Appendix F

Summarized Comments Received from Members of the Public

Tables F-1, F-2, and F-3 summarize the comments received from the public regarding potential effects of genetically engineered crops as well as questions and suggestions. When multiple comments focused on the same issue, one was selected as representative. The second column of the table describes the general topic related to each comment, and the third column directs the reader to the location in the report where the relevant claim is addressed.

TABLE F-1 Public Comments Regarding Potential Adverse Effects of Genetically Engineered (GE) Crops and Their Accompanying Technologies

	General Description	Page Number(s)
Agronomic		
The net gain/increases in yields due to GE crops have been overstated.	Effects of genetic engineering on yield	98–104
Insect-resistant GE crops rely on *Bt* toxins. These additional proteins come at a cost to the plant's productivity. Because insect-resistant transgenes typically go into male parents, the 'best' *Bt* transgenes can effectively kill some inbred seedlings.	Effects of genetic engineering on yield	104–116
Soil erosion rates in U.S. agriculture declined before the introduction of HR crops and have not declined since their introduction.	Effects on soil health and runoff	152–154
The dominance of any specific hybrid or variety in one crop over a major geographical segment of the market should be of concern. The pervasive planting of GE crops modified for one or two traits presents an opportunity for a wipe out by blight.	Genetic diversity in crop varieties	143–146
Greater use of crops with resistance to more than one herbicide will lead to the increase in the severity of resistant weeds.	Effects of insect and weed resistance	136–139
Environmental		
Herbicide-resistant crops promote greater use of and dependence on toxic herbicides, harming human health and the environment.	Effects of pesticide residues	133–135
The current predominant GE crops and traits have exacerbated several of the problems associated with industrial agriculture, such as increased pesticide use and pest resistance.	Effects of insecticide and herbicide use Effects of insect and weed resistance	116–121, 122–126, 133–135, 136–139
Resistance to *Bt* is rapidly emerging and spreading.	Effects of insecticide and herbicide use	122–126
IR traits have not deterred the rise in the use of neonicotinoids because the spectrum of insects susceptible to *Bt* toxins is narrow. Neonicotinoids are highly toxic to many vertebrates and persistent in the environment.	Effects of insecticide and herbicide use	120, 142

TABLE F-1 Continued

	General Description	Page Number(s)
Herbicide use associated with GE crops has caused herbicide-resistant weeds. The rapid evolution of herbicide-resistant weeds creates a "transgene treadmill." It also leads to more tillage and therefore more soil erosion.	Effects of insect and weed resistance	136–139, 152–154
The planting of continuous corn because of GE has indirect and landscape-level effects like the elimination of milkweed in the Midwest and the increase in nitrate pollution and anoxic coastal zones because of the nitrate loss to leading due to the shallow root system of corn and the lack of rotation with other crops to make use of the excess nitrates.	Effects on landscape biodiversity Effects on soil health and runoff	148–150, 152–154
Herbicides like glyphosate and 2,4-D are killing honeybees.	Biodiversity within farms and fields	133–135
Glyphosate-resistant crops are negatively affecting monarch butterfly populations.	Biodiversity within farms and fields	148–150
Insect-resistant crops harm biodiversity, including natural enemies of agricultural pests.	Biodiversity within farms and fields	141–142
Bt toxins kill beneficial insects like lacewings and lady beetles. Studies that show otherwise have design flaws in which the insects do not actually ingest the toxin.	Biodiversity within farms and fields	141–142
The potential hazards posed by RNAi–based pesticides and GE crops to nontarget organisms include off-target gene silencing, silencing the target gene in unintended organisms, immune stimulation, and saturation of the RNAi machinery. The persistence of insecticidal small RNAs in the environment is unknown. It is also unknown if laboratory toxicity testing can accurately predict the field-level effects of this technology.	Biodiversity within farms and fields	416–419, 506–507
GE technology facilitates the spread of monoculture. Monoculture systems are associated with increase pest pressure, lower yields (often compensated for by higher purchased input use), leakage of nutrients causing water pollution, climate emissions, air pollution, and reduced biodiversity.	Biodiversity within farms and fields	140–154

