
Changing Consumer Demands Can Drive Biotechnology Adoption

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Appreciating the role of the consumer in shaping the agricultural and food system is key to understanding its structure and evolution. Emerging patterns in food demand help explain the transformation of agriculture from a commodity business, in which competition to sell homogenous goods is based solely on price, to one that delivers a broadening range of quality-differentiated products.

One of the immutable relationships in economics is known as Engel's law, which holds that as consumer incomes increase, the proportion of income spent on food decreases (Tomek and Robinson 1981). At lower income levels, spending on food may increase in proportion with income growth to ensure a sufficient quantity of food is purchased. As income continues to grow, food spending will continue to expand as individuals or households seek better quality food or buy food with more "built-in" services (as with food consumed in restaurants, for example). Eventually, food spending in the absolute may level off, so that it accounts for an ever-smaller proportion of growing income. At this stage, the demand is not so much for larger quantity but better and more diverse food quality. Although Engel's law technically pertains to food spending by individuals or households, the concept can be used to characterize differences in national spending patterns and to illuminate different demands being placed on food systems.

To begin close to home, consider the United State's food market. In the U.S., food quantity consumed in the aggregate essentially increases only with population growth. The proportion of income spent on food has fallen steadily over the past century. In a mature food market such as this, growth in demand for one food product likely only comes at the expense of another product. Consumers may switch from one product to another based on a desire for a

different quality characteristic, as from one kind of breakfast cereal to another. No more cereal is consumed, so growth in one cereal's market share comes at the expense of another's.

The proliferation of many types or varieties of foods is called product differentiation, and there are many examples outside of food and agriculture. The automobile industry evolved from one where any color of Model A could be had as long as it was black, to one in which new models appeared that were differentiated along many quality dimensions, including safety and styling, as well as performance. Much U.S. spending on clothing is predicated on the imperative of product differentiation, that is, the demand for clothes for different occasions, seasons, and other quality dimensions. In the food business, the past 10 or 15 years has seen an explosion in the number of new product introductions. Retail food stores offer choices that provide novelty or variety or convenience. Examples include organic produce, exotic fruits, marinated cuts of meat, and brands of bottled water. At the same time, spending on food consumed away from home continues to rise, reflecting the purchase of food with more built-in services.

How does the agro-food industry organize to meet food demand in this kind of mature market? One response, similar to that adopted in other sectors, is to coordinate the different parts of the supply chain more closely in order to assure that signals from consumers are translated swiftly and effectively. Food retailers, for example, may seek direct ties to growers in order to contract for products with specific qualities for delivery at specific times. Vertical integration in the hog industry appears to have helped develop the market for pork, including the introduction of convenience products, such as pre-trimmed and marinated tenderloins of uniform size and meat quality. Another response may involve focus on niche markets, which can exist side-by-side with mass retailing. Here, a good example is found in the wine industry where premium vintners thrive along with large volume distributors.

So far, explanation of structural change in the US agro-food sector has not included discussion of the use of biotechnology in food production or processing. But the question can now be posed: how will consumer demand pull biotechnology through the system? One possibility is expansion of the already-observed demand for "functional foods," which are products differentiated by nutritional content in ways that appeal to consumers' concerns about diet and health. New margarines or potato chips that have desirable types of fat are but two examples of new products that receive premium prices. The bottom line is that if biotechnology can be used to create products with characteristics that consumers value, then they will be used in production and processing. This is the promise of the so-called "second generation" of biotechnology products, as distinguished from the "first generation," which were innovations largely applied to reduce the costs of commodity production or boost yields but which imparted no changes to commodity quality.

In the United States, Canada, Western Europe, and a few other places, it is fair to characterize food markets as mature, with product quality differentiation explaining much of the dynamics of change. But in other parts of the world, the motivations underlying expansion of food demand and markets still have to do with desires to attain caloric sufficiency and key diet quality improvements. Some 800 million people, according to United Nations estimates, are malnourished, and many of them live in sub-Saharan Africa, as Per Pinstrup-Andersen explained. For these people and many others around the world, markets are a less important source of food than their own subsistence farms. First-generation biotechnologies matter here, where reliable growing is the main concern. But there are billions more people in Asia and Latin America, for example, who do have the wherewithal to demand more in food markets, seeking better diet quality, largely in the form of animal protein. Indeed, one of the most striking aspects of U.S. agricultural export growth over the past 15 years has been acceleration in meat exports. Indeed, the Governor of Nebraska told of his recent trip to Taiwan and Japan, where there are important consumers of key state products such as beef. It is true that economic growth in Asia is significantly off the pace of earlier projections. However, with well-educated and motivated labor forces these Asian nations still possess the fundamental determinants of food demand growth. Biotechnologies for these consumers may mean first-generation applications but increasingly could mean second-generation uses as diet quality becomes central.

In conclusion, it is worth emphasizing the importance of understanding causality — why events happen — in trying to assess the role of biotechnology in the food and agriculture systems of both developed and developing nations. There is currently much change in these sectors, and so care must be taken neither to demonize or lionize any one factor — whether it be biotechnology or industrialization or consolidation — as responsible for all that occurs. In particular, the role that consumers play in driving change deserves more attention. Competition for the food dollar will lead retailers and others who sell directly to consumers to look for ways to provide quality-differentiated products in the form and at the times that the market demands. Forging new supply chains and adopting new production and processing technologies will likely be parts of the adjustment to consumer-driven agriculture. Ultimately, it is only by understanding causality that there is any serious prospect of affecting outcomes, which is the real reason to be thoughtful in sorting through the complexity and ambiguity of change.

REFERENCES

W. G. Tomek and K. L. Robinson, eds., *Agricultural Product Prices* (Ithaca, New York: Cornell University Press, 1981)