African Union

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State and Future of Biotechnology Seeds and Plant Breeding Innovation in Africa

Introductory Presentation

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Overview

- Status of Biotechnology Seeds
- Status of Seeds Regulations
- Future of Biotechnology Seeds Innovation in Africa

Literature references

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1. Advancing Policy and Science: A Game Changer in the Adoption of Genome Editing Technology in the Continent of Africa, Akinbo et al inpress
2. Africa and Zero Hunger Agenda: Genome Editing Policy Landscape, Challenges and Opportunities, Akinbo et al 2025 0nline Provisionally accepted
3. Genetic engineering and genome editing technologies as catalyst for Africa's food security: the case of plant biotechnology in Nigeria, Adegbaju et al 2024
4. The African continent should consider a harmonized consultative and collaborative effort towards coordinated policy and regulatory guidelines across the fields of biotechnology, Masehela and Barros, 2023
5. Genome Editing for Sustainable Agriculture in Africa, Tripathi et al 2022
6. Commercial Release of Genetically Modified Crops in Africa: Interface Between Biosafety Regulatory Systems and Varietal Release Systems, Akinbo et al 2021
7. Biosafety Regulatory Reviews and Leeway to Operate: Case Studies From Sub-Sahara Africa, Komen et al 2020

Commercialisation of GMOs Seeds in Africa

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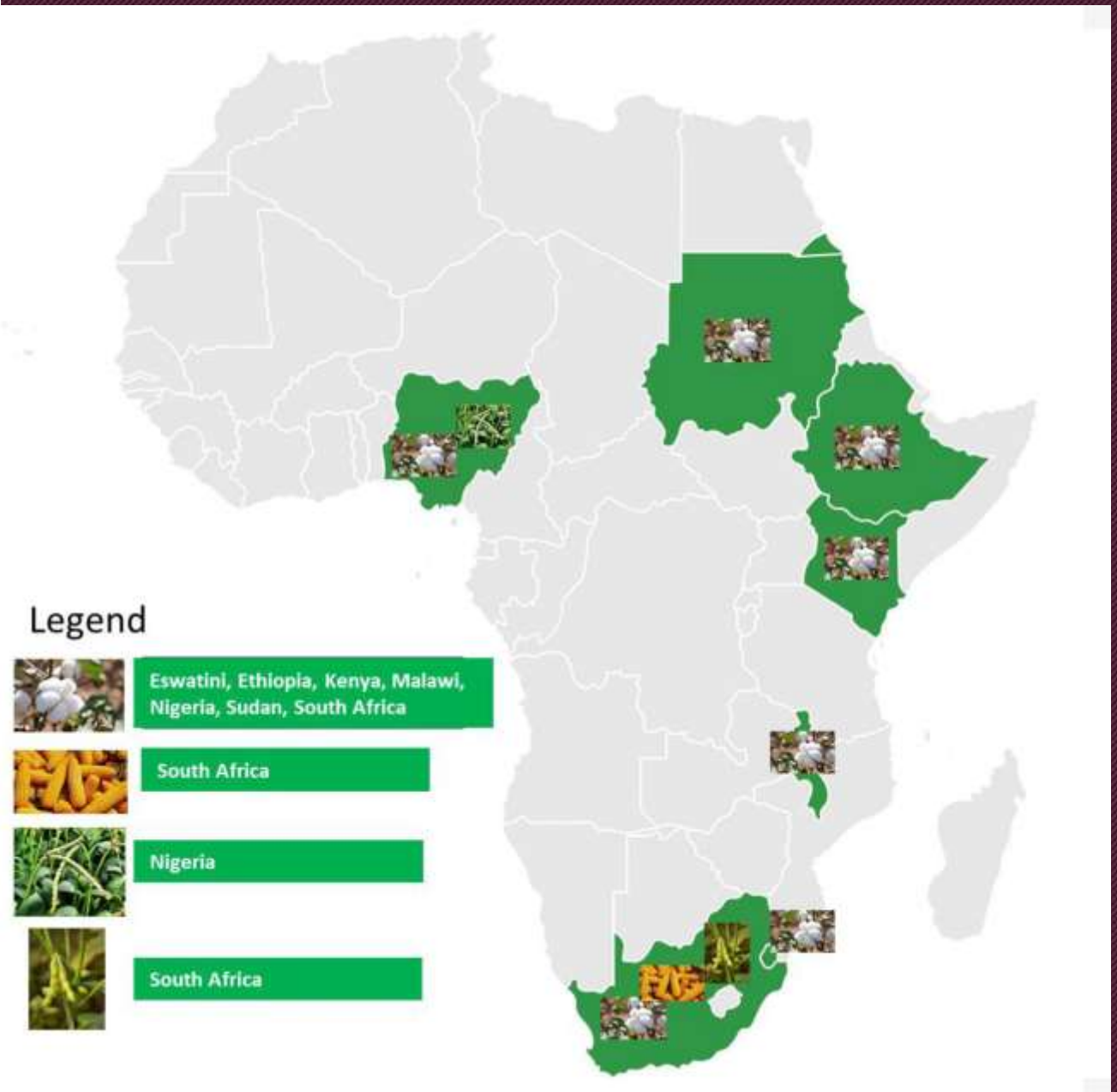

