UNIVERSITY OF CALIFORNIA GIANNINI FOUNDATION

UPDATE

Agricultural and Resource Economics

VOL. 6 NO. 1 SEPT/OCT 2002

International Approaches to the Labeling of Genetically Modified Foods

by

Colin A. Carter

"The campaign of fear now being waged against genetic modification is based largely on fantasy and a complete lack of respect for science and logic. Genetic modification can reduce the chemical load in the environment, and reduce the amount of land required for food crops."
Dr. Patrick Moore, ecologist and co-founder of Greenpeace, March 2001. Ê

For his recent support of bioengineered crops, involving the transfer of genes into plants, environmental groups (including his own Greenpeace) have accused Patrick Moore of being a turncoat. His dispute with his fellow environmentalists underscores the controversy surrounding the production and labeling of genetically modified (GM) foods. Governments around the world are struggling to develop optimal labeling requirements for GM foods. There is confusion among consumers, because they are unsure as to what exactly GM foods are and whether these foods are harmful. Science has determined that bioengineered food is nutritionally equivalent and as safe as conventional food, but the GM labeling issue is not necessarily just about science. Rather, the politicians and environmental groups in Europe and elsewhere say GM labeling is about consumer choice and consumer rights and is not even a health issue. The purpose of this article is to discuss international approaches to the GM labeling issue.

The United States accounts for over two-thirds of bioengineered crops produced globally. Other major suppliers include Argentina, Canada and China, growing predominantly biotech soybeans, corn, cotton and canola. In addition, biotech ingredients and biotech processes are used in the production of a wide selection of food and beverage products such as meat, poultry, cheese, milk, wine and beer. At the present time in California, the major GM crop is cotton. However, biotech food ingredients and biotech processes are a significant factor in the California food industry.

Calgene's Flavr Savr™ tomato was one of the most famous biotech crops ever grown in California. The tomato was genetically engineered to slow its rate of ripening. For various reasons, the Flavr Savr™ variety was never a big success in the U.S. fresh market. Ironically, large quantities of California-grown Flavr Savr™ tomatoes were sold in the United Kingdom (U.K.) in the mid 1990s as tomato puree, clearly labeled as a GM food product. Consumers in the U.K. are viewed as being anti-GM, but they aggressively purchased Flavr Savr™ puree because the price was right.

Mandatory Labeling Issues

Any labeling of GM food presents major challenges for policy makers. The most fundamental problem relates to DNA detection or lack thereof, because the measurement of GM material becomes

Also in this issue.....

In the next issue.....

Do Polluters Head Overseas? Testing the Pollution Haven Hypothesis

Ann Harrison

Table 1. Sample of International Guidelines for Labeling Genetically Modified Foods

	Labeling Scheme	% Threshold for Unintended GM Material	Are Some Biotech Foods and Processes Exempt?
Canada	Voluntary	N/A	N/A
United States	Voluntary	N/A	N/A
Argentina	Voluntary	N/A	N/A
Australia & New Zealand	Mandatory	1	Yes
European Union	Mandatory	0.5[a]	Yes
Japan	Mandatory	5[b]	Yes
S. Korea	Mandatory	3[b]	Yes
Indonesia	Mandatory	5[c]	Yes
Russia	Mandatory	5	Yes

N/A means not applicable
a. Proposed threshold in the EU, lowered from 1 percent
b. Top 3 ingredients in Japan and top 5 ingredients in S. Korea
c. Not yet operational

difficult or impossible if the GM crop is highly processed. For example, products such as soybean oil or meat produced from GM feedstuffs may not contain any evident GM protein. In addition, biotechnology is used in certain food and beverage manufacturing processes and this cannot always be detected in the final product. For instance, most cheese and wine is made with genetically engineered enzymes.

Proponents of mandatory GM food labeling believe that consumers have the right to know whether or not they are eating GM foods. Opponents say that such a label implies a food safety risk that does not exist and trying to label something that is not detectable invites fraud and the fraud cannot even be detected. Mandatory labeling would result in unnecessary marketing costs with no apparent offsetting consumer benefit, and would be a nightmare to implement. Marketing costs would increase with segregation and identity preservation requirements. In addition, mandatory labeling requirements could inhibit further development of GM technology. The United States has criticized the EU's mandatory GM labeling as being nothing more than trade protection.

