Food Security and Biotechnology in Africa

This project is financed by the European Union
and implemented by the ACP Secretariat

Module 6

TAILORING BIOTECHNOLOGIES: TOWARDS SOCIETAL RESPONSIBILITY AND COUNTRY SPECIFIC APPROACHES

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For detail see word document and supporting PDF materials

Course Structure

1. Unit 1: Technology and innovation to the rise of biotechnology: 5 hours
2. Unit 2: Policy-making and communication: 3 hours
3. Unit 3: Value chain, agribusiness, local and global development: 3 hours
4. Unit 4: Stakeholder participation: 3 hours
5. **Unit 5: Case studies of tailor-made biotechnology in specific countries: 6 hours**

The final version of this module is on February 28th, 2017

For detail see word document and supporting PDF materials

Objective of module 6

The objective of this module is to allow students to understand how the innovation and policy making lead to tailor-made of both classic and modern versions of biotechnology to the needs and customs of specific countries. Tailoring biotechnology involves that stakeholders can use the tool within their own context and on their own conditions and have the opportunity to fulfil the required social, financial, ethical and other conditions for the implementation of the new technology.

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6.5. Unit 5 . Case studies of tailor-made biotechnology in specific countries

For detail see word document

Objective of unit 5

The objective of this unit is to understand current experiences in African continent throughout case studies of five countries that are involved in GMO crop experiments or commercialisation.

Overview of status of Biotechnology and Biopolicy in Africa

African countries have different experience in biotechnology.

This is mainly due their institutional capacity to monitor the new technology, the lack of political support and anti-GMO activism.

Most African governments still lack commitment to science, technology and innovation and as a result fewer companies have been attracted.

Overview of status of Biotechnology and Biopolicy in Africa

Current GM projects in Africa focuzed on:

- Nigeria, Malawi: Bt cowpea, Insect resistant cotton
- Kenya: Insect resistant maize, Virus resistant cassava; biofortified cassava; biofortified sorghum; drought tolerant maize
- Uganda: Insect resistant cotton, fungus resistant banana ; virus resistant cassava; biofortified banana; drought tolerant maize
- South Africa: Bt potato; virus resistant maize, Drought tolerant maize; biofortified sorghum
- Burkina Faso: Insect resistant cotton, biofortified sorghum, insect resistant soybean, drought tolerant maize,
- Mozambique: Drought tolerant maize
- Tanzania: Drought tolerant maize

Confined Field Trials in Africa

- 10 food security biotech crops in 7 African countries on CFTs (Cameroon, Egypt, Ghana, Kenya, Malawi, Nigeria, Uganda)
- Food security crops: banana, cassava, potato, cowpea, maize, rice, sorghum, wheat, sweet potatoes
- 37 traits focused on addressed specific high relevance challenges in Africa:

✓ 23 traits focused on tropical pests and disease resistance

✓ 5 - nutritional enhancement

✓ 4 - drought tolerance

✓ 3 – nitrogen use efficiency and salt tolerance

✓ 1 – flower colour in Gypsophilla flowers

✓ 1 – modified oils in soybean

Overview of status of Biotechnology and Biopolicy in Africa

COUNTRY Crop	BFA	EGY	GHA	KEN	MWI	MOZ	NGA	ZAF	SDN	TZA	UGD	ZWE
Banana											CFT	
Canola								CR, CFT				
Cassava				CFT			CFT	TR			CFT	TR
Cotton	CR*, CFT	CR, CFT	CFT	CFT	CFT	CFT		CR, CFT	CR		CFT	CFT
Cowpea	CFT		CFT				CFT					
Maize	GH	CR, CFT		CFT		CFT		CR, CFT		~CFT	CFT	~CFT
Potato		CFT						TR			CFT	TR
Rice			CFT								CFT	
Sorghum	GH			GH			CFT	TR				
Soybeans	GH							CR, CFT				
Sugar cane								CR, CFT				
Sw.potato				TR							GH	
Tomato		GH										
Wheat		CFT										

Abbreviations: Commercial Releases (CR, CR* with temp suspension), Confined Field Trials (CFT), Greenhouse (GH), and Transformations (TR)

Overview of status of Biotechnology and Biopolicy in Africa

Five categories of African countries engaged in biotechnology could be distinguished:

-A: those that are generating and commercializing biotechnology products and services,

-B: those that are engaged in third generation biotechnology R&D with confined field testing,

-C: those that are engaged in contained research;

-**D:** those that are developing capacity for research and development ;

