice in choosing their representatives in government, they expect to have choices in the marketplace. Although U.S. consumers appear to be able to choose from whichever foods they wish to purchase, those consumers who desire to make their food decisions based on information about GEOs do not have easy access to clear information from a neutral source. To illustrate, a Google search of “safety GMO food”, as of April 26, 2013, has 24.5 million results. The top result is from WebMD, followed by a University of California–Davis publication, the Public Broadcasting Service (PBS), Monsanto Inc., and the Center for Food Safety. These five sources reflect the beliefs of two of the six stakeholder groups that will be discussed later in this brief, but only the PBS website includes quotes on safety of GE products from industry, academia, NGOs, and the federal government (Viewpoints, 2001).

Evidence for the lack of understanding about GEOs among consumers is clear in the Pew Research Center and the International Food Information Council studies mentioned earlier in this paper (Eng, 2011). Of the 26 % who believed they had eaten foods made of GEO crops, some would likely be surprised to know GEOs are present in foods purchased in organic markets. Alexis Baden-Mayer, political director of the Organic Consumers Association told LA Times writer Monica Eng, “No one would guess that there are genetically engineered foods right here in Whole Foods” (2011). Consumers who perceive Whole Foods or other natural foods stores to be bastions of organic and natural products may not fully realize the pervasive presence of GEOs in the food chain. Since foods containing GEOs are not labeled as such, consumers may make assumptions about where products containing GEOs are found. For those who are interested in purchasing products made of non-GEO ingredients, these knowledge gaps must be addressed.

EVIDENCE FOR ALTERNATIVES

Science Review

In 2002, the United Kingdom undertook a GE Science Review Panel to explore scientific uncertainty in GE crops entitled “GM Nation?.” The goal of the panel was to “address questions and concerns about GM crops that were expressed by the public in a series of workshops and meetings, and through the science review website” (Myhr, 2010). Rowe et. al (2005) evaluated the public debate and identified weaknesses in results including:

participants were not particularly representative of the wider public, and they tended to be more negative (or at least, less positive) about GM food than the UK public. The ultimate influence of the debate was also minor (as suspected might be the case by participants at the time), as became apparent later, when subsequent policy was set in accordance to other concerns and with no clear input from the debate results. Resources (especially in terms of time) were also insufficient (Rowe, 2005).

However, feedback from participants was generally positive regarding the moderators and the events. GM Nation? provides a valuable model upon which to base a national-level public debate, as well as valuable information on potential shortfalls of such a system. One of the major problems of the GM Nation? debate was a failure to articulate clear objectives for the panel until well into the process (Rowe, 2005). Future implementation of a program similar to the UK panel should be sure to articulate clear objectives prior to the start of the program, and take into account representation, intended influence, and appropriate resources.

Stakeholder Forums

Between early 2001 and May 2003 the Pew Initiative on Food and Biotechnology (PFIB) established a stakeholder forum that included representatives of the biotechnology industry, environmental and consumer advocacy organizations, farming and ranching communities, food processing and marketing companies, and academia (2003). The goal of the forum was to achieve “consensus on a package of regulatory reforms described in sufficient detail to enable an agreement on implementation” (PFIB, 2003). The forum did not succeed in its primary goal. However, it achieved other successes that are relevant to consumer education. Specifically, the forum allowed “members to be exposed to different ideas and perspectives, learn from each other, and forge new relationships” (PFIB, 2003). These would be useful goals when establishing forums that seek to provide balanced and accurate information to the public. One downside was that the Pew forum was confidential in nature and was thus not open to the public, which would not be appropriate for a forum seeking to provide public education. Aspects of the forum, however, would be fitting analogs. For example, the Pew forum hired neutral mediators from an outside company, and all members of the forum agreed to a basic set of assumptions about the

discussion and rules of behavior within the forum. While the Pew Initiative provided funding for its own forum, the alternative recommended in this paper calls for federal funding for stakeholder forums. As long as genuine efforts are made to ensure neutral moderation, the funding source should not affect the goals of the forums. When the Pew forum concluded, members agreed that it was a productive process and that reconvening later to try to achieve compromise toward regulatory reform would likely be worthwhile. Providing information to the public is a broader and more open goal than that proposed by the Pew forum. Using some of the methods from the forum as well as including consumers in a much larger discussion is expected to promote the goals of public education and feedback.

Online Consumer Education

Internet use has become a powerful tool for interface between government and constituents. 82% of internet users, comprising 61% of all Americans, had looked for or completed a transaction on a government website within the previous 12 months in a study conducted by the Pew Internet and American Life Project in 2009 (Smith, 2010). This represents an ideal opportunity to make information available to interested consumers. The USDA Agricultural Marketing Service created the Organic Literacy Initiative as a system for educating consumers about USDA organic standards and initiatives. It provides consumers and other stakeholders a single-source point of information about USDA organic certification process and standards through informational briefs, blogs, brochures, and email updates available through the USDA website (USDA AMS, 2012). Other agencies, such as the National Science Foundation (NSF), have pursued similar initiatives. The NSF offers media to even the youngest consumers, providing resources to educators on a broad range of topics. A federal GEO sub-agency would be responsible for

consolidating information at a single-source website and offering resources to consumers through briefs, videos, blogs, and email updates. It would consolidate trends in consumer concerns from local branches and use this information to provide relevant and accessible information through its website.

