The use of genetically modified (GM) crops has increased over the years since the United States, Argentina, Canada, Australia, and Mexico each commercialized one or more of certain GM crops—insect-resistant cotton and maize and herbicide-tolerant canola and soybeans—in 1996. By 2012, at least 12 crops with a number of GM traits were planted on 170 million hectares in 28 countries. Most adopting countries have commercialized these crops after implementing regulatory frameworks that include standard food and environmental risk assessments. Numerous countries, including some in Africa, are making decisions based not only on these risk assessments but also on the potential socioeconomic effects of GM crops’ adoption and use, such as their impact on trade and farmers’ income.
Countries that are party to the 2000 Cartagena Protocol on Biosafety (CPB) to the Convention on Biological Diversity, an international agreement that provides “an enabling environment for the environmentally sound application of biotechnology” (text from the CPB), are required to have biosafety frameworks in place to regulate transboundary movements of GM organisms before releasing these organisms within their jurisdictions. The protocol also states that nations can voluntarily include socioeconomic considerations in their regulatory processes.

*Socioeconomic Considerations in Biosafety Decisionmaking: Methods and Implementation* addresses potential methodological constraints when including socioeconomic considerations in GM crops’ regulatory process. The authors provide guidance on conducting an ex ante economic assessment of a GM crop by using the case of GM cotton in Uganda. Such an assessment can be used when making decisions to support decisionmaking about GM crop adoption.

Uganda is still developing official policies and regulations for biotechnology and biosafety. The National Biosafety Committee of Uganda, the country’s competent regulatory authority, asked the International Food Policy Research Institute and its Program for Biosafety Systems (IFPRI/PBS) to conduct an assessment of insect-resistant (Bt) and herbicide-tolerant (HT) cotton. Confined field trials of these biotechnologies have been completed, and the biotechnologies are currently being proposed for commercialization approval in the country. If the government decides to include socioeconomic considerations in its regulations, decisionmaking processes, or both, effective impact assessments are crucial. The methodology proposed by the IFPRI/PBS study in Uganda can be used for evaluating GM crops as part of biosafety regulatory and decisionmaking processes in other countries.

Bt and HT cotton are among the most commonly planted GM crops: GM cotton has been commercialized in 15 countries, and planting estimates show that more than 47 percent of world cotton is planted with a GM variety. To assess socioeconomic impact, the study evaluates first the institutional context in which the GM cotton may be used in Uganda and then the impacts on farmers, the national economy, and trade. The assessment does not include other aspects of GM cotton adoption, such as impacts on health, biodiversity, or property rights.

A point worth highlighting is the “ex ante” nature of these types of appraisals. Ex ante assessments are by definition conducted before the technology has been approved or used by farmers and therefore involve assumptions about and projections of the potential impact of the technology, if adopted. The relevance and applicability of an ex ante study rests on the reliability of the assumptions used.

Regulatory and decisionmaking bodies need standards by which to judge the quality and reliability of a socioeconomic assessment of GM crops and its underlying assumptions. This study provides basic directions and some lessons that will enable the derivation of such standards.

**COTTON PRODUCTIVITY AND PROFITABILITY IN UGANDA**

Production and price fluctuations have made cotton cultivation in Uganda risky. As a result, conventional cotton producers have been switching to other crops or to non-agricultural activities over the last 15 years. In the survey sites chosen for the study, cotton production under either the traditional or organic system shows low profitability because of poor and variable yield performance resulting from low use of fertilizers and insecticides.

The study’s findings suggest that Bt and HT cotton have the potential to contribute to the improvement of cotton productivity in Uganda. Bt cotton has some potential to increase yields, compared to conventional cotton, due to its resistance to the bollworm complex. It consequently requires fewer pesticide applications to control bollworm. However, its overall potential to contribute to increasing productivity is limited, because although Bt cotton will reduce pest damage it probably will not increase yields above those obtained in the absence of such pests. Significant productivity improvements require making production inputs such as fertilizers and pesticides (for targeting pests other than bollworm) available to producers.
FIGURE 1  Distribution of marginal benefits for cotton producers

Source: Authors’ survey data.

HT cotton can be a good alternative to conventional or organic cotton, as it frees labor from weeding, a back-breaking and time-consuming activity. Producers can reduce the costs from family labor, hired labor, or both and can use their free time to grow other crops or pursue other economic activities.