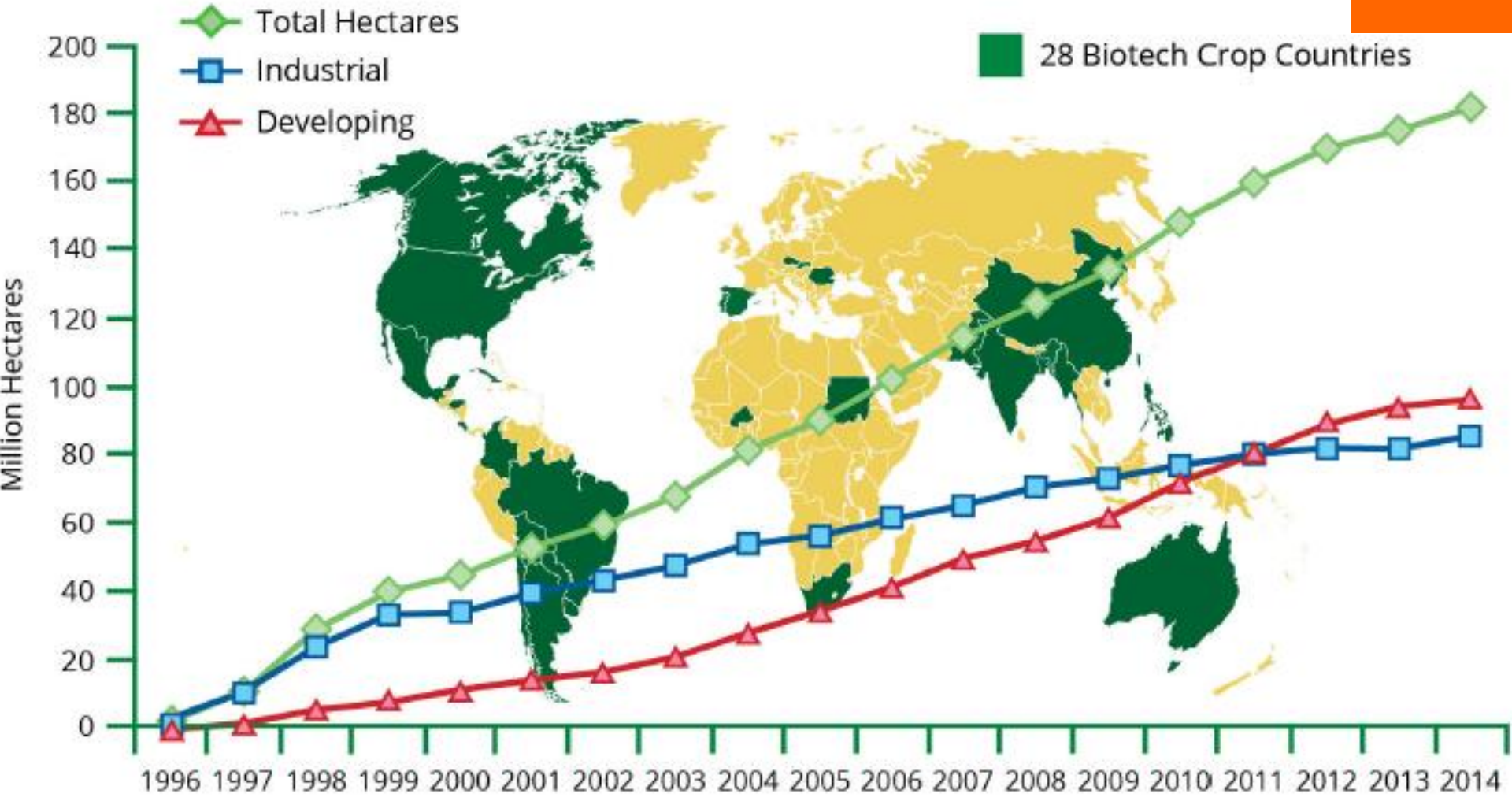
-E : those that are developing internal laws.

Overview of status of Biotechnology and Biopolicy in Africa

In 2014, out of the 54 African member states, 22 countries have biosafety laws, regulations, guidelines or policies in place related to genetic engineering and modern biotechnology.

In 2014, globally more than 175 million hectares of GM crops were world wide grown at an annual increase rate of 3%. By this date, four African countries planted 3.2 million hectares (ha) and commercialized them: South Africa, Burkina Faso, Egypt and Sudan. To date, however, only South Africa, and Sudan grew commercial GM crops as the Egyptian and Burkina Faso governments placed a temporary planting restriction.

