Consumer Acceptance of Genetically Modified Food Products in the Developing World

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Abstract: World-wide consumer response toward food products made from genetically modified ingredients has been largely negative. However, the majority of the previous studies on consumer attitudes towards genetically modified food products were conducted in developed countries in Europe as well as Japan. The small number of studies conducted in developing countries obtained different results from the developed world. This paper considers the motivations for consumer attitudes towards genetically modified foods in developing countries. We conclude that the generally positive perception towards genetically modified foods in developing countries could be the result of a cost-benefit analysis consistent with expected utility theory. Developing countries have more urgent needs in terms of food availability and nutritional content. Additionally, perceived levels of risk may be smaller due to trust in government regulation, positive perceptions of scientific discovery, and positive media influences. This is contrary to the small benefits and high perceived risks found in many developed countries, and hence, the rational for low or non-acceptance of genetically modified foods in those countries.

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Introduction

The use of genetically modified ingredients in food products has been highly controversial. Consumer attitudes toward genetically modified (GM) food products are largely negative in many of the developed countries in Europe as well as Japan. Consumer skepticism in Europe and Japan is usually attributed to the unknown environmental and health consequences of genetically modified crops. Such consequences include, but are not limited to, unanticipated allergic responses to new food substances, the spread of pest resistance or herbicide tolerance to wild plants, also referred to as "super weeds", and inadvertent toxicity to wildlife.

Studies conducted in Europe and Japan provide strong evidence that consumers are only willing to take on the unknown risks of consuming genetically modified foods, if these products are offered at significant cost savings over non-genetically modified foods. One study conducted in Norway by Grimsrud *et al.* (2002) concluded that consumers in Norway were willing, on average, to purchase bread made with GM wheat only if it were offered at a 49.5% discount over non-genetically modified bread. Burton *et al.* (2001) in a study of consumer attitudes toward genetically modified foods in the United Kingdom, concluded that male shoppers were willing to pay an extra 26% to avoid animal and plant genetically modified technology, while female shoppers were willing to pay an extra 49.3%. McCluskey *et al.* (in press, 2003) found that on average, Japanese consumers were willing to purchase genetically modified noodles at a 60% discount over non-genetically modified noodles.

Studies in the United States found consumers to be more accepting of genetically modified foods compared with consumers in Europe and Japan. For example, a study by Lusk (2001) found that 70% of the junior and senior-level agricultural economics students at Kansas State University involved in the study were not willing to pay a premium for non-genetically modified corn chips. Similarly, a Canadian (ICAST, 1995) study found that consumers were willing to purchase genetically modified potatoes if offered at equal or slightly discounted prices. However, it was important that the product have an enhanced attribute not typically found in non-genetically modified potatoes. These studies suggest that American and Canadian consumers do not require the large discounts necessary in Europe to entice them to purchase genetically modified foods.

Although, there has been little research conducted on consumer attitudes towards genetically modified foods in developing countries, recent studies in China and Colombia find similar results. Li *et al.* (2003) concluded that Chinese consumers, on average, were willing to pay a 16% premium for genetically modified soybean oil and a 38% premium for genetically modified rice over the non-genetically modified alternatives. Pachico and Wolf (2002) found that 66% of the survey respondents in Colombia were willing to try genetically modified foods, and the willingness to purchase genetically modified foods was high among those who felt they did not have adequate or high quality foods available at home.

The disparity between consumer attitudes toward genetically modified foods world-wide is obviously large, ranging from price discounts of 60% to price premiums of 38%. In recent research aimed at explaining the differences between the United States and Europe, Nelson (2001) concludes that European consumers only consider the unknown risks associated with genetically modified products, but not the benefits, whereas U.S. consumers

evaluate neither the risks nor the benefits. Nelson, using the risk matrix presented by Margolis (1996) and shown in Figure 1 in the current paper, demonstrates that European consumers fall into Cell 2 labeled "Better Safe than Sorry" because they treat the potential harm of genetically modified foods as certain, so they avoid them at all costs. This "Better Safe than Sorry" approach to GM foods is basically the "Precautionary Principle," which dominates European environmental and food safety policy. The Precautionary Principle calls for preventive measures to be taken when an activity raises threats even if the direct cause-effect relationship has not been scientifically proven. In its strongest and most distinctive forms, the principle imposes a burden of proof on those who create potential risks, and it requires regulation of activities even if it cannot be shown that those activities are likely to produce significant harms (Sunstein, 2002).

