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# The Global Food Fight

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## FOOD FOR THOUGHT

Powerful new technologies often provoke strong resistance. When the internal combustion engine gave us automobiles, advocates of horse-drawn buggies scorned the fad. When nuclear fission was first mastered, much sentiment turned against its use—even for peaceful purposes. Thus today's backlash against the commercial use of recombinant DNA technology for food production should not be surprising. Consumer and environmental groups, mostly in Europe, depict genetically modified (GM) food crops, produced mostly in the United States, as dangerous to human health and the environment. These critics want tight labeling for GM foods, limits on international trade in GM crops, and perhaps even a moratorium on any further commercial development of this new technology—all to prevent risks that are still mostly hypothetical.

The international debate over GM crops pits a cautious, consumer-driven Europe against aggressive American industry. Yet the real stakeholders in this debate are poor farmers and poorly fed consumers in Asia, Africa, and Latin America. These are the regions most in need of new transgenic crop technologies, given their difficult farming conditions and rapidly growing populations. Yet poor farmers in tropical countries are neither participating in nor profiting from the GM crop revolution.

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## GENE GENIE

THE GENETIC MODIFICATION of plants and animals through domestication and controlled breeding has gone on with little debate for roughly 10,000 years. But since 1973, genetic modification has also been possible through the transfer of isolated genes into the DNA of another organism. This type of genetic engineering—also known as genetic transformation, transgenesis, or simply GM—is a more powerful and more precise method of modifying life. Genes carrying specific traits can be transferred using a "gene gun" between species that would not normally be able to exchange genetic material. A trait for cold resistance, for example, can be transferred from a fish to a plant.

As powerful as GM technology is, the large corporate investments needed to develop commercial applications for transgenic crops did not begin until 1980, when the U.S. Supreme Court extended patent protection to new types of plants and plant parts, including seeds, tissue cultures, and genes. Only after the Court guaranteed the protection of intellectual property rights did private corporations make the substantial investments necessary to develop commercially attractive transgenic crops.

The first GM crops that emerged were designed to solve important farm problems: pest control, weed control, and soil protection. The Monsanto Company, for example, developed soybeans with a built-in immunity to glyphosate, the active ingredient in the Monsanto herbicide Roundup. Having planted these GM soybeans, farmers could control weeds with a single spray of glyphosate, which had previously been lethal to the soybean plant. This reduced the need to employ more toxic and long-lasting weed killers or soil-damaging tillage. Several companies also developed GM varieties of cotton and corn engineered to contain a naturally occurring toxin—*Bacillus thuringiensis* (also known as Bt)—that minimizes insect damage to plants while dramatically reducing the need for chemical sprays.

These new GM field crops were finally released for large-scale commercial use by U.S. farmers in 1996. This followed years of laboratory testing and controlled field trials to screen for risks to other crops and animals, to the larger environment, and to human health. Once the Environmental Protection Agency, the Food and Drug Administration (FDA), and the U.S. Department of Agriculture approved the new GM

seeds, American farmers gave them a try and instantly liked the results. By 1999, roughly half the U.S. soybean crop and one-third of the corn crop were genetically modified. While the seed companies made money, American farmers were the biggest winners, capturing roughly half of the total economic benefit from the new technology. (Patent-holders and seed companies gained only about a third of the added profits, while consumers got less than that.)

Enthusiasm for GM crops among American farmers is not hard to understand, given the decreased need for chemical sprays and tillage. Most U.S. farmers growing "Roundup Ready" soybeans need to spray only once, cutting chemical costs by 10–40 percent. Transgenic cotton often requires no spraying at all (compared to the 4–6 sprayings previously needed), reducing production costs by $60–$120 per acre.

Surprisingly, however, the GM seed boom has only been effectively realized in three countries. In 1999, 72 percent of all land planted with transgenics worldwide was in the United States, while Argentina had 17 percent and Canada 10 percent. The nine other countries that were (openly, at least) growing some transgenic crops—China, Australia, South Africa, Mexico, Spain, France, Portugal, Romania, and Ukraine—split the remaining one percent.