GLOBAL AREA OF BIOTECH CROPS
Million Hectares (1996-2014)

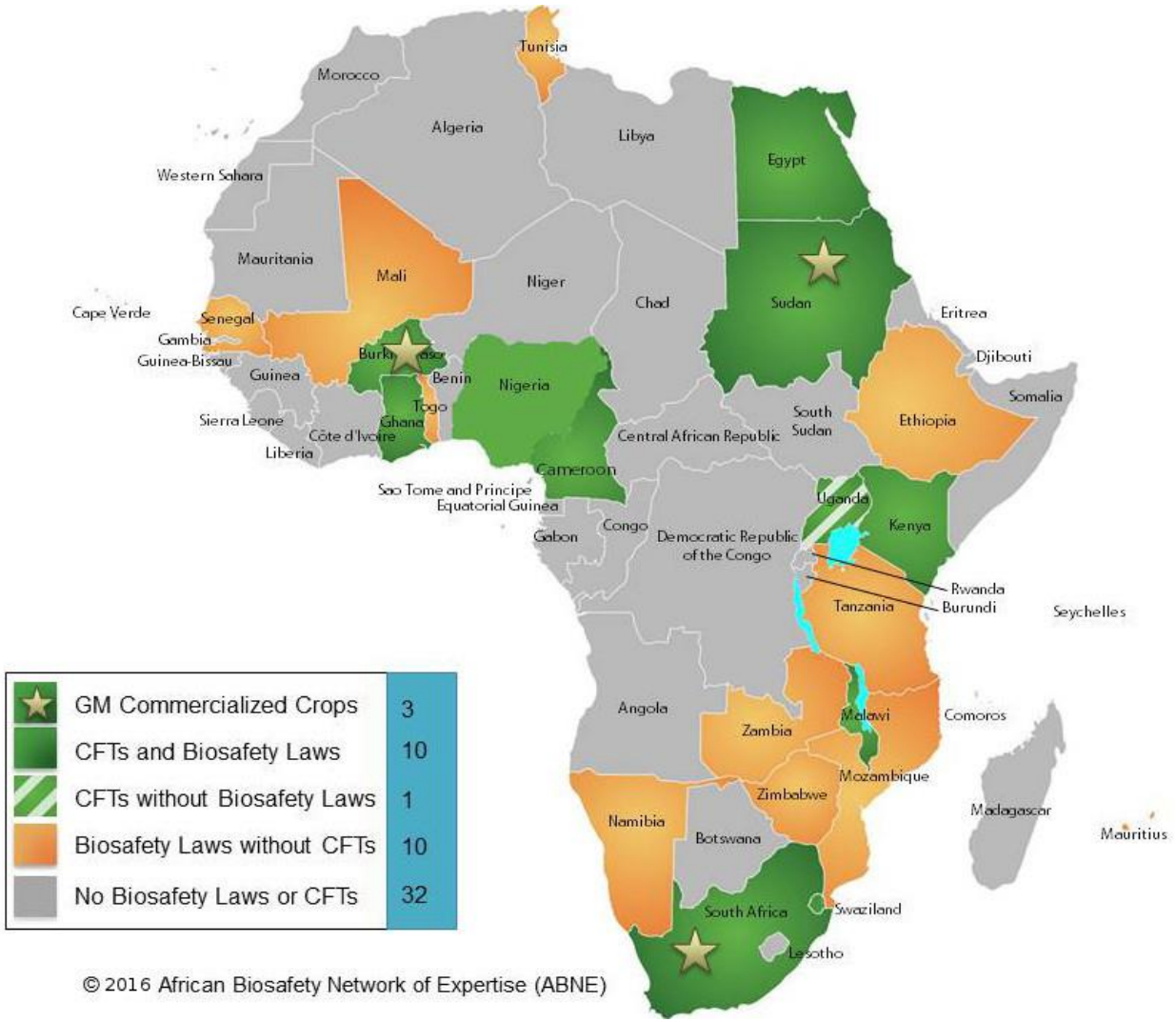


A record 18 million farmers, in 28 countries, planted 181.5 million hectares (448 million acres) in 2014, a sustained increase of 3 to 4% or 6.3 million hectares (~16 million acres) over 2013.

Source: Clive James, 2014.