Social media has widely been accepted in business as a replacement to the suggestion box (Bi & Kanston, 2012). More recently, it has come to be accepted as an increasingly powerful tool for civic engagement. 60% of American adults use social network sites and 66% of those have taken part in some sort of civic engagement via social media (Pew, 2012). A number of government agencies have created effective tools for marketing and education that employ the internet and social media. The National Academies Press (NAP) and the NSF allow the public to follow the latest news and updates on Facebook, Twitter, YouTube, and other social media sites. The NSF social media site strives to “ [keep]... the goals of open government (transparency, public participation and collaboration),” and provides rules and disclaimers for ensuring that public comments are appropriate. NAP’s and NSF’s employment of social media share several characteristics: they are conspicuous on their main websites, they take advantage of multiple social media platforms, they are easy to find using popular search engines, and they offer users opportunities to stay engaged through comment sections, email newsletters, and other Internet updates.

Other social media sites, such as “Quora,” provide an efficient and cost-effective model for promoting the flow of information to and from the public. Quora supports an easy to navigate question and answer style forum where expert-provided answers are promoted by Quora users above amateur responses. This forum promotes a sense of accountability from those who contribute, and persons who continually provide false information lose credibility.

The Internet contains vast and expanding stores of information. It can be a helpful resource for consumers, but its very vastness is also its downside. An individual consumer would never be able to sift through all of the information available, so must instead make judgments about the credibility of sources and reliability of information. While polls have shown that people are turning to the Internet for information, no studies have yet demonstrated whether the information available is helping consumers to make better-informed choices. Additional research is needed on the efficacy of social media as a public education tool.

POLICY ALTERNATIVES

This section examines four potential methods of improving the flow of information to consumers about GEOs. These include [1] Current Education and Regulation Methods (Baseline); [2] Creation of a Federal GEO Sub-agency; [3] Federal nationwide Science Review Panels; and [4] Federal Promotion of Public GEO Communication and Education Forums.

[1] Current Education and Regulation Methods (Baseline)

This method presents no change in course from the current state of GEO education strategies directed at consumers. This model relies on scientific information to be disseminated to consumers through public and private means. Applied research, public and private alike, will be relied upon to provide consumers who seek it with usable knowledge about GEOs. Consumers who wish to take part in the rulemaking and regulatory process will rely on this information. This group will continue to have access to regulatory reviews performed by federal regulators, and will also have opportunity to take part in the Department of Agriculture's public input EIS

draft stage, where its feedback and suggestions are taken into consideration by the department when drafting final regulations. This model assumes consumers will be provided with information by either federal regulatory reviews or by private corporate and organization sources, which is then applied to informed involvement in purchasing decisions and policy support. Federal costs for this alternative are fairly low.

[2] Creation of a Federal GEO Sub-agency

In this alternative, a Congressional statute will define authority of a newly created sub-agency over all matters related to GEO production in the United States. These “enabling acts” will include all GEO regulation and information activities formerly tasked to the USDA, FDA, and the EPA. This model dictates that the newly created sub-agency will regulate GEO environmental standards, agricultural security, and human consumption safety. Many of the regulation tenets of this new agency will be derived from the Coordinated Framework for Regulation of Biotechnology (Executive Office of the President, 1986). Aside from creating a single regulation agency of GEOs in the United States, the key responsibility of this sub-agency will be to gather, analyze, and disseminate scientific information regarding GEOs for public and consumer knowledge. In an effort to increase public trust of federal activity, information gathering and public dissemination oversight will be provided by the non-profit National Academy of Sciences. A budget will be provided for applied GEO federal research conducted within the sub-agency, as well as a sub-agency discretionary budget for funding research by public and private sources. Local branches of this sub-agency will be dispersed throughout the United States. These local branches will be responsible for relaying scientific discoveries to the public in their respective areas through a variety of means such as consensus conferences,

coordination with local press and media outlets, and town hall style gatherings, among others. Efforts will be made by this newly formed agency's local branches to extend information outreach methods to a variety of demographic populations (e.g. rural, urban, high-income, low-income). Internet marketing efforts of agencies such as NSF and USDA can be used as a model for outreach programs by the new agency. Cost estimates for this model range anywhere from \$150 million (Treasury, 2012) to \$450 million (Prior, 2012) annually, plus initial start-up and implementation costs.

[3] Federal Nationwide Panels

This alternative calls for a federal initiative with the intention of evaluating current scientific understanding about GEOs, as well as identifying areas of uncertainty and public concern. This model will be designed in a similar fashion to efforts undertaken by the United Kingdom in 2002 (Myhr, 2010). There will be three major strands of this effort: scientific review about current GEO findings, economic studies about how GEOs impact relevant economic sectors and geographical areas, and a public debate among consumers. Lessons from both the Pew forum and GM Nation? panel can be used in designing the public debate. These nationwide science review panels will be organized and conducted by the Office of Science and Technology Policy (OSTP) in conjunction with the USDA, FDA, and EPA. OSTP will organize, design, and distribute panels across the country to conduct a series of voluntary meetings and workshops. Through these panels, OSTP will discuss relevant scientific and economic information regarding GEOs, using information provided by relevant federal agency reports. Crucial to this alternative is identifying the questions and concerns of constituents and consumers regarding GEOs, and addressing them specifically in the meetings and workshops. The public debate portion of this

alternative provides a platform of discussion to occur between consumers, and topics of debate will be determined in a “town-hall” format, with consumers providing areas of concern or uncertainty to be discussed. Annual budgets are expected to be approximately \$5 million GM Watch, 2003).

