Food Policy, Trade, Markets, and Genetically Modified Foods: A Review of the Literature on the Science, Technology, Politics, and Economics of Labeling

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The issue of whether or not to label will be a crucial one for the U.S. agricultural sector in the coming years. This paper develops a discussion of biotechnology in agriculture in the U.S., reports on the results of a survey to examine consumer response to labeling genetically modified foods, and discusses policy implications for markets and trade in genetically modified foods. Two hundred and fifty responses to a 2003 mail-questionnaire survey were analyzed for the paper. Chi-square test of independence was applied to data. Analyses showed that only 4.6% of consumers agreed that labeling should not be required for any biotech foods, while 94.4% agreed with the statement that labeling should be required for some or all biotech foods sold in the U.S. At $p \leq 0.001$, chi-square tests showed that preferences for the labeling scenarios posed were dependent on gender, number of people in household, race, religious preference, age, education, place of residence, and income. Results can be used in providing guidance for labeling policy.

Although modified inputs have contributed to a production boom, they have also contributed enormously to the current debate on agricultural biotechnology. Whether they are called Genetically Altered Crops (GACs), Genetically Modified Organisms (GMOs or GM), Genetically Engineered Crops (GECs), or simply Biotech Crops, they will remain a fundamental part of U.S. agriculture for years to come. Although some researchers have used these terms interchangeably (Van der Sluis, Diersen, and Dobbs 2001), they evoke different consumer reactions according to others (Hallman et al. 2003; Tegene et al. 2003). Biotechnological innovations in agriculture are centuries old (Yaukey 2000; Fernandez-Cornejo, Caswell, and Koltz-Ingram 1999; Blaine 2000; Manning 2000). Using science to create desirable traits in organisms, (Nuffield Council on Bioethics 1999; Nelson et al. 1999), biotechnology applications have raised numerous ethical, moral, political, and economic questions.

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The Role of Information in the Debate and Consumer Willingness to Accept GMOs

The kind of information needed for making informed decisions is of crucial importance to farmers who have expressed fear that they may not be able to sell their commodities because of the controversy surrounding the altered seeds used as input. In 1999 American farmers were planning a 20% cut-back in the planting of genetically altered crops, and the American Corn Growers Association had estimated that their farmers would loose $200 million in sales to Europe, where there was heightened fear of GMOs (Tangley 1999:49). The adoption of GM crops has remained strong, and in 2002 the value of the global transgenic seed market reached $4.0 billion, up from $3.7 billion in 2001 (ISAAA 2003). Since the first altered tomato was commercially grown in the U.S. in 1994, the food market has witnessed an astronomical growth in the sale of such products to the extent that by the beginning of 1999 there were 33 genetically modified seed brands available to U.S. farmers (Feldman, Morris, and Hoisington 2000; *The Tennessean* 1999; USDA 2000). The U.S. market for biotechnology-based food applications is estimated to reach $1.7 billion per year by 2006 (Sporleder 1999).

For the past few years there has been interesting

debate on consumers' willingness to accept genetically modified organisms in their food-consumption bundle. The evidence so far suggests that the issue will continue to generate an interesting debate for years to come (Juma 1999; Greenberg and Graham 2000). GMOs are the outcome of agricultural biotechnology, and a balanced discussion is one that focuses on both consumers and producers (Greenberg and Graham 2000).

Opposition to genetically modified crops includes perceptions not only that they are "unnatural" and can potentially damage the local ecosystem, but also that they are unsafe (Finnegan 1999; Tangley 1999) and have the potential to bring about fundamental changes in the structure of agriculture (Fernandez-Cornejo, Caswell, and Koltz-Ingram 1999). Food-safety issues are also getting more attention as world trade expands (Buzby and Roberts, 1999). Despite all the concerns, GMOs are so pervasive that they have become part of the many foods that humans consume (Manning, 2000).

