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Food Security Now or Wait for Research to Assess Risks?

Genetically Modified Crops and Smallholder Farmers in Africa

Genetically modified (GM) crops are by proponents considered as a possible solution to the food and nutrition problems in developing countries.

However, there are also concerns of how side effects may affect environment and human health. These will probably still remain unknown for decades.

But can Africa wait 30 years for research to give a definite answer about the risks connected with biotechnology?

Photo: Sven Torfinn/CABO/Panos

The main concerns about GM crops are that the side effects are still largely unknown. Picture shows a plant pathologist in Kenya examining farmer's crops for diseases.

Genetically modified organisms (GMO) are created by moving genetic "information" from one species to another in a way that does not take place in nature. Biotechnology in this field is developing fast and is moving towards simpler, cheaper and more effective modes that can be used on a large scale. Currently, there are mainly two trends in agriculture, namely herbicide tolerance and insect resistance, used separately or in combination, and aiming to increase productivity. There is considerable discussion worldwide about GM crops, particularly about the risks and benefits of cultivating and consuming them.

Concerns and potential benefits

The main concerns about GM crops are that the side effects, in terms of adverse impacts on the environment and human health, are still largely unknown and probably will be so for decades. Consequently, further research is needed. Large multinationals like Monsanto have significant control over seed production for these crops, which means that farmers are dependent seed supplier. These companies are patenting genes and other materials essential for the crop production.

The potential benefits of GM crops are that they may be able to reduce the environmental footprint of farming, reduce the use of pesticides, save fossil fuels, decrease CO2 emissions and conserve soil and moisture. Proponents also consider GM crops indispensable in meeting the serious food and nutrition security problem in developing countries. GM crops are not, however, regarded as a "silver bullet" that will solve all these problems, but it is stated they can make a significant contribution to agricultural output.

African countries have now built up several regional bioscience centres, such as, for example, the Southern Africa Network for Biosciences (SANBIO) to serve the continent as Centres of Excellence for the various aspects of biotechnology. The essential purpose of these centres is to ensure African control and ownership of the biotechnology agenda and products as timely and functional tools for the continent´s overall development.

240 million undernourished

According to FAO, about 230 million hectares are under rain-fed cultivation in sub-Saharan Africa (SSA). Small farms of less than 2 ha. cover about 80 per cent of arable land in SSA. Priority crops in SSA are cereals (maize, millet, sorghum and rice), legumes (groundnuts, cow peas and common beans) and roots and tubers (cassava, yams and sweet potatoes). By 2012, GM crops were cultivated in three SSA countries, mainly in South Africa but also to some extent in Burkina Faso and Sudan. Maize, soybean and cotton cover about 3 million hectares in SSA. According to FAO, the population in SSA is expected grow from 770 million (2005) to approximately 1,500-2,000 million in 2050. Today, about 240 million people are undernourished in SSA.

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Average cereal yields in SSA are relatively small (1-2 tonnes per ha.), and have not increased significantly over recent decades. The main limiting factors are reported to be poor weed-, soil-, fertiliser- and water management; poor cultivar selection; and late planting. White maize is the most widely grown staple in SSA, with more than 300 million people depending on it as their main food source. Some farmers successfully cultivate conventional hybrid maize, for instance.

As most biotech agriculture takes place in South Africa, it is natural to focus on reports and studies of small-scale farmer experiences there. All cotton grown in SA is GM, with a drastically decreased need for pesticides and increased yields compared to conventional cotton. Regarding GM maize, there are cases in South Africa where the insect resistance of maize has been compromised. This is natural: pest and disease resistance created by plant breeders is normally compromised sooner or later. Studies of the impact of GM maize and cotton on small farms in SA reveal that planting these crops has a marked positive effect on most farmer´s yields. The benefits of GM maize, whether conventionally pollinated or hybrid, are most marked where the genetic make-up is best suited to local growing conditions.

"GM crops are not a "silver bullet" that will solve all problems, but they can make a significant contribution.

However, most GM crops today are cultivated on large farms. In that context, there is a need for significant credit and capital, enough land, good education, skilled advisers, modern agriculture technology and knowledge, infrastructure, marketing channels, etc. In addition, GM crops alone should not be overemphasised as a way to end hunger and develop farming in Africa, because these poor countries have very complex problems that such crop inputs cannot solve.