Even with mandatory labeling, standards are inconsistent and consumers are not necessarily provided with greater choice. In Japan and the EU (where GM labeling is mandatory) it is virtually impossible to find any products on the food shelf that are labeled as containing GM ingredients. So the approach taken by Japan and the EU is not really giving consumers a choice. Furthermore, there is a substantial amount of GM food eaten in the EU and Japan that does not have to be labeled. These products include cheese, soy sauce, vegetable oils, baked goods and numerous manufactured foods.

Internationally, the Codex Alimentarius Commission, an international standards-setting body for food, has a Committee on Food Labeling. Codex is trying to develop guidelines for the labeling of biotech foods but there is no agreement as to what the international standards should be. In all likelihood, there will be no final Codex standard on the labeling of biotech foods for many years.

International Approaches to GM Labeling

There is a huge gap in approaches taken in different countries towards GM food labeling (see Table 1). For instance, the EU has very strict GM labeling guidelines and they appear to be getting stricter. At the other end of the spectrum are the United States, Argentina and Canada, whose governments do not believe in mandatory labeling. Japan, South Korea, China and other countries are somewhere in between the EU and the United States on this issue. The reason given for the U.S. government's lack of support for the mandatory labeling of GM foods is that the FDA believes there is no scientific evidence that GM foods are nutritionally different than non-GM conventional foods.

This labeling debate hits close to home in California because anti-biotech groups in Oregon have recently put the labeling issue on the state's ballot for the fall 2002 election. The Oregon initiative is ballot Measure 27. The anti-biotech groups have declared that a similar initiative is planned for California. If labeling guidelines similar to those in Measure 27 were imposed on California agriculture, the economic

GM FOODS DEBATE-*Continued on page 10*

Information Systems in Agriculture

by

David Just and David Zilberman

Some farmers must rely upon a complicated web of both public and private sources in order to obtain the information necessary to manage their farms. A recent survey analyzes the inadequacies of the information currently being generated and suggests possible solutions for a more efficient process. Ê

Farming is a knowledge-intensive industry. Growers need to obtain and process financial, climatic, technical and regulatory information to manage their farms. Both public and private institutions have emerged to supply farmers with information and analysis. However, inadequacies in this agricultural information system, such as the inability to consistently provide accurate, timely and easily accessible information, present several challenges to farmers.

One of the roles of government is the provision of information to increase efficiency and improve the performance of the economy, but government activities are constrained by budget. Information is also provided by members of the private sector, and effective policy design needs to identify where investment in public information is most effective. Therefore, our research aims to understand networks of information and, in particular, who is the provider and who is the user of certain types of information.

Types of Information, Providers and Users

It is useful to distinguish between formal and informal information. Formal information is typically written and may be divided into data (numbers and other raw information) and processed information that is based on interpretation and analysis of the raw data. Informal information consists of information obtained through conversation and business transactions. Gossip is an important source of informal information.

Sources of formal information include public agencies such as the USDA and Cooperative Extension, commodity groups, and a wide array of private providers including commercial vendors, agricultural and non-agricultural media and, in some cases, in-house analysis in which large farms hire professionals to interpret information. The information users can be divided into two groups: end-users of information (e.g., farmers) and intermediaries, for example, consultants, who serve as the main suppliers of information to the end-user. To understand information-use patterns, we conducted a national survey.

Understanding the Network of Information

Data was collected through face-to-face and mail surveys in four commodity systems: Washington potatoes, Washington wheat, Iowa hogs and California fresh tomatoes. To capture some of the tremendous diversity in agriculture, we selected contrasting commodity cases in terms of market size and geography, export intensity, perishability and use of contracting. We obtained 684 observations of data used by various participants in the farm community including farmers, shippers, input suppliers, bankers and consultants.

Priorities of Information Providers

We investigated which sources of information play the most important roles in various decisions. For example, we distinguish between production, marketing and regulatory compliance decisions. We found that the public sector through the USDA, the land grant system and Extension are especially effective in providing information on prices, market conditions, general production practices and technologies. The public sector emphasizes provisional information that has public good properties and can be useful to a large audience. The USDA, for example, emphasizes information for crops that are grown in many states, i.e., major commodities such as corn, soybeans and wheat, while state agencies provide information on crops that are specific to the state. Thus, there is a relationship of complementarity between federal and state agencies. In our survey, hogs are a major commodity that is supported more substantially by USDA. Wheat, in general, is a major crop but

we surveyed wheat growers from Washington who receive less USDA information than other wheat growers. Potato is a major crop in terms of its volume and value, but it is grown in a small number of states and thus, may receive less USDA coverage than, perhaps, corn. While tomatoes are a major California crop, it is not grown much elsewhere in the U.S. and is not a major target for USDA information.