[4] Federal Promotion of Public GEO Communication and Education Forums

This alternative involves a two-way interaction between GEO consumers and producers through a process that is facilitated by components of the federal government. Creation of information networks and communication routes will allow for consumers to converse directly with major stakeholders (other consumers, scientists, industry, etc.). Participation by all stakeholders will be on a voluntary basis, and most of the discussion will occur online through web outlets (forums) created and maintained by OSTP directly. This alternative allows and encourages wide stakeholder participation, in hopes of generating conversation and education from a variety of perspectives. A limited number of regional public forums that promote in-person dialogue among all stakeholders will be included, using the Pew forum as a model. In addition to online and regional forums, OSTP will generate conversation on social media outlets such as Twitter, Facebook, Reddit, Quora, etc. This alternative will be relatively inexpensive for the federal government to implement and maintain, in line with current federal social media efforts such as the White House’s Google Hangout series (Schulman, 2013), the Federal Communications Commission’s (FCC) Roundtable program (FCC, 2013), and The National Aeronautics and Space Administration (NASA) frequent use of Reddit to generate public discussion.

STAKEHOLDER ANALYSIS

A study undertaken by the USDA Economic Research Service identified the three major stakeholders concerned with GE crops as the seed industry and technology providers, farmers, and consumers (Fernandez-Cornejo & Caswell, 2006). The specific issue of consumer education in GEOs includes these stakeholders, as well as organic farmers, non-governmental organizations (NGOs) and regulatory agencies. Organic farmers are included separately from conventional farmers due to the groups' fundamentally different views on GEOs (food certified as USDA organic must be less than 1% GE), as well as the rapid growth in the market for organics - 17,281 farms and processing facilities were certified USDA organic between 2002 and 2012, an increase of 240% prior to 2002 (USDA, 2012). Organic farmers represent the most fluid stakeholder group, whose influence and interest in consumer education is likely to change over time with changes in popularity of organic products. NGOs represent varying interests in the debate over GEOs, but generally support consumer education. Regulatory agencies are also included as stakeholders, because the authors believe that it is primarily the responsibility of regulatory agencies to provide accurate, accessible, and balanced information to consumers. Table 1 uses the Varvasovszky & Brugha (2000) model for stakeholder analysis to provide the breakdown of stakeholder interests and influence.

Table 1. Stakeholder Analysis.

Stakeholders	Characteristics	Interest	Influence	Position	Impact
Seed suppliers/ Technology providers	Strong economic interest in ensuring efficient approval and path to market of GEOs. Prefer consumer education be biased toward positive perception of GEOs.	High	High	Conditionally Opposed	High
Conventional Farmers	Interested in safe and efficient farming practices that have the potential to increase yields and ease struggles with plants pests and weeds. Consumer education a low priority.	Low	Medium	Uncertain	Medium
Organic Farmers	Rely on organic (non-GEO) standards for their market. Potential contamination with GE crops threatens the organic market. Prefer consumer education be biased toward risks of GEOs and advantages of non-GEO crops.	High	Medium	Conditionally Favorable	High
Consumers	Multiple concerns. Economic interests (prices), food safety, long-term ecological and environmental safety.	Varying	Medium	Uncertain	Varies
Regulatory Agencies	Responsible for providing a means for consumers to gather balanced, accurate information.	High	High	Favorable	High
Non-Government Organizations	Represent consumer, farming, and other stakeholder groups.	High	Medium	Favorable	Uncertain

CRITERIA

Each policy alternative is evaluated according to five major criteria: [1] public trust of information, [2] effectiveness in maintaining rights of stakeholders, [3] equality of information availability, [4] political feasibility, and [5] cost.

[1] Public Trust in Quality of Information Provided

Alternatives are expected to increase the amount of knowledge amongst GEO consumers by utilizing minimally biased information. By educating consumers with minimally biased sources of information, an increase of public trust should be expected. Any chosen alternative is expected to demonstrate an associated increase of public trust in the quality of information provided. The importance of public trust rests on the assumptions that both accurate and balanced information is the basis of the public trusting information providers. This criterion will be measured by a series of surveys designed to explore public trust of the GEO industry, NGOs, the National Academy of Sciences (NAS), the NSF, the International Food Information Council (IFIC), involved federal agencies, and any other organization that might have a stake in the process. As accurate and balanced information is so critical to increasing consumer knowledge, only those alternatives that are expected to increase public trust of information providers should be considered.

[2] Effectiveness in Maintaining Rights of Stakeholders

Any policy alternative that infringes further on the legal or market rights of stakeholders should not be considered. Alternatives that seek to increase the quality of knowledge to consumers about GEOs should also be considered for their impact on each stakeholders' legal and economic rights.

[3] Equality of Information Gain

Any alternative, or set of alternatives, chosen should improve consumer knowledge related to GEO production and use equally across demographic and socioeconomic groups. There should

not be any one consumer group that becomes more knowledgeable while other groups continue to lag behind. The only appropriate unequal increase in information gain between groups would be if those currently undereducated groups were to increase their knowledge of GEOs at a faster pace than those who are considered to currently have a high degree of knowledge, in effect lessening the knowledge gap between the two groups. As the goal here is to increase total consumer knowledge, this convergence cannot be at the expense of those who are considered informed on GEOs. Equality of information gained will be measured by national polls designed to determine how much consumers feel they are informed about GEOs and what opinions on current individual GEO issues are. Demographic and socioeconomic indicators will be requested with each answer set. An alternative that is not expected to increase knowledge of all consumers should not be considered.

[4] Political Feasibility

Current and future political activity must also be considered when choosing policy alternatives. With potential alternatives that require large-scale federal and local coordination, it is crucial to understand how these actions will be reflected and supported amongst other governing bodies and constituents. Considering the amount of large-scale federal and local coordination proposed in several alternatives, political feasibility will also be measured by the likelihood of being able to successfully implement a given alternative. If one alternative is considered to be extremely unpopular politically, or is expected to provide great difficulties in implementation, it should not be considered.

