Genetically modified crops: how long before Africa sees its share of the gains?


FAO

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The technology of genetic modification (GM) has now been utilised globally on a widespread commercial basis for 18 years and by 2012, 17.3 million farmers in 28 countries had planted 170 million hectares of crops using this technology.[1] Some 90 per cent of these are resource-poor farmers in developing countries.

During this period, GM technology has delivered important positive socio-economic and environmental benefits for both farmers and citizens in the adopting countries.[2,3,4] These have arisen even though only a limited range of GM agronomic traits – largely herbicide tolerance and insect resistance – have so far been commercialised, and only in a narrow selection of crops (mostly cotton, canola/rapeseed, maize and soybeans).

Genetically modified crops have brought very significant gains at farm level.

There have been very significant net global economic benefits at the farm level amounting to US$ 116.6 billion for the 17-year period 1996–2012, and US$ 18.8 billion in 2012 alone (in nominal terms).[2] These economic gains have been divided equally between farmers in developed and developing countries. Adopting farmers in developing countries have also seen the highest yield gains associated with use of the technology and derived the largest financial gains on a per-hectare basis.

Genetic modification has also made important contributions to increasing global production levels of the four main crops, having for example added 122 million tonnes and 230 million tonnes to the global production of soybeans and maize, respectively, since the introduction of the technology in the mid-1990s.

In terms of key environmental impacts, the adoption of the technology has reduced pesticide spraying by 503 million kilos (a global reduction of 8.8 per cent) and, as a result, decreased the environmental impact associated with herbicide and insecticide use on these crops by 18.7 per cent as measured by the Environmental Impact Quotient indicator (EIQ). The EIQ distils the various environmental and health impacts of individual pesticides in different GM and conventional production systems into a single "field value per hectare", and draws on key toxicity and environmental exposure data related to individual products. Developed at Cornell University in the 1990s, it provides a better measure to contrast and compare the impact of various pesticides on the environment and human health than weight of active ingredient alone. It is however, an indicator only (primarily of toxicity) and does

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not take into account all environmental issues and impacts.

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The new GM technology has also facilitated a significant reduction in the release of greenhouse gas emissions from the cropping area through reduced fuel use and the facilitation of no-tillage production systems that allow more carbon to be stored in the soil. In 2012, this resulted in 26.7 million tonnes of carbon dioxide no longer being released into the atmosphere, which is a saving equivalent to removing 11.9 million cars from the roads for a year – equal to 41 per cent of all cars registered in the UK.

Adoption in Africa

To date, the commercial adoption of crop biotechnology in Africa has been very limited. South Africa first embraced the technology in 1998 and applies insect-resistance technology in its maize and cotton crops and herbicide-tolerance technology in maize, cotton and soybeans. The incomes of farmers using the technology increased by US$ 1.15 billion during the period 1998–2012, and resulted in savings of more than 1.2 million kilos of insecticide active ingredient and a reduction of about 0.9 million kilos of herbicide active ingredient.

Only two other African countries have – more recently – adopted biotech crops: Burkina Faso, where farmers using insect-resistant cotton since 2008 have seen farm income gains worth US$ 187 million, and Sudan, which first used the same technology in its cotton crops in 2012 and where adopting farmers are reported to be benefiting by up to US$ 400 per hectare from significantly higher yields.

So why has Africa been slow to adopt crop biotechnology?

A primary reason has been the way in which African governments have chosen, or are choosing, to regulate the technology.[5] Many African governments have adopted the European approach to regulating genetically modified organisms (GMOs). This requires new and separate laws, new institutions, and applies a very cautious approach to approvals in which non science-based decision-making occurs. This inevitably leads to delays.

Establishing biotech systems is time-consuming because of the need to identify local experts with relevant knowledge and skills to develop and implement the new laws and institutions. This is followed by the requirements to pass new bio-safety laws through parliaments followed by new implementing regulations, and to establish a functioning biosafety committee that can review applications. The whole process, where started, has also been undertaken in an environment of suspicion and concern about possible negative environmental and human health, fuelled by anti-technology activist groups, typically located outside Africa, which are ideologically opposed to GMO applications in agriculture.

