

Reducing Pesticide Dependence through Genetically Modified Crops: Adoption Barriers and Yield Benefits in Sub-Saharan Africa

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INTRODUCTION & AIM

- The overreliance on chemical pesticides in sub-Saharan African (SSA) agriculture poses major challenges to human health, biodiversity, and environmental sustainability [1]. While genetically modified (GM) crops such as *Bacillus thuringiensis* (*Bt*) cotton, pest-resistant cowpea, and pest-resistant maize have demonstrated potential to lower pesticide use and increase crop yield, their widespread adoption remains limited across SSA. As illustrated in Figure 1, only a few African countries have commercialized or conducted field trials of GM crops, reflecting the uneven progress of biotechnology adoption across the continent.
- Thus, this study aims to assess the contribution of GM crops to pesticide reduction and yield improvement; examine the barriers to the adoption of GM crops and the strategies that can enhance their uptake for more sustainable and resilient crop production in the region.

Africa Biotech/GM Research and Commercialization Status by 2020

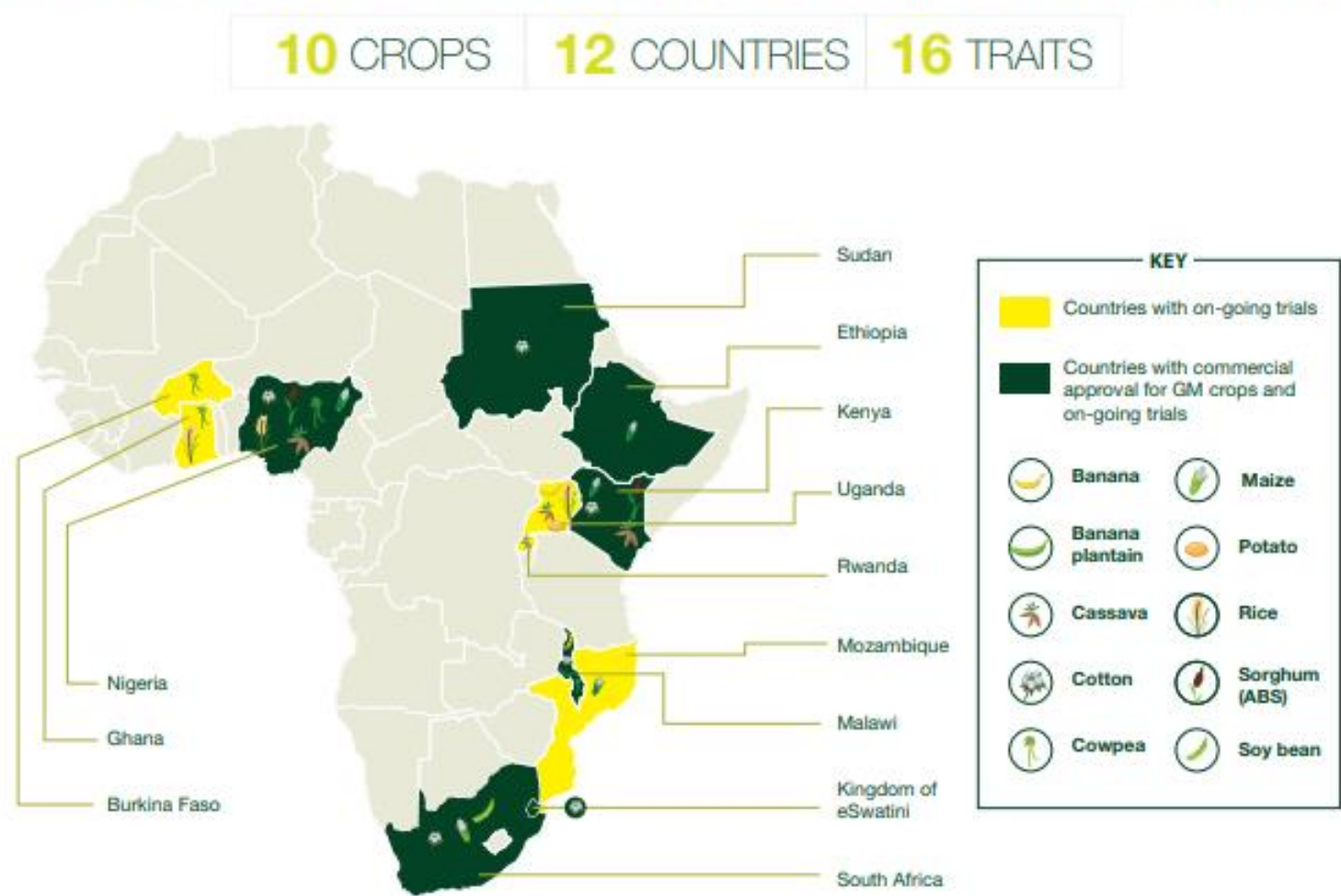


Figure 1. GM crop adoption in Sub-Saharan Africa, 2020 (Source: ISAAA AfriCenter, 2021 [2]).

