PLANT BIOTECHNOLOGY RESEARCH AND DEVELOPMENT IN AFRICA: CHALLENGES AND OPPORTUNITIES

HEARING

BEFORE THE

SUBCOMMITTEE ON RESEARCH

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

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June 12, 2003

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PLANT BIOTECHNOLOGY RESEARCH AND DEVELOPMENT IN AFRICA: CHALLENGES AND OPPORTUNITIES

THURSDAY, JUNE 12, 2003

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON RESEARCH,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:20 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Smith [Chairman of the Subcommittee] presiding.

RESEARCH SUBCOMMITTEE
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

Plant Biotechnology Research and Development in Africa: Challenges and Opportunities

Thursday, June 12th, 2003
10:00 AM
2318 Rayburn House Office Building (WEBCAST)

Witness List

Panel I

Honorable J. Dennis Hastert
Speaker of the House
U.S. House of Representatives

Panel II

Dr. Rita Colwell
Director
National Science Foundation

Honorable Andrew Natsios
Administrator
U.S. Agency for International Development

Panel III

Dr. Gordon Conway
President
Rockefeller Foundation

Dr. John Kilama
President
Global Bioscience Development Institute

Dr. Robert B. Horsch
Vice-President
Product and Technology Cooperation for Monsanto

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HEARING CHARTER

SUBCOMMITTEE ON RESEARCH
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

Plant Biotechnology Research and Development in Africa: Challenges and Opportunities

THURSDAY, JUNE 12, 2003
10:15 A.M.—12:30 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

1. PURPOSE

On Thursday, June 12, 2003, the House Science Committee will hold a hearing to examine plant biotechnology research and development activities relevant to African food crops and the challenges and opportunities involved in these activities.

2. WITNESSES

Panel I

The Honorable J. Dennis Hastert is Speaker of the U.S. House of Representatives.

Panel II

Dr. Rita R. Colwell is Director of the National Science Foundation (NSF). Before joining the Foundation, Dr. Colwell served as President of the University of Maryland Biotechnology Institute and Professor of Microbiology at the University Maryland. She was also a member of the National Science Board from 1984 to 1990.

The Honorable Andrew Natsios is Administrator of the U.S. Agency for International Development (USAID), the lead U.S. government agency for economic and humanitarian assistance. In addition to his duties as administrator of USAID, Natsios serves as the President's Special Coordinator for International Disaster Assistance and Special Humanitarian Coordinator for the Sudan. Before assuming the lead position at USAID, Natsios served the agency as director of the Office of Foreign Disaster Assistance and assistant administrator for the Bureau for Food and Humanitarian Assistance.

Panel III

Dr. Gordon Conway is President of the Rockefeller Foundation, a New York-based charity dedicated to improving food security around the world. Dr. Conway's previous positions include Vice-Chancellor of the University of Sussex (England) and Director of the sustainable agriculture program of the International Institute for Environment and Development in London. He has authored *Unwelcome Harvest: Agriculture and Pollution* (1991) and *The Doubly Green Revolution: Food for All in the 21st Century* (1999).

Dr. John Kilama is President of the Global Bioscience Development Institute, a firm providing training and consulting to policy-makers in developing countries on biotechnology regulation, intellectual property rights, and international trade development. His background is in pharmaceutical and agricultural biotechnology and agrochemistry. Previously, Dr. Kilama worked at the DuPont Company, specializing in developing chemicals for crop protection and establishing collaborations between DuPont and institutions in developing countries.

Dr. Robert B. Horsch is Vice President of Product and Technology Cooperation for Monsanto Corporation. He led the company's plant tissue culture and transformation efforts, contributing to the development of the Bollgard, YieldGard, and Roundup Ready traits in broad use today. Dr. Horsch received the Presidential Medal of Technology in 1999 for his contributions to the development of agricultural biotechnology. He is a member of the Private Sector Committee of the Consultative

Group for International Agricultural Research (CGIAR) and the United Nations Millennium Project Task Force on Hunger.

3. OVERARCHING QUESTIONS

The hearing will address the following overarching questions:

- What is the status of plant biotechnology research efforts in Africa, what research opportunities are the most promising, and what barriers to progress exist in this area?
- What is the scope and structure of U.S. support for plant biotechnology research and development in Africa? What activities are private organizations such as the Rockefeller Foundation and the Monsanto Corporation supporting?
- How are agencies such as the National Science Foundation (NSF), U.S. Agency for International Development (USAID), and U.S. Department of Agriculture (USDA) working together to coordinate research programs and promote the dissemination of accurate scientific information on plant biotechnology? How are they coordinating with each other, with industry, and with non-governmental organizations to better meet overall goals of reducing hunger and fostering agricultural sustainability?

4. BRIEF OVERVIEW

- Genetically modified (GM) crops, which involve the transfer of genes from one organism to another, were first introduced in the United States in the mid-1990s. They have expanded rapidly but in a limited number of countries. In 2002, they were planted on 140 million acres in 16 countries. The primary crops grown are insect-resistant cotton and corn, and herbicide-tolerant soybeans.
- Plant biotechnology holds tremendous promise to contribute to improved food security in sub-Saharan Africa, where 190 million people are undernourished. It is estimated that even a one percent increase in agricultural productivity in Africa could bring six million people out of poverty.
- However, for a variety of complex reasons, including trade concerns, the lack of an adequate regulatory structure and resources, and the fact that much of the biotech research and development has focused on crops that are not suitable for African crop systems, most countries in Africa have not yet benefited from biotech crops. To date, adoption has primarily been limited to South Africa and Kenya.
- The U.S. government, through agencies such as USAID, NSF, and USDA, supports several research, development, and outreach programs related to plant biotechnology in Africa. Last December, President Bush signed into law the *National Science Foundation Authorization Act of 2002* (P.L. 107–368), which authorized NSF to establish a grant program for Plant Biotechnology Partnerships for the Developing World.
- Non-governmental organizations (NGOs) and private industry, led by the Rockefeller Foundation and Monsanto, respectively, are also active supporters of advancing plant biotechnology in Africa. The Rockefeller Foundation recently announced a new initiative with USAID and several agriculture companies, the African Agricultural Technology Foundation, which will work to arrange intellectual property agreements to encourage more biotech research on crops suitable to Africa.

5. BACKGROUND

Status of Plant Biotechnology Outside of Africa

The first GM crops became commercially available in the United States in the mid-1990s. In less than a decade, their adoption has been extremely rapid, and the area of U.S. crop land planted with GM crops has grown from just two million acres in 1995 to 100 million in 2002. This includes 69, 68, and 26 percent of the cotton, soybean, and corn acreage in America, respectively. Today, 12 varieties of various crops are approved for commercial production in the U.S. Most of these varieties offer one of two primary types of improved traits over their traditional predecessors: insect resistance or herbicide tolerance.

Worldwide, a total of 140 million acres of GM crops were planted in 2002 (a 12 percent increase over 2001) in 15 nations in addition to the U.S., including (in approximate order of decreasing acreage) Argentina, Canada, China, Bulgaria, Colombia, Germany, Honduras, India, Mexico, Romania, South Africa, Spain and Uruguay.

Status of Plant Biotechnology in Africa

Many people believe that modern biotechnology holds great promise to provide Africa with the means to achieve the food security that the Green Revolution (the dramatic increase in agricultural productivity during the 1960s) did not supply. Recent studies have estimated that a one percent increase in agricultural productivity could reduce poverty by six million people in Africa. One of the most promising tools on the horizon to realize these productivity increases is plant biotechnology. However, for a variety of complex reasons, including trade concerns and the lack of an adequate regulatory structure, a shortage of resources, and the lack of available crop varieties suitable to African climate and cropping systems, adoption of transgenic crops in Africa has been very limited.

The nation of South Africa, with relatively strong government support, more resources and a stronger regulatory structure (and less reliance on Europe as a trading partner), has by far led the continent in development and adoption of biotech crops. Four types of GM crops are approved for commercial use in the country: insect-resistant cotton, herbicide-tolerant soybeans, and two kinds (white and yellow) of insect resistant maize. South African farmers have generally embraced these biotech crops, and their use has expanded rapidly. Almost 200,000 hectares were planted with GM crops in the 2001/2002 summer season. A survey of small farmers in the Makhatini flats of Kwazulu Natal in South Africa showed farmers that planted transgenic cotton experienced increased yields of 33 percent, saved an average of six pesticide sprays per year, and had a 27 percent increase in net income.

South Africa also has the strongest plant biotechnology research effort in Africa. The government has developed and approved a National Biotechnology Strategy for the country to stimulate growth and investment in this sector, and has also passed a national biosafety framework to establish acceptable standards for research and risk assessment related to biotechnology (including pharmaceuticals). Biotech research efforts are focused on development of transgenic grains (maize, sorghum, millet, and barley) and fruits (citrus, mango, and banana).

Kenya also has a significant biotechnology research program through the Kenyan Agricultural Research Institute (KARI), which works in coordination with USAID, private industry, and non-governmental organizations. This program has developed draft biosafety regulations and guidelines for the growing biotechnology industry, and has also successfully developed new varieties of crops important to Kenyan farmers. One example is a new variety of sweet potato which is resistant to the feathery mottle virus that used to destroy 60 percent of the crop each year. The new variety not only increased yields, but it also dramatically reduced input costs by reducing the amount of pesticides farmers need to use. (Kenyan farmers typically used to spend 30 percent of production costs on pest control.) KARI also successfully developed transgenic banana varieties through its research program. In 1997, farmers began planting the bananas in a farm community about 75 km north of Nairobi. By 2000, average yields in the community had risen from 10 tons per hectare to 40–50 tons per hectare.

Safety Concerns and Trade of Biotech Crops

Notwithstanding the potentially large benefits of plant biotechnology for Africa, risks and uncertainties do exist related to the safety of transgenic crops. While earlier fears that GM foods are not safe for consumption have largely been eased (70 percent of food in U.S. supermarkets contains genetically modified material), questions still remain about the long-term impact of transgenic crops on biodiversity and the environment. The most notable of these questions are how and how often transgenic genes to "jump" to other species and whether these genes have a significant negative impact on ecosystems and/or human health.

The debate over these safety risks has sparked worldwide controversy. The European Union (EU) has cited these concerns as its reason for not processing new applications of GM crops for importation. The U.S. has argued that the moratorium on new applications is not based on sound science, and on May 13, 2003, initiated a World Trade Organization (WTO) challenge to the EU position. The U.S. has also argued that, because of their dependency on Europe as a trading partner, the EU position has caused many African nations to shun plant biotechnology.

U.S. Support of Plant Biotechnology in Africa

- National Science Foundation (NSF)

NSF has long been at the forefront of research aimed at better understanding the molecular, genetic, and biochemical nature of plants. Developments based on this research have driven progress in plant biotechnology—and thus are of tremendous interest to the agricultural community. In keeping with the agency's mission of

basic research and expansion of knowledge, NSF-funded research in this area has focused primarily on improving understanding of the fundamental biology and genomic composition of plants.

One area of particular focus for NSF has been study of the plant *Arabidopsis thaliana,* which is a relative of plants such as broccoli and cauliflower. A model organism for plant biology studies, *Arabidopsis* has been researched by scientists for many years, and an effort to sequence the entire *Arabidopsis* genome—analogous in many ways to the Human Genome Project—was completed in December 2000. That effort, part of NSF's Plant Genome Research Program, involved the work of a consortium of scientists from six different countries. NSF led the effort for the United States with support from USDA and the Department of Energy (DOE).

While having the complete DNA sequence of an organism is an important step in understanding how that organism functions, just knowing the sequence of all of an organism's genes is not enough to gain a full understanding of the organism. Central to scientists' efforts to better understand plants is a clearer understanding of what individual genes in the organism actually do—information that cannot be derived from DNA sequences alone. NSF recently launched a research program to determine the functions of all 25,000 *Arabidopsis* genes—the "2010 Project," which began in FY 2001. Better understanding the specific roles of various plant genes and how they contribute to the overall function of the plant provides the foundation for all aspects of plant biotechnology.

Building on NSF programs to answer these fundamental questions, Representatives Smith (MI) and Johnson (TX) authored legislation in the 107th Congress, H.R. 2051, establishing new research programs at the National Science Foundation, including one that directs NSF to award grants for research partnerships focused on the developing world. This legislation was passed by the House, and later included in the NSF authorization bill that was signed by the President last December (P.L. 107–368). This committee expects the program to be developed and implemented through NSF's Plant Genome Research Subactivity in the Biological Sciences Directorate. This Subactivity received $75 million in funding in fiscal year (FY) 2003, and the FY 2004 request for the program was also $75 million.

- United States Agency for International Development (USAID)

USAID's agriculture strategy aims to stimulate economic growth and food security by increasing agricultural productivity. To that end, USAID has been involved in agricultural biotechnology for more than a decade as a way to reduce hunger and to combat malnutrition. To realize the promise of biotechnology, USAID supports research, informs decision-makers, helps countries formulate regulations, and funds public outreach to promote the safe use of biotechnology in developing countries.

Initiative to End Hunger in Africa (IEHA)

As part of that effort, USAID formally launched IEHA, a multi-year effort to cut hunger in African in half by 2015, at the World Summit on Sustainable Development in 2002. IEHA seeks to accomplish that goal by decreasing Africa's dependence on food aid by $2.6 billion, laying the foundation for sustainable economic growth, rapidly increasing agricultural productivity and building African-led partnerships to address the problems of famine and poverty.

Adapting technology to local needs is a substantial component of the IEHA. Specifically, the IEHA partners, which include the U.S., Canada, the EU, Germany, Mali, Mozambique and Uganda and other organizations and societies, have created a continent-wide Technology Access Fund to make new crop technologies, including biotechnology, available to all African farmers. IEHA also has developed the Technology Applications for Rural Growth and Economic Transformation program to adapt and disseminate technologies that can improve African agriculture through crop and livestock management and other activities. The initiative also has launched two regional and five country-specific integrated biotechnology systems development programs to create a new partnership to expand the use of biotechnology applications in Africa. Moreover, IEHA is helping to further these and other biotechnology efforts by creating and linking International Agriculture Research Centers with 10 U.S. and African universities and research centers, thereby increasing investment on research aimed at ways to fight drought, disease and pests and facilitating exchanges.

To launch IEHA, the President requested and received an increase of 25 percent in the USAID annual budget to support agricultural development efforts in Africa. This effort builds on existing programs on the continent and, as a result, USAID funding has grown from $113 million in FY 2001, to $137 million in FY 2002, to $164 in FY 2003 in sub-Saharan Africa. For FY 2004, the President has requested

$159 million, of which approximately 30 percent, or $55–$60 million, is expected to be allocated for technology, including biotechnology.

- Rockefeller Foundation

The Rockefeller Foundation is a New York-based global charity established in 1913 with the stated commitment to "enrich and sustain the lives and livelihoods of poor and excluded people throughout the world." Rockefeller's activities focus on four thematic lines of work: Creativity and Culture, Food Security, Health Equity, and Working Communities.

With regard to Food Security, the Rockefeller Foundation has a goal to cut global poverty and hunger in half by 2013. This effort includes a variety of research and other grant-making activities, some of which focus on plant biotechnology.

The African Agricultural Technology Foundation (AATF), a new initiative led by the Rockefeller Foundation was announced in early 2003 in collaboration with USAID and agriculture companies Monsanto, Syngenta, Dow, and DuPont. One of the goals of the AATF is to find solutions to the complex intellectual property arrangements that often hamper plant biotech research and development in Africa. In addition to certain patent rights, the companies will donate seed varieties, laboratory expertise, and other aid to African scientists working to battle plant diseases, insects, and drought. The AATF will have a $2.5 million operating budget that includes $1 million from the Rockefeller Foundation and $550,000 from USAID.

6. WITNESS QUESTIONS

Panel I

No questions for Speaker Hastert.

Panel II

The witnesses were asked to address the following questions in their testimony:

Questions for Dr. Rita R. Colwell

- What is the status of implementation of the Plant Biotechnology Partnerships for the Developing World program authorized by Section 8(c) of last year's NSF authorization legislation (P.L. 107–368)? How can NSF leverage the activities of this program with those of other government agencies, non-governmental organizations, and private industry to maximize the success of these efforts?
- How does NSF coordinate support of these research activities with other federal agencies involved in this effort, such as the U.S. Agency for International Development and the U.S. Department of Agriculture?
- What other fundamental research on plant genomics specifically related to food crops grown in Africa does the NSF Plant Genome Research Program support? What countries and cropping systems does this research focus on and why? What areas of plant biotechnology research carried out in Africa hold the most promise to improve food security and foster sustainable agriculture in Africa?

Questions for Mr. Andrew Natsios

- What is the current scope and structure of the U.S. Agency for International Development's (USAID) support for plant biotechnology research carried out in Africa (including specific budget information)? In addition to research, what other activities aimed at advancing development and adoption of plant biotechnology in Africa does USAID support? How does USAID coordinate these activities with other federal agencies involved in this effort, such as the National Science Foundation and the U.S. Department of Agriculture?
- What areas of plant biotechnology research hold the most promise to improve food security and foster sustainable agriculture in Africa? What are the primary impediments to advancing this research and development, and how can these barriers be lifted?
- Describe the Administration's recently announced *Initiative to End Hunger in Africa* (IEHA). How are scientific and technological solutions to hunger such as plant biotechnology are integrated into the IEHA plan? Please also describe USAID's new Collaborative Agricultural Biotechnology Initiative (CABIO) and how it is related to IEHA. What countries and cropping systems are these initiatives focusing on?
- What are the objectives and status of the recently announced African Agricultural Technology Foundation (AATF) partnership between USAID, the Rocke-

feller Foundation, Monsanto, Dupont/Pioneer, Dow Agrosciences, Syngenta, and Aventis? What is USAID's role and level of support in this initiative?

Panel III

Questions for Dr. Gordon Conway

- What is the status of plant biotechnology research and development carried out in Africa? What successes have been achieved and what areas of research hold the most promise to improve the lives of Africans in the future? What are the primary impediments to advancing the use of biotechnology as a tool to combat hunger and foster sustainable agriculture in Africa?
- Please describe the objectives and status of the African Agricultural Technology Foundation (AATF). What is the Rockefeller Foundation's role in this partnership with the U.S. Agency for International Development (USAID) and private industry? What countries and cropping systems is the initiative focusing on and why?
- What can the Federal Government, specifically the National Science Foundation, U.S. Agency for International Development, and the U.S. Department of Agriculture, do to improve coordination of plant biotechnology research carried out in Africa? What countries and cropping systems should we be focusing on to maximize the use of available resources? How can these agencies best leverage their efforts with those of private industry, universities (U.S. and African), African governments, and non-governmental organizations?

Questions for Dr. John Kilama

- What is the status of plant biotechnology research and development carried out in Africa? What successes have been achieved, and what areas of research hold the most promise to improve the lives of Africans in the future?
- What are the primary impediments to advancing the use of biotechnology as a tool to combat hunger and foster sustainable agriculture in Africa, and how can these barriers be lifted? To what extent do you believe the European Union's trade policy toward genetically modified crops has stalled plant biotechnology research in Africa?
- What can the Federal Government, specifically the National Science Foundation, U.S. Agency for International Development, and the U.S. Department of Agriculture, do to improve coordination of plant biotechnology research carried out in Africa? What countries and cropping systems should we be focusing on to maximize the use of available resources? How can these agencies best leverage their efforts with those of private industry, universities (U.S. and African), African governments, and non-governmental organizations?

Questions for Dr. Robert B. Horsch

- What is the status of plant biotechnology research and development carried out in Africa? What successes have been achieved and what areas of research hold the most promise to improve the lives of Africans in the future?
- How is Monsanto working with non-governmental organizations such as the Rockefeller Foundation to advance the development and adoption of new crop varieties that will benefit the people of Africa? How does Monsanto balance its need to continue developing new and profitable products with its desire to share intellectual property with developing nations that could benefit from such property but do not have the means to purchase it?
- What are the primary impediments to advancing the use of biotechnology as a tool to combat hunger and foster sustainable agriculture in Africa, and how can these barriers be lifted? To what extent do you believe the European Union's trade policy toward genetically modified crops has stalled plant biotechnology research in Africa?
- What can the Federal Government, specifically the National Science Foundation, U.S. Agency for International Development, and the U.S. Department of Agriculture, do to improve coordination of plant biotechnology research carried out in Africa? What countries and cropping systems should we be focusing on to maximize the use of available resources? How can these agencies best leverage their efforts with those of private industry, universities (U.S. and African), African governments, and non-governmental organizations?

Panel 1

Chairman SMITH. The Subcommittee on Research will come to order. Our first witness will be the Speaker of the House, Dennis Hastert. Mr. Speaker, thank you very much for sharing your comments and enthusiasm on biotechnology. Mr. Johnson would like to make a comment acknowledging his service under you in your State.

Mr. JOHNSON. It is just my honor as Vice Chair of the Committee, and as a former colleague, and as a member of the delegation to welcome the Speaker of the House to our presence, and really welcome your testimony, and appreciate your being here.

Chairman SMITH. Mr. Speaker, please proceed.

STATEMENT OF HONORABLE J. DENNIS HASTERT, SPEAKER OF THE HOUSE, U.S. HOUSE OF REPRESENTATIVES

Speaker HASTERT. Thank you. When Mr. Johnson talks about a former colleague, we were actually former colleagues in the Illinois General Assembly together, so now we are colleagues, and I am not announcing retirement or anything. I just wanted to make that perfectly clear.

Mr. JOHNSON. I am not either.

Speaker HASTERT. Mr. Chairman, thank you, and Chairman of the Full Committee, thank you for your graciousness in allowing me to testify today on something I think is very important. You know, I think back—before I get into a formal presentation—I think back 15–16 years ago when I first came to Congress, and in that period of years, I served on the Commerce Committee, and you are always looking at the food safety issues. And constantly, we are talking about, you know, less fertilizer so we didn't contaminate our water supply, and we talked about let us use less herbicides so that we didn't have these contaminants, and less insecticides so that we could preserve not only the fauna that we have but the wildlife and those types of things. And you know, how can we make this ecology that we have better and safer and still carry on the essential process of agriculture that we have in this country.

And one of the ways and solutions—I remember visiting Northern Illinois University where they were growing corn and making it resistant to fungus. And I thought it was amazing how you could just change those pieces of matter around, the genes in the corn, and produce something that is completely new, that could withstand a great deal, whether it might be drought, or different types of fungus attacks, or insecticide attacks, or corn borer, whatever it may be.

So with that in mind, I just want to go back and say that as a representative of the 14th District of Illinois, my district currently covers portions—excuse me—of eight counties, which includes four of the top twenty-five corn producing counties and three of the top 50 soybean producing counties in the Nation. The State of Illinois is the second largest producing state of both corn and soybeans in the country, and 40 percent of this production currently goes to exports valued at approximately $2.7 billion per year.

U.S. agriculture ranks among the top U.S. industries in export sales. In fact, the industry generated a $12 billion trade surplus in

2001, helping mitigate the growing merchandise trade deficit. It is important to realize, however, that 34 percent of all corn acres and 75 percent of all soybean acres are genetically modified. And what exactly are we talking about when we say genetically modified? The EU and other countries would have you believe that this is a new and special type of food, questionable for human consumption. In fact, since the dawn of time, farmers and those who have used the sweat of their brow to use the earth and the soil to sustain themselves have been modifying plants to improve yields and to create new varieties resistant to pests and diseases. And why would we want to snuff out human ingenuity that benefits farmers and consumers alike?

Such advancements have been achieved by taking plants with desirable traits and crossbreeding them. In fact, almost all of today's commercial crops are now distant cousins from the plants that first appeared in this country. Biotechnology is merely the next stage of development in this age old process. And if you were a junior high student or in the early years of high school and studying, basically, the basics of reproduction, you always had the lessons of Mendel and how he took certain flowers and crossbred them and came up with a different variety. I mean, this has been going on for ages and ages.

With respect to biotechnology research, both agricultural and pharmaceutical, the U.S. has been an undisputed world leader. In fact, in my district alone, two research facilities that directly contribute to the efforts in assisting third world countries through the development of drought resistant varieties of agriculture products exist. Yet, over the last few years, we have seen country after country implementing protectionist trade policies under the cloak of food safety, each one brought on by emotion, culture, or their own poor industry or history with food safety regulation and technology.

Among others, China has developed new rules for the approval and labeling of biotech products. An overwhelming portion of the entire $1 billion U.S. soybean export crop is genetically modified. Although implementation has been delayed, such a labeling program would certainly result in higher food costs for consumers and higher production costs for farmers. And of course, most troubling, American farmers have been subject to an indefensible 5-year moratorium imposed by the European Union on agriculture biotechnology. This is non-tariff barrier based simply on prejudice and misinformation, not sound science. In fact, their own scientists agree that genetically modified foods are safe.

Simply put, this type of non-tariff protectionism is detrimental to the free movement of goods and services across borders. We all know that free trade benefits all countries. However, free trade will be rendered meaningless if it is short circuited by non-tariff barriers that are based on fear and conjecture, not science. In fact, there is general consensus among the scientific community that genetically modified food is no different from conventional food. What is different is not the content of the food but the process by which it is made. Even labeling genetically modified products would only mislead consumers and create an atmosphere of fear.

I congratulate President Bush and Ambassador Zoellick for meeting this resistance head on and putting American farmers and

sound science first by challenging the EU's illegal trade ban on genetically modified foods before the WTO. And I applaud Argentina and Canada for joining us in this critical effort to support a technology that holds colossal benefits for producers and consumers throughout the world. As part of this endeavor, it is also important for the public to know that the U.S. Government has safely regulated biotechnology since its inception over 30 years ago. And with the rapid evolution of plant biotechnology in the early 1980's, additional regulation was added. Ask any American farmer about Government regulation, and not one will tell you that they are underregulated.

Biotechnology products are screened by at least one, and often by as many as three Federal agencies. From conception to commercial introduction, it can take up to 10 years to bring a biotech variety to market. Throughout the process, the public has ample opportunity for participation and comment and data on which the regulatory decisions are based and readily available.

Mr. Chairman, I am going to let the rest of my comment go to the record, but let me just say a couple of things. Some of you had the opportunity to travel, and some of them was with great pleasure to travel with me. A couple of years ago, we went to South Africa, and on that trip we went out to a farm just north of Johannesburg. And on that farm were native South Africans growing crops. Side by side, the traditional maize or corn that they would grow, and next to it, the maize or corn that had been genetically modified. It was genetically modified so it didn't—it was drought resistant. It was genetically modified so it would resist the corn borer or the worms that penetrate into the plant of the corn, and it used less fertilizer. The plants stood side by side; the same soil, the same farmer, the same environment. One plant was infested with worms, it stood about three feet tall. The plant next to it had a huge amount of grain compared to the first plant, it had no worms, it stood about eight feet tall and, you know, it was a product that people could have and, you know, they could nourish themselves.

Today, when we see starvation, especially in some of our African countries, we see people who are artificially putting barriers or threats to us being able to move good healthy food products into those countries. In my view, that borders on genocide. It is wrong, it shouldn't happen, and we need to use our science, we need to use our technology, and we need to fight those folks who are trying to stop this good, healthy, nourishing food from going to countries that need it.

I thank you in this committee for your passion to make sure that we can deliver the best products not only to just the American people, but all the people in this world, and holding this hearing today to make sure that this could move forward. Thank you very much, Mr. Chairman, and Mr. Chairman, and all members. I appreciate your indulgence and your kindness.

[The prepared statement of Speaker Hastert follows:]

PREPARED STATEMENT OF SPEAKER J. DENNIS HASTERT

Thank you Mr. Chairman for the opportunity to appear before the Committee today to comment on the future of biotechnology research. I appreciate your Committee's work on this important issue, and thank you for holding this hearing.

As the Representative of the 14th District in Illinois, my district currently covers portions of eight counties, including four of the top 25 corn-producing counties, and three of the top 50 soybean-producing counties in the nation. The State of Illinois is the second largest producing state of both corn and soybeans in the country. Forty percent of this production currently goes to exports, valued at approximately $2.7 billion per year.

U.S. agriculture ranks among the top U.S. industries in export sales. In fact, the industry generated a $12 billion trade surplus in 2001, helping mitigate the growing merchandise trade deficit. It is important to realize, however, that 34 percent of all corn acres and 75 percent of all soybean acres are genetically modified.

And what exactly are we talking about when we say "genetically modified?" The EU and other countries would have you believe this is a new and special type of food, questionable for human consumption. In fact, since the dawn of time, farmers have been modifying plants to improve yields and create new varieties resistant to pests and diseases. Why would we want to snuff out human ingenuity that benefits farmers and consumers alike?

