Agricultural biotechnology policy review in Africa: A case study of Kenya

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Abstract: Production of genetically modified crops and animals is still a widely debated topic across the globe. There are a lot of players when it comes to the acceptance and adoption of biotechnology in agriculture for the aim of increased food production, quality addition among other goals. One of the key stake holders are policy makers. Many African countries have developed Agricultural policies which address the research, development, production and regulation of genetically engineered crops and animals. Through these policies, A number of new crops have been developed tested and approved, addressing important traits of particular significance for smallholder farmers in Africa. Since most of these policies are still new, there are issues that face the agricultural biotechnology sector in these countries that making it difficult to achieve the potential. The major problems include misinformation and politicization of core issues relating to biotechnology. However, these issues can be addressed easily with implementation of the guidelines delayed in the policy. Kenya developed and adopted such a comprehensive policy in 2006. However, to date, the full implementation and complete adherence to the document guidelines has not been fully achieved. This paper uses several case studies to review the Agricultural Biotechnology policy in Kenya, evaluating what is outlined in the policy adopted slightly more than a decade ago against what has been achieved so far.

Keywords: Agricultural Policy, Agricultural Biotechnology, Genetically engineered crops, Genetically Modified crops, Research and Development

Introduction

Kenya is a country in East Africa with coastline on the Indian Ocean. It encompasses savannah, lakelands, the dramatic Great Rift Valley and mountain highlands. It's also home to wildlife like lions, elephants and rhinos. From Nairobi, the capital, safaris visit the Maasai Mara Reserve, known for its annual wildebeest migrations, and Amboseli National Park, offering views of Tanzania's 5,895m Mt. Kilimanjaro. Agriculture remains the backbone of the Kenyan economy, contributing 25% of GDP. About 80% of Kenya's population work at least part-time in the agricultural sector, including livestock and pastoral activities. Over 75% of agricultural output is from small-scale, rain-fed farming or livestock production. Table 1 and Figure 1 show some basic sociodemographic statistics of Kenya and the climatic zones in the country respectively

Background

Biotechnology is defined as any technological application that uses living organisms, or derivatives thereof to make or modify new products or improve existing ones. In spite of advances in biotechnology having great potential to improve an economy, it is imperative that it be applied systematically, responsibly and in a way, that responds to a country's priority needs. In this regard, the government of

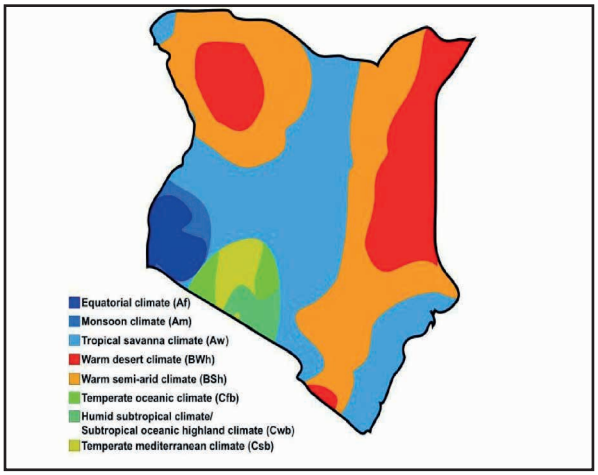

Figure 1. Map of Kenya with Climatic Classification. The map shows the agricultural climate zones as an indicator of the agricultural capacity of the country and the apparent need to adopt biotechnology to attain adequate food production for domestic consumption and possibly export. Source; Wikipedia

Table 1. About Kenya

Population	46,790,758 (2016 *est.)*
Age structre	**0-14 years:** 40.87% (male 9,592,017/female 9,532,032) **15-24 years:** 18.83% (male 4,398,554/female 4,411,586) **25-54 years:** 33.54% (male 7,938,111/female 7,755,128 **55-64 years:** 3.84% (male 819,665/female 976,862) **65 years and over:** 2.92% (male 590,961/female 775,842) (2016 est.)
Median age	total: 19.5 years male: 19.4 years female: 19.6 years (2016 est.)
Urbanization	**urban population:** 25.6% of total population (2015) **rate of urbanization:** 4.34% annual rate of change (2010-15 est.)
Major cities population	NAIROBI (capital) 3.915 million; Mombassa 1.104 million (2015)
Land use and agriculture	Total area 580,367 sq km, land: 569,140 sq km, of which agricultural land covers 48.1%, with arable land taking up 9.8%; permanent crops cover 0.9%; and permanent pasture 37.4%

Kenya developed a comprehensive national policy to guide research, development and commercialization of modern biotechnology products. The policy, which was approved in September 2006, was the result of several years of work involving all major biotechnology stakeholders nationally, internationally working closely with relevant government departments. This paper is a review of the current policy on Agricultural Biotechnology in Kenya.