[5] Cost

Alternatives that are low in cost will make it possible for the federal government to consider as many methods as possible to improve the quality of information about GEOs reaching consumers. Cost will be measured in both initial, up-front expenditures, as well as future maintenance.

OUTCOMES

The outcomes expected from the proposed policy alternatives as well as the trade-offs are discussed in this section. The outcome matrix below illustrates projected outcomes of each alternative as measured by the related criteria. With the exception of “Cost,” the outcome matrix assigns either a “Low”, “Moderate”, “High”, or “N/A” for each alternative/criteria relationship.

[1] Status Quo

Expectations from the “do-nothing” approach are low. There is a significant lack of understanding of GEOs among the public. As mentioned previously, only slightly more than a quarter of Americans believed they had ever eaten GE products, and less than 30% thought GEOs were sold in stores (Eng, 2011). Expectations for the alternatives seek to increase public understanding and awareness of GEO foods above this baseline.

Cost

Continuance of current consumer education methods is projected to have the lowest additional cost to the federal government out of all examined alternatives. Future consumer education will continue to be provided primarily by NGOs and GEO industry stakeholders, and no additional cost will be expected on behalf of the federal government.

Table 2. Projected Outcomes Matrix

	Public Trust in Quality of Information Gained	Effectiveness in Maintaining Stakeholder Rights	Equality of Information Gained	Political Feasibility	Cost
Current Education Methods (Baseline)	Low	N/A	Low	High	No Additional
Creation of a Federal GEO Sub-agency	Moderate	Low	Moderate	Low	\$150-\$450 million annually
Federal Nationwide Panels	Moderate	High	Low	Moderate	\$5 million annually
Federal Promotion of Public GEO Communication and Education Forums	Moderate	High	High	High	<\$1 million annually

[2] Federal Sub-Agency

The creation of a federal GEO sub-agency would be intended to provide an honest-broker approach to information disseminated to the public about GE foods. Much of the information most accessible to the public is highly biased, both pro- and anti-GEO. A sub-agency would compile accurate scientific information and offer a single source for valid, balanced information for consumers looking for a scientifically accurate and unbiased perspective on these foods.

Public Trust

Building public trust could be achieved through this sub-agency alternative if managed appropriately. Transparency to stakeholders, particularly consumers, is crucial and must be prioritized. Two-way communication in the dissemination information is paramount and would

enhance public trust of the agency. Consumers need to know that their concerns are being acknowledged and addressed. This alternative is expected to increase public trust of stakeholders by increasing the public's perception how information is gathered and distributed. Public trust can be gained through a variety of means including: responsiveness to constituents, setting realistic goals that can be attained with current resources, good communication - giving the public information when they need to know it as opposed to when it is politically strategic, and showing a need for the goals of the agency and unbiased information (Mathers, 2012). Oversight by the NAS will create a "buffer" of perceived unilateral federal power and education orientation, easing public concerns about potential federal capture. A non-profit scientific organization such as the NAS is likely a beneficial partner in increasing public perception of unbiased information, since a 2010 study conducted by the NSF concluded that roughly equal percentages of Americans expressed "a great deal" of confidence in medical and scientific leaders (National Science Foundation, 2012).

Effectiveness in Maintaining Rights of Stakeholders

Creating a federal sub-agency for the purpose of governing all matters related to GEO products will impact stakeholder rights quite differently across different groups. The implications of a newly created governing body is expected to impact seed suppliers, farmers, consumers, and other regulatory bodies, so the maintenance of current stakeholder rights must be considered.

Right maintenance for the following stakeholder groups are projected here:

- For seed suppliers and technology providers, a sub-agency could potentially be a hindrance to their business model because of increased intervention. However, for consumers opposed to GE products primarily because of the lack of information, the creation of a sub-agency could quell their concerns and be beneficial in the long term for seed suppliers and technology providers.

- Conventional farmers may be interested in incorporating certain GE techniques and products into their production, and having a sub-agency devoted to disseminating information could be potentially useful for them to make those decisions, as it comes from an alternative, theoretically unbiased, source rather than seed suppliers and technology providers.
- Organic farmers would likely be the stakeholder group most interested in the creation of a federal sub-agency. Through this agency, it is predicted that they would lobby for more stringent regulations on GE crops to keep these crops from encroaching onto organic fields. This group would most likely be in favor of the distribution of unbiased information about GE crops.
- A federal sub-agency would be beneficial to consumers as it could be an honest-broker to a greater extent than current information sources, but for the most part consumers would not be substantially involved in this alternative.
- For regulatory agencies this would be the alternative with the greatest impact. Funding from other agencies directed at GE products would be pooled to create this agency, new employees would be needed, and guidelines and roles for the agency established. While this alternative would mean the most work for the government, it would also have the greatest control in the actions and direction of the agency, and therefore the future of GE products in the American marketplace.
- The new agency would need to ensure that its educational material takes into account all stakeholders' viewpoints in order to maintain the rights of NGOs.
- Recent analysis suggests that placing responsibility directly on a federal sub-agency to represent a wide-variety of stakeholder perspectives is not necessarily appropriate (Meghani & Kuzma, 2011). The authors suggest that regulatory agency reliance on industry specialists for information and expertise may give the industry an unfair representation in the regulatory process. Assuming that this observation is true in this newly created sub-agency, education of consumers by this sub-agency may be overly influenced by a single stakeholder group (industry) as well, and thus will not be effective in maintaining the rights of all stakeholders.

Equality of Information

While it is possible for a federal sub-agency to keep an unbiased view of GE products, and this is the goal of the agency, there is significant lobbying power and funding from lobbying groups that could be persuasive. In order for this alternative to succeed at informing wide demographic and socioeconomic groups, this agency needs to take a true honest-broker approach and not allow exterior interests to push it into an issue advocate role.