Such advancements have been achieved by taking plants with desirable traits and crossbreeding them. In fact, almost all of today's commercial crops are now distant cousins from the plants that first appeared in this country. Biotechnology is merely the next stage of development in this age-old process.

With respect to biotechnology research, both agricultural and pharmaceutical, the U.S. has been the undisputed world leader. In fact, my district alone includes two research facilities that directly contribute to the efforts in assisting third world countries through the development of drought-resistant varieties of agricultural products.

Yet, over the last few years we have seen country after country implementing protectionist trade policies under the cloak of food safety—each one brought on by emotion, culture, or their own poor history with food safety regulation.

Among others, China has developed new rules for the approval and labeling of biotech products. An overwhelming portion of the entire $1 billion U.S. soybean export crop is genetically modified. Although implementation has been delayed, such a labeling program would certainly result in higher food costs for consumers and higher production costs for farmers.

And of course most troubling, American farmers have been subject to an indefensible five-year moratorium imposed by the European Union on agricultural biotechnology. This is a non-tariff barrier based simply on prejudice and misinformation, not sound science. In fact, their own scientists agree that genetically modified foods are safe.

Simply put, this type of non-tariff protectionism is detrimental to the free movement of goods and services across borders. We all know that free trade benefits all countries. However, free trade will be rendered meaningless if it is short-circuited by non-tariff barriers that are based on fear and conjecture—not science.

In fact, there is general consensus among the scientific community that genetically modified food is no different from conventional food. What's different is not the content of the food, but the process by which it is made. Even labeling genetically modified products would only mislead consumers and create an atmosphere of fear.

I congratulate President Bush and Ambassador Zoellick for meeting this resistance head-on and putting American farmers and sound science first by challenging the EU's illegal trade ban on genetically modified foods before the WTO. And I applaud Argentina and Canada for joining us in this critical effort to support a technology that holds colossal benefits for producers and consumers throughout the world.

As part of this endeavor, it's also important for the public to know that the U.S. government has safely regulated biotechnology since its inception over 30 years ago. And with the rapid evolution of plant biotechnology in the early 1980s, additional regulation was added. Ask any American farmer about government regulation and not one will tell you that they are under-regulated.

Biotechnology products are screened by at least one, and often by as many as three, federal agencies. From conception to commercial introduction, it can take up to 10 years to bring a biotech variety to market. Throughout the process, the public has ample opportunity for participation and comment, and data on which regulatory decisions are based are readily available.

Nevertheless, regardless of the overwhelming evidence to the contrary, we should all be concerned that this irrational policy is spreading. And, as a point of fact, the worldwide impact has been staggering.

The current EU moratorium on genetically-modified products has translated into an annual loss of over $300 million in corn exports for U.S. farmers. More disturbing is the recent trend in Africa, where several nations have rejected U.S. food

aid because the shipments contained biotech corn. This based solely on the fear that EU countries will not accept their food exports if genetically modified seeds spread to domestic crops.

Specifically, Zambia, Zimbabwe and Mozambique refused U.S. food aid which consisted of biotech corn. Zimbabwe and Mozambique eventually accepted the aid, but only after making costly arrangements to mill the corn so African farmers could not try to grow it.

In addition, it was recently reported that Sudan denied the entry of genetically-modified agricultural products as aid in relief camps. According to USAID, this will bring harm to around 97 percent of children living in relief camps—this is simply unconscionable.

Furthermore, the Ugandan Government has refused to take advantage of biotech bananas because of fears that the EU will retaliate and refuse to buy their exports.

Consequently, U.S. farmers are already beginning to plant more non-biotech seeds. This trend will increase farmers' cost of production as well as increase the damage from harmful insects. In fact, the U.S. Environmental Protection Agency has recently approved a corn technology that will allow the commercialization of the first corn designed to control rootworm—a pest that costs U.S. farmers approximately $1 billion in lost revenue per year. It is absurd to think that farmers would not be able to take advantage of this technology.

Clearly, the long-term impact of these policies could be disastrous for U.S. farmers and research efforts in terms of competitiveness and the ability to provide food for the world's population. Addressing world hunger is particularly critical when approximately 800 million people are malnourished in the developing world, and another 100 million go hungry each day. Biotechnology is the answer to this pressing problem. Farmers can produce better yields through drought-tolerant varieties, which are rich in nutrients and more resistant to insects and weeds, while those in need reap the benefits.

Halting or even slowing down the development of this technology could have dire consequences for countries where populations are growing rapidly and all arable land is already under cultivation.

One would think that the European Union, and any country that has adopted similar protectionist policies, would embrace a technology with such promising advantages. Sadly, they have not. It has become clear, that only official WTO action will send a convincing message to the world that prohibitive policies on biotechnology, which are not based on sound science, are illegal.

Hopefully, the WTO will act quickly to resolve the Administration's case on behalf of American farmers and ongoing research efforts. There's no doubt that the U.S. and American agriculture go into this battle with the facts on our side. We simply cannot allow the free trade of our agricultural products to be restricted by these unfair and unjust policies. After all, the price of inaction is one we can no longer afford to pay.

Chairman SMITH. Mr. Speaker, again, thank you very much. In fact, we included testimony from a farmer from South Africa, T.J. Buthelezi, that had the same experience that you described, so tremendous potential. Thank you very much, for what I think your presence here does today is add momentum to the fact that we have got to continue to move ahead on something that can tremendously help the world, especially, developing countries, and expand trade. So again, thank you very much.

Speaker HASTERT. Thank you. You are very kind. I appreciate it.

Chairman SMITH. We will proceed with the opening statements, and I would call on Mrs. Johnson first and then I will follow her.

Ms. JOHNSON. Thank you very much, Mr. Chairman. I am pleased to join you in welcoming our witnesses and I was delighted to see the Speaker. I was on the trip with him when we went to Africa a couple of years ago. I think that the hearing on *Plant Biotechnology Research and Development in Africa: Challenges and Opportunities* is a good topic and will focus on how plant biotechnology research can aid in efforts to combat hunger in Sub-Saharan Africa.

The world population has topped six billion people and is predicted to double in the next 50 years. Ensuring an adequate food supply for this booming population is going to be a major challenge in the years to come. However, in recent years, Sub-Saharan Africa is the only region where agricultural output has fallen behind population growth. Food demand in this region has been expanding at an annul rate of 3.1 percent since the mid-1980's.

It is estimated that about 200 million people in Africa are chronically hungry. At least 25 percent of the world's undernourished people live in the region. Millions of Africans, mostly children under the age of six years, die every year as a result of hunger. Plant biotechnology research has the potential to help Sub-Saharan Africa increase food security and improve the quality and nutritional content of food. Additionally, biotechnology can also improve the health of citizens of developing countries by combating illness.

Substantial progress has been made in the developed world on vaccines against life-threatening illnesses but, unfortunately, infrastructure limitations often hinder the effectiveness of traditional vaccination methods in some parts of the developing world. For example, many vaccines must be kept refrigerated until they are injected. Even if a health clinic has electricity and is able to deliver effective vaccines, the cost of multiple needles can hinder vaccination efforts. Additionally, the improper use of hypodermic needles can lead to HIV virus infection and the spread of the virus that causes AIDS. Biotechnology offers the prospect of orally delivering vaccines to immunize against life-threatening illnesses through agricultural products in a safe and effective manner.

During the 107th Congress, we successfully created a competitive merit-based grant program at the National Science Foundation to conduct basic genomic research on crops that can be grown in developing countries. We believe that this program can make an invaluable contribution in the fight against hunger, malnutrition, and disease, by providing research grants to U.S. institutions and scientists in developing countries to address agricultural challenges. I hope we will learn more today about how the program will accomplish these goals, and also, whether or not we have launched this grant program.

It is our hope that trade disputes between the United States, the European Union, and African countries do not prevent this promising technology from benefiting ordinary Africans facing ongoing food shortages due to agricultural challenges such as pests, drought, and disease. With increased investment in genetic engineering that targets specific food production challenges, the region may achieve what is necessary to build the basis for food security, reducing dependency on food aid.

Again, I would like to thank you, Mr. Chairman, for holding this hearing, because I think it is a very important issue. In addition, I would like to thank all of those in attendance for appearing at what promises to be a very informative hearing. And perhaps, Mr. Chairman, when we finish the hearings, we can go look at some of the work. Thank you.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Mr. Chairman, I am pleased to join you in welcoming our witnesses today to this hearing on *Plant Biotechnology Research and Development in Africa: Challenges and Opportunities.* This hearing will focus on how plant biotechnology research can aid in efforts to combat hunger in Sub-Saharan Africa.

The world population has topped six billion people and is predicted to double in the next 50 years. Ensuring an adequate food supply for this booming population is going to be a major challenge in the years to come.

However, in recent years Sub-Saharan Africa is the only region where agricultural output has fallen behind population growth. Food demand in this region has been expanding at an annual rate of 3.1 percent since the mid-1980s.

It is estimated that about 200 million people in Africa are chronically hungry. At least 25 percent of the world's undernourished people live in this region. Millions of Africans, mostly children under the age of six years, die every year as a result of hunger.

Plant biotechnology research has the potential to help Sub-Saharan Africa increase food security and improve the quality and nutritional content of food. Additionally, biotechnology can also improve the health of citizens of developing countries by combating illness. Substantial progress has been made in the developed world on vaccines against life-threatening illnesses, but, unfortunately, infrastructure limitations often hinder the effectiveness of traditional vaccination methods in some parts of the developing world. For example, many vaccines must be kept refrigerated until they are injected. Even if a health clinic has electricity and is able to deliver effective vaccines, the cost of multiple needles can hinder vaccination efforts. Additionally, the improper use of hypodermic needles can spread HIV, the virus that causes AIDS. Biotechnology offers the prospect of orally delivering vaccines to immunize against life-threatening illnesses through agricultural products in a safe and effective manner.

During the 107th Congress, we successfully created a competitive, merit-based grant program at the National Science Foundation (NSF) to conduct basic genomic research on crops that can be grown in developing countries. We believe that this program can make invaluable contributions in the fight against hunger, malnutrition and disease by providing research grants to U.S. institutions and scientists in developing countries to address agricultural challenges.

It is our hope that trade disputes between the United States, the European Union, and African countries do not prevent this promising technology from benefiting ordinary Africans facing ongoing food shortages due to agricultural challenges such as pests, drought, and disease. With increased investment in genetic engineering that targets specific food production challenges, the region may achieve what is necessary to build the basis for food security: reducing dependency on food aid.

Chairman SMITH. A good time to bring that up with the Chairman of the Committee here, who will, I am sure, be delighted to approve our Code L to do that. Mr. Chairman, would you like to make a comment?

Chairman BOEHLERT. No. I am just anxious to get on with the hearing. It is a very important subject, and we have some very distinguished witnesses, and we have been delayed somewhat, as to the Speaker's schedule, but I was so happy to see him here. I was privileged to accompany him on that trip and I saw and I marveled at the same things he saw and marveled at, and the potential is just unlimited. So the more good science we can introduce to the subject, the better off we are all going to be, and we are going to hear from some of the best, so let us get on with the hearing, Mr. Chairman.

Chairman SMITH. Well, I have to make a short opening statement, Mr. Chairman, but I want to welcome everybody to this hearing. I think it is exceptionally important. I, especially, compliment Representative Johnson, the Ranking Member of this committee, for her bill 2912 that was incorporated into the National Science Foundation bill that opens, really, the door for helping peo-

ple in the world that need that help, and part of this hearing will be to review how we progress on that particular help.

The Subcommittee is here to discuss these issues of biotechnology, their potential, their safety. Specifically, we will discuss this morning the status of plant biotechnology research and development in Africa, examine why most of Africa has not benefited from biotech crops today, and try to determine what factors may be limiting the research efforts in Africa. We will also review how the Federal Government, through USAID, NSF, USDA, other agencies, can improve coordination with each other and with non-Government entities, and ultimately, improve communication of accurate scientific information on the potential and safety of plant biotechnology. This will accelerate progress toward development and adoption of new beneficial crop varieties in Africa and other developing countries and throughout the world. I am also particularly interested in learning how NSF will be participating in this effort and how they will be implementing the plant genome centers and partnerships dealing with these developing countries.

It is estimated that most of the people in Africa are undernourished, over 190 million people in that continent. Since 1990, per capita incomes there have actually been decreasing. If something isn't done, if action isn't taken, then we are going to be facing an even greater calamity than what can be avoided. The potential of biotechnology is only limited by the creativity of the science community in developing the kind of plant nutrition, developing the kind of products that can grow in the soil and the climate that heretofore haven't been able to produce adequate supplies of food. There is no question that we have made some inroads. There is no question that Administrator Natsios, and AID more probably than ever before in AID's history, has moved ahead in exploring agriculture as a fundamental need, as a starting point that needs to be accomplished if we are going to contribute significantly to aiding these countries that especially need our help.

Without objection, the rest of my statement will be entered into the record, but I want to say through plant biotechnology research, scientists are developing a genetically modified banana that is resistant to a Black Sigatoka disease that is now spreading throughout the world. Our product that is going to resist that disease and produce a banana where you don't have to have the expense of these fungicides is, in effect, in the refrigerator ready to go, and there is an unwillingness in Africa to move ahead, and in other countries producing this banana, because of fear that Europe might shut off their exports. It seems to me that if we can just start doing some of the projects to help these people, if we can help convince Europe on the safety of these products, then we are going to have the ability to move ahead helping these countries. And with that, without objection, the rest of my statement will be entered into the record.

[The prepared statement of Chairman Smith follows:]

PREPARED STATEMENT OF CHAIRMAN NICK SMITH

Good morning and welcome to this hearing of the Subcommittee on Research. Today the Subcommittee meets to discuss an issue of great interest to Ranking Member Johnson and I—advancing plant biotechnology research and development

to help the world's poorest continent take advantage of a powerful tool in the battle against poverty and hunger.

Specifically, we will discuss this morning the status of plant biotechnology R&D in Africa, examine why most of Africa has not benefited from biotech crops to date, and try to determine what factors may be limiting research efforts. We will also review how the Federal Government, through USAID, NSF, USDA, and other agencies, can improve coordination—with each other and with non-government entities—and ultimately improve communication of accurate scientific information on the potential and safety of plant biotechnology. This will accelerate progress toward development and adoption of new beneficial crop varieties for the countries of Africa. I am also particularly interested in learning how NSF will be participating in this effort, and how they will be implementing the Plant Genome Centers and Partnerships with the Developing World programs that we established in the new NSF authorization law, which to date has been unclear.

It is estimated that 190 million people in Sub-Saharan Africa are undernourished. Since 1990, per capita incomes there have actually been decreasing. If action is not taken, conditions are expected to worsen even more. We work hard to provide adequate food aid to the people of Africa, but this only provides short-term relief. In the long term, increasing agricultural productivity is the best way to help Africa achieve food security. Even modest successes in this effort could have a tremendous impact on the people of Africa, with a one percent productivity increase estimated to bring six million African men, women and children out of poverty.

Our best hope to realize those productivity increases is by harnessing the powerful tool of plant biotechnology. Plant biotechnology has the potential to create new varieties of crops that can tolerate drought and infertile soils, resist pests and disease, and provide other unique characteristics such as enhanced nutrient content.

In some parts of Africa, farmers have already benefited from GM crops. We received written testimony for this hearing from T.J. Buthelezi, a cotton farmer in South Africa, whose crop yields doubled and pesticide applications decreased by more than 80 percent after he began planting biotech "Bt" cotton. Now, 90 percent of the farmers in Mr. Buthelezi's region are using Bt cotton. Similarly, researchers in Kenya are completing development of a virus resistant sweet potato capable of withstanding a disease that traditionally destroys 60 percent of the crop in a normal year. Soon, Kenyan farmers will also be able to benefit from the reduced input costs and increased yields offered by many biotech crops.

Contrary to what much of the organized opposition to plant biotechnology has argued, the farmers have overwhelmingly welcomed this new technology. As Mr. Buthelezi noted in his written testimony, "We were not pushed to this improved seed, but we were attracted by the benefits.. . .Countries in Africa should be encouraged to use these improved crops because farmers will improve yields and make more money to improve their lives. That is what all farmers want."

Another example of the potential impact of biotech crops is in Uganda, where the Black Sigatoka fungus currently devastates banana yields by as much as 70 percent. Farmers are spending over 25 percent of their input costs on fungicides alone. But through plant biotechnology research, scientists are developing a GM banana that is resistant to the disease, and would reduce the need for fungicide applications while also dramatically increasing yields. I am concerned, however, that European trade pressures may be slowing the development of this new banana variety into commercial application, and I would like to discuss this more today.

Indeed, many exciting opportunities are beginning to open up for the people of Africa. Unfortunately, the success stories in South Africa and Kenya have been the exception rather than the rule. It is important that other nations are equipped with the level of resources, expertise, and infrastructure needed to take advantage of these opportunities with the same degree of success that South Africa has.

Now, perhaps more than any other time, the people of Africa are at a very important crossroads. One on hand, they face the ominous prospect of rapid population growth and continued agricultural productivity declines leading to increased poverty and starvation in the next decade. One the other, however, with the help of new tools such as plant biotechnology, they have the potential to dramatically increase agricultural productivity and consequently achieve food security. More than a political debate, this is a debate about the very lives and future of African people. To do our part to ensure the balance shifts toward increased food security, we must be proactively engaged in this issue.

This will require an effective coordinated effort by federal agencies such as NSF and USAID, as well as non-governmental entities such as those we have before us this morning. It will also require that we ensure our policy approach to plant biotechnology minimizes the influence of politics and maximizes the influence of sound science, with full consideration given to the benefits, costs, and risks associated with

the technology. This should be the case in all aspects of plant biotech policy—trade, research, regulation—we must demand sound science drives decision-making.

I hope this morning's hearing will contribute positively to that effort.

Panel 2

Chairman SMITH. And if Director Colwell and Administrator Natsios will come to the witness table? Let me just say that Rita Colwell, who is Director of the National Science Foundation, is an exceptional leader in science. We have—under her leadership and guidance, we have moved ahead greatly over the last several years, so we appreciate you, Dr. Colwell, being in your job and giving it the effort that it takes to make it a success. And the Honorable Administrator Natsios, thank you for being here this morning. You have excited me personally in some of your testimony before Congress in terms of the kind of spirit and enthusiasm that it is going to take to make biotechnology a reality in the rest of the world. So with that, Dr. Colwell, first, we will call on you, and then Mr. Natsios.

STATEMENT OF DR. RITA R. COLWELL, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. COLWELL. Thank you, Mr. Chairman, and Ranking Member Johnson, and Members of the Committee. I very much appreciate the opportunity to testify today on this very important topic, Plant Biotechnology and Research in Africa, but I want to say in aside, this is a very special day. To have the Honorable Speaker of the House testify on behalf of fundamental research, I have to tell you, I am a very happy scientist.

I would also add for the record that a few weeks ago I visited the University of Illinois, Urbana–Champaign, on the occasion of the University commencement where I received an honorary degree. While I was there, I did, indeed, tour the fields where the crop research is being done, and the basic research is excellent and a major contribution to plant genomics.

So let me now return to my testimony and tell you that for the past 50 years, the National Science Foundation, NSF, has been engaged with the global scientific community through collaborative partnerships. And in recent years, we have witnessed what I would call a very dramatic growth in the connectivity of the world's scientific and engineering community. It offers enormous opportunities and challenges. Of particular importance to the Foundation and to me personally are NSF's partnerships with scientists and engineers in the developing world. My own research career has built, really, very strongly on collaborative interactions and work with scientists in Bangladesh and India.

The National Science Foundation's approach to collaborative work in the developing world has built on our principles of quality, merit review, and the integration of research and education. We are able to support the movement of students and researchers who travel to Africa and participate in seminars and research in Africa. These American researchers function as collaborators, and in some cases, their trainers. We estimate that NSF has spent approxi-

mately $63 million in the past four years on research with and about Sub-Saharan Africa.

Now, based on the experiences of NSF with international collaborations and the importance of these efforts, we want to and will do more. NSF, under the auspices of the National Science and Technology Council's Interagency Working Group on Plant Genomes, has initiated discussions with AID, USAID, and also with the Department of Agriculture and the Department of Energy, to support research collaborations between scientists from U.S. academic institutions and developing countries in plant biotechnology. Although we are still early in the stages of these efforts, NSF is moving in the direction that is provided for in our recently enacted reauthorization and many of NSF's ongoing programs in plant genome research are going to be very important—in fact, instrumental—in meeting the Committee's interest in these areas.

We currently support workshops, collaborative efforts throughout the developing world, but we want to expand these efforts and establish stronger partnerships which address some of the capacity needs in the developing world, and we will need to continue to partner with other agencies that are able to provide significant funds to institutions in the developing world. Now, as you know, at NSF we focus resources on funding U.S. scientists and institutions, but we also establish partnerships with other agencies, including USAID, and thereby, will be able to develop programs that address critical research topics, engage the U.S. scientific and engineering community, and build collaborative projects with developing country scientists, and contribute to capacity building in the developing world.

Let me speak for a moment about how the interagency coordination takes place. The National Plant Genome Initiative was established in 1998, and I know you, Mr. Chairman, are a very strong supporter of the initiative. It is a coordinated National Plant Genome Research Program. Under the auspices of the NSTC, it includes representatives from the Department of Agriculture, Department of Energy, National Institutes of Health, National Science Foundation, Office of Science and Technology Policy, and the Office of Management and Budget. USAID joined in 2002. Simply stated, the National Plant Genome Initiative has transformed plant research in the United States. It has resulted in a new generation of scientists entering the field and it has changed the way research is conducted in plant biology. During the past five years, U.S. researchers and their international partners have formed research teams for wheat, rice, bananas, and cereal crops to coordinate research on crops that are grown in Africa and worldwide.

Now, many assert, just as the Speaker has done, that science and technology can help bring food stability to regions like the Horn of Africa which has suffered from a terrible drought that has affected 15 million people. In July 2002, the Nobel laureate, the father of the Green Revolution, Dr. Norman Borlaug, said that he believes the world has the technology that is either available now or very well advanced in the research pipeline to feed on a sustainable basis a population of 10 billion people. Revolutionary advances in plant genomics can accelerate the process of knowledge transfer for the benefit of developing countries. A genomic based revolution in

world agriculture, equaling a success of the Green Revolution that doubled the yield of cereal crops, is a real possibility, and it could, indeed, alleviate the suffering of millions of people.

So let me conclude my brief remarks by saying that NSF and the NSF supported research community are poised to work with scientists in developing countries to realize the full potential of plant genomics on a global scale. We are enthusiastic about participating in this extremely important endeavor. We will bring our resources to bear. We are already working with our sister agencies through the established and very successful National Plant Genome Initiative. And I am going to close by again quoting Dr. Borlaug. "It took some 10,000 years to expand food production to the current level of about five billion gross tons per year. Within 25 to 35 years, or 30 years, we will have to nearly double the current production again. This cannot be done unless farmers across the world have access to current high-yielding crop production methods, as well as new biotechnological breakthroughs that can increase the yields, the dependability, and the nutritional quality of our basic food crops."

Thank you, Mr. Chairman, for your support and for this opportunity to testify. And I really want to express our appreciation for your continued very strong support of NSF. I will be happy to answer any questions.

[The prepared statement of Dr. Colwell follows:]

PREPARED STATEMENT OF RITA R. COLWELL

Mr. Chairman, Ranking Member Johnson, and Members of the Committee, I appreciate the opportunity to testify today on this important topic—Plant Biotechnology and Research in Africa. Since its creation the National Science Foundation has recognized the central role international partnership plays in achieving America's research and development objectives. For over fifty years we have been engaged with the global scientific community through collaborative partnerships. In recent years we have witnessed a dramatic growth in the connectivity of the world's scientific and engineering community—which offers enormous opportunities and challenges.

Of particular importance to the Foundation and to me personally are NSF's partnerships with scientists and engineers in the developing world. In the developing world there are scientific challenges and scientific expertise that are important to the U.S. Our partnership with the developing world holds the potential for growth in many areas. My own research career has built strongly on collaborative work with scientists in Bangladesh. Traditionally, NSF has worked with developing countries through its own programs and in the past, through partnerships with USAID.

The Foundation's approach to collaborative work in the developing world has built on our principles of quality, merit review, and the integration of research and education. Our potential lies in our ability to mobilize and support the U.S. scientific and engineering community. We are able to support the movement of students and researchers who travel to Africa and participate in seminars and research. These American researchers function as collaborators and in some cases, trainers. American students who travel to Africa expand their own training, share their evolving expertise and contribute to research advances. In the past four fiscal years, we estimate that NSF has expended approximately $63 million on research with and about sub-Saharan Africa.

In the past strong partnerships across institutions and countries have resulted in important progress. The successful sequencing of the rice genome was the result of collaboration and investment by several partners—the Rockefeller Foundation, USAID (through its contributions to the Consultative Group on International Agricultural Research), NSF, USDA, DOE and the funding agencies of many of our international partners. The current efforts in rice functional genomics are coordinated by the International Rice Research Institute (IRRI) in the Philippines. Additionally, we have partnered with USAID, to work on the important topic of biodiversity in the developing world.

Based on these experiences and the importance of these efforts we want and plan to do more. We have heightened our activity with our interagency partnerships, and are currently having discussions with both USAID and the World Bank. The interagency process for coordination of efforts is underway. We will continue to seek to develop partnerships that bring to bear the resources of the development agencies for capacity building that will mobilize and support the best scientists and engineers in the U.S. and its international partners.

Efforts to Establish a Plant Biotechnology Partnership for the Developing World

Recognizing the readiness of the research community and the scientific opportunities available, NSF, through the auspices of the National Science and Technology Council's Interagency Working Group on Plant Genomes, has initiated discussions with USAID, the Department of Agriculture (USDA), and the Department of Energy (DOE) to support research collaborations between scientists from U.S. academic institutions and developing countries in plant biotechnology.

The key interest is in greater engagement with developing countries in plant biotechnology research. We agree that plant genome research provides an ideal opportunity to work together toward this goal. A joint activity under discussion will link U.S. researchers with partners from developing countries to address developing country needs with the most current and appropriate technologies available, and to establish long-term relationships between participating scientists. It is important that exchange of ideas and people are reciprocal, and should be built on equal partnerships between the U.S. and scientists of developing nations.

Although we are still early in the stages of these efforts, NSF is moving in the direction provided for in the National Science Foundation Act of 2002 (P.L. 107–368), and many of NSF's ongoing programs in plant genome research will prove instrumental in meeting the Committee's interests in these areas.

Currently NSF's Office of International Science and Engineering is exploring how we can build on our existing investments and develop innovative programs with developing world scientists. We currently support workshops and collaborative efforts throughout the developing world. However, to expand these efforts and establish stronger partnerships which address some of the capacity needs in the developing world, we will need to continue to partner with other agencies that are able to provide significant funds to institutions in the developing world. As you know we must focus NSF resources on funding U.S. scientists and institutions. However, through partnerships with other agencies, such as USAID, we will be able to develop programs that address critical research topics, engage the U.S. scientific and engineering community, build collaborative projects with developing country scientists and contribute to capacity building in the developing world.

Coordination of Plant Biotechnology Research Activities

The National Plant Genome Initiative (NPGI) was established in 1998 as a coordinated national plant genome research program by the Interagency Working Group (IWG) on Plant Genomes, under the auspices of the National Science and Technology Council, with representatives from the Department of Agriculture (USDA), Department of Energy (DOE), National Institute of Health (NIH), National Science Foundation (NSF), Office of Science and Technology Policy, and the Office of Management and Budget (OMB). USAID joined the IWG in 2002.

Under the NPGI, genomics has transformed plant research in the United States. It has changed the way research is conducted in plant biology; it has attracted a new generation of scientists into the field; and it has contributed new information and knowledge to science. The NPGI has built a foundation on which the scientific community can advance research, not only in plant genomics but also in diverse disciplines ranging from fundamental biological sciences to biotechnology.

Recognizing that science is global, the NPGI actively encourages international partnerships. During the past five years, U.S. researchers and their international partners have formed the Cereal Genome Initiative, the International Genome Research Organization for Wheat; the International Rice Functional Genomics Consortium; and the Global Musa (banana and plantain) Genomic Consortium, to conduct and coordinate research on crops grown in Africa and worldwide.

One of the scientific thrusts of the NPGI five-year plan is "Translational Plant Genomics." As functions are assigned to genes in a few key model plant species, this information can be used to explore basic plant biology and to develop technologies to enhance the yields of crops of economic value. These technologies will be especially valuable for addressing issues associated with crops grown in developing countries.

