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Biotechnology and Food Security

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Issue. Population increases, especially in developing countries, create the need for an ever-larger food supply. Many observers have suggested that biotechnology has the potential to increase world food output and reduce food insecurity by improving crop yields and reducing crop loss. As with any improvement in technology, farmers in developing countries must find the new advances profitable. Consumers in developing countries will benefit if biotech crops are less expensive or more nutritious than traditional crops.

Background. Food Availability: By adding genes to conventional crops to help them resist pests, disease, or drought, producers of biotech seed can make crops that use less of an expensive input or crops that produce higher yields. Any one, or several, of these improvements can be tailored to make individual crops more likely to thrive in a particular country's growing conditions, and can potentially allow a wider variety of innovations.

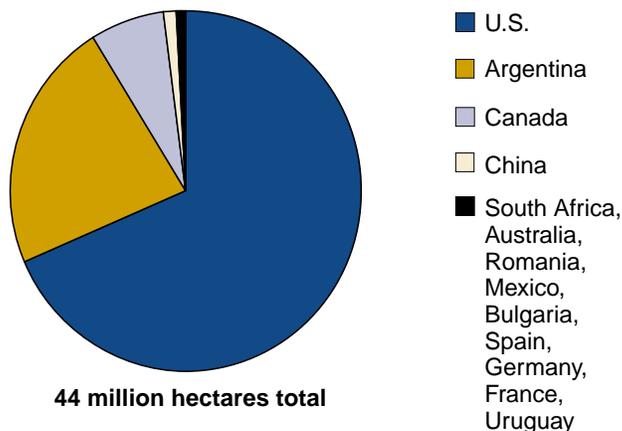
A number of economic criteria must be met to unleash the potential of biotechnology. Farmers must be willing to plant biotech varieties, and those varieties must be suited to local conditions. Most of the research in biotechnology thus far has been done by the private sector for temperate-climate crops. Some research on the staple crops of developing countries is in progress, but this market has developed more slowly, in part because of concerns related to farmers' ability to purchase the inputs and the lack of protection of intellectual property in developing countries. Some developing-country farmers are already cultivating biotech crops. Developing countries account for about 24 percent of the 44.2 million hectares planted to biotech crops in 2000, although most of that production is in one country—Argentina.

As with any technological innovation, growing biotech varieties requires farmers to change their production methods. Farmers will adopt the new varieties if the gains from the higher yields or lower costs of producing biotech varieties outweigh any new costs associated with the technolo-

gy, like the need to purchase more expensive seeds, to purchase seeds more frequently, or to use more expensive inputs. Developing countries also have fewer institutions to cushion the risk of adopting new technology. Financial and technical assistance to ameliorate some of these risks could encourage farmers in developing countries to use biotech varieties.

Adoption by small farmers is important because, in many lower income countries, a large percentage of the population is engaged in agriculture, which must provide not just adequate quantities of food, but adequate incomes that allow farm families to purchase adequate and nutritionally complete diets. During the "Green Revolution" in Asia, many farmers clearly gained by adopting new technology in the form of high-yield grains. Countries/farmers who did not take advantage of the new technology saw little gain in production and income. With any new innovation, non-adoption can be costly in the long term, because when a new technology is adopted widely, output will increase, leading not only to a reduction in prices, but to reduced incentives to invest for those who have not yet adopted the technology. Those price reductions can also diminish the

Share of world transgenic crop area, 2000



Clive James, ISAAA

initial increases in profits experienced by those who adopt the technology early.

Food Consumption: Consumers in developing countries may also benefit from biotechnology. If domestic food production rises, food prices will decrease, making an adequate diet more affordable. Even if biotech-induced increases in food production occur outside the country, world prices could fall, making food more affordable. Crop varieties can also be altered to provide greater nutrition. Biotechnology can be used to alter conventional crop varieties to enhance their micro-nutrient and protein content. Several research institutes are developing “Golden Rice,” which will have a higher Vitamin A and iron content. This development could help to reduce the incidence of diseases like blindness and anemia that are related to vitamin deficiencies. Such varieties might be well received in developing countries.

Governments in the developing world will also need to feel confident about using foods produced through biotechnology. Several countries are considering regulations to require labeling of foods produced with biotechnology, and other countries are developing safety regulations for biotechnology.

Alternatives. Public agricultural research agencies such as governments, universities, and non-governmental agencies can make biotechnology more accessible for farmers in developing nations, chiefly by targeting innovations to their needs. Some governments, notably that of China, are actively engaged in research. The International Rice Research Institute is working on several varieties of rice, including one that increases yields substantially. The Rockefeller Foundation has been actively involved in developing “Golden Rice” and in training scientists in developing countries. Michigan State University, Scripps College, and Cornell University all have partnerships with Egypt’s agricultural research institute to develop genetically engineered varieties of vegetables.

Public support can also reduce the cost of seeds for crop varieties developed via biotechnology. Research costs of

developing biotech varieties are very high, especially as some of the technology used is proprietary and must be licensed from private companies. It is difficult for low-income countries, and even for public institutions, to afford the development costs. The CGIAR centers (Consultative Group on International Agricultural Research) spend \$25-\$35 million per year on agricultural biotechnology. By comparison, Monsanto’s 1998 R&D budget (mostly for agricultural biotechnology) was \$1.3 *billion*.

Some public-private partnerships have already begun to facilitate access to biotechnology and the design of new crop varieties for developing countries. The Mexican Government received some technology free of charge from Monsanto. Through Michigan State, the Rockefeller Foundation, and USAID, several U.S. companies are working with the governments of Indonesia, Kenya, and Egypt to develop new crop varieties. How widespread these partnerships are and how many of them will concentrate on varieties relevant to developing nations will affect the usefulness of the biotechnology revolution for developing countries.

Other policies can also facilitate small farmers’ access to technology. When hybrid corn varieties were first introduced in developing countries, wealthier farmers could afford the expensive seeds and inputs. Output rose, and consumer prices declined. Some smaller farmers, those who did not or could not buy the new seed, did not experience the higher outputs and incomes. Often, it was not the nature of the technology itself, but a lack of credit and extension for small farmers that impeded their access to the new technologies. Policies that help developing-country farmers buy and implement new technology will enhance biotechnology’s ability to improve food security. South Africa, for example, has used extension schemes to help farmers grow varieties propagated by tissue culture.

Developing countries would also benefit from aid in developing safety regulations governing research and marketing of products of biotechnology. The World Bank’s Global Environmental Fund will provide some technical assistance; the program is still in the design phase.

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