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The global adoption of genetically modified (GM) agricultural crops has been presented by supporters of this technology as an example of "one of the highest adoption rates for crop technologies."[2] GM crop seeds became commercially available to farmers in the United States, Europe, and Japan in 1995-96, and since that time the global area planted to GM crops has increased to 58.7 hectares (145 million acres), an area equal to roughly two and a half times the total land area of the United Kingdom. GM crops are now being grown by approximately 6 million farmers in 16 different countries. As of 2002, more than half of all the soybeans hectares planted world wide were GM, 20 percent of the world's cotton hectares, 12 percent of the world's canola hectares, and 9 percent of maize hectares. The total global market value of these GM crops by 2002, only six years after the technology had been introduced, reached $4.25 billion. [3]

Beneath the surface of this apparent adoption victory lies a far more complex picture. Most of the increased acreage planted to GM crops remains confined to just a few countries in the Western Hemisphere. One GM industrial crop, Bt cotton, is now being planted in some important developing world countries (e.g., in China, India, and

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[2] Dr. Clive James, Chairman of Board of Directors of International Service for the Acquisition of Agri-biotech Applications, letter to "Dear Friends and Colleagues," January 2003.

[3] Clive James, "Preview: Global Status of Commercialized Transgenic Crops: 2002," ISAAA Briefs, No. 27-2002.

Indonesia) but GM food and feed crops are not. As of 2002, 99 percent of all the world's GM food and feed crop acreage could still be found in just four Western Hemisphere countries: the United States, Argentina, Canada, and Brazil. Why hasn't the GM food and feed crop revolution spread more widely?

The answer to this question is over-regulation. In most developing countries it is not yet legal for farmers to plant any GM food or feed crops. In all of the developing countries of Asia (including east, southeast, and south) only one country so far – the Philippines – has approved the planting of GM maize. The planting of GM rice, soybeans, or potatoes has not been approved yet by any country in developing Asia. In all of sub-Saharan Africa, only one country (South Africa) has yet approved the planting of any GM crops (cotton and maize). The other 46 countries of this impoverished region are still proudly "GM free." In all of North Africa and the Middle East, not a single country has yet approved the planting of any GM crops – not even cotton.

This over-regulation of GM crops in the developing world at first seems out of character, as governments in the developing world are usually eager to get their hands of productive new technologies, not push them away. When regulating for health and environmental safety these governments ordinarily err on the side of being too permissive rather than too cautious. So why have these governments adopted an extreme version of precaution when it comes to GM crops?

Developing countries beyond the Western Hemisphere are staying away from GM food and feed crops because in this area they are following the regulatory lead of Europe rather than the lead of United States. European-style precautionary regulations (in the areas of food safety and also crop biosafety) toward GM crops are being pushed into the

developing world through four distinct channels of influence: Intergovernmental organizations (IGOs), bilateral development assistance, NGOs, and commercial markets.

Leading IGOs in the fields of agricultural development that should be promoting GM crops in the developing world (the World Bank, the CGIAR) are not doing so for fear of losing political and financial support from important European governments. Instead of promoting the spread of GM crops these organizations are either studying them (the World Bank), under-investing in them (CGIAR), or saying they are not needed (FAO). These institutions increasingly speak with a European voice in part because America's investments in multilateral institutions have recently faltered. As the United States fell behind in paying its dues to FAO, the relative influence of European governments grew within that organization. When the U.S. cut its contributions to the core budget of the CGIAR by 50 percent after 1992, U.S. influence within that organization waned. EU contributions to the CG system are now twice as large as U.S. contributions, so it should be no surprise to see Europe's precautionary view toward GM crops blocking CG research in this area.

Meantime a parallel set of global environmental institutions that are even more heavily dominated by European money and influence have been busy promoting the tight regulation of GM crops in the developing world. UNEP, an organization dominated by EU money and subject to heavy European green party influence, is using money from the Global Environment Facility (GEF) to persuade governments in the developing world to ratify the highly precautionary 2000 Cartagena Protocol on Biosafety (which took formal effect in September 2003), and to set in place tighter biosafety laws and regulations for GM crops within their own borders. The Cartagena Protocol empowers governments to

block the importation of living GMOs (LMOs) on grounds of precaution alone, without any scientific evidence of risk. In this regard it has undermined the traditional authority of the U.S.-favored SPS agreement within the World Trade Organization.[4]

A second channel through which European precaution is being projected onto the developing world is bilateral assistance. When the cold war ended the United States cut its agricultural development assistance programs by more than 50 percent, but the European countries – especially the Dutch, the Danes, and the Germans – remained engaged, and under the influence of green parties at home these European governments have recently been using their assistance programs to help governments in poor countries, especially in Africa, set in place highly precautionary biosafety regulations for GM crops. The German development assistance agency just announced a new 2 million Euro program in Africa to set up biosafety testing labs and train lawyers and customs officials in how to enforce the Cartagena Protocol. Instead of giving poor countries the means to use this new technology, European development assistance agencies are coaching poor countries in how to regulate it.