This adds up to high costs and uncertain regulatory systems, which are a recipe for stifling innovation. This is especially discouraging when the new technology involves locally adapted applications for the benefit of the farmers themselves – such as combating crop losses due to viral, bacterial, insect and fungal infestations of major African crops including so-called orphan crops like bananas and cassava. It is therefore not surprising that few GMO crop applications have completed the regulatory approval process for commercialisation in African countries, especially as strong

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political support is required to overcome organised anti-science-based opposition.

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Proceeding with caution is a valid and virtuous principle to apply to the regulation and application of crop biotechnology in African countries. However, largely copying the overly precautionary approach commonly applied in Europe has resulted in Africa losing out much more than food-secure Europeans. The "losses" experienced from lack of access to GMO agriculture in Europe manifest themselves in higher production costs and prices of non-GM derived foods, lower rates of growth in agricultural productivity and declining competitiveness relative to GMO-adopting countries, plus the foregoing of environmental benefits. As European citizens are generally well-fed (many increasingly overfed) and well-off relative to their African counterparts, it matters much less to European consumers if the price paid for food is higher than it could be if GM crop technology were more freely applied to European agriculture. Similarly, it matters much less to European farmers than to African farmers if they are denied access to productivity-enhancing technology because European farmers still have access to relatively generous agricultural income support systems and subsidies.

The future in African countries

Some positive signs of progress can be seen. Confined field-trial approval has been granted in Ghana, Nigeria, Cameroon, Kenya, Uganda and Malawi for traits of direct relevance to local crops including insect-resistant cowpea, nitrogen-efficient and salt-tolerant rice, wilt-resistant banana and bio-fortified sorghum. Biosafety legislation also moves forward in some countries. The Ugandan government, for example, has endorsed the 2012 Biosafety Bill, which has

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been tabled for ratification by Parliament. Regional initiatives are also progressing, for example the Common Market for Eastern and Southern Africa (COMESA) initiative to help countries with limited resources share information and implement international biosafety standards.

However, there remain a number of challenges to be overcome before African farmers and citizens can share in the benefits of crop biotechnology. Progress continues to be slow, even for GM crop technology that has already been widely adopted around the world such as insect-resistant cotton, which continues to experience delays to commercialisation in countries like Kenya and Uganda. New crop biotechnology innovations specifically targeted at African problems and crops have not yet progressed beyond confined trials, and remain at best five and more likely ten years away from possible farm-level adoption.

If African countries are to see any of the potential benefits that crop biotechnology has to offer at anything other than a very slow pace, there is an urgent need for both citizens and politicians to recognise that their countries have much more to lose from shunning an important agricultural technology that enhances productivity and contributes sustainably to food security than their European counterparts. If this recognition can rapidly become a broader consensus in Africa, it may help deliver the political will to move forward with legislation and to apply a science-based system to facilitate the approval and availability of crop biotechnology in many countries. There is also an urgent need for continued capacity building to adapt new GM technologies to African crops and growing conditions, and to redress the lack of trained scientists with experience of working with African agriculture.

References

1 James, C. (2014) Global status of commercialised biotech/GM crops: 2013, *ISAAA Brief* No. 46. International Service for the Acquisition of Agri-Biotech Applications, Ithaca, NY. ISBN 978-1-892456-55-9. www.isaaa.org/resources/publications/briefs/46/.

2 Brookes, G., Yu, T.-H., Tokgoz, S., Elobeid, A. (2010) The production and price impact of biotech crops, *Agbioforum* 13(1): 25–52. www.agbioforum.org.

3 Brookes, G., Barfoot, P. (2014) Economic impact of GM crops: the global income and production effects 1996-2012, *GM Crops and Food, Biotechnology in Agriculture and the Food Chain* 5.11: 1-11. www.landesbioscience.com.

4 Brookes, G., Barfoot, P. (2014, forthcoming) Key global environmental impacts of GM crop use 1996-2012, *GM Crops and Food, Biotechnology in Agriculture and the Food Chain*. www.landesbioscience.com.

5 Paarlberg, R. (2008) *Starved for Science: How Biotechnology is Being Kept Out of Africa*. Cambridge, MA, Harvard University Press.

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