# ❑ THE ROLE OF AGRICULTURAL BIOTECHNOLOGY IN WORLD FOOD AID

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*Biotechnology has the potential to play a key role in reducing chronic hunger, particularly in sub-Saharan Africa, which missed out on the "Green Revolution" of the 1960s and 1970s, says Bruce Chassy, professor and executive associate director of the Biotechnology Center at the University of Illinois Urbana-Champaign. He urges more public investment in agricultural research, education and training at the local, national and regional levels.*

Food aid is one of several global mechanisms created to deal with hunger and food insecurity. The need for food aid around the globe varies from specific responses to acute and episodic shortages to long-term donations of food to abate continuing chronic inability of some regions to become agriculturally self-sufficient. While agricultural biotechnology is not a panacea to food insecurity, it is likely to play a vital role in the delivery of food assistance and reduction of hunger for generations to come.

## THE GLOBAL NEED FOR FOOD AID

The U.N. Universal Declaration of Human Rights declares the right of access to food and freedom from hunger as a fundamental right.

Although we live in a world of unprecedented prosperity and technological development, 800-850 million people are malnourished. More than 200 million of these are children, many of whom will never reach their full intellectual and physical potential. Another 1-1.5 billion humans have only marginally better access to food and often do not consume balanced diets containing sufficient quantities of all required nutrients.

The majority of this nutritionally at-risk population lives in developing countries. Most, perhaps 75 percent, live in rural agricultural regions. Most are very poor. There is a well-recognized link between poverty and hunger. In fact, family income is probably the single most important determinant of adequacy of access to food. The World Food Summit in 2002 reaffirmed a commitment made by the international community five years earlier to halve the number of hungry people by the year 2015. That goal will not be met unless agricultural productivity and personal income can be improved in the world's poorest regions.

It is argued by some that eliminating poverty is more important than producing more food since there is more than enough food produced in the world to feed everyone. Economists tell us that there is a surplus of food in the world — or at least a surplus of grain that when tabulated as potential caloric intake could theoretically adequately feed the current global population. But the sad lesson of both recent and ancient history is that adequate food supplies do not reach everyone. The large number of hungry people proves that. It is pointless to argue whether poor agricultural productivity or extreme poverty is more to blame when people are starving. What is clear is that if the rural poor can produce a surplus of food in a more efficient and sustainable manner, there will be adequate food supplies, increasing income and the opportunity for supporting rural development.

While most experts would agree that the only long-term solution to hunger is economic development and the elimination of poverty, people who are food self-sufficient through local or regional agriculture will not go hungry. Unfortunately, neither the required increases in agricultural productivity nor the necessary rural development will happen overnight. The question then becomes “What do we do in the meanwhile?” The short-term solution for the hungry is food aid. But even food aid has become politicized as skeptics have charged that it is simply a way for rich over-producing nations to eliminate the surpluses produced by their heavily subsidized farmers. The skeptics also assert that food aid robs local farmers of markets and makes them hungrier. These arguments ignore the daily reality faced by hundreds of millions of hungry people for whom the immediate alternatives are simple: continued hunger and ultimate starvation or the acceptance of food aid.

## ELIMINATING CHRONIC HUNGER: A ROLE FOR BIOTECHNOLOGY

The Green Revolution of the 1960s and 1970s helped India and China and other Asian countries become agriculturally self-sufficient net exporters of food in the last three decades. The increased productivity has been accompanied by increases in personal income and stimulus to national economies. Similarly, through application of new technology, agricultural productivity per hectare has doubled in most developed countries in the same timeframe. The development of new high-productivity agricultural technologies resulted from investment in agricultural research performed in government laboratories, research universities, and non-governmental institutes such as the Consultative Group on International Agricultural Research (CGIAR) centers scattered around the globe. A crucial element of success has been the deployment of effective systems of outreach education and technology transfer. Research and technology transfer has also taken place in the private sector.

For a variety of complex reasons, improvements in agricultural productivity did not take place in all developing countries. Quite the contrary, some of the least developed countries are now even less able to produce sufficient food. There, the Green Revolution never happened. While civil unrest and political corruption may have contributed greatly to this phenomenon, from an agricultural point of view, the failure lies in the lack of investment in and adoption of new technologies and management practices. Often this occurred because there was not sufficient attention paid or investment made in research to develop effective local or region-specific strategies and technologies.

Sub-Saharan Africa is a region where growth in agricultural production has not kept pace with expanding need. As a whole, the region has some of the poorest and most depleted agricultural soils. Only 4 percent of the farmed land is irrigated. Significant areas of agricultural land are at risk of becoming desert while in some parts of the region excessive humidity and high temperatures contribute to a high incidence of disease and pests. Weeds such as Striga stifle yields. Droughts are commonplace in some parts of the region. Outright crop failure is common and poor yields are endemic. There is clearly a need to develop crop varieties and management strategies that are more productive under these conditions. High on the list of desired traits are crops with enhanced resistance to environmental stresses such as drought, temperature and salinity; enhanced resistance to diseases and pests; and improved agronomic properties and yield potential. The heavy reliance on a few staple crops makes biofortification — the boosting of the vitamin and mineral components of foods to enhance the nutritional value — an attractive strategy as well.