The advantages of both Bt and HT cotton can potentially lead to improved benefits for producers: Figure 1 illustrates the predicted differences in net benefits among conventional, insect-resistant, and herbicide-tolerant cotton. Nevertheless, if biotechnology is to have a positive impact on cotton production and its profitability, institutional constraints need to be addressed.

GM cotton does not pose a risk to exports of conventional cotton, but it could affect organic cotton exports. There are incentives for both the GM and organic cotton industries to keep their outputs separated. GM technology owners need guarantees of their intellectual property rights over their materials, while organic cotton producers need to maintain cotton that is free of GM elements in order to keep their certification to export organic crops to the world market. Their interest in keeping the certification will probably be determined by the organic production volumes they can achieve. Also, cotton ginneries’ ability to freely switch from conventional to organic and back could no longer be supported if GM cotton is commercialized and begins to mix with conventional cotton. Coexistence of both GM and organic cotton is possible if institutional arrangements are made to avoid mixing them.

LESSONS FOR THE INCLUSION OF SOCIOECONOMIC CONSIDERATIONS

When conducting impact assessments, researchers should adhere to the following principles:

- Determine how the institutional setting could affect the technology’s deployment. An understanding of the institutional setting informs researchers’ assumptions about cotton yield, costs, prices, and other cotton-adoption characteristics that the analytical models rely on. This understanding also helps the technology’s developers to deploy it in a way that both takes advantage of the institutional setting and makes the technology more likely to have the impact predicted by the analytical models.
Draw a sample that is representative of farmers’ conditions. Sample size and selection influence assessment results and thus final recommendations. The selected sample should be nationally representative of the country’s agroecological conditions so as to allow country-level conclusions.

Estimate or derive the technology’s capacity to reduce crop losses, which at the farm and industry levels are referred to as “technology efficiency.” The impact of technology efficiency on production is significant, and thus a technology-efficiency estimate needs to be as accurate as possible. In an ex ante assessment, probability distributions and stochastic analysis are the best methods of dealing with a lack of information about a technological effect in the field. These methods provide possible ranges within confidence intervals, rather than less accurate single-value results.

Consider the use of stochastic partial analysis to account for temporal and spatial variability in farm conditions. As noted above, the results of a stochastic analysis are ranges of values for the outcome of interest. These results cannot be assigned a significance level but may nevertheless be subject to further analysis and evaluation according to a set of robustness criteria.

In ex ante studies, the underlying parameters used in representing a nation’s economy—size and openness of the economy, size of the relevant crop sector, adoption rates, and other characteristics—need to be pulled from previous research or elicited through interviews with local experts. Their accuracy will therefore be limited, and allowance should be made for this fact.

Incorporating socioeconomic considerations into a country’s biosafety or decisionmaking process without carefully ensuring that the process remains transparent can pose some significant drawbacks, including making regulation difficult and costly to navigate and impeding effective decisionmaking. In addition, incorporating socioeconomic considerations will require a nation to pay particular attention to the following issues:

Rigorous assessment methods can be expensive, especially if they cause additional costs and time delays. Expenses are particularly difficult for public-sector research and development organizations in developing countries that struggle with binding budget, human resource, and time constraints above and beyond what those in industrialized countries will likely encounter. Another drawback is that regulatory intensity (and thus cost) has an inverse relationship with the level of technologies deployed for farmer use.

Interpreting the results of biosafety assessments may also be challenging. When the socioeconomic, food, feed, and environmental-risk assessments show consistent results, the regulatory decision to approve the technology for release to farmers might be an easy one to make. The regulatory decisionmaking process might be quite difficult, however, when there are mixed positive and negative results.

The inclusion of socioeconomic considerations could hinder decisionmaking. If a socioeconomic assessment shows, for example, that there are institutional constraints on the adoption of GM technology, should decisionmakers halt the approval of a technology that has gone through successful environmental and health risk assessments? Or should governments allow its release pending resolution of the underlying institutional constraints, which are likely binding not only for GM but conventional technologies as well? The latter option may not even be within the purview of the regulatory agency or other competent authority responsible for the technology’s risk assessment.

All of these issues and decisionmaking processes will require more research, discussion, and debate with stakeholders in countries contemplating the inclusion of socioeconomic considerations.

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