Global Risks of Rejecting Agricultural Biotechnology

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A PATH FORWARD:

In a world where population increases mean the demand for food by 2050 will nearly double, biotechnology can lead to increased food security, as well as improving health in developing countries by enhancing food nutrition. In agriculture, biotechnology has enabled the genetic advancement of crops, improved soil productivity, and enhanced weed and pest control. Unfortunately, such potential has largely remained untapped by African countries, where persistent food shortages have wide implications.

- Biotechnology has the potential to improve access to more nutritious food, leading both to lower health care costs and higher economic performance due to improved worker health.
- A growing backlash against GM foods in some African nations has created a harsh political atmosphere under which tight regulations are being developed.
- To take full advantage of the many applications of biotechnology in agriculture, African policymakers should consider whether overregulation of GM crops is warranted.
- Agriculture needs to be viewed as a knowledge-based entrepreneurial activity. Smart investments in agriculture will have multiplier effects in many sectors of the economy and will help spread prosperity.

The demand for nutritious food continues to rise. By 2050 the global demand for food could nearly double as the population grows and the developing world becomes more affluent, demanding more calories in their daily diet. This demand will need to be achieved under ecological constraints imposed by shrinking land availability and climate change. The world will need to expand the contents of its technological toolbox to meet the challenges.

Biotechnology has the promise to contribute to the rising demand for nutritious food. It can lead to increased food security, as well as improving health in developing countries by enhancing food nutrition. In agriculture, biotechnology has enabled the genetic advancement of crops, improved soil productivity, and enhanced weed and pest control. Unfortunately, such potential has largely remained untapped by African countries, where persistent food shortages have wide implications.

In addition to increased crop productivity, biotechnology can create more nutritious crops, produce more food, increase household income, and provide a better quality of life for millions of people. About 250 million children suffer from vitamin A deficiency, which weakens their immune systems and is the biggest contributor to blindness among children. Other vitamins, minerals, and amino acids are necessary to maintain healthy bodies, and a deficiency will lead to infections, complications during pregnancy and childbirth, and impaired child development.

Biotechnology has the potential to improve access to more nutritious food, leading both to lower health care costs and higher economic performance (due to improved worker health).

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"Biotechnology has the potential to provide more nutritious food while promoting economic development and increasing profits for farmers."

The Biotechnology Revolution

In 2013, 18 million farmers grew genetically modified (GM) crops in 27 countries around the world, of whom over 90 percent were small and resource-poor farmers from developing countries. Most of the benefits to such farmers have come from cotton. For example, from 2002-to-2010, Bacillus thuringiensis (Bt) cotton added $9.4 billion worth of value to farmers in India, cut insecticide use by half, helped to double yield, and turned the country from a cotton importer into a major exporter.

Africa is steadily joining the biotechnology revolution. South Africa's GM crop production stood at 2.3 million hectares in 2011. In West Africa, Burkina Faso grew 300,000 hectares of Bt cotton the same year, up from 260,000 in 2010. It had the fastest adoption rate of a GM crop in the world in 2009. In 2011, Egypt planted nearly 2,800 hectares of Bt maize, a 40 percent increase over 2010.

African countries, by virtue of being latecomers, have had the advantage of using second-generation GM seed. African farmers can take advantage of technological leapfrogging to reap high returns from transgenic crops while reducing the use of chemicals. In 2010, Kenya and Tanzania announced plans to start growing GM cotton in view of the anticipated benefits of second-generation GM cotton. The door is now open for the revolutionary adoption of biotechnology that will extend to other crops as technological familiarity and economic benefits spread.

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Growth in the worldwide amount of farmland has increased for 18 straight years, despite political and social efforts aimed at slowing or prohibiting such use. Trends suggest that future decisions on GM crops will be driven by local

needs as more traits become available. For example, crops that tolerate various stresses such as drought are likely to attract interest among farmers in Africa. The Water Efficient Maize for Africa project, coordinated by the African Agricultural Technology Foundation in collaboration with the International Centre for the Improvement of Maize and Wheat and Monsanto and supported by the Howard Buffett Foundation and the Bill and Melinda Gates Foundation, is an example of such an initiative that brings together private and public actors.

The Precautionary Principle

"In order to take full advantage of the many potentials of biotechnology in agriculture, Africa should consider whether aversion to and overregulation of GM production are warranted."