Overview of status of Biotechnology and Biopolicy in Africa

Current status of GM-crops in Africa (2016)



Specific country case studies GMOs adoption in Africa

Selected countries:

Burkina Faso
Egypt
Kenya
Nigeria
South Africa

Specific country case studies GMOs adoption in Africa

Burkina Faso

In Burkina Faso agriculture contributes almost 40% of the Burkina Faso GDP and provides employment to 80-85% of the country's total population. Cotton is the main cash crop from which over 3000 stakeholder associations are involved in its production and commercialization. With average cotton holding at 3.25 hectares per farm, there were approximately a total of 76,000 Bt cotton farmers in Burkina Faso in 2011.

Specific country case studies GMOs adoption in Africa

Burkina Faso…..

Because of chemical resistance and several damage of the cotton caused by insects, the government, through a partnership with **Monsanto**, decided to explore the use of Bt cotton.

Stakeholders realized that the use of biotechnology must go hand-in-hand with biosafety measures as required by the CPB.

To date, Burkina Faso is the only francophone West African country to have a functioning biosafety regulatory system that has approved the commercial release and use of GM products.

The cotton remains the principal cash crop.

Specific country case studies GMOs adoption in Africa

Burkina Faso…..

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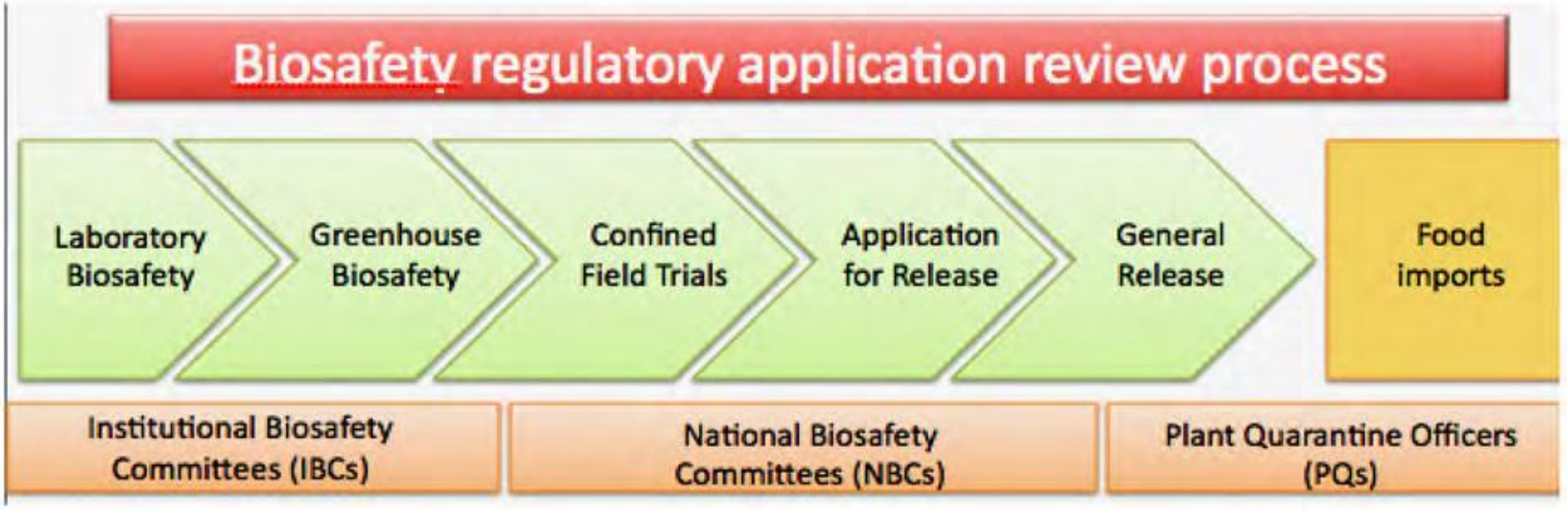
Benefits from Bt cotton include an average yield increase of almost 20%, plus labor and insecticide savings (2 rather than 6 sprays), which resulted in a net gain of about us $66 per hectare compared with conventional cotton.

It was estimated that Bt cotton has the potential to generate an economic benefit of up to us $100 million per year for Burkina Faso.

