University of Arkansas School of Law
NatAgLaw@uark.edu $ (479) 575-7646

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Who Needs GMOS? Technology, Democracy, and the Case of GM Crops

by

Jody A. Roberts

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WHO NEEDS GMOS? TECHNOLOGY, DEMOCRACY, AND THE CASE OF GM CROPS

Jody A. Roberts[*]

In the first week of March, two stories related to GM crops, notably different, broke in the news. On the fifth of March, the USDA took measures to stop U.S. farmers from planting one of the more popular varieties of long grain rice after preliminary tests showed evidence that the seed stock may have become contaminated with a GM rice variety not approved for marketing. As the *Washington Post* author Rick Weiss notes, "(t)he announcement marks the third time in six months that U.S. rice has been found to be inexplicably contaminated with engineered traits."[1] Unfortunately, the troubles did not stop there for the farmers. The rice seed now found to be contaminated was to be used in place of another rice variety many of the farmers had planned to use in place of another also found to be contaminated.[2] But this was not the only story involving GM crops to make headlines in the early days of March. Just days prior, the USDA gave a preliminary "green light" to the California based biotech firm Ventria Bioscience to begin commercial production of a new rice variant containing human genes, taken from breast milk and saliva, to be used in the production of bacteria-fighting proteins.[3] According to the product developers, the proteins from the rice crop will be harvested and used in treating children with diarrhea. The rice plants are to be used as biofactories for these proteins, a process generally known as "pharming"—referring to the process by which potential pharmaceutical agents are "grown" in a host organism, harvested, and extracted. The first crop of this human-rice hybrid

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1. Rick Weiss, *Rice Recalled Over Gene Contamination*, WASH. POST, Mar. 6, 2007, at A08.

2. *Id.*

3. Sean Poulter, *GM Rice with Human Genes to be Approved for Commercial Use*, DAILY MAIL (London), Mar. 6, 2007, at 8; Rick Weiss, *USDA Backs Production of Rice with Human Genes*, WASH. POST, Mar. 2, 2007, at A02 [hereinafter *USDA*].

comes to the fields of Kansas after other potential sites, such as those in Missouri, backed away from the offer. Anheuser-Busch, the country's largest purchaser of rice, feared contamination and product boycott, and so it pressured the state not to allow Ventria to use Missouri for its testing grounds. The 450 acres of Kansas soil used for the production of this hybrid crop will be the only place where rice is grown in the state, something officials hope will eliminate the possibility of contamination of other crops. The USDA, through its environmental assessment, has been quick to point out that the project poses "no undue risks."[4] However, because the crop will yield potential pharmaceutical agents, some oppositional groups have voiced concerns about how dose will be controlled and what affects might result from possible allergies to these proteins. While the possibility for contamination is thought to be nil, episodes from this same week seem to indicate that the possibility, however remote, is real. As Rissler notes, "this is not a product that everyone would want to consume."[5]

The problem is more than just the possible contamination of non-GM crops with the new hybrid version. Something deeper is at the heart of this debate. In his report on the hybrid rice story, Sean Poulter sums it up this way:

> As well as the contamination fears there are serious ethical concerns about such a fundamental interference with the building blocks of life. Yet there is no legal means for Britain or Europe to ban such products on ethical grounds. Imports would have to be accepted once they had gone through a scientific safety assessment.[6]

In the following pages, I want to explore the tensions highlighted here between the science/technology (or "technoscience"[7]) of GM or transgenic organisms,[8] legal concerns arising from the production of these new artifacts, and the varying ethical concerns raised by groups in opposition. There are too

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4. *USDA*, *supra* note 3, at A02.