The Kenya National Biotechnology Development Policy (2006)

The policy covers all biotechnology applications, including tissue culture and micropropagation, biopesticides and biofertilizers, livestock technology, DNA Marker technology, and genetic engineering. It also covers research, development and use of biotechnology in various key fields such as agriculture, environment, human and animal health and industry. The policy takes cognizance of international instruments, such as the Cartagena Protocol on Biosafety. The objectives of this policy include to:

- Prioritize, promote, and coordinate research in basic and applied bio-sciences,
- Promote sustainable industrial development for production of biotechnologically derived products,
- Create enabling administrative and legal frameworks for biotechnological development and commercialization of such related products,
- Develop mechanisms for the provision of sustainable funding for biotechnology research and products' development,
- Support and facilitate capacity building on all aspects of biotechnology including intellectual property access and protection, biosafety and bioethics,
- Support the development and retention of human resources in science, innovation and biotechnology,
- Stimulate collaboration among public, private sectors and international agencies in order to advance biotechnology both locally and internationally.
- Promote public understanding of the potential benefits and address stakeholder concerns on modern biotechnology.

Scope of the Policy

The government of Kenya adopted biotechnology for the purpose of improving the quality of human welfare, maximizing productivity in agriculture and industry and protecting the environment, conserving biodiversity and bioprospecting. The biotechnology policy therefore seeks to address:

- Traditional and modern biotechnology;
- Genetically modified organisms that are human food and animal feeds and pharmaceuticals.

The policy targets to cover all biotechnology applications including tissue culture and

 DOI: 10.18380/SZIE.COLUM.2017.4.2.47

micropropagation, biopesticides and biofertilizers, bioremediation, Livestock technology, DNA Marker technology, and genetic engineering (Karembu et al., 2010). The policy is broad based and covers research, development and use of biotechnology in various fields such as agriculture, environment, human health and industry.

The scope of the policy takes cognizance of local and international agreements and protocols such as the Cartagena Protocol on Biosafety, World Trade Agreements, Application of Sanitary and Phytosanitary Measures, the Agreement on Trade Related Aspects of Intellectual Property Rights, International Convention for the Protection of New Varieties of Plants.

The government recognizes that the domestic regulations governing the importation and use of pharmaceuticals, biologicals, food and feeds, may not be adequate. Therefore, it facilitate the process of aligning the policy to the regulations and policies governing the importation and use of the related products.

The policy outlines six key areas of focus as follows;

1. Agricultural Biotechnology
2. Education
3. Bioresources
4. Environmental Biotechnology
5. Medical Biotechnology
6. Industry and Trade.

Implementation of the Agricultural Biotechnology Policy in Kenya

Regulatory Framework: The National Biosafety Authority of Kenya (NBA), established by the Biosafety Act No.2 of 2009, is under the Ministry of Agriculture, Livestock and Fisheries administratively, but under the Ministry of Education, Science and Technology legally. Kenya Plant Health Inspectorate Service (KEPHIS): under the Ministry of Agriculture, Livestock and Fisheries, oversees the introduction, testing and use of biotechnology plants and seeds. The NBA is the main regulatory agency that oversees agricultural biotechnology in Kenya. It is responsible for regulations and policies, as well as general supervision and control over the transfer, handling, and use of GE products. Four biotechnology implementing regulations were released following the Biosafety Act 2009:

- Contained Use Regulation, 2011;
- Environmental Release Regulation, 2011;
- Import, Export, and Transit Regulation, 2011;
- Labeling Regulation, 2012; and
- Packaging, Transport, and Identification regulation, 2014

