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BRIEF NO. 1 OF 5

ASSESSING THE POTENTIAL ECONOMIC IMPACT OF GENETICALLY MODIFIED CROPS IN GHANA

A METHODOLOGICAL FRAMEWORK

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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 varieties of tomato, cabbage, garden egg, and cassava 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.

Ghana Study Case

Agriculture in Ghana is characterized by low yields and productivity, which are compounded in the long run by production shocks due to environmental stresses such as drought, pests, and diseases. Vegetables are more susceptible to these biotic constraints than other crops. Chemical pesticides and, to a limited extent, integrated pest management (IPM) practices have been applied to control the pests and diseases but with limited success. Pesticide use has been ineffective, leading farmers to apply high dosages. In this context, the use of GM crops to address pest and disease problems is an option worth examining in terms of its feasibility, cost effectiveness, and long-term impact on productivity and yield stability.

Crop Selection and Research Design

Four commodities (tomato, cabbage, garden egg, and cassava) were selected for evaluation as GM crops based on their roles in the economy, the availability of and public access to the technology, and the magnitude of their productivity constraints.

1. Tomatoes are an important food commodity in Ghana, as they are consumed almost daily and are traded by a broad range of market participants. During the rainy season, the country is able to cover domestic tomato demand. During the dry season, however, the lack of irrigation facilities, together with the higher incidence of the tomato yellow leaf curl virus (TYLCV), drastically reduces total production, with major consequences for farmers. Tomatoes are imported from Burkina Faso during five to six months of the year. The USAID West African Regional Program has identified research on virus-resistant (VR) tomatoes as a priority. Ghana is included in a seven-member regional investigation of the tomato virus disease complex.

2. Cabbage is an emerging crop in Ghana and a means of earning a living for migrants in urban areas. Cabbage is consumed fresh and in sauces and is used by the growing fast-food, hotel, and restaurant industry. The diamondback moth (DBM), *Plutella xylostella*, severely limits cabbage production, causing farmers to use chemical pesticides. DBM has now developed resistance to almost every known or approved insecticide. A gene from the soil bacterium *Bacillus thuringiensis* (Bt) confers resistance to a range of lepidopteran species including the DBM. The transfer of the Bt gene to the genome of several cultivated plants is probably the most studied and used genetic modification. Thus, Bt cabbage, a technology that is readily

available for use, could solve a major productivity constraint and generate positive health, economic, and environmental benefits for urban areas.

3. Garden egg (*Solanum aethiopicum*) is an indigenous species produced mainly by smallholders and consumed frequently in local dishes. Garden egg may be attacked by disease and several pests, including fruit and shoot borers, which can cause major economic loss. A Bt garden egg that is resistant to fruit and shoot borers would be relatively easy to develop, given the vast experience of scientists in the use of Bt in genetic modifications. However, almost all garden egg seed is recycled by farmers from the previous season. To improve seed quality standards, more formal seed systems will have to be developed.

4. Cassava is widely grown in Ghana as a staple crop. The Ghana Living Standards Survey estimates that in 1998/99, about 1.5 million households produced the crop. Cassava is produced in all but two regions in the northernmost part of the country. Although several diseases affect the crop, cassava mosaic virus (CMV) is the most difficult to control. CMV disease is present in all areas of cultivation and currently there is no economically viable way to control this disease. Virus-resistant (VR) cassava could increase the performance of the crop and contribute to country goals with respect to starch production.

At the farmer level, we base our evaluation on partial budget analysis. Market chain analysis, economic surplus, and rapid trade analysis cover the other sectors of the economy. The analysis of cassava is based on an extensive literature already produced by research institutions in Ghana, while the analysis of vegetable crops is based on primary data collected in selected sites in Ghana by agro-ecological zone, region, and district. With the help of agricultural extension officers, we identify specific town or production areas and weigh them by their number of producers. For each crop, a random sample of farmers is drawn. Primary data collected through interviews with traders in markets are supplemented by statistical data.

Main Results

The use of genetically resistant varieties would generate benefits both for individual growers and for Ghanaian society as a whole. Still, study findings indicate that while farmers currently tend to use higher than recommended doses of pesticides, the reduction in pesticide use may not be as great as expected. This is because farmers' investments in pesticides, as a percentage of total production costs, are low for tomato, garden egg, and cassava. Only in the case of cabbage is the prospect of reducing the costs of pesticide use through growing GM crops likely to be a critical determinant of adoption. Nevertheless, any technology that will reduce yield variability (in the case of vegetables) or yield losses from damage (cassava) will contribute to long-term poverty reduction among vulnerable groups. At the trade level, Europe (the main destination of Ghana's agricultural exports) has tight regulations on GM foods imports, but generally, export levels of the studied crops are rather low. Therefore, the benefits at the farm level might be higher than potential losses in trade.

Policy Implications

Whether successful outcomes would be achieved from GM crops on farms depends on a number of factors. One critical factor is the variety chosen by innovators for genetic modification. Except for garden egg, the other crops have limited diversity and farmers depend on a small selection of varieties. Ideally, the variety selected for transformation should have attributes demanded by producers and consumers. Even if the trait transfer is effective, farmers may not realize the full benefits of growing resistant varieties, unless farmers are knowledgeable about the appropriate use of pesticides. Hence, appropriate extension support and the implementation of IPM practices would be critical to ensure success.

Even when the GM technology comprises all of the attributes demanded, widespread adoption of GM varieties depends on institutional factors. For example, the technology fee reflected in the seed price is amenable to policy formulation and would directly affect the distribution of benefits among actors. Who will provide the GM technology? Under which institutional and property right arrangements? It is clear that both the public and private sectors must be involved. The public sector could be responsible for GM variety development, as this will entail the establishment of basic infrastructure, collaboration with other countries, and importation of material for initial testing. The private sector should play a dominant role in seed multiplication and distribution of vegetable crops.

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FOR MORE INFORMATION

Horna, D. et al. *Assessing the Potential Economic Impact of Genetically Modified Crops in Ghana: Tomato, Garden Egg, Cabbage and Cassava*. PBS report, October 2006. Available upon request (dhorna@cgiar.org).