Wholesalers and Retailers of Information

We found that the extent and detail of information provided by the USDA and states affects the activities of other information providers. Commodity groups provide information that is needed by growers in their industry and is not provided by the public sector. For example, they specialize in providing interpretation and analyses of regulation as well as specific information on market condition or technological issues that are specific to the industry. Private sector consultants provide information that is more personalized and meets the needs of the specific customer. Many of the consultants, and other intermediaries, are quite heavily reliant on USDA information and data, and process it to meet the needs of the specific customer. Thus, the USDA is to a large extent a wholesaler of information while consultants and other private-sector information providers are the retailers.

Media, especially industry magazines, is another vehicle for dissemination of analysis. It also relies upon USDA data information appropriate to the target audience, it disseminates analysis of extension personnel and other experts, and it is an especially valuable source of information about new technological innovation and major trends.

The American Agricultural Economics Association data task force suggests that the network of information provision in agriculture is quite efficient and operates in a way that aims to minimize the cost of delivery of the information. Our findings, to a large extent, are consistent with this perspective. For example, we find that informal sources are used in situations where formal sources do not exist. In some cases informal sources provide up-to-date information about prices. In other cases, informal information is used to assess and evaluate the performance of new technology or important new regulations. New formal sources of information are established when there is constant and continuous demand for certain information that is provided informally. For example, a newspaper assessing a certain type of information or providing market news is established when the size of a group of users is sufficient to cover the newspaper's costs. Large farmers may hire an expert to provide in-house analysis of production or market conditions when existing sources are insufficient and the gain from the new information exceeds its cost.

What Farmers Need

Our analysis found that farmers recognized that information has various attributes and appreciate the timeliness, accuracy and reliability of information. They treasure USDA for its relative accuracy, impartiality and reliability, but they give it low scores on timeliness. Many USDA publications may appear quarterly and thus, the information may not be sufficient for decisions on a daily basis. Some respondents commented that the value of USDA information has improved as it has become available on the web and is updated more frequently. Many users found USDA information to be too general and not addressing their specific needs. Information provided by consultants has the drawback of being costly, but its main appeal is that it is tailored to an end-user's needs. Our respondents were well aware of biases associated with information in the media and information provided by intermediaries, especially dealers and commodity buyers. Respondents find informal information to be very timely in most case, but they recognize that it may be inaccurate as well as biased. Our interviews suggest that information users recognize differences in quality of information among different sources and adjust their reliance on this information.

Socioeconomical Factors

Our study also finds that socioeconomic variables significantly affect various patterns of use of information. Information intermediaries and growers with a graduate education have a higher tendency to use public information as well as raw data than other groups. Similarly, we find that education is positively related to the use of formal information and an individual who has a high school education or higher is more likely to use formal information.

End-users and Intermediaries

Some of our findings are summarized in Table 1. The first column identifies the percentage of informal

information use by various groups of end-users and intermediaries. The second column presents the percentage use of private information and the third column, of public information. But some of the private information used by the end-users originated with public sector sources, so the fourth column provides an estimate of total public information used both directly and indirectly by the different groups. For example, 46 percent of the information used by wheat farmers is informal. Out of the 54 percent of formal information they use, 33 percent is private and 21 percent is public. However, the share of the public information increases significantly to 31 percent if one takes into account both the direct and indirection contribution of the public sector. As Table 1 illustrates, there is vast reliance by the end-user in the farm sector upon informal information, and intermediaries rely much more upon formal information (approximately 70 percent). One reason for the larger reliance upon informal information among end-users is that they may need informal information of pricing, etc. that is not available from formal sources while intermediaries spend much of their time analyzing and then refining formal information to meet the client's needs.

Table 1. Information Sources for End-users and Intermediaries

End-user	% Informal Information	Formal Information: % Private Information	Formal Information: % Public Information	% Total Public Information (Direct + Indirect)
Wheat farmers	46	33	21	31
Wheat elevators	45	39	17	35
Wheat exporters	55	38	7	34
Potato grower/packer/ shippers	74	18	8	20
Potato processors	64	26	10	24
Hog farmers	22	57	21	60
Hog processors	60	26	14	30
Hog input suppliers	60	22	18	36
Tomato growers	65	33	2	4
Tomato grower/packer/shippers	69	22	9	10
Tomato input suppliers	50	31	20	22
Banks	40	40	20	43
Miscellaneous end-users	32	42	26	48
Total end-users	**52**	**34**	**14**	**28**
Intermediaries				
Brokers	21	52	27	48
Commodity associations	31	39	30	57
Agricultural media	23	44	33	77
Non-agricultural media	53	23	24	-
Commercial info. vendor	30	41	29	57
Extension	28	27	45	59
In-house analysts	22	55	23	-
Miscellaneous intermediaries	12	37	51	-
Total intermediaries	**28**	**40**	**32**	**58**