TABLE 1 Regulatory processes adopted by different African countries (adopted and modified from Akinbo et al., 2021).

	Biosafety regulatory framework	Seed acts and implementing regulations
Kenya		
Laws and Regulations	Biosafety Act 2009 and implementing regulations to cover contained use, environmental release, import, export, and transit	Seed and Plant Varieties Act (Seed Act; Cap.326 (Gok, 2012) and the Seeds and Plant Varieties Regulations (NPT Regulations)
Agencies/Department	National biosafety Authority is the Competent Authority	KEPHIS, Ministry of Agriculture
Committees	Scientific Advisory Committee	National Performance Trial Committee National Variety Release Committee
Nigeria		
Laws and Regulations	National Biosafety Management Agency Act 2015 revised in 2019 to National Biosafety Management Agency Act 2019	National Agricultural Seeds Act, N5 Laws of Nigeria, 2004 revised to give National Seed Act (NSC) Act 2019
Agencies/Department	National biosafety Management Agency (NBMA) is the National Biosafety Authority	National Agricultural Seeds Council (NASC), an agency of the Federal Ministry of Agriculture and Rural Development
Committees/ PARTNERSHIPS	The Nigeria Agricultural Seed Council; National Agricultural Quarantine Service; Nigeria Customs Service; National Agency for Food and Drug Administration and Control; Federal Ministry of Agriculture (Department of Veterinary and Pest Control); Standard Organization of Nigeria; Federal Competition and Consumer Protection Commission	National Crop Varieties and Livestock Breeds Registration and Release Committee