5. *Id.*

6. Sean Poulter, *supra* note 3, at 8.

7. The term "technoscience" is often used as a way to demonstrate the inextricable connections between traditional scientific research and the technology that makes it possible and results from it. *See generally* Donna J. Haraway, *A Game of Cat's Cradle: Science Studies, Feminist Theory, Cultural Studies*, 1 CONFIGURATIONS: J. OF LITERATURE AND SCI. 59, 59-71 (1994); Ursula Klein, *Introduction: Technoscientific Productivity*, 13 PERSPS. ON SCI. 139, 139-41 (2005); Bruno Latour, *Why Has Critique Run out of Steam? From Matters of Fact to Matters of Concern*, 30 CRITICAL INQUIRY 225, 225-48 (2004).

8. While there is some debate about exactly how we ought to refer to these specific technologies, I do not see a need to engage in that debate here. While it is true that we, as a species, have been "genetically modifying" organisms at least since the establishment of agriculture, if not well before; this concept is only true after we have a conception of genetics from which to draw. Despite the historical specificity of the term, it is true that what we are actually dealing with here, in many cases, is the concern about "transgenic" organisms, or the placement of a gene segment from one organism into another. However, I am concerned here most with public perceptions of the science, and not strictly with the science itself. Therefore, I think it is important to highlight the terms actually used in public debate about these technologies. For that reason, I will use the term "GM" to refer to the broad type of technologies under consideration.

many nuances to the debate to cover them all, and many of them have been covered elsewhere, so I will focus my attention on the issues just highlighted: (1) how does technoscience trump debate on ethical concerns, and (2) how might we incorporate these concerns into our discussions *before* the creation of the artifact rather than waiting to argue about it *after* it has been created?

The specter of capital "S" Science carries with it tremendous authority in Western cultures, and particularly in the Unites States.[9] We associate it with notions of progress and thus with the easing of burdens, improvement, and human potential. Our collective faith in science and technology as solutions to societal problems is longstanding and evidenced in our mechanization of the home to make our lives more efficient, the mechanization of agriculture to procure more food from less space and with less effort, and the ongoing hope that technology will save us from impending challenges linked to, for example, global warming (and the associated climate changes it entails), a growing world population, growing demands for energy, and the scarcity of clean water.

Yet our faith in technoscientific progress often comes at the cost of remembering the specifics of some of our earlier adventures with these technologies. The mechanization of the home led to greater work for women as more of the tasks that would have traditionally been taken care of outside of the home became the responsibility of the lady of the house.[10] The increased use of farming technologies in the Midwest helped turn the plains into a "Dust Bowl,"[11] and the continued use of chemical technologies is creating vast "dead zones"[12] in places like the Gulf of Mexico—not too mention what these chemicals are doing to entire ecosystems where they persist and accumulate. Why then do we continue to rely upon technoscience to solve our social problems? In part, it is because the technoscientific infrastructure that so pervades our society remains largely invisible, mysterious, and inaccessible—something always and everywhere present, but never quite available for engagement.

The same holds true for the way in which science and technology operate in legal contexts here in the United States. Through the *Daubert* trilogy, the courts wrestled with just how to judge scientific evidence and expertise and to decide what role it ought to have in the courtroom.[13] If anything is clear from

9. *See, e.g.*, THOMAS F. GIERYN, CULTURAL BOUNDARIES OF SCIENCE: CREDIBILITY ON THE LINE 1-36, 115-82 (Univ. of Chicago Press 1999).

10. *See, e.g.*, RUTH SCHWARTZ COWAN, MORE WORK FOR MOTHER: THE IRONIES OF HOUSEHOLD TECHNOLOGY FROM THE OPEN HEARTH TO THE MICROWAVE (Basic Books 1983).

11. *See, e.g.*, DONALD WORSTER, DUST BOWL: THE SOUTHERN PLAINS IN THE 1930S (Oxford Univ. Press 1979).

12. *See, e.g.*, Cheryl Lyn Dybas, *Dead Zones Spreading in World Oceans*, 55 BIOSCIENCE 552-57 (July 2005).