Labeling of Genetically Modified Foods

Labeling provides an avenue of presenting information about a product. In many countries, including the United States, there have been increasing calls for GM labeling (Harl 2000; Prideaux 2000; Kilman 2000). The majority (84%) of Americans participating in a 2003 national survey indicated that they would like to see GM foods labeled as such, even when about 95% of them indicated that they would not pay attention to the labels. Of the Americans participating in the survey, 54% said that they frequently or always read food labels, 30% said they sometimes read them, and 17% said they rarely or never read the labels (Hallman et al. 2003). Labeling, however, is not a panacea for problems associated with GMOs and there is no consensus whether this approach would help (Runge and Jackson 2000; Caswell 2000; Unnevehr and Hasler 2000; Shoemaker, Johnson, and Golan 2003). The level of information to provide on labels and how best to educate consumers must be seriously considered (Teisl 2000). The labeling problem could change the world's food industry, and countries continue to hold significantly different positions on the matter (Teisl and Caswell 2003). The issue of estimating benefits and costs of labeling becomes more important in the face of existing divergent views. In the U.S., a consumer attitude survey conducted by Wiorthlin Worldwide (Wirthlin Group 2000) for the International Food Information Council in May 2000 showed that more than 69% of all Americans support the Food and Drug Administration (FDA) policy of not requiring mandatory labeling of biotech foods. There is no internationally accepted definition of what constitutes a genetically modified food and there is no one method for measuring and certifying foods that are GMO-free. There are no standard tolerance levels for GMOs in foods that would signal a level to regulate. This is an important point if one is to propose regulation (Nankivel 2000). Kershen (1999:137) notes the

> "acceptance or rejection of biotechnology will ultimately occur as a result of ideological and political beliefs and pressures . . . the debate about biotechnology will not be resolved primarily based on expanded knowledge and understanding of biotechnology as a science."

The three federal agencies charged with food regulation (the Food and Drug Administration, the Environmental Protection Agency, and the United States Department of Agriculture) have done more testing on biotechnology products than on conventional products, and their committee has found the foods and related products to be safe (Council on Biotechnology Information 2000).

Attitudes, and therefore behavior, can be shaped by the availability of information. This is true for consumers' demand for biotech foods (Tegene et al. 2003). In the authors' experimental-auctions experiment, information played a crucial role in how much consumers were willing to pay for biotech foods. The Worthlin Group has been commissioned by the International Food Information Council to conduct numerous surveys to assess consumer attitudes toward biotechnology. The surveys have indicated that despite the low percentage of Americans (43% in 2000, 36% in 2003) who were aware that biotech foods are in their supermarkets, 59% in 2000 (62% in 2003) still believed that they would benefit from biotechnology in the next five years, while 54% in 2000 (56% in 2003) somewhat or very likely would purchase biotech food products that have been enhanced to taste better or fresher and 69% in 2000 (69% in 2003) were willing to buy products that have been protected

from insect damage or genetically engineered to require fewer pesticides (see http://mindfully.org/GE/Wirthlin-IFIC-Survey.htm and http://ific.org/research/loader.cfm?url=/commonspot/security/getfile.cfm&PageID=1491).

One of the most controversial issues facing the discussion of agricultural biotechnology is the labeling of genetically modified foods, food ingredients, organisms, or crops. The discussion on labeling has been quite extensive, with a plethora of literature dealing with the subject (Ekanem et al. 2001; Caswell 2000; Runge and Jackson 2000; Unnevehr and Hasler 2000; Shoemaker, Johnson, and Golan 2003). Part of the legislative process that has guided current labeling directions can be seen in the Nutrition Labeling and Education Act (NLEA) of 1990—which mandated more nutritional information on food labels—the Dietary Supplement Health and Education Act of 1994, and the 1997 Food and Drug Administration Modernization Act, among others. Although much has already been done, more still needs to be done in the area of food labeling (Greenberg and Graham 2000; Golan, Kuchler, and Mitchell 2000).

Up to 70% of the processed food on American grocery shelves contain genetically modified organisms. About 93% of the Americans surveyed in 2001 believed that the federal government should require labels on genetically modified foods even though they lacked understanding of what constituted a genetically modified food (DeWan 2002). The FDA thinks otherwise, citing the "substantial equivalence" of GM crops to their conventional counterparts. Consequently, no labels are required unless there is a significant difference in composition, nutritive value, or allergen content between the two. But the question is whether or not labels would allow consumers to make informed choices based on information derived from them.