Recent advances in molecular biology and genomics greatly enhance the plant breeder's capacity to introduce new traits into plants. Commercial applications of agricultural biotechnology have already produced crops such as Bt-maize, rice, potatoes, cotton and sweet corn (sweet maize) that can protect themselves against insects; virus-resistant papaya, squash and potatoes; and herbicide-tolerant crops such as wheat, maize, sugar cane, rice, onions and beets that allow more effective weed management.

There is accumulating evidence that these biotech crops can be more productive and profitable for farmers. Major reductions in costs for labor, energy and chemicals have been documented. The crops have also proven to be environmentally-friendly, particularly with regard to biodiversity, reduction of agricultural chemicals in soil and water, and decreased exposure of workers and communities to chemicals.

There is also an emerging international consensus of scientific and regulatory opinion that crops derived through biotechnology are safe to eat as food and feed and beneficial for the environment. These and other promising technologies are now being directed at improving the production and yield of African staple crops: banana, cassava, maize, millets, oil crops, peanut, potato, rice, sorghum, soybean, sweet potato and wheat. Protein-enhanced sweet potatoes and potatoes and carotene-enhanced rice and oilseeds promise to improve the nutritional value of the diet. Thus, over the long term, agricultural biotechnology promises to play a crucial role in improving agricultural productivity and reducing the environmental impact of agriculture leading to agricultural sustainability and food security in many regions of the world. While it would be foolish to say that agricultural biotechnology alone will solve the world's food problems, it would be equally foolish to assert that food insecurity can be eliminated without agricultural biotechnology.

In recent years, there has been a significant change in the organization of agricultural research directed at improving food security. It is now recognized that research needs to be done at local, national and regional levels in order to address specific agricultural challenges and produce new varieties appropriate to local agriculture and customs. This change is particularly focused on utilizing and expanding local scientific and agricultural human and capital infrastructure that can work in partnership with international scientists and funding. Although the path is clear and there are numerous successful examples of these kinds of international partnership, global funding for such activities falls far short of the level required to achieve global food security in the next decades.

## RECENT CHALLENGES POSED BY ACUTE FOOD SHORTAGES

Widespread local or regional crop failure often leads to acute food shortages and hunger. The reason for episodic events can be as varied as flood, droughts or civil war. The United Nations, national governments and an assortment of nongovernmental organizations (NGOs) often respond by mobilizing an immediate food aid program. Food aid distribution can be hindered by lack of infrastructure for storage and transportation of food, and there are often concerns for the security of aid workers.

Recently, a new obstacle to food aid distribution has been identified. Repeated crops failures in Southern Africa have placed millions of people in six nations at risk. In response, the United States offered food aid that included substantial shipments of maize. The maize supply in the United States is approximately 30-35 percent insect-protected Bt-maize developed through biotechnology. This variety of maize had been approved by the U.S. Environmental Protection Agency (EPA), the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) as safe for consumption as food and feed. It was commingled with conventional maize in the U.S. commodity system. However, since the intended recipient nations did not use biotech seed varieties and imported few commodities such as maize, they for the most part lacked specific laws and regulatory systems with respect to foods produced through biotechnology. Genetically modified (GM) maize was an unapproved food in their regulatory systems. In light of the global scare campaign against GM foods, several countries hesitated to accept the aid. Ultimately, intensive international consultation and fact-finding satisfied all of these countries save Zambia, which continued to refuse GM food aid. One obvious conclusion to be drawn from this experience is that regulatory systems and training need to be in place before the need for food aid arises again.

## PUBLIC INVESTMENT IN RESEARCH, EDUCATION AND TRAINING

What the experience of recent decades has taught is that agricultural biotechnology can be a powerful tool in the development of improved crop varieties for developing countries. The promised benefits can only be realized in a permanent and sustainable manner when the countries that benefit play a role in defining the need, developing the solution and implementing the education and technology-transfer systems. Each nation must decide what agricultural goals are in its national interest and what technologies are consistent with consumer acceptance and customs. Shared ownership leads to good stewardship.

Partnerships that lead to shared ownership can solve another challenge to applying technology. One major concern about agricultural biotechnology is that the seeds are owned and sold by large multi-national corporations who might eventually exert external domination and control local seed markets and farmers. An additional problem is that developing countries may have limited access to intellectual property rights that would provide them access to modern agricultural technologies such as new seed types. To help counter these challenges and promote public sector uses in developing countries, a consortium of public universities and public sector institutions has recently announced the formation of the Public Sector Intellectual Property Resource for Agriculture (PIPRA). PIPRA will work to make public-sector research available to more of the people who want it and insure freedom to operate. Multi-national corporations have also demonstrated their willingness to donate their technology and expertise to such efforts.

There is a holistic answer to all these food security needs and concerns. The global community needs to invest more capital in creating agricultural institutions and infrastructure in countries that face food security challenges. Investment must be made in legal and regulatory systems, agricultural research, transportation and processing systems, and education. The success of the Land Grant University system in improving agriculture and contributing broadly to society in the United States over the last 140 years demonstrates that the development of human capital and educational systems is as important as scientific discovery. The creation of institutions and public/foundation funding mechanisms would create a platform for international collaboration that is open to government, university and private-sector collaborators. If the world community is to arrive at its stated goal of food security for every person, it must put aside ideological and political divisions and pragmatically embrace each technology that leads to sustainable food security. ❑

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*Note: The opinions expressed in this article do not necessarily reflect the views or policies of the U.S. Department of State.*