13. *See* Daubert v. Merrell Dow Pharms., 509 U.S. 579 (1993); Gen. Elec. Co. v. Joiner, 522 U.S. 136 (1997); Kumho Tire Co. v. Carmichael, 526 U.S. 137 (1999). For discussions of these cases, and their role in the broader contexts of science, expertise, and authority *see also* SHEILA JASANOFF, THE FIFTH BRANCH: SCIENCE ADVISORS AS POLICYMAKERS ch. 3 (Harvard

the result of these three cases, it is that almost nothing is clear when it comes to science: how to define it, and who can speak of it or for it. The result has been the reinforcement of a system of science experts and expertise—a "fifth branch" of government.[14]

This fifth branch, our system of science experts, becomes a factor not only in the courts, but also in the regulation of technoscientific objects and artifacts. The role of science in regulatory affairs is nothing new, especially when it comes to dealing with issues of safety and efficacy. Following the inclusion of the Data Quality Act ("DQA") in the omnibus budget bill of December 2000, scientific evidence (or debates about it) and this network of science experts have been given a new trump card in regulatory (and thereby legal) debates.[15] The DQA requires the federal government, through the Office of Management and Budget ("OMB") to hear appeals from groups concerned about scientific evidence used in the creation and enforcement of a regulatory policy. That is, it creates a system by which evidence used for regulatory decisions can be challenged based on a lack of "certainty" in the scientific data under review.

There are numerous questions, concerns, and problems associated with the DQA, but here I am interested only in highlighting this idea of certainty versus uncertainty in science because it plays to the point that I am trying to spell out here: namely, that understandings of how science work vary, especially as we move from "within" science to "outside" of science. If you are looking at science from the perspective of its actual practice, uncertainty is an inherent characteristic of the scientific enterprise. However, outside of these bounds, science becomes locked into the dichotomies that characterize so much of our political sphere; the science is either certain, or it is not, and if it is not, do we dare act on it?

There are ways to handle these instances of uncertainty and its relationship to the regulatory and legal frameworks within societies; the most visible of these has been the "precautionary principle."[16] Based upon the ideas coming out of the Wingspread Conference, it states quite simply that if we do not have enough information about the possible consequences of the development, or use of a specific technology or class of technologies, then we should assume a precautionary posture until more information is available. That is to say, the burden of proof is placed upon those seeking development or

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Univ. Press 1998), and Margaret A. Berger, *The Supreme Court's Trilogy on the Admissibility of Expert Testimony*, *in* FEDERAL JUDICIAL CENTER, REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 9-38 (2d ed. 2000), *available at* http://www.fjc.gov/public/pdf.nsf/lookup/sciman00.pdf/$file/sciman00.pdf, and Davis S. Caudill and Lewis H. LaRue, *Why Judges Applying the Daubert Trilogy Need to Know About the Social, Institutional, and Rhetorical, and Not Just the Methodological, Aspects of Science*, 45 B.C. L. REV. 1 (2003).

14. JASANOFF, *supra* note 13.

15. Data Quality Act, Pub. L. No. 106-554, § 515, 114 Stat. 2763A-153 (2000).

16. SCI. & ENVTL. HEALTH NETWORK, PRECAUTIONARY PRINCIPLE (1998), http://www.sehn.org/wing.html.

use to demonstrate that no harm will result.

In the European Union (EU), we might say that the precautionary principle has been used with some success. In the recent passing of the REACH protocol, concerning research into chemical production and use, the EU again has demonstrated that they wish to pursue a path towards the institutionalization of something like the precautionary principle. In the U.S., however, the principle has never quite developed any legs upon which to stand. One could gesture towards any number of reasons for this difference—the logical impossibility of proving a negative, the problems associated with burdens of proof within our legal system, or the economic consequences of slowing research. Despite my personal desire to have something like the precautionary principle in place in this context, the principle itself is symptomatic of the more pervasive problem that allows science—not just "uncertain" science—to trump all other modes or reasons for objection and disagreement. That is, using the precautionary principle reinforces the idea that only science can save us from technologies we do not want and that only risks to our health and safety ought or need be considered in decisions about the acceptance or refusal of specific lines of technoscientific inquiry. How did things end up this way, and is there a way out of this narrowly defined debate?