continued

TABLE F-1 Continued

	General Description	Page Number(s)
Seed company consolidation due to GE crops has threatened biodiversity.	Biodiversity within farms and fields Genetic diversity in crop varieties	143–146
Human Health and Food Safety		
GE corn has higher levels of rotenone, a plant-produced insecticide that may cause Parkinson's disease.	Health effects of *Bt* crops	231–233
Some *Bt* proteins can enter the bloodstream intact, and some *Bt* proteins and/or fragments can survive the acidic conditions of the upper GI tract. The survival of these proteins in the GI tract could be linked to the rise in GI tract disorders in recent years.	Health effects of *Bt* crops	215–218, 221–225
Bt proteins or fragments are found in umbilical cord blood at birth.	Health effects of *Bt* crops	224–225
Bt proteins pose harm to gut walls, blood cells, fetal development, and the immune system.	Health effects of *Bt* crops	221–225
GE foods are detrimental to human health, causing sterility, cancer, asthma, autism, birth defects, chronic disease in children, and liver and kidney problems. They have caused the epidemic levels of obesity, diabetes, cancer, and allergies.	Health effects of *Bt* crops Health effects of herbicides associated with herbicide-resistant crops	207–221
There is evidence in mammal feeding studies that long-term feeding of GE corn and soybeans causes damage to kidney, liver, and bone marrow, possibly indicating chronic disease.	Health effects of *Bt* crops Health effects of herbicides associated with herbicide-resistant crops	184–198
Consumers of GE food have a higher likelihood to have multiple health issues and to consume more corn with less milling. Therefore, GE trait exposures in these populations could pose unique health-status related risks.	Health effects of *Bt* crops Health effects of herbicides associated with herbicide-resistant crops	207–225, 231–233

TABLE F-1 Continued

	General Description	Page Number(s)
Genetic engineering could lead to new animal and plant diseases, new sources of cancer, and novel epidemics.	Health effects of *Bt* crops Effects on plant disease Health effects of herbicides associated with herbicide-resistant crops	207–225, 231–233
GE crops cause gluten sensitivity by affecting intestinal permeability, imbalanced gut bacteria, immune activation and allergies, impaired digestion, and damage to the intestinal wall.	Health effects of *Bt* crops Health effects of herbicide-resistant crops	215–218, 221–225
Livestock fed GE diets require more antibiotics and have more gastrointestinal disorders and lower birth rates/litters than livestock fed non-GE diets.	Health effects of *Bt* crops Health effects of herbicide-resistant crops	195–197
GE soybean has increased levels of antinutrient soy lectin and allergen trypsin inhibitor and higher lignin content with reduced protein, a fatty acid, an essential amino acid, and phytoestrogens.	Health effects of herbicides associated with herbicide-resistant crops	193–194
Formulated pesticide mixtures have not been investigated for long-term toxicities. Long-term and multigenerational testing in vivo is needed.	Health effects of herbicides associated with herbicide-resistant crops	231–233
EPSPS transgene and other mutational effects in GE corn and their metabolic consequences cause endocrine disruptions.	Health effects of herbicides associated with herbicide-resistant crops	200–201
Glyphosate blocks the shikimate pathway; gut bacteria use this pathway to produce aromatic amino acids like L-Tryptophan, which is a precursor to serotonin and melatonin.	Health effects of herbicides associated with herbicide-resistant crops	231–233
Glyphosate is toxic to human cells.	Health effects of herbicides associated with herbicide-resistant crops	212–213