Nelson argues that U.S. consumers fall in to Cell 4 labeled "Indifference" because Americans feel genetically modified foods are no different from other foods and are evaluated with equal standards.

Figure 1: Risk Matrix

		Opportunity	
		Yes	**No**
Danger	**Yes**	1. Fungability (Costs and Benefits)	2. "Better Safe than Sorry" (Only Costs)
	No	3. "Waste not, Want not" (Only Benefits)	4. Indifference (Neither Costs Nor Benefits)

Source: Margolis, 1996

However, when one closely examines the benefits and perceived risks of genetically modified foods stemming from trust in government regulators, attitudes toward scientific discovery, and media influences, it is highly plausible that consumers in the United States and Europe consider both the benefits and the potential costs of genetically modified foods. Differing perceived risks explain the rationale behind their differing attitudes. Using the same analysis, one might conclude that consumers in developing countries are also evaluating the benefits and potential costs of genetically modified foods. Developing countries have more urgent needs in terms of food availability, nutritional content, and income to pay for food. If there is decreasing marginal utility in calorie consumption per capita, the marginal utility of the last calorie consumed is much higher in developing countries.

Risks and Benefits Associated with Consumer Choice in the Developing World

The rational consumer makes decisions under uncertainty by assigning probabilities of occurrence to uncertain outcomes. Analysis of the benefits and potential costs of an action, such as consuming genetically modified foods, results in an expected utility payoff for each action. The consumer weighs the expected present benefits and expected future costs depending on his/her risk tolerance. The scientific consensus is that GM foods do not pose any risk to consumers. However, there is a distinction between scientifically assessed risk and perceived risk. The public's beliefs about risk are often very different from the experts. Hence, these perceived risks are seen as potential future costs by the consumer, carry probabilities of occurrence assigned by the consumer, and are thus subjective. The probability that the consumer assigns to each potential cost or risk primarily stems from three

main sources: the level of trust in government regulators regarding food supply safety, attitudes toward scientific discovery, and the influence of media coverage (Table 1).

A study by Baker and Burnham (2001) showed that consumer decisions regarding their willingness to buy genetically modified corn flakes in the United States were highly dependent on cognitive variables such as the consumer's beliefs (risk tolerance), opinions toward biotechnology, and knowledge levels. Frewer *et al.* (1998) concluded that television, radio, and newspapers, followed by discussion with other people were the main information channels by which people base their decisions. Hence, the views expressed by the media would influence subjective probability decisions.

Table 1: Influences on Risk Perceptions Associated with GM Foods

Representative Countries	Government Regulation	Media Coverage	Attitudes toward Science
China/Colombia "Developing Nations"	+	+	+
U.S./ Canada	+	+/-	+
Europe/Japan	-	-	-

Key: +: Positive influence, -: Negative Influence, +/-: No influence

Conclusions based on the survey of 599 Chinese consumers conducted by Curtis *et al.* (2003) support this theory. Survey respondents were found to be trusting of government regulators concerning the safety of the food supply and very positive towards science, including the use of biotechnology in agriculture. When asked why they would be willing to pay a premium for genetically modified foods, many responded that they felt positively about

science, were willing to try new products, or the price change was not enough to keep them from purchasing the products. Additionally, the government controlled media coverage in China concerning genetically modified crops has been very positive. China is the fourth largest producer of genetically modified crops in the world, and continues to support biotechnology research in an effort to sustain self-sufficiency food policies. Thus, it is not surprising that only 9.3% of the survey respondents in these two studies had a somewhat negative or very negative opinion concerning the use of biotechnology in foods, 54.1% claimed to have no knowledge of genetically modified products at all, and only 7.8% associated high risk with genetically modified foods. Additionally, 64.6% of the respondents considered advertising in their food choice decisions.