Country	Project title	Challenges being addressed	Objective(s)	Target gene(s) and Phenotype(s)	Institution/ affiliation(s)	Lead scientist(s)
Nigeria[a]	Genome Editing for improved resistance to cassava Bacterial Blight (CBB) Disease	Yield and harvest loss due to CBB disease	To develop cassava resistant or with improved tolerance to CBB by disrupting gene(s) aiding disease establishment and spread	(T) MeSWEET10a gene, a susceptibility gene for CBB targeted with CRISPR-Cas9	National Root Crops Research Institute (NRCRI) Umudike	Dr. Ihuoma Chinaza Okwuonu
South Africa[a]	Genome editing of potato	Viral infection in Potatoes	To produce virus-resistant potatoes	(T) Eukaryotic initiation factor 4E (EiF4E)	Stellenbosch University	Prof. James R. Lloyd
South Africa[a]	High-throughput screening of genes associated with the response of cassava to geminivirus South African Cassava Mosaic virus (SACMV)	Yield loss due to susceptibility of African cassava varieties to cassava mosaic disease (CMD)	To silence genes putatively associated with the response to SACMV infection in susceptible and tolerant cassava landrace protoplasts using CRISPR gene editing 2. to identify the hub or key genes associated with SACMV tolerance in cassava protoplasts	Ubiquitin proteasome system genes (e.g. E3 ligase), transcription factor genes (e.g. WRKY) and resistant genes (e.g. NLRs)	University of the Witwatersrand	Prof. Chrissie Rey
Uganda[a]	Application of targeted gene editing for development of high yielding, stress resistant and nutritious crops	Scarce information on molecular basics of flowering and lack of double	Production of fertile flowers and seeds by CRISPR-Cas9 mediated editing of endogeneous anti-flowering genes in cassava	(T). Phytoene desaturase and Terminal flower 1 (P). Photo bleaching and Early flowering	National Agricultural Research Organization (NARO), National Crops Resources Research Institute (NaCRRI)-Namulonge Campus	Dr. John Odipio
Ethiopia[a]	Improving oil qualities of Ethiopian mustard (Brassica carinata) through application of CRISPR/Cas 9-based genome editing	high level of erucic acid in elite varieties of Brassica carinata, beyond Nutritionally acceptable level	To develop B. carinata genotype with low erucic acid and glucosinolate for food and feed application. To enhance the level of erucic acid for industrial application	(T). FAE1 and FAD2 genes for food. GTR1 and GTR2 genes for feed and FAR and WS genes for Industries	Addis Ababa University	Prof. Tekkhaimanot Hadesbeatie Tahlo
Ethiopia[b]	Improving the susceptibility of Teff (*Eragrostis tef*) to lodging	Teff production is adversely affected by lodging	to develop semi-dwarf tef varieties	N/A	Ethiopian Institute of Agricultural Research (EIAR) and Donald Danforth Plant Science Center, USA	N/A
Kenya[c]	Modulation of energy homeostasis in maize to develop lines tolerant to drought, genotoxic and Oxidative stresses	Drought susceptibility in Maize	Metabolic engineering of Poly (ADP-ribosyl) ation pathway-a stress tolerance in plants by maintaining energy homeostasis during stress conditions	(T) Poly (ADP-ribose) polymerase (PARP1 and PARP2) (P) Maize tolerant to drought, DNA damage and oxidative stresses	Kenyatta University and Ghent University Belgium	Dr. Elizabeth Njuguna
Kenya[d]	Genetic improvement of banana for control of bacterial wilt disease	Control Xanthomonas wilt disease of banana in East Africa	To develop genome-edited banana resistant to bacterial wilt disease	(T) disease susceptibility 'S' genes (P) disease resistance	International Institute of Tropical Agriculture	Dr. Leena Tripathi
Kenya[d]	CRISPR/Cas9 editing of endogenous banana streak virus in the B genome of Musa spp. overcomes a major challenge in banana breeding	Difficulty in breeding plantain (AAB) due to existence of integrated endogenous banana streak virus (eBSV) in the B genome	Improve B genome germplasm and usefulness in breeding program	(T) (eBSV) (P) Prevent infectiousness of eBSV due to activation	International Institute of Tropical Agriculture and University of California, Davis, USA	Dr. Leena Tripathi
Kenya[c]	Gene editing to control maize lethal necrosis in Africa for improved maize productivity and grain harvests	Maize lethal necrosis (MLN) disease causes several losses to maize in Kenya and neighbouring countries	Introduce resistance against MLN disease directly into parent inbred lines of popular commercial maize varieties, which are currently susceptible to the disease, and reintroduce them to the farmer's fields in Kenya with possibility of scaling out to other countries in East Africa	(T) A strong quantitative trait locus on maize chromosome 6 (P)high-level of resistance against MLN disease	Kenya Agriculture and Livestock Research Organization	James Kamau Kasonja
Kenya[e]	Evaluation of Striga Resistance in Low germination Stimulant 1 (LGS1) mutant sorghum	Parasitic weed striga is a huge constraint to production of sorghum and other cereals crops	Evaluate LGS1 gene knockout in conferring Striga resistance in sorghum	(T) LGS1 (P) Mutant alleles at the LGS1 locus drastically reduce Striga germination stimulant activity	Kenyatta University	Prof. Steven Runo

N.B. sourced from:
[a]Kanomba and Ngure (2022).
[b]Genome editing communication course in Ethiopia by AUDA-NEPAD (2018).
[c]Njuguna et al. (2017).
[d]Tripathi et al. (2019).
[e]Runo et al. (2020).