continued

TABLE F-1 Continued

	General Description	Page Number(s)
Glyphosate interferes with other metabolic pathways, including cytochrome P-450 pathway needed for proper liver detox.	Health effects of herbicides associated with herbicide-resistant crops	231–233
As a result of IARC's rigorous and independent review, the link between glyphosate and cancer has now been greatly strengthened. This toxic herbicide probably causes cancer in people. This new evidence of a serious health threat provides an additional justification for an urgent re-evaluation of glyphosate, separate and apart from the chemical's documented ecological harm, which in and of itself is sufficient to trigger immediate review and restrictions on use.	Health effects of herbicides associated with herbicide-resistant crops	208–213, 231–233
Exposure to 2,4-D will increase with the use of Enlist Duo because more 2,4-D will be in water, food, and air and be available for accidental ingestion.	Health effects of herbicides associated with herbicide-resistant crops	180–184
Glyphosate-resistant crops have new metabolites.	Health effects of herbicide-resistant crops	173–178
Four alternately spliced, overly long RNA transcripts were created with glyphosate-resistant soybean; these new proteins carry health risks.	Health effects of herbicide-resistant crops	233–235
RNAi-based GE crops do not produce a novel protein, but they may still present an ecological and food-safety risk. The "safeness" of the food may depend on the physiology of the consumer.	Health effects of RNAi technology	233–235, 416–419
Adjuvants in formulated pesticide mixtures are more toxic than the active ingredient(s) in the pesticide chemical. Acceptable daily intake thresholds for pesticides are therefore not valid because the intake thresholds only account for active ingredients, not adjuvants.	Appropriate animal testing	184–201
Gamma zein, a well-known allergenic protein, has been detected in MON810 corn. A number of seed storage proteins exhibited truncated forms.	Health effects of *Bt* crops	204–205

TABLE F-1 Continued

	General Description	Page Number(s)
Most serotonin is produced in the gut in response to tryptophan. Wheat is a good source of tryptophan, but when wheat is contaminated with glyphosate, the gut cells go into overdrive and begin producing too much serotonin, which in turn produces many of the common symptoms of celiac disease, such as diarrhea.	No herbicide-resistant wheat – not within the study's scope	217–218
Treating wheat with glyphosate just before harvest causes celiac disease. The glyphosate residue on the wheat gets in food and causes celiac disease because it will destroy the villi in the gut. Glyphosate also prevents the body from breaking down gliadin, a protein found in wheat.		At the time the committee was writing its report, there was no wheat with GE resistance to glyphosate.
Economic		
The dominance of GE varieties in the market has led to a decrease in private breeding programs, that is, a consolidation of industry.	Consolidation in agriculture	324–331
Seed company consolidation due to GE crops has caused the entrenchment of input-intensive monoculture farming systems based on propriety genetics.	Consolidation in agriculture	316–331
Seed company consolidation due to GE crops has driven up costs.	Consolidation in agriculture	324–327
Patent practices have locked up germplasm, both from competitors and from public-breeding programs. This has contributed to making non-GE seeds difficult to buy.	Genetic diversity in crop varieties	316–331
Seed company consolidation due to GE crops has narrowed farmers' seed options.	Genetic diversity in crop varieties	324–327
Reliance on glyphosate has created an expensive-to-fix problem in herbicide-resistant weeds. Reliance on *Bt* threatens to create a similar situation with insects.	Effects of insecticide and herbicide use	122–126, 136–139
Commitment to growing GE crops will eventually bar U.S. food and food products from other countries because the United States will not be compliant with labeling laws that will be adopted in most markets around the world.	Effects on global markets	306–310

continued

TABLE F-1 Continued

	General Description	Page Number(s)
Public and Social Goods		
Seed company consolidation due to GE crops allows a few companies to dominate the market, the result of which is products that are not technically superior or socially useful even if they are profitable.	Consolidation in agriculture	324–327
Seed company consolidation due to GE crops has further restricted the rights of farmers to save and exchange seed.	Seed saving	316–327
Genetic engineering has curtailed severely farmers' ability to breed and select their own seeds.	Seed saving	316–327
Seed company consolidation due to GE crops has skewed public sector R&D priorities.	Public sector research	327–331
Donor support for GE crop development shifts plant-breeding efforts in developing countries away from ongoing work in conventional plant breeding to genetic engineering. Research also shifts away from crops in which genetic engineering is not currently being pursued and away from agroecological improvement efforts.	Public sector research	283–287, 327–331
Historical public goods in agriculture, such as crop improvement for developing countries and specialty or minor crops, are moving into the realm of private goods because of patent protection of intellectual property. This change impacts the pace of research on these types of crops.	Public sector research Intellectual property	316–331
Farming with GE crops has caused or at least accelerated the deskilling of farmers in the United States and in developing countries that have adopted the crops.	Farmer knowledge	288–291
Social benefits of HR and *Bt* traits have been equivocal, variable, and uncertain. Productivity gains have been largely due to technologies and methods such as breeding rather than genetic engineering. Genetic engineering has contributed little so far to the response to climate change, to preserving biodiversity, to reducing pollution, and to conserving finite or scarce resources.	Effects of genetic engineering on yield Effects on landscape biodiversity	98–116, 127–133, 140, 331–333, 419–422
There have been negative effects on lives and cultures, especially those of indigenous peoples.	Effects on indigenous peoples	288–291

