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GMOs or local crops for climate change adaptation in Africa?

Key findings and policy recommendations from the AfricaAdapt network

Climate change is reframing Africa's food security debate. Farmers have long adapted to recurrent droughts through traditional practices such as intercropping. But now they face increasingly unpredictable weather patterns, degraded soils, declining yields ... and ever more mouths to feed. Can transgenic biotechnology partially mitigate climate change and help Africa's farmers adapt to its impacts?

The AfricaAdapt network asked its members to discuss whether African countries should embrace genetically modified organisms (GMOs) as a means to cope with climate change. This polarizing issue drew responses from agricultural researchers, academia, extension organizations and grassroots community groups. The diverse perspectives - economic, ecological, political and social - made for a lively debate. This brief summarizes their insights and recommendations.

Key policy recommendations

1. Invest in research on GMOs and local seed varieties to determine the best solutions to Africa's food security crisis in the face of climate change.
2. Increase investment in research on the potential impacts of GMOs on human health, biodiversity and local economies.
3. Build capacity for climate change adaptation among African scientists and increase funding for research on adaptive agricultural approaches.
4. Create policies that protect smallholder farmers by ensuring the preservation of local seeds and traditional knowledge as means to adapt to climate change.

“Africa must continue to promote investment in both conventional and non-conventional approaches and develop stringent biosafety measures to support both. African scientists need training to develop their own crops, which are grossly under-researched.”

Stuart Coupe, Practical Action

Key policy recommendations

1. Invest in research on GMOs and local seed varieties to determine the best solutions to Africa's food security crisis in the face of climate change.

Nearly all participants in the AfricaAdapt discussion group stated the need for more data on GMOs and their potential benefits and risks. But just as many people stressed the critical lack of knowledge about Africa's diverse traditional food crops, which are already adapted to their environments and may be more resilient to climate change than transgenic monocultures.

Many felt that the potential of Africa's local species is yet to be tapped. Charles Dhewa of Knowledge Transfer Africa bemoaned, “billions have been invested in African agriculture to date, but little has been devoted to local varieties and breeds”.

Several respondents doubted the ability of GMOs to solve Africa's food crisis. Some criticized the emphasis on herbicide and pest resistance in transgenic varieties, stating that more should be done to increase the nutritional capacity of GMOs. Others questioned the assumption that production shortages are at the root of food insecurity – 30–40% of Africa's agricultural produce is lost due to poor post-harvest handling, storage and processing methods.⁹ But some felt that Africa cannot afford to lag behind when it comes to biotechnology, stressing the need to embrace the potential solutions offered by GMOs, while carefully monitoring any risks.

“Africa stands to benefit immensely from the promotion of GMOs in the region. However, not enough research has been done to establish the long-term effects, impact and repercussions of large-scale adoption of GM seed technology.”

B.T. Hanyani-Mlambo, University of Zimbabwe

“After a decade of commercial growing of GMOs, only two features dominate – resistance to herbicides and resistance to some insects. This is the feature that farmers are lobbied to pay for. Therefore, a discussion on GMOs' contribution to alleviate poverty and hunger is hypothetical.”

Teshome Hunduma, The Development Fund

2. Increase investment in research on the potential impacts of GMOs on human health, biodiversity and local economies.

GMOs have encountered strong resistance since they were introduced, with fears of ‘Frankenfoods’ that may cause widespread illness in human and animal populations. But researchers assert that transgenic biotechnology poses no greater risk than hybrid crops, which have been bioengineered for decades.¹⁰

Still, many countries in Europe and elsewhere have banned GMOs or insisted on labeling them. Discussion participants argued both sides of the health equation, but all called for the need to fully research how GMOs will affect human and environmental health. Concerns focus on increased exposure to herbicides, potential allergic reactions and antibiotic resistance.

Biodiversity was raised as a key issue, particularly with respect to local seed varieties. FAO estimates that about 75% of the genetic diversity of agricultural crops has been lost since 1900, as traditional crops are replaced with hybrid monocultures.¹¹ Potential ecological risks of GMOs include GMOs mixing with local crops, resulting in the loss of genetic purity; the development of ‘superweeds’ and pest resistance; and the killing of beneficial insects along with crop pests. Also, the use of ‘terminator technology’ creates sterile plants, depriving insects, birds and mammals of the pollen, nectar, seeds and fruit they need to survive.