METHOD

A structured literature-based approach was used to synthesize evidence from peer-reviewed articles and government reports published between 2010 and 2025. The summary of approved GM crop events and crop types for the three focus countries were also retrieved from the International Service for the Acquisition of Agri-biotech Applications (ISAAA) database [3].

- Focus countries:** Nigeria, South Africa, and Burkina Faso.
- Comparative analysis:** Examined GM crop performance, pesticide usage rates, and yield outcomes across these nations.
- Adoption barrier framework:** Identified factors under three domains—regulatory/policy, socio-economic/cultural, and institutional/knowledge-based barriers.
- Success Factors:** Evaluated factors that have contributed to and could be leveraged for the adoption of GM crops.

RESULTS & DISCUSSION

Table 1. Summary of Approved GM Crop Events and Crop Types in Nigeria, South Africa, and Burkina Faso

Each “event” represents a unique gene insertion conferring specific traits such as pest resistance, herbicide tolerance, or improved yield (Source: ISAAA GM Approval Database, 2025).

Crop (Scientific name)	Nigeria	South Africa	Burkina Faso	Interpretation:
Cotton (<i>Gossypium hirsutum</i> L.)	1 Event	11 Events	1 Event	South Africa demonstrates the highest diversity of GM crop events, particularly in maize and cotton, reflecting a well-established biosafety framework and commercial-scale adoption. Nigeria shows emerging diversity with recent approvals for GM cowpea and maize, while Burkina Faso's GM activities remain limited following the suspension of <i>Bt</i> cotton.
Cowpea (<i>Vigna unguiculata</i>)	1 Event	—	—	
Maize (<i>Zea mays</i> L.)	19 Events	49 Events	—	
Soybean (<i>Glycine max</i> L.)	11 Events	16 Events	—	
Wheat (<i>Triticum aestivum</i>)	1 Event	—	—	
Canola (<i>Brassica napus</i>)	—	5 Events	—	
Rice (<i>Oryza sativa</i> L.)	—	1 Event	—	

Environmental and Agronomic Impact:

- Nigeria's adoption of GM cowpea (SAMPEA 20-T), has shown strong farmer acceptance. The *Bt Vigna unguiculata* (pod-borer resistant cowpea) exhibits resilience against the *Maruca vitrata* pest, resulting in higher yields and reduced pesticide use, thereby enhancing food security [4].
- In South Africa, commercial production of *Bt Zea mays* L. and *Gossypium hirsutum* L., which are resistant to insects, has greatly raised yields and decreased pesticides use [4].
- Burkina Faso's adoption of *Bt* cotton (*Bt G. hirsutum* L.) initially led to higher yields, reduced pesticide use, and increased farmer income, but cultivation was later suspended due to fiber quality and policy concerns, leading to a decline in progress [4].

Table 2. Key Barriers to the Adoption of GM Crops in Sub-Saharan Africa

Category	Key Barrier	Example
Regulatory	Lengthy approval and biosafety delays	Burkina Faso's suspension of post-field trials
Socio-economic	Limited farmer awareness and misconceptions	Misinformation on GM food safety in Nigeria
Cultural	Public hesitancy driven by distrust in foreign technology	Regional variation across West Africa
Economic	High seed cost and dependence on private companies	Smallholder farmers' limited access

Success Factors:

- Supportive biosafety frameworks (e.g., South Africa's broad regulatory framework that permits the commercial production of specific GM crops).
- Farmer training and demonstration plots that build confidence.
- Partnerships between research institutes, NGOs, and local cooperatives.

CONCLUSION/ FUTURE WORK

GM crops in sub-Saharan Africa have shown strong potential to reduce pesticide use, boost yields, and improve farmer livelihoods. Yet, adoption remains limited due to regulatory, policy, and public perception challenges. Future efforts should strengthen biosafety frameworks, enhance public awareness, and promote regional collaboration and research on locally adapted GM varieties to advance sustainable and resilient agriculture in Africa.

REFERENCES

- Fuhrmann, S., Wan, C., Blouzard, E., Veludo, A., Holtman, Z., Chetty-Mhlanga, S., ... & Rother, H. A. (2021). Pesticide research on environmental and human exposure and risks in sub-Saharan Africa: a systematic literature review. *International journal of environmental research and public health*, 19(1), 259.
- ISAAA AfriCenter (2021). Towards the Crowning Moment: ISAAA AfriCenter 2020 Annual Report. Retrieved from <https://africenter.isaaa.org/wp-content/uploads/2021/08/AfriCenter-Annual-Report-2020.pdf>
- ISAAA GM Approval Database. Retrieved 18th October, 2023. <https://www.isaaa.org/gmapprovaldatabase/cropslist/default.asp>
- Sadikiel Mmbando, G. (2024). The adoption of genetically modified crops in Africa: the public's current perception, the regulatory obstacles, and ethical challenges. *GM crops & food*, 15(1), 185-199.