NSF's Plant Genome Research Program (PGRP) and Plant Biotechnology in Africa

A regional drought in the Horn of Africa has created a food crisis affecting 15 million people in Eritrea, Ethiopia and Somalia. As a result, chronic child malnutrition is dangerously high and is creeping higher. In addition, substantial seed shortages exist that may inhibit recovery even if the rains materialize.

While the issue is a complex one, many assert that science and technology can help bring food stability to regions like the Horn of Africa. In July 2002, the Nobel laureate and "father" of the "Green Revolution," Dr. Norman Borlaug, said he believes the world has the technology—either available now or well advanced in the research pipeline—to feed on a sustainable basis a population of 10 billion people.

To achieve this goal, U.S. and international organizations, such as USAID, the Consultative Group on International Agricultural Research (CGIAR), and the Rockefeller Foundation have been working to bring the latest scientific knowledge to the developing world.

NSF's Plant Genome Research Program (PGRP) can play a pivotal role by bringing together scientists from the U.S. and developing countries, and by developing long-term partnerships. The PGRP supports research on many of the crops grown in Africa as well as on plant traits that are important to agriculture in Africa.

Cereal crops grown in Africa include rice (African varieties) grown in Western Africa, wheat and barley in Northern Africa, Maize in sub-Saharan Africa, sorghum which originated in Africa, and millet in the Sahelian Zone of Africa. In addition to grains for food, Africans utilize straws (stalks) of cereal plants for animal feed, building materials or fuels. Food legumes grown in Africa include chickpea, cowpea, beans, lentil, pigeonpea and soybean: Oil crops include coconut and groundnut. Other important crops grown in Africa are coffee, spices, cassava, potato, sweet potato, yam, banana and plantain.

NSF also supports plant biotechnology research that holds significant promise to improve food security and foster sustainable agriculture in Africa. Examples include: the interactions between Striga (the number one weed pest in Africa) and host plants; tolerance to environmental stresses such as drought and salinity; insect resistance; and resistance to fungal and viral diseases.

Research supported under the PGRP can contribute to identifying valuable genetic resources in native germplasm and marker-assisted breeding of African crops. More importantly, new and unexpected ways to improve plants or to use native plants will occur over time.

Clearly, the NSF-supported researchers are poised to work with scientists in developing countries to collaborate on translational plant genomics, which will contribute to sustainable food security in developing countries.

Revolutionary advances in plant genomics can accelerate the process of knowledge transfer for the benefit of developing countries. A genomic-based revolution in world agriculture, equaling the success of the Green Revolution that doubled the yield of cereal crops, is a real possibility, and could help alleviate the suffering of millions of people.

Concluding Remarks

Mr. Chairman, NSF's ongoing efforts in these areas are consistent with the recommendations contained in the National Science Board's 2001 report, *"Toward a More Effective Role for the U.S. Government in International Science and Engineering"* which observed that:

> ". . .NSF can contribute significantly to the improvement of scientific capabilities in a number of developing countries through its support of global- and regional-scale research, and by promoting increased interaction among U.S. scientists and engineers and those in developing countries."

The Board went on to recommend that:

> "NSF should take a more active role in facilitating cooperation in international S&E and higher education. It should work closely with other federal technical agencies and multilateral scientific organizations that have S&E interests in the developing countries, and with domestic and international development assistance organizations in seeking out opportunities, identifying goals and targets, and developing cooperative projects in partnerships."

NSF and the NSF-supported research community are poised to expand our work with scientists in developing countries in realizing the potential of plant genomics to its fullest on a global scale. We are excited to participate in this extremely important endeavor and will bring our resources to bear. We are already working with

our sister agencies through the established and successful National Plant Genome Initiative. I would like to close by again quoting Dr. Borlaug:

> "It took some 10,000 years to expand food production to the current level of about five billion gross tons per year. Within 25–30 years, we will have to nearly double current production again. This cannot be done unless farmers across the world have access to current high-yielding crop-production methods as well as new biotechnological breakthroughs that can increase the yields, dependability and nutritional quality of our basic food crops."

Thank you Mr. Chairman for this opportunity to testify, and for your continued strong support of NSF. I would be happy to respond to any questions you might have.

BIOGRAPHY FOR DR. RITA ROSSI COLWELL

Dr. Rita R. Colwell became the 11th Director of the National Science Foundation on August 4, 1998. Since taking office, Dr. Colwell has spearheaded the agency's emphases in K–12 science and mathematics education, graduate science and engineering education/training and the increased participation of women and minorities in science and engineering.

Her policy approach has enabled the agency to strengthen its core activities, as well as establish support for major initiatives, including Nanotechnology, Biocomplexity, Information Technology, Social, Behavioral and Economic Sciences and the 21st Century Workforce. In her capacity as NSF Director, she serves as Co-chair of the Committee on Science of the National Science and Technology Council.

Before coming to NSF, Dr. Colwell was President of the University of Maryland Biotechnology Institute, 1991–1998, and she remains Professor of Microbiology and Biotechnology (on leave) at the University Maryland. She was also a member of the National Science Board (NSF's governing body) from 1984 to 1990.

Dr. Colwell has held many advisory positions in the U.S. Government, non-profit science policy organizations, and private foundations, as well as in the international scientific research community. She is a nationally respected scientist and educator, and has authored or co-authored 16 books and more than 600 scientific publications. She produced the award-winning film, *Invisible Seas,* and has served on editorial boards of numerous scientific journals.

She is the recipient of numerous awards, including the Medal of Distinction from Columbia University, the Gold Medal of Charles University, Prague, and the University of California, Los Angeles, and the Alumna Summa Laude Dignata from the University of Washington, Seattle.

Dr. Colwell has also been awarded 26 honorary degrees from institutions of higher education, including her Alma Mater, Purdue University. Dr. Colwell is an honorary member of the microbiological societies of the UK, France, Israel, Bangladesh, and the U.S. and has held several honorary professorships, including the University of Queensland, Australia. A geological site in Antarctica, Colwell Massif, has been named in recognition of her work in the polar regions.

Dr. Colwell has previously served as Chairman of the Board of Governors of the American Academy of Microbiology and also as President of the American Association for the Advancement of Science, the Washington Academy of Sciences, the American Society for Microbiology, the Sigma Xi National Science Honorary Society, and the International Union of Microbiological Societies. Dr. Colwell is a member of the National Academy of Sciences.

Born in Beverly, Massachusetts, Dr. Colwell holds a B.S. in Bacteriology and an M.S. in Genetics, from Purdue University, and a Ph.D. in Oceanography from the University of Washington.

Chairman SMITH. Thank you, Madam Director. Mr. Administrator.

STATEMENT OF ANDREW S. NATSIOS, ADMINISTRATOR, U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

Mr. NATSIOS. Thank you very much, Congressman Smith and members of the Committee. I want to thank you for inviting us today to testify on this extraordinarily important subject, a subject that I am deeply concerned about. I am an Africanist. While I have responsibility for the whole world, developing world, I spent a good

deal of my time in Africa, and so I am very familiar with the statistics that Congresswoman Johnson from Texas mentioned earlier, that ⅓ of Africans are chronically food insecure.

The only way we can change this bleak situation in Africa is to invest more in agricultural development. Beginning in 1987, we began cutting our agriculture budget in AID. We had a budget of $1.3 billion in 1986. When I arrived in AID in 2002—I am sorry, 2001—our budget had declined to $243 million. So there was a $1 billion cut in agricultural development in AID over that period of time. And the whole constituency had deteriorated for agriculture, but there has been a terrible consequence for that, and that is that the only area of the world in which productivity is declining in agricultural production is Africa. The only way we are going to reverse this bleak situation is: (1) To put more money into agricultural development; (2) To invest some of that in biotechnology and biotechnology research in Africa to develop seed varieties appropriate to the agriclimatic conditions in Africa.

Biotechnology is not going to solve all of the problems because poverty and hunger are a complex phenomena, but biotechnology can be an important part of a broader solution to increase productivity. Seventy percent of Africans depend on agriculture for their livelihood, 70 percent. And that is true, actually, worldwide, 70 percent of the poorest people in the world live in rural areas and they are farmers and herders. If we do not invest in agricultural development, we will not deal with the problem of global poverty.

Let me just give you four statistics that are very disturbing. Yields of basic food grains in Africa per hectare are 1/5 of those in China, 1/5. Fertilizer use in Africa is eight kilograms per hectare, 8. In Latin America it is 60 kilograms per hectare, in Asia it is 100 kilograms per hectare. Only four percent of Africa's farmland is irrigated, while in the Middle East it is 29 percent and in Asia it is 34 percent. The Green Revolution has only begun to touch Africa in the last decade. In Asia and Latin America, between 60 and 80 percent of the crop area is planted with modern improved varieties of different, either fruits or vegetables or grains. In Africa, the percentage is only 20 to 30 percent. The results are stark. Per capita agricultural activity has declined over the last four decades where everywhere else in the world it has increased.

New research published last month in Science Magazine has shown that the Green Revolution is finally reaching Africa, and it is interestingly enough in the three countries in Africa we put a lot of money in agricultural production: Angola, Mozambique, and Uganda. That is where the biggest productivity increases have been shown based on improved seed technologies. We believe that if this Green Revolution can be accelerated, it can address the problem of chronic malnutrition and food insecurity.

I want to go through some of the charges made against biotechnology by some of the groups that have been leading the charge against it, particularly, in Europe. The first argument is that biotechnology in Africa is taking investment away from other interventions. In fact, we are only spending about $25 million on biotech out of our $300 million agriculture budget. We would like to increase that and we intend to over time as the research capacity improves. But biotechnology, if you talk to African scientists, African

agriculture ministers, they believe this, in fact, holds one of the many solutions they need to catch up.

The second is that accepting biotechnology crops will make African farmers dependent on multinational companies, and this is sort of part of the anti-globalization hysteria that we hear, that we have seen in some of the multilateral institution meetings. Well, we are actually working right now with African universities and national research programs to develop African solutions to African problems. I opened in January of last year a new biotechnology research center at the Ministry of Agriculture in Egypt that was jointly financed by the Egyptian Government and by USAID, the U.S. Government, and the State Department. The Minister of Agriculture was close to tears. He had been trying for 20 years—he is an agricultural scientist—to get this center open. Finally, his dream was achieved and they are now beginning to develop varieties that would be appropriate for the agriclimatic soil conditions of Egypt.

So we have begun this process already. We have also invested heavily in the capacity of South-African universities to develop material, genetic material, that is appropriate for South African and other African climates. Farmers in Africa will be their own judge of what is commercially viable for them in terms of biotech seeds. If it gives them a good return, they are going to buy it; if it doesn't, it is not going to. And if we start developing seed varieties that are in the public domain, which, in fact, is what we are doing in many of these countries, it is not a matter of multinational corporations. So this is really an illusion and I think it is a rhetorical excess to argue that multi-nationalism in terms of the international economy is going to somehow make Africa dependent. Latin American countries like Argentina, Asian countries like India and China, are already investing in this, and the Philippines, for example, another country that is investing in this technology now.

The third argument is that biotechnology derived crops will adversely affect the environment in Africa. In science, there is no such thing as no risk with any new crop variety or any new technology. The question, of course, is an economist's and a scientist's question, what is the alternative? If the alternative is improved varieties or hybrids, there are risks with those as well. The question is, if we take the view that all improvements in technology and science cause unacceptable risks, then we will never make any scientific progress, and we, in fact, will not address the major agricultural and nutritional problems facing the continent.

Canada, Argentina, the U.S., the Philippines, India, and South Africa have all shown that risks can be safely managed and effective. There is a wonderful book by IFPRI [International Food Policy Research Institute], which is a think tank on food security that is a subsidiary of the UN. It was run until recently by a Danish scientist, Per Pinstrup-Andersen, a good friend of mine, and he wrote a wonderful book with another Danish colleague. I point this out because they are Europeans, let me just say, not Americans. They wrote a wonderful book called Seeds of Contention about biotechnology, and they go through the empirical evidence and the research, and they conclude, one, Africans and other third world countries need to make their own decisions. Obviously, all of us

agree with that. But the evidence is overwhelming that this is an option that will help in many countries to deal with these problems.

In China, we know that when biotech cotton was introduced, farmers no longer had to buy atropine. You know what atropine is for. For people who get poisoned, atropine is a way of preventing the person from dying. Literally, Chinese farmers, when they bought their pesticides, had to buy atropine because their kids would get poisoned with it. They are savings hundreds, if not thousands, of their own farmers lives now by not having to use pesticide anymore when they are growing their cotton crop; that is saving peoples' lives, and we have had Chinese farmers and scientists publicly testify at international meetings on this.

This is the next charge, growing biotechnology derived crops will harm export of agricultural products to Europe. This is the thing that is most disturbing to me. When we had one of the most serious droughts in southern Africa in a very long time, during the Johannesburg summit, some groups began arguing—they were not African groups, I might add—that this was dangerous to accept food aid from the United States because our corn crop, one-third of our corn crop, is biotech corn, and it has been for seven years. I went on TV all over Africa and said the President eats it, all of our Members of Congress eat it when they eat cereals, and the reality is that there hasn't been any health problems, there haven't been any lawsuits, and we are a litigious society, and it is in our food system. And frankly, you have been eating it for seven years because you have been getting food aid from us. I find it curious that this issue was brought up after seven years of that food being distributed, and everybody knew in senior ministries that we had biotech corn in the United States and that was part of our food basket we provided food aid. They decided to bring it up in the middle of this conference, in the middle of a terrible food emergency facing 25 million people.

Now, what was spread around Africa during that crisis is this. In one country, a science and technology minister who supported biotech privately told me in the Muslim areas of this country, the rumors are being spread by these groups that we had put pig genes into corn and that the corn we were providing in food aid had pigs in it, which, of course, is sacrosanct in terms of Islamic teaching. I said, none of our 52, or whatever it is, corn varieties—I think seven of which we actually have in our agricultural system—have any animal genes, let alone pig genes. I have never heard of a pig gene being in any of our research and certainly isn't in corn. Who told you this? And he said, these groups are spreading this in the Muslim areas to create a hysteria.

The second rumor, this is in another country that exports vegetables, grains—not grains—vegetables, fruits, and nuts to Europe, but no grains. Europe is not going to import corn from Africa. They grow their own corn. They don't need corn from Africa. What they do need are various fruits, and vegetables, and nuts. They were told—the scientists were ignored in the ministries—these groups are spreading rumors around that if you plant the food aid that starving people would be getting—by the way, I have never seen, and I have done famine work all over the earth—people who are

hungry do not take food aid and plant it as seed. Do you know why? Because they are worried they are not going to survive until the next harvest. They are not going to plant it for food aid. We give them seed separately to plant and it is usually from local varieties or improved varieties. They don't use food aid for seed purposes, but they were told if you plant it, the corn will cross pollinate with your tomatoes, and your nuts, and your coffee, and your tea, and none of us in Europe will import it because of the damage it is going to do to your agricultural system.

Well, I said, I am not a scientist, but our scientists tell me you cannot cross match through open pollination a corn that is planted, even though it is unlikely that would happen, with another variety. You can do it with another variety; you can't do it with fruits, or vegetables, or corn. It is just scientifically not going to happen. But once again, these rumors are being spread around. So most of this stuff, this material, this information that is being spread around, is deliberately designed to cause panic. So let me just—the final comment is that we are dumping surplus food that we won't eat ourselves. That is the argument I heard of our food aid in the developing world, because Americans won't eat it. That is complete nonsense. We all know that is nonsense, and I mentioned this argument repeatedly because of how fraudulent it is. We are not dumping anything, in fact. We buy the same food in the same markets in the same areas of the middle west for our food aid as the food we all eat on our breakfast table.

So finally, I just want to say, we have a great opportunity to reverse this by public education, to push these groups aside that are misleading people so much. It is very troubling that this is happening. It is an enormous opportunity. I will, in the questions and answers, go into what we are doing and what we are investing in now, but my time has run out. Thank you, Mr. Chairman.

[The prepared statement of Mr. Natsios follows:]

PREPARED STATEMENT OF ANDREW S. NATSIOS

Chairman Smith and Members of the Committee, I am pleased to participate in this important discussion today on biotechnology research and development in Africa.

The African Challenge

Hunger and poverty are widespread problems on the African continent. In sub-Saharan Africa, one-third of the population, almost 200 million people, are food insecure—lacking enough food to lead healthy productive lives. Half of the population in this region, about 300 million people, lives on less that $1 per day. If current trends continue, by 2010 Africa would account for nearly two-thirds of the undernourished people in the world. This vicious cycle of hunger and poverty must be broken.

Agriculture offers the means to reverse the trends and stimulate wider economic growth. Seventy percent of the people in sub-Saharan African live in rural areas and are dependent on agriculture for their livelihoods. But in almost every crucial measure, African agriculture is lagging:

- Globally, Africa suffers from the lowest productivity of staple food crops. Yields of basic food grains in Africa are one-fifth those of China.
- Fertilizer use in Africa is 8 kilograms per hectare; in Latin America it is over 60 kilograms per hectare, and in Asia, over 100 kilograms per hectare.
- Only 4 percent of Africa's farmland is irrigated; in the Middle East and Asia, the figures are 29 percent and 34 percent, respectively.
- The Green Revolution has only begun to touch Africa in the last decade. In Asia and Latin America, between 60 percent and 80 percent of crop area is

planted with modern varieties; in Africa, the figure is in the 20 to 30 percent range.

The results are stark: While per capita agricultural productivity rose sharply in the last forty years in Asia and Latin America, it actually declined in Africa. There is less food per person now than at the time of independence, and in some countries, there is much less. You see the results in the headlines—hunger, famine, poverty, disease, and the social and political upheaval that accompany them.

But there is hope. Last month's issue of the journal Science carried an article by Professor Robert Evenson of Yale University showing that, in the last decade, improved crop varieties are finally reaching African farmers. Progress has been slow because of the harsh physical environment and the many crop pests and diseases in Africa. We need to foster this new trend to increase productivity at the farm level so that agriculture becomes an engine of growth and prosperity in Africa. If this is done well, Africa will eventually be able to feed its people.

The scientific resource base in Africa has suffered from years of under-investment. We need to invest in science to increase productivity in the basic food crops of Africa—corn, cassava, cowpeas, bananas, and rice. New tools in agriculture, such as the application of modern biotechnology, need to be brought to bear to address Africa's agricultural problems. Biotechnology alone cannot solve the complex problems of poverty and hunger; it is not a "silver bullet."

But it is a critical part of the solution, and cannot be ignored. Why? Analysis from the International Food Policy Research Institute (IFPRI) shows that by 2020, between 6 and 16 million more African children will be malnourished if we do not turn the situation around. What does this mean? Sadly, it means that if we do not act, poverty, disease and death will increase in Africa. The World Health Organization tells us that 56 percent of all child mortality is due to underlying malnutrition that makes children vulnerable to disease and infection.

But, if we can increase annual crop productivity growth from 1.5 percent to 2.5 percent, the opposite happens. In that case, 11 million fewer children will be hungry, and millions less will die young from diarrhea, malaria and other diseases. Knowing this, can anyone in good conscience say that we should close off a whole new area of science that can help us reach these and greater goals?

Unfortunately, some outside groups have actively spread misinformation about biotechnology, trying to sow confusion and fear. I would like to take a few minutes to describe to you some of the falsehoods that have been spread by those who for unfathomable reasons want to prevent the benefits of modern science from helping some of the world's poorest farmers.

Frequent Criticisms Leveled at Biotechnology

Charge: Biotechnology is not what Africa needs, and investment in it is taking away from other interventions.

In the wake of the International Food Policy Research Institute studies, it is patently untrue to assert that Africa does not need biotechnology. Africa needs agricultural growth, and economic studies tell us that accelerated productivity growth due to biotechnology will be crucial to reducing hunger and poverty. It is not true to say that biotechnology takes away from our other investments; biotechnology complements and enhances those investments. What is true is that other donors should be doing far more, but because of political constraints, they under-invest in biotechnology.

Charge: Accepting biotechnology crops will make African farmers dependent on multinational companies.

USAID is working with African universities and national research programs to develop African solutions to Africa's problems. In some cases, they may choose to work with international partners as a means of accessing important new technologies. Local companies may do the same thing. These alliances are happening in Africa, India and elsewhere. Farmers in Africa will be able to decide for themselves whether biotech crops are in their economic interest. If biotech seeds give them a good return, then and only then will they decide to purchase the seeds.

Charge: Biotechnology-derived crops will adversely affect the environment in Africa.

In science, there is no such thing as "no risk" with any new crop variety of any other technology. But all experience to date, here in the United States, Canada, Argentina, the Philippines, India and South Africa, shows that potential risks can be managed in safe and effective ways. The safety of biotech-derived crops needs to be examined by applying science-based biosafety policies. USAID supports capacity

building in public institutions in Africa so that they can operate good, effective regulatory systems. USAID is working with African partners to understand and manage potential environmental issues such as gene flow, for example.

While not downplaying risk, we also need to consider the environmental and health benefits of biotechnology, for example, in reducing use of dangerous pesticides. The *New York Times* has reported that, in China, farmers who have adopted biotech cotton no longer need to purchase atropine for themselves and their children. Their children were literally being poisoned by pesticides. Now they can enjoy a safer and cleaner environment.

Charge: Growing biotechnology-derived crops will harm export of agricultural products to Europe.

There is no question that the lack of a functional, science-based regulatory system and the irrational fear of biotechnology in the European Union have affected development of biotechnology products in Africa. The reality is that most biotechnology applications for small-holder, food-insecure farmers in Africa are not likely to affect commodities exported to Europe. Unfortunately, misinformation has added to these concerns that somehow biotech genes will cross from one species to another, from corn to fruit trees, or equally wild assertions.

Charge: U.S. food aid containing biotech crops is a tool to dump unwanted grain and force Africans into accepting biotechnology.

U.S. food aid makes the difference between life and death for millions of people in Africa. Despite this, rumors have been spread that pig genes are being cloned in crops destined for countries with large Muslim populations. Even African senior government officials have shared these concerns with me. The truth is that U.S. food aid is made up of the same safe food we consume here and export to Canada, Japan and dozens of other countries that purchase it. Furthermore, the food is intended for consumption and would be poorly adapted and of little interest to farmers if planted under Africa's environments.

Potential of Biotechnology in realizing Agricultural Productivity in Africa

Africa presents the highest potential for realizing major benefits from biotechnology precisely because it lags behind the rest of the world in using agricultural inputs. Low yields due to pests, diseases, drought and even poor soils can be boosted by application of readily available tools of biotechnology, and bring significant economic benefits to small-scale farmers.

This has been demonstrated to be the case in the adoption of biotechnology-derived corn and cotton among small-holder farmers in South Africa, the only country to adopt these crops in Africa. In the Makatini Flats in South Africa, seventy percent of the cotton grown is "Bt cotton," containing a pest-resistant gene derived from the bacterium *Bacillus thuringiensis* (Bt). Small-scale cotton farmers in this region, primarily women, typically farming just a few acres, have captured significant economic benefits due to increased yields, decreased pesticide usage and overall saving in farm labor. Yield increases have been greater than 30 percent. These increases combined with decreased input and labor costs have resulted in income increases of approximately 30 percent. Similarly, farmers growing insect-resistant yellow and white corn in South Africa are starting to see increased economic benefits, and the acreage of these biotechnology derived crops is rising.

To realize the potential of biotechnology we will need to foster international partnerships to enable African scientists to apply biotechnology in the near term, while building their human and institutional capacity in the longer term. Some African political leaders recognize the role of science and technology in improving African agriculture. President Obasanjo of Nigeria has publicly endorsed biotechnology and criticized the efforts of those seeking to prevent its benefit from coming to Africa. South Africa has moved even farther forward, approving new crop varieties just recently. It is encouraging to see Africa's two largest economies embracing these new technologies. We can hope their example is emulated elsewhere.

USAID's Biotechnology Effort

USAID has been, and continues to be, a leader in taking on these challenges to ensure that Africa is part of this new scientific revolution. In the last three years, we have more than tripled our support for biotechnology through the launching of the Collaborative Agricultural Biotechnology Initiative (CABIO).

The CABIO Initiative is one component of our overall agricultural strategy for stimulating economic growth and food security in developing countries. It brings to bear the tools of modern biotechnology to increase agricultural productivity and improve environmental sustainability and nutrition. We conduct research and analysis

to develop technology and policy, we build human and institutional capacity, and we broadly engage our partner countries in every aspect of the program. The CABIO Initiative builds upon USAID's 12 years of experience in biotechnology, carrying forward lessons learned while adapting to changes in the economic and regulatory realities.

In Africa, the activities of the CABIO Initiative are directly linked to President Bush's Initiative to End Hunger in Africa (IEHA). This initiative calls for a partnership with African leaders and governments to work together to invest in a smallholder-oriented agricultural growth strategy. Science and technology, including our support for biotechnology, is one of the two major thrusts of IEHA, with markets and trade being the other.

USAID's biotechnology approach in Africa has two goals:

- to link Africans to the international research community to develop biotechnology for the benefit of small African farmers; and
- to build African leadership and decision-making, vis-à-vis using biotechnology domestically, to ensure that Africa drives its own future.

To achieve these goals USAID has supported a number of important African organizations to develop strategies in biotechnology in leading countries like Kenya, Uganda, Nigeria, and South Africa. We also support networks of agricultural research institutions that can expand the impact of research beyond one country. These include the sub-regional organizations, Association for Strengthening Research in East and Central Africa, and the West and Central African Council for Agricultural Research and Development. USAID is also supporting the Forum for Agricultural Research in Africa (FARA), an emerging voice for African agriculture, which is linked to the implementation of the African-led New Partnership for African Development (NEPAD).

Partnerships and Alliances

As we move forward in realizing the potential of this technology for Africa, we recognize that we will have greater impact through strategic partnerships and alliances between our development resources and with those engaged in the cutting-edge science. Our key partners in this effort are public and private sector institutions, in the United States, in African countries and international organizations.

U.S. universities and industry lead the world in biotechnology research. USAID is partnering with these institutions to develop crops resistant to diseases and pests. A number of U.S. universities partner with USAID in developing technologies to address agricultural constraints in Africa and in policy development and outreach activities in biotechnology. These include Cornell University, University of California at Davis, Tuskegee University, Michigan State University, and Purdue University. We also work closely with centers of excellence, the Danforth Plant Science Center in St. Louis being a prime example.

Since the earliest programs in Africa, the Agency has leveraged the tremendous investments and technical expertise of the private sector through partnerships aimed at developing technology for small farmers. Beginning with a partnership with Monsanto Company to develop virus-resistant sweet potatoes for Kenya in 1990, we have continued engagement with the private sector. We have an on-going partnership with Syngenta Company to develop insect-resistant potatoes for Africa.

Biotechnology also opens up new avenues to fight old problems. The World Health Organization tells us that between 100 million and 140 million children in the developing world suffer from vitamin A deficiency. Each year, between one-quarter and one-half million of these children go blind, and many more die as a result of greater susceptibility to infection. In a partnership involving Monsanto Company, Iowa State University, the University of Illinois, and two Consultative Group for International Agricultural Research (CGIAR) centers, USAID is supporting the development of vitamin A enhanced corn for Africa. In India, we are developing vitamin A mustard oil. It will also have potential to save lives in some parts of Africa.

It is clear that projects such as these require the best science available. USAID is, of course, first and foremost a development agency. Although we are expanding our scientific staff and capabilities, we recognize that to capture the cutting edge of science, for example, to use crop genomics to produce more drought tolerant varieties, we will need to partner with the scientific resources of agencies such as the U.S. Department of Agriculture and the National Science Foundation. Similarly, the private sector is a major source of cutting-edge technology. We have found that those in the private sector are more than ready to see their skills applied to the needs of poor people. All of these alliances can lead to breakthroughs that can ultimately benefit farmers here at home, as well as in Africa and the rest of the developing world.

We are also partnering with others outside the U.S. Government, such as the international agricultural research centers (IARCs) sponsored by the Consultative Group on International Agricultural Research. These centers provide a vital link in our efforts to integrate biotechnology into programs to develop improved, higher-yielding and more stress-tolerant crop varieties. Some of the technologies we are supporting include virus-resistant cassava, fungal-resistant bananas, "golden maize," drought-tolerant wheat, insect-resistant cowpea, and many others. The CGAIR centers serve as a bridge between universities and other advanced institutions in the United States and international nongovernmental organizations and other partners working with millions of farm families in Africa and elsewhere in the developing world. Increasingly, USAID is designing its investments to strengthen linkages between our U.S. partners and the research and development programs of the CGAIR centers, increasing the effectiveness of all partners in applying science and also in making sure that innovative technologies reach the farmer.