Counter claims state that herbicide-resistant GMOs can actually improve the diversity of soil fauna and flora, because farmers disturb the soil less before sowing. This could lead to less water and wind erosion, and thus increased soil moisture. However, many respondents felt that the known and potential negative impacts of GMOs far outweighed the benefits seen to date.

Resistance to GMOs in Africa's export countries will have a major impact on the decision to adopt transgenic crops. Several discussants pointed out that consumers are becoming more selective, leading to more discriminatory markets. Sustainability labeling could play a major role in the cost-benefit ratio for African farmers.

“The most serious problem ... is that African governments do not want to invest in agricultural research. If African governments invested significantly in African-centered research, we could be debating a different mix of options now, rather than the simple ‘GMOs or no GMOs’ debate.”

Muyeye Chambwera, IIED

3. Build capacity for climate change adaptation among African scientists and increase funding for research on adaptive agricultural approaches.

Capacity is a critical issue facing agriculture in Africa. Institutional infrastructure, resources and training are limited along the production chain – from basic research through agricultural practices to market access and development. Farmers in sub-Saharan Africa don’t have access to tractors and other farm machinery; agriculture relies overwhelmingly on human power.¹² Thus, the argument that GMOs can reduce GHG emissions through lower fuel use for tilling and spraying is much less relevant.

“Africa cannot be isolated from the rest of the world in taking advantage of technological innovations ... it still needs to have the capability – human and technical – to undertake the necessary risk assessments linked to GMOs.”

Judith Francis, Technical Centre for Agricultural and Rural Cooperation (CTA)

“There is a lot of room to use biotechnology and genomics to better understand local crops and varieties of major crops in African agro-ecosystems, which play an important role in local culture. Improving the yields of those crops and fully using their adaptive traits should be the focus.”

Carlo Fadda, Bioversity International

Africa’s continued dependence on human power was highlighted by several participants. Many felt strongly that adaptation research should initially focus on getting smallholders up to speed in adopting fertilization techniques, water harvesting and high-yielding seeds, to see what improvements can be made before considering GMOs.

Many contributors called for governments to fund demand-driven research. The lack of support for Africa’s competent scientists has led to a ‘brain drain’ as skilled researchers leave for better opportunities in Europe and North America. If adequate funding is lacking for basic agricultural research, the risks of introducing GMOs will be even higher.

“Human and institutional capacity to enable Africa to keep abreast with international initiatives and developments in the area of GMOs is critical. It needs to be addressed at all levels, especially in policy to ensure that national governments allocate adequate – not cosmetic – resources to capacity development issues.”

Anthony Youdeowei, International Consultant

“The technology itself is not the issue, but rather how public and private R&D institutions set priorities, involve farmers, and deliver the goods.”

Shawn McGuire, University of East Anglia



“We don’t necessarily have to abandon traditional methods when we are confronted with new ones. Those who believe in GMOs should be able to try them, but we should also capitalize on existing techniques to safeguard traditional methods and empower African farmers and rural people.”

Martin Tsounkeu, Africa Development Interchange Network

4. Create policies that protect smallholder farmers by ensuring the preservation of local seeds and traditional knowledge as means to adapt to climate change.

Smallholder agriculture is the foundation of food production in Africa. Discussants emphasized the need to make sure that smallholders do not become dependent on biotechnologies, no matter how effective they may seem. Several researchers raised the example of *Bacillus thuringiensis* (Bt) cotton in India, where farmers were forced to pay for more fertilizer and herbicides when yield increases faltered after 2 years. They also shared concerns over the potential risk of litigation for intellectual property right infringements if smallholder plots are contaminated by nearby GMO fields.

Climate change is a major factor in the GMO vs. local seeds debate. Smallholders have practiced *in situ* conservation of local seed varieties for centuries; this preserved diversity has allowed them to adjust to seasonal variations. Many are doubtful that GMOs will prove as resilient to drought and flooding, and fear that local agrobiodiversity and knowledge will be lost permanently.

Smallholders cannot meet the conditions needed for modern agriculture on small plots of land with hand-held hoes. René Segbenou of Bénin questioned the ethics of using Africa’s limited resources to develop biotechnologies at the expense of priorities such as water and soil management, documentation of local seed varieties, and access to markets.