The weak participation of tropical countries can be partly explained by the industry's initial focus on temperate-zone crops such as soybeans and corn. But how can we explain the lack of enthusiasm among farmers in western Europe? There should have been nothing to prevent these farmers from making the switch to GM seeds. American companies have tried to market transgenic seeds in Europe, and some attractive GM crops have also been developed and patented by European-based companies. Yet within the European Union the new technology has not taken hold. As of 1999, only a few farms in Spain, France, and Portugal were planting transgenic crops.

## ALLERGIC REACTION

EUROPEAN FARMERS have stayed away from transgenic crops largely because European consumers have become frightened of eating them. Consumers in Europe are now leading a backlash against GM crops—even though no safety risks linked to any GM crops on the

market have ever been documented in Europe or anywhere else. After conducting its own 18-month study of this question, the U.K.-based Nuffield Council on Bioethics published the following conclusion in May 1999:

> We have not been able to find any evidence of harm. We are satisfied that all products currently on the market have been rigorously screened by the regulatory authorities, that they continue to be monitored, and that no evidence of harm has been detected. We have concluded that all the GM food so far on the market in this country is safe for consumption.

Yet such expert reassurances are discounted by European consumers, distrustful since the 1996 "mad cow disease" scare. That crisis undermined consumer trust in expert opinion after U.K. public health officials gave consumers what proved to be a false assurance that there was no danger in eating beef from diseased animals. Although mad cow disease had nothing to do with the genetic modification of food, it generated new consumer anxieties about food safety at precisely the moment in 1996 when U.S.-grown GM soybeans were first being cleared for import into the EU.

Exploiting such anxieties, a number of third parties, including nongovernmental organizations (NGOs), quickly stepped into the fray. Greenpeace and other European activist groups that had previously struggled against nuclear power and the use of various man-made chemicals (especially chlorine, which Greenpeace had tried to label "the Devil's chemical") inflamed consumer phobias of GM foods. In Britain, Prince Charles (a self-described organic farmer) and Paul McCartney joined the chorus. In France—where food is never just food—a broad coalition of farmers, labor unions, environmentalists, and communists launched attacks against not only GM food but also McDonald's, imported beef grown with (non-GM) hormones, Coca-Cola, and various other threats to what they called French "culinary sovereignty." In Germany, GM opponents drew dark parallels between the genetic manipulation of food and their country's earlier lapse into human eugenics.

These well-publicized campaigns forced significant corporate and government concessions in Europe. In April 1998, without scientific evidence of any harm from GM foods, Brussels stopped approving

new GM crops for use in or import into the EU. This has meant a de facto ban on all corn imports from the United States (worth roughly $200 million annually), since bulk shipments might contain some GM varieties not yet approved. The EU also enacted a GM food labeling provision in 1998, requiring its 15 member states to begin marking all packaged foods that contain GM corn and soy. The United Kingdom went even further, requiring that restaurants, caterers, and bakers either list all GM ingredients or face fines of up to $8,400. To avoid consumer boycotts and lawsuits brought by activist groups, a growing number of food companies, retail stores, and fast-food chains (including both Burger King and McDonald's) in Europe pledged in 1999 not to use GM ingredients—at least where it could be avoided.

This backlash began to spread in 1999 to food-importing nations outside of Europe. Japan, South Korea, Australia, and New Zealand made plans to begin mandatory labeling for some transgenic foods, including heavily imported products such as GM soybeans and GM corn if intended for human consumption (as opposed to animal feed). Japan and South Korea together represent an $11.3 billion annual market for U.S. agriculture, and U.S. officials have worried that protectionist farm interests lie behind these labeling moves. But consumer anxiety is once again the more powerful factor at play. Responding to such fears, Japan's Kirin Brewery Company recently announced that starting in 2001 it would use only non-GM cornstarch for its beer; Kirin's competitor, Sapporo Breweries, made a similar announcement the next day.