We are also working closely with the Rockefeller Foundation to establish the African Agricultural Technology Foundation (AATF). The Foundation is a new and unique public-private partnership designed to assist small-holder farmers in Africa to gain access to existing agricultural technologies, including biotechnology, with the goal of relieving food insecurity and alleviating poverty. USAID contributes $500,000 a year of core support to the AATF. AATF complements and links with additional USAID funding through our African partners. I am sure Gordon Conway will discuss the AATF in more detail.

Summary and Conclusions

I would like to conclude by underscoring the importance of African leadership and partnerships with African countries and institutions. The region faces the greatest needs, and provides a compelling case for harnessing all tools in the fight against hunger and poverty. These are not just biotechnology tools, but they include biotechnology, and these tools can help us realize a new Africa where food security and prosperity predominate, and where hunger and famine are things of the past.

USAID's programs in biotechnology reinforce the ability of Africans to make their own decisions. Everything we do in biotechnology is done collaboratively—from problem identification and priority setting to aiding the development of policies designed to establish risk assessment programs and protect intellectual property. Our programs are demand-driven. Our African partners want and need the strategic uses of biotechnology in agricultural research and development. USAID is committed, with your help and support, to ensuring that the scientific revolution in agriculture bypasses no one, least of all poor farm families in Africa.

A small farmer in South Africa is already living this vision of Africa. On his 10 acres, T.J. Buthelezi grows biotech cotton and gets four times the yield he used to. For the first time, he says, "I'm making money!" He and his wife have been able to decide how to spend and invest their newfound income, instead of struggling just at the subsistence level. His example is not unique. Farmers are finding that biotech crops can give them money for school fees, medicines and other necessities that just a few years ago were luxuries.

I am glad to tell you that this hopeful outlook is Africa's own vision. Two weeks ago, the Forum on Agricultural Research in Africa, charged with the agenda of the New Program for Africa's Development, or NEPAD, held a meeting in Dakar. I would like to read you one of the six priorities that are contained in the Dakar Declaration:

> *" [the participants]. . .declare their commitment to. . .building Africa's human and physical capability in biotechnology to be able to engage with global public and private sector partners to capture the advances needed to sustainably intensify African agriculture.. . ."*

That need is urgent. This year the Horn of Africa is in the middle of a serious food security crisis caused, in part, by drought and low agricultural productivity. The United States alone has provided more than $350 million of food aid to address urgent food needs in the region. In order to break the cycle of crisis in the Horn of Africa and other vulnerable regions around the world, donors must make available and countries must utilize all resources, including biotechnology, to improve their ability to meet their food needs. Through biotechnology, improved drought and pest resistant seeds have been developed that mitigate the effects of adverse weather and insects on food production. Through U.S. leadership in investments in science and technology, the international community can help Africa strengthen its agriculture and ensure that the specter of famine is someday just a memory.

USAID is ready and eager to work with your committee, with others in Congress, and within the Executive Branch in making our common vision, shared between the

United States and Africa, of an Africa without starvation and famine, a reality in our lifetime.

Thank you.

BIOGRAPHY FOR ANDREW S. NATSIOS

Andrew S. Natsios was sworn in on May 1, 2001, as Administrator of the U.S. Agency for International Development (USAID). For more than 40 years, USAID has been the lead U.S. government agency providing economic and humanitarian assistance to transitioning and developing countries.

President Bush has also appointed him Special Coordinator for International Disaster Assistance and Special Humanitarian Coordinator for the Sudan.

Natsios has served previously at USAID, first as director of the Office of Foreign Disaster Assistance from 1989 to 1991 and then as assistant administrator for the Bureau for Food and Humanitarian Assistance (now the Bureau of Democracy, Conflict and Humanitarian Assistance) from 1991 to January 1993.

Before assuming his new position, Natsios was Chairman and Chief Executive Officer of the Massachusetts Turnpike Authority from April 2000 to March 2001, and had responsibility for managing the Big Dig, the largest public works project in U.S. history. Before that, he was Secretary for Administration and Finance for the Commonwealth of Massachusetts from March 1999 to April 2000. From 1993 to 1998, Natsios was Vice President of World Vision U.S. From 1987 to 1989, he was Executive Director of the Northeast Public Power Association in Milford, Massachusetts.

Natsios served in the Massachusetts House of Representatives from 1975 to 1987 and was named legislator of the year by the Massachusetts Municipal Association (1978), the Massachusetts Association of School Committees (1986), and Citizens for Limited Taxation (1986). He also was Chairman of the Massachusetts Republican State Committee for seven years.

Natsios is a graduate of Georgetown University and Harvard University's Kennedy School of Government where he received a Master's degree in public administration.

Natsios is the author of numerous articles on foreign policy and humanitarian emergencies, as well as the author of two books: *U.S. Foreign Policy and the Four Horsemen of the Apocalypse* (Center for Strategic and International Studies, 1997), and *The Great North Korean Famine* (U.S. Institute of Peace, 2001).

After serving 23 years in the U.S. Army Reserves, Natsios retired in 1995 with the rank of Lieutenant Colonel. He is a veteran of the Gulf War.

A native of Holliston, Massachusetts, Natsios and his wife, Elizabeth, have three children, Emily, Alexander, and Philip.

DISCUSSION

Chairman SMITH. That was part of my concern, Administrator. In going around to different countries over the last eight years, asking our people in the State Department, asking our people, our agriculture attaches even, the USAID people, the people in Commerce at the different embassies around the world, do you know why—what the requirements are in the United States to help assure that these biotech products are going to be safe to people, to animals, and the environment, and my consternation was that they didn't know what the scientific evidence was. And so that is why we—I think we sent you a draft proposal of the bill, saying that we have—and what I put in the State Department authorization bill was that we need the kind of written, accurate, scientific information so that our American people around the world have better knowledge when they talk to the people in these other countries.

Mr. NATSIOS. We will support your amendment, Congressman.

Chairman SMITH. Good. Well, and I assume, Dr. Colwell, that the NSF would like to be part of this group if it is going to exist to coordinate, to cooperate, to make sure that that scientific, accurate, factual, scientific information is out there.

Dr. COLWELL. As a scientist, I couldn't do otherwise.

Chairman SMITH. Let me ask the question on trade that you mentioned, Dr. Natsios. Is the threat of trade restrictions of some of those products going to Europe part of the reason that is holding down research at the African universities?

Mr. NATSIOS. It is not holding down the research.

Chairman SMITH. The biotech research.

Mr. NATSIOS. It is affecting the farmers' use of the improved varieties of the biotech material. The scientists still want to get the research, and most of the heads of state, even the one country that actually banned it completely. By the way, that is the only country in Africa that has banned completely any biotech food aid from the United States. The perception was everybody was doing it. One country did it. Even Zimbabwe, and Dr. Mugabe is not one of my favorite people. He is destroying his country. But he banned it because of this cross pollination thing, even though it was inaccurate; not based on health requirements. And he didn't ban its use; he just required that it be milled before it was distributed. And even in the country that banned it, Zambia, they want the technical help to build up their capacity to do this research themselves. They asked for it when I met with the president of the country. He asked for it and we brought those scientists to the United States. The National Science Foundation has helped us, USDA has helped us, the EPA has helped us, in terms of taking scientists from Africa and economists around to show what our regulatory systems are, how careful we are about this, what our regimes are, how we do research. And we sent them up to Harvard, because a Kenyan scientist heads the biotech research center at Harvard University and is a big advocate of biotech research himself. He is an African scientist at Harvard. And it was very useful, but we need more of these.

Chairman SMITH. Dr. Colwell, can you be more definitive in terms of, for the record, what we put in the NSF bill in terms of the competitive merit based awards for partnerships that entered into a partnership that shall include one or more research institutions in one or more of the developing countries to have that? Has a request for proposals been sent out? Will universities start putting in proposals for this specific partnership with researchers in other countries to make sure that we move ahead on that section of the law?

Dr. COLWELL. We are working through the auspices of the NSTC and the working group on the plant genomes. We initiated discussions with USAID, the Department of Agriculture, the Department of Energy, to support these research collaborations.

Chairman SMITH. But this is partnerships with scientists, African scientists, in their particular country?

Dr. COLWELL. Yes.

Chairman SMITH. To try to develop products that are going to be most helpful for their countries?

Dr. COLWELL. Yes. We are funding already U.S. scientists who are partnering with African scientists. We are providing the training.

Chairman SMITH. Can you give me some examples?

Dr. COLWELL. Training, NSF awards have enabled African researchers to come to the U.S. for collaborative research and train-

ing, and we have been funding projects for African based equipment, scientists, and we have leveraged funds as well by providing funds that then can be matched in the country. So we are working very strongly.

Chairman SMITH. Well, just I hope you will review the language.

Dr. COLWELL. Sure.

Chairman SMITH. And I don't mean to be in a scolding nature or anything, but specifically, we wrote in that, institutions in those African countries that we would partnership with, so maybe review it. I just think it is so important that we work with those countries, with scientists in those countries, that are going to add to the credibility of the product that they develop and with the helpful assurance that it is going to be something that is going to help with their needs of more quantity of agricultural production or more quality in terms of health.

Dr. COLWELL. One area that I feel very strongly that we need to strengthen is the microbiological resource centers in the biotechnology centers that have been set up that are located in Kenya, and Uganda, and so forth. These, I think, already are doing biotechnology research, and I think can be enhanced and strengthened at the grassroots level. And I think that is very important to do.

Chairman SMITH. Well, we tried—and just to wrap it up—we tried to assure that—we said that some of the money that is being appropriated in Section 5 has to be used for this kind of partnership, so please review that.

Dr. COLWELL. I will indeed.

Chairman SMITH. Representative Honda.

Mr. HONDA. Thank you, Mr. Chairman. I appreciate you having this hearing and appreciate the testimony, also. For a long time, I have had interest in things that are not going on in Africa and our attention to that country, so I think it is very appropriate that we look at this. My question would be more in line with trying to analyze the resistance rather than trying to promote biotech. I mean, I am on it, I support it. One of the questions I have is all I heard so far about biotech is the production of corn and the deployment of corn in terms of biotech. Are you looking at plants and food stuffs that are native to Africa that people are more used to? Because when I was in the Peace Corps back in the 1960's, you know, one of the things I tried to show is that we can increase production tenfold if we use hybrid corn seeds. And we showed that we could increase the production, but they said, you know, you are right, we can, but do you know what? The corn tastes different, you know. So there are probably some biases within a culture and a country, but then I think there are some advantages of taking what it is that they understand and know and develop that, too.

And I guess the other question is, if we are trying to address the issue of famine by introducing biotech, is biotech the only factor that lends itself to famine, or is it the way land is used, is it the way ownership is done? Because with USAID, understand in different countries, you know, land ownership could be hierarchal and poor farmers are not the large landowners, so they may not be the one that does the export. So are there class differences and are there other social differences that we need to pay attention to as we move forward on biotech?

Dr. COLWELL. Your questions are extraordinarily perceptive, and indeed, the first question with respect to the varieties you are familiar with in a country, that is entirely important. That is to have African rice genetically engineered to be resistant to fungus and infection, and at the same time to be enriched with vitamin A to prevent blindness, those varieties in the country are the ones that should really be addressed. And I think that will also enhance acceptance, because as you say, it can be as simple as taste. It can be texture or whatever. But it is important and it is critical. So we are, in fact, focusing on the foods that are used in the country.

And I also find your comment and question about other applications of biotech. Plant biotech is important, but bioprocessing is also very important. And use of biotechnology for maintaining, let us say, treatment of soil and also for treatment of waste products, so that they can be reused and recycled is very, very important. So plant biotech is, of course, the subject of today's hearing, but it is but one of many opportunities and applications that can be made. So this is—to bring the technology, the tools, the methods, the fundamental research into the hands of the scientists and the agriculturists in the countries is clearly very, very important.

Mr. HONDA. Then to follow up with the Chairman's question about reading the bill, will the bill provide you the flexibility you need in order to create the process that you are describing? Because a lot of times bills will be very narrow and prescriptive.

Dr. COLWELL. May I respond to you in writing, because I want to be precise and I want to be very helpful. And rather than just answer off the cuff——

Mr. NATSIOS. If I could add, what we are doing in AID, we have already invested in research in 26 African food crops for basic research through biotechnology to deal with diseases and improved efficiency. Let me give you some examples. We are developing a vitamin A enhanced corn for Africa. Vitamin A, by the way, can reduce by 25 percent the death rate among children under 5 because it protects a child against infection. And vitamin A deficiency is a major problem that we face in countries that have a very limited food basket. In other words, they don't have a lot of variety in their food. They don't have vitamin A. We just introduced sweet potatoes into South Africa—I mean, Mozambique, because a vitamin A deficiency is killing so many children. Now, we will permanently get it into the agricultural system.

We are developing a cassava biotech variety in Nigeria, Ghana, Kenya, Danforth Center, a cowpea improvement project in Nigeria. Rinderpest, which is a major problem for cattle in Africa and Kenya, a papaya resistant—there is a papaya ringspot virus in the Lake Victoria region of Africa. We are doing that with USDA. The banana disease that you mentioned, Mr. Chairman, earlier is, in fact, we have invested in that research as well. So there are 26 of these different—they are insects, viruses, some of them are animal, some of them are plant, but they are all using biotechnology and they do this through a thing called the Collaborative Agricultural Biotechnology Initiative. We call it CABIO. It invests $15 million to $20 million a year in this sort of research through institutions where we match an American research facility with one in Africa or another country around these specific issues.

So we are focused specifically on exact diseases and local varieties. They have to be acceptable, because if people eat them and they don't like them, they are not going to use them and the farmers will never grow them. So we have a whole set of tests we go through, not just to solve a technical problem, but they have to sell the taste test and everything else. We are also working with a number of foundations like the Rockefeller Foundation. Gordon Conway is one of the leading experts in the world on this, and we have been very close to Rockefeller, actually, since the Green Revolution. The Green Revolution was the World Bank, the Rockefeller Foundation, and the USAID with Norman Borlaug 35 years ago that helped create this Green Revolution. We believe by the use of this technology and other reforms in the markets that we can deal with the problem of famine in Africa.

One of the reasons that we face famine in Africa, only one, is, in fact, drought. A South African scientist is now taking a gene from what they call a de minimis plant. It is a plant that needs almost no water. They are taking the gene and they are going to cross match it, cross breed it, with a maize variety, a corn variety, that will be extremely drought resistant. And if we can get that variety to be acceptable to people and to do what it needs to do, we may solve one of the ongoing problems in Africa that famine is driven by, and that is drought. It doesn't solve all the problems. You have to deal with markets, you have to deal with infrastructure, you have to deal with predatory governments like the Zimbabwe Government, but drought is one of the major factors, and we can deal with this, we believe, through this research, and we are supporting this research.

Chairman SMITH. Mr. Atkin indicated that he doesn't have any questions at this time, so I would call on Representative Lofgren.

Ms. LOFGREN. Thank you. And Mr. Chairman, I think this is a very important hearing, and I appreciate the fact that we are having it. Thinking about what is going on in famine and the lack of uptake of the technology in Africa leads me to think about the EU. And in some ways, I think it is so shocking and really scandalous that people in Europe who have so much would take the actions they have done to disadvantage the poorest people on the planet, really, who live on the continent of Africa. I just think it is outrageous. So I am thinking what you are doing is important. It is good, it is thoughtful, but if we don't actually deal with Europe, we are facing barriers to actually achieving a goal that is so decent and good.

And I am wondering if you have given any thought to how we might not only deal with the governments of Europe, but with some of the interest groups that are behaving in this shockingly bad way, how we might influence that.

Dr. COLWELL. Well, there is a certain irony in that NSF participates in a direct partnership with the European community in a biotechnology initiative which has been ongoing for several years, maybe as long as 10 years, and a lot of the research is going on there. So there is a very dramatic irony in the situation. It is really a consumer issue. It is not a science question with respect to not accepting the biotechnology products. And I would say that, as a scientist, I believe that if the African Government leaders, and

some have spoken out very strongly, and the individual African consumers can see the direct tangible benefits, I think they will embrace the technology.

Mr. NATSIOS. Let me just add, most of the development ministers in Europe are very good friends of mine, and I would say at least half the development agencies, the USAID's of Europe, strongly support biotech research and use of biotech seed in the developing world as one of the many things we need to do to deal with this problem of hunger and of drought and famine. And they actually invested money in it, but there is a hysteria that has been whipped up and many of them are on the defensive now as a result of their support for this, and we talk about how to deal with this. Tony Blair realizes it is damaging British agriculture to have this kind of hysteria. Part of it is this animal disease that devastated their animal herds in Europe. That, apparently, is one of the things that some of these advocacy groups have played on, in terms of public fears, to turn around public opinion on this subject.

The European Union actually, privately, had already approved I think five of our corn varieties before this became a big controversy, and we were exporting the corn to Europe, and they already take our soybeans now. And I think 70 or 80 percent of our soybean crop is biotech. They are using it in Europe now. I might also add that three or four percent of the corn crop in France is already biotech, and I am told that German scientists are now developing biotech grapes for the vineyards in Germany. So the scientists are okay and most of the political leaders I deal with are okay and understand this. The problem is there is a divide between public opinion because of what happened with these animal diseases and the political leadership.

Blair is having a series of town meetings across Britain because he thinks it is hurting the long-term economic interests of British agriculture to have this hysteria against it. A lot of research is going on, but what is happening also now is because of the hysteria, the research has slowed down and the seeds are not being used in the agricultural system and they are behind us. So you are having a marrying of some extremist advocacy groups with agricultural interests who want this, but because they are far behind us, are very worried that we are going to take over their markets because we are doing this so much better than they are. Having those two interests married at the same time is not in anyone's interest, but it has happened. So they are facing a very difficult situation now, and unfortunately, it is getting worse and worse.

Ms. LOFGREN. I don't know if you are able to do this, but can you identify kind of the sector where this hysteria is originating in the EU?

Mr. NATSIOS. I would rather not do it publicly at this meeting, because I have to deal with these people, and some of them will get upset. If I tell you which development ministers are probiotech, they may get removed.

Ms. LOFGREN. No, I don't mean that. Actually, I am not being clear with my question. There are private groups, I presume, and this isn't just necessarily emanating from governments, that are spreading rumors in Africa, of distributing lies that actually are re-

sulting in the starvation of young children. I would like to know who those people are.

Mr. NATSIOS. I will tell you what the groups are later. I, actually, made a public statement at—they demanded my resignation. I said it publicly who the groups are at the Johannesburg conference. They demanded my resignation, they have issued long, some of them personal, attacks on me, on USAID, and some of these groups, full of the most extraordinarily abusive slant.

Ms. LOFGREN. Well, it can be after this meeting, but it seems to me that we ought to take some action that is necessary legally, but I mean, the church groups ought to become involved. What these groups are doing is unconscionable and they ought to be ashamed of themselves.

Mr. NATSIOS. I think they should be ashamed.

Ms. LOFGREN. It is like a war crime what they are doing and we should start a counter effort because we should just not accept this.

Mr. NATSIOS. When I said this publicly in August of last year, it was very interesting. One of the groups said they would suspend their opposition because I accused them of, in fact, starving people to death, by name. They did not like it and they said they would suspend their opposition to biotech for the extent of the food emergency. But then two weeks later, someone convinced them that that was the wrong thing to do and they announced they were still opposed to any food aid being imported. I said if the Europeans want to import food, or export food to Africa in the form of food aid to take the place of ours, I am happy to do it. But they don't do a lot of food aid, so they couldn't do it. We were it, basically, in terms of the great bulk of the food that was going to these emergencies.

So there is a problem. Some of them are simply irresponsible. I have never seen such egregious abuse of fact and science as the material they put out. It is on their websites. I saw a card being sent out by one of these groups in South Africa at the Johannesburg summit, and it said you will change your gene pool if you eat biotech corn. That is what it said. They were sending these postcards out to people. I said, what is this based on?

Ms. LOFGREN. Well, my time is up, but I would very much like to have some further information after this hearing about the origin of this assault on the children of Africa. Thank you.

Chairman SMITH. Zoe, your terminology is great, and thank you for your comments. It was interesting, when I was visiting with the scientists, the research scientists, the Federal research that is the equivalent of NSF in the Netherlands, they said, well, you folks in America are a little dumb on how you are going about this. Why don't you start producing things that are going to really help people? Producing food where they can't produce enough and they are starving now, or producing the kind of food that is going to be more nutritious. And I think that is sort of what inspired me to generate this kind of hearing and the language that the Ranking Member and I have tried to push, that if we can get our foot in the door in Africa, then it is going to be the start of a better understanding. And with that, I would ask the Ranking Member.

Ms. JOHNSON. Thank you, Mr. Chairman. I would like to understand better the relationship between the NSF and USAID and

other Federal agencies and how you might work together with this plant biotechnology development of something in Africa.

Mr. NATSIOS. What we do together, and not just in this area but in the health field and other fields, is we jointly fund things. So we will—USDA and AID will jointly fund a research project in South Africa, for example, or Kenya, or something like that. Or the National Science Foundation will do the same thing, or with the EPA. So we do this jointly in terms of funding. Our scientists talk to the scientists from other Federal agencies all the time on these sorts of things and we have a structure, CABIO, as I described earlier, which is a network of American universities that partner with African universities, and some of these partnerships that are dealt with through CABIO grants involve other Federal agencies that we also get funding for.

Ms. JOHNSON. Is it a formal coordination or just informal?

Mr. NATSIOS. Is there a formal mechanism?

Dr. COLWELL. It is a bit of both. In some programs, such as the plant genome centers, the research that is done and the interactions are regularized. But we also do a lot of sharing of information and developing programs together, and that is more or less ad hoc, so it is a mixture.

Ms. JOHNSON. Okay. For the USAID supported research at U.S. universities that address agricultural problems in Africa, to what extent are African scientists involved in the activities, including the setting of goals and that sort of thing?

Mr. NATSIOS. Let me just give you an example. I visited the Danforth Center in St. Louis, which is one of the premiere institutions in terms of research. We are supporting a cassava biotechnology for Africa, but it is being done by training African scientists from Nigeria, Ghana, and Kenya. In fact, some of them I met when I was there. Some of them already have their Ph.D.'s as scientists and they are getting post graduate research work done, and then they go back to the universities and teach it at their universities. In other cases, we have actual universities in Africa that have agriculture schools where there will be a partnership between an American university and an African university, and some of this work is done through the ministries of agriculture in Africa. So it depends on the—I can give you a list, actually, of the portfolio, and you can see some of the things that we have that we do try and do.

[Note: Information referred to is located in Appendix 2: Additional Material for the Record.]

Ms. JOHNSON. Okay. There are a few land grant colleges throughout the country that have agricultural programs, and I wonder if you work with any of them in relationship with Africa?

Mr. NATSIOS. Yes, we do, definitely. Michigan State, Cornell University is on the list here, Tuskegee, Purdue.

Dr. COLWELL. Riverside.

Mr. NATSIOS. University of Florida, UC Davis. Those are just some of them. We will give you a list.

[Note: Information referred to is located in Appendix 2: Additional Material for the Record.]

Ms. JOHNSON. Okay. I wonder about Texas A&M or——

Mr. NATSIOS. Texas A&M, yes, is definitely on the list.

Ms. JOHNSON. Okay. Thank you, Mr. Chairman.

Mr. NATSIOS. You are from Texas, Congresswoman, I did remember that.

Chairman SMITH. I suspect you knew that. We have three votes. We have probably the most outstanding panelists on the third panel that any committee in Congress could bring together to give Congress, this committee and Congress, guidance on where we go. We have a 15-minute vote that is in process now, two 5-minute votes, so it is my guess that it will be about 20 minutes then we will reconvene. So again, Dr. Colwell, Administrator Natsios, thank you very much, again. We hope that you are open for additional questions that haven't been asked, if we could send them to you.

Mr. NATSIOS. Absolutely.

Dr. COLWELL. Absolutely.

Chairman SMITH. And with that, the Subcommittee is in recess at the call of the Chair.

[Recess]

Panel 3

Chairman SMITH. The Subcommittee will end its recess and come back to order and work. I would like to make a couple of comments before we proceed. Number one, thank you so much for your time and being at this panel. Dr. Conway, Dr. Kilama, and Dr. Horsch, a video, not only the transcript, but a video of your testimony will be made available to the rest of the Committee, plus it will be made available to interested parties in biotech. I am a member of the Biotech Caucus in Congress, and so we very much look forward to your comments and testimony.

A statistic that Dan has given me—and Dan Byers, thank you so much for all of your work in having a great hearing this afternoon—is the fact that a tremendous impact on the people of Africa where a one percent productivity increase is estimated to bring six million African men, women, and children out of poverty. So just even some small changes and the potential for great changes, I think, is with us if we are smart enough to move ahead. And probably, we are not going to stop biotech development, but some of the environmental groups that want an emotional issue, that are looking for a precautionary principle to slow down the advancement, are going to slow it down. But it is such a tremendous opportunity for the many populations of the world that, eventually, it is not going to be stopped.

With that, let me introduce our third panel, and Mr. Akin has suggested that he would like to introduce Dr. Horsch in a little more detail. Dr. Gordon Conway is President of the Rockefeller Foundation, a New York based charity dedicated to improving food security around the world. Dr. Conway's previous positions include Vice Chancellor of the University of Sussex in England; Director of the Sustainable Agriculture Program of the International Institute for Environment and Development in London, and he has authored Unwelcome Harvest: Agriculture and Pollution, 1991; and The Doubly Green Revolution: Food for All in the 21st Century, in 1999.

Dr. John Kilama is President of the Global Bioscience Development Institute, a firm developing training and consulting to policymakers in developing countries on biotechnology regulation, intellectual property rights, and international trade development. His background is in pharmaceutical and agricultural biotechnology and agrichemistry. And previously, Dr. Kilama worked at the Dupont Company, specializing in developing chemicals for crop protection and establishing collaborations between Dupont and institutions in developing countries. And with that, I would yield to Mr. Akin for an introduction.

Mr. AKIN. Thank you, Mr. Chairman, and I appreciate this opportunity to do a little bragging and also introduce our third panelist. I really appreciate your holding the hearings. I also thank the panelists for their long suffering. We have had—it has been a pretty long series of meetings today. Of course, Monsanto is headquartered in my hometown of St. Louis, and that is our area. It is a leading provider of agricultural products and integrated solutions for farmers, and it is a critical element of the Missouri economy. In the past few years, the St. Louis region has been recognized as the biobelt, the world class center for plant and life science research, and Missouri researchers are discovering new genes that could increase drought tolerance or utilize nitrogen more efficiently, thereby, requiring fewer fertilizers, which in Africa is also expensive. And as we have heard in previous testimony, hard to come by. The work is groundbreaking and will save countless lives.

Monsanto is also partnered with Donald Danforth Plant Science Center in St. Louis, and the Danforth Plant Science Center is an independent, not for profit, research center in the St. Louis area. It has made a special commitment to assisting countries in the developing world, including many in Africa, in building their capacity for sustainable agriculture and nutrition. Efforts are underway at the Danforth Center to develop crops with increased resistance to disease and pests. For example, scientists are working to develop varieties of cassava, a starchy root crop that is Africa's most important staple food, that are resistant to the devastating plant disease known as mosaic virus. It is estimated that upwards of 35 million metric tons of food are lost in Africa each year due to the devastating impact of that virus alone. These important discoveries are vital to increasing crop yields and resistance in many developing countries where the majority of people depend on agriculture for their livelihood.

More importantly, on a continent where at least $\frac{1}{3}$ of the population lacks adequate food supplies, it is essential that we remain committed to plant biotechnology research. There is little doubt that these findings could contribute to an overall growth of the country's economy by reducing property and increasing the ability to grow and buy food, and creating higher standards of living, including better health and education. For all these reasons, it is my great pleasure to introduce Dr. Robert Horsch, the Vice President of Product and Technology Cooperation for the Monsanto Corporation. He has led the company's plant science culture and transformation efforts contributing to the development of the Bollard,

the YieldGard, and Roundup Ready traits which are in broad use today.

In 1999, Dr. Horsch received the Presidential Medal of Technology for his contributions to the development of agricultural biotechnology. He is also a member of the Private Sector Committee of the Consultant Group of International Agricultural Research. It sounds like CGIAR when you put it together. And the United Nations Millennium Project Task Force for Hunger. Doctor, it is a pleasure to have you here and the rest of our panelists. Unfortunately, I have got two other concurrent meetings, so you are going to have to excuse my slipping out. Mr. Chairman, thank you very much, and thank you very much for just a great series of hearings.

