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BRIEF NO. 4 OF 5

ASSESSING THE POTENTIAL ECONOMIC IMPACT OF GENETICALLY MODIFIED CROPS IN GHANA

INSECT-RESISTANT GARDEN EGG

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In many countries, economic considerations are an important factor in government decisionmaking on the introduction of genetically modified (GM) products. However, reliable information on their actual or likely economic impact is often lacking. This brief illustrates the use of a methodological framework to assess the potential economic impact of introducing GM garden egg in Ghana. The framework consists of four interrelated levels of analysis, corresponding to four sets of actors in the economy: (1) farm (smallholder producers); (2) market (processors, traders); (3) the pertinent industry or sector of the national economy (consumers and producers, linked by markets); and (4) international trade.

Garden Egg and the Shoot and Fruit Borer

The African garden egg (*Solanum aethiopicum*) is one of the most important vegetable crops in West Africa and probably the third most consumed vegetable in Ghana. Medicinal properties are attributed to its roots and fruit. It is used as a carminative or sedative and for the treatment of colic and high blood pressure. The African garden egg also has potentially useful agronomic traits, such as drought tolerance. Furthermore, many varieties of garden egg are cultivated in Ghana. Garden egg represents the main source of income for many rural households in the forest zone of the country. Still, regardless of its importance, there is little accumulated knowledge about the plant. Research efforts to fill this gap have been limited.

Several pests and diseases affect the crop by reducing total production as well as product quality. The shoot and fruit borer (SFB, *Leucinodes orbonalis*) is one of the main pest problems. SFB is widely distributed across all areas in Ghana that produce garden egg. The damage caused by fruit borers affects the price significantly in local markets. Still, the vegetable sells in its damaged state at a discounted price. Fruits that show borer damage cannot be exported, however. If the SFB is not controlled, productivity is reduced and the chances of having net returns below zero could be as high as 75 percent.

Constraints to Garden Egg Production

Despite prices varying greatly throughout the year, garden egg is still a very profitable activity in Greater Accra, where yields and prices are both comparatively higher than in the rest of the region. Estimates from our survey suggest yields of around 8 metric tons per hectare. Seed costs vary across regions, but they generally represent a small fraction of the total costs. Seed availability is a major constraint to garden egg production. Ghana's Crop Research Institute has been working on improved lines, but no variety has been officially released. Expenditure on fertilizers is low, while pesticides represent 5 percent of the total costs. Harvest of garden egg is labor intensive. Unless the crop is harvested two times per week, the fruits mature on the plant, develop seeds, and change color.

Farm level

SFB is a pest that farmers can identify, and it is present in all the garden egg producing areas in Ghana. Either Bt-garden egg varieties or Integrated Pest Management (IPM) practices could represent viable alternatives for farmers to control this pest.

Farmers surveyed perceived that yield losses from SFB could be as high as 21 percent. When we compared Bt and IPM scenarios to the use of conventional seed and insecticides, we found that in the Bt scenario, seed costs could increase dramatically given that current seed prices reflect only the seed price produced by the informal system. In the IPM scenario, field sanitation is not a common practice among garden egg producers, but its implementation would reduce SFB infestations. Returns to investment are high for both scenarios. These results might suggest that farmers would prefer IPM over Bt seed, given its lower costs and high returns, but adoption of a complete IPM package is unlikely unless additional incentives are provided to farmers.

Market level

The garden egg has a well-developed marketing channel that links actors at different spatial locations from rural communities to national, regional, and international destinations. The value chain is composed of a number of actors that operate at different market levels. Mobile wholesalers move the produce from producing areas to major market and consumption centers, while retailers move it from larger to smaller markets. Farmers either travel to the market to sell their produce or sell at the farm gate. Consumers are satisfied with varying attributes and qualities. Although quality suffers considerably from postharvest handling and transport, consumers have adjusted not only to lack of uniformity in attributes but also to unstable supply and vast price fluctuations. GM or any other technology development that addresses poor shelf life, postharvest handling, and quality standards would likely have a positive impact on the livelihood of smallholder farmers in Ghana.

Industry level

Investment in Bt garden egg would mainly favor smallholders in rural areas. The distributions show only a small possibility of negative net benefits across all the scenarios. Returns to investment, however, are rather low. The relatively small area cultivated probably affects these results. Under the less favorable scenario (irregular adoption patterns including R&D costs), returns to investment are only 55 percent. We have assumed a 35 percent maximum adoption rate, using the case of tomato as a point of reference. Net benefits are mainly sensitive to the reduction in the rate of yield loss as a result of the GM technology. Benefits are much less affected by elasticity of supply and the percentage change in pesticide application.

Trade level

Garden egg is traded internationally on a limited scale. Bilateral data analysis reveals that most of these exports (80 percent) go to the European Union (COMTRADE), and largely to the United Kingdom (EUROSTAT). Consequently, the introduction of GM garden egg could result in small, but proportionally significant, export losses at least in the short run. Implementing a functional segregation system and preserving the identity of non-GM garden eggs for export could avoid trade disruption. This type of system would make sense if export demand remained the same, and if the cost of implementation was not prohibitive. With segregation, Ghana would take advantage of potential productivity gains while maintaining its niche export market in the European Union. We suggest that export losses be compared to potential benefits in order to assess whether the government should encourage a strict separation of non-GM garden egg to maintain export opportunities.

Policy Implications

A GM garden egg that contains the Bt protein so that the crop becomes resistant to SFB could have a positive impact in the Ghanaian economy. First, garden egg is a widely cultivated crop. Second, borers are a serious pest for garden egg, diminishing the quantity and quality of produce. Improving the quality of garden egg would benefit both the local and export markets. Since there are several pests affecting garden egg (as is also the case for tomatoes in Ghana), the use of pesticides may not decline substantially with the use of a variety resistant to the shoot and fruit borer.

To improve the likelihood of benefits accruing to farmers, more investment in garden egg research is needed. In particular, programs need to be developed that will generate improved varieties from local genetic resources. Garden egg is a highly diverse crop of African origin, the development or introduction of a GM garden egg variety should be done in a way that does not adversely affect local genetic diversity of the crop.

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FOR MORE INFORMATION

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