Yet, despite strong opinions on both sides of the debate, many believed in the value of combining traditional and modern methods. Whichever path countries choose, they must consider who the real beneficiaries are and prevent public exploitation through proper policy and legislation.

Safe development of biotechnologies depends on clear national policies. Currently, 45 African countries have ratified the Cartagena Protocol of Biosafety,⁷ and many are developing regulatory systems for modern biotechnology application (see Fig. 1). Only within such a framework can African countries map their own path to food security in the face of climate change

“The issue of GMOs is more than just an experimental scientific question where field results on yields are compared. All economic, cultural, sociological, political and environmental aspects should be considered, from the very local (i.e. smallholder farm plots) to country, region and continent scales.”

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GMOs in Africa: What are the issues?

According to the latest Food and Agriculture Organization (FAO) statistics, over 25% of the world's 925 million hungry people live in sub-Saharan Africa. Half of the world's hungry are from smallholder farming communities, living on marginal lands that are vulnerable to the effects of climate change.¹ Yet, in Africa, smallholder farmers produce nearly 90% of the continent's total food output.²

GMOs may help mitigate climate change. Herbicide-tolerant and pest-resistant crops need less tillage for weeding and less spraying of pesticides, and thus less farm diesel on mechanized farms. Leaving crop residues on the ground in 'no-till' farming practices can increase soil moisture and carbon sequestration. Nitrogen fertilizer accounts for one third of greenhouse gas (GHG) emissions produced by agriculture;³ these emissions can be lowered by GMOs that use nitrogen more efficiently. In terms of adaptation, drought-tolerant crop varieties, such as those promoted by the Water Efficient Maize for Africa partnership⁴ may help farmers better cope with the effects of climate change.

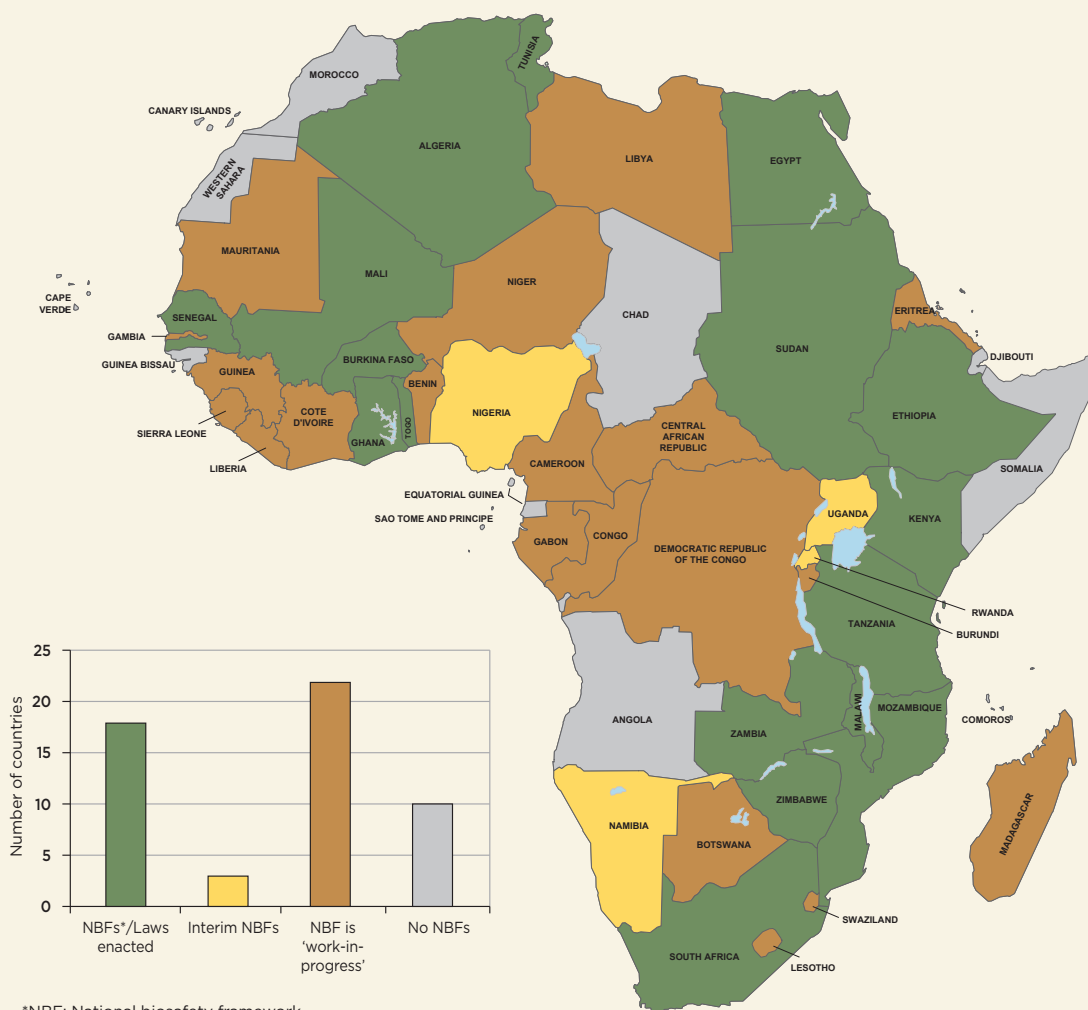
However, GMOs remain controversial due to the lack of long-term data about their safety and effectiveness. One study of 130 research projects over 25 years concluded that GMOs are not per se riskier than conventional plant breeding technologies.⁵ But another report of data from over 400 scientists found a lack of transparent communication about GMOs' benefits and risks.⁶ There is widespread resistance to GMOs in Europe, and to date only 3 African countries produce GMO crops for commercial purposes.⁷