[The prepared statement of Mr. Akin follows:]

PREPARED STATEMENT OF W. TODD AKIN

Thank you Mr. Chairman. I would like to thank you for holding this important hearing and I want to thank the witnesses for testifying in front of the Committee today.

Headquartered in my hometown St. Louis, Missouri, Monsanto employs approximately 14,700 people in 60 different countries worldwide. Monsanto is a leading provider of agricultural products and integrated solutions for farmers and is a critical element of Missouri's economy.

In the past few years, the St. Louis region has been recognized as the "Biobelt" a world-class center for plant and life sciences research. Missouri researchers are discovering new genes that could increase drought tolerance or utilize nitrogen more efficiently, thereby requiring fewer fertilizers, which in Africa is often expensive and hard to come by. This work is groundbreaking and will save countless lives.

Monsanto has also partnered with the Donald Danforth Plant Science Center in St. Louis.

The Donald Danforth Plant Science Center is an independent, not-for-profit research center in St. Louis. The Center has made a special commitment to assisting countries in the developing world, including many in Africa, in building their capacity for sustainable agriculture and nutrition. To deliver on this commitment, the Danforth Center has established a series of objectives for the next five years, among which are to:

- Make discoveries that can benefit developing countries;
- Establish meaningful collaborations with research institutions in developing countries;
- Facilitate the development of biotechnology products for developing countries;
- Integrate training with research and development for developing countries;
- Improve the regulatory climate for biotechnology in developing countries; and
- Raise understanding of the potential benefits of biotechnology for developing countries.

Efforts are underway at the Danforth Center to develop crops with increased resistance to disease and pests. For example, scientists are working to develop varieties of cassava—a starchy root crop that is Africa's most important staple food—that are resistant to a devastating plant disease known as the mosaic virus. It is estimated that upwards of 35 million metric tons of food are lost in Africa each year due to the devastating impact of this virus.

Danforth Center scientists are also developing plants to improve human nutrition and health—for example, plants with increased levels of iron and folate. They are also studying plant nutrition to better understand how roots absorb minerals and survive drought. This research could lead to plants that can grow in mineral-poor, arid or saline soil, and foods enriched in essential elements.

The Danforth Center is working to share the benefits of biotechnology with the developing world and in doing so is demonstrating in a very clear way that cutting-edge plant science can contribute to improvements in agriculture, nutrition and health in poor nations.

These important discoveries are vital to increasing crop yields and resistance in many developing countries where the majority of people depend on agriculture for their livelihood.

More importantly, on a continent where at least one-third of the population lacks adequate supplies of food, it is essential that we remain committed to plant biotechnology research. There is little doubt that these findings can contribute to the overall growth of a country's economy by reducing poverty, increasing the ability to grow and buy food and creating higher standards of living including better health and education.

For all these reasons, it is my great pleasure to introduce Dr. Robert Horsch, the Vice President of Product and Technology Cooperation for the Monsanto Corporation. He has led the company's plant tissue culture and transformation efforts, contributing to the development of the Bollard, YieldGard, and Roundup Ready traits, which are in broad use today. In 1999, Dr. Horsch received the Presidential Medal of Technology for his contributions to the development of agricultural biotechnology. He is also a member of the Private Sector Committee of the Consultative Group for International Agricultural Research (CGIAR) and the United Nations Millennium Project Task Force for Hunger.

Chairman SMITH. I did mention that the testimony will be made available to you. You will be tested on all of the testimony, especially, of Dr. Horsch. I would like to also mention that——

Mr. AKIN. I notice there is no one else here. This is a tough committee.

Chairman SMITH. I would like to mention, also, that I requested and we received written testimony for this hearing from T.J. Buthelezi. He is a cotton farmer in South Africa. His testimony is in each one of the member's folders, plus is available on the distribution table outside. And in his own words, it was just very interesting that he talked about raising the biotech cotton, and he started with just a small plot, and as he saw that he could save labor, and pesticides, and the potential damage of applying that extra pesticide, he kept expanding. I think he started with three hectares, and then he went to five, and now he is up to twenty-six, and his testimony is very interesting, because unlike a lot of farmers in the world, he indicated he has got so much money now. And with that, Dr. Conway, please proceed.

[Note: The statement of Thembeitshe Joseph Buthelezi appears in Appendix 2: Additional Material for the Record.]

STATEMENT OF DR. GORDON CONWAY, PRESIDENT, ROCKEFELLER FOUNDATION

Dr. CONWAY. Thank you, Mr. Chairman, Ranking Member Johnson, and the entire distinguished Subcommittee. I am pleased to be here for this hearing on an extraordinarily important subject. I am delighted you are going to be setting an examination at the end. As a former professor, I will slip in a trick comment. The central mission of the Rockefeller Foundation for its 90-year history is to improve the lives and livelihood of poor and excluded people around the world. And this inevitably involves food and hunger. And I want to point out, of course, that we were as Dr. Natsios said, at the beginning of the Green Revolution in the 1940's. Norm Borlaug was a member of the staff of the Rockefeller Foundation when he did this groundbreaking work.

But today, of course, it is Africa that is the top of the list of the world's regions where the poor are chronically hungry. And at this point in time, it will be impossible to do too much to address this problem. In my oral testimony, I would like to focus on three key issues. First, I want to briefly describe some of the key challenges faced by Africa and its agricultural sector. Second, I will talk about some principles that I believe can guide policy-makers who are con-

sidering biotechnology applications in Africa. And finally, I will briefly describe some of the Rockefeller's specific efforts that may be of interest in this field.

The facts concerning Africa are well known and have been laid out before you all this morning. Very simply, Africa is not currently growing enough food. In most African countries, the per capita food production is going down. There are many reasons for this: conflicts, disease. They are all taking a terrible toll on Africans, including farmers. But one important cause is simply that agricultural productivity is just too low. The average yield on African farms is the same as the average yield on European farms at the time of the Roman Empire 2000 years ago.

The typical African farmer today is a woman with a family, farming a small plot of low fertility land, confronted by a variety of challenges: pests, diseases, terrible roads, erratic rainfall, lack of fertilizers. And everyone agrees that improvements in her productivity will be beneficial to her and to her family. What, of course, is disputed is whether biotechnology can be helpful to African agriculture. And the skeptics fall in one of two camps. There are those who are concerned about the health, environmental, and safety impacts. Then there are the others who are concerned that so much of the new technology is in the hands of western companies, that it is expensive to purchase, it may be inappropriate for use in developing countries.

These are important concerns, but for us at the Rockefeller Foundation, what we are attempting to do is address two central questions. First of all, how can we help poor, small holder, African farmers increase their food security? And secondly, what tools can be made available to them to address the difficult challenges they face in producing a healthy harvest? And in considering those two questions, we have to be absolutely clear that biotechnology is but one tool in a larger toolbox, from which African farmers must themselves choose. There is no magic solution to the problems of African hunger and African agriculture, but the problem is so big that the Africans should have the right to consider every possible tool at their disposal. We believe that Africans should be the ones to weigh the cost and benefits, and we believe Africans should have access to the knowledge to help themselves, and we have constructed our strategy around that goal.

This principle, that Africans should be able to choose, has led us to work toward putting African scientists and farmers in positions to draw down upon the new technologies and to adapt them for their uses. Western corporate ownership of much of the intellectual property necessary for use in biotechnology presents an impediment. We need to go to public resources to help African institutions and regulatory bodies, its scientists, and its farmers. The fact is that improvements in African agricultural productivity are not likely to be made in American laboratories, but in applied settings by African scientists, drawing upon the best of the world's know-how in real situations. Africans need commitments from governments, their own governments and western governments, to help in building the necessary capacity in Africa. And they need western companies to make available the knowledge that might be adaptable, and that is what we at the Rockefeller Foundation are trying to do.

We recently created the African Agricultural Technology Foundation, which is African led, African based. It is designed to resolve many of the barriers that prevent small farmers, small holder farmers, from gaining access to enabling agricultural technologies. It is based in Nairobi Kenya, and directed by Dr. Eugene Terry from Sierra Leone, who is superbly qualified in his field. We have also worked to help strengthen African regulatory bodies and to train hundreds of African scientists. We make grants to help appropriate regulatory and managerial systems so they can function effectively.

We have made a number of other grants in Africa, undertaken a variety of other efforts, but in my opening remarks, I want to suggest this central principle and goal to you. Let us look at how Africans can be free to make choices and use the full range of ideas and techniques, from conventional crop breeding and soil fertility improvement to advanced technologies, to help themselves.

I spent most of my life not in New York or London, but in the field, in developing countries, working as an ecologist. Many parties working together learned a lot, including learning what did work and what did not work as a result of the so called Green Revolution in Asia in the 1960's and 1970's. I was proud to be a part of that. Now we must all focus new and innovative ideas on helping Africa be in a better position to help itself, and I am grateful for your inviting me here for this most important discussion. Thank you, sir.

[The prepared statement of Dr. Conway follows:]

PREPARED STATEMENT OF GORDON CONWAY

Thank you Mr. Chairman, Ranking Member Johnson, and the entire distinguished Subcommittee. I am pleased to be here for this hearing on an extraordinarily important subject and to represent the Rockefeller Foundation.

I know that we have been asked to limit our spoken testimony to approximately five minutes. Like the other panelists, I have submitted longer written testimony to the Committee and will answer any questions about those submissions. In my oral testimony I'd like to focus on three areas that I believe are central to successfully dealing with the current situation. First, I will very briefly describe some key challenges faced by Africa and its agricultural sector. Second, I will talk about some principles that I believe can help guide policy-makers who are considering biotechnology's applications in Africa. Finally I will briefly describe some of Rockefeller's specific efforts that may be of interest in this field.

The facts concerning Africa's current situation are well known to you—and very serious. As we meet this morning in Washington, there are literally millions of people in Africa who do not have enough to eat and are at risk of starvation. While this current crisis is real, it is not new. There are about 200 million chronically malnourished human beings in Africa and 40 million African children who are severely underweight for their age. One estimate is that there are about six million children a year who perish in the world from illnesses related to malnutrition—six million children dying without enough to eat is a terrible reality, a horrifying number that I believe should shame every civilized person.

The next fact that must be mentioned is that Africa is not currently growing enough food. There are many, many reasons for this—armed conflicts and disease among other factors are taking a terrible toll on Africans, including farmers. But one important cause is simply that agricultural productivity in Africa is just too low. Indeed, the average African farmer's crop yields are about the same as those enjoyed by some farmers during the Roman Empire. That too is a shame, and many parties, including the Rockefeller Foundation, are trying to improve agricultural productivity in Africa.

But I do not want to just reiterate facts about the need to improve African agricultural productivity. Everyone likely agrees that improvements in productivity would be beneficial. What is sometimes disputed is whether *biotechnology* can be helpful to African agriculture.

Skeptics of biotechnology for Africa usually come from one of two camps. First, some are concerned over the health and safety impact of new technologies. Second, others are troubled that so much of the new technology is developed by Western companies, it is expensive to purchase, and it may be inappropriate for use in developing nations.

These are important concerns. In charting our course at Rockefeller and trying to answer them, we have found a single central principle has helped guide us. That is, how can we help Africans be in a better position to evaluate what technologies are right for them, and to be able to obtain and implement helpful technologies? We believe Africans should be the ones to weigh costs and benefits. And Africans should have access to the knowledge to help themselves and their farmers. We have constructed our strategy around that goal.

Here in the United States, and many other places, the decision has been made to use biotechnology—indeed more than 75 million acres in the United States are planted with genetically modified crops. As some of you know, I am an applied ecologist, and I have looked into the scientific issues extensively. I could talk at some length about my opinion on the subject.

But my ultimate conclusion is that just as Americans and Europeans are free to make reasoned and fair decisions for themselves, so should Africans have the same choice.

Similarly, our principle—that Africans should be able to choose—has led Rockefeller to work towards putting African scientists and farmers in a position to draw upon and adapt new technologies. Western corporate ownership of much of the intellectual property necessary to use biotechnology is a problem. We need greater public resources to help African institutions and regulatory bodies, its scientists and its farmers. The fact is improvements in African agricultural productivity are not likely to be made in American labs, but in applied settings—most likely by African scientists drawing upon the best of the world's know-how in real world situations. Africans need commitments from governments to help build the necessary capacity, and they need Western companies to make available knowledge that might be adaptable.

In Asia, locally based scientists have made thousands of important advances and are experimenting with hundreds of new crops. Africa needs to be in a position to do the same—it needs a variety of institutions to help Africans be able to evaluate and develop potentially useful technologies.

That is what we at the Rockefeller Foundation are trying to do. We have recently helped create an African-based, African-led organization, the African Agricultural Technology Foundation, designed to resolve many of the barriers that have prevented smallholder farmers from gaining access to enabling agricultural technologies. It is based in Nairobi Kenya, and directed by Dr. Eugene Terry who is originally from Sierra Leone and is superbly qualified in the field.

We have also worked to help strengthen African regulatory bodies and train hundreds of African scientists. We make grants to help appropriate regulatory and managerial systems so they can function effectively.

We have undertaken a variety of other efforts in Africa, but in my opening remarks I wanted to suggest this central principle and goal to you—let us look at how Africans can be free to make choices and use this technology to help themselves.

I have spent most of my life not in New York or London, but in the field, in developing countries, working as an ecologist. Many parties working together achieved great things as part of the so-called Green Revolution in Asia in the 1960s and 1970s. I was proud to be a part of it. Now we must focus new and innovative ideas on helping Africa be in a better position to help itself.

I look forward to our discussion, and working together to improve the situation of many millions of very poor people.

Thank you.

BIOGRAPHY FOR GORDON CONWAY

Gordon Conway, a world-renowned agricultural ecologist, was elected the 12th President of the Rockefeller Foundation in New York City, in April 1998. He is the first non-U.S. citizen to lead the Foundation, which was founded in 1913 by philanthropist and international businessman John D. Rockefeller. Prior to joining the Foundation, Dr. Conway was Vice Chancellor (President) of the University of Sussex in Brighton, one of the United Kingdom's leading research universities, and Chair of the University's Institute of Development Studies.

The Rockefeller Foundation is a knowledge-based, global foundation with a commitment to enrich and sustain the lives and livelihoods of poor and excluded people throughout the world. Dr. Conway oversees the Foundation's philanthropic grantmaking in its four program themes: Food Security, Health Equity, Working Commu-

nities and Creativity & Culture. The four themes and a cross theme of Global Inclusion fund program initiatives including those to increase food production in developing countries; develop medicines and vaccines for diseases like HIV/AIDS, tuberculosis and malaria; and, in the United States, to create strategies to move people out of persistent poverty and to reform public schools.

Dr. Conway pioneered integrated pest management in Sabah, North Borneo, Malaysia, in the 1960s; developed agroecosystems analysis in Thailand in the 1970s; and in the 1980s was one of the first to define the concept of sustainable agriculture—a field that is critical to successful development of poor countries—as the Director of the Sustainable Agriculture Program of the International Institute for Environment and Development in London. Dr. Conway developed interdisciplinary centers of environmental education at London University in the 1970s and helped set up similar centers in the Sudan, Indonesia, the Philippines and Thailand.

In the late 1980s Dr. Conway worked on participatory projects in northern Pakistan and Ethiopia, which enabled villagers in these countries to analyze, define and implement solutions to their own agricultural and environmental problems.

Dr. Conway has written more than 100 papers, monographs and books on applied ecology, resource and environmental management, and international development. His most recent book, *The Doubly Green Revolution: Food for All in the 21st Century* (Penguin and University Press, Cornell), was published in 1999.

A former Ford Foundation representative for India, Nepal and Sri Lanka, Dr. Conway spent 12 years as an Administrator, Director and Professor at England's Imperial College of Science, Technology and Medicine. He also chaired the Commission on British Muslims and Islamophobia for the Runnymede Trust, a U.K. think tank on race and ethnicity.

Dr. Conway has worked with several American-based research institutions including leading a team charged with producing a new vision for the Consultative Group on International Agricultural Research in Washington, D.C., that coordinates the work of the International Agricultural Research Centers, many of which are or have been Rockefeller Foundation grantees.

Dr. Conway has a Bachelor's degree in zoology from the University College of North Wales, Bangor, United Kingdom, a diploma in agricultural science from the University of Cambridge, United Kingdom, and a diploma in tropical agriculture from University College of West Indies, Trinidad. He received his doctorate degree in agricultural ecology from the University of California, Davis. He holds honorary fellowships from the Institute of Biology and the University of Wales, Bangor, United Kingdom; and honorary degrees from the Universities of Sussex and Brighton, United Kingdom, and the University of the West Indies, Trinidad. He is a fellow of the American Academy of Arts and Sciences, an Emeritus Professor at the University of Sussex and Visiting Professor at Imperial College.

Dr. Conway is married with three children. He and his spouse, Susan, reside in Sleepy Hollow, New York.

THE ROCKEFELLER FOUNDATION

July 15, 2003

The Honorable Nick Smith
Chairman, Research Subcommittee
2320 Rayburn Office Building
Washington, DC 20515

Dear Congressman Smith:

Gordon Conway
President

Thank you for the invitation to testify before the U.S. House of Representatives Research Subcommittee on June 12 for the hearing entitled *Hearing on Plant Biotechnology Research and Development in Africa: Challenges and Opportunities.*

In accordance with the Rules Governing Testimony, this letter serves as formal notice that I received no federal funding directly supporting the subject matter on which I testified, in the current fiscal year or either of the two preceding fiscal years.

GC/lm

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Chairman SMITH. Dr. Conway, thank you very much, and it is awkward. We just finished voting on the last vote. I voted quickly and then came over, but I would like to also mention that this is live on our Science Committee website, and it will be available on the website for anybody's review for the next year-and-a-half until the conclusion of this Congress. Dr. Kilama.

STATEMENT OF DR. JOHN KILAMA, PRESIDENT, GLOBAL BIOSCIENCE DEVELOPMENT INSTITUTE

Dr. KILAMA. Thank you, Honorable Chairman Nick Smith, and Honorable Eddie Bernice Johnson, Ranking Member, for providing me with the opportunity to speak to you, and distinguished Members of the Subcommittee on Research, regarding Plant Biotechnology Research and Development in Africa: Challenges and Opportunities. Mr. Chairman, the tragic truth is unavoidable. Despite the great potential of plant biotechnology to improve food pro-

duction, Africa is losing the war against hunger. As USAID Administrator Natsios has noted, an estimated 435 million Africans could face severe food insecurity by the year 2010. And yet, this doesn't mean that plant biotechnology has failed in Africa. On the contrary, plant biotechnology has not been given a chance to work in Africa.

Why is plant biotechnology research and development not yet successful in Africa? We have the temptation to blame the European Union moratorium on GMOs for Africa's failure to adopt biotechnology. But in my opinion, there is more fundamental and more troubling factors that are responsible. Even if the European Union ends its moratorium on GMOs, and surely it will, plant biotechnology will still face a bleak future in Africa unless we develop a clear roadmap to address the root causes of this crisis, rather than its symptoms.

In my view, developing a roadmap for creating sustainable biotechnology applications that eliminate food insecurity in Africa must consist of the following steps. We must focus on financial support of the long-term strategic plan, not on making short-term investments. These plans would include developing a process for coordinating all the efforts of the African assistance for biotechnology that are currently provided to Africa by various U.S. agencies.

We must revive and rebuild Africa's battered capacity for applied research and make research institutions a cornerstone of our efforts. This process should encourage a spirit of entrepreneurship and the incubation of private companies that commercialize innovations that come out of Africa applied research centers at various universities.

We must focus on applied research to solve problems that Africans themselves identify as essential and relevant to the food crisis. Africans must be involved at every stage of the planning and implementation.

We must rebuild Africa's battered infrastructure for agricultural extension at a time when it is more essential than ever. We must help Africans create legal certainty, predictability, transparency to help spur investment from the public sector and to nurture an entrepreneurial spirit. And we must act very quickly because technology is moving so fast, and if Africa is already behind and nothing is done, it is unbelievable what is going to happen in 10 or 15 years. We have seen Asia move, we have seen South America move. Africa is moving backwards.

Mr. Chairman, continuing to apply short-term fixes will not reduce potential food catastrophe in Africa. Only long-term strategic investment will address the problems. We need to support the building of African university institutions by providing adequate funding and working with university officials in partnership with African policy-makers to help them understand their options for making decisions about biotechnology research. The support would be on the basis of how they may contribute to solving the hunger problem five years or ten years down the road.

Mr. Chairman, Africa's infrastructure for applied research in biotechnology is in bad shape. In a recent study, Dr. Alhassan, a visiting scientist at the International Institute of Tropical Agriculture pointed out that the National Agricultural Research System of the

following seven countries in West Africa, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Mali, Nigeria, and Senegal has no capacity to do any advanced research. So the question I would ask then, how can we expect advanced research to take place when African scholars are poorly paid? Libraries lack modern research tools such as computerized databases. Research institutions lack internet connectivity. African scholars are isolated from the main currents in their discipline, both within Africa and across the globe.

We know it doesn't have to be this way because in the 1960's and the 1970's it wasn't. During that period, many African universities enjoyed a significant budget for applied research. Most African governments spend at least one percent of their GDP on scientific research. Today, you would be hard pressed to find even five governments that spend as much as one percent of their GDP on research. Many governments only spend one-tenth of one percent. What went wrong? It is easy to point fingers, civil wars, corrupt self-serving governments that are very oppressive and ill informed about biotechnology. Even the World Bank, in pursuit of structural adjustments, put pressure on African government to discourage research and higher education in favor of short-term approaches. At least now, I have seen they are beginning to review that policy.

In any case, finger pointing won't get the job of rebuilding done. So where do we start? Across the continent, there are several African leading universities and research institutions that have considerable potential to emerge as centers of quality research in plant biotechnology. Among those I would include the University of Botswana, Ahmadu Bella University in Nigeria, and I would include Yaounde University in Cameroon, the National University in Cote d'Ivoire, Addis Ababa University, Omar Bongo University in Gabon, the University of Ghana, the University of Namibia, University Cheikh Anta Diop of Dakar, and Makerere University in Uganda. A number of African research institutes, as well, are very active, and one of them is KARI [Kenya Agricultural Research Institute], which has now produced some variety in sweet potatoes as a result of partnership between USAID and Monsanto Company.

It is very important that innovations within African universities be given a chance to move into the private sector, and I want to give one example. The University of Western Cape in South Africa can serve as a role model. At that university, the South African National Bioinformatics Institute, SANBI, is developing bioinformatics analysis site and using it as an incubator for new companies. The mission is very simple. It is to produce innovations which can then be passed on to private sectors. And I believe the solutions for food security is not a matter of simply producing food for Africans to eat. It has to be looked at in the global system, economic system, and I believe that is one way in which we can be able to reduce hunger in Africa.

It is important to bring biotechnology to the heart of the African people, rather than create centers of excellence that are far away and far less responsive. Africa needs to bring biotechnology to its grassroots. Technology must be supported by local expertise and local universities that understand local needs. Sources of knowledge and support must be on the ground close to the farmers. I want to give you an example. I live in Delaware. If the chicken

farmers or the poultry farmers in Delaware had to rely on centers of excellence in, let us say, Nebraska or California, I don't think that would be serving the interests of the farmers in Delaware. And that is why the center of excellence for poultry is located in the University of Delaware. So why should we really begin to try to introduce scientific research from far away and not creating those centers within each country? And I think it is very important that the source of strength for developing capacity in plant biotechnology has to lie within the university.

I want to say that during my recent trip to Brazzaville, the capital of the Republic of Congo, I met with Honorable Jeanne Dambendzet, the Minister of Agriculture, and during our meeting, she expressed great concern about the problems that they are experiencing with cassava blight, which is a disease that is destroying the cassava. And by the way, cassava is the second leading source of carbohydrates after rice, and yet, there is not sufficient funding that is available to provide the opportunities for Africans to grow cassava, which is essential in most of West Africa and East Africa Central, including even South America and Asia.

One other thing, also, I discovered within Central Africa is a product they call koko, and this is harvested wild, and it is a very important source of protein for a lot of people in Central Africa, from Cameroon to Gabon, to Congo, to Central Africa. And yet, there is an issue of it being destroyed in the environment. So allow me to conclude by saying that it is very important that whatever we try to do, it has to be long-term, and we begin to see the benefits of long-term strategy in Asia, which is bearing fruit today. If we continue to provide short-term fixes, it will not solve the problems of Africa. And in fact, it is very important that research become a cornerstone of our efforts, and it has to be imbedded in universities, strengthened universities.

And one last point, when I was growing up and going to high school, there were so many Americans who were imbedded in the universities as professors. Today, you would be hard pressed to find any single individual in most of these universities who are serving one year of sabbatical in African universities. In fact, we prefer Africans to come into the United States. I think that is beneficial, but it is more beneficial if we begin to have the traffic both ways. And I think one of the efforts that should be done by the National Science Foundation is to encourage the university professors here to go and spend a year or two years, and by doing that, it provides opportunities for the African scientists to learn some of the more sophisticated ways of conducting research. And I thank you for giving me the opportunity.

[The prepared statement of Dr. Kilama follows:]

PREPARED STATEMENT OF JOHN KILAMA

Thank you, Hon. Chairman, Nick Smith and Hon. Eddie Bernice Johnson, Ranking Minority Member, for providing me with the opportunity to speak to you and Members of the Subcommittee on Research of the U.S. House of Representatives' Committee on Science regarding "Plant Biotechnology Research and Development in Africa: Challenges and Opportunities."

The tragic truth is unavoidable: Africa is losing the war against famine. Despite the enormous potential of plant biotechnology to improve food production, Africa is losing the war against hunger. As USAID Administrator Andrew Natsios has noted,

an estimated 435 million Africans could face "severe food insecurity" by the year 2010,

And yet, this doesn't mean that plant biotechnology has failed in Africa. On the contrary, plant biotechnology has not been given a chance to work its wonders in Africa—and that is almost as terrible a tragedy.

Why hasn't plant biotech been given a chance? Although it is tempting to blame the European Union's moratorium on GMOs for Africa's rejection of biotech, more fundamental—and more troubling—factors are responsible. Even after the European Union ends its moratorium on GMOs—as surely it will—plant biotechnology will have a bleak future in Africa unless we develop a clear road map to address the root causes of this crisis—rather than its symptoms.

In my view, developing a road map for creating sustainable biotechnology applications that eliminate food insecurity in Africa must consist of the following steps:

1) We must focus on financial support of a long-term strategic plan; not on making short-term investments. This will require developing a process for coordinating all the efforts of foreign assistance that are currently provided to Africa by various U.S. agencies.
2) We must revive and rebuild Africa's battered capacity for applied research, and make research institutions a cornerstone of our efforts. This process should encourage a spirit of entrepreneurship—and the incubation of private-sector companies that commercialize innovations that come out of applied research centers at Africa's universities.
3) We must focus on applied research to solve problems that Africans themselves identify as essential—and relevant—to the famine crisis. Africans must be involved at every stage of planning and implementation.
4) We must rebuild Africa's battered infrastructure for agricultural extension at a time when it is more essential than ever.
5) We must help Africans create legal certainty, predictability and transparency to help spur investment from the public sector, and to nurture an entrepreneurial spirit.

We must act with a sense of urgency, because the gap between the technology "haves" and the "don't-haves" is expanding daily. As technology becomes increasingly sophisticated, that gap will continue to widen—unless we act decisively.

Allow me, please, to elaborate my approach in a bit more detail.

An Emphasis on the Long-term

First, instead of continuing to apply short-term "fixes," we need to focus on long-term strategic investments. We need to patiently nurture and rebuild African university institutions—and work with African policy-makers to help them understand their options for making decisions about biotechnology research—and its enormous potential for eliminating hunger, and fueling economic development. We must assist African universities with both financial and strategic planning so as to rebuild Africa's deteriorated university systems.

The consequences of a long-term approach are profound. We need to evaluate biotechnology options and technologies—*not* by assessing how much they will pay off this year or next year, but on the basis of how they may contribute to solving the hunger problem five years or ten years—or even further down the road.

Although this means taking risks—and betting on uncertain, new options—we cannot afford *not* to take risks, if we want to develop long-term meaningful solutions. If we don't think long-term, there is no doubt that we—or our counterparts—will be discussing the issue of African famine in even more dire terms, some ten or twenty years from today.

To monitor the progress of our long-term approach, we also need a process for coordinating the efforts of various U.S. agencies—in order to make sure that their programs are consistent, and there is no redundancy.

Focusing on Applied Research

Next, we must rebuild Africa's battered infrastructure for applied research, and make it a cornerstone of our long-term efforts. Africa's infrastructure for applied research in biotechnology is in tatters. Biotechnology budgets have dried up, and professional standards have declined to the point where advanced research is virtually non-existent.