Biotechnical research in SSA

There are many biotechnical research and development projects in SSA. Water Efficient Maize for Africa (WEMA) is a good example. The expectation is that in the near future, pending regulatory approval, maize varieties that are royalty-free, insect-protected and drought-tolerant will be introduced and delivered to smallholder farmers in Africa, to enable them to manage risk and increase food security. Other examples of ongoing projects in SSA relate to sorghum: increased levels of iron, zinc, vitamin A and E; rice: increased nitrogen efficiency and salinity resistance; cassava: virus resistance and increased levels of protein, iron, zinc, vitamin A and E; sweet potatoes: insect and virus resistance; Irish potato: late blight resistance; Pigeon peas: insect resistance; and cotton: drought tolerance, insect resistance and herbicide tolerance.

Photo: Sven Torfinn/Panos

GM crops alone should not be overemphasised as a way to end hunger and develop farming in Africa. So far, they are mainly cultivated on large farms that have the necessary support.

Many socioeconomic factors in the daily livelihoods of farmers affect the adoption of improved agricultural practices throughout southern Africa. The main ones in SA are: many farmers are older than 60 years and tend to be more risk averse; low reliance on own-farm income contributes to low adoption rates, because low farm productivity and off-farm income are inter-related; few young people are involved in farming; poor technology transfers to resource-poor farmers; the distance from homesteads to fields naturally influences agricultural intensity; and factors such as crop damage by animals due to the absence of fences.

The adoption of technical innovation implies a certain amount of risk and managing this risk is an important component of decision making. Assessment of the socioeconomic impact of a new technology is crucial. Not all GM crops available for transfer are relevant to African growing conditions, but the only way to assess the effectiveness and appropriateness of GM planting material is by testing it locally.

Many farmers in favor of GMO

Reports on the relevance of non-GM crop biotechnology and of some commercial GM crops to small farmer development in Africa are mainly positive. Of the five GM crops approved for production in South Africa, two have shown benefits for emerging and subsistence farmers: insect-resistant cotton and insect-resistant maize. The benefits of these approved commercial GM crops largely accrue to the farmers, who record easier management, less pesticide use, less labour and lower production costs as important factors in adoption. The value of good planting material is widely understood and accepted by small-scale farmers and they buy such material when it is needed, available and affordable. But this material alone will not ensure a good crop.

Small-scale farmers are mostly well versed in the input requirements, but constrained by lack of land, capital, technology and communication, and good marketing infrastructure. However, they receive very little assistance from their governments to boost their yields. There is a wide acceptance of the technology in areas with heavy insect infestation,

Photo: Brian Sokol/IDRC/Panos

It is not only about science. The traditions of the area, where development agencies and researchers want to introduce improved technologies, need to be considered.

coupled with pragmatic evaluation of input costs and savings where only periodic insect infestations are experienced. One of the frustrations of local recipients is the top-down approach adopted by technology donors. Arriving with a project proposal, donors are often confused by the lack of enthusiasm.

Successful agricultural technology transfer projects, like farming systems research, have not focused on the science only. They have included issues of farmer participation in research activities, consultation and acceptance, affordability of equipment, dissemination of knowledge to farmers and market access. It is important to recognise the complexity of agricultural systems as well as be sensitive to the traditions of the area into which development agencies and researchers want to introduce improved technologies.

Policies and trade legislation

It is crucial that the release of GM crops does not bring new risks and have irretrievable consequences for human health. In the face of the ongoing globalisation of agricultural production and the food trade, it is desirable to achieve global harmonisation of legislation and regulations on GM crops. These are becoming increasingly significant in world crop production and trade. The main opinion among scientists is that crop improvement by the modern molecular techniques of biotechnology is safe and no riskier than consuming crops modified by conventional plant breeding techniques. No scientist can, however, claim that there is a zero environmental and human health risk, especially in a long term perspective. GM agriculture as a whole faces the most restrictive regulatory framework outside the nuclear industry. All technologies and related activities are considered part of a risk/benefit trade-off. So the crucial question is whether Africa can wait for say, 30 years, for a more definitive answer about the risks connected with biotechnology.