The NBA works together with eight other regulatory agencies that have different roles in regulating Biotechnology products. These regulatory agencies are:

- Department of Public Health, under the Ministry of Health, safeguards consumers' health through food safety and quality control, surveillance, prevention and control of food borne diseases. The Agriculture committee has recommended the establishment of a Food Safety and Control Unit to evaluate food safety of GE foods for human consumption, and to issue import permits for GE foods;
- Kenya Bureau of Standards, (KEBS) under the Ministry of Industrialization and Enterprise Development, develops food standards, quality assurance, and testing;
- National Environment Management Authority (NEMA), under the Ministry of Environment, Water, and Natural Resources, oversees environmental questions and conducts environmental impact assessments. NEMA issues licenses that permit national performance trials (NPTs) on GE crops and plants.
- Pest Control Products Board, (PCPB), under the Ministry of Agriculture, Livestock and Fisheries, regulates pesticide use;
- Kenya Wildlife Service (KWS), under the Ministry of Environment and Natural Resources, handles biodiversity and biotechnology related matters in wildlife and forestry;

- Kenya Industrial Property Institute (KIPI), under the Ministry of Industrialization and Enterprise Development, handles intellectual property issues; and,
- Department of Veterinary Services (DVS).

Figure 2 and figure 3 show the process for approving production of Genetically engineered crops developed in Kenya and the regulatory processes of such crops respectively.

1. Industry and Trade

The National Biosafety Authority (NBA) is responsible for the approval process of import shipments of GE products. The authoritative legislation, Kenya's Biosafety Act of 2009, stipulates that the approval process should take 90-150 days. Also, the Kenya Plant Health Inspectorate Service (KEPHIS) requires imported GE plant products to have:

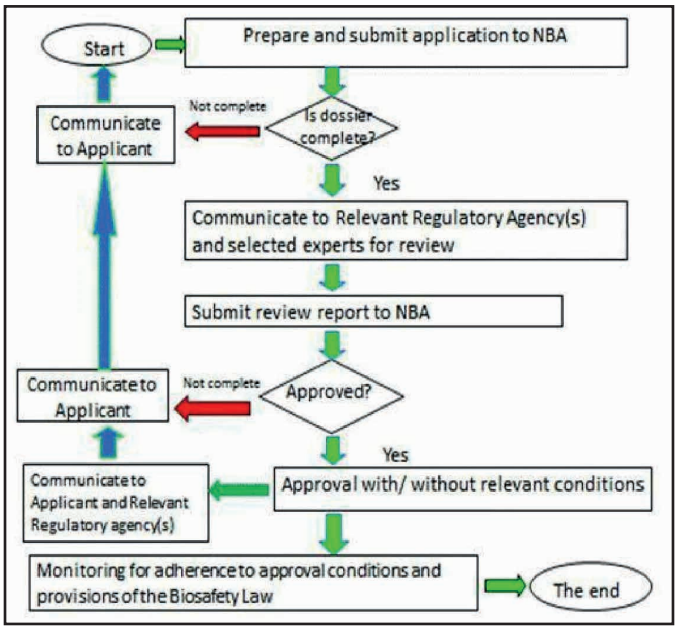

Figure 2. The Approval process for production of Genetically engineered crops developed in Kenya, Source; National Biosafety Association of Kenya. The figure shows a breakdown of the process due to be followed before a scientist, biotechnologist, or any other individuals or companies can be approved to produce genetically engineered crops in Kenya for whichever goal.