Countries	Transgenic name	Gene/ sequence introduced	Source	Gene product	Molecular function	References
Uganda, Kenya and Nigeria	VICRA Plus project	near full-length coat protein (CP) genes	cloned from CBSV and UCBSV	N/A	RNAi	Taylor et al. (2012)
		NPTII	*Escherichia coli*	neomycin phosphotransferase II enzyme	allows transformed plants to metabolize neomycin and kanamycin antibiotics during selection	Taylor et al. (2012)
		IRT1 and *FER1*	*A.thaliana*	Iron transporter and Ferritin	Significantly increase the accumulation iron and zinc levels	Narayanan et al. (2019)
Kenya, South Africa, Nigeria	TELA Maize Project	cry2Ab2	*Bacillus* thuringiensis subsp. kumamotoensis	Cry2Ab delta-endotoxin	Confers resistance to lepidopteran insects	ISAAA, 2023b
		cry1A.105	*Bacillus* thuringiensis subsp. kumamotoensis	Cry1A.105 protein which comprises the Cry1Ab, Cry1F and Cry1Ac proteins	Confers resistance to lepidopteran insects	ISAAA, 2023b
		cspB	*Bacillus subtilis*	cold shock protein B	Maintains normal cellular functions under water stress conditions by preserving RNA stability and translation	ISAAA, 2023a
		nptII	*Escherichia coli* strain K12 Tn5 transposon	neomycin phosphotransferase II enzyme	Allows transformed plants to metabolize neomycin and kanamycin antibiotics during selection	ISAAA, 2023a
	Pod Borer-Resistant (PBR) Cowpeas	*Cry1Ab*	*Bacillus* thuringiensis subsp. *kurstaki*	Cry2Ab delta-endotoxin	Confers resistance to lepidopteran insects	AATF (2022)
		nptII	*Escherichia coli*	neomycin phosphotransferase II enzyme	allows transformed plants to metabolize neomycin and kanamycin antibiotics during selection	AATF (2022)
Nigeria, Uganda, Ghana	NEWEST Rice	*HvAlaAT*	*Hordeum vulgare*	alanine aminotransferase	Confers nitrogen efficiency on rice	Arcadia Biosciences (2018)
Nigeria, Kenya, Burkina faso South Africa, Egypt	Africa Biofortified Sorghum project	*Hv-HGGT*	*Hordeum vulgare*	homogentisate geranylgeranyl transferase	Increase Vitamin E	AHBFI (2023)
		At-DXS	*Arabidopsis thaliana*	1-deoxy-D-xylulose-5-phosphate synthase	Increase carotenoids	AHBFI (2023)
		Zm-PSY1	*Zea mays*	Maize phytoene synthase 1	Increase carotenoids	AHBFI (2023)
		CRT I	Bacterial (*Erwinia*)		Increase Vitamin A biosynthesis	AHBFI (2023)
		PMI	*Escherichia coli*	phosphomannose isomerase	A selection gene instead of antibiotic markers	AHBFI (2023)

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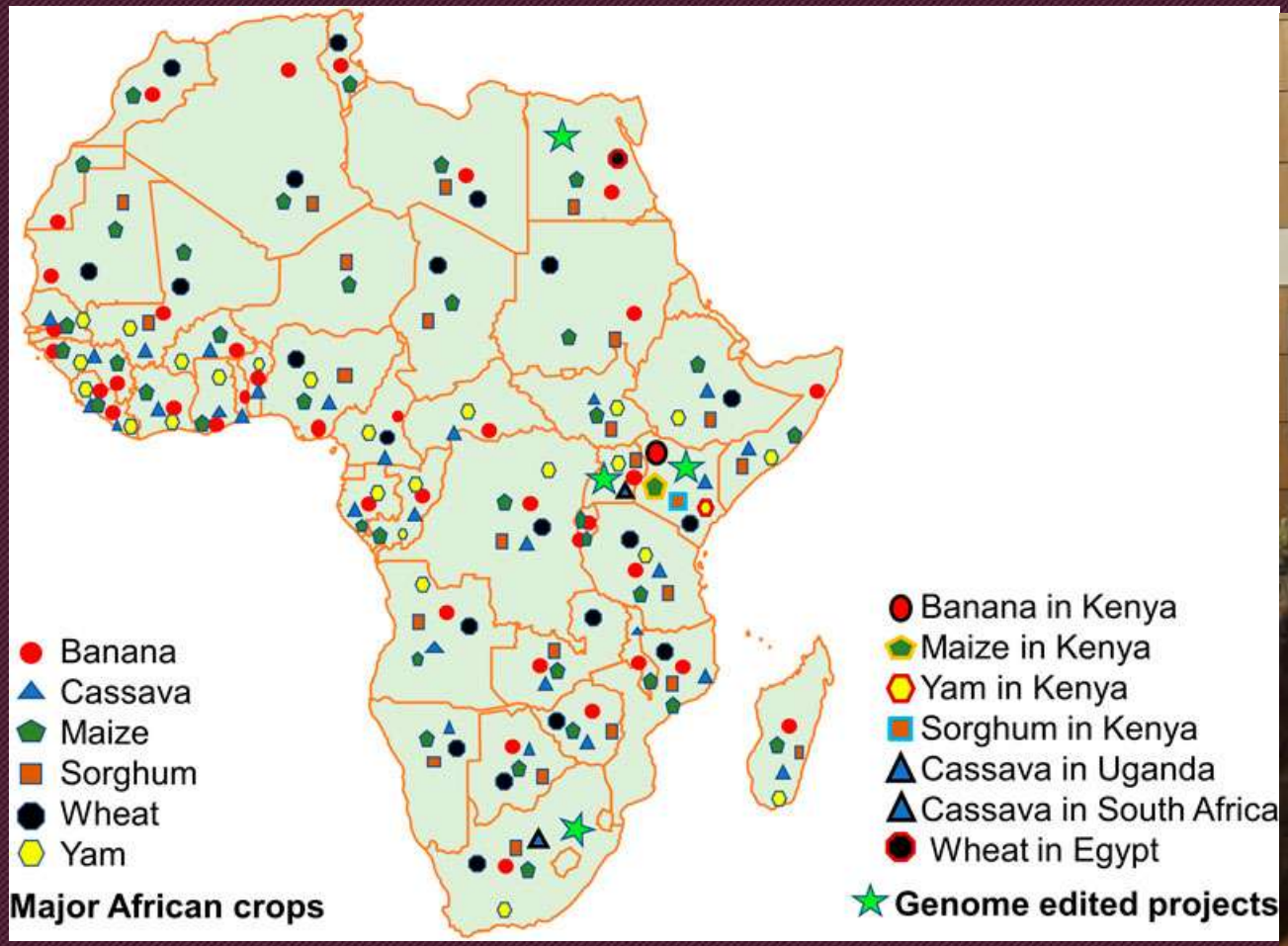
Build Healthy ECOSYTEM on R&D for the Technology and Seeds