European-based environmental and developmental NGOs are a third channel of influence. Groups such as Greenpeace, Friends of the Earth, ActionAid, and Genetic Food Alert are active in the developing world using demonstrations, press releases, lawsuits, and direct actions to persuade governments to reject GM crops. Such actions blocked for 5 years the legalization of GM soybeans in Brazil, and more recently blocked the planting of GM cotton in northern India. NGO campaigns in southern Africa in 2002

[4] The SPS agreement allows governments that lack scientific evidence of risk to block imports only on a "provisional" basis while seeking more information, not on a more open-ended "precautionary" basis.

helped persuade a number of governments in that region, even when facing famine, to reject the importation of unmilled GM maize from the United States as food aid.

The most important channel of European influence over GM crop regulation in the developing world is the commercial marketplace. Europe imports 2/3 more food and farm products from the developing world than does the United States. Europe imports more food and farm products from the developing world than the United States, Canada, Japan, and Australia combined. Governments in the developing world are trying to remain "GM free" in food and feed crops today in hopes of retaining their commercial access to this important European market. They know that consumers in Europe would prefer not to consume GM foods, and they see regulators in Europe setting in place increasingly onerous rules on the labeling and tracing of GM foods through the market. The easiest way to avoid antagonizing consumers in Europe and to avoid triggering these onerous trade and labeling rules, is to remain GM free.

The EU Council and Parliament in 2003 enacted new regulations on the labeling and tracing of GM foods and feeds, expected to come into effect early in 2004, that will be highly prejudicial against exporting countries that plant GM crops. Such exporters, if they wish to sell to Europe, will now have to begin physically segregating GM from non-GM at a low contamination tolerance threshold of just nine-tenths of one percent. And when selling GM food and feed products to Europe they will now have to provide not only a GM label (which will be stigmatizing in the eyes of European consumers) but also an "audit trail" of legal documentation tracing the GM product all the way back to the farmer who planted the seed. Developing countries know they will be unable to provide either the strict product segregation or the credible tracing documentation required by

these new EU regulations. The best way for them to retain their access to the important European market will be to plant no GM food or feed crops at all.

This analysis suggests that several dramatically different alternative futures are now possible for the GM crops over the coming decade or so. In the longer run this technology is nearly certain to become pervasive, because of its power and growing record of safe use. Yet over the next decade or so it is possible to imagine one scenario under which the spread of the technology remains badly stalled. Under this scenario, the planting of GM cotton would continue to spread in the developing world, eventually even to the Middle East and Africa, but the planting of GM food and feed crops would not spread significantly beyond the four Western Hemisphere countries currently planting 99 percent of those crops. In those four countries, moreover, the introduction of new GM crop varieties (e.g., wheat) would be indefinitely postponed for fear of international market rejection, and the share of U.S. soybeans and corn grown under strictly contracted "GM free" conditions to service export markets would begin to expand. Increasing numbers of scientists working on GM crops would leave Europe and come to the United States, while increasing numbers of U.S. food processing and manufacturing companies that sell in Europe would relocate their production facilities to that region, so as to be able to source GM-free ingredients and hence avoid the cost and stigma of GM labels.

The big losers in this first scenario would be the U.S. biotech companies and their shareholders who had earlier bet on the rapid global adoption of this new technology, Poor farmers in the developing world would also lose, as they would be denied access to the lower production costs associated with GM seeds. Food consumer benefits (lower

food prices, and access to foods with enhanced nutrient properties) plus significant rural health and environmental benefits (fewer applications of insecticides and applications of fewer, less toxic, and less persistent herbicides) would also be foregone in poor countries.

To avert such a discouraging near term future the United States government is placing its hopes in the rules (the SPS and TBT agreements) and enforcement powers (the Dispute Settlement Body) of the World Trade Organization (WTO). Yet even if the DSB finds the continuing EU moratorium on new GM crop approvals a violation of the SPS agreement, and even if the EU consequently lifts its moratorium on new approvals (rather than refusing to lift its ban, as it did in the beef hormone case), exporters in the Untied States and the developing world will still be left facing the EU's new and even more constraining regulations on labeling and traceability. Winning a DSB case against the labeling and traceability regulations will be far more difficult in the WTO (it will have to be a TBT case, not a SPS case), and even if such a case is won securing EU compliance will be even less likely, since these new regulations are not just an informal policy of the Commission, but the fully legitimate result of a two year democratic legislative process between the Council and the European Parliament.