TABLE F-1 Continued

	General Description	Page Number(s)
Scientific Progress		
Seed company consolidation due to GE crops allows a few big companies to set the current priorities and future direction of agricultural research worldwide.	Consolidation in agriculture	324–327
Seed company consolidation due to GE crops has inhibited independent research.	Consolidation in agriculture	316–331
The shift to concentrating on molecular biology in the university system has depleted funds to public breeding programs.	Public sector research	327–331
Corporate support of university research makes public university scientists biased supporters of GE crops. The dramatic increase of private research funding of agriculture at universities, while public funding has been reduced, raises questions about the relationship between public and private genetic-engineering research agendas.	Public sector research	327–331
There is decreased access to and decreased public support for non-GE seed and indigenous seed because of GE seed.	Genetic diversity in crop varieties	318–319

TABLE F-2 Public Comments Regarding Potential Benefits of Genetically Engineered (GE) Crops and Their Accompanying Technologies

	General Description	Page Number(s)
Agronomic		
GE crops have contributed to increased production of soybean and corn globally.	Effects of genetic engineering on yield	98–104
GE rice with improved agronomic traits could deliver traits with consumer benefits.	Effects of Golden Rice	226–228, 283–285
Genetic disease resistance in crop seed is an easily deliverable, environmentally benign, and effective means of managing crop disease. Genetic disease resistance can be achieved by conventional breeding, but in some cases, genetically engineering resistance may be faster, more robust, or the only way possible to accomplish resistance.	Effects on plant disease	281–282, 406–408, 415–416
Environmental		
GE crops can contribute to increased production with reduced environmental impact.	Effects on environment	98–104, 140–154
	Effects of genetic engineering on yield	
The use of GE crops has reduced the release of greenhouse gas emissions globally because of reduced tractor fuel use and additional soil carbon sequestration.	Effects on environment	152–154, 420
Genetic engineering can be used cost-effectively to increase nutrient-use efficiency and resilience to climate change.	Effects on environment	422–425
GE trees may be the best approach to combatting disease and pest pressure on trees that may increase because of climate change.	Effects on environment	412–415
GE varieties have transformed American agriculture, helping U.S. farmers remain internationally competitive while reducing costs and promoting important environmental and sustainability goals.	Effects on landscape biodiversity	256–270
	U.S. socioeconomic effects	
Returning blight-resistant American chestnut (through genetic engineering) to eastern forests, especially on private land, can help restore the structure and function of these forests.	Effects on landscape biodiversity	412–415
GE methods provide one way that science can combat the decline and eventual extinction of ecologically important species like trees.	Effects on landscape biodiversity	412–415