Political Feasibility

The plausibility of creating a sub-agency would be dependent on the politics of the administration. The staffing of the agency should be made by non-partisan players that could resist lobbying efforts of both industry and anti-GE groups to ensure unbiased information dispersal to the public. Out of all examined options, this alternative will likely require the most coordination across federal agencies, as well as extensive cooperation with state and local governments throughout the data gathering and education process. The high cost and difficult implementation of this alternative is likely to draw public criticism.

Cost

Creation of a single federal sub-agency is likely to have the highest start-up and annual costs out of each proposed alternative. Cost estimates project annual federal expenses to be between \$150 million and \$450 million. These projections are based on annual budget requests of two recently created federal agencies, the Office of Financial Research (OFR) and the Consumer Financial Protection Bureau (CFPB). The OFR and the CFPB annually request approximately \$150 million (Treasury, 2012) and \$450 million (Prior, 2012), respectively. This projection assumes that similar annual infrastructure and human capital levels required by the OFR and the CFPB will be provided for this newly created sub-agency as well. Additional cost estimates must also consider the potential start-up costs of a federal sub-agency.

[3] Federal Review Panels

The creation of federal review panels & engagement would seek to educate the segment of the population most interested in learning more about GEOs. This alternative would be focused more on consumers who already have interests in learning about the foods they are consuming, but it is hoped that the popularity of these programs would encourage other less-informed consumers to seek additional information about their foods. Additionally, the accessibility of these panels would be an attempt to make it easier for citizens uneducated about GEOs to increase their knowledge.

Public Trust

The direct role of consumers in attending science review panels would likely go to increasing public trust, but only significantly for those actually attending the panels. The ability of the consumers to have their questions answered directly in a public forum should enhance this as well. In a memorandum from President Obama to the Heads of Executive Departments and Agencies, he stated: “government should be participatory. Public engagement enhances the Government's effectiveness and improves the quality of its decisions” (Obama, n.d.). This is central to the federal review panels. There could be significant dissent about the facts presented, including accusation of the panelists to be bowing to pro- or anti-GE interests. It is likely that these panels would be attended by people with strongly held feelings about GE products and any dissenting information from the attending public’s opinion could be seen as a cover-up of the facts.

Effectiveness in Maintaining Rights of Stakeholders

Federal Review Panels, although expected to be quite extensive in terms of scope and participation, likely represents a greater respect for stakeholder rights than other large-scale alternatives. Important stakeholder groups will be impacted in the following ways:

- Seed suppliers and technology providers would likely be more open to this approach than a sub-agency approach as it would inform the public and give the biotechnology industry the opportunity to make a good case for their products. But as these panels would not be directly related to policy, this alternative would be unlikely to further delay the approval process of getting products to market.
- While science review panels would not necessarily affect conventional farmers directly, they could get a better idea of consumers' wants and needs in food production which could be useful in their own practices.
- A large percentage of the consumers interested in science review panels would likely be those in favor of organic products, as they are a vocal consumer group concerned with the nature of their food sources. For organic farmers this could be beneficial to the sale of their products in grocery stores.
- Consumers would be the greatest beneficiaries from the science review panels. Interested consumers would have balanced information available to them and would have the opportunity to encourage their peers with less interest or education about GE products to take advantage of the process.
- Regulatory agencies would likely be involved in setting up the science review panels, perhaps with moderators from the government, but there would be far less involvement by the government in this alternative than in the creation of a sub-agency.
- NGOs would have a voice in the science review panels and allow them to offer assessments of science based on the values they represent.

Equality of Information

Science review panels would provide appropriate information for those in attendance, but the individual concerted effort required to attend these panels is significant. For the entire consumer base, equality of information is poor, because attendance is required, and this could present issues in geographical location, time, and accessibility of panels to all consumers, in addition to ensuring that all consumers are notified. Consumers in rural areas and those who are likely to

have little time to attend science review panels as a result of strenuous work schedules are not able to benefit from the educational impact that this alternative attempts to provide.

Political Feasibility

These panels should be politically feasible, unless there is significant argument with the price (discussed below). A representative of the OSTP would travel around the country to host these panels, and if the information provided is truly unbiased there should not be significant opposition by any local government. It is unlikely that a majority of citizens will outright reject federal funding and coordination of science review panels.

Cost

Additional cost estimates for federal science review panels are close to \$5 million annually. These projections consider annual costs of a similar program that was implemented in the United Kingdom (UK). The UK government agreed to provide roughly £500,000 to fund science review panels and concurrent public debates (GM Watch, 2003). Considering inflation (2003 to 2013), current exchange rates, and a larger population in the United States than in the United Kingdom, projected costs are expected to be higher than those seen in the United Kingdom in 2003.

[4] Federal Promotion of Public GEO Communication and Education Forums

This alternative could potentially reach the greatest segment of the population who may not otherwise engage in GEO research on their own. Through dissemination of information through social media outlets that are utilized by many different demographics, 66% of all adults who use the Internet use some sort of social media. A large portion of the population can be exposed to

scientific information about GE products through social media, particularly with people aged 18-49, those with some college education, and those with a household income of less than \$30,000 per year (Brenner, 2012).

Public Trust

Information easily accessible on the Internet through social media has the potential of reaching many consumers who might otherwise not engage in the research on their own. Details about what makes consumers disbelieve what they read on the Internet can help tailor the presentation of GEO information to alleviate any concerns about the credibility of information. A Harris Interactive Survey states that four reasons people might not believe what they read on the internet are: too many ads (59%), outdated information (56%), biased information (53%), and unfamiliar forums (45%) (Mancx Survey, 2012).