In what follows, I want to argue for a more democratic process of science that could help inform and involve our debates on issues such as the research, production, and use of GM technologies. This is not an argument for or against these technologies, although admittedly, I have serious reservations about them. This is, instead, a plea to initiate a discussion preliminary to the debates currently taking place. As I see it, the question that still needs an answer is this: "Why do we need GMOs?" What are these technologies designed to do, and why should I agree to these specific technologies as a solution to these specific problems?

It may seem odd that I would frame the discussion as one asking why and what if even as GM crops have become an increasingly large percentage of our everyday food supply, as new crops are being planned for the fields of Kansas, and as biotech businesses vie with one another for the next marketable breakthrough. That is precisely my point; why are we just now having conversations like this? Likely, it is because no one has bothered to ask us any earlier. The formulation I will lay out, then, is more of fanciful thinking about the recent past, but also, hopefully, part of a model for discussions to come in the very near future.

In too many of the debates currently taking place, this step has been simply passed over in silence. We (especially in the United States) have been told to simply accept GMOs as the next step forward on the unending treadmill of progress. But what would a more democratic process look like? That is, how can we think about technoscientific research and its resulting artifacts as an extension of and contributing to a more democratic society? In order to think about this more constructively, I have laid out a series of questions that individuals and groups might ask about specific trajectories and technologies.

I will walk through them here, beginning with the question, "what are the concerns we have that we are developing these technologies for?" I will then briefly analyze the nature of GM technologies, possible alternatives to them, and finish with a discussion of what the most democratic option might look like.

It may seem odd that so much of the emphasis in the legal realm is placed upon the scientific aspects of the GM debate when the companies producing them have long employed a much more moral line of argumentation for researching, developing, and using their technologies.[17] The major moral thrust of these companies and organizations falls along the lines of this: "In a world where the human population can be expected to grow by several billion in the coming decades, we as citizens of the world must find a way to feed the growing masses." They continue, "Transgenic crops offer the greatest opportunity to produce more for more, using less." It is what is often referred to in other environmental/sustainability discourses as a "win-win" scenario, because therein we cannot locate any deducible problem. We can grow more to feed more using fewer resources. The argument continues, "To object or interfere with the research, production, and distribution of transgenic plants (and animals) is to deny the growing masses access to food." The conclusion then is simple: "We *must* research, develop, produce, and distribute transgenic crops and animals."

The argument seems pretty air-tight. By disagreeing with the premises of it, you implicitly make yourself an enemy of progress and one who is against making basic life-sustaining resources available to those most in need, namely the "developing world" of Africa and Asia. It should be noted that this argument is not, in any way, unique to the debates about transgenic technologies; the same basic format has become a mainstay in several other arenas as well, for example, in debates about the development and use of nuclear power to combat global warming. But just how airtight is this argument?

When organizations like BIO or one of the companies supporting these technologies present their argument to the media and public, they offer it as a package deal; you choose to either accept it or not. The problem with this package deal is that it frames the discussion in advance, limiting the ways in which we can engage the issues, creating predetermined pro and con positions, and forcing us to take a position in the scripted argument as our own. It has been an unfortunate artifact of this debate that we as consumers, tax payers, and citizens have been handed a debate that fails to articulate clearly the multitude of positions, concerns, and thoughts one might have on these issues. Rather we have been stuck in a debate between "frankenfoods" and the starving masses. Surely these characterizations fail to accurately reflect the diverse thoughts and concerns that we hold.

17. JIMMY CARTER, SUSTAINABLE AGRICULTURE IN DEVELOPING COUNTRIES, http://www.bio.org/foodag/background/developingc.asp (last visited Apr. 9, 2007).