TABLE F-2 Continued

	General Description	Page Number(s)
Genetic engineering, as in the case of the American chestnut, has the ability to correct for invasive diseases that wipe out native species (e.g., trees) and repair a biome.	Effects on landscape biodiversity	412–415
Northeast forests are losing all of their ash and hemlock trees to invasive insects. In some areas of the native forest, tent caterpillars have devastated sugar maples and, if the Asian longhorned beetle becomes widely-distributed, forest cover will be reduced by more than 50%. GE trees must be a part of the defense against such a tragic outcome. GE American chestnut is particularly important because of this tree's tremendous benefit to wildlife.	Effects on landscape biodiversity	412–415
The wood of the American chestnut is beautiful, strong, and rot resistant. Unlike oak, the tree produces a mast crop every year for wildlife. The ecosystem is not the same without it. Genetic engineering is the key to bringing the species back from the brink. We are not going to achieve recovery by relying on breeding these trees with resistant relatives.	Effects on landscape biodiversity	412–415
Adoption of GE crops has reduced the amount of pesticide sprayed globally.	Effects of insecticide and herbicide use	108, 116–121, 133–135
The use of glyphosate and glyphosate-resistant crops replaced the use of more hazardous herbicides in terms of pounds of active ingredients used.	Effects of insecticide and herbicide use	133–135
Herbicide-resistant crops have facilitated the expansion of conservation tillage, helping to reduce soil erosion.	Effects on soil health and runoff	152–154
Human Health and Food Safety		
Regulatory delays of second-generation GE crops have created a cost to productivity and to human health.		310–316
GE cotton has increased yields in India, leading to fewer suicides.	Effects of genetic engineering on yield Socioeconomic effects in developing countries	111–114

continued

TABLE F-2 Continued

	General Description	Page Number(s)
Reductions in aflatoxin and fumonisin contamination have been documented in field studies of *Bt* corn due to reduced insect injury to corn kernels. This is particularly the case under conditions moderately to highly favorable for ear rot and mycotoxin contamination.	Health effects of *Bt* crops	229–231
Economic		
GE crops have created net economic benefits at the farm level amounting to $18.8 billion in 2012 and $116.6 billion of 17 years (in nominal terms). Economic gains are split 50/50 between farmers in developed countries and farmers in developing countries.	Effects on farmers in developed and developing countries	256–287
GE crops under development in some African countries, such as black sigatoka resistant banana in Uganda and maruca-resistant cowpea in Ghana, will help improve the livelihood of smallholder farmers because this kind of technology is relevant to their needs and interests. To be effective, it also needs to be affordable, accessible, and profitable.	Effects on farmers in developing countries	283–285
The aggregated global benefits of GE rice are estimated to be valued at $64 billion per year.	Effects of Golden Rice	226–228
Public and Social Goods		
Genetic engineering is useful because it can make possible some breakthrough advances in crop variety improvement for some orphan crops or crops of importance to developing country farmers that conventional processes could not reach.	Socioeconomic effects in developing countries	405–408
Bringing technology like genetic engineering to agriculture in some African countries will make farming modern and more profitable, which will make a profession in agriculture more attractive to young people and stem the flow of migration out of rural areas.	Socioeconomic effects in developing countries	271–287
Study after study has shown GE crops to be safe for consumption. In the case of trees, they could help save an industry (citrus greening) and help repopulate a beloved native species (American chestnut).	Socioeconomic effects	225, 412–415

TABLE F-2 Continued

	General Description	Page Number(s)
Scientific Progress		
Directly manipulating gene expression in combination with “ask the organism” experimental designs provides the fastest way forward to understanding how nature works.		417
Genetic engineering is useful for trees because of their long-breeding cycle, the difficulty of introgressing new genes, and the challenges in identifying dominant genes. It can deliver diverse traits to tree variety development.	Special concerns with trees	412–419
Traditional breeding is tedious and time-consuming for trees. Genetically engineered American chestnut is a much faster and surer way to bring back a valuable species.	Special concerns with trees	405–410

TABLE F-3 Public Comments Offering Suggestions or Raising Questions About Genetically Engineered (GE) Crops and Their Accompanying Technologies