Numerous issues must be considered when discussing labeling, including how consumers perceive information from labels, the educational information to be derived from the label, and the costs and benefits of the label. The FDA's position has been that labeling can create confusion if put in place when it is not needed. The American Medical Association's (AMA) Council on Scientific Affairs, which recommended voluntary labeling to increase consumer acceptance and knowledge of agricultural biotechnology, saw no scientific merit in special labeling of genetically modified foods, a position also endorsed by the U.S. delegation to the meeting of the Codex Committee on Food Labeling. On April 5, 2000 the U.S. National Academy of Sciences issued a report suggesting that biotechnologically based food products were no less safe than those produced with conventional crops, supporting the two previous positions. According to Jackson (2000: 661), different labeling policies could "act as non-tariff barriers, altering the relationship between trading partners." As indicated earlier, there are also no universal standards for acceptable GMO content in food products, which causes more confusion for policy-makers.

Objectives

This paper develops a discussion of biotechnology in U.S. agriculture, reports on the results of a 2003 survey to examine consumer response to labeling in Arkansas, North Carolina, and Tennessee, and discusses policy implications for markets and trade in genetically modified foods. Qualitative and quantitative approaches are employed in presenting the ideas and analyzing the data collected for this study. Extensive review of the pervasive literature on genetically modified crops and food is used in accomplishing the stated objectives.

Data and Methodology

Following a series of focus-group meetings in the three states participating in this study, a questionnaire survey based on input from the focus-group meetings was developed and used in collecting data reported in this paper. Mail-survey questionnaires from 250 respondents to a survey in Arkansas, North Carolina, and Tennessee were analyzed for this paper. A detailed discussion of the focus-group meetings and how results were obtained and incorporated into the final questionnaire survey developed are reported elsewhere (Ekanem et al. 2004). Chi-square tests were applied to data.

GM Labeling: Results of a 2003 Consumer Pilot Study

This section discusses a recently completed study of consumers in Arkansas, North Carolina, and Tennessee. A specific question seeking consumer response to labeling of biotech foods is analyzed in this paper. Results are presented in Table 1.

When asked what their labeling preferences would be, about 4.6% of respondents agreed that labels should not be required for any biotech food, while 27.6% agreed that they should be required for some biotech foods (current policy). A majority of the respondents (66.8%) would prefer that labels be required for all biotech foods. These findings are in line with previous studies.

Conclusion

The debate on whether or not to label products of agricultural biotechnology will be with us for a long time. The issues in the debate cut across many disciplines, including science, politics, and economics. Opponents and supporters of the many innovations from genetic engineering are usually armed with arguments to support their positions. Labeling of genetically modified organisms and food is a very controversial issue. Mandatory or voluntary labeling is not costless, and consumers may ultimately pay for the cost of implementation. The educational and informational value of labels to consumers is quite suspect based on current literature on labeling. Knowledge about ingredients of the food does not necessarily make the food safe.

Many of the issues discussed in this paper can disrupt international trade in agricultural commodities; however, these issues could also be resolved through a reasoned approach that balances scientific inquiry with consumers' right to know. Scientists with expertise and experience in agricultural biotechnology, policy makers (political scientists and lawyers), agricultural economists, trade economists, regulators, and ethicists are needed in providing a comprehensive program to define and to set standards and rules in matters relating to GMOs. Producer and consumer concerns should be equally important in any attempts to resolve issues arising from the debate. The importance of the political sensitivity and national pride associated with the current debate on GMOs must be fully integrated into a solution. In-country groups should be allowed to participate fully in any dialogues and should be encouraged to be involved in any processes involving certification, updating, and dissemination of any information on the subject.

Many have suggested that certification, testing and labeling, and separating of products should be used to inform consumers of the contents of the foods they are consuming. It may be that consumers will be more willing to accept GMOs when they know from the information conveyed from labels the kind of food they are buying. It may also be too early to tell.

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Table 1. Response to Labeling for Genetically Modified Food.

Labeling Scenario	% of response
Labeling should not be required for any biotech foods	4.6
Labeling should be required for some biotech foods	27.6
Labeling should be required for all biotech foods	66.8

Labeling question posed in the questionnaire survey: The U.S. Food and Drug Administration (FDA) regulates food labeling requirements. Currently, foods produced through biotechnology do not require labeling unless biotechnology substantially changes the food's nutrient content or composition or if it is known to cause an allergic reaction. Some think that the FDA should require labeling of biotech food even if it has the same safety and nutritional content as other food and exhibits no known negative effects.

Which of the requirements listed below do you prefer for biotechnology food labeling (check one an-

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