Although GM crops have the potential to greatly increase crop and livestock productivity and nutrition, a popular backlash against GM foods has created a harsh political atmosphere under which tight regulations are being developed. Much of the inspiration for restrictive regulation comes from the Cartagena Protocol on Biosafety under the United Nations Convention on Biological Diversity. The central doctrine of the Cartagena Protocol is the "precautionary principle" that empowers governments to restrict the release of products into the environment or their consumption if there are any hypothetical hazards even if there is no scientific evidence that they are harmful. This approach differs from food safety practices adopted by the World Trade Organization (WTO) that allow governments to restrict products when there is sufficient scientific evidence of harm.

Under the precautionary principle, public perceptions are enough to trigger a ban on such products. Those seeking stringent regulation have cited uncertainties such as horizontal transfer of genes from GM crops to their wild relatives. Others have expressed concern that the development of resistance to herbicides in GM crops might result in "super weeds". Some have raised fears about the safety of GM foods to human health. Other concerns include the fear that farmers would be dependent on foreign firms for the supply of seed.

Such precautionary regulations have extended to African countries, where the cost of implementation is often beyond their reach. These regulations also tend to conflict with the great need for increased food production. As developed countries withdraw funding for their own investments in agriculture, international assistance earmarked for agricultural science has diminished.

In June 1999, five European Union members (Denmark, France, Greece, Italy and Luxembourg) formally declared their intent to suspend authorization of GM products until rules for labeling and traceability were in place. This decision followed a series of food-related incidents such as "mad cow disease" in the UK and dioxin contamination in Belgium. These events undermined confidence in regulatory systems in Europe and raised concerns in other countries. Previous food safety incidents tended to shape public perceptions over new scares. Much of this was happening in the early phases of economic globalization when risks and benefits were uncertain and open to question.

Much of this debate occurred at a time of increased awareness about environmental issues that stemmed from considerable investment in public environmental advocacy in preparation for the 1992 United Nations Conference on Environment and Development in Rio de Janeiro. Many activist groups coordinated campaigns on issues such as consumer protection, perceived corporate dominance, conservation of traditional farming practices, illegal dumping

of hazardous waste, and promotion of organic farming to oppose the introduction of GM crops. The confluence of forces made the opposition to GM crops a global political challenge, which encouraged countries facing GMO related disputes to seek solutions through multilateral diplomatic circles.

The EU moratorium was followed by two important diplomatic developments. First, the EU used its influence to persuade its trading partners to adopt similar regulatory procedures that embodied the precautionary principle. Second, the United States, Canada and Argentina took the matter to the WTO for settlement in 2003. Under the circumstances, as the EU was the primary trading partner, African countries opted for a more restrictive approach partly because they were subject to diplomatic pressure. (Their links with the US were largely through food aid programs.)

Challenges in Africa

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In 2006, the WTO issued its final report on the dispute; the findings were largely on procedural issues and did not resolve the root cause of the debate such as the role of the "precautionary principle" in WTO law and whether GM foods were substantially equivalent to their traditional counterparts. But by then a strong anti-biotechnology culture was entrenched in most African countries. For example, even after developing a GM potato resistant to insect damage, Egypt refused to approve it for commercial use. This resistance grew to the point that Africa ceased to accept unmilled GM maize from the US as food aid. A severe drought in 2001–02 left 15 million Africans with desperate food shortages; countries such as Zimbabwe and Zambia turned down shipments of GM maize, fearing that the kernels would be planted instead of eaten.

Unlike the situation in developed countries, where food security is assured, GM foods in emerging countries have the potential to revolutionize the lives of suppliers and consumers. To take full advantage of the many applications of biotechnology in agriculture, African policymakers should consider whether the prevailing aversion to an overregulation of GM crops is warranted.

In Nigeria, the findings of a study on biotechnology awareness demonstrate that while respondents have some awareness of biotechnology techniques, this is not the case for biotechnology products. Most of the respondents are favorably disposed to the introduction of GM crops and would eat GM foods if they would be shown to be more nutritious than non-GM foods. However, the risk perception of the respondents suggests that although more people are in favor of the introduction of GM crops, they do not consider the current state of Nigeria's institutional preparedness satisfactory for the approval and release of GMOs.

It is important to consider that African farmers will not grow successful crops if prices are low or dropping. Additionally, complications with regulation and approval of GM crops make obtaining commercial licenses to grow certain crops difficult. Also, neighboring countries must often approve similar legislation to cover liabilities that might arise from cross-pollination by wind-blown pollen, for example. Biosafety regulations and strict liability provisions in law often stall developments in the research of GM crops and could have negative impacts on regional trade.