Here, I want to open up the packaged argument to see what is inside. Once we have the package open, I hope that we might get a better sense for what else might be lurking in this argument. It will also offer us a way to begin talking about what might accompany transgenic technologies; if we accept these new technologies into our socio-technical systems, what else will we also be (wittingly or otherwise) accepting? Finally, I hope that we can find a way to discuss these technologies in terms of democracy; who should decide whether or not we accept transgenic technologies, and do these technologies further promote democratic values and ideals?

To help get us out of the tangled mess of polemical debates currently at work, we need to change out focal point. Following Bruno Latour, I suggest moving our focus away from arguments over matters of fact, and instead towards thinking and engaging at the level of matters of concern, from a philosophy of science towards a philosophy of research.[18] That is to say, for our purposes here, what are the concerns raised by these groups? Are they concerns upon which we can agree, that we share? From here, can we begin thinking about how we want our various scientific and technological tools to address these concerns? The focus shifts away from a debate about transgenic crops and towards the issues and concerns that transgenic crops are supposed to address. We can ask the questions, "Do we want to use this specific set of technologies to address these concerns?" "Are there other ways of addressing these them?" "What is entailed in the selection of one set of technologies over the other?" "If we decide to accept transgenic crops, what else are we implicitly accepting?" Technologies are not stand-alone entities or artifacts; they come packaged with other technologies of the physical and social kind. Thus, the question I am really interested in provoking in this article is: "How do we go about making both our technologies and choice of technologies more democratic in nature?" A correlative question might be: "How do we make sure that the technologies we choose are not only chosen in a democratic way, but also enhance and support democratic systems, themselves?"

The guiding questions that I have put together are intended to promote discussion rather than to quash it, which is exactly what happens when we are offered prepackaged arguments. My hope is that moving through this list of questions, we will make visible the places where people might generally agree, make note of places where differences occur, and then find a productive way to transform the differences into discussion of alternatives.

18. *See* Bruno Latour, *From the World of Science to the World of Research?*, SCIENCE, Apr. 10, 1008, at 208-09, *available at* http://www.sciencemag.org/cgi/content/full/280/5361/208. *See generally* Latour, *Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern*, 20 CRITICAL INQUIRY 225-48, *available at* http://criticalinquiry.uchicago.edu/issues/v30/30n2.Latour.html, *and* LATOUR, POLITICS OF NATURE: HOW TO BRING THE SCIENCES INTO DEMOCRACY 244 (C. Porter trans., 2004).

Can we agree that there are matters of concern that we ought to have?

The switch from considering matters of fact to matters of concern would seem to be as obvious as it sounds; we need to decide on a set of concerns that we might share. For the sake of the topic here, we need to decide whether we agree with the concerns raised in the arguments being made in support of transgenic crops. What are the issues these techno-organisms are designed to address? Can we agree that these concerns warrant our attention and efforts? We might say that there are roughly three arguments being made for why we need these new organisms: 1) demand for an increased food supply to match increased consumption by a growing population; 2) environmental concerns, such as those associated with pesticide and fertilizer use, but also with land management, and our ability to increase the efficiency of a specified plot of land; and 3) energy needs, or the increasing market for the biofuels and biofeedstocks as a portion of our country's energy portfolio.

We have not heard as much "out there" about how GM products are going to address energy concerns. Right now, we are mostly told that biofuels will be simply that: bio-based. What we are often not told is the role that biotech will play in the formulation of specific hybrids for similar reasons being expressed here in relation to food supplies, namely efficiency, land use, etc. I will not spend any time on the energy issues since the general theme here is focused on GMOs and food, but I want to note here that as biofuels become a stronger contender, the arguments of both the GM foods and GM fuels will play off of the "need to get more from less" argument as a way of making sure people believe that sacrificing a field of corn to fill your SUV is not taking a field of corn out of our collective mouths.

Let us now take a look at the first two arguments under a more focused lens.