In a recent study, Dr. Walter S. Alhassan, a Visiting Scientist at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, pointed out that the National Agricultural Research Systems (NARS) of the following seven African coun-

tries have no capacity to conduct advanced biotechnology: Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Mali, Nigeria, and Senegal.

Elsewhere, the situation is similar, except for in South Africa. How can we expect advanced research to take place? Consider that:

- African scholars are poorly paid.
- Libraries lack modern research tools such as computerized databases.
- Research institutions lack Internet connectivity.
- African scholars are isolated from the main currents in their discipline both within Africa and across the globe.
- There is no credible legal system to protect innovations of Africans through fundamental international standards such as the WTO Agreement on Trade Related Aspects of Intellectual Property rights.

We know that it doesn't have to be this way—because from the 1960s through the 1970s, it *wasn't.* During that period, many African universities enjoyed a significant budget for applied research. Most African governments spent at least one percent of their GDP on scientific research. Today, you would be hard pressed to find even five governments that spend as much as one percent of their GDP on research. Many governments only spend one-tenth of one percent.

A generation ago, professional standards were high. Moreover, Africa's researchers had ample opportunity to engage in exchange programs with their counterparts in the United States and Europe. Many Americans took sabbaticals in Africa, as did some of their counterparts in Europe. These reciprocal exchanges strengthened the skills of African professionals, and kept them up-to-date with their colleagues elsewhere around the world.

What went wrong? It's easy to point fingers. Civil wars. Corrupt, self-serving governments that are repressive and ill informed about biotechnology. Even the World Bank, in pursuit of "structural adjustments," put pressure on African governments to discourage research and higher education in favor of shorter-term approaches. Now I am glad to see that they are reversing that policy, and recognizing the importance of quality research and high standards.

In any case, finger pointing won't get the job of rebuilding done.

So where do we start? Across the continent, several of Africa's leading universities and research institutions still have considerable potential to emerge as centers of quality research in plant biotechnology—provided that we make a patient, long-term commitment to funding—and guiding—their progress along the right path. According to the same study by Dr. Alhassan, The West and Central African Council for Agricultural Research and Development (WECARD)[1] recognizes the importance of biotechnology for agricultural research in the region.

Some highlights of Dr. Alhassan's study:

- There is considerable strength in tissue culture and a growing potential for molecular biology work in Cameroon.
- Except for a shortage of manpower, the infrastructure for biotechnology in Côte d'Ivoire is above average for the subregion.
- In Ghana, the biotechnology infrastructure is weak but the manpower base is relatively strong.
- Nigeria has a strong infrastructure in tissue culture work, but it is relatively weak in molecular biotechnology infrastructure. However, this will develop over time, as Nigeria draws up its guidelines for biotechnology development policy and biosafety, and as it establishes institutions to promote biotechnology research and joint development with emerging local entrepreneurs.
- Senegal has the best laboratory infrastructure and manpower for agricultural biotechnology in the subregion. Its standard of biotechnology work is relatively more advanced than the neighboring countries.

Several African universities have considerable potential, if their infrastructures are provided with additional support. Among these, I would include the University of Botswana—which has one of the best chemistry departments in Sub-Saharan Africa except for in South Africa—and Ahmadu Bello University in Nigeria, which is headed by a no-nonsense administration that is looking for funding to engage in applied research in biotechnology. Other universities with significant promise include the University of Yaoundé (Cameroon); the National University of Côte d'Ivoire; Addis Ababa University in Ethiopia; Omar Bongo University in Gabon; the Univer-

[1] CORAF (Conseil Quest et Centre Africain pour la Recherche et le Developement Agricoles)

sity of Ghana; the University of Namibia; University Cheikh Anta Diop of Dakar, Senegal; and Makerere University in Uganda, the country in which I was born.

A number of African research institutes, as well as institutes within ministries of agriculture, are also in a position to emerge as applied research centers in plant biotechnology. Most remarkable is the Kenya Agriculture Research Institute (KARI), which is already engaged in a fruitful partnership with the USAID and the private sector. The fruits of that partnership are already apparent in the form of genetically modified sweet potatoes.

For an example of how university research can incubate new companies—and strengthen entrepreneurship—the University of the Western Cape, in South Africa, can serve as a role model. At that university, the South African National Bioinformatics Institute (SANBI) is developing a bioinformatics analysis site, and using it as an incubator for new companies. The mission of SANBI is to "develop analysis systems relevant to the South African Community." Instead of relying on a developed country to come in and rescue Africa from its problems, young companies such as Electric Genetics believe that South African citizens should learn about bioinformatics and help themselves. Gensec Bank and Real Africa Holdings launched the first biotech venture capital fund, Bioventures, in 2001.

We should also do everything in our power to reduce the painful isolation of Africa's scientific community—by fostering exchange programs and sabbaticals that expose Africa's Molecular biologists and biotechnologists to the ferment of new ideas and new technologies in the United States. In this regard, I suggest we leverage the sizable community of African scientists who are permanent residents in the United States, including many U.S. citizens. Many members of this African Diaspora are ready and willing to contribute their skills and perspectives, without necessarily relocating to Africa.

Bringing biotech to the heart of the people

Next, we must bring biotech to the heart of African people rather than create "centers of excellence" that are far away—and far less responsible. Africa needs to bring biotechnology to its grass roots. Technology must be supported by local expertise at local universities that understand local needs.

Sources of knowledge and support must be on the ground, close to farmers—and readily available to support them—not halfway across Africa, as some people have proposed. Imagine poultry farmers in Delaware relying on research support centers in faraway Nebraska or California, instead of centers at the University of Delaware. It's hard to see how that sort of research center can be responsive to the needs of farmers in Africa, who are far more isolated than farmers in Delaware. Moreover, it's a lot cheaper to create three or four first-class institutes in a country than to ask people to bear the impossible cost of traveling abroad for assistance.

On the contrary, local communities must become engaged in making vital decisions about where and how to apply biotech research efforts. Only then—and only after gradual, patient efforts—will plant biotech be viewed as "local" and "African"—rather than alien and threatening.

We must work with local communities to identify their needs, their priorities—and the technologies that are the best fit. Local communities will be the best judges of research projects that are worth pursuing, not faraway institutes that deal with only a handful of scientists from each country.

How exactly can locally focused applied research help? Here are several options that seem especially promising:

First, applied research can help develop new varieties of plants that are critical to African nutrition—but are currently threatened by disease or biodiversity loss. Although most of the genetically modified organisms intended to be introduced to Africa are in cotton, rice and corn, there is a good opportunity for biotechnology to have a significant impact on the production of cassava, which is currently suffering widespread blight disease in Africa. Cassava is the second most important source of carbohydrates in the world—and the consequences for African famine will be devastating if production drops severely.

During my recent trip to Brazzaville, capital of the Republic of the Congo, I met with the Hon. Ms. Jeanne Dambendzet, the Minister of Agriculture. During our meeting, the Minister expressed her deep concern about the devastation of cassava blight disease in her country. She is very fearful of the impact on local cassava production and how Congolese rural communities will cope with the shortages of food. Madame Ambassador Robin Sanders, U.S. Ambassador to the Republic of the Congo, arranged my trip. Ambassador Sanders is taking a leading role in assisting the efforts of Congolese leaders to combat the problem of serious cassava blight disease. At the moment, there is no light at the tunnel for solving this blight—because

there is not enough funding directed towards solving the cassava problems in Africa, or anywhere else.

Second, applied research can help local communities effectively cultivate and commercialize many wild products that are popular—but whose future is threatened by over-harvesting. One such product is *Gntum* leaves that are known throughout Central Africa, mostly by the vernacular name *koko.*[2] Commercial activity in these leaves has been increasing for several years. Today they are sold in most European countries. In all Central African countries, women play a primary role, from gathering to selling. An investigation in 1980[3] found that the trade in *Gnetum* in the Koilou region of the Congo employed over 400 women to harvest the leaves from the wild. It's a popular but endangered wild plant.

Many Central Africans, especially in Cameroon, Congo, Gabon and the Central African Republic, depend on *koko* for the nutritional value of its leaves, a significant source of protein, essential amino acids, and mineral elements. Yet *koko* could soon become extinct if researchers don't get a solid opportunity to apply biotechnology to its cultivation. Hon. Djombo, Minister of Forest Economy and Environment, for the Republic of the Congo echoed these concerns during our recent meeting in Brazzaville.

Next, applied research can help us develop a model for moving biotechnology into local communities effectively. Although biotechnology has the power to enhance valuable traits—and ward off disease—crops that are genetically modified can nevertheless suffer from weeds. So we need research that helps farmers manage their crops that include genetically modified organisms.

Which research projects will turn out to be the most useful? I can't tell you—and neither can anyone else. Only local African communities will be able to make that judgment—and only if their local applied research institutions are allowed to flourish—and share their knowledge. Only if local communities can get involved in monitoring programs—and seeing which projects are really addressing their needs and which are not.

Strengthening infrastructure for agricultural extension services

In addition, we need to see revive institutions of applied research as the source of agricultural extension services that African farmers need to survive—and thrive—in the age of biotechnology and global markets.

Several factors make agricultural extension more essential than ever before: The faster pace of technological change; the globalization of agricultural markets; and the growing integration of biotechnology with information technology.

These factors make the challenges confronting Africa's farmers today very different from the challenges that faced my father in Uganda when I was growing up in that country.

When I was a child, my father grew tobacco and cotton on a farm that benefited enormously from the "Green Revolution." If it hadn't been for the Green Revolution, my father would not have had the resources to make a good living—and lay the seeds for my higher education and career as a scientist.

Unfortunately, few African farmers today are making the smooth adjustment to new agricultural technologies that my father did during my childhood. Many farmers who have been introduced to new technology are abandoning their farms—because of the failure of today's infrastructure for agricultural extension.

To understand why, consider the fundamental contrast between the Green Revolution and the Biotech Revolution of today—and the greater demands on agricultural extension today. The Green Revolution brought new technology in the form of fertilizers, fungicides, insecticides and herbicides. Although new, these technologies did not require the long learning curve required of today's line-up of new products. They were not only less sophisticated than today's new technologies, they weren't changing rapidly. A fertilizer was a fertilizer; it was not being continually redesigned and improved—like today's products in biotechnology and information technology. Getting a handle on new technology today is harder than ever—because technology is a moving target. Anyone who works with computers knows that.

In my father's generation, it was also much less of a challenge to understand the risks involved in using new technologies, as well as their impact on the economic and social patterns of communities. In those days, African farmers did not have to become skilled in the new art of risk assessment. There weren't as many new prod-

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[2] Mialoundama, F., "Nutritional and Socio-Economic Value of Gnetum Leaves in Central African Forest," Chapter 14, Man and the Biosphere Series, Volume 13.

[3] Mialoundama, F., (1980). "Action regulatrice des feuilles sur l'activité morphogenetique du bourgeon terminal chez Gnetum africanum Welw." Comptes Rendus des Séances de l'Academie des Sciences; Paris, 291, 509–512.

ucts—and the risks were easier to assess. Nor did farmers have to learn about regulatory regimes; or about regional, national—even global economic conditions that affect their livelihood.

Now, at the very time when African farmers must learn continuously in order to survive, agricultural extension services designed to help them have been gutted by budget cutbacks, and other forces we have discussed earlier. At a time when Africa's farmers need more support than ever, the infrastructure for agricultural extension has eroded.

Is it any wonder that many farmers fail to take full advantage of the biotechnology that is made available to them? Is it any wonder that so many abandon their farms—and return to the city? Is it any wonder that they become biotechnology Luddites—rejecting a technology that could do them so much good because they don't have the resources—including funding and skills—to use it effectively?

Plant biotechnology is constantly changing, and farmers need to understand complex processes of risk assessment. New products are newer and harder to grasp; that is the wonder of biotechnology—but also a challenge for gaining acceptance.

We must also make sure that agricultural extension services are equipped to explain regulatory issues to farmers, as well some of the economic complexities that reflect the influence of the global marketplace. All of these efforts must be continuous—rather than one-shot efforts at training—because everything is always changing.

Creating Legal Certainty, Predictability and Transparency

Research is expensive and we can't depend on governments alone to get the job done. We need to get the private sector actively involved. A key to boosting biotechnology lies in developing strategies for stimulating private-sector investment. However, the current absence of legal certainty, predictability and transparency creates major obstacles to investment for research-intensive industries in the biotechnology sector. Without laws that conform to minimal international standards—such as the WTO Agreement on Trade Related Aspects of Intellectual Property Rights—businesses are unable to make the investments needed in terms of capital and technology transfer; and in the training and upgrading of local personnel.

In the long run, these factors are critical to sustainable economic diversification and sustainable economic growth. In the absence of protection for trademarks, patents, undisclosed information and copyrights, African countries are unable either to protect the intellectual capital of their own elites or attract foreign capital from innovative multinational companies. The absence of IP protection also contributes substantially to brain-drain. Many of Africa's most talented and capable scientists, doctors and inventors have "voted with their feet." They have emigrated to European and American laboratories or clinical research facilities, where they have greatly enriched global science and technology across many sectors. However, they have been unable to contribute to the economic development of their home countries, apart from sending remittances.

Staying the Course

If we neglect this approach—and focus on technology, rather than the entire agricultural system—many farmers are likely to throw up their hands in defeat, when they hit their first hard times.

If we continue to focus on the short-term, and neglect the kinds of applied research that can bring science to the people, biotechnology will have a bleak future in Africa. And if we don't focus on bringing biotech to the heart of the people, hundreds of millions of Africans will lose their best chance to stave off famine. But if we act now to take a more strategic, longer-term view, I'm confident that we can turn the corner in the struggle against famine.

About GBDI

Since GBDI was established in 1999, we have conducted multidisciplinary training sessions about biodiversity, biotechnology and related intellectual property law in Kenya, Botswana, Nigeria, Tanzania, and Benin. Overall, nearly 500 scientists, lawyers, public officials and other professionals from 43 sub-Saharan countries in East Africa, West Africa and Southern Africa have received GBDI training and consultation in biodiversity, biotechnology and related law. We are also deploying our professional resources to provide consultations for public- and private-sector institutions that want to expand their presence in promising markets for bioresources—or move into new markets.

A major goal of our current efforts is a program designed to overcome the barriers that have stood in the way of passing biosafety regulation throughout Africa. Biotechnology in Africa faces a critical challenge. Not one country in Africa has yet to

enact biosafety regulatory law, despite the fact that biosafety regulations are mandated by the Biosafety Protocol. Unless African leaders pass biosafety regulatory laws—and implement them effectively—Africa will never adopt and develop biotechnology, or acquire biotechnology through technology transfer from the U.S. or other trading partners.

In addition, we are planning to work with the Republic of the Congo (Brazzaville) and the U.S. Embassy in Brazzaville to organize a conference for African heads of state, to focus on the critical issue of cassava blight and how biotechnology offers a great solution to it.

Some of these programs that we want to implement will depend on the availability of funds.

BIOGRAPHY FOR JOHN KILAMA

Dr. John Kilama, President of Global Bioscience Development Institute, has a broad background in the pharmaceutical, agricultural biotechnology and agrochemical chemistry. Born in Uganda, Dr. Kilama received his Ph.D. in Medicinal Chemistry from the University of Arizona in Tucson, Arizona in 1988, a Pharmacy degree from the University of Kentucky, Lexington, Kentucky in 1979 and a BA in chemistry from Berea College, Berea, Kentucky in 1976.

Dr. Kilama worked in DuPont Company as a Senior Medicinal Research Chemist, and was awarded several patents that cover innovative applications of new classes of chemicals for crop protections and published several scientific peer-reviewed articles in the agrochemicals journals. At DuPont, he developed a natural product team in the Chemical Discovery Department. He also helped established several collaborations between DuPont and other institutions in developing countries. He developed an approach to establishing a long lasting, workable relationship between multi-national corporations and institutions in developing countries.

GBDI brings very unique experiences of organizing complex training in developing countries and an unparalleled network among scientists, lawyers, political leaders, and policy-makers in developing countries.

ADDRESS

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CAREER SKILLS/KNOWLEDGE

Management

- Organizing professional training sessions on biotechnology, biodiversity and intellectual property law for the promotion of economic development.
- Raising funds from leading international organizations.
- Analyzing international trade regulations and their impact on the economic development of developing nations.
- Evaluating technical assistance most suited for promoting economic growth of developing countries in biotechnology, biodiversity and intellectual property.
- Formulating effective private/public sector partnerships.
- Recruiting and managing professional staff in the research and development of pharmaceuticals and agricultural products

Pharmaceuticals

- Extensive background monitoring the use of drug products at the community level.
- Designing and managing mechanisms for distribution of pharmaceutical drug products at community levels.
- Supervising and directing advanced research and development in pharmaceuticals and agricultural products.

Biotechnology

- Formulating biosafety guidelines for developing countries.
- Public speaking on economic development issues related to biotechnology, biosafety and intellectual property.

- Evaluating biotechnology policy options and setting priorities for developing countries.

CAREER ACHIEVEMENTS

- As founder and president of the Global Bioscience Development Institute, Inc. (GBDI), created and supervised intensive practical training about global biodiversity, bioprospecting, biotechnology and intellectual property law for 500 executives and officials from 45 countries.
- Raised and managed over $750,000 in funding for GBDI operations since its establishment.
- Established GBDI training curricula used by numerous national leaders in Africa and Asia as a model for practical professional training beneficial to sustained economic development.
- Created and led several effective partnerships between multinational corporations and institutions (private and public) in developing nations.
- Cited as an expert on biotechnology, biodiversity and intellectual property in leading publications around the world.
- Delivered numerous presentations at professional conferences and seminars hosted by leading bioscience institutions around the world.
- Active participant in advisory boards of World Health Organization—IPPPH (Initiative on Public-Private Sector Partnership for Health) in Switzerland, and the International Organization for Chemistry in Development (IOCD), in Belgium.
- As senior medicinal research chemist at DuPont Co., awarded several patents covering innovative applications of new classes of chemicals for crop protection.
- As senior medicinal research chemist at DuPont Co., headed a team that utilized natural products as a broader research and development program.

CAREER EXPERIENCE

MANAGEMENT

Global Bioscience Development Institute, Inc., Wilmington, DE—1998–Present

President

Total responsibility for managing GBDI, a global institution providing practical training in biodiversity, biotechnology and related intellectual property law for scientists, senior executives, government officials, lawyers, economists, intellectual property professionals and technology transfer professionals.

- Direct all fundraising efforts for programs that have trained more than 500 professionals in 45 countries around the world.
- Work with professional trainers to develop targeted course work that meets the needs of local institutions and professionals.

RESEARCH AND DEVELOPMENT

DuPont Life Sciences, Wilmington, DE—1990–2000

Senior Medicinal Chemist, Chemical Discovery Dept., Agricultural Division

- Created and led successful project teams combining chemical, biochemical and physical techniques such as molecular modeling to design and synthesize novel biologically active compounds.
- Developed a workable approach to establishing long-term relationships between multinational corporations and institutions in developing countries. Awarded several patents covering innovative applications of new classes of chemicals for crop protection.

CLINICAL PHARMACY PRACTICE

Community Practice and Consultant

Wilmington, DE—1994–present
Tucson, AZ—1984–1990

Presbyterian Hospital

Dallas, TX, Clinical Hospital Pharmacist, Pharmacy—1979–1982

PRESENTATIONS ON BIOTECH AND BIODIVERSITY POLICY

- April 2002: "BioEconomy: The Future of World Economy in the 21st Century," at the "BangaloreBio2002: Showcasing Karnataka's Biotechnology Agenda" conference in Bangalore, India.
- March 2002: "BioDiversity—A Key to Economic Prosperity in Africa," at the "Sasol Scifest 2002" conference in Grahamstown, South Africa.
- March 2002: "Challenges to Adopting Science and Technology to Create Wealth in Africa," at the "Sasol Scifest 2002" conference in Grahamstown, South Africa.
- March 2002: "Appropriate Information on Biotechnology: Key to Understanding the Opportunities That Biotechnology May Offer to African Seed Trade Association (AFSTA) and Africa," at the African Seed Trade Association's (AFSTA) congress in Dakar, Senegal.
- March 2002: "Bread for the World Institute's Conference on Agricultural Biotechnology: Can it Help Reduce Hunger in Africa?" at "Key Food Safety & Biodiversity Concerns on Agricultural Biotechnology in Africa" conference in Washington, DC.

TRADE MISSIONS

- Sept. 2002: Delegate from Philadelphia to the People's Republic of China.
- July 1994: Member of U.S. delegation to Uganda headed by Congressman Tony Hall (Ohio).

EXAMPLES OF SCIENTIFIC PUBLICATIONS

- "Aryl-substituted quinoxalines and related heteroarenes as novel herbicides prepared via palladium-catalyzed cross-coupling methods." ACS Symposium. Ser. (1995), 584 (Synthesis and Chemistry of Agrochemicals IV), 171–85 (with Smith, Ben K.; Denes, Radu; Selby, Tom).
- "A new synthetic approach to the C–D ring portion of streptonigrin analogs." *J. Heterocyclic Chem.* (1990), 27(5), 1437–40 (with Iyengar, Bhashyam S.; Remers, William A.; Mash, Eugene A.).
- "Racemization-Free amidation of unprotected alpha amino acids or ester via aluminum amides." 206th American Chemical Society National Meeting, Chicago, II, 1993 (with Tim Neubert).

EDUCATION

Postdoctoral, University of Minnesota, Minneapolis, MN—1988–1990

Ph.D., Medicinal Chemistry, University of Arizona, Tucson, AZ—1983–1988

BS.C., Pharmacy, University of Kentucky, Lexington, KY—1976–1979

B.A., Chemistry, Berea College, Berea, Kentucky—1973–1976

Committee on Agriculture
U.S. House of Representatives
Required Witness Disclosure Form

House Rules* require nongovernmental witnesses to disclose the amount and source of Federal grants received since October 1, 2000.

Name: John Kilama, Ph.D.

Address: 702 West Street, Suite 205, Wilmington, DE 19801

Telephone: (302) 656-6439

Organization you represent (if any): Global Bioscience Development Institute (GBDI)

1. **Please list any federal grants or contracts (including subgrants and subcontracts) you have received since October 1, 2000, as well as the source and the amount of each grant or contract. House Rules do NOT require disclosure of federal payments to individuals, such as Social Security or Medicare benefits, farm program payments, or assistance to agricultural producers:**

Source: DFS/FO/CC/PD Department of State **Amount:** $ 8033.00

2. **If you are appearing on behalf of an organization, please list any federal grants or contracts (including subgrants and subcontracts) the organization has received since October 1, 2001, as well as the source and the amount of each grant or contract:**

Source: USAID (ATRIP Program) **Amount:** $240,000.00

Please check here if this form is NOT applicable to you: _____

Signature: John Kilama

* Rule XI, clause 2(g)(4) of the U.S. House of Representatives provides: *Each committee shall, to the greatest extent practicable, require witnessess who appear before it to submit in advance written statements of proposed testimony and to limit their initial presentations to the committee to brief summaries thereof. In the case of a witness appearing in a nongovernmental capacity, a written statement of proposed testimony shall include a curriculum vitae and a disclosure of the amount and source (by agency and program) of each Federal grant (or subgrant thereof) or contract (or subcontract thereof) received during the current fiscal year or either of the two previous fiscal years by the witness or by any entity represented by the witness.*

PLEASE ATTACH DISCLOSURE FORM TO EACH COPY OF TESTIMONY.

Chairman SMITH. Dr. Kilama, thank you. Very good. Dr. Horsch.

STATEMENT OF DR. ROBERT B. HORSCH, VICE PRESIDENT, PRODUCT AND TECHNOLOGY COOPERATION FOR MONSANTO.

Dr. HORSCH. Thank you, Mr. Chairman, and Members of the Subcommittee. I would like to submit my entire statement for the record. I will be brief right now. I appreciate this opportunity to testify today, and I thank Congressman Akin for his very kind introduction. Today, I lead Monsanto's partnerships with public institutions and nonprofit foundations to help small holder farmers in developing countries. We help them to gain access to better agricultural products and technologies and research that will lead to that.

Monsanto's presence in Africa is centered in South Africa, where we have an advanced breeding and research facility in Petite. There we develop seeds for much of Sub-Saharan Africa. This includes both conventional seeds and seeds improved with biotechnology traits. The Speaker and Representative Johnson toured our Petite research facility on a fact finding tour of issues facing Africa a year or two ago.

How can we improve productivity in Africa and can biotech play a key role? The biggest problems in my studies and travels have been pests, depleted soils, drought, and poor human nutrition from inadequate completeness of the diet. On pests, the tropics have much worse pest problems than we face here, where our winters set the pests back every year. Africans either use chemical pesticides, or much more often, nothing at all and suffer the losses. Biotech is a proven solution for controlling key pests everywhere in the world it has been applied. And researchers are pursuing genes that will control many other serious pest problems beyond those we have solutions for today.

Depleted soils: The soils in Africa are fragile and depleted of nutrients plants need to grow and develop. By combining biotech with no till farming, the soils can be restored. A concerted research effort on improving nitrogen use efficiency by the crops could increase productivity where fertilizer is limiting and expensive.

Drought: Desertification or failure of rains to come at critical times during plant growth frequently leads to crop failure. We have heard a lot about, and I have seen preliminary results with genes designed to alleviate and reduce drought stress and losses due to drought that are promising in greenhouse tests and lots of technology and science that is promising to help solve this problem.

Human Nutrition: Essential nutrients can be built into starchy staple foods, such as rice or corn, right on the farm in areas where there are no groceries to provide enriched processed foods or dietary supplements.

We already know biotech can be used successfully by small holder African farmers because they have been using it in biotech cotton for several years already to great advantage, and Chairman Smith has provided the testimony of T.J. Buthelezi. I will just point out similar results are being obtained by thousands of his neighbors in South Africa.

Ongoing biotech research is aimed specifically at African problems in growing staple foods. I mentioned sweet potato, which is also an important subsistence crop because it will grow in poor soil

and survive droughts already, but it suffers from a devastating viral disease. With partial funding from USAID, Dr. Florence Wambugu and other Kenyan scientists have worked in my lab and then returned to Kenya to continue work to finish developing a biotech solution for the sweet potato virus problem. You have heard from Congressman Akin and others about work on cassava diseases ongoing at the Donald Danforth Plant Science Center, and Monsanto is fully supportive of the new African Agricultural Technology Foundation that Gordon Conway has described. Other examples are in my written submission.

Mr. Chairman, I would like to emphasize three recommendations to this committee. We should continue to strengthen investment in basic and applied research and in agricultural innovation and conservation in the United States. Our leadership benefits our country and it benefits the rest of the world as well. We should continue our leadership in establishing science based regulatory principles and policies and help other countries to do so, too. Lack of working regulatory systems is becoming a major obstacle to introducing new biotech products in other countries or even just to conduct the science and field tests to do product development locally, as Dr. Kilama has so ably recommended as important.

Finally, and most importantly, I think we must work together to get needed products into farmers' hands and farmers' fields sooner rather than later. To do this, we will need to create a new focus and priority on turning research into products that farmers need and can use to grow more and better food. And then we must gain the appropriate regulatory approvals and find mechanisms to deliver these public goods, biotech products, such as the disease resistant cassava, sweet potatoes, or improved nutrition staples that I mentioned earlier, to the subsistence farmers across Africa. And I would agree with my esteemed colleagues here that it must be done in a way that gives each country choice, each farmer choice, about how this is done, and that much of the local adaptation and research work must be done in partnership and at the local institutions. Mr. Chairman, thank you.

[The prepared statement of Dr. Horsch follows:]

PREPARED STATEMENT OF ROBERT B. HORSCH

Introduction

Mr. Chairman, Members of the Subcommittee, my name is Rob Horsch and I am Vice President of Product and Technology Cooperation for Monsanto Company. I appreciate this opportunity to meet with you today.

First, I would like to give you some background on my career in science and agriculture, which will explain why I am here today, and why I am so passionate about the need for agricultural research and development in Africa and the rest of the developing world.

I received my Ph.D. in genetics at the University of California, Riverside in 1979, and conducted postdoctoral work in plant physiology at the University of Saskatchewan. I then joined Monsanto as a scientist in 1981 to lead the company's plant tissue culture and transformation efforts, and contributed to the development of the insect-protected and herbicide-tolerant biotechnology traits in broad use today in soybeans, corn, cotton and canola.

In 1999, I, along with three of my colleagues, was honored to be awarded the National Medal of Technology by the President of the United States for our contributions to the development of agricultural biotechnology.

