

determining if the products were unsafe. The study concluded that GM crops so far developed and marketed had not shown any new risks on human health or the environment.

In May 2003, the Royal Society in London presented to a government-sponsored review in the United Kingdom two submissions that found no credible evidence that GM foods were harmful. Again in May 2004, FAO issued a report summarising the evidence drawn largely from a 2003 report of the International Council for Science (ICSU) – that ‘to date, no verifiable untoward toxic or nutritionally deleterious effects resulting from the consumption of foods derived from genetically modified organisms have been discovered anywhere in the world.’ Consequently, Dr Jacques Diouf, the Director-General of FAO, endorsed the spread of more productive biotech crops into poor countries, noting that the world would need to feed an additional two billion people by 2030, including 750 million more in Africa alone.

Conclusions

From the forgoing discussion, it is evident that biotech crops and products are safe if not safer than their conventional counterparts. Tanzania as a country has both regulatory and research capacities to safely deploy biotech products for the benefit of the people and to realise the objectives of the *Kilimo Kwanza* national initiative. Developing biotechnology in ways that contribute to the sustainable development of agriculture can help Tanzania to significantly meet the food and livelihood needs of its growing population.

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Facts on the safety of modern biotechnology

About AATF

The African Agricultural Technology Foundation (AATF) is a not-for-profit organisation that facilitates and promotes public-private partnerships for the access and delivery of appropriate proprietary agricultural technologies for use by resource-poor smallholder farmers in Sub-Saharan Africa (www.aatf-africa.org).

About WEMA

The Water Efficient Maize for Africa (WEMA) project is a public-private partnership coordinated by AATF to develop drought-tolerant African maize using conventional breeding, marker-assisted breeding, and biotechnology and make it available royalty free to small holder farmers in Sub-Saharan Africa.

Introduction

In Tanzania, agriculture accounts for about one third of the national income and provides employment opportunities for about 80 percent of the nationals. While Tanzania is endowed with abundant natural resources, it is among the poorest countries in the world, with over 30 percent of the population living below the poverty line. In Vision 2025, the government is committed to transforming the agricultural sector from subsistence to a commercial-oriented venture in order to make the country food secure and self sufficient. The Vision is very clear that the application of science and technology is pivotal to the country's quest to eliminate hunger.

With the high rate of population growth, poverty and diminishing areas suitable for food production, there is strong justification for introduction of high yielding biotech crop varieties. Tanzania's *Kilimo Kwanza* (agriculture first) initiative, which is aimed at accelerating agricultural productivity, is a noble initiative but it may remain an empty slogan if it is not backed by increased use of new technologies and good agronomic practices.

However, there are numerous myths, concerns and misinformation surrounding modern biotechnology products that could limit acceptance of such products in Tanzania. This policy brief highlights some of the benefits and safety of biotech crops to enable policy makers forestall such an eventuality.

What is modern biotechnology?

Simply defined, modern biotechnology is a technique used to isolate, select and transfer beneficial genes from one organism into another through a process known as genetic engineering. For hundreds of years, farmers and breeders have been improving crops through selection and breeding that resulted in transformation of some weeds into the crops that we cherish today. The only new thing is that today breeding has become more precise, efficient and effective, thanks to modern biotechnology.

Benefits of modern biotechnology

There are many benefits farmers derive from growing biotech crops. They include less cost of production, higher yields, less use of pesticides, safer environment, tastier and more nutritious foods and more income. For example, one of the benefits of transgenic

crops, such as *Bt* maize, is enhanced grain quality that helps to ensure food and feed safety. Scientists have shown that reduction of insect damage with use of these improved maize varieties results in lower levels of grain contamination by mycotoxins. Furthermore, increased drought tolerance and reduced insect damage to these improved varieties also means the healthier maize plants will utilise soil nutrients more efficiently, leading to higher yields.

The demonstrated benefits and safety of biotech crops may explain why, in a short period of time, the number of countries growing biotech crops jumped from six in 1996 to 25 in 2009. Of the 25 countries planting biotech crops, 15 are developing and 10 are developed. In 2009 a total of 14 million farmers grew the superior crop varieties, up from 12 million in 2007.

Status of biosafety and biotechnology in Tanzania

Tanzania has made great strides in terms of putting in place the National Biosafety Framework (NBF) to regulate and govern research, development and deployment of modern biotechnology into its agricultural systems. To begin with, the country is a signatory to the Cartagena Protocol on Biosafety. The government promulgated a national biotechnology policy in May 2009. The broad objective of the policy is to ensure that Tanzania has the capacity for safe and responsible application of modern biotechnology. And with the Environmental Management Act already in place to regulate biotechnology research and development, the country has high chances of reaping the benefits.

The country has about 16 agricultural research institutes (ARIs) out of which five have human and infrastructural capacity for biotechnology research and development. The institutes are ARI Mikozeni, ARI Uyole, Horti Tengeru, ARI Ukiriguru and ARI Mlingano. Public universities involved in agricultural biotechnology research and development are Sokoine University of Agriculture (SUA) and the University of Dar es Salaam. About 48 well trained Tanzanian biotechnology experts, majority of whom are PhD holders, run the institutions.

The Water Efficient Maize for Africa (WEMA) is the first research project aiming to conduct confined field trials of genetically modified (GM) crops in Tanzania. Drought is the most important constraint to African agriculture severely affecting maize, the most important African staple food crop. Three-quarters of

the world's severe droughts over the past 10 years have occurred in Africa. The WEMA partnership was formed in 2008 in response to a growing call by African farmers, leaders, and scientists to address the effects of drought in a way that is cost effective for African smallholder farmers.