The first concern raised relates to our need to find ways to feed the growing population of humans that inhabit the Earth, a number expected to grow at unprecedented levels in coming decades. The questions we face then are twofold: do we have the means to feed a population that may reach roughly 10 billion people before leveling out? Do we have an obligation to make sure that we can? I think we could all agree that the second answer is yes, that feeding the world's population (no matter the size) is a legitimate matter of concern—even if we also believe that the population should not have ever gotten that big, or if we believe in zero or negative growth. Few of us would actually go on the record as saying, "No, I have no concern about feeding the growing population." The first question, however, is a little more difficult, but if we agree on the second, we have to see the production of "enough" (whatever that may be) as a legitimate concern.

The second concern comes, in part, as an implicit critique of current farming practices, or at least concerns about certain aspects of them. Current practices incorporate enormous amounts of synthetic chemicals to provide us with large, efficient, monoculture farming. As concerns about such things as

pesticide exposure—to the workers, the makers, and those living downstream (which it would now seem includes everyone and everything)—alternatives are being sought, although not terribly quickly. We have come to accept that current practices necessitate these sorts of chemical interventions and that without them, we simply might not have enough food. Even as we fight the fear associated with hunger, nervousness about what this continued exposure to these chemicals—organochlorine and organophosphate pesticides, for example—might mean for our health and the health of our ecosystems grows. Regardless, this continued exposure poses serious concerns. We might also explore aspects of "environmental" concerns that incorporate issues of land use, water use, and the like, but I think we can stop here and say that environmental concerns (broadly conceived) represent an area of concern that needs to be addressed.

We will take as our first set of assumptions that we need to start thinking and tackling some solid concerns, but how are we to address these concerns? The trick comes with our interpretation of this question; is this a political, social, or technical problem? For the case of GMOs, from the perspectives of the GMO manufacturer, the scientist, and the bioengineer, the answer is fairly clear; maintaining food supply while addressing environmental concerns is a technical problem and thus requires a technical solution. For others, perhaps the answer is not; perhaps it is political, or social, or even something else.

Do transgenic crops address these concerns?

Once we have come to some sort of tentative agreement on what concerns we might have, and what requires action, we need to think about what possibilities exist or might be made to exist to address these concerns. In this case specifically, we already have one set of solutions proposed: the use of transgenic organisms. Our question then is this: "Do transgenic organisms actually address our concerns?"

Beginning with our first concern, food supply, we have what is perhaps the argument made most often and loudest by the biotech industries: there is no way to meet growing demands for food by current methods, and so we need a radical innovation—by way of biotech—to revolutionize the farming industry to meet this new need. Will GMOs actually do this? It is difficult to say in advance, but we might say safely that these crops will produce more of whatever it is they are designed to produce. In a very basic way, then, GMOs address this concern.

Our second main concern involves potential effects on the environment. This issue is a bit murkier than the previous, which makes it much more difficult to say that GMOs actually have benefits to accommodate our environmental concerns. Pesticide use, as one indicator, remains ambiguous. While some report a global decline in pesticide use,[19] others note that use often

19. *See* Graham Brookes & Peter Barfoot, *GM crops: The Global Economic and*

spikes with new GM crops since the crops are often specifically designed to withstand application of a chemical. This leads to one—sometimes two—additional crop sprayings beyond which spraying would normally have stopped.[20] Thus, at least when it comes to pesticide use, we have at least some uncertainty. At best, overall use may decrease; at worst, it increases. More likely, it simply displaces use of one herbicide by another.

Additionally, the adoption of GM crops reinforces the planting and cultivating of large monocultures that threatens to squeeze out local biodiversity crops (and the ecological systems that require the very biodiversity of the fields being plowed under). Finally, many of the crops we have chosen to modify are energy intensive, whether that means they require more fertilizer applications (leading to more run-off) or larger amounts of water to feel sought-after efficiency effects.[21] These are not characteristics that suit these crops to very many places in the world, so environments are often recreated to suit these plants. We are left to conclude that understanding exactly how GMOs will positively address out environmental concerns remains to be seen.