Today I lead Monsanto's efforts to partner with public and private institutions to help farmers in developing countries gain access to better agricultural products and technologies. We share fundamental scientific data; technology, including genes and

traits; training to move technology into crops important for food security; consultation on environmental stewardship and information on food safety; and licenses to patented technologies—all to develop crops that can produce more food, use less pesticide, and improve people's health around the world.

This commitment to the developing world dovetails with our corporate mission at Monsanto to make a positive difference in agriculture—arguably still today the world's most important industry.

Monsanto Company's Commitment to Plant Biotechnology

The vision of the people at Monsanto is abundant food and a healthy environment. We are working to deliver products and solutions that help to meet the world's growing food needs, while conserving natural resources and protecting the environment.

Monsanto has a long history of turning innovative science into successful, high-value products that improve the efficiency of crop and animal agriculture.

Biotechnology is an example of our commitment to agricultural innovation. We developed Roundup Ready seeds that have been genetically enhanced to provide herbicide tolerance, thereby allowing Roundup herbicide to be applied directly over the top of the crop in the field. This provides outstanding weed control without damaging the crop, and protects the environment.

In fact, according to a recent study by the National Center for Food & Agricultural Policy, the eight biotech crop varieties currently grown in the United States like corn, cotton and soybeans have reduced pesticide use in 2001 by 46 million pounds.

That's millions and millions of pounds of synthetic chemicals that biotechnology eliminated in just one year. And reductions in pesticide use continue to increase each year as farmers substitute more biotech crops for pesticides.

We have also developed YieldGard and Bollgard seeds that protect themselves from harm by damaging insect pests. This provides outstanding pest control, built right into the seed, without the use of chemical insecticides.

We also believe that biotechnology will be an important tool in helping to feed our planet's population.

In the last 60 years alone, the world's population has tripled from 2 billion to 6 billion. The United Nations estimates there will be another 2 billion people by the year 2020, most living in the world's poorest regions.

With more people in the world, we're going to have to find ways to provide more food. According to Nobel Laureate Dr. Norman Borlaug, "You've got two choices. Either you improve yields so that you can continue to produce the food that is needed on the soil that is well-adapted to agricultural production, or you'll be pushed into cutting down more forests."

We believe that biotechnology will be a crucial part of expanding agricultural productivity in the 21st century because it will help people to grow more and better food that is needed today, while also conserving natural resources that are important for a sustainable future.

This technology can be particularly beneficial for Africa and the developing world where productive agriculture is so crucial.

Agricultural Situation in Africa

I understand that Speaker Hastert and Congresswoman Eddie Bernice Johnson recently visited Africa to view the challenges faced by African farmers first-hand. In fact, they visited Monsanto's Petite Facility in South Africa.

We are one of the largest and highest quality seed producers on the African Continent and have invested in advanced breeding and research facilities at Petite, serving the needs of much of sub-Saharan Africa. We also have invested in top quality seed production facilities in Africa and serve customers in South Africa, Zimbabwe, Malawi, Tanzania, Kenya, Uganda, Mozambique and Zambia.

Through my position at Monsanto, I also have had the opportunity to travel to many of these countries and to witness the daunting agricultural challenges faced by farmers in Africa.

Mr. Chairman, I'd like to share with you and the subcommittee my assessment of the agricultural challenges faced in Africa—challenges that make it difficult for farmers there to grow a healthy harvest.

In general, there is a lack of infrastructure and markets in Africa to support development of local businesses, economy, and trade. In terms of agriculture, this lack of infrastructure makes it difficult to get modern tools to farmers, including fertilizer, improved seed, and crop protection chemicals.

In addition to this lack of infrastructure, environmental conditions in Africa make it difficult for farmers there to cultivate a healthy crop.

All across Africa, despite hard work and ingenuity, significant portions of the harvests are often lost to factors farmers cannot control. These factors include depleted soils that lack sufficient nutrients to grow a decent crop; a lack of rainfall and water for irrigation results in severe and frequent drought; and plagues and pests, including weeds and insects.

Robert Paarlberg, professor at Wellesley College, in an article titled Environmentally Sustainable Agriculture in the 21st Century recently said, "The social welfare consequences of this farm productivity failure in Africa have been devastating. Lagging productivity on small farms is the chief reason why 30 percent of children in Africa are still chronically malnourished. For Africa more than any other region, the problem of inadequate food consumption grows directly from an unsolved farm production problem."

According to the Food and Agriculture Organization, cereal production in sub-Saharan Africa is now 19 percent lower on a per-capita basis than it was in 1970. And grain production is the lowest in the world at 1.7 tons per hectare—less than half the global average of 4 tons per hectare.

Biotech's Relevance to Africa's Needs

Given the enormous infrastructural and environmental challenges for agriculture in Africa, biotechnology can be an extremely beneficial tool for farmers there because the technology is delivered directly through the seed. Biotech crops don't require additional inputs to make the technology work, like expensive farm equipment or extensive training.

Pests

The first generation of biotech products was developed to help farmers to control insect, virus and weed pests. This application of biotech has proven its relevance to agriculture in all world areas, including Africa. The results have been striking in boosting productivity, and are now being well documented by third-party studies. And there is much more that can be done to solve other insect and viral diseases, to solve fungal and bacterial infections, to solve nematode and parasitic weed attacks.

Depleted Soils

Biotech solutions for adding nitrogen to starved soils may not occur during my career, but improving nitrogen use efficiency is possible and may help modest levels of fertilizers produce a bigger harvest. And in an indirect, but very real way, reducing pest damage helps to get more food from whatever nutrients are available to the crop. The biggest need for depleted soils is fertilizer (either inorganic or organic), but biotech can help make its use more efficient.

Drought

In a similar way, biotech can not substitute for rainfall, irrigation or good water management practices, but it can help improve water use efficiency by reducing yield loss from drought stress and by increasing yield potential in water limited environments. I have seen tremendously exciting, although preliminary, results in greenhouses tests of new genes designed to protect against the damage of drought stress. We typically measure yield per acre of land. In the future, we may come to measure yield per gallon of water. Here too, yield lost to pests is a waste of water as well as a waste of soil nutrients and labor.

Nutrition

Nutritional enhancements like the higher beta carotene (vitamin A precursor) in golden rice are being expanded to include golden mustard oil and other golden staples. Beyond that, promising research on increasing iron availability and other vitamins, minerals and proteins can provide much needed enriched food on the farm where grocery store access to enriched processed foods or multi-vitamins is neither possible nor affordable.

Many people in Africa don't even have enough basic calories to lead a healthy and active life. Increases in productivity and yield are needed to boost total food production. And because of the AIDS epidemic in Africa, in some regions of the country human labor is the limiting factor in how much food can be grown—and lack of good nutrition can be a hindrance to avoiding infections or respond well to medical treatment.

Poverty

Similarly, biotechnology can't solve poverty in a direct way, but it can increase ag productivity in ways that help resource poor farmers to become more economi-

cally successful. And because it is information technology, not resource and energy intensive material technology, it can be shared without being consumed.

Biotechnology can't create markets and infrastructure of course, but because it is built into the seed, it holds promise to bypass this critical lack and help jump-start nutritional and economic successes that could then help markets to develop.

A Success Story in Makhathini Flats, South Africa—Insect-Protected Cotton

Where developing countries have reviewed and approved biotech crops for planting, farmers have benefited dramatically.

South Africa has approved four GM crops for commercial release: insect tolerant cotton (approved 1997); insect tolerant maize (approved 1998); herbicide tolerant cotton (approved 2000) and herbicide tolerant soybeans (approved 2001). The total area under GM crops in the 2001/2002 summer season was estimated at almost 200,000 hectares.

Since their approval in South Africa, farmers have eagerly adopted biotech crops, which provide better yields, more convenience, improved personal safety and environmental advantages.

For example, Monsanto's insect-protected cotton has been a particular advantage to growers in the Makhathini Flats region of South Africa, one of the poorer regions of the world, where bollworms traditionally have destroyed up to 60 percent of growers' harvests. Insect-protected cotton, enhanced through biotechnology to repel bollworms, significantly reduces pesticide use and increases yields.

Average yields for biotech cotton in South Africa from 1998 and 2001 were 25 percent higher than for conventional varieties, according to one study. Another study of the 1999–2000 growing season said average yields were 93 percent higher than for conventional varieties—with an average earnings increase of 77 percent.

Any yield increase can make a significant difference in an area where half the people survive on less than $1 per day, and three-quarters on less than $2 per day. According to a 2001 study by the United Kingdom's Department for International Development, even a one percent increase in overall yields would help raise the incomes of six million people above $1 per day.

"In low-income developing countries, agriculture is the driving force for broad-based economic growth and poverty alleviation," wrote Per Pinstrup-Andersen and Marc Cohen of the International Food Policy Research Institute, in an article titled "Modern Biotechnology for Food and Agriculture: Risks and Opportunities for the Poor."

That's particularly significant given that 70 percent of the African population relies on agriculture for their sole source of income.

T.J. Buthelezi one of the first farmers to plant biotech cotton in South Africa, says higher yields from biotech cotton have helped him invest for the future in more land and better equipment. T.J. recently told me, "For the first time I'm making money. I can pay my debts."

The successful adoption of biotech cotton clearly shows the power and relevance of biotechnology for Africa.

Other Biotech Products in Development for Africa—Sweet Potato

Biotechnology is also being applied to staple food crops in Africa to help develop a product that can survive difficult environmental conditions, or that is enhanced to provide improved nutrition.

For example, several research institutions in Africa are partnering with others, including Monsanto, to help save the sweet potato, one of the most important food crops for small-scale farmers in Africa. Sweet potato is an important subsistence crop in many parts of Africa because it will grow in poor soils and survive droughts that will kill other crops like corn.

However, the sweet potato feathery mottle virus, a virus spread by insects and is resistant to chemical control, robs African farmers of up to 80 percent of their sweet potato yield each year. Indeed, Africa's yield is less than half of the world average for sweet potato.

The project to find a biotech solution to the feathery mottle virus began in 1991 when, with partial funding from USAID, I recruited a bright young scientist from the Kenyan Agricultural Research Institute named Dr. Florence Wambugu—a specialist in sweet potato viral disease.

Florence joined my laboratory in St. Louis, Missouri for two years, sharing her knowledge of the crop and the disease. Several other Kenyan scientists followed in Florence's footsteps, steadily making progress on this difficult problem.

In 2000, I had the pleasure to visit the first field tests of engineered sweet potato in Nairobi, along with Florence who had long before returned to her homeland to continue her work to bring new technology to Africa.

The first field test revealed what virtually all first tests reveal—more work is still needed to produce a satisfactory product. The commercial biotech products my company began selling in 1996 are the result of going back to the drawing board four or five times.

The project has a way to go before African farmers are able to realize the benefits of virus resistant sweet potatoes. But while the problem is a difficult one and the resources and capacity for solving it have been modest, progress has been steady and the method has been proven for other crops and viruses.

Other Biotech Products in Development for Africa—Cassava

In addition, the Donald Danforth Plant Science Center—a not-for-profit research facility in St. Louis, Missouri, dedicated to agricultural research to benefit the developing world—is actively conducting research on disease in cassava, another staple food crop grown in Africa.

Cassava, a tropical crop grown for its starchy, tuberous roots, contributes to food security and rural income in many developing countries and feeds nearly 600 million people daily. However, cassava is estimated to be performing at only a tenth of its production potential due in large part to drought, pests and diseases, including Cassava Mosaic diseases.

Cassava must be processed soon after it is harvested to prevent spoilage, which places a burden on small farmers to get the crop from the field to the table. Also, the protein content of cassava could be increased significantly, providing a more stable and dependable source of nutrition for the developing world.

The Danforth Center is partnering with several international organizations to develop a comprehensive global research plan to conduct research and develop a comprehensive global research plan to tackle the most significant challenges facing cassava farmers, including control of disease, post-harvest deterioration, and enhancing the nutritional content of the crop.

In order to accelerate the center's efforts, Monsanto granted the Danforth Center a royalty-free license to use proprietary enabling technologies in this research. Monsanto philanthropic arm, the Monsanto Fund, also supports research at the Danforth Center on virus-resistant cassava through a multi-year grant.

Partnerships to Develop Biotech Products for Africa

The key to encouraging continued biotech research for Africa—and eventually successful adoption of these products—are the partnerships that have been formed to pool and deploy the resources of public and private organizations from around the world.

As a company dedicated to sharing our knowledge and technology, we participate in many global partnerships.

For example, at a policy level, we recently joined the Partnership to Cut Hunger and Poverty in Africa, a new coalition developed to focus policy, public attention, and new resources on the continuing problems of hunger and malnutrition in Africa. The Partnership focuses solely on the agriculture sector, and is asking the United States to increase assistance in several areas, including improving agricultural technology development and transfer, such as biotechnology.

In addition, Monsanto is a supporter of the African Agricultural Technology Foundation (AATF), which was launched by the Rockefeller Foundation earlier this year to make important genetic information developed by the major Western agricultural companies—including Dow, Dupont and Syngenta—available to African subsistence farmers.

We also work with partners to facilitate the sharing and transfer of the broad range of technologies needed by resource poor farmers in Africa, Asia and Latin America.

Over the past decade, we have assisted hundreds of thousands of farmers in the developing world by partnering with local communities, government entities, public and private sector institutions, and non-governmental organizations. Together, we work to understand the full range of needs that these farmers have in order to provide enough food for their families and communities.

The solutions provided to these farmers are often a package of existing commercial technologies, including improved seeds, biotechnology traits where approved and applicable, conservation tillage practices, crop protection products and other inputs, as well as training and technical assistance.

Monsanto and its partners also often provide for self help group formation, support for the creation of other income generating activities, access to microcredit, as well as linkages to grain traders and processors who purchase surplus crops, produced as a result of the improved technology package.

Farmers participating in these programs have experienced an increase in social, economic and environmental benefits, including an increase in food security and income. In 2001, Monsanto participated in 21 projects in 13 countries, reaching more than 330,000 small holders farming 400,000 hectares of land. These countries included Mexico, India, Indonesia and ten countries within Sub-Saharan Africa, a cross section of key geographies.

These projects support our company's pledge "to bring the knowledge and advantages of all forms of agriculture to resource poor farmers in the developing world, to help improve food security and the environment."

Only by working together and continuing to share our resources can we bring the tools of modern agriculture to those who may not otherwise have access to them. In doing so, we're helping people initiate a more positive economic cycle for their own benefit and that of future generations.

I and my colleagues at Monsanto hope sharing our data and technologies encourages additional research and collaborations that will lead to a wide variety of discoveries to enhance food security and nutritional needs throughout the developing world. Although much is being done to make new technologies available to resource-poor farmers worldwide, there is still more that we can do together.

Recommendations to Address Challenges and Take Advantage of Opportunities in Africa

In conclusion, Mr. Chairman, I would like to make the following recommendations, which I believe will serve to augment plant biotechnology research and development in Africa, and help ensure that African farmers have access to the most modern agricultural tools possible.

- *First, we must continue to strengthen investment in basic science and education in the United States, such as is supported by the National Science Foundation and conducted at U.S. universities and research centers.*

  It is hard to prove looking forward, but abundantly clear in hindsight, that breakthroughs in basic research today will provide technologies and benefits for the future that we can scarcely imagine. Investment in education and the development of our country's human capacity has never failed to return benefits exceeding expectations.

- *We must continue to strengthen support for innovation and conservation in U.S. agriculture, as is the mission of the U.S. Department of Agriculture and the Land Grant Colleges.*

  Our farmers are among the most productive and efficient in the world, and our country has benefited from their abundant, diverse, and nutritious harvests. We have re-invested some of these gains in conservation and restoration of wetlands and wildlife habitat and improvements in water quality without sacrificing our economy or our food supply. As a result, our agricultural system is the envy of the world, which sends its brightest to study at our universities and bring home important knowledge to improve their own agriculture.

  Our leadership benefits our country and the rest of the world as well.

- *We must continue our country's leadership in developing open trade policies and practices around the world, as is the mission of the U.S. Trade Representative.*

  The recent trade-related fears of several African countries acceptance of U.S. Food Aid are a terrible consequence of the squabble with the EU. The reality is that Americans have been very generous in sharing the bounty of our harvests for emergency food aid needs around the world.

  Our country's trade policies ensure that our producers are as competitive as possible in an open global market place, bringing high quality food and other agricultural products to growing markets around the world. By our example, hopefully one day consumers around the world will be able to benefit from our productivity as we enjoy their goods and services in exchange.

- *We must continue our leadership in establishing science-based regulatory policies.*

  The so-called precautionary principle advocated by the Europeans fails to recognize the greater risks and harm that will certainly be caused by moving more slowly than is warranted by careful analysis of risks and needs. The opportunity cost for developing countries to forgo much needed benefits for the principle of precaution at any price is too great a price to pay—and certainly not necessary to ensure safety.

The United States has acted with precaution—but followed by learning and progress in biotechnology. As a result, we enjoy both the safety and benefits of biotech crops and products.

USAID's current support for building the capacity of African decision-makers to assess and approve the biosafety of biotechnology crops will help ease the most significant constraint to the introduction of biotechnology products that work for small-holder farmers.

- *We must reverse the declines in international agricultural development assistance as pledged by the current administration and as being implemented by USAID.*

The vicious trap of poverty can only be broken in our lifetime if we and other developed countries extend a helping hand in development. This will require both funding and know-how to reach the people who most need our help.

I think one of the best ways to do this is my last and perhaps most important recommendation:

- **We must get needed products into farmers hands and fields sooner rather than later. To do this, we need to create a new focus and priority on finishing and delivering public-sector biotech products—such as virus-resistant sweet potatoes, cassava, and other staple food crops in Africa—to subsistence farmers sooner rather than later—a goal consistent with the vision of the Rockefeller Foundation, USAID and the newly launched African Agricultural Technology Foundation.**

The partnerships I described earlier and others I did not have time to mention have made admirable progress. But they are still far short of the need.

We must mount a bigger and more focused effort to reach developing country farmers with products they can put to use in their fields to increase the food on their tables and the income in their households. Private investments such as my company is making will flow where the infrastructure, markets and regulatory policies make it financially worthwhile.

But to serve subsistence farmers who are a long way from the market economy, public investment is critical in developing and delivering products—public goods products that will not attract private investments in any reasonable timeframe.

Closing

I mentioned earlier that as part of my position at Monsanto I am able to travel to areas of the developing world to see with my own eyes the challenges farmers and their families and communities face in Africa and other areas of the developing world.

During my travels I've seen stunted and yellowed fields of corn that might yield less than the grain used to plant them. I've seen the ravages of caused by the twin scourge of hunger and poverty due to decimated harvests. I've seen teenagers in Africa who looked like 8-year-olds because they were suffering from chronic malnutrition caused by both a shortage of calories and lack of sufficient proteins and vitamins.

But I've also seen the hope for more and better food that is possible by applying modern science to solving age-old problems in agriculture. In Malawi, I saw farms with fields of corn that were as green and laden with ears as I have seen in Missouri because the farmer was given access to modern agricultural tools, including better seed and fertilizer. In Kenya, I saw the field trials of sweet potatoes that have new genes for virus protection added using biotechnology.

Research is underway at Monsanto and in laboratories throughout the world to develop hardier and more nutritious food crops that would benefit Africa and other areas of the developing world. As legislators, researchers, philanthropists, and business leaders, it is in our best interests to ensure these products make it from the lab to the fields of Africa and beyond.

Mr. Chairman, the people of Monsanto look forward to working together with you, the Members of this committee, and African growers to help find solutions to the complex issues discussed during the Committee hearings. Thank you.

BIOGRAPHY FOR ROBERT B. HORSCH

Education:

B.S. Biology, University of California, Riverside, 1974; Ph.D. Genetics, Genetics Program, University of California, Riverside 1979; Postdoctoral Fellow, Plant Physiology, University of Saskatchewan 1979–1981.

Employment:

Dr. Horsch joined Monsanto Company in May of 1981 and is currently Vice President, Product and Technology Cooperation, in the Global Product Management Division, with responsibility for small-holder agricultural development partnerships and public-private technology cooperation programs. He led the company's plant tissue culture and transformation efforts from 1981 until 1995. In that capacity, he contributed to the development of the Bollgard, YieldGard, and Roundup Ready traits in broad use today. In 1996 he became Vice President and General Manager of the Agracetus Campus of Monsanto Company's Agricultural Sector in Middleton, Wisconsin, serving in that capacity until the end of 1999.

Selected Awards and Honors:

1985–88—Invited to co-organize the Plant Molecular Biology Course at Cold Spring Harbor Laboratories.

1986—Thomas & Hochwalt Award: Monsanto Company's highest award for science & technology.

1987–present—Appointed Adjunct Professor of Biology, Washington University.

1988–94—Founding co-editor of *The Plant Cell*—now the leading journal in the plant sciences.

1989—Principle Investigator on Technology Transfer grant award from USAID (Virus resistant sweet potatoes for Africa).

1990—Appointed to National Research Council Panel on the Status of Plant Science in the U.S.

1992—Organizer of FASEB Conference on Plant Molecular Biology.

1993–present—Invitations to speak, review, debate, or organize workshops, scientific meetings and university seminars; appointed to Editorial Boards of several major journals; invitations to advise government agencies, universities, international programs.

1996—Appointed Chairperson, Committee of Visitors, Developmental Biology Program, National Science Foundation.

1997—Appointed member of Basic Energy Sciences Advisory Committee, Department of Energy (until 2001); appointed member of Bio-advisory Board, National Science Foundation (served until 2001); appointed member of Panel on Proprietary Science and Technology for the Consultative Group on International Agricultural Research, and invited to testify before the Senate Agriculture Committee on the National Research Initiative.

1998—Appointed to the Board of Trustees for Lindenwood University, St. Charles, MO (served until 2000).

1999—Awarded the National Medal of Technology by the President of the United States for contributions to the development of agricultural biotechnology.

2000—Appointed to the Private Sector Committee of the Consultative Group for International Agricultural Research (CGIAR).

2001—Appointed to the Board of Visitors, University of Wisconsin, Madison; Appointed as a founding Editor to launch a new scientific journal called *Plant Biotechnology* in 2002.

2002—Named as the Distinguished Alumnus of the Year, University of California, Riverside.

Publications:

Author of over 50 articles on plant biology and plant biotechnology.

Selected Recent Speeches:

Isadore Bernstein Symposium at the University of Michigan School of Public Health, October 26th, 2001, "Agricultural Biotechnology—the information age comes to agriculture"

University of Wisconsin, Madison, March 22, 2001 "Plant Biotechnology and Agriculture"

EMBO meeting, October 16th, 1999, Prague, Czech Republic, Science and Society Symposium, "Environmental and economic impacts of agricultural biotechnology"

New York Society of Security Analysts, June 3, 1999, New York, NY, "Creating Shareowner Value Through Sustainable Business Development"

The Fourth Nathan Lecture on the Environment *in honour of Lord Nathan* given by Robert B. Horsch, Ph.D., on April 6th, 1999, *at the Royal Society of Arts,* chaired by Sir William Stewart "Economic growth sustained by sunlight and information"

Remarks prepared for seminar at Harvard University, March 23rd, 1999, Boston, MA, "Transgenic Crops: possibilities for small farmers & food security in Asia"

Remarks prepared for seminar at Yale University, March 24th, 1999, New Haven, CT, "A Vision for the Future of Agriculture"

Remarks prepared for seminar at the University of California, Riverside, March 4th 1998, Riverside, CA, "Agricultural Biotechnology and Sustainable Development"

Remarks prepared for the Department of Energy, Basic Energy Sciences Advisory Committee meeting on February 23rd, 1998, in Gaithersburg, MD, "On the importance of plants and plant science for energy, environment and economy"

Remarks prepared for the meeting on Biotechnology and Biosafety sponsored by the World Bank, October 9–10, 1997 in Washington, DC, "Biotechnology and sustainable development"

Remarks prepared for the Prince of Wales Business and The Environment Programme, Salzburg, Austria, September 15, 1997, "Decision and Risk"

Testimony of Robert B. Horsch, Monsanto Company, before the United States Senate, Committee on Agriculture, Nutrition and Forestry, March 18, 1997, "Why investing in public research is important"

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June 12, 2003

The Honorable Nick Smith
Chairman, Research Subcommittee
2320 Rayburn Office Building
Washington, DC 20515

Dear Congressman Smith:

Thank you for the invitation to testify before the U.S. House of Representatives Committee on Science, on June 12th for the hearing entitled *Plant Biotechnology Research and Development in Africa: Challenges and Opportunities.* In accordance with the Rules Governing Testimony, this letter serves as formal notice of the Federal funding my organization currently receives in support of the work I will discuss during my testimony.

Federal funds have been received by Monsanto under US Agency for International Development (USAID) Cooperative Agreement No. DAN-A-00-91-0000126-00 "Agricultural Biotechnology Support Project" with Michigan State University Institute of International Agriculture. Pursuant to Sub-agreement No. 61-2908 between Michigan State University and Monsanto Company, a total of $200,590 has been received for services performed within the project "The Development of a High Beta-carotene Variety of Mustard for Potential Deployment in a Food-based Approach to Reduce Vitamin A Deficiency in India."

- $15,902; Received in March 2003 for services performed between January 1 and December 31, 2002
- $26,250; Received in July 2002 for services performed between January 1 and December 31, 2001

Sincerely,

Robert B. Horsch
Vice President, Product & Technology Cooperation

DISCUSSION

Chairman SMITH. Thank you. Yesterday, I met with representatives of USDA, our regulatory review groups, Food and Drug, and USDA, and EPA. USDA and the Food and Drug said, probably, testing genetically modified agricultural products developed in Africa or any other place in the world, probably examining them for being healthy to people and animals, could be accommodated in this country very easily. EPA was a little more reluctant, thinking that maybe some of the environmental considerations should be actually done in place on those—in the countries and areas where they should be provided. Is the regulatory structure to develop the sample food plots and to help assure safety to people in the environment, how big a problem is that in terms of restricting, having some of the technology developed and implemented? Let us go right down the line, Dr. Conway, Dr. Kilama, and Dr. Horsch.

Dr. CONWAY. Well, obviously, it is still an impediment in Africa. There are only a few countries in Africa that have got the beginnings of a regulatory system. Kenya is one, Nigeria is another, Uganda. I think the advice you got was probably correct. I think you can do the regulatory and safety testing, as far as human and animal health is concerned, in a single location, whether it be in Africa or elsewhere. I think when it comes to the environmental consequences of growing GM crops, then you do have to have a degree of local specificity, because one of the questions you want to ask is whether genes can flow from the GM crop to the wild relatives. And so if you are growing a crop that has got wild relatives in Africa, then you need to look at that much harder. If you are growing GM maize then, of course, it is not an issue because you don't have the wild relatives.

So you have to treat each situation in its own right and look at what is needed, but you will need in Africa a growth of local regulatory and biosafety capacity.

Chairman SMITH. Dr. Kilama, is it restricting to some extent the implementation of it?

Dr. KILAMA. Mr. Chairman, you probably put your finger on a very critical issue, and let me address it this way. When I was growing up in Uganda, my father grew tobacco and cotton, and used a little bit of the Green Revolution to be able to provide for my education. At that time, my father did not require to know anything about risk assessment, didn't have to deal with the intellectual property issues, didn't have to deal with many of the issues that pertain to the food safety. And I think if there is one thing that we really need to pay a great deal of attention to, it is the regulatory issues in the continent of Africa, and that in itself might be one single most important reason why there hasn't been a considerable movement in the biotechnology area.

There is not a single African country south of the Saharan Africa, it could include the whole of Africa, even north, that has really enacted any biosafety laws that have gone through the legislative branches where they have debated, where the public has some input, to be able to enact it as the law. In Nigeria, they are using a constitutional loophole. In Kenya, they are using a constitutional loophole in order to get the biosafety protocol for allowing for

GMOs or for any genetically modified organisms to be tested. And my feeling is that—and I have been to both of those countries a great deal. I don't believe once, especially, in Nigeria, when GMOs begin to really come into the picture in terms of field testing, the population probably will have problems with it, and that is because a substantial number of the population of Nigeria hasn't really been brought to understand the important biotechnology. Yes, there are people in the government that understand that. Yes, there are ways in which you can actually get around it, to be able to try to do field testing. But until we really try to address the issue of regulatory, there will be problems in the future. Not only problems for developing biotechnology, but also, problems for encouraging private sectors like Monsanto and others to really invest in the country, which are very important.

Chairman SMITH. I mean, part of it, it seems to me, would be real in terms of examining the safety. Part of it is a psychological, maybe, or an emotional reaction of consumers and farmers being comfortable, that somehow there is something out there that helps give that assurance. Dr. Horsch.