The Importance of Public Information

The table also shows that end-users are more likely to rely upon private information than do intermediaries. End-users perceive that only 14 percent of their information is provided by public research and Extension and attribute most of their formal information to intermediaries, but intermediaries rely heavily upon public-sector data information. End-users may be unaware of the impact of public sector information on the

intermediary output, and the correct accounting of the contribution of the private sector to the end-user information combines both the direct and indirect contributions. Thus, the overall contribution of the public sector, both directly and indirectly to the end-user is about 28 percent as conveyed in the last column of Table 1. Thus, the importance of public provision of information to end-users is significantly underestimated.

Variability of Information Used

The analysis shows significant differences in use of information categories among commodities. Hog farmers receive almost 80 percent of their information from formal sources. This is a major crop covered by USDA publications with an intensive network of intermediaries who provide detailed production and economic analysis. End-users of white wheat are the second most intensive user of formal information, even though significantly below that of hogs. Perhaps, this is the case because this crop is not the main variety of wheat in the U.S. The crops that are concentrated in specific regions, processing tomatoes and especially potatoes, are the least intensive users of formal information. Perhaps this is because USDA puts relatively more effort on providing information to commodities that are grown nationwide. The surprisingly low reliance of Washington potato growers upon formal information may reflect that the major potato-growing region is in Idaho, and the scale of potato production in Washington is not sufficient to support formal information outlets by private vendors or grower associations.

There is much less variability in the use of formal information among intermediaries than among end users. Non-agricultural media mostly relies on informal information because they provide the farm sector with news and commentary from policy-makers. Commodity associations and Extension rely relatively more upon informal information than in-house analysts or brokers because they integrate input from farm leaders and experts with USDA and other sources of written information. Extension relies the least upon private, formal information—a natural result given its mission to link research at the university and the USDA with the farm community. Brokers and commercial vendors heavily rely upon private, formal information because of their link to large agribusiness organizations.

Summary and Conclusion

We were surprised about the extent to which USDA information does not go directly to end-users but, instead, is intensively processed by intermediaries. We also recognize significant differences in information availability among end-users. Large farmers, for example, are able to have their own in-house information processing capacity and subscribe to expensive private consultants, while smaller growers who may not have the tools with which to interpret raw data and general analysis provided by the USDA, must rely upon media and informal sources. The disparity of information available provides an incredible challenge for Extension specialists and farm advisors. Perhaps the new means available will lead to a generation of information that will bridge the information gap in agriculture, especially now that the use of the Internet in agriculture is growing and more than 60 percent of farmers have access to the Internet.

We also conclude that the complexity of the agricultural information system leads to an underestimation among end-users of the importance of publicly provided information that, to a large extent, provides the raw material for many of the intermediaries. This lack of knowledge of the role of public information may weaken the support for public information funding as a major priority in agriculture. An increase in funding for public information should allow for an increase in the accessibility of public information to farmers. Because of the specialized nature of many of the crops grown in California, these crops are likely to be de-emphasized by the USDA's information and analysis effort. This may lead to an over-reliance upon formal information, and suggests an avenue for a more intensive public-sector information provision effort by the state and the university.

David R. Just is an assistant professor in the Department of Applied Economics and Management at Cornell University. He can be reached by e-mail at drj3@cornell.edu. Ê
David Zilberman is a professor of agricultural and resource economics at UC Berkeley with interests in agriculture, water and environmental policy design, the economics of technological change and the agricultural resource base. David can be reached by phone at (510) 642-6570 or by e-mail at zilberman@are.berkeley.edu. Ê

Global Warming Policy and the Role of Improved Scientific Information

by

Larry Karp

There is a great uncertainty regarding the relation between greenhouse gas stocks and climate change. The economic and environmental consequences of climate change are also uncertain, as is the cost of abating greenhouse gas emissions. Optimal abatement policies depend upon our interpretation of current scientific information, but these policies are insensitive to the anticipation of the future arrival of better information. Ê

Global climate change caused by increased stocks of greenhouse gasses (GHGs) is potentially one of the most serious environmental problems facing mankind. There are several important types of uncertainty associated with this problem: the relation between GHG stocks and climate change is uncertain, as are the environmental and economic costs of climate change; the economic cost of reducing GHG emissions is also unknown. This degree of uncertainty makes it difficult to achieve a consensus about what policies nations should adopt. There is currently substantial disagreement between the official U.S. position and the position adopted by many of its allies.