A study of Colombian consumers conducted by Pachico and Wolf (2002) found similar results. A positive predisposition towards scientific innovation was demonstrated by a strong agreement among 68% of the respondents that science improves the quality of life. Additionally, 75.3% of the respondents agreed or strongly agreed that their government provides an adequate level of safety in their food supply. The respondents also indicated that television is their major information source concerning genetically modified foods, with peer discussion and radio following in at second and third place. Nearly 75% of the consumers surveyed agreed that there may be some risk associated with genetically modified foods, but almost as many were willing to try genetically modified foods in any case.

The benefits of genetically modified crops and hence genetically modified foods are largely crop dependant. Many vegetables and fruits have been modified to provide pest resistance, increase herbicide tolerance, or supplement dietary intake of Vitamin A for example. Pest resistance seems to be one of the most widely found benefits of genetically

modified crops. Pest resistance leads to a dramatic reduction in the necessary pesticide applications (almost half in many cases). Such reductions provide a safer environment for growers, reduce pollution from irrigation water run-off, and reduce the public health consequences associated with pesticide ingestion. Genetically modified crops also reduce soil erosion because they require less tillage due to the plants resistance to herbicides. Additionally, many genetically modified crops produce higher yields per-acre of crop land over non-genetically modified varieties. Genetically modified crops are either cost reducing/output enhancing or product-enhancing. Hence, many genetically modified crops provide the ability to produce greater quantities at lower costs and others provide important nutritional supplements.

Table 2: Utility Contribution of GM Crop Benefits

Representative Countries	Cost Reduction	Output Enhancement	Product Enhancement
China/Colombia "Developing Nations"	+	+	+
U.S./ Canada	+	-	-
Europe/Japan	+	-	-

Key: +: High MU, -: Low MU.

The benefits of genetically modified foods to the developing world concern food availability, nutrition, and economic development (Table 2). Food availability is a large problem in the developing world. Bread for the World estimated that approximately 800 million people in the developing world today suffer from hunger. Forty percent of the survey participants in the Pachico and Wolf (2002) study in Colombia felt that they did not have adequate food for their family. China currently has almost 1.3 billion people and is likely to

exceed 1.4 billion by 2050 (PRB, 2002). China recognizes that if it is going to continue to feed its people, it must find more efficient agricultural production methods. To this end, China is spending close to $120 million each year on biotech research. Additionally, more than a dozen genetically modified crops have been approved for development in China (Huang *et al*., 2001). Increased yields provided by many GM crops may provide answers to food availability issues in the developing world. James and Krattiger (1999) estimate that transgenic technology may increase rice production in Asia alone by 10-20% in the next decade.

A second major problem in the developing world is malnutrition, especially Vitamin A deficiency (VAD). It is estimated that a quarter to half a million Vitamin A deficient children go blind each year (Zimmerman and Qaim, 2002). Since rice is widely consumed in developing countries, golden rice was genetically engineered to provide Vitamin A, and thus reduce Vitamin A deficiencies. Zimmerman and Qaim (2002) estimate that golden rice could reduce related health care costs in the Philippines by up to 32% and avert from 2,200 to 10,200 cases of blindness each year. Consumers in developing countries are concerned with their nutritional intake. Li *et al.* (2003) found that consumers in China were willing to pay more for genetically modified rice than for genetically modified soybean oil, due to the existence of additional vitamins in the rice product.

A third problem facing developing nations is economic advantage. In order to be competitive in world markets, growers must find cost efficient production methods. Genetically modified soybeans, also known as Roundup Ready (RR) soybeans, have provided Argentina an increase in total factor productivity in soybean production of 10% due to cost savings (Qaim and Traxler, 2002). A study by Kirsten *et al*. (2002) found that both

large and small scale Bt (Bacillus thuringiensis) cotton farmers in South Africa realized net income gains due to higher yields and savings on pesticides. These gains prevailed even with higher seed costs and technology fees not found with traditional seed varieties. The use of insect resistant Bt cotton in China reduced production costs by 14-33% (Pray et al., 2000).

As is evident from the above discussion, the developing world may benefit greatly from transgenic technology. When such benefits are compared with the relatively small perceived costs associated with genetically modified foods, due to consumer risk perceptions stemming from a trust in government regulation, positive media attention, and a positive predisposition for scientific discovery, it makes sense that consumers in developing countries would accept genetically modified food products through cost-benefit analysis.