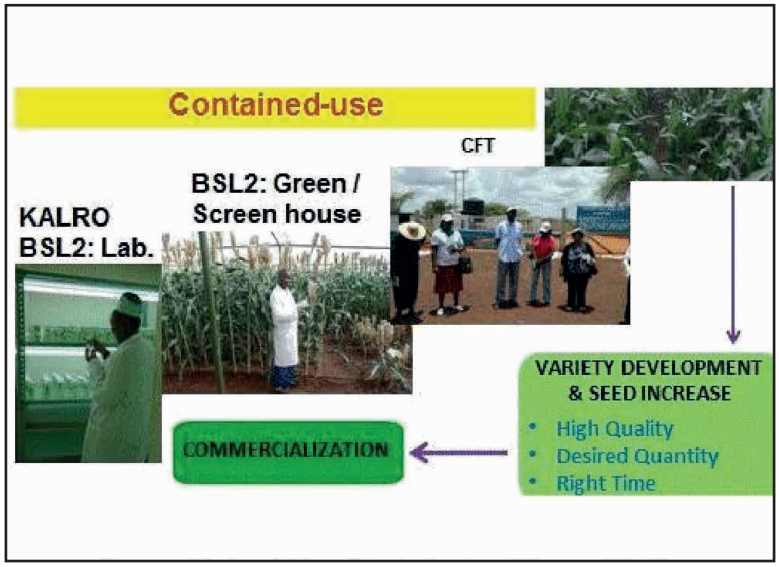

Figure 2. The regulatory processes for genetically engineered crops in Kenya, Source; National Biosafety Association of Kenya. The figure shows the steps involved in the regulatory process for biotechnology crop products in the country.

DOI: 10.18380/SZIE.COLUM.2017.4.2.47

- A declaration from the country of origin that states the import's GE status, and
- A phytosanitary certificate.

However, progress in agricultural biotechnology suffered a setback after the National Assembly's Agriculture committee recommended that a new food safety law on genetically engineered (GE) products be put in place, before the 2012 import ban is lifted.

The Agriculture committee's move follows an earlier decision by Kenya's National Environment Management Authority (NEMA) to retract the open field trials license for Bt corn. NEMA had previously retracted its license for Bt corn open field trials despite prior approval by NBA, thus, creating confusion in the regulatory framework. NEMA is still reviewing applications for open field trials for Bt corn and Bt cotton, exceeding the 45 days allowed by law.

2. Plant Biotechnology Research, production and commercialization

Participation on the NBA includes representatives from Government Ministries, as well as scientists from civil society and the national universities. Government ministries and key players on the NBA include the Kenya Plant Health Inspectorate Service, Ministry of Agriculture, which oversees the introduction, testing and use of biotechnology plants and seeds; the Ministry of Health and the Kenya Bureau of Standards, which regulate food safety; and the Ministry of Environment and Natural Resources, which oversees environmental questions and conducts environmental impact assessments among others.

In terms of commercialization of bio-engineered food products in studies done in 2003, 2006 and 2007 by the International Maize and Wheat Improvement Centre (CIMMYT), KALRO and Kansas State University, Kenyan consumers were found to accept agricultural biotechnology and genetic modification of foods at rates well below 50 percent. Processors and retailers showed a higher level of acceptance, especially with regard to genetically modified foods. This showed the need for public education, awareness creation and sensitization on the stringent measures put in before the production and commercialization of products to ensure the safety of the consumers. Table 2 shows the Awareness on Agricultural Biotechnology in 2007

A new approach to the comprehensive agriculture policy that includes capacity and confidence building, policy stability in form and application from year-to-year and production and trade enhancing characteristics is still needed in Kenya before the full benefits of agriculture biotechnology can be realized. Poor policies mean farmers minimize their investment in agriculture, because of their inability to predict/expect profits from efforts (Adato - Meinzen-Dick 2002).

Top government leaders, cereal millers, traders, and agricultural research scientists widely acknowledge that modern biotechnology is an important tool for improving agricultural production in Kenya, and have continued to publicly support agricultural biotechnology. Agricultural biotechnology awareness campaigns initiated by institutions like BioAware, ISAAA, Open Forum on Agricultural Biotechnology, African Biotechnology Stakeholders Forum and Africa Harvest Biotech Foundation International avail credible information and demystify misconceptions related to agricultural biotechnology. Kenya has advanced in agricultural biotechnology governance, as evidenced by the Biosafety Act of 2009, establishment of NBA,

Table 2. Awareness on Agricultural Biotechnology in 2007

Type	Area or Industry	Number of respondents	Awareness (Percentage)	
			Biotechnology	GM crops
Urban consumers	Nairobi	612	46	38
Rural consumers	Western Kenya	121	16	13
	Eastern Kenya	400	63	31
Gatekeepers	Milling companies	32	67	87
	Supermarkets	40	83	79

Source: The International Maize and Wheat Improvement Center (CIMMYT)

regulations and policies. To maximize on these gains, Kenya needs encouragement to:

- Reverse the GE foods import ban;
- Commercialize Bt cotton;
- Continue public awareness on modern biotechnology and biosafety; and
- Continue capacity building on biotechnology to manage and strengthen research, development and trade

Case Studies for the implementation of the Policy

To further clarify the state of affairs in regard to research activities and the need for action, the following are some case studies of recent agricultural research and development work in Kenya.