Effectiveness in Maintaining Rights of Stakeholders

Federal GEO education and communication forums likely represent the most effective method to maintain stakeholder rights out of the alternatives proposed. Generally, there would be a sense of apathy by seed suppliers and industry advocates, and other stakeholder groups would likely see an increase in their rights and participation in the process. Stakeholder rights can be broken down further:

- For the most part, seed suppliers and technology providers would be the most apathetic to education forums if they chose not to become involved. Conversely, they may find the forums to be receptive to direct industry conversation and feedback.
- For conventional farmers, communication and education forums would likely not involve them, unless they chose to be part of the conversation.
- Organic farmers would likely want to be part of the communication and education forums – and it would be pertinent to assure that there would not be arguments between the GE

industry and the organic industry by encouraging dialogue and providing a space for each group to present their case and air concerns. These forums would be moderated to ensure constructive conversation.

- Consumers would benefit from this alternative the most. It is the most easily accessible and is structured around their current lifestyles. It would allow them to spend the time and energy that they wish on finding out more about GE products, and with the community aspects of social media already in place in our society, it would introduce the idea of GE foods to people who wouldn't otherwise be exposed, necessarily interested, or would go out of their way to attend a science review panel.
- Regulatory agencies may be casually interested in the communication and education forums going on, but they would likely not be very engaged in the day-to-day conversations. If they were looking for the opinion of the public, however, this would be a trove of information.
- NGOs often struggle to come up with funding that would allow them to more effectively put out their message. Forums would give them the opportunity to be heard fairly alongside industry representatives.
- In general, this alternative will address the issue of perceived objectivity by the federal government. By accepting the fact that risk assessment evaluations are normatively charged and biased in nature (Meghani & Kuzma, 2011), the arguments made from each stakeholder group can be properly assessed when given a proper forum.

Equality of Information

The Internet is a great equalizer in our society. With access to the Internet, at home, work, on cell phones, or in a library or school, the same information is available to everyone. "Minority Americans are just as likely as whites to use government tools to keep up with the government, and are much more likely to agree that government outreach using these channels makes government more accessible" (Smith, 2010). With widespread dispersal of unbiased GE information via the Internet, the largest number of consumers would be able to increase their knowledge and make informed choices about their food purchases.

Political Feasibility

The Internet is a neutral forum for this type of information. As long as the facts presented are unbiased, pushback from political groups should be minimal. Sources of information would be available for any political group to use and reference, as well as allow the information to be presented through social media to be reposted by consumers themselves.

Costs

Projected costs for this alternative are expected to be the second lowest of all possible alternatives, at lower than \$1 million annually. This projection rests on several major assumptions. The first of these major assumptions is that little training of federal employees and stakeholders will be needed to effectively utilize social media outlets to generate conversation and inform the public. With examples such as the NAP, the NSF and the USDA's Agricultural Marketing Services already relying on social media communication, it is not a stretch to assume that little additional federal training/hiring will be required for this alternative's implementation. Another critical assumption of this policy is that the cost of communication will continue to drop, offsetting any additional costs that would be associated with expanding the reach of communication (a major tenant of this alternative).

TRADE-OFFS

The trade-offs for these policy initiatives are limited, but not inconsequential. The primary goal of these alternatives is to increase consumer knowledge of GE products, optimistically creating greater consensus among consumers. However, this is not a guaranteed outcome. Ensuring that consumers are well informed, or at least have access to the unbiased information that would be

required to make an informed decision, is an important part of living in a democratic society. The status quo leaves many consumers unaware of the products around them, tentative about GEOs, and unable to make educated decisions at the grocery store.

- A cost trade-off for any of these alternatives, though particularly for the sub-agency, would be that the resulting agency would likely reduce funds from the other agencies (FDA, EPA, and USDA) that currently regulate GEOs among other duties.
- Politicians who have large agricultural constituencies could be either for or against various alternatives based on their political affiliation. Representatives or senators with constituents who farm GE crops, for example, might oppose measures that in their mind would threaten their livelihood. Lobbying groups could also present difficulties in this respect. Lobbying groups for the agricultural industry, and largely agricultural states utilizing GE technologies would be against the creation of a sub-agency for fear it would slow down any approval processes.
- While each of the alternatives presents different ways to access unbiased information and allows consumers to educate themselves in the most convenient way, it is not guaranteed that all consumers will receive the education as hoped. A lack of interest on the part of consumers cannot be controlled, but making sure that each consumer is educated equally could be difficult when taking location and accessibility of the alternatives into consideration.
- It is possible that some stakeholders, likely seed suppliers and technology providers, will feel that their rights are being infringed upon if any of these education alternatives affect their business or the speed at which products are approved by the government for manufacture. It is not the goal of the authors to infringe upon these in anyway; not to slow the process of approval nor to hurt the retail viability of any GE or organic products.
- While it is possible that some consumers will be wary of any government intervention into their foods, it is hoped that consumers will trust the organizations providing them with the necessary information to make informed decisions about GE products.

An Executive Order by President Barack Obama shortly after he took office suggested to the director of the Office of Management and Budget that public opinion and participation should be

considered when evaluating regulatory process, and that the process should be transparent (Obama, 2009). This was discussed by Thompson (2007) with regard to GE products: “Non-governmental organizations, consumer groups and concerned citizens have ... been forced to construct arguments that are grounded in “science-based” risk evaluations to ensure that regulatory agencies will enter into a dialogue with them.” Introducing a forum for consumers, either through town-hall style discussions or via an online forum could make the regulatory process more transparent and understandable for consumers. This would fundamentally change the way the United States government makes regulatory decisions. While significantly important for the democratic process, it is not how regulation has traditionally occurred and a change from this process must be made carefully and with much thought.