Plant Breeding Innovation Enablers: Technology (Science, Capability, Intellectual Property & Collaborations), Policy (Regulatory Approaches), Public Acceptance (Societal Trust, Benefits / Sustainability)

Policy Future

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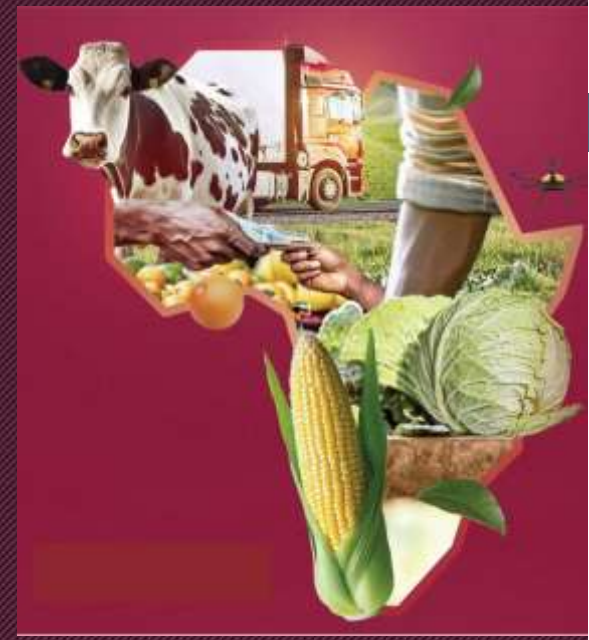

- Kampala Declaration:
  - **RECOGNIZING** the crucial role of inclusive agro-industrialization to drive economic growth, job creation, and shared prosperity, it is essential to integrate agricultural production into broader supply chains to combat food insecurity and improve nutrition. Achieving this, however, **requires investment in technology innovation systems**, efficient services, infrastructure, as well as policy, regulatory and institutional arrangements to enhance the performance and competitiveness of the emerging agrifood processing sector.
  - **ACKNOWLEDGING** the **transformative potential of emerging technologies to boost productivity and resilience in Africa's agrifood systems,** these innovations offer powerful solutions to pressing challenges such as food and nutrition insecurity, and climate change by improving farming techniques and optimizing resource management. The adoption of mechanization, **digital agriculture, biotechnology**, and other technological advancements is essential to enhance efficiency, sustainability, and scalability in the sector.
  - **We**, hereby, adopt the ***CAADP Strategy and Action Plan: 2026-2035*** and the following ***Kampala CAADP Declaration on Building Resilient and Sustainable Agrifood Systems in Africa***