## OVER HERE

EUROPE'S CONSUMER-LED BACKLASH against GM crops put U.S. officials in an awkward spot. Usually the United States urges Europe and Japan to be more market-oriented in their food and agricultural policies; now, consumer-led market forces obliged the United States to adjust. U.S. officials have opposed the mandatory labeling of GM products. But the U.S. farm sector is so heavily export-oriented (U.S. farmers export more than 25 percent of the corn, soybean, and cotton they produce, and more than 50 percent of wheat and rice) that foreign pressure is prompting an informal movement in the other direction. The Archer Daniels Midland Company, a prominent U.S.-based

soy-processing and export firm, announced in 1999 that it would henceforth ask U.S. farmers to deliver their GM and non-GM soybeans in separate batches so ADM could offer "GM free" products to consumers in Europe and Japan. Two large U.S.-based baby-food companies, Gerber and H.J. Heinz, announced in 1999 that they would soon switch to non-GM ingredients—not because of any new evidence that transgenic ingredients were unsafe, but out of fear of a Greenpeace-led boycott. Frito-Lay, the nation's major snack-food provider, followed suit, announcing that it would no longer use GM corn. In November 1999, several members of Congress introduced a "Genetically Engineered Food Right to Know" bill that would require labels on any food containing at least 0.10 percent GM ingredients. The Grocery Manufacturers of America opposed this measure but supported stronger consultation requirements between food companies and the FDA, hoping to boost consumer confidence.

The European and Asian backlash against American GM foods could generate sharp international conflicts.

Credible labeling of all food produced from GM commodities would be an expensive proposition for U.S. farms, agribusinesses, and consumers. It would require complete physical segregation of GM and non-GM food along every step of production, from the farm gate to the grocery shelf. U.S. officials estimate that this could increase costs by 10–30 percent.

In the meantime, the European and Asian backlash against U.S.-grown GM crops could generate sharp conflicts in several international settings, including the World Trade Organization (WTO) and the Convention on Biological Diversity (CBD). Within the WTO, the Sanitary and Phytosanitary (SPS) Agreement permits nations to restrict imports in the name of health or environmental protection. But an unresolved question is whether governments can restrict imports under conditions of scientific uncertainty, on a precautionary basis. The SPS agreement allows import restrictions only on a provisional basis while governments seek additional information.

The EU is trying to weaken this WTO requirement. In January 2000, it managed to insert language supporting its precautionary

principle into the text of the new Protocol on Biosafety in the CBD. Hammered out by environmental rather than trade ministers, this protocol was drafted specifically to govern international trade in transgenic organisms, and it now states in several places that a "lack of scientific certainty due to insufficient relevant scientific information and knowledge" should not prevent states from taking precautionary import actions. The protocol then goes on to oblige exporters of living modified organisms meant for environmental release (such as plants or seeds) to provide prior notification of relevant biosafety information and to solicit an informed consent agreement from importers.

The United States fought to include language in the protocol that would place it under the authority of WTO rules, but was blocked from doing so by the EU and most developing countries. State Department officials reluctantly accepted the final terms of the protocol, partly with the hope that it might calm consumer and importer fears if the United States and the EU were seen to agree on the issue. By accepting the protocol, the United States also avoided further isolation within the CBD (to which Washington is not yet a formal party, since the Senate has failed to ratify it). But this acquiescence may have weakened America's hand on future GM trade issues within the WTO.

Such conflicts between the United States and Europe over GM crops may continue to escalate in the months and years ahead. Yet the most important stakeholders in the fight over GM foods have not been heard. It is among poor farmers and poor consumers in developing countries that the potential gains from this new technology are most significant. In the tropics, many consumers are not yet well fed and most farmers are not yet wealthy. Larger investments in the genetic modification of some crops could open a new avenue of escape from poverty and malnutrition for hundreds of millions of citizens in Asia, Africa, and Latin America. Yet far too little is being done to make that happen.

## SERIOUS STAKES

IF PROPERLY EXPLOITED, the GM crop revolution will have life-changing—and even live-saving—implications in developing countries. Food-production requirements are increasing rapidly in the tropics due to population growth. Yet agriculture there is lagging, in part

because of poor soil; extremes of moisture, heat, and drought; and a plenitude of pests and diseases that attack animals and crops. Poor farmers in tropical Asia and Africa currently lose much of their crop production every year (often more than 30 percent) to insects and plant disease.