For these reasons, approval and use of potentially beneficial crops are often difficult. However, despite potential challenges, biotechnology has the potential to provide both great profits and the means to provide more food to those who need it in Africa. Leaders in the food industry in parts of Africa prefer to consider the matter on a case-by-case basis rather than adopt a generic approach to biosafety. In fact, the tendency in regulation of biotechnology appears to follow more divergent paths reflecting unique national and regional attributes. This is partly because regulatory practices and trends in biotechnology development tend to co-evolve as countries seek a balance between the need to protect the environment and human safety and the need to foster technological advancement.

Measuring the Impact of GMOs

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Advancements in science have allowed scientists to insert characteristics of other plants into food crops. Since the introduction of large-scale GM crop cultivation in 1996, more than 79 percent of soybean, 70 percent of cotton, 32 percent of corn, and 24 percent of canola grown worldwide today comes from GM seed. The rapid adoption of GM crops demonstrates that they offer great economic benefits for farmers. In general, farmers experience lower production costs and higher yields because weed control is cheaper and fewer losses are sustained from pests. GM crops are safer to handle than traditional chemical pesticides and herbicides, increasing worker safety and limiting the amount of time workers spend in the field.

While the supply-side benefits for farmers are clear, it is not completely understood how genetic modification affects the market value for these crops. Holding technological achievement constant, any gains tend to dissipate over time. The world cannot apply uniform standards for managing new technologies. It is important to recognize that developing countries face a separate set of risks from those of industrialized countries. New technologies may require training or monitoring capacity that may not be locally available, and this could increase risks associated with their use. This has been demonstrated where a lack of training in pesticide use has led to food contamination, poisoning and pesticide resistance. In addition, the lack of consistent regulation, product registration, and effective evaluation are important factors that developing Africa will need to consider as it continues to explore these platform technologies.

Probably the most significant research and educational opportunities for African countries in biotechnology lie in the potential to join the genomics revolution as the costs of sequencing genomes drop. When James Watson, co-discoverer of the DNA double helix, had his genome sequenced in 2008 by 454 Life Sciences, the price tag was $1.5 million. A year later a California-based firm, Applied Biosystems, revealed that it had sequenced the genome of a

Nigerian man for under $60,000. In 2013 another California-based firm, Illumina, announced that it could sequence a human genome for about $1,000.

Dozens of genomes of agricultural, medical and environmental importance to Africa have already been sequenced. These include rice, corn, mosquito, chicken, cattle, and dozens of other plant, animal and human pathogens. The challenge facing Africa is building capacity in bioinformatics to understand the location and functions of genes. It is through the annotation of genomes that scientists can understand the role of genes and their potential contributions to agriculture, medicine, environmental management, and other fields. The field would give African science a new purpose and help to integrate the region into the global knowledge ecology. This opportunity offers Africa another opportunity for technological leapfrogging.

Transforming Opportunities

"…smart investments in agriculture will have multiplier effects in many sectors of the economy and help spread prosperity."

Science and innovation have always been the key forces behind agricultural growth in particular and economic transformation in general. More specifically, the ability to add value to agricultural produce via the application of scientific knowledge to entrepreneurial activities stands out as one of the most important lessons of economic history. But science and innovation represent only one of the major opportunities that can help transform Africa's agriculture into a force of economic growth. There must also be efforts to create regional markets to provide new incentives for agriculture production, and a new generation of African leaders must help the continent focus on long-term economic transformation. Agriculture needs to be viewed as a knowledge-based entrepreneurial activity. Smart investments in agriculture will have multiplier effects in many sectors of the economy and will help spread prosperity. More important, future technological options must be left open. In the long run, not adopting agricultural biotechnology carries more risks than adopting it in time.

From Dr. Juma's comments to a 2014 U.S. Congressional subcommittee hearing on biotechnology in agriculture:

"The largest benefits of transgenic crops are economic and derive from increased income from higher yields and resistance to loss…
"Second, transgenic crops offer the ability to biofortify key crops, which is especially helpful in numerous countries where Vitamin A deficiency is a concern (e.g., Golden Bananas in Uganda and Golden Rice in the Philippines)…
"Finally, transgenic crops offer environmental benefits by requiring less spraying of pesticides, reducing the amount of arable land needed for increased agricultural production, and combating the effects of climate change through the development of drought-resistant crops…
"The balance of evidence suggests that transgenic crops offer no greater risks than their conventional counterparts, and their economic, nutritional, and environmental benefits are extensive. Yet whether or not the crops described above reach the farmers and consumers who need them most depends on the regulatory agencies and the lengthy and costly approval processes of each country, as well as on public resistance to transgenic crops in general."

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