AGRICULTURAL BIOTECHNOLOGY
Benefits, Opportunities and Leadership

Calestous Juma, PhD
Professor of the Practice of International Development
Belfer Center for Science and International Affairs
Harvard Kennedy School, Harvard University

Testimony to the
US House of Representatives
Committee on Agriculture
Subcommittee on Rural Development, Research, Biotechnology and Foreign Agriculture

Washington, DC

June 23, 2011

Introduction[1]

Writing exactly 130 years ago, Robert Louis Stevenson acknowledged in *A Plea for Gas Lamps* that "Cities given, the problem was to light them." Then he proceeded with his indictment of electricity saying the "urban star now shines out nightly, horrible, unearthly, obnoxious to the human eye; a lamp for a nightmare! Such a light as this should shine only on murders and public crime, or along the corridors of lunatic asylums, a horror to heighten horror." Today we acknowledge that given growing human numbers, the problem is to feed them. However, we also cast dark shadow over the prospects of using biotechnology to address the global food crisis.

The United States has been a leading light in agricultural biotechnology as a platform technology and continues to serve as an important role model for countries around the seeking to address global food challenges. A key source of this leadership has been its commitment to using a science-led regulatory system for determining the approval of new products. The rest of the world needs this demonstrated leadership now more than ever given rising food prices and related political unrests around the world. Failure on the part of the United States to champion agricultural biotechnology will undermine confidence in the ability of the global community to confront the challenges of food security. Retracting from using science and technology to address emerging challenges will not result in any savings; it will only defer problems and future costs are likely to be higher.

In the 1970s skeptics argued that new technologies were generally more expensive, less reliable, more complicated, controlled by corporate monopolies and therefore inaccessible to the poor. They went further and claimed that a "technology divide" would emerge between industrialized and developing countries. This ideological framing was applied to emerging information and telecommunications technologies and the word "digital divide" became a template for international debates on innovation, human rights and the quest for prosperity.

In effect, the skeptics sought to slow down the adoption of new technologies in developing countries and advocated the use of what they called "appropriate technology." They sought to freeze technology in time and by doing so they also compromised improvements in human welfare and the spread of prosperity. Some international organizations advocated policies aimed at curbing the introduction of microelectronics in developing countries with the objective of protecting workers against labor displacement.

Reality has turned out to be different. Information and communications technologies are now a key source of economic productivity and a platform for socio-economic transformation worldwide. Many African countries, for example, have been able to "leapfrog" into the modern information age through the mobile phone and the stage is now set for a move into mobile broadband that will see many rural areas move to transform education, health, governance and many aspects of socio-economic life. The spread of this technology has been possible because of the sovereign leaders provided by a few countries to reforming their national policies to create space for mobile technologies.

BENEFITS OF BIOTECHNOLOGY

Biotechnology—technology applied to biological systems—has the promise of leading to increased food security and sustainable forestry practices, as well as improving health in developing countries by enhancing food nutrition. In agriculture, biotechnology has enabled the genetic alteration of crops, improved soil productivity, and enhanced weed and pest control. Unfortunately, such potential has largely been left untapped by African countries.

In addition to increased crop productivity, biotechnology has the potential to create more nutritious crops. An example of this is rice engineered to provide additional vitamin A whose deficiency affects about 250 million children worldwide. Other vitamins, minerals, and amino acids are necessary to maintain healthy bodies, and a

[1]. This testimony is derived from Juma, C. *The New Harvest: Agricultural Innovation in Africa*. New York: Oxford University Press, 2011. A full digital copy of this study is made available as an optional annex to this testimony.

deficiency will lead to infections, complications during pregnancy and childbirth, and impaired child development. Biotechnology has the potential to improve the nutritional value of crops, leading both to lower health care costs and higher economic performance (due to improved worker health).

Skeptics have sought over the last 20 years to slow down the application of agricultural biotechnology. International collaboration on biotechnology for African agriculture has also been uncertain. But the tide is turning. For example, a recent study prepared by the European Commission, *A Decade of EU-Funded GMO Research (2001-2010)*, concluded:

> "Biotechnologies could provide us with useful tools in sectors such as agriculture, fisheries, food production and industry. Crop production will have to cope with rapidly increasing demand while ensuring environmental sustainability. Preservation of natural resources and the need to support the livelihoods of farmers and rural populations around the world are major concerns. In order to achieve the best solutions, we must consider all the alternatives for addressing these challenges using independent and scientifically sound methods. These alternatives include genetically modified organisms (GMO) and their potential use."

The study drew its conclusions from the work of more than 130 research projects, covering a period of more than 25 years of research involving more than 500 independent research groups. Its most important conclusion was **"that biotechnology, and in particular GMOs, are not *per se* more risky than e.g. conventional plant breeding technologies. Another very important conclusion is that today's biotechnological research and applications are much more diverse than they were 25 years ago..."** The conclusions are similar to those reached by the United States National Academies and reinforce the science-based practices that inform the work of Unites States regulatory agencies.

The promise of the technology and evidence of its contributions to rural development around the world is serving as a source of inspiration for emerging nations to complement existing practices with agricultural biotechnology. Three African countries (South Africa, Egypt and Burkina Faso) have adopted genetically modified crops and are providing initial evidence of their long-term implications. The scientific and technical community is being embolden by these developments and is working with governments to explore ways to build up the much needed capacity in these fields. Other African countries have started conducting field trials and plan to adopt biotechnology crops in the coming years.