	General Description	Page Number(s)
Environmental		
Genetic engineering is one of the safest and environmentally beneficial technologies available to mankind and it is important that it is used widely to the benefit of man and nature.	Effects on environment	140–154, 236–237
In order to cope with increasingly complex and severe environmental problems, all options need to be assessed dispassionately and not muddied with emotional appeals based on fear and ignorance.	Effects on product development	508–513
Peer-reviewed scientific studies have demonstrated that genetic-engineering processes are safe. The alternative of pesticide and fungicides will be more detrimental to the environment and people.	Effects on environment Effects of insecticide and herbicide use Health effects of *Bt* crops Health effects of herbicide-resistant crops	116–121, 133–135, 184–207, 236–237
EPA needs to put a system in place that proactively detects and then remediates populations of resistant insects.	Effects of insect and weed resistance	122–126
EPA should mandate herbicide resistance management and provide incentives for integrated weed management.	Effects of insect and weed resistance	136–139
The American chestnut is a species that provides high quality wood. Its absence for a century has left a void in the ecology and food chains of U.S. eastern forests. The loss of this species was an almost incomprehensible ecological loss of which most people are unaware.	Effects on landscape biodiversity	412–415
GE may be favored over other promising methods or systems like conventional breeding and agroecology by policy-makers because it is seen as more profitable to the industry. For example, agroecological methods typically are less dependent on purchase inputs like seed, fertilizers, or pesticides than industrial agriculture.	Comparison to non-GE systems	283–287

TABLE F-3 Continued

	General Description	Page Number(s)
The opportunity cost of not considering sound agroecological and other proven sustainable small scale and locally productive farming methods (perhaps better suited to many smaller African and Asian farmers) should not be overlooked.	Comparison to non-GE systems Farmer knowledge	283–287
Funding for GE crop development often comes without funding for complementary longer-term interventions. Agroecological and farm management interventions are prerequisites for the introduction of technologies like genetic engineering, but they are often underfunded and neglected.	Comparison to non-GE systems	283–287, 331–333
Agroecology is sometimes presented as an alternative to crop improvement via genetic engineering. These do not have to be an "either-or." There is no reason that GE traits cannot be introgressed into local crop varieties that might be used in an agroecological farming system.	Comparison to non-GE systems Farmer knowledge	283–291
Human Health and Food Safety		
FDA's review of GE crops is not sufficiently adequate to alleviate health concerns. FDA's reviews are not comprehensive.	FDA regulatory actions	184–207, 466–477
FDA's current approach may not sufficiently address the safety of imported products made from GE crops.	FDA regulatory actions	184–207, 466–477
FDA should require premarket safety assessments for all GE crops, including stacked trait varieties.	FDA regulatory actions	466–477, 508–513
GE trait, crop, and food testing methods and results are inherently suspect because all studies are carried out by the technology developers or their contractors. The details of these studies are not published, and full sequence information is not disclosed. GE trait patent holders often impose limits on who can conduct science on their seeds and traits and malign scientists who report findings that raise questions about GE trait or crop safety or performance.	Bias in testing of GE crops and food	184–207, 316–331
No government funding is provided to independent scientists to evaluate GE crop and food safety.	Bias in testing of GE crops and food	171, 184–207
Industry supports most of the studies of GE crops and foods; therefore, these results cannot be trusted.	Bias in testing of GE crops and food	171, 184–207

continued

TABLE F-3 Continued

	General Description	Page Number(s)
The majority of nutritional studies conducted on GE crops do not assess health effects, concentrating instead on animal weight gain or milk or egg production.	Sufficiency of health testing	176–207
No study has tested whether there are unique human health and environmental risks associated with stacked-trait GE cultivars. Most GE foods now contain multiple stacked traits with multiple promoter genes and regulatory sequences. This fundamental change leads to novel and more complex ways in which environmental conditions can alter gene expression patterns and the presence and levels of novel toxins and allergens.	Sufficiency of health testing	176–207, 464–493
One or more of the GE traits in almost all of today's GE corn and soybean varieties has not been analyzed or addressed in any health studies published in peer-reviewed journals.	Sufficiency of health testing	176–207
The dose levels of *Bt* are not adequately evaluated by EPA in foods like *Bt* sweet corn and *Bt* eggplant. No study has been done on the impacts of transgene and *Bt* proteins in GE eggplant on human reproductive outcomes and neurological development.	Sufficiency of health testing	176–225
New GE-traited food for human consumption should have full 'omics' molecular profiling performed as well as siRNA/miRNA profiling to determine differences between GE and isogenic non-GE variety grown in the same location at the same time. Such data would rule out the presence of potential toxins, allergens, and compositional/nutritional disturbances caused by GE transformation. There should be 2-year feeding studies in rats and/or mice, followed by large farm animal toxicity studies, and then human dose escalation trials. Such testing should be paid for by the government.	Sufficiency of health testing	200–201
There are no proven and reliable animal models to detect new, food-based human allergens, so GE foods would have to be tested on human volunteers to find new and unexpected allergens.	Sufficiency of health testing Appropriate animal testing	202–207
Current allergy testing is not rigorous enough.	Sufficiency of health testing	202–207
GE crops and food negatively affect everyone, but particularly those with chronic health conditions.	Sufficiency of health testing	202–225