This article summarizes current information about GHG-related climate change. It then addresses a particular aspect of the controversy surrounding the choice of climate change policies.

The Policy Question

It is widely believed that scientific information about the effect of GHG stocks on climate change will improve over time. This belief gives rise to the following policy question: How should this anticipation of better knowledge in the future affect our current decisions on climate-change policy?

Although this question may appear rather abstract, it has become an important part of the debate on climate change policy. Both sides of this debate have supported their position by arguing that research will lead to better information. One view is that it is better to postpone economically painful cuts in emissions until we learn whether global warming is a serious problem. If we make those cuts now and later learn that the problem is not severe, we will have wasted resources. The other view is that it is better to begin making cuts in emissions now, as a form of environmental insurance. If we delay cutting emissions and later learn that global warming is a serious problem, we will suffer avoidable environmental damages.

In other words, the expectation that we will learn more about climate change has been used to argue that we should delay cutting emissions, and that we should accelerate these cuts. Before describing research that examines how the anticipation of learning should affect policy, we summarize the current scientific evidence of climate change.

Current Information about Global Warming

Clouds and GHGs allow the sun's heat to pass through to the earth, but they form a barrier to the outgoing infrared heat, thus acting as a greenhouse. A greater concentration of GHGs increases this effect, leading to the possibility of climate change and global warming. The atmospheric concentration of carbon dioxide (CO_2), the major GHG, has increased by approximately 30 percent since the industrial revolution.

The Intergovernmental Panel on Climate Change (IPCC), a United Nations-sponsored research group, identifies a number of recent climate changes that are attributable in part to human activity. The estimated global mean temperature has increased by 0.6^0 plus or minus 0.2^0 C over the last fifty years. Continental precipitation has increased by 5 – 10 percent in the Northern Hemisphere, and decreased in some regions. The frequency and intensity of drought and El Niño events have increased. Warming during the 20th century has likely contributed to the global average sea level increase of one to two millimeters per year. Nonpolar glaciers have retreated. The agricultural growing season has lengthened by one to four days per decade during the last forty years in the Northern Hemisphere.

In the absence of policy intervention, CO_2 concentrations are projected to increase by 75 to 350 percent above pre-industrial levels during the next century. Temperature is projected to increase by $1.4 – 5.8^0$ C, a change approximately two to ten times larger than the estimated increase during the last century. This projected rate of increase in temperature is probably greater

than those experienced during the last 10,000 years. Global average annual precipitation is also projected to increase. At regional levels precipitation may either increase or decrease by 5 – 20 percent. The global sea level is projected to rise by 0.09 to 0.88 meters over the next century. Climate change will reduce available water in many areas, chiefly due to changes in runoff caused by changes in precipitation. The predicted regional effects differ according to the assumptions used in models. For example, under different assumptions, the change in annual runoff may be positive or negative for California.

Models predict that higher GHG concentrations increase the frequency and intensity of extreme events, such as heat waves and heavy rains. There may also be large-scale changes, such as changes in soil and vegetation; a weakening of the gulf stream of oceans and a consequent reduction of heat transported to high altitudes in Europe; and significant loss of polar ice sheets, contributing to the rise in sea level.

If the temperature change is small, temperate area agricultural yields are likely to increase, particularly for cereal crops. Even small temperature increases would likely reduce agricultural yields in tropical and subtropical regions. Human health effects may also vary over climatic regions. Global warming may improve health in cold climates as a result of reduced cold stress, and worsen health in tropical climates due to greater heat stress. These health effects will also depend upon local environmental and economic conditions (e.g., the level of medical infrastructure). There is great uncertainty about the economic effects of these changes, but they are likely to lower income in developing countries. A small temperature change might increase or decrease income in developed countries, but a large change would more likely lower income. Since developing countries are likely to be exposed to most of the dangers of climate change, global inequality would increase.

Four aspects of the climate change problem deserve emphasis. First, GHGs are a global pollutant. GHG emissions created in any part of the world contribute to global stocks. The possibility of climate change is related to these stocks; it does not depend upon which country produced the emissions. GHGs are consequently a global rather than a national problem. Second, the probable effects of climate change differ in different parts of the world. Some regions might benefit from moderate (but not severe) global warming, whereas other regions—particularly the poorer areas—are more likely to be harmed. Third, there is tremendous uncertainty regarding the scale of damages. Under some assumptions climate models predict that the damages are likely to be negligible; under others, damages might be catastrophic.