RECOMMENDATION

When evaluating potential alternatives and policy recommendations for GEO consumer education, it is critical to understand the implications of recommending inappropriate action for GEO policy and civic engagement. The status quo (Alternative 1) does not offer a sizeable increase in public trust or equity of information gained. It has been proven to fail in educating vast numbers of consumers, and a continuance of this tactic will surely result in failed GEO policy in the future. Creating a single federal GEO sub-agency (Alternative 2) has been proposed in the past, yet is highly contentious. A lack of feasibility combined with the high cost of implementation makes this policy alternative prohibitive. Considering the potential implications of any recommendation, the authors have determined that an ideal solution is not reliant on one policy alternative alone. The authors believe that the benefits provided by creating Federal Review Panels (Alternative 3), and federal promotion of online GEO communication and

education forums (Alternative 4) are the most appropriate alternatives to adopt at this time. Pairing these alternatives will best meet the proposed criteria at the minimum cost. It is recognized that this recommendation brings questions as to how policy decisions and risk assessments are typically conducted, but in light of the initial move made by the President in the Executive Order, these policy alternatives and recommendations are made within clear bounds of political feasibility. The pairing of Alternatives 3 and 4 will be both practical and feasible in providing consumers with reliable and balanced information. The combination of these federal nation-wide panels and the online public forums provides consumers with an engaging and accessible platform for GEO knowledge while maintaining the rights of all stakeholders and securing trust in the information gained.

REFERENCES

- American Public Media. (2012). *History of genetic engineering*. Retrieved from: http://americanradioworks.publicradio.org/features/gmos_india/history.html
- Baertlein, L., & Gillam, C. (2012, November 7, 2012). California voters reject labeling genetically altered food. *Reuters*. Retrieved from: <http://www.reuters.com/article/2012/11/07/us-usa-campaign-california-gmo-idUSBRE8A60ZH20121107>
- Brenner, J. (2012). Pew Internet: Social Networking (full detail). Pew Internet & American Life Project: Pew Research Center. Retrieved from: <http://pewinternet.org/Commentary/2012/March/Pew-Internet-Social-Networking-full-detail.aspx>
- Bi, F., & Konstan, J. A. (2012). Customer Service 2.0: Where Social Computing Meets Customer Relations. *Computer*, 45(11), 93-95.
- Bittman, M. (2012, September 15). GMO's: Let's label 'em. *New York Times*, pp. SR3.
- Boderke, D. (2012, September 15). GM crops banned in Peru. *Farmers Guardian*. Retrieved from: <http://www.farmersguardian.com/home/latest-news/gm-crops-banned-in-peru/43842.article>
- Byrne, P. (2010, September). Labeling of genetically engineered foods. Accessed April 21, 2013. Retrieved from: <http://www.ext.colostate.edu/pubs/foodnut/09371.pdf>
- California Business Roundtable (2012). Initiative Survey Series 2012. Retrieved from <http://www.cbirt.org/initiative-survey-series-2012/>
- California Official Voter Information Guide (2012). Retrieved from: <http://vig.cdn.sos.ca.gov/2012/general/pdf/complete-vig-v2.pdf>
- Convention on Biological Diversity. (2012). *About the protocol*. Retrieved from: <http://bch.cbd.int/protocol/background/>
- "Consumer perceptions of food technology" survey. (2012). (Survey). Washington, DC: International Food Information Council.
- Department of the Treasury (2012). *Financial research fund FY 2013 President's budget submission*. Retrieved from: [http://www.treasury.gov/about/budget-performance/Documents/14-FY 2013 FRF CJ.pdf](http://www.treasury.gov/about/budget-performance/Documents/14-FY%202013%20FRF%20CJ.pdf)
- Diamond v. Chakrabarty (US Court of Customs and Patent Appeals. 447 U.S. 303 [1980]).
- Eng, M. (2011, May 24). With no labeling, few realize they are eating genetically modified

foods. *Los Angeles Times*. Retrieved from: <http://www.latimes.com/health/ct-met-gmo-food-labeling--20110524,0,6084626,full.story>

Executive Office of the President, Office of Science and Technology Policy. (1986). *Coordinated framework for regulation of biotechnology* (51 FR 23302)

Federal Communications Commission (FCC), (2013). *Cybersecurity Roundtable: Protecting Small Businesses*. Retrieved from website: <http://www.fcc.gov/events/cybersecurity-roundtable-protecting-small-businesses>

Fernandez-Cornejo, J. and Caswell, M.(2006). The First Decade of Genetically Engineered Crops in the United States. *Economic Information Bulletin* No. (EIB-11). Retrieved from: <http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib11.aspx>

Frewer, L. J., Miles, S., & Marsh, R. (2002). The Media and Genetically Modified Foods: Evidence in Support of Social Amplification of Risk. *Risk Analysis*. Vol. 22 No. 4; 701-711.

GM Watch (2003, February 27). UK debate on gm food to start in May/FSA attacked. Retrieved from: <http://www.gmwatch.org/latest-listing/42-2003/9313-uk-debate-on-gm-food-to-start-in-mayfsa-attacked-2722003>

Goya, P. & Gurtoo, S. (2011). Factors Influencing Public Perception: Genetically Modified Organisms. *GMO Biosafety Research*. Vol 2, No.1 1-11 (10.5376/gmo.2011.02.0001).