Although genetically modified food acceptance is thus far relatively high in developing nations, recent surveys show that consumers wish to know which foods contain genetically modified ingredients. Pachico and Wolf (2002) show that 90.7% of their survey respondents in Colombia considered mandatory labeling of genetically modified foods very or somewhat important. However, only 64% of the respondents said they read food labels very or somewhat often. Curtis *et al*. (2003) found that 89.8% of their survey respondents in China considered labeling foods with genetically modified ingredients somewhat or very important.

Developed World Comparisons

The situation, as illustrated in Tables 1 and 2, in the developed world is quite different from the lesser developed countries (LDCs). Both the United States and Europe benefit from genetically modified technology through more efficient production stemming

from decreased input costs. Since nutritious food in both the United States and Europe is readily available, consumers in these countries do not perceive the same benefits from GM foods as those in developing countries. In fact, European consumers are focused on eliminating risks in the food supply rather than increasing it (Nelson, 2001). Additionally, recent outbreaks of Bovine Spongiform Encephalopathy (BSE), also know as 'Mad Cow Disease' have promoted little trust in government regulators regarding food safety.

Further, Europeans and Japanese cultures tend to take pride in traditional ways of doing things and do not necessarily see scientific discovery as life-improving. Europeans are often skeptical of new developments and have a "Why fix our food system if it isn't broken?" attitude. It is for these reasons that the Europeans and Japanese assign high probabilities to the potential risks of consuming genetically modified foods. The Eurobarometer surveys in 2000 and 2001 found that 59.4% of Europeans thought genetic modification could have negative impacts on the environment, and 70.9% did not want to see living organisms, such as plants and animals, genetically modified in any way. High potential risk perceptions coupled with minor benefits of genetically modified foods, provide a strong argument for the anti-genetically modified food sentiments in Europe attained through cost-benefit analysis.

In the United States, consumer concerns regarding genetically modified foods are generally limited. A small number of activist groups have spoken out against genetically modified foods, and there has been little media attention given to transgenic technology. Additionally, consumer trust in government authorities regarding food safety is relatively high due to the prevalence of regulation agencies. The Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the U.S Department of Agriculture (USDA), all evaluate genetically modified organisms for food, environmental, and public

health safety. Hence, the minor benefits from genetically modified foods for U.S. consumers combined with the minor potential costs fostered by a lack of media attention, positive disposition towards scientific innovation, and trust in government regulators concerning food safety, provide evidence for a general acceptance of genetically modified foods without large price premiums or discounts.

Conclusions and Implications

The urgent concerns of food availability and nutritional intake are much greater in lesser-developed countries (LDCs) compared to the United States, Europe, and Japan. Increased crop yields and dietary supplements provided by genetically altered foods would be of greater benefit in terms of food availability and nutrition problems for LDCs. These potential benefits along with lower perceived risks have contributed to generally more positive attitudes toward genetically modified foods in developing nations. Does this mean that developing nations should readily adopt transgenic technology and provide genetically modified foods to their populations? The literature plainly states that such action should not be taken without comprehensive communication and assistance from developed nations. Rissler and Mellon (1996) advocate that the United Nations develop international bio-safety protocols to ensure that developing countries prevent the risk of genetically engineered crops endangering domestic crop diversity. Nelson (2001) concludes that public evaluation of genetically modified organisms which considers the costs and benefits with a special preference for public health protection is necessary prior to future development.

A second issue of concern for developing countries, especially those which depend on food exports to developed areas such as Europe and Japan, is the potential for market loss

due to new regulations requiring labeling and traceability on all foods with genetically modified ingredients. In an effort to ensure GM-free exports, developing countries may be discouraged from planting genetically modified crops due to the extraordinary expense involved in segregating GM and GM-free crops. This strategy has already been seen in Brazil's recent capture of a US $6-7 per ton premium over U.S. corn sales to Spain and Japan due its GM-free corn status. However, the results of an empirical study completed by Nielson *et al.* (2001) indicate that global markets will adjust to segregation of GM and GM-free foods with South America and low-income Asia benefiting the most.

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