Some in the U.S. biotechnology industry may be hoping that the emergence of a second generation of GM farm crops with attractive "food traits" will eventually overcome consumer resistance in Europe, thereby loosening the regulatory straightjacket. Crop scientists in the laboratory have already been able to insert plant traits for higher quality oils, or for reduced allergens. Yet European consumers have so far shown no interest in using GM foods as their pathway to better health. They will continue to favor getting vitamins and minerals either from foods they view as "natural" or from

pharmacies and drug stores, rather than from farmers and grocery stores. Environmental and development NGOs in Europe have shown no interest in "food trait" GM crops; they have criticized transgenic vitamin A enriched "golden rice" just as harshly as they have criticized agronomic trait GM crops such as herbicide tolerant soybeans or insect resistant maize. This second generation of GM crops with distinct food traits would have to be regulated more strictly than the first generation of GM crops, which were substantially equivalent to conventional crops from the consumer's vantage point. Because the second-generation crops will be more like drugs or medicines, they will have to be regulated more like drugs or medicines, which is to say more tightly.

WTO actions and the second-generation crops are thus not likely to be the key. In order to imagine an alternative future in which the rapid spread of GM crops is not delayed by Europe's influence, on the developing world, we must make two assumptions. First, we must assume that farmers attracted to the new technology will defy regulators and plant GM seeds illegally. It was the spectacular success of illegally planted GM cotton seeds in India that eventually forced national regulators in that country to permit the legal planting of GM cotton in some regions in 2002. It was the wide spread of illegally planted GM soybeans in Brazil that finally forced the government of that country to legalize the technology in 2003. GM soybeans are now spreading illegally into several other countries in South America, and in Asia, a black market has emerged for GM cottonseeds from China.

Second, we must assume that China will eventually lead the way in Asia by commercializing not only GM maize (primarily an animal feed in that region) but also GM rice. China has been holding back on the commercialization of GM maize since

1998, for fear of lost export sales in the region to countries such as Korea, and it has been holding back on GM soybeans ever since a shipment of GM soy sauce (crushed from U.S. beans) was turned back from Europe in 1999. China has also been holding back on GM rice, another occasionally exported food crop. But as China's spectacular success with GM cotton spreads[5], and as its domestic needs for maize and rice continue to grow with population size and with the income-driven enrichment of China's diet, officials will almost certainly decide at some point to set international market acceptance concerns aside, and legalize the planting of GM maize and rice. Chinese officials will make this decision if only to avoid a continuing waste of the substantial state investments they have long been making in developing their own GM crop technologies.[6] Because China has developed its own varieties of GM rice, it will be able to commercialize this technology without any increased dependence upon an unpopular and mistrusted private international company such as Monsanto. It will be able to celebrate the release as a victory for the nation's own scientists. China could also find it easier to go first in making such a break-through decision, compared to the countries of South or Southeast Asia, because in the PRC environmental NGOs from Europe are given less room to operate, and because China is less dependent on international assistance from Europe or on European-dominated IGOs.

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[5] Nearly half of China's cotton is now GM. Farmers planting GM seeds have been able to reduce insecticide applications significantly, thus cutting chemical costs, saving labor time, and limiting occupational exposure to a serious health risk.

[6] See Robert Paarlberg, *The Politics of Precaution: Genetically Modified Crops in Developing Countries,* Johns Hopkins University Press, 2001. In China's tenth five-year plan (2001-2005) total state investment in agricultural biotechnology R&D is expected to reach $1.5 billion, four times the amount spent in the previous 15 years. Economist Intelligence Unit (EIU) 21 October 2003.

Once China goes ahead with the commercialization of a crop such as GM maize or GM rice, other nations in Asia could quickly follow. India has also made significant state investments in developing its own varieties of GM rice, and like China it faces rapidly growing food needs in the decades just ahead. India is currently growing its second crop of GM cotton, and like China it could use this industrial crop success as the foundation for approving GM food crops. Indonesia, another Asian giant already growing GM cotton, could then take the GM rice step as well.

In this alternative scenario the developing country regions most likely to remain resistant to GM food and feed crops will be Sub-Saharan Africa and North Africa and the Middle East, partly because of the preponderance of post-colonial European political influence and commercial ties in both of these regions. The planting of GM cotton may at some point begin to spread in Africa and the Middle East, but weak national research programs unable to develop home-grown GM food varieties, plus fears of lost market access in Europe, plus biosafety fears and regulations spread by European-influenced IGOs and NGOs, may combine to keep GM food and feed crops out of these two regions for some years into the future. If so, this second scenario will fall short of being an ideal scenario for poverty reduction and enlarged food security, since sub-Saharan Africa is the one region most in need of a farm technology upgrade to help address such problems, and since GM crops could have been an important part of that technology upgrade.

How can U.S. policy encourage the more rapid future spread of GM crop technologies? In the second scenario presented here, the successful breakout of the technology in Asia is attributed in large part to the stronger national agricultural research capacities found in countries such as China and India. For largely political and

ideological reasons, governments in most developing countries find it easier to accept a new farming technology if it emerges from trusted national public sector laboratories, rather than from the mistrusted labs of profit-seeking foreign multinational corporations. USAID assistance to national agricultural research systems in the developing world has fallen sharply over the past dozen years. One way to empower governments to go ahead with GM crops, in regions such as Africa, is to reverse this decline and begin investing more USAID money in the independent capacity of poor and hungry countries to begin doing their own modern crop biotechnology at the molecular level.