Global GEd Guideline developed

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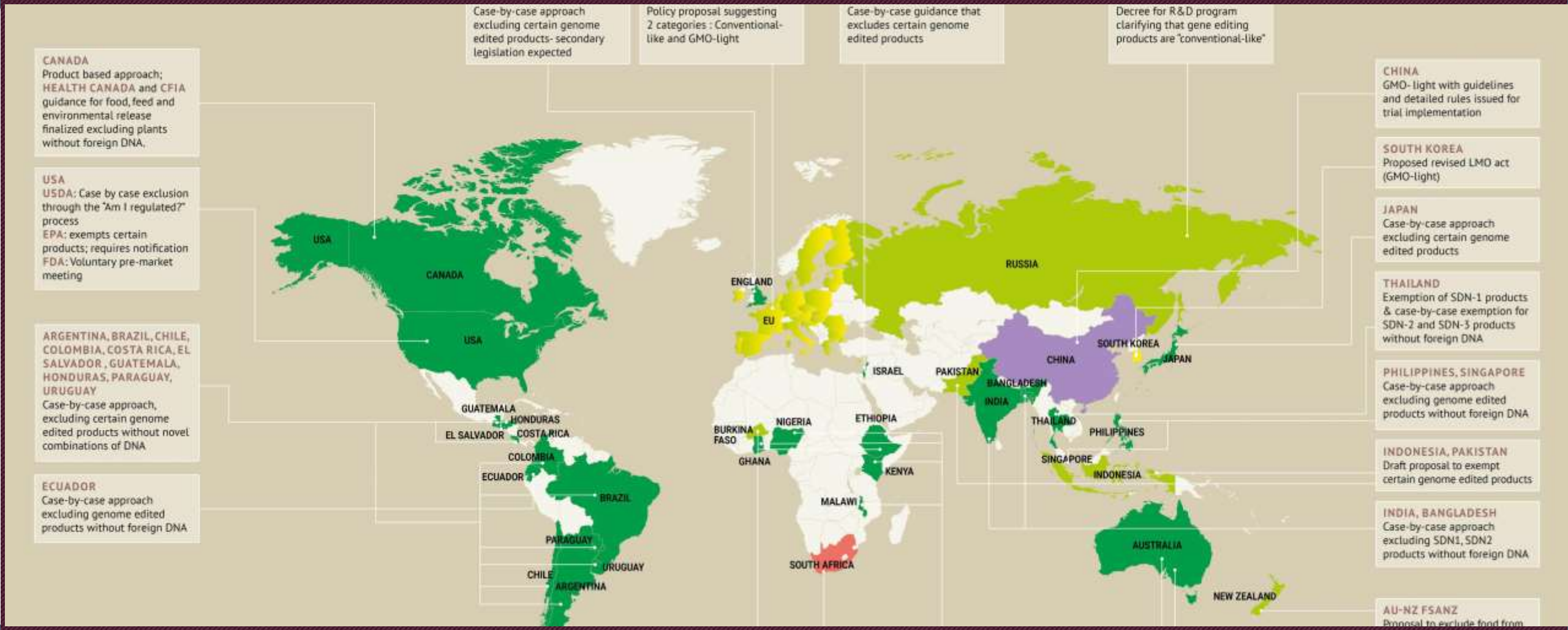

Regulatory Tree

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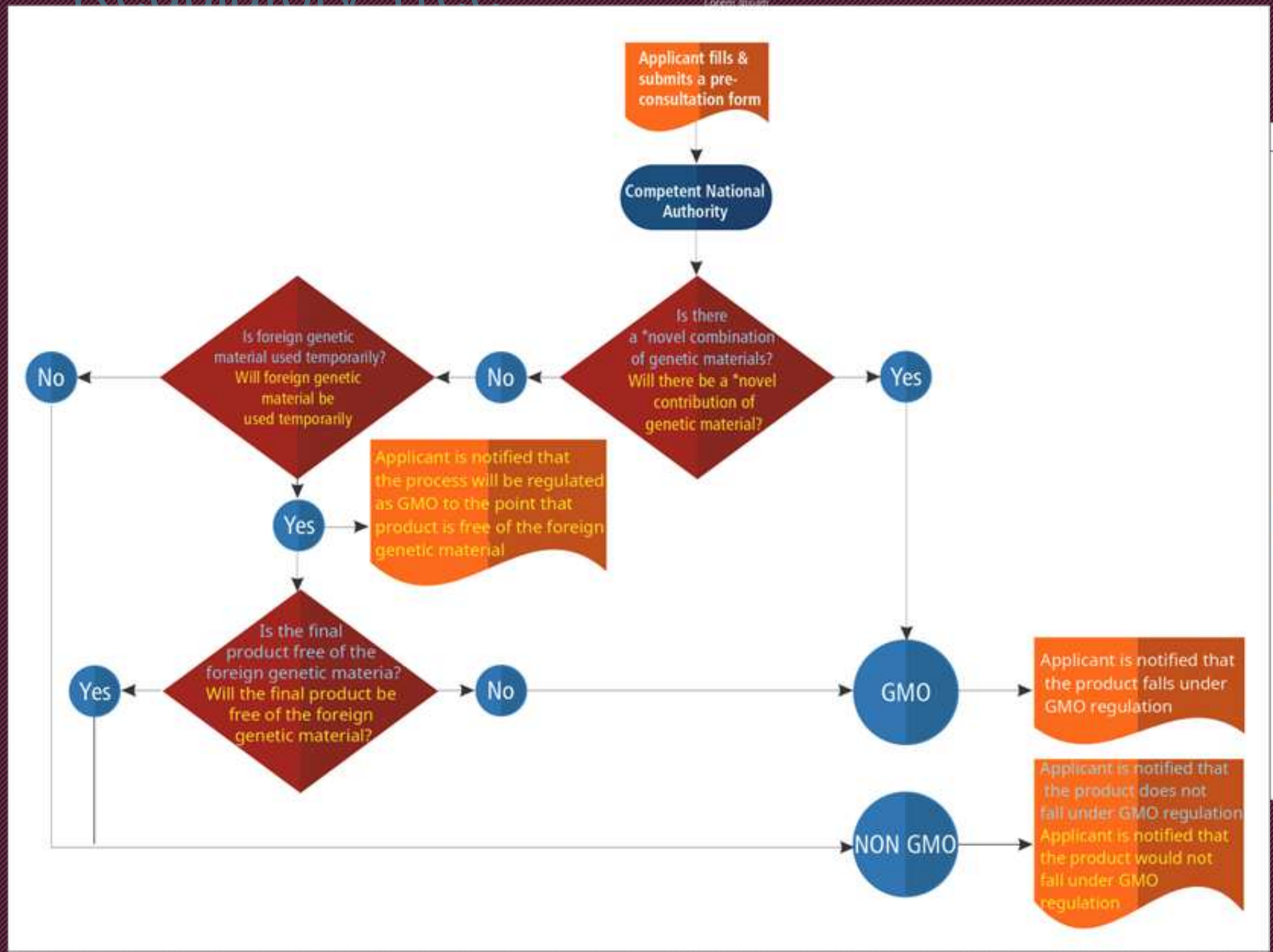