Fourth, the relation between emissions and environmental problems is cumulative and long lasting. Most GHGs decay very slowly. For example if a ton of CO_2 is emitted into the atmosphere today, half a ton will remain approximately 90 years from now. Other GHGs decay even more slowly. Since the current rate of emissions of GHGs exceeds the current rate of decay, GHG stocks would continue to rise even if emissions (a flow) were stabilized at the current rate. Stabilizing GHG stocks have a persistent effect on the climate. Even if GHGs were stabilized, surface air temperature would continue to rise slightly for a century or more, and sea-levels would rise for many centuries.

Model Description and Results

Our research is designed to shed light on the policy question identified above: How should the anticipation of improved science affect our current policy choice? In order to address this question in a manageable model, we ignore several important issues and concentrate on three of the four aspects of the problem identified above: the problem is global, the relation between environmental damages and GHG stocks is uncertain, and the problem is cumulative and long lasting. We constructed a mathematical model that captures these features, while still being simple enough to be relatively transparent.

Using this model, we calculated the optimal level of abatement over time under two types of scenarios. In the first scenario, we assumed that the relation between GHG stocks and environmental damages is uncertain, but we suppose that the policy-maker never expects to learn about this relation. In the second scenario, we also assume that the relation between GHG stocks and environmental damages is uncertain, but here we suppose that the policy-maker understands that science will improve, i.e., the policy-maker understands that better information will become available. Of course, in the second scenario, the policy-maker does not know whether the future information will be good news or bad news. Thus, in the initial period the only difference in the two scenarios is that in the first, the policy-maker expects never to get better information, and in the second, the policy-maker realizes that information will improve. By comparing actions in the initial

period, we can assess the importance of taking into account the expectation that future information about climate change will be better.

Our model summarizes the true relation between GHG stocks and environmental damages using a single parameter, which is unknown to the policy-maker. This unknown parameter equals the average annual reduction in Gross World Product due to a doubling of GHG stocks from the pre-industrial level. (Current stocks are 30 percent above the pre-industrial level.) In the case where the policy-maker does not expect to learn, the parameter ϕ represents the policy-maker's belief about this unknown parameter. We solve this model for four different values of ϕ (percentage of reduction in gross world product).

Table 1. Impact of Reduction in Gross World Product (GWP) on Abatement of GWP Emission and Optimal Carbon Tax

	0.3	1.33	3.6	21	Anticipated learning
Abatement of Green Gasses Emission	2.35	9.80	23.40	77.70	9.60
Carbon Tax	5.32	22.03	52.50	174.19	21.50

For example, ϕ= 1.33 means that the policy-maker believes that doubling GHG stocks would lead on average to a 1.33 percent annual reduction in Gross World Product; this is regarded as a reasonable but optimistic estimate. A reasonable but pessimistic estimate is ϕ= 3.6. The estimate ϕ= 0.3 implies that the policy-maker thinks that GHGs are not a significant environmental problem, whereas ϕ= 21 implies that the policy-maker thinks that GHGs are likely to cause catastrophic damages. A larger value ϕ means that the policy-maker believes that the problem is more severe.

Table 1 provides a partial summary of our results. For columns two to five, the column headings give the value of ϕ used in the experiment; the second row of the table gives the optimal level of abatement in the first period, as a percentage of the "business as usual" (or unregulated) level of emissions. The bottom row gives the carbon tax that would be needed to achieve this level of abatement. For the estimate ϕ= 1.33, the optimal initial level of abatement is 9.8 percent, slightly higher than the level proposed by the Kyoto agreements. As these columns show, the optimal level of abatement is very sensitive to the policy-maker's belief about the severity of the environmental problem associated with GHGs, as reflected by the value of ϕ.

The last column gives the optimal level of abatement and the carbon tax when the policy-maker begins with the belief that a doubling of stocks will cause on average a 1.33 percent reduction in Gross World Product (GWP), but understands that information will arrive over time, changing those beliefs. (Again, the policy-maker does not know whether the news will be good or bad, or how beliefs will change.) The optimal policy in this experiment should be compared with the column labeled ϕ= 1.33, since the only difference between the two experiments concerns the anticipation of future learning.

In this model, anticipated learning causes a small decrease in the level of abatement. To this extent, the model supports the position of those who argue that the anticipation of learning means that we should "wait and see," i.e., act less aggressively to reduce emissions.