Given that SSA countries are aiming to be self-sufficient in food in the future, there is a need for investments in agriculture, and resources must be allocated to all kinds of promising approaches.

First, investments must be focused on human capital. Appropriate education is necessary, not least for women, as they account for a large part of agricultural production. Improved extension services are a key factor in achieving sustainable and higher yielding agricultural production

The development of agricultural research is also, of course, significant. Investment in soil management to improve soil fertility and resilience is necessary. This may include no-tillage, appropriate crop rotation and incorporation of organic crop residues into the soil. Other approaches include agroforestry and avoiding slash-and-burn agriculture as well as bare soils as far as possible. Emphasis must also be placed on the interactions between the components of cropping systems and livestock production.

Food demand will increase

However, there is also a need for intensive soil mapping as regards both macro- and micronutrient content in various soils. Basic mechanisation, adopting improved seeds (including biotechnology crops) better irrigation and planting techniques, etc. are an absolute requirement. Probably intensification is imperative, by improving the efficiency of our scarcest ecological resources, land and water. Food demand will inevitably increase this coming half-century, especially in Africa, because of the twin pressures of population growth and economic development. GM crops will probably be one tool in an integrated, evidence-based, and sustainable agro-ecological production system for the future, with as few negative side effects on the surrounding environment as possible.

We can foresee that plant biotechnology could provide several benefits and address many challenges in food production. However, it is also crucial that the release of GM crops does not bring new risks and irretrievable consequences for the environment or human health.

Relevant literature

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Arguments and Disputed Scientific Conclusions

A Litterature Review of the Impacts

Influence on Human Health

Promising: Future GM plants are likely to have increased nutrient levels, produce pharmaceutical molecules, and have improved resistance to disease, cold, or drought, thus increasing food security in disadvantaged areas. There is as yet no evidence that transgenetic food is a health risk. The use of GM plants is generally reducing exposure to pesticides and changing the patterns of herbicide use to favour those with low toxicity, such as glyphosate, and might reduce the exposure of populations to mycotoxins, e.g., in maize.

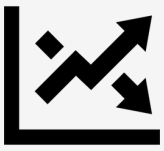
Adverse: The introduction of foreign genes into food plants may cause the emergence of new allergens and/or horizontal gene flows to the microbiological flora in the human digestive system, which might have a negative influence on health.

Environmental Impact

Promising: Herbicide-tolerant transgenetic plants have lower fitness outside cultivated land and are no problem. Systems are developed to prevent gene flow by using selectable marker excision. GM crops decrease the ecological footprint through soil conservation and improvement, and also by restoring populations of organisms living or nesting in the soil, as well as reducing the use of pesticides and fuels.

Adverse: Transgene flow to weed relatives may occur and thereby contribute to herbicide-resistant weeds. Property-related problems caused by unintended pollination of neighbouring crops are likely to arise. Horizontal gene transfer to prokaryotes (bacteria) living in the environment may occur.

Food Quality



Promising: One of the important benefits of transgenic crops is the ability to generate more nutritious varieties, possibly to the benefit of a malnourished population. GM agriculture as a whole faces the most restrictive regulatory framework outside the nuclear industry. The dogmatic requirement for ”zero risk” is astonishing, given that all human technologies and activities are considered to be part of a risk/benefit trade-off.

Adverse: The results have been far from successful. The only putative success has been obtained with”Golden Rice,” a producer of pro-vitamin A. In the absence of ”adequate” safety studies, the lack of evidence that GM food is unsafe cannot be interpreted as proof that it is safe.

Economic and Social Views

Promising: GM crops increase food production, while reducing the environmental footprint. Overall, in developed and developing countries the adoption of GM crops increases farmers' income. The increase in income for small-scale farmers in developing countries can have a direct impact on poverty alleviation and quality of life. Globally, about 90 per cent of the farmers who grow biotechnology crops are small farmers in developing countries (mainly in Asia).

Adverse: GM crops favour large farms and increase capital inputs and decrease labour needs, leading to the exclusion of subsistence agriculture. This leads to a structural rationalisation, with small farmers leaving their land, and the loss of traditional agricultural knowledge.

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