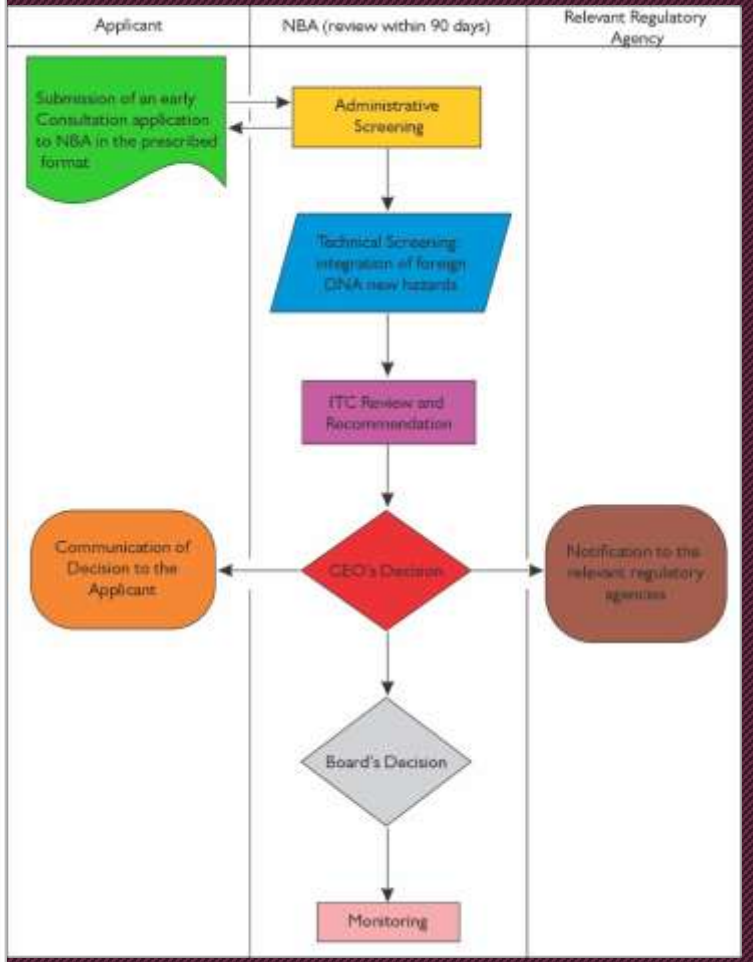

The Future

- Seed sector development has been on the agenda of Heads of State and Government since 2005.
- Head of State recognition of the importance of access to quality seed in enhancing agricultural production and productivity
- The need to accompanied this by development of efficient and effective implementation of national seed laws and seed regulations or decrees.
- Regional Harmonization of Seed Legislation.
- Support Malabo Commitment on ending hunger and malnutrition

Future of Biotechnology Seeds in Africa

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- Concerted efforts are required at continental, regional and national level in identification of strategic interventions in key areas including:
  - Enhance policy and regulatory framework for an efficient seed system
  - Strengthen seed production systems (Innovation)
  - Enhance development of quality assurance systems with improved stakeholder contributions
  - Improve seed storage, marketing and distribution channels
  - Knowledge Management and communication
  - Enhance biotechnology uptake for an efficient seed system in Africa
  - Healthy collaborations (Seed Industries, CGIAR, NARs, Government Agency)