What else do we get when we support the production and use of transgenic crops?

For the sake of argument, let us assume that we find that transgenic organisms do indeed provide an adequate solution to the matters of concern identified above. In this case, we agree that the use of these organisms, should we continue to research and develop them, will help us to combat global hunger, will increase our abilities to use land more efficiently, and will reduce our reliance on pesticide use. The question we face now is this: "If we choose transgenic organisms as our means of addressing these concerns, what else comes along with our research, development, and use of these organisms?" We must keep in mind that objects and artifacts in the world do not stand alone, but exist as only part of a larger sociotechnical system blending, blurring, and merging various infrastructures required for their production and maintenance in our world. Transgenic organisms do not come into existence on their own; we must confront what allows their construction in the first place, and what will be required to maintain them as a (potentially) viable answer to our concerns. Thus, in thinking about whether or not we want our scientists, engineers, corporate managers, politicians, farmers, and others to pursue these products, we must also decide whether or not we accept the inevitable accompaniments.

We need to keep in mind that GMOs are high technology. That is, they

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Environmental Impact-The First Nine Years 1996-2004, 8 AGBIOFORUM 187 (2005), *available at* http://www.agbioforum.org/v8n23/v8n23a15-brookes.htm.

20. *See* DANIEL L. KLEINMAN, SCIENCE AND TECHNOLOGY IN SOCIETY: FROM BIOTECHNOLOGY TO THE INTERNET 18-22 (2005).

21. *Id.* at 15-33.

are products of the lab, not the land; they require a lab culture to keep them running. Unlike other fruits of the land, they are not sown, reaped, and re-sown. Rather, they are purchased, sown, reaped, and repurchased. Accordingly, GMOs present us with two unique problems that ought to be considered before we adopt (and use) them wholesale. First, agriculture becomes completely "scientized." Some could argue (quite rightly) that farming has been a scientific endeavor for at least a century, if not many. However, this is a different form of scientific endeavor altogether—and not just because GM has gone transgenic. The problem is the way in which the expertise of farming, existing in some collaborative form, "knowing the land," has completely left the land and entered the laboratory. The once tacit understanding of the land developed between farmer and farm—long under attack in our culture—will finally be severed, perhaps completely this time. Landscapes are engineered to fit crops, not vice versa. Farmers will, thus, become wholly dependent upon the knowledge and expertise of those working in remote locations to understand how best to grow this new organism to its fullest potential. Adopting GM crops requires an enormous amount of trust on our part in the scientific infrastructure that makes them possible. Given the scope and scale of many of the environmental concerns I raised earlier, and their root in the very same scientific infrastructure, ought we to trust this system with the precious power of the ability to transform the land in order to feed us? It is a question that I do not think we have ever been able to discuss, but we certainly deserve the opportunity to do so.

There is a second concern that we must face as well, and that is the location of these laboratories in the heart (or perhaps belly) of private corporations. By accepting biotech as a solution to our concerns, we are placing trust (and control) of our food supply in the hands of private vendors on a scale that makes this something of a new concern.[22] Since we cannot be sure that out public regulatory agencies will adequately protect us (as I think the stories in the introduction highlight), what recourse will we as citizens have before and after the inevitable contaminations occur? What recourse does the local farmer, the organic farmer, the home gardener have when their crops become crossed with these hybrids? Thus, corporate control of the global food supply, strengthened through patents, seems like something we might want to consider ahead of time, rather than playing the traditional "wait and see" game used so often here in the United States.