Here is where modern transgenic technology carries special promise for the tropics: it can engineer plants and animals with highly specific pest and disease resistances. For example, poor farmers in Kenya today lose 15–45 percent of their maize to stem borers and other insects. If they could plant maize seeds engineered to contain Bt, a pest-killing toxin, they could reduce their losses without reliance on chemical sprays. Similarly, transgenic virus-resistant potatoes could help small-scale farmers in Mexico who currently suffer substantial crop damage. And a World Bank panel has estimated that transgenic technologies could increase rice production in Asia by 10–25 percent within the next decade. Without such gains, increasing demand from a growing population could push the price of rice beyond the reach of the poor.

Genetic technology could also improve nutrition. If the 250 million malnourished Asians who currently subsist on rice were able to grow and consume rice genetically modified to contain Vitamin A and iron, cases of Vitamin A deficiency (which currently kills 2 million a year and blinds hundreds of thousands of children) would fall, as would the incidence of anemia (one of the main killers of women of childbearing age).

The U.N.'s Food and Agriculture Organization has recently estimated that one out of every five citizens of the developing world—828 million people in all—still suffers from chronic undernourishment. One reason for this is lagging agricultural production in some poor regions despite the earlier innovations of the so-called green revolution. The disadvantaged (and mostly female) farmers of Africa were bypassed by the dramatic gains brought on by the conventional (non-GM) plant-breeding breakthroughs of the 1960s and 1970s. Between 1970 and 1983, new high-yielding rice varieties spread to about 50 percent of Asia's vast rice lands but to only about 15 percent in sub-Saharan Africa. Similarly, improved wheat varieties spread to more than 90 percent of Asia and Latin America but to only 59 percent of sub-Saharan Africa. This helps explain why agricultural production has increased ahead of population growth in both East and South Asia while falling behind population growth in sub-Saharan Africa—leaving an estimated 39 percent of Africans undernourished.

African farmers fell behind because they had greater difficulty than Asians in getting access to the full package of green revolution technology. Earlier cross-bred crops still required farmers to buy supplementary products, such as chemical sprays. But with new transgenic crops, all the potential for enhanced productivity exists in the seed itself. Pests and diseases are managed not with chemicals but through genetic engineering.

Critics of the GM revolution fear that the environment might be hurt if engineered crops are released into rural tropical settings where wild relatives of food plants can often be found. If an engineered herbicide-resistance trait breeds into a weedy wild relative, the result might be a hard-to-manage "superweed." Or widespread planting of Bt crops might trigger an evolving population of "superbugs" resistant to the toxin. Legitimate biosafety concerns such as these have so far been addressed in rich countries on a case-by-case basis, through field testing under closely monitored conditions; the means for such testing and monitoring are still largely missing in the developing world. Even so, the hypothetical threat to biosafety posed by GM crops remains demonstrably smaller than the actual threat posed by invasions of exotic but non-GM plant and animal species. By some estimates, exotic species movements (having nothing to do with genetic engineering)

currently generate tens of billions of dollars in losses to agriculture annually in the developing world. If these countries are truly concerned with biosafety, GM crops should hardly be their first focus.

Transgenic products not only reduce chemical sprays, they can also aid in land conservation and species protection. For small farmers in the tropics, if GM crops or animal vaccines make farm and grazing lands more productive, there will be less need to plow up or graze more fragile lands in the future. In sub-Saharan Africa, roughly 5 million hectares of forest are lost every year, primarily to new clearance for low-yield agriculture. The real threat to biodiversity in poor countries today comes from such cutting of natural habitats. Thus the ultimate environmental payoff from transgenic crop technologies could include fewer watersheds destroyed, fewer hillsides plowed, fewer trees cut, and more species saved.

## POUND FOOLISH

ALTHOUGH THE GM crop revolution could greatly benefit poor farmers in poor countries, this potential is not being realized. As noted above, their relatively prosperous colleagues in North America and Argentina grow 99 percent of all GM crops. Why have poor farmers in developing countries not participated in the boom?

First, consider the market-driven motives of the private GM seed companies that have been making the largest investments in this new technology. These multinationals have been criticized for their alleged efforts to make poor farmers in the developing world dependent on GM seeds. In fact, the GM seeds these companies are bringing to market have mostly been designed for sale to farmers in rich (mostly temperate-zone) countries. The danger is not that poor farmers in the tropics will become dependent on these companies; the danger is that corporate investments will mostly ignore the tropics because farmers there do not have the purchasing power to buy expensive GM seeds.