Communication: Engagement with Pan-African Parliamentarians

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Appeal to the Parliamentarian

Creation of awareness on the potential of GEd for the realization of CAADP objectives and Agenda 2063

Endorsement of the Landscape Analysis outcome and support at the STC level

Support the AU member States and REC in the development implementation of Harmonised GEd Guidelines and appropriate legislation for investment in R&D for GEd technology

Policy to Science to Practice (End users)

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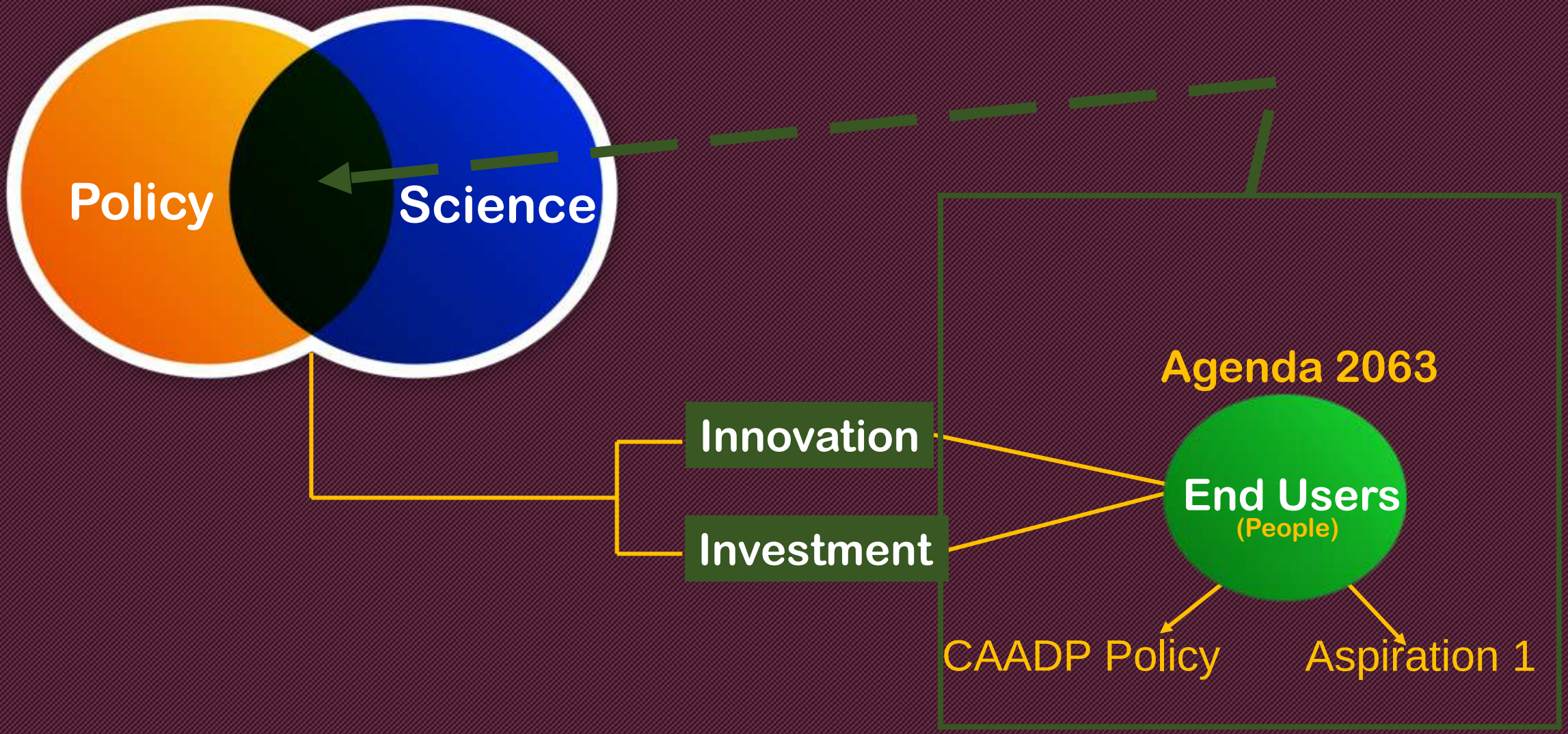

Agend/A 2063

The Africa we Want

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Thank You • شكرا • Merci • Obrigado • Asante