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ASSESSING THE POTENTIAL IMPACT OF GENETICALLY MODIFIED COTTON IN UGANDA

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Cotton has been planted in Uganda for more than a century, despite its low productivity. In an effort to improve productivity, the Ugandan government is considering genetically modified (GM) varieties such as insect resistant (IR) and herbicide tolerant (HT) cotton. This brief summarizes a study which examines the risks and benefits of GM technology to agricultural growth in Uganda. Through an ex-ante impact analysis of GM cotton adoption in Uganda, it considers the impacts to farm, market, trade and industry, and the institutional environment of the cotton sector as a whole. The findings provide stakeholders and policymakers with tools to analyze and make decisions about the approval and adoption of GM cotton in Uganda.

Genetically modified cotton in Uganda: Economic impact on farmers

Farmers are key actors at the core of the impact evaluation studies, particularly when evaluating technological interventions that seek to improve agricultural production. Given that GM cotton has not yet been planted in Uganda, the study is based on assumptions, such as GM prices and adoption rates, which are crucial to the results of the economic evaluation. A survey was used to calculate partial budgets for representative growers and to compare partial budgets for various simulated scenarios. The scenarios include: a traditional low-input system, a system with higher use of inputs (including fertilizers and pesticides), an organic production system, and a conventional system using GM seed.

The analysis shows that the traditional low-input system and organic cotton production are not profitable, but they might be better performing than a cotton production system where the farmer makes use of higher, but still suboptimal, levels of pesticides and fertilizers. Interestingly, organic cotton shows higher returns to investments than conventional production but also a higher downside risk. Despite the dramatic yield losses to biotic constraints (up to 80 percent), farmers are not using significant levels of pesticides. Therefore, an expected reduction in pesticide use would not be significant with the adoption of IR cotton. HT cotton, on the other hand, can be a good alternative for Uganda, since it will reduce weeding time and allow for other activities. But the lack of experience of farmers in the use of herbicides, in addition to issues of availability and price of the appropriate herbicides, may limit the impact of this technology. Overall, the simulations show that conventional production using IR and HT cotton varieties could yield the highest returns, but that profitability of the crop will not increase dramatically. The study concludes that, independently of the type of seed used or farming system implemented, an investment in fertilizers and good quality seeds is crucial to improving the profitability of cotton in Uganda.

Risks and benefits of GM adoption: Impact on the national industry

To evaluate the impact on the cotton industry, the increase in supply expected from the adoption (economic surplus) of GM seed is measured and the range of productivity impacts is considered with statistical distributions. Given that this is an ex-ante evaluation, variables such as costs (including the technology fees necessary to move the technology from the R&D phase to the hands of farmers), prices, quantities, time or adoption lags, adoption levels, and durability of resistance are estimated based on farm-level data or constructed based on informed assumptions. Multiple scenarios are developed to account for different technology delivery arrangements: public or private delivery, full or reduced technology fee, and IR only or stacked-gene technology.

The results of the economic surplus show that at the aggregate level Uganda can gain from the introduction of GM cotton. However, the Internal Rate of Return estimated across the scenarios, although higher than the threshold interest rate (bank

interest), is not as high as other results for agricultural research outcomes. In most developing countries, significant attention is directed toward the probability of getting negative returns, that is, toward the downside risk. In the case of a public or private sector release, where the developer charges a full technology fee, the probability of a negative return could be as high as 38 percent. If Uganda wants to maximize the level of benefits and reduce the downside risk to its farmers, it is necessary to improve overall cotton productivity. Yield levels have a critical role in explaining benefits in our simulations. In fact, the relative impact of yield levels is five times higher than the impact of technology fees. A significant proportion of farmers interviewed have relatively low yields—partially due to low input use. A damage abatement technology, such as GM cotton, will reduce the level of yield losses, but will not increase the potential yield. It is unlikely that the developer will release the technology for free by donating the intellectual property rights to Uganda. Uganda therefore needs to implement a strategy to negotiate the technology fee charged to farmers before releasing GM varieties.

Trade considerations: Coexistence of GM and organic production in Uganda

The study reviews the possible trade considerations with the introduction of GM cotton in Uganda, by providing a rapid assessment of the potential consequences and possibilities of coexistence of organic and GM cotton, based on a review of secondary information and available literature. Between 1996 and 2007, around 87 percent of Uganda's cotton lint production was exported, making cotton Uganda's third-largest export crop.

There is no differentiation of GM and non-GM cotton lint on the international cotton market, so the introduction of GM cotton does not pose a risk to exports of conventional cotton. However, the introduction of GM cotton in Uganda could affect the market for organic cotton, which forbids the use of GM seeds. Because organic cotton lint is already separated, the main issue would be related to the separation of GM and organic seeds. Coexistence of both systems is possible if institutional arrangements are implemented to avoid seed mixing and certification losses. The study suggests three alternative scenarios: (1) the separation of organic seeds, (2) the separation of GM seeds, and (3) the separation of both organic and GM cotton seeds. The choice of alternative would depend on the control strategy of the developing company with respect to intellectual property rights and on the volume of organic, conventional, and GM seeds. In the short-to-medium run, the seed marketing channel will likely be unaffected, since there are incentives for a developing GM company to take measures and separate its own seeds. Once GM cotton is adopted in a larger area, organic seeds will also have to be separated to ensure that the certification remains valid. Therefore, although there is no reason to fear export losses of any kind, policymakers should actively engage with developing GM companies and organic producer associations to discuss seed marketing strategies and the coexistence of their market channels before the introduction of GM cotton. This needs to be done to ensure that each cotton producer can choose its own production system independently of others.

Adoption of GM cotton in Uganda: Institutional analysis

Economic literature on the adoption of GM cotton underlines the importance of taking into account the institutional framework, particularly within the context of small-scale farmers. Using Net-Map, an interview-based mapping tool, the study evaluates the institutional environment to assess possible limitations and identify necessary changes that need to be in place for the approval and adoption of GM cotton in Uganda. The institutional analysis is done at three stages of the process: (1) approval of GM cotton confined trials, (2) approval of the Biosafety Bill, and (3) adoption of GM seed by farmers.

The institutional analysis shows that despite some bottlenecks, the regulatory process will eventually lead to the approval of the Biosafety Bill and the implementation of the confined trials in Uganda. But, in order to facilitate the adoption of the technology by farmers and, therefore, its success, the public sector needs to make decisions with respect to the institutional arrangement. The option exists of commercializing imported GM varieties, like other small adopting countries have done, or alternatively, investing additional time and resources to genetically modify the unique variety currently distributed. Such decisions would have to be made alongside the progress of the regulatory process. Delaying this important step would most likely have consequences on the benefits and costs of the adoption**.** Strong public institutions, support of the state, a dynamic research sector, provision of extension support (for adequate GM crop management), and credit services are all needed for the successful diffusion of transgenic cotton. Furthermore, as the organic cotton sector is growing with increasing external market potential, farmers may hesitate to plant GM crops.

Conclusion

Overall, the findings of the ex-ante study suggest that GM cotton has the potential to improve the productivity of cotton, but it is not a silver-bullet solution to the low performance of cotton in Uganda. GM cotton can be viewed as a risk-management tool for farmers in Uganda to reduce downside risk. To support the release of the GM cotton variety, Uganda will need to implement programs that will facilitate farmers' access to complementary inputs.

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