TABLE F-3 Continued

	General Description	Page Number(s)
A high concentration of GE *Bt* toxins in food has not previously been a part of the human or animal diet and their impact on GI tract health and its possibility to be an antinutrient have not been researched.	Sufficiency of health testing	215–225
Glyphosate has not been tested or assessed for long-term safety for regulatory purposes. Independent studies show it is highly toxic to animals and humans.	Sufficiency of health testing	212–213, 231–233
The impacts of GE crops/food on the gut bacteria (horizontal gene transfer, antibiotic effects of glyphosate, block production of aromatic amino acids, etc.) and their impact on the health of individuals and newborns is unclear.	Sufficiency of health testing	221–225
GE crop test sites should be publicly posted. Contamination of conventional and organic crops puts farmer livelihood at risk as well as risking allergic and toxic impacts to the general population that also severely handicaps their doctors' ability to diagnose.	Sufficiency of health testing Coexistence of GE and non-GE crops	176–225, 296–302
There are few if any chronic studies (2-year feeding trials, multigenerational studies) that have been done in rats, mice, or other species that had to be done to uncover a risk that was not suspected due to similarity to known toxins. And many of the studies that are being submitted to journals like *Food and Chemical Toxicology* and *Regulatory Toxicology and Pharmacology* have significant design problems and the results are not fully reliable especially for characterizing human risks. Often the test materials are not well characterized, inappropriate controls are used and the publications report "statistically significant differences" without any measure or certainty about the biological relevance of the data. Thus the studies should and must be questioned in terms of relevance to human food safety. We need to use first principles of science before we demand a lot of unnecessary, expensive, and potentially confounding testing on products that are scientifically relatively easy to evaluate.	Sufficiency of health testing	184–198

continued

TABLE F-3 Continued

	General Description	Page Number(s)
A review of proper peer-reviewed literature on GE crops reveals a long history of safety and utility. It has been documented that many billions of animals worldwide over many years have consumed GE feed, and no effect on the health of these animals has been detected. It is very telling that so many animals over such a long time have been eating GE feeds. There is no reasonable way to discount this hugely important fact.	Sufficiency of health testing	195–198
There should be post-approval surveillance monitoring (as called for in the 2004 NRC report).	USDA regulatory actions	202–207, 464–493
There needs to be safety assessment protocols for double-stranded RNA.	Health effects of RNAi technology	233–235, 359–360, 416–419
The GE crop system (including seeds and coatings, pesticides and inert ingredients, and study findings hidden behind Intellectual Property Rights barriers) should not be framed in a way that suggests local regulation will be a hindrance to transgenic crops whilst paying lip service to robust risk assessment and transparency of transgenic study data to the public at large.	Effects of debate about genetic engineering	5–28
Economic		
A recent industry-sponsored study found that the average cost to develop a trait through GE was about $136 million (mostly from R&D rather than regulatory costs), while development of typical traits using conventional breeding was about $1 million for grain crops.	Cost of research and development Cost of regulation	310–316
Regrowth of the American chestnut would be a major boost to the furniture and lumber industry.	U.S. socioeconomic effects	412–415
Public and Social Goods		
Often quick scientific assessments in developing countries are used to bolster larger claims about the usefulness of genetically engineered crops to farmers in those countries.	Socioeconomic effects in developing countries	257–287
More effort needs to be devoted to understanding, over the course of time, which demographic groups in developing countries benefit from the introduction of GE crops.	Socioeconomic effects in developing countries	271–287, 291–294