One final concern deserves mentioning. I want to emphasize again the interrelatedness of certain technologies within a system, as difficult as it may be, at times, to see from "within." These linkages of technical, social, and political artifacts becomes increasingly evident as we consider how these crops might be introduced into other areas of the world, those we consider "developing" and in need of our help. Several of these countries have turned

22. *Compare* Martha L. Crouch, *Biotechnology is not Compatible With Sustainable Agriculture*, 8 J. AGRIC. & ENVTL. ETHICS 98-111 (1995), *with* Donald N. Duvick, *Biotechnology is Compatible with Sustainable Agriculture*, 8 J. AGRIC. & ENVTL. Ethics 112-25 (1995).

this food away at their borders. Many an astounded scientist with whom I have spoken think this is positively inconceivable—and utterly immoral. But perhaps their distance provides perspective. These crops are not free; they come with increasing dependence on foreign grains rather than support of these regions' own local agriculture. If you accept the seeds (not just the grain), you invite increasing dependence on pesticides, fertilizers, and water;[23] if you accept the seeds, you accept the replacement of your knowledge with their knowledge. These have been the lessons and legacies of colonialism.

What alternatives are available or ought to be made available?

Now that we have investigated the possibilities surrounding the production and use of transgenic organisms, we need to think about what alternatives might exist for addressing our same sets of concerns agreed upon earlier. This is the part that is normally omitted from the debate. Accordingly, it might be difficult to prod ourselves to think in these terms. Yet, this is one way to get us thinking about what possibilities might exist. What if we interpreted the question I asked earlier—are food supply and environmental concerns technical, political, or social in nature—differently? What if we looked instead to non-technical solutions to what might be considered inherently socio-political in nature? For instance, what if we took our concern about food supply and discovered that we actually already have tremendous amounts of extra, unused food produced every year that is simply turned back into the soil or somehow destroyed? From this vantage point, it might seem that what we really need is a better means for distributing food, not more food. We might think, "What are the possible socio-political\ issues preventing this food from reaching those that need it?" We might think about socio-political interventions rather than technical ones. We might also explore why hunger or famine are occurring in the first place. We might think about ways of supporting systems of food production that combated these problems rather than smoothing them over with a technical fix.

Perhaps we decide we would like a technical fix. Are there alternatives to GMOs that might address our concerns of food supply and environmental health? There might be, but they might not be seen as compatible with current modes and methods for food production. They might involve breaking down large monocultures. Integrated pest management, organic farming, and other 'non-conventional' modes of farming are presenting new ideas, but at this point many of them have gone untested. Perhaps somewhere in the mix, we can find other suitable alternatives that help address our base concerns: decreasing pesticide use; achieving sufficient production and reliable yields. There are concerns here, too. What exactly would we mean by organic farming? How will—or can—tilling methods be altered to cut back on soil erosion and still maintain healthy production? There are truly limitless ideas, and we ought to be exploring them with the same vigor (and same financial

23. *See* KLEINMAN, *supra* note 20, at 15-33.

resources) that we are exploring the GM option. But we are not.

Which choice supports and fosters democracy?

How will we measure which options we should pursue? We should choose the option that most wholly encompasses our shared value of fostering democracy—from beginning to end. Do GMOs fit this model? Do they foster a democratic process? Does their use enhance democracy in our culture? These are questions we need to talk about together. We need to begin thinking about democracy not simply something that "is," but as a *process*—one in which we engage on a daily basis, and one that requires maintenance. If indeed we live in a democratic society, it is because we work to maintain it, and work against its dissolution. The structures of this socio-political system extend into—and are intermeshed with—other systems within our society: the scientific and technological, the economic. Maintaining democracy means fostering it in all of these places.

Perhaps the more important issue is the moral argument; from that standpoint, I would add one more element to the discussion. While it has become quite common to refer to these new crop hybrids as so-called "frankenfoods"—invoking the old fear of the monster that simply does not "fit in"—we should keep in mind Shelley's[24] more important message in that famous book: we must accept *responsibility* for our actions and be held *accountable* to those touched by them.

24. *See generally*, MARY SHELLEY, FRANKENSTEIN (Penguin Classics 2003).