A more important result, however, concerns the magnitude rather than the direction of the difference—9.6 percent rather than 9.8 percent. This difference is very small, especially in light of the many approximations built into the model.

Since these results are based upon a specific mathematical model and use a specific calibration, we do not want to exaggerate their importance. However, they suggest the following policy recommendation: Current climate change policy should be based on the best current science; the anticipation of future improvements in science—better information in the future—is not a significant factor in choosing current policy.

For additional information, the author suggests the following references and sources:

IPCC Third Assessment Report-Climate Change 2001, http://www.ipcc.ch/

"Bayesian Learning and the Regulation of Greenhouse Gas Emissions" by Larry Karp and Jiangfeng Zhang, UC Berkeley, Department of Agricultural and Resource Economics, 2002.

Larry Karp is a professor in the agricultural and resource economics department at UC Berkeley. He can be contacted by phone at (510) 642-7199 or by e-mail at karp@are.berkeley.edu. Ê

GM FOODS DEBATE-*Continued from page 2*

burden would undoubtedly be high as many of California's food products would require labeling.

This summer, the European Union's (EU) Parliament approved new GM labeling proposals that, if implemented, could jeopardize a large share of U.S. food exports to European consumers. These new guidelines will now be debated in the EU Commission, and it will be several months before we know the final outcome with regard to the new EU labeling rules.

The proposed EU regulations would require the labeling of foods whose ingredients contain 0.5 percent or more of GM DNA or protein, whereas the current tolerance level is 1 percent. The new EU regulations would require labeling of food and feed products containing GM material irrespective of whether the GM material can be detected. Importantly, only authorized GM material would be allowed in food and feed sold in the EU. Compared to the U.S., there are only a small number of authorized GM crops in the EU.

Partly in response to these new EU labeling proposals, the U.S. government is threatening to file a World Trade Organization (WTO) complaint against the EU for restraining trade. The trade action would be directed at the EU moratorium on the approval of any new GM crops in Europe, in place since 1998.

Australia and New Zealand jointly adopted mandatory labeling with a 1 percent threshold for the unintended presence of GM product. A number of foods are exempt from their labeling requirements including vegetable oils, food additives, and food processing aids, such as enzymes used in cheese and brewing.

Japan's labeling regulations are much more reasonable than those in the EU. The Japanese government requires mandatory labeling when GM material is present in the top three raw ingredients and accounts for 5 percent or more of the total weight. So tofu must be made from non-GM soybeans or else be labeled accordingly. Exemptions to Japan's labeling requirements include feedstuffs, alcoholic beverages, and processed foods such as soy sauce, corn flakes and other vegetable oils. South Korea's regulations are similar to Japan's except the tolerance level is 3 percent for the top five ingredients. In the EU, the threshold applies to all ingredients.

China leads the world in public support of biotech crop research. GM crops in the field trial stage include rice, wheat, corn, soybeans, potatoes, cabbage and tobacco. GM cotton accounts for about 30 percent of China's cotton acreage. China has not yet announced a firm position on GM labeling, but it has recently proposed unexpected restrictions on GM crop imports. Outside China, this is viewed as a trade barrier that limits soybean imports from the United States.

Conclusion

So why do we observe the wide difference in approaches to GM labeling across countries? There are a number of possible explanations. The EU and Japan have experienced domestic food scares in recent years. So consumers in these countries do not believe scientists who say GM food is safe. Political pressure from environmental groups plays on this fear and raises concerns about GM food safety. Labeling is also a convenient trade barrier. Other countries, such as China, Australia, Indonesia and Russia wish to continue exporting food to the EU and Japan and they are concerned about importer reaction to GM foods.

Remember California's Big Green Initiative (Proposition 128) in November 1990? The Big Green Initiative would have lowered the use of pesticides by California farmers. However the initiative was defeated after voters in the state realized the implications for retail food prices. If Oregon's GM food labeling petition moves to California, it could be the next Big Green facing California agriculture.

For additional information, the author suggests the following references and sources:

- International Service for the Acquisition of Agri-biotech Applications (www.isaaa.org).
- Codex Alimentarius Commission (www.codexalimentarius.net).
- Pew Initiative on Food and Biotechnology (http://pewagbiotech.org).
- Greenpeace (www.greenpeace.org/homepage).
- Friends of the Earth (www.foei.org).