History of genetic engineering (2012). *American Public Media*. Accessed: April 21, 2013. Retrieved from: http://americanradioworks.publicradio.org/features/gmos_india/history.html

International Food Information Council (2010). Consumer Perceptions of Food Technology Survey. Retrieved from: http://www.foodinsight.org/Content/3843/Final_Executive%20Summary%20Food%20Tech%20Report_Website%20version_7-7-10.pdf

International Food Information Council (2012). Consumer Perceptions of Food Technology Survey. Retrieved from: <http://www.foodinsight.org/Resources/Detail.aspx?topic=2012ConsumerPerceptionsOfTechnologySurvey>

Kuzma, J. and Meghani, Z. (2009). The public option. *EMBO Reports*. 10, 1288-93.

Kuzma, J., Najmaie, P., & Larson, J. (2009). Evaluating oversight systems for emerging technologies: A case study of genetically engineered organisms. *The Journal of Law, Medicine & Ethics*, 37(4), 546-586.

Lifscher, M. (2012, September 27). Poll finds Prop. 37 is likely to pass. *Los Angeles Times*. Retrieved from: <http://articles.latimes.com/2012/sep/27/business/la-fi-prop37-times-poll-20120927>

Magana-Gomez J, de la Barca AMC (2009). Risk assessment of genetically modified crops for nutrition and health. *Nutrition Rev* 67: 1–16.

Manx Survey: 98% of Americans Distrust Information On The Internet (2012, July 17). Business Wire. Retrieved from: <http://www.businesswire.com/news/home/20120717005277/en/Manx-Survey-98-Americans1-Distrust-Information-Internet>

Mathers, E. (2012, March). Local government's success in maintaining public trust. *Public Management*. 97(2).

McHugen A, Smyth S (2008). US regulatory system for genetically modified [genetically modified organisms (GMO), rDNA or transgenic] crop cultivars. *Plant Biotechnol J* 6:2-12

Meghani, Z., & Kuzma, J. (2011). The “revolving door” between regulatory agencies and industry: A problem that requires reconceptualizing objectivity. *Journal of Agricultural and Environmental Ethics*, 24, 575-599.

Mellman, M. (2012). Majority want more labels on food. Retrieved from: <http://justlabelit.org/majority-want-more-labels-on-food/>

Myhr, A. (2010). The challenge of scientific uncertainty and disunity in risk assessment and management of GM crops. *Environmental Values*, 19, 7-31.

National Science Foundation (2012). Science and Engineering Indicators 2012. *Chapter 7. Science and Technology: Public Attitudes and Understanding*. Retrieved from: <http://www.nsf.gov/statistics/seind12/pdf/c07.pdf>

Obama, B. (2009). Transparency and open government. Retrieved from: http://www.whitehouse.gov/the_press_office/TransparencyandOpenGovernment

OSTP (1986). Coordinated framework for the regulation of biotechnology. *Fed Regist* 51: 23302.

Pew Research (2012). 4-in-10 Adults Use Social Networking to Engage in Political or Civil Activities. *Pew Internet and American Life Project*. Retrieved from: <http://pewresearch.org/pubs/2394/social-media-political-civic-engagement-facebook-twitter-social-networking>

PIFB (2003). The Stakeholder Forum on Agricultural Biotechnology: An Overview of the Process. *Pew Initiative on Food and Biotechnology*.

Prior, J. (2012, February 14). *House to scrutinize \$448 million cfpb budget*. Retrieved from: <http://www.housingwire.com/news/house-scrutinize-448-million-cfpb-budget>

Rowe G, Horlick-Jones T, Walls J, Pidgeon N (2005). Difficulties in evaluating public engagement initiatives: reflections on an evaluation of the UK GM Nation? public debate about transgenic crops. *Public Understanding of Science*, 14: 331-352.

Smith A (2010). Government online: the internet gives citizens new paths to government services and information. *Pew Internet and American Life Project*. Retrieved from: <http://pewinternet.org/Reports/2010/Government-Online.aspx>

Smith, M. D. (2011). Say no to GMOs. *Better Nutrition* March: 46-50.

Ten Eyck T.A., (2005). The media and public opinion on genetics and biotechnology: mirrors, windows, or walls? *Public Understanding of Science*, 14(3): 305-316.

The Mellman Group, Inc (2006). Review of public opinion research. *The Pew Initiative on Food and Biotechnology*. Accessed: April 21, 2013. Retrieved from: http://www.pewtrusts.org/uploadedFiles/wwwpewtrustsorg/Public_Opinion/Food_and_Biotechnology/2006summary.pdf

Thompson P (2007). *Food Biotechnology in Ethical Perspective*. Dordrecht, the Netherlands: Springer.

USDA (n.d.). Glossary of Agricultural Biotechnology Terms. Retrieved from: <http://www.usda.gov/wps/portal/usda/usdahome?contentid=BiotechnologyGlosary.xml&navid=AGRICULTURE>

USDA (1997). Introduction of Organisms and Products Altered or Produced Through Genetic Engineering which are Plant Pests or Which There is a Reason to Believe are Plant Pests. 7 CFR 340. Retrieved from: <http://ecfr.gpoaccess.gov>

USDA (2010). Adoption of Genetically Engineered Crops in the U.S. Retrieved from: <http://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us.aspx>

USDA AMS (2012). 10 Years of USDA Organic. Retrieved from: <http://www.ams.usda.gov/AMSV1.0/getfile?dDocName=STELPRDC5100865>

USDA National Organic Program. Last modified: (2012, September 12). *Organic Literacy Initiative*. <http://www.ams.usda.gov/AMSV1.0/organicinfo>

Varvasovszky, Z. and R. Brugha (2000). How to do a stakeholder analysis. *Health Policy and Planning* 15: 338-345.

Viewpoints: Is genetically modified food safe to eat? (2001). Retrieved December 10, 2012, from <http://www.pbs.org/wgbh/harvest/viewpoints/issafe.html>