Some GM crop technologies originally developed for the temperate zone (Bt maize and cotton, for example) might readily be adapted for use in the tropics by transferring the desirable GM traits into locally grown crops through conventional plant breeding. Private companies, however, have little incentive to invest in such local adaptations where

farmers are poor. Worse, they may seek to block local adaptations if poor countries are not willing to protect corporate intellectual property rights (IPRs). Seed companies had once hoped to solve piracy problems by engineering a natural sterility (called gene-use restriction technology, or GURT) into the seeds of GM plants. But such thoughts were set aside in 1999 when Monsanto agreed, under intense pressure from critics, not to commercialize its "terminator" GURT technology.

Protection of intellectual property is less of a problem in rich countries such as the United States. If anything, the U.S. Patent and Trademark Office has given corporations more protection than is good for them. Companies can now patent not just the inventive use of plant traits and genes, but also some of the smallest fragments of genetic material. Since the commercialization of a single transgenic insect-tolerant plant can now require the combination of many separately patented subtechnologies, problems with legal gridlock arise.

In most developing countries, however, IPR protection for GM crops tends to be too weak rather than too strong. A WTO agreement on trade-related aspects of intellectual property rights (TRIPS), reached during the Uruguay Round of negotiations, requires that all WTO members—including even the poorest countries after 2006— provide IPR protection for plant varieties. Yet many developing countries will try to satisfy TRIPS without giving up the traditional privileges of farmers to replicate and replant protected seeds on their farms.

This being the case, corporations will remain wary. As long as both purchasing power and IPR protection remain missing, private firms will probably not invest in the innovations most needed by poor farmers in tropical countries. For these farmers, the marketplace by itself is unlikely to produce much GM magic. Market forces have not prompted international drug companies to do adequate research in tropical diseases such as malaria. Similarly, market forces alone will not trigger the GM crop investments most needed by poor farmers in Asia and Africa.

A historical comparison drives the point home. Hundreds of millions of poor farmers in the developing world (at least those on good land) benefited from the earlier green revolution because in that case private multinationals were not in the lead. Instead, the leaders were governments, international financial institutions, and private philanthropies

(especially the Ford and Rockefeller foundations). Market-oriented corporations did not build the laboratories or support the plant-breeding efforts in Mexico and in the Philippines that led to new, high-yielding varieties of wheat and rice in the 1950s and 1960s. These strains were developed and later adapted for local use by plant breeders working within the public sector, paid for in large part by Cold War–era foreign aid. The adapted local varieties were then replicated by national seed companies and given away to farmers. Intellectual property rights were not an issue, since government agencies wanted the seeds to spread as fast as possible. During this original green revolution, the public sector often went so far as to extend subsidies to farmers for cheap irrigation and fertilizers along with the seeds themselves.

Today's public-sector institutions are showing much less leadership in promoting the gene revolution. Reasons for this include a mistaken impression that all regions shared in the green revolution's success; the much larger and riskier investments in science that are needed to develop and commercialize new GM crop varieties; the dramatic shrinkage in budget leeway in most developing countries since the 1980s debt crisis; the model of market-led development pushed onto borrowing countries by the World Bank and the International Monetary Fund after that crisis; the disrepute of public sector–led development following the collapse of the Soviet Union; and finally, the diminished rationale for generous foreign aid to poor countries following the end of the Cold War.

Unfortunately, public development institutions also shy away from investment in GM technology out of fear: fear of media criticism, of litigation, or of physical attack by anti-GM activists. These are not imagined risks. The headquarters of the U.S. Agency for International Development's principal developing-country biotechnology support project, located at Michigan State University, was set on fire just before midnight on December 31, 1999, by an underground group calling itself the Earth Liberation Front.