Colin A. Carter is a professor in the Department of Agricultural and Resource Economics at UC Davis. His interests include agricultural marketing and international trade. Colin can be reached by e-mail at colin@primal.ucdavis.edu or by telephone at (530)752-6054. Ê

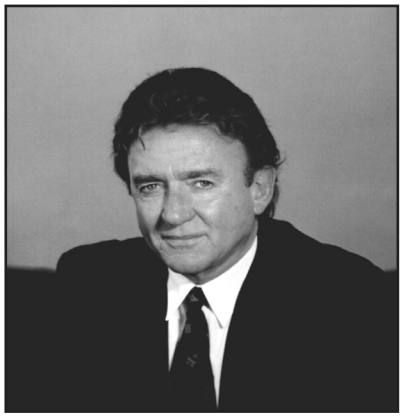
Faculty Profile

Gordon Rausser is the Robert Gordon Sproul Distinguished Professor in the Department of Agricultural and Resource Economics at UC Berkeley. Gordon is a fellow of the American Agricultural Economics Association (AAEA), the American Statistical Association and the American Association for the Advancement of Science. Gordon's broad research interests focus on contract markets, public policy, economic regulation, political economy, environmental and natural resource economics, applied econometrics and statistical decision theory.

Gordon spent his childhood years on a dairy farm in California and completed his advanced degrees in agricultural economics at UC Davis. In his second year of graduate studies, he accepted a position on the faculty at UC Davis and simultaneously, upon the death of his father, became the manager of the family dairy farm while also completing his dissertation, teaching graduate courses, and chairing the dissertations of six other Ph.D. students. In the face of this hectic launch of his professional career, Gordon was granted tenure at UC Davis, one year following the completion of his dissertation. Subsequently, he was awarded a postdoctoral fellowship at the University of Chicago in economics and statistics, became a professor of economics and statistics at Iowa State University and Harvard University. He returned to California in 1979, becoming the Chair of the Department of Agricultural and Resource Economics at UC Berkeley until 1985, and again in 1992.

Gordon has remained in Berkeley since, except when he served with the President's council of economic advisors and, at another time, as the chief economist of the U.S. Agency for International Development. He has assumed a wide array of leadership responsibilities at UC Berkeley, including serving as the Dean of the College of Natural Resources at UC Berkeley, where he provided the creative spark to design innovative public-private research agreements; expanded the faculty by 50 percent; increased the development contributions by 300 percent; and instituted a merit-driven allocation for college resources.

Professor Rausser's research has greatly enhanced the toolbox of agricultural economics and has anticipated and contributed solutions for the most important issues of the time. Gordon developed techniques to make better decisions for allocation of resources over time and under conditions of uncertainty. This work won the AAEA Enduring Quality Award and has provided a framework for management of commodity inventories and for analysis of price dynamics. In the 1980s, Gordon's public policy research distinguished between predatory verses productive government policies and suggested policy-making procedures that would increase the likelihood of sustainable, productive policies. This work received AAEA's distinguished public policy award in 1993 and the 2000 USDA Secretary of Agriculture Award.



Gordon Rausser
Robert Gordon Sproul Distinguished Professor
Department of Agricultural and Resource Economics
UC Berkeley

Gordon also pioneered the formal research of the links between agricultural economy and general economy and introduced tools to predict the impact of macroeconomic forces in the farm sector. This, too, led to one of Gordon's sixteen national research awards. In the late 1980s, Professor Rausser established the Institute for Policy Reform, and led this think tank to produce critical research on constitution design and the role of legal and regulatory institutions in supporting and sustaining economic growth.

In recent years, Gordon's research has proposed a new paradigm for management of public research and intellectual property, collective decision-making and multilateral bargaining, especially in water resource systems, and the application of his active learning and risk management frameworks to contract markets. Today, Gordon continues to research emerging societal problems and shape the landscape of agriculture and natural resources.

Gordon Rausser can be reached by telephone at (510)642-6591 or by email at rausser@are.berkeley.edu.

Giannini Foundation of Agricultural and Resource Economics Update

ARE Update is published six times per year by the University of California Giannini Foundation of Agricultural Economics.
Domestic subscriptions are available free of charge to interested parties. International readers are encouraged to view the ARE Update online.

Visit our Web site at: http://giannini.ucop.edu

To subscribe to **ARE Update**, contact:
Julie McNamara, Outreach Coordinator
Department of Agricultural and Resource Economics
University of California
One Shields Avenue, Davis, CA 95616
E-mail: julie@primal.ucdavis.edu
Phone: 530-752-5346

ARE Update is available online at: www.agecon.ucdavis.edu/outreach/outreach.htm

One Shields Avenue
Davis, CA 95616