The African Agricultural Technology Foundation (AATF) is coordinating the partnership whose objective is to develop and make drought-tolerant maize using conventional breeding, marker-assisted breeding, and biotechnology. AATF works with the internationally funded non-profit International Maize and Wheat Improvement Center (CIMMYT), the private agricultural company Monsanto, and the National Agricultural Research Systems (NARS) in eastern and southern Africa in this effort. Each partner brings its unique expertise to the project. AATF contributes expertise in leadership, public-private partnership management, technology stewardship and project management. CIMMYT provides high-yielding maize varieties that are adapted to African conditions and expertise in conventional breeding and testing for drought tolerance. Monsanto provides proprietary germplasm, advanced breeding tools and expertise, and drought-tolerance transgenes developed in collaboration with BASF. The national agricultural research systems, farmer groups, and seed companies participating in the project contribute their local germplasm, land and expertise in field testing, seed multiplication and distribution. WEMA is funded by the Bill and Melinda Gates and the Howard G. Buffett Foundations. Other countries participating in the WEMA project are Kenya, Uganda, Mozambique and South Africa.

The goal of WEMA is to make drought tolerant maize available royalty-free to smallholder farmers in Sub-Saharan Africa. The new varieties are expected to increase yields by 25 percent during moderate drought. Risk of crop failure from drought is one of the primary reasons why smallholder farmers in the country do not adopt improved farming practices. A more reliable harvest could give them confidence and incentive adopt new technologies.

Concerns about modern biotechnology

The advent of modern biotechnology and especially the potential for its application in agriculture and food processing was greeted with high expectations. Even so, the development and application of the technology

in a safe and sustainable manner remains a subject of considerable debate worldwide, and Tanzania is no exception.

Concerns, anxieties and fears have been raised about the safety and ethical aspects of genetically modified organisms to consumers and the environment. Biosafety regulations governing crop improvement technologies under the Cartagena Protocol are meant to ensure safe transfer, handling and use of GM technology to optimise benefits and minimise risks.

Even so, it is instructive to note that there has been no scientific evidence to prove that transgenic crops have any negative effect on human health, the environment or beneficial insects, such as bees and monarch butterflies, that play crucial roles in maintaining environmental integrity.

The genes introduced are for specific targeted traits and there are stringent verification procedures to ensure that they are the only ones expressed in resultant transgenic organism. The gene products are further tested for any adverse effects including toxicity and allergenicity at the early stages in the transgenic crop's development. The concept of 'substantial equivalence' is used to determine if the crop is substantially the same as the conventional variety. But before a judgment is made, the products must undergo extensive biochemical composition (nutritional testing) including assessment on long term effects through animal and insect feeding studies. According to the European Food safety Authority (EFSA), United Nations Food and Agriculture Organization (FAO) and United Nations World Health Organization (WHO), a transgenic product is considered fit for human consumption if it meets the above criteria.

Another concern regarding transgenic products is the possibility that its deoxyribonucleic acid (DNA) can alter consumer/human or animal DNA. DNA is a form of protein and is broken down in the intestinal tract before absorption. In the stomach, only DNA fragments can be absorbed, irrespective of whether from conventional or non-conventional foods. Hence, introduced gene is completely metabolised and not incorporated into human or animal DNA.

Before any biotech crop is released for field trials, data on food safety must be provided, among other criteria. Field trial data to ensure no adverse impacts on the environment, biodiversity and other concerns is required to support approval for its commercialisation.

Thus, foods derived from genetically improved organisms have to undergo a more stringent safety evaluation than non-transgenic ones, the latter being only tested for incidental contaminants.

Apart from pest or disease resistance, some biotech crops have been improved to enhance beneficial traits such as high vitamin A or essential amino acids (high lysine) in target crops. This makes them more nutritionally balanced compared to conventional foods. In reality, it is more likely to get nutrient imbalance or food-borne illness from non-transgenic than from transgenic foods, given the rigorous risk assessment they undergo.

There are no reported adverse health effects that have been reported from the consumption of food products derived from biotech maize, soybeans and other crops which have now been in the world market since 1996. Notably, the US for example has some of the most stringent food safety laws and regulations but continues to approve biotech crops for commercialisation as long as there is supporting data on each product's safety.

Indeed, the real objective of biotechnology is to enhance crop yields and reduce food losses at farm level (pest resistance, disease resistance, drought tolerance, etc) and reduce post-harvest losses (improved shelf life) as well as to improve nutritional value (such as high vitamin A, high essential amino acids, etc). The latter results in improved nutrient balance in staple foods such as maize. As the biotech debate will continue for a while, the scientific community and policy makers have a responsibility to communicate facts and not to be drawn into sensational discourse regarding the technology.

Some of the policy concerns in Tanzania, and indeed Africa, include fear that multinationals will control the food, feed and seed sectors; fear of loss of trade with Europe; loss of indigenous knowledge systems and ethics. The Tanzania Government has started to put measures in place to ensure that such concerns are adequately addressed through awareness creation and building of local biotech capacities.

In addition, it is important to note that major reputable international research bodies have given biotech crops a clean bill of health. For example, in 2001 the Research Directorate General of the European Union (EU) released a summary of 81 separate scientific studies conducted over a 15 year period aimed at