Case Study 1: Cotton

Cotton production in Kenya has declined over the years due to yields being affected by bollworm, necessitating the search for varieties that will be resistant to bollworm. Work on Bt. Cotton began with Bt. cotton seeds with a gene of resistance against the bollworm being imported for trials from South Africa in late May 2004 (Kameri-Mbote 2003). This was after the plant regulatory authority, the Kenya Plant Health Inspectorate Service (KEPHIS) granted KARI a permit to introduce the seeds. The trials were done at KARI Fiber research station in Mwea Tabere whose biosafety facilities have been inspected and approved by KEPHIS on behalf of the National Biosafety Committee. However, upon the success of the project, the seeds were not commercialized. If these seeds were handed to the farmers, this would have a very significant impact on the Kenyan Cotton industry, and the country's economy by proxy.

Case study 2: Maize

The main thrust of agricultural research on maize in Kenya has traditionally focused on breeding for both higher yields and drought tolerance (Smale - Jay 2003). Not much attention has been given to breeding for pest and disease tolerance and consequently, small-scale farmers have been affected substantially as they plant improved maize varieties under very poor pest and disease management conditions. They end up not benefiting from the yield potential of such varieties.

Stem borers pose one of the most serious threats to the production of maize in Kenya, with losses estimated to be about 15 % of the harvest. These problems have continued to intensify as most subsistence farmers are poor and cannot afford to buy pesticides to curb the menace posed by the borers.

The Insect Resistant Maize for Africa (IRMA)

The Insect Resistant Maize for Africa project started in 1999 by KALRO working together with the International Maize and Wheat Improvement Centre (CIMMYT) with funding from the Syngenta Foundation for Sustainable Agriculture. The overall objective of the project was to increase maize production and enhance food security through the development and deployment of insect resistant maize that is adapted to various agro-ecological zones in Kenya (IRMA).

In furtherance of the objectives of the project, maize leaves with Bt. toxins were imported into Kenya from Mexico and these underwent trials at various KALRO research stations (Kameri-Mbote 2003). The project was continued in a green house and controlled environments until seeds which were approved as fit, safe and stable for human consumption were obtained at the end of the project.

By the end of the project in 2014, the project had succeeded in developing maize varieties that can better resist attack by the three major insect pests in Kenya – stem borers, maize weevils, and the larger grain borer (LGB).

Nine maize varieties (both open pollinated and hybrid) with remarkable resistance to stem borers were released. They can control three of the four main stem borers (IRMA).

DOI: 10.18380/SZIE.COLUM.2017.4.2.47

IRMA project achievements

It identified new germplasm sources of resistance to stem borer and post-harvest insect pests among landraces, open pollinated varieties (OPVs) and CIMMYT lines (CMLs), and developed new insect resistant germplasm. Kenya released 13 stem borer-resistant (SBR) conventional maize varieties (three OPVs and 10 hybrids) and four storage pest-resistant (SPR) hybrids. Kenya has also nominated several stem borer and four postharvest-resistant hybrids for national performance trials(IRMA).

Three insect-resistant varieties were commercialized in Kenya by Monsanto, Wakala Seeds and the Kenya Agricultural Research Institute Seed Unit. These are the KH 414-1 SBR and 414-4 SBR hybrids, and the OPV Pamuka (IRMA). However, the uptake of these commercialized varieties was low since the Kenyan policy was not particularly clear on the matter at the time of release, therefore making it difficult to advertise or market the varieties.

Key Policy Recommendations

I. Prioritization and Coordination of Research and Development

The policy recommends establishment of a National Biotechnology Enterprises Programme that will consist of a National Commission on Biotechnology, a National Biotechnology Education Centre and a National Biosafety Authority. Although the NBA has already been established, the establishment of the NCB and NBEC is necessary.