More than just GM research is being left undone. Public-sector support for agricultural development has collapsed across the board. Annual foreign aid to agriculture in poor countries fell by 57 percent between 1988 and 1996 (from $9.24 billion down to just $4.0 billion, measured in constant 1990 dollars), and annual World Bank lending

for agriculture and rural development fell by 47 percent between 1986 and 1998 (from $6 billion to just $3.2 billion, measured in constant 1996 dollars). As donors have pulled back, governments in the developing world have not filled the gap. Poor countries remain notoriously unmindful of the need to invest in agriculture, despite the documented high payoffs. These governments are distracted by demands from more powerful urban constituencies, often led by the army, state-owned industries, or the state bureaucracy. On average, developing countries devote only 7.5 percent of total government spending to agriculture, and little of this goes for research. Sub-Saharan Africa has only 42 agricultural researchers per million economically active persons in agriculture, compared with an average of 2,458 researchers per million in developed countries.

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Even taking these private-sector limitations and public-sector lapses into account, the near total exclusion of poor-country farmers from today's GM crop revolution remains surprising. Even where useful GM technologies are commercially available, officials in poor countries have been curiously slow to allow their use. One reason has been the export to the developing world of the highly cautious attitude of European consumers and environmental groups toward GM crops. European fears have been exported both through market channels and through activist campaigns launched or supported by European-based NGOs.

In Thailand, for example, where exports of agricultural products such as rice, shrimp, tapioca, and poultry provide 23 percent of total export earnings and where local scientists have already engineered some improved GM crop varieties under greenhouse conditions, the actual planting of GM seeds is now blocked by the government. Warnings from customers in Europe and Australia that Thai exports might be shunned if they include any GM ingredients prompted Bangkok to announce, in mid-1999, that henceforth GM seeds would not be brought into the country until proven safe for human consumption. Some GM soybean and cotton seeds (grown safely and profitably by farmers in the United States since 1996) are rumored to be reaching

Thai farmers through black-market channels, but the Thai government—which until recently had supported GM crops—now views such imports as criminal.

In Brazil, farmers who had hoped to plant herbicide-resistant soybeans in 1999 were blocked at the last moment when a federal judge granted an injunction filed by Greenpeace and a Brazilian consumer institute on grounds of a possible threat to the Brazilian environment. Higher courts are now reviewing the case, but a ban on planting remains in place. Farmers eager to get GM soybean seeds have been smuggling them in from Argentina, but the state government of Rio Grande do Sul, partly in hopes of being able to offer GM-free products to customers in Europe and Japan, has threatened to burn their fields and jail any farmers found to be growing GM soybeans. Greenpeace has thrown its weight behind efforts to keep Rio Grande do Sul a "GM-free zone."

In India, devastating bollworm infestations in cotton plants have brought despair—and reportedly hundreds of suicides—to poor cotton farmers. Insects have developed resistance to the heavy volume of pesticides sprayed on Indian fields. (Cotton accounts for 50 percent of all pesticide sprayed in India, even though the crop takes up only 5 percent of total farmland.) In recent Indian field tests, a GM cotton variety genetically modified to control bollworm increased crop yields by 40 percent while permitting seven fewer sprayings. But commerical release has been delayed because NGOs have filed a public-interest lawsuit against the government agency that authorized the trials, and activists have destroyed some of the test fields. Many of the same activist groups that oppose GM seeds in India today also opposed the introduction of improved non-GM seeds during the earlier green revolution.

Tragically, the leading players in this global GM food fight—U.S.-based industry advocates on the one hand and European consumers and environmentalists on the other—simply do not reliably represent the interests of farmers or consumers in poor countries. With government leadership and investment missing, the public interest has been poorly served. When national governments, foreign donors, and international institutions pull back from making investments of their own in shaping a potentially valuable new technology, the subsequent public debate naturally deteriorates into a grudge match

between aggressive corporations and their most confrontational NGO adversaries. This confrontation then frightens the public sector, deepening the paralysis.

Breaking that paralysis will require courageous leadership, especially from policymakers in developing countries. These leaders need to carve out a greater measure of independence from the GM food debate in Europe and the United States. Much larger public-sector investments of their own in basic and applied agricultural research will be necessary to achieve this autonomy. New investments in locally generated technology represent not just a path to sustainable food security for the rural poor in these countries; in today's knowledge-driven world, such investments are increasingly the key to independence itself.