Dr. HORSCH. I would just add that, first, the answer is yes. The slowness of regulatory system development is hindering the scientific research, product development, and product use. Solutions to it have been suggested by my colleagues. I would like to point out, though, that biotechnology is at its very beginning of what will be a very long-term future as science develops over the next century. And that today, we don't have to anticipate and regulate the entire and future area of technology on the backs of the very first applications, which are much simpler and clearer cut than the potential of anything you could do with biotech. And the U.S. system is very facile in this, starting out precautionary and then learning and making progress based on data and experience to move to deregulate aspects of this science that have proven to be safe in experience and data, while keeping a precautionary stance for things in the future that may have more risk than what we are using today, and that would be a very useful tool in the toolkit. Thank you.

Chairman SMITH. Now, Dr. Conway, you mentioned that recently you testified before the British Parliament. What was their reaction?

Dr. CONWAY. This was a meeting that included both members of the House of Lords and members of the House of Commons, and also, members of the public. I think most of those who were at the meeting were people who were very concerned about the situation of food in Africa and in the developing world as a whole. I think they were very sympathetic to the argument that there is a great deal that has to be done, which includes, as we have heard today, fertilizers, and roads, and markets, and improved nutrition of the soils, but they all, I think, as I understood it, accepted that biotechnology had a role to play. It was one of the tools that needed to be used. That was the reaction I got from that audience.

Chairman SMITH. Let me ask a question on the African Agricultural Technology Foundation that you mentioned. What is the reaction of African scientists and political leaders to that effort?

Dr. CONWAY. Well, this is something which has very much come out of the concerns of African scientists. African scientists, plant

breeders, and others are very frustrated because they see difficulties in getting hold of proprietary technologies to do the work they want to do. And so in a sense, many of them came to us and said, can you help us with providing access to some of these technologies that are held by companies like Monsanto and so on? These aren't, necessarily, GM technologies. They can be tissue culture or even conventional breeding technologies that are held by western companies. And so it was a scientist who, basically, said, we would like to see this happen. And so we set up this foundation with support from USAID and with very warm support from Monsanto and other western companies. Under this agreement, African scientists who are trying to produce some new kind of resistant crop or whatever it happens to be, will say, look, to make this happen, I need this kind of technology. We think Monsanto has it or another company has it. Can you broker an arrangement and a legal agreement with Monsanto so that we have got access to this technology for us to use in Africa, not for us to use in the United States but for us to use in Africa?

Chairman SMITH. But I hear you saying the support is good. You are reacting to a need and the support is good. Dr. Kilama and Dr. Horsch, help us understand a little better some of the things that are impeding some of this research actually being done in Africa at African research centers. Is it equipment, communication, water, some of the things that are most needed to best stimulate more research? Dr. Horsch, why don't you go first, and then Dr. Kilama.

Dr. HORSCH. I think I would agree with Dr. Kilama's assessment of the situation. It is really all of those things. The strategy that we have used as a company has been to bring African scientists to study for a short period of time in our laboratories here and then continue to collaborate with them when they have gone back to their institutions in Africa and participate and support them in strengthening the institutional and human capacity back home.

Chairman SMITH. Dr. Kilama.

Dr. KILAMA. I think there are really no short answers to it, but let me try to be very brief. Africa went through a period between the late 1970's, up to today, where there was a continuous deterioration of university systems, and either through civil wars or through problems in terms of budget, productivity and so forth. And institutions, as a university, really are in bad shape, and I can't emphasize this more than what I am saying today. Whether you go to Makerere University, which was one of the premiere universities in Africa in the 1960's, from just a simple thing as books, journals, current journals—I recently went to Uganda. There is a small company called—I think it is called Medical Product, run by two individuals. They have better facilities—and these are just run by two people—better facilities than the Department of Biology, Department of Chemistry at Makerere University.

There is no access to the world, to the greater people, in terms of understanding what are some of the current things going in research. And the problem to me is just so enormous, and I don't have any, really, way on how we can be able to bring this back in——

Chairman SMITH. In onus, in both talent and equipment?

Dr. KILAMA. In terms of talent, in terms of standards. Standard, for example, is a big issue in Nigeria. If you take a look at the University of Ibadan, take a look at Bello University in the northeast, the standard university in Africa is simply very poor right now. That is the best I can say. There are a few individuals who come out of there, most of them go overseas. Really, the problem is equipment, access to communications, having tools that they can use and the pay.

Chairman SMITH. So how can we—for all three of you, how can we—what is necessary to encourage additional funding for research in Uganda, Zimbabwe, other countries, Dr. Conway, in expansion of this?

Dr. CONWAY. In the 1990's, the Rockefeller Foundation supported the training of 300 to 400 Asian scientists in biotechnology. There are now over 1,000 biotechnologists in Asia producing new varieties. In China, there are several hundred new biotechnology varieties in the pipeline. That is what we did over 10 years. We have started to do this in Africa. I was at a meeting in Entebbe in Uganda in November with 100 African biotechnologists and plant breeders all giving papers at the cutting edge of biotechnology and breeding. It was very impressive. But as for the whole country, we just need to multiply that, and it is a big "just."

In particular, I would like to see more funding going to USAID. USAID used to be the great funder of agricultural research in developing countries. It is doing much more now under Dr. Natsios. But the more funding that can go toward the training of people in biotechnology in Africa and to the training and to the development of their research capacity, as Dr. Kilama said, and to giving them money when they go back to Africa to do the research, and fellowships for their Ph.D.'s, that is one of the most important things that you could encourage, sir.

Chairman SMITH. Is Rockefeller one of the largest foundations involved in this effort of agriculture? What would be the top three or four foundations that are contributing to the agricultural——

Dr. CONWAY. In terms of agricultural development, it is, basically, ourselves. The McKnight Foundation does a bit, but basically, in agriculture, it is just us.

Chairman SMITH. I serve on three committees in Congress. One is International Relations, one is Science, and then, of course, Agriculture. And so in all three areas, I have been pushing one thing, and that is that research and development of more efficient use—of using less fertilizer, particularly, nitrogen. Of course, our nitrogen fertilizer in this country is, primarily, natural gas. We use about—we are at around 6 or 7 percent—5, 6, 7 percent of our natural gas in this country is used to produce nitrogen fertilizer. It is one of our prime, first choice, supplies of energy. So I put nitrogen fixation in the agricultural bill for research and the science bill for research, and the Department of Energy bill for research.

And it just seems to me tremendous potential if we pursue it with enough vigor to have the kind of legumes and nodules not only on the existing legume plants of the clovers and the soybeans or whatever, but to also look at the possibility of nitrogen fixation capabilities in some of the other plants that could so significantly improve the production in Africa or anyplace else in the world. Are

any of you aware of anything being done? When you mention in your testimony plants that can get along with less fertilizer, what are you talking about? I think it was you, Dr. Horsch, that might have mentioned it.

Dr. HORSCH. Yes. The ability to scavenge rare fixed nitrogen from the soil is something different plants do better or worse. And there are biochemical tools that should be discoverable and usable to increase the ability of a plant like corn to find and absorb lower concentrations of nitrogen than it is capable of today, and that means that you can increase the efficiency of fertilizer use. You can apply lower rates and still get good yields. A second area I will just mention is the use of nitrogen fixing plants themselves as green fertilizers or green manures, which can be combined with fertilizers with No-till, with other practices and biotechnology, to bring a more efficient source of nitrogen at lower levels as well.

Chairman SMITH. We sent you some of my draft legislation on coordination and to have better information of Americans over in these other countries to start more capably spreading the word on accurate scientific information on the potential and safety. Have you reviewed it, would you support such legislation, Dr. Conway, Dr. Kilama, Dr. Horsch? Would that help? Can you come up with any suggestions to improve it?

Dr. CONWAY. I think that first of all, it is very important that these debates that we have been hearing about this morning are conducted on the basis of science, so the more that is out there which relates to the real truth about these contentious issues, the better it will be. However, I would want to couple that with the points that we have been making, particularly, in this session, is that the most important thing in Africa is to build up the African staff in biosafety, in regulation, in biotechnology, so Africans can make much better decisions for themselves.

Chairman SMITH. So what I hear you saying is acceptance is not a problem, but it is. I mean, if you accept it and you know more about it, you are going to move ahead quicker, I suppose. Dr. Kilama.

Dr. KILAMA. I, actually, welcome it very wholeheartedly, Mr. Chairman, because one of the problems I have observed in Africa, in particular, is there are so many programs that are coming in from various sources, whether it at EU, in the U.S., from Asia, and there is a little bit of confusion within the Africans because there is so much redundancy in some of the programs that are being provided, and it actually has created a little bit of a problem in itself. And what I see as this bill doing is streamlining the process in which the U.S. Government provides support to Africa.

And I may want to add one more thing to the bill, and that is to actually encourage coordination of assistance that is being provided by the various agencies, and I am not in the government so I don't know how much they talk among each other. But at least sitting from the outside, I see that there are so many programs that could have been combined so there is no redundancy. And in fact, in a way, it might save us a lot of money if that is being coordinated by a group like the one you are proposing. So I am really very much in support of that bill and I believe it will do some good in terms of providing that opportunity for explaining biotech or

streamlining the kind of assistance that would be provided for Africa in biotechnology.

Chairman SMITH. Dr. Horsch, and maybe add to your response who should be the lead agency. Should it be Agriculture that, at least by name, is certainly involved with agriculture? Or in the draft legislation we wrote in the State Department, but it could very well be the Department of Agriculture.

Dr. HORSCH. Well, that is a hard question. I would definitely support your ideas in that bill and think it is a great idea. I have seen other examples of the interagency cooperation that have been very effective and helpful. I would like to just point out that NSF is probably the world's best, along with NIH, at competitive grants management, using reasonable amounts of money to very cost effectively and facilely focus attention on the most productive ideas. They are just second to none in the world. But they do lack a certain experience with application and with translating into farmers' fields and agriculture. USAID has that, in part, as their mission, and they are actually very good at getting things on the ground and out in farmers' fields, but they lack a certain facility with sort of rapid movement of competitive grants that could go to address some of the needs that we have heard. And if there was a way to kind of marry the two capabilities together to get this technology out to serve farmers' needs in farmers' fields more rapidly, I think that would just be a brilliant outcome.

Chairman SMITH. Any other comments on the lead agency?

Dr. KILAMA. I think we have got to look at biotechnology in two ways; one is research, one is politics. And at the moment, I think politics is very, very much out front, and I think an agency that understands the political world will also be very useful. At the same time, an agency that understands the need on how to bring this technology to the farmers would be important. So if I was going to really have a vote, maybe a co-chair between the Department of Agriculture as well as the State Department, because a lot of the things that we are discussing here have a lot of political implications to them. Socioeconomic issues and some of these things are better addressed at a political level as well as at the research or product level.

Chairman SMITH. Any comments or shall I go to the next question? I am not going to—you folks haven't eaten probably, and I am dedicated to being thinner so I might go on too long. A report released yesterday by the Nuffield Counsel on Bioethics, a policy group of the European Commission, actually suggested that maybe Europe's trade policies were hindering the advancement of biotechnology development in the world that could especially help developing countries. I mean, to me, it was maybe the beginning of an opening up of better information, better understanding, in the European community of the consequences of them being so dedicated to keep out any genetically modified products. Any reaction that the three of you might have?

Dr. CONWAY. Can I—if you don't mind, sir, if I can just correct you a little? The Nuffield Counsel on Bioethics is an independent body set up by the Nuffield Foundation. The Nuffield Foundation is a bit like the Rockefeller Foundation, so it actually has no rela-

tionship to the European Union except it is in the geographical mass called Europe. So I don't think——

Chairman SMITH. Aw, shucks.

Dr. CONWAY. My apologies, but I think it is important to make that clear. This is an independent body, which has come out yesterday with an extraordinarily good statement. By the way, there was also yesterday a statement by the International Council on Scientific Unions, which has made the statement that—it is in the Financial Times yesterday, so I am only quoting from that, which has made a similar strong statement about the role of GM crops and GM foods. I think it is very important when looking at Europe to distinguish between the European Union, European governments, activist organizations, and the general public. Europe is like the United States; it is a very complicated place, and one has to understand the different components that are in there.

Chairman SMITH. I am not sure, but it is certainly a challenge where we go. I mean, emotion can be so significant in restricting trade development. Greenpeace is very aggressive in suggesting the precautionary principle that something might happen later on, and so they sort of put science aside for the moment. But also, they become very—it seems to me very liberal with their interpretation of some of the testing that has gone on, whether it is the monarch butterfly or other problems that has been achieved. And somehow, there just needs to be a better understanding of the traditional crossbreeding and hybrid breeding that that also has dangers when you come up with 25,000 genes of two different plants and mate them together, you can end up with a lot of bad characteristics, sometimes dangerous characteristics. And being precise and understanding the results of taking one gene and folding it in, and the protein influence, it seems to me that Bt, for example, is now simple enough, and maybe that is not the right word, but that we could apply it in so many different products to help in different Bt's that are more effective in dealing with some of the specific problems and some of the specific plants. And Dr. Horsch, just your comments. It seems like the gates are just a little bit open and somehow we need to learn to open them the rest of the way.

Dr. HORSCH. Bt is a really interesting set of organisms. There are actually thousands of varieties of bacillus thuringiensis, which make proteins that control different kinds of insects. And we discovered and used ones for both caterpillars and certain kinds of beetles. Other labs have found ones that will control mosquitoes. Our newest product in the market controls the corn root worm, which is a different insect than the corn borer, and they are very different but both Bt genes. It is, as you point out, a very facile area of technology. And this diversity is all existing in nature for us to discover and put to use.

Chairman SMITH. What I would like to do is not keep you any longer, but let me ask each one of you to take a minute or two to conclude any comments that should be passed on to this subcommittee and our full Science Committee. So just sort of do a wrap-up, if you will, of any other thoughts that maybe we should be considering, and we would also ask you that you allow us and staff to send you some of the questions that we haven't asked

today. And so as far as a wrap-up, Dr. Conway, then Dr. Kilama, then Dr. Horsch.

Dr. CONWAY. Let me say, I think what is important is to understand that we are at the beginning of a decade long program here for Africa. That is the kind of time span that we have to be thinking of. This is what we have learned in our work in Asia to develop the role of biotechnology and food security, along with the other tools that are necessary. Keep stressing that. And anything that this Congress can do, anything that this Government can do, anything that American scientists, and American universities, and American private companies like Monsanto, can do to make that happen is going to be welcomed.

What it is going to take is people on the ground, Africans, and there are beginning to be a number; there needs to be more. What it is also going to take is the development of research capacity in the universities, and I don't just mean applied research. I mean, pure research, microbiology and other such departments in African universities. That is what we have seen as being most valuable in Asia. And in particular, it is going to mean a real partnership. It is going to mean bringing American, European scientists, together with African scientists, to crack this problem in partnership. And in particular, it is going to mean public-private partnerships of a kind like African Agricultural Technology Foundation, where you have got a foundation like ourselves, you have got companies like Monsanto, you have got the U.S. Government like USAID. That is the model for the future, and anything you can do in this committee to further that kind of model for Africa is going to be extraordinarily valuable. Thank you, sir.

Chairman SMITH. Dr. Kilama. Thank you, Dr. Conway.

Dr. KILAMA. I wanted to quickly respond to one thing before I make my final remark, and that is Greenpeace came out in this discussion in a variety of ways, and I have been troubled quite a bit as I discuss a lot of these issues in many radio stations in Africa why there is very little response to Greenpeace or to some of these organizations that are really damaging in terms of wrong information to the African people. And today, I am still troubled, why we haven't responded very strongly in terms of answering these people, word by word, or case by case. And I hope the Committee can at least look at ways in which we can address some of these issues pertaining to misinformation.

I believe what the Committee can really do is to look at Africa not in just one single issue. There is a very major problem in that continent that we really have to take a very close look and look at it from a global perspective. We have to look at why Asia, some of the countries in Asia, have moved far away from Africa, and yet, 30 years ago, many of them were at the same level. I think the problem really has to do with the way that many of these governments are running the institutions in Africa. There are no credible institutions in Africa that can stand up to some of the problems that might be created by government. I think we have to look at how we provide assistance to Africa.

If we simply want to provide a quick fix to certify maybe some response to pressure groups, we will be here 20 years from now talking about the same issues. But if we look at the issue in terms

of long-term process, building up the institutions, creating conditions in which the private sector can really flourish in Africa, and my view is very strong on this. The only way Africa is going to provide security for the food is to create a lot of private sector development in Africa, and there is no way out of this. Government cannot do it. The only way we can really solve the problem is to create the conditions in which the private sector can be able to flourish in Africa, investment from the private sector. And if we can address that issue, I think we will not be talking about it in 10 years.

Chairman SMITH. Very good. Dr. Horsch.

Dr. HORSCH. Thank you, Mr. Chairman. I would just like to reiterate the concept of partnerships. I think that is at the heart of what is needed and what will work. If you go to the dictionary, partnership has three different aspects: a common vision among the parties. Here, I think we all agree that farmers' success, good nutrition, and adequate food, and environmental conservation are a common vision for agriculture around the world.

The second component is sharing with each other, and biotechnology, in particular, is relevant to the sharing concept. Because it is an information technology, rather than a material or energy based technology or product, it can be shared without being used up. For energy, for chemistry, for tractors and such, if you share them, or use them, you consume them. Whereas, information technology, like biotech built in a seed, it can be propagated and shared without consumption.

And lastly, is cooperation with clear responsibilities, and I think we have heard today some mechanisms for both understanding and strengthening the different roles and responsibilities in the private sector, the public sector, and the public itself has to play in this process. Thank you.

Chairman SMITH. Gentlemen, we are grateful for your time, for your expertise. On behalf of the Congress, our compliments for your achievements, and with that the Subcommittee is adjourned.

[Whereupon, at 1:15 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Rita R. Colwell, Director, National Science Foundation

Q1. At the hearing, Congresswoman Johnson asked, "How do your agencies interact with non-governmental organizations that support research and development and capacity-building activities in Africa that are relevant to applications of plant biotechnology? What are some examples of such collaborations?" Could you please give some specific examples of interaction with non-governmental organizations? Can you give us specific names of programs or institutions you have been working with?

A1. Three examples are provided of recent interactions with NGO's that support research and development and capacity-building activities relevant to the application of plant biotechnology.

In FY 2003, NSF staff met with Executive Director and other staff of AfricaBio, an NGO based in South Africa that works with university, government, corporate and community stakeholders to promote the safe, ethical and responsible application of biotechnology. There are plans for NSF staff to meet with this group again in South Africa this summer to further explore ways of strengthening NSF support for collaborative research in the area of biotechnology in Africa.

NSF is part of an interagency group (including USDA and NIH) that funds several African-based International Cooperative Biodiversity Groups (ICBG's). These projects, one based in Cameroon and Nigeria and the other in Madagascar, combine chemical exploration of plants for agriculturally and/or pharmaceutically valuable compounds with biodiversity conservation and economic development. Each project involves one or more NGO's. In the Cameroon and Nigeria project, for example, NSF support helps fund the participation of Bioresources Development and Conservation Programme (BDCP), an NGO that undertakes capacity building for bioprospecting, biodiversity conservation, and natural products chemistry for agriculture and pharmaceuticals.

More broadly, NSF's work to bring the latest genomics research to scientists in the developing world has included working with the Rockefeller Foundation on the International Rice Genome Sequencing Project (IRGSP), and with several CGIAR Centers (Consultative Group on International Agricultural Research) on the global Musa (banana and plantain) genome, and on cereal crop genomes (e.g., corn, rice, and wheat).

Q2. Describe, including funding level, the current NSF programs that support U.S. scientists to do research in the area of plant biotechnology at institutions in Africa. For the most recent year for which data is available, and for the two preceding years, how many U.S. scientists participated in such programs, and what were the U.S. and foreign institutions involved?

A2. NSF-funded U.S. scientists are conducting research in areas relevant to plant biotechnology with institutions in Africa:

FY 2003: Several relevant awards for this fiscal year have not yet been finalized. Although details are not yet available, we can indicate that several awards are being recommended for FY03, to include activities such as joint research projects, support for African graduate students to attend a genomics meeting, and funds to send U.S. scientists to a scientific meeting in Africa. NSF/BIO (the Division of Environmental Biology) also contributed approximately $170,000 total to the two Africa-based International Cooperative Biodiversity Group (ICBG) projects that conduct chemical exploration of plants for agriculturally and/or pharmaceutically valuable compounds.

FY 2002: NSF's Office of International Science and Engineering provided $26,400 in support of an international meeting in South Africa that focused on an important plant pathogen, bacterial wilt. NSF funds supported twelve U.S. scientists or students to attend the meeting, which was also attended by twenty-two Africans from six nations. NSF (the Division of Environmental Biology) contributed approximately $170,000 total to the two Africa-based ICBG projects that conduct chemical exploration of plants for agriculturally and/or pharmaceutically valuable compounds.

FY 2001: NSF (the Division of Environmental Biology) contributed approximately $170,000 total to the two Africa-based ICBG projects that conduct chemical exploration of plants for agriculturally and/or pharmaceutically valuable compounds.

Appendix 2:

Additional Material for the Record

STATEMENT OF THEMBEITSHE JOSEPH (TJ) BUTHELEZI

"Biotechnology in South Africa"

My name is Thembeitshe Joseph Buthelezi (TJ), Thembitshe means Trust the Rock. My father said that I must not trust man, but the rock. I am from Northern Kwa-Zulu Natal in South Africa, next to the border of Mozambique and Swaziland—a place called the Makathini Flats. A hot, dry but fertile land where thousands of farmers grow cotton and corn to earn a living.

I am the chairperson of Hlokohloko Farmers Association which has 350 members. Our association is part of a larger farmers union called the Ubongwa farmers Union comprising 5000 members. Ubongwa is an umbrella body consisting of 50 farmers associations and meets once a month to discuss issues and address farmers' problems like market issues, cotton lint prices and seed varieties. When we want to talk to different supply companies or to government officials, or to forward information to our farmers, we do so under the banner of Ubongwa. I am also the chairperson of Ubongwa.

Cotton has been planted in the Makhatini for more than 40 years, and I have been farming it for 20 years. Now about 5 years back while I was preparing for our monthly meeting as usual, I was approached by a seed company's representative asking for an opportunity to introduce a new technology seed to our farmers which he said will improve yield while reducing input costs. Of course I was very much impressed to hear such good news and I put it on our monthly agenda. And when he came he gave his presentation, which was very nice. But farmers did not believe him, because they thought such technology would not work—and it was also more expensive than conventional seed.

However as a leader, I decided to take a risk and try the seed, because there is a quote that goes 'that the greatest risk in life is to risk nothing. And a person who risks nothing does nothing, achieves nothing and has nothing to tell.' And I said to myself if this seed does not work, I would tell the farmers it does not work. And if it works, I will tell them that it works and that they should try it. Therefore I bought one 25kg bag of the new cotton seed called Bollgard Bt cotton.

I planted 10 lines along side of my other cotton field and it did not take me long to realize I had made a mistake by planting only ten lines. The ten lines were much better than the other cotton on the field and I had sprayed very little pesticide. Come harvesting time, I harvested ten lines on Bt and ten on conventional cotton and the yield of Bt cotton was more than double.

The following season I planted 2 hectares of non-Bt and 2 of Bt cotton. That year we had a flood disaster and it rained for three months non-stop. I could not spray my fields because the chemicals would have been washed off by the rain. On the conventional cotton I remember I used to watch bollworms feeding on my plants but could do nothing about it. Sometimes I felt like crushing the bollworms with my own hands! But on the Bt side everything was fine. The cotton was growing nicely with no bollworm damage. It was amazing.

When I went to monthly meetings the farmers cry was that we were not going to harvest anything that season. On the one hand, the non-Bt crop, I agreed with them, but on the other hand I was very happy with the Bt crop. When harvest time came, I made 12,7 on the Bt side and only three bales on non-Bt cotton—and even this cotton was not of good quality. The other farmers asked me how I managed to get 16 bales while the situation was so bad. I told them that Bt cotton made it happen.

When the next season came I increased my cotton hectares from 4 to 8 and planted it all Bt cotton. I was surprised to see how much easier the Bt cotton was to grow and how I had to spend less time on the fields. I remember I used to go to the fields with other farmers and find that I had much less to do and could sometimes go under a tree enjoy the fresh air, while other farmers on each side of me were busy spraying and sweating in the sun. And when it came to harvest time again, I got more bales than they did. This time from 15 to 17 bales per hectare, while they were making only 6 to 8 bales per hectare. That encouraged me again to increase my hectares from 8 to 12. This season, seeing again that I harvest better yields with less inputs, I have decided to go for 25 hectares. I have enough time to do that size of land, maybe even more, and I am busy clearing the bush in preparation for the planting season. This is only possible for me because of Bt.

The benefits I get from Bt are the reduction of sprays from 10 to 2, and increased yield from 8 to 17 bales per hectare. The only sprays I use are the lighter less toxic chemicals—I can even see more frogs and bees in my fields, and no more dead birds.

As a result of these benefits, over 90 percent of the farmers in the Makhathini now grow Bollgard Bt cotton.

Let me say this one thing: We were not pushed to this improved seed, but we were attracted by the benefits. Bt cotton will also have an impact on improving South Africa's cotton production, because the country only meets about 55 percent of its needs and has to import the rest. The rest of Africa really wants to boost cotton production so that they can export cotton bales and also develop their own textiles especially since AGOA encourages them to export textiles to the United States. African farmers want freedom to grow any crop of their choice and have access to the best available technology. I support a free environment for growing and trading in biotech crops. Countries in Africa should be encouraged to use these improved crops because farmers will improve yields and make more money to improve their lives. That is what all farmers want. It is very unfortunate that some African countries are scared of using biotech because of the pressure and negativity from Europe.

We in the Republic of South Africa have decided to move strongly forward with biotech and we encourage other African farmers and countries to do the same.

Thank you.

An African Agricultural Biotechnology Portfolio

Portfolio Sector Items

Biofortification

Biotechnology Assisted Development, Deployment and Nutritional Efficacy Testing of High Mineral Beans to Combat Anemia in East Africa—East Africa—IFPRI

Development of Vitamin A enhanced maize for Africa—Pan African—Monsanto, Iowa State

Disease and Pest Control

West African Cacao: A Coordinated Biotechnology-Based Program to Breed Cacao for West Africa—West Africa (Nigeria, Ghana, Cameroon, Cote d'Ivoire—USDA

Capacity-Building in Cassava Biotechnology in Africa—Nigeria, Ghana Kenya—Danforth Cente

Biotechnology for Cowpea Improvement in Africa—Nigeria—UC–Davis, IITA

Preparation of Infrastructure for Extended Field Testing of Recombinant Rinderpest Vaccines—Kenya—UC–Davis

USAID/SADC Heartwater Research Project—Pan African—University of Florida

Development of Transgenic Papaya Resistant to Papaya Ringspot Virus for the Lake Victoria Region of Africa—USDA

Biotechnological Approaches to Improved Banana Production in Eastern Africa—INIBAP

Agricultural Biotechnology Support Project II—regional research projects in East, West and Southern Africa—Cornell University

South Africa supported research projects—indigenous buchu crop, apricot rootstock, livestock diseases

Uganda supported projects—insect, weevil, nematode resistant bananas

Kenya supported projects—virus resistant sweet potatoes, maize resistant to storage pests, livestock diseases

Nigeria supported research projects—cowpeas, cassava

Zambia supported projects—specifics to be determined

Mali and Mozambique—will support biotechnology research projects—specifics to be determined

Biosafety

Developing an ASARECA Program in Biotechnology and Biosafety

WECARD/CORAF: Biotechnology Capacity Building in West Africa

Risk Assessment for Genetically Modified Cowpea in Africa

Assessment of Ecological Impacts of Introducing GE Crops into Africa

SARB: Southern African Regional Biosafety Program

PBS: Program for Biosafety Systems—regional approach to biosafety in East, West and Southern Africa—ISNAR, IFPRI

Biosafety programs thru bilateral programs in Uganda, Kenya, Mali, Mozambique, Nigeria

OTHER—IMPACT ASSESSMENT, PUBLIC OUTREACH

Assessment of the Potential Impacts of Agricultural Biotechnology in East Africa—IPPRI, Purdue University

Biotechnology for International Agricultural Development—public outreach with Tuskegee University

Agricultural Biotechnology Support Project II—economic analysis to be done by Cornell University

U.S. Universities Working with USAID on Agriculture in Africa

University of California at Davis
Cornell University
University of Florida
Michigan State University
Ohio State University
Purdue University
Texas A & M University
Tuskegee University
Virginia Polytechnic Institute