II. Public Education and Awareness Creation

1. Creation of public awareness on biotechnology issues and investment opportunities;
2. Access to information held by public authorities;
3. Public participation in decision making process;
4. Access to judicial and administrative provisions.

III. Public Protection and Support

1. Protecting Intellectual Property Rights (IPR) is a critical aspect of biotechnology innovation, and ensuring effective public and private sector participation in research and product development.
2. The Government recognizes the existing policies and legislation on protection of traditional knowledge and resources.

IV. Infrastructure, Facilities and Equipment

The National Biotechnology Enterprises Programme to put in place mechanisms to create linkages and networks among public research institutes and universities for optimum access and utilization of available resources while supporting initiatives for the establishment of biotechnology parks at R & D institutions as incubators to stimulate the growth of small and medium size businesses with potential to mature into high technology companies.

V. Financial and Business Support

The key recommendations here are;

1. Create incentives to encourage partnerships between public research institutes and the private sector
2. Waiver of taxes on research materials and equipment to encourage further research
3. Encourage specialized technological financing agencies to provide loans to firms or consortia and research institutions.
4. Direct public budgetary allocation to biotechnology research and development.

Conclusion

The policy provides a road map for agricultural biotechnology and should effectively guide the country into a pre-eminent position of a knowledge-based economy for overall sustainable economic growth, poverty alleviation and wealth creation.

The policy is well structured and covers the most key issues dealing with biotechnology in the country. However, its slow implementation and unclear distinction of the parts played by different

DOI: 10.18380/SZIE.COLUM.2017.4.2.47

agencies defined within it may cause conflicts and thus slow down the progress of the country towards having an efficient biotechnology framework. It is crucial for the Government to come up with an evaluation strategy to evaluate the effectiveness and efficiency of the policy so as to find out rising issues as the implementation roles out further. Moreover, the evident interference on the implementation of the policy by the political class should be closely monitored and strictly regulated.

References

2011 Kenya's Agricultural Biotechnology Report https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20A nnual_Nairobi_Kenya_8-2-2011.pdf

2015 Kenya's Agricultural Biotechnology Report Approved By: Lee Schatz Prepared By: Carol N. Kamau https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnology%20A nnual_Nairobi_Kenya_8-7-2015.pdf

Adato M., Meinzen-Dick R. (2002): Assessing the Impact of Agricultural Research On Poverty Using the Sustainable Livelihoods Framework (http://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/71441/filename/71385.pdf)

CMMYT, The International Maize and Wheat Improvement Center http://www.cimmyt.org/

Government of Kenya; A NATIONAL BIOTECHNOLOGY DEVELOPMENT POLICY 2006 http://en.biosafety-scanner.org/pdf/doc/350_allegato.pdf

IRMA Project. The Syngenta Foundation, https://www.syngentafoundation.org/irma-achievements

IndexMundi http://www.indexmundi.com/kenya

Kamau C. N. (2016) Kenya's Agricultural Biotechnology Report Approved By: Kevin Sage-EL Prepared https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Agricultural%20Biotechnolo gy%20Annual_Nairobi_Kenya_12-21-2016.pdf

Kenya gets national biotechnology policy, Kenya 2006 News article http://www.biovisioneastafrica.com/news_events/kenyabiopolicy_biovision.html

M. Karembu, D. Otunge, D. Wafula. (2010): **Developing a biosafety law: lessons from the Kenyan experience,** Nairobi, Kenya: ISAAA *Afri*Center. (http://www.isaaa.org/resources/publications/). 66 pp.

M. Smale, T. Jay (2003): Maize in Eastern and Southern Africa: Seeds of Success in Retrospect, ne,. (https://www.researchgate.net/publication/5056187_Maize_in_Eastern_and_Southern_Africa_Seeds_of_Success_in_Retrospect)

Patricia Kameri-Mbote, Regulation of GMO Crops and Foods: Kenya case Study, University of Nairobi.

The Program for Biosafety Systems in Kenya https://pbs.ifpri.info/files/2011/09/pbskenyabrief_final.pdf

The international Service for the Acquisition of Agri Biotech Applications (ISAA, May 2017) http://isaaa.org/resources/publications/pocketk/28/default.asp

 DOI: 10.18380/SZIE.COLUM.2017.4.2.47