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Measuring the Impacts of Transgenic Crops in Developing Agriculture during the First Decade: Approaches, Findings, and Future Directions

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Background

The impacts of transgenic crops in developing countries have been documented since their first release to farmers in 1996, but the scope remains narrow. Only a few crop–trait combinations have been examined in a limited number of countries over a brief time period. This summary is based on a forthcoming IFPRI Food Policy Review, which, focusing on applied economics models, examines the literature to date, based on the analysis of empirical data that has been published in peer-reviewed articles.

The review aims to identify components of good practices methodology for applied economists who seek to guide national policymakers with relevant and credible information about transgenic crops. The studies have been grouped into four categories: (1) Analysis of crop adoption and impacts on farmers; (2) Attitudes of consumers toward products made with transgenic ingredients; (3) Impacts of transgenic crops on the industry (producers, consumers, and innovators); and (4) Impacts of transgenic products on international trade.

Review of Findings

Farmers

Literature about the economic impacts of transgenic crops on farmers is the most extensive among the topic areas, documenting actual patterns of adoption and impacts. Overall, the research indicates that transgenic crops have provided economic advantages for smallholders in developing countries. One decade after the adoption of transgenic crops is a suitable juncture at which to review the methodological limitations associated with the first generation of studies.

Several caveats must be kept in mind when interpreting the literature. For example, the magnitude of the economic advantages associated with these crop–trait combinations depends greatly on the nature of the cropping season and the location of the study, so studies conducted in one year or place are not likely to be representative. It is important to observe adoption and impacts over a longer time period and broader geographical range before drawing conclusions. Furthermore, the literature so far is dominated by insect-resistant (Bt) cotton, and cotton is a crop with unique properties.

Selection bias, measurement errors, and biased estimation procedures are common in initial studies. Significantly, political controversies surrounding transgenic crops make randomizing samples and designing research that overcomes these limitations difficult. Despite the challenges involved, these controversies underscore the importance of documenting impacts objectively.

Consumers

Consumer attitudes are fundamental, as farmers cannot sell their crops at market without consumer demand. Two main bodies of literature address the influence of transgenic crops on consumer behavior: surveys of consumer attitudes and hypothetical estimates of consumer willingness to pay for transgenic-free products.

China is most heavily represented in this literature, which reveals that Chinese consumers are more accepting of biotech products than those in other countries for a variety of political, cultural, and historical reasons. Studies indicate that information is crucial to shaping preferences, and most developing country consumers have serious constraints to accessing this information. How survey questions are framed is thus very important. Furthermore, studies that combine revealed and stated preference approaches could help strengthen research that is mostly hypothetical or ex ante. Since few biotech foods have entered developing economy markets, there is little connection between farmer and consumer studies.

Industry

Almost all studies about industry impacts have been conducted ex ante and use the economic surplus model. While this approach portrays the distributional effects of a range of institutional and market structures and provides a starting point for strategic investments in agricultural research, it still has its shortcomings. Economic risk, and other key factors that determine the likelihood that the projected benefits will be realized, as well as potential impacts on health and the environment, have not been incorporated into the model. The next generation of studies is expected to include a wider variety of crops and traits, and provide quantitative analysis of issues such as biosafety regulations, supply channel performance, and industrial organization.

Trade

The primary transgenic crops on the market (soybean, cotton, maize, and canola) are all major, internationally-traded commodities, and countries have established specific trade-related regulations for them, unlike for non-transgenic goods. The issue of market segregation between transgenic and non-transgenic products is also increasingly prominent. Three types of analyses, all ex ante, have been conducted: analyses of bilateral trade, partial equilibrium models, and multi-country general equilibrium models.

The studies consistently found that countries that do not adopt transgenic crops are hindered if they stay behind—the "first-mover" advantage. Productivity growth is a risk in markets with inelastic demand, which benefits consumers while harming producers. Also, export loss fears resulting from adopting transgenic crops are excessive relative to the potential gains from productivity enhancement. At this point, biosafety regulatory processes have only been addressed marginally in most of these trade-related studies.

Recommendations for Future Studies of the Impacts of Transgenic Crops in Developing Countries

The institutional and social context of seed supply and demand can exert a greater influence over the relative success of the improved seed than its scientific performance in fields. The reliability of input and output markets is a crucial factor that is often absent from empirical studies. The crucial role of information flows and knowledge formation by farmers should also receive greater attention.

Regarding farm impacts, attention should shift from examining changes in yield, costs, and profits to the impacts of transgenic crops on health, environment, and poverty. At the same time, improved research protocols can enhance the validity of cost and yield advantage estimates. Industry studies will improve as higher-quality data become available. Approaches that account for risk and uncertainty are also needed. Trade models should link with improved sector models that better depict the productivity shifts brought on by technology adoption. Sector and trade models could be improved by calibrating to empirical cases relating to proprietary rights over the transgenic construct. As markets open in developing countries, the breadth and geographical scope of consumer studies will need to expand.

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See also:

Parables: Applied Economics Literature about the Impact of Genetically Engineered Crop Varieties in Developing Economies. Smale, Melinda; Zambrano, Patricia; Falck-Zepeda, Jose; Gruere, Guillaume P. IFPRI: Washington, D.C., 2006. http://www.ifpri.org/divs/eptd/dp/eptdp158.asp