Africa has not experienced a Green Revolution as seen in Asia and Latin America. Its soils are more degraded, drought is more common, and it lacks the research capacity to boost wide-scale productivity. Its smallholder farmers have no access to the financing, crop insurance and government support that modern agriculture depends on.⁸ Any discussion of GMOs in Africa must address its unique circumstances.

Questions raised in the debate include:

- ▶ **Food security** – Can GMOs provide higher yields consistently over the long term? Are they more resilient to climate change than local crops?
- ▶ **Health** – What are the potential long-term impacts on human health and wellbeing?
- ▶ **Biodiversity** – How will GMOs change agricultural ecosystems (e.g. impacts on pollinating insects, weed resistance and local varieties)?
- ▶ **Trade** – How would adopting transgenic crops affect African export markets?
- ▶ **Cost-benefit ratio** – Do the higher yields justify the higher cost of GMO seeds and fertilizer? What is the true cost to smallholders over the long term?
- ▶ **Capacity** – Do African countries have the scientific infrastructure and knowledge for research, monitoring and evaluation?
- ▶ **Livelihoods** – What are the potential socioeconomic impacts on smallholder farmers? Will traditional knowledge and culture be eroded?
- ▶ **Equity** – Will smallholders be vulnerable to prosecution for breach of copyright by biotech companies in the case of contamination?

Status of biosafety regulation in Africa



*NBF: National biosafety framework

Source: NEPAD Agency African Biosafety Network of Expertise (ABNE) (2010). 'Status of crop biotechnology in Africa'.
 Online: <http://www.nepadbiosafety.net/abne/wp-content/uploads/2012/02/ABNE-NBFs-February-2012.png>

“The balance of evidence is certainly not in favor of those who take extreme positions on the issue. This is not a blanket endorsement of the technology. To the contrary, it is a case for basing all decisions on logic and evidence and continuing to monitor applications. No action, including nonaction, is risk-free.”

Calestous Juma, Harvard University

“What Africa lacks is the kind of open debate enjoyed by other regions. There are limited opportunities for African scientists to inform politicians and the public on the merits and demerits of technologies. ... [the AfricaAdapt network] is a useful forum for scientists of different specializations to provide their arguments for or against GMOs.”

Muyeye Chambwera, IIED

AfricaAdapt would like to thank all of the participants in the e-discussion for their contributions, as well as the selected smallholder farmers for generously sharing their experiences and local knowledge.

AfricaAdapt is an independent bilingual (French/English) network focused exclusively on Africa. The network facilitates the flow of climate change adaptation knowledge for sustainable livelihoods between researchers, policy makers, civil society organizations and communities who are vulnerable to climate variability and change across the continent. AfricaAdapt is hosted by Environment and Development in the Third World (ENDA-TM), Forum for Agricultural Research in Africa (FARA) and IGAD Climate Prediction and Applications Center (ICPAC), and is funded through the UK Department for International Development (DFID) and the International Development Research Centre (IDRC) Climate Change Adaptation in Africa Programme.

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