TABLE F-3 Continued

	General Description	Page Number(s)
It has been documented that the adoption of *Bt* cotton in Colombia was received favorably by women because it reduced the number of laborers they had to hire to spray pesticides.	Socioeconomic effects in developing countries	291–293
Agricultural biotechnology can improve productivity, secure and improve yield, and produce higher quality crops. It is critical to the sustainability of agriculture. If food production is to increase to meet projected population rises over the next generation, genetic modification and other biotechnologies should be available to growers as an option.	Feeding the growing world population	331–333, 437–442
Socioeconomic controversies have lowered the long-term potential for GE to advance sustainable agriculture and ensure food safety.	Effects of debate about genetic engineering	302–331, 436–442
Lack of public-sector support for applied research in genetic engineering hinders the number and types of traits developed.	Public sector research	283–287, 327–331
The monopolistic powers that create and market GE seeds have disingenuous motives.	Consolidation in agriculture	316–331
After over a decade of development, Golden Rice has lower yields than comparable rice and has not yet been shown to address vitamin A deficiencies under community conditions.	Effects of Golden Rice	226–228, 432–436
Access to Information		
Food-safety agencies and authorities and private companies do not publish raw data of their studies.	Transparency in data reporting	502–506
Locations of test plots should not be kept secret from farmers whose crops, markets, and communities could be harmed by their proximity to these plots.	Transparency Coexistence of GE and non-GE crops	296–302, 502–506
USDA should require sequence information for all field trials.	Transparency Regulation of GE crops	466–477, 508–510
Confining the debate on GE crops to peer-reviewed literature is elitist.	Data quality and comprehensiveness	37–44
Lack of labeling takes away consumer choice.	Public right to know	303–306, 462, 501

continued

TABLE F-3 Continued

	General Description	Page Number(s)
Is it scientifically justified for some GE crops to be regulated because of Agrobacterium transformation but not if the transformation is made with a gene gun?	Regulation of genome editing	466–477, 493–500
Intellectual property protection for GE crops is important to encourage investment in crop development and ensure their best use for agriculture. Patent protection can be used to block competitors, but it can also be used to promote broad use of technologies because it encourages inventors to bring forth new ideas by providing the security that these ideas will be protected.	Intellectual property	316–324
The biggest issue with GE crops is the surrounding policy and patent abuse, not the underlying science itself.	Intellectual property Cost of regulation	316–324
Scientific Progress		
The frequency of transformation-induced mutations and their importance as potential biosafety hazards are poorly understood.	Unintended effects of genetic engineering	378–395
Genetic engineering is unnecessary meddling with Mother Nature.	Ethics of genetic engineering	65–73
Marker-assisted selection (MAS) breeding can achieve the same claims as genetic engineering without the drawbacks. The low number of commercialized GE traits is evidence that the technology is not that successful and is therefore not needed because conventional breeding and MAS breeding can get better results on a faster timescale.	Effects of genetic engineering on yield Comparison to non-GE systems	354–357, 405–408
The genomes of living things code for many thousands of proteins, and alteration or addition of a single gene does not create some freakish hybrid. It also does not change the basic nature of the plant itself.	Ethics of genetic engineering	65–73, 406–408
Diseases have devastated (chestnuts) and are devastating trees (e.g., citrus greening). Modern breeding can assist in controlling these diseases and protecting the diversity and health of tree species and forests.	Effects on plant disease	412–419

TABLE F-3 Continued

	General Description	Page Number(s)
Efficiency and efficacy of RNAi differ among species, mode of delivery, and genes targeted. There is currently limited capacity to predict the ideal experimental strategy for RNAi directed at a particular insect because of an incomplete understanding of how the RNAi signal is amplified and spread among insect cells.	RNAi	416–419
Changing the nature, kind, and quantity of particular regulatory-RNA molecules through genetic engineering can create biosafety risks. While some GE crops are intended to produce new regulatory-RNA molecules, these may also occur in other GE crops not intended to express them.	RNAi	233–235, 359–360, 416–419
Genome editing is creating indistinct boundaries in existing government regulations of GE crops.	Regulation of GE crops	493–500