The uptake of genetically modified (GM) crops is the fastest adoption rate of any crop technology, increasing from 1.7 million hectares in 1996 to 148 million hectares in 2010, and an 87-fold increase over the period. In 2010, there were 15.4 million farmers growing GM crops in 29 countries around the world, of whom over 90% were small and resource-poor farmers from developing countries. Most of the benefits to such farmers have come from cotton. For example, over the 2002–09 period, the insect resistant *Bacillus thuringiensis* (Bt) cotton added US$7 billion worth of value to Indian farmers, 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 2.0 million hectares in 2010. Burkina Faso grew 260,000 hectares of *Bt* cotton the same year, up from 115,000 in 2009. This was the fastest adoption rate of a GM crop in the world that year. In 2010, Egypt planted nearly 2,000 hectares of *Bt* maize, an increase of 100% over 2009.

African countries, by virtue of being latecomers, have had the advantage of using second-generation GM seed. Akin to the case of mobile phones, 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 revolutionary adoption of biotechnology that will extend to other crops as technological familiarity and economic benefits spread.

OPPORTUNITIES FOR INTERNATIONAL BIOTECHNOLOGY COOPERATION

The United States has been an important leader in promoting plant biotechnology. It is for this reason that African countries are starting to adopt GM crops. But their nutritional requirements are not limited to crops. Another important area of interest to Africa is protein derived from livestock and fish. Advances in genomics provide tools that can help countries to farm breeds that confer health benefits to the population and help address emerging challenges such as obesity. But little of this will happen without the kind of sovereign leadership that the United States has been providing on science-based regulatory approaches.

One of the most sustainable forms of meat protein to farm is fish. For every pound of meat produced, fish consume less than 15% of the feed required by land animals such as cattle. Farmed fish are a staple not just for industrialized countries, but even more so for emerging nations of the world. Aquaculture is emerging as an important substitute for wild fish whose stocks are being depleted at an alarming rate.

The role of biotechnology in aquaculture represents one of the key tools that could enable humanity to expand protein production in a sustainable way. The United States needs follow its own lead in agriculture and provide regulatory support to sustainable aquaculture. I understand this House passed an amendment to the Agriculture Appropriations Bill that would effectively prevent the Food and Drug Administration (FDA) from completing its safety assessment of the first food fish that makes use of this technology, an Atlantic salmon that reaches full size rapidly and consumes less feed than other fish of its kind.

It is not this particular fish that is at stake. It is the principle behind the amendment and its wider ramifications. It sends the message to the rest of the world that the science-based regulatory oversight as embodied in the FDA review process is subject to political intervention. Furthermore, it signals to the world that the United States may cede its leadership position in the agricultural use of biotechnology. Biotechnology is vital to feeding the world in the present and even more so in future, and I believe it is imperative that the United States stay the course it has set in not letting politics interfered with its science-based regulatory system that is truly the envy of the world.

The changing outlook was recently demonstrated by the outcomes of the "International Conference on Agricultural Biotechnology in Africa: Fostering Innovation" held on May 13- 14 in Addis Ababa, Ethiopia. It stressed the urgency to build capacity in Africa to facilitate the application of biotechnology in agriculture (covering crops, fisheries, livestock and conservation of biological diversity). The conference also underscored the importance of pursuing biotechnology in a safe and sustainable manner in keeping with enabling biosafety laws.

Events like this demonstrate the growing commitment and interest among African countries to contribute to global efforts to address food security. The impact of their dedication will be limited unless they are able to benefit from prior knowledge and expertise accumulated in other countries. This is where the United States can serve as a role model in the use of biotechnology in agricultural transformation and science-based approaches in regulation. It is only by helping countries around the world to adopt modern biotechnology can we hope for a brighter agricultural future. America's leadership in this field can help humanity avoid being seduced by the dim light of technological stagnation.

BIOGRAPHICAL SUMMARY

Calestous Juma is Professor of the Practice of International Development and Director of the Science, Technology, and Globalization Project at Harvard Kennedy School. He focuses on the role of science and innovation in development. Juma also directs the School's Agricultural Innovation in Africa Project funded by the Bill and Melinda Gates Foundation. The report of the project, *New Harvest: Agricultural Innovation in Africa*, was published in 2011 by Oxford University Press. He is a former Executive Secretary of the UN Convention on Biological Diversity and founding Executive Director of the African Centre for Technology Studies in Nairobi. He was Chancellor of the University of Guyana; member of the National Social and Economic Council of the President of Kenya; Special Advisor to the International Whaling Commission; and co-chaired the African High-Level Panel on Modern Biotechnology of the African Union and the New Partnership for Africa's Development (NEPAD). He has been elected to several scientific academies including the Royal Society of London, the US National Academy of Sciences, the Academy of Sciences for the Developing World (TWAS), the UK Royal Academy of Engineering and the African Academy of Sciences. He serves on the boards of WWF International, One Laptop per Child Foundation (OLPC), London International Development Centre, and Belfer Center for Science and International Affairs at Harvard Kennedy School. Juma holds a DPhil in science and technology policy studies from the University of Sussex (UK) and has received several international awards and honorary degrees for his work on sustainable development. His latest publications include *The New Harvest: Agricultural Innovation in Africa*; *Going for Growth: Science, Technology and Innovation in Africa*; *Innovation: Applying Knowledge in Development*; *Freedom to Innovate: Biotechnology in Africa's Development.*; and *Engineering Change: Towards a Sustainable Future in the Developing World*. He is editor of the peer-reviewed *International Journal of Technology and Globalisation* and the *International Journal of Biotechnology.* He teaches graduate courses on "Innovation, Development and Globalization" and "Technology and Sustainability" and an undergraduate seminar on "Biotechnology, Sustainability and Public Policy".