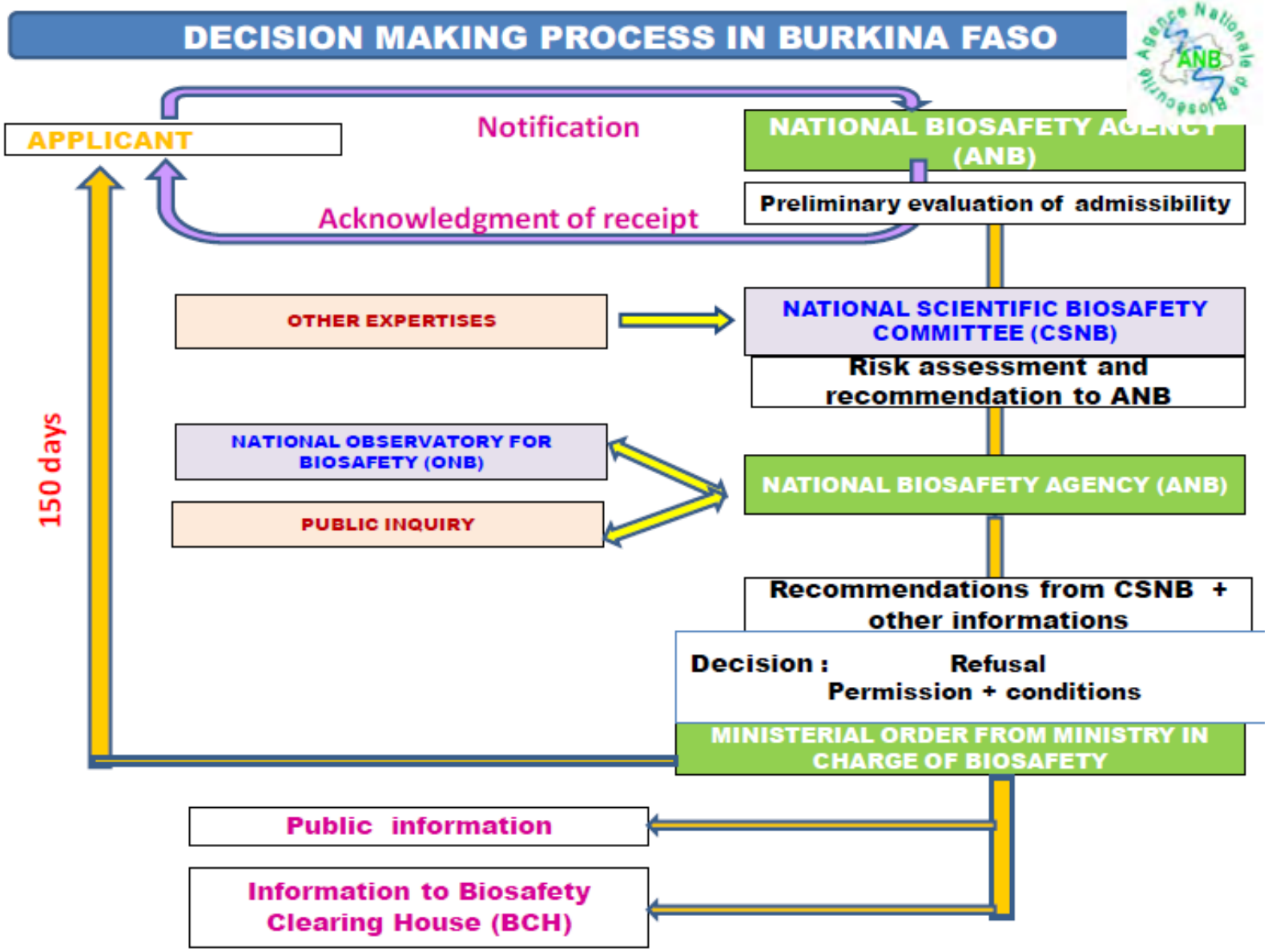
Specific country case studies GMOs adoption in Africa

Burkina Faso

Farmers in Burkina Faso have been successfully growing Bt cotton since 2008. The biosafety is controlled by the national Biosafety Agency (Agence Nationale de Biosecurité) according to the following biosafety scheme:



Specific country case studies GMOs adoption in Africa



Specific country case studies GMOs adoption in Africa

Burkina Faso

In addition to Bt cotton, confined field trials are currently ongoing for improved nutritional sorghum (vitamin A and lysine), *Maruca*-resistant cowpea and RoundupReady® cotton.

Specific country case studies GMOs adoption in Africa

Burkina Faso

The adoption of Bt cotton was very fast in Burkina Faso, from an initial area of approximately 8 500 hectares in 2008 to more than 500,000 hectares in 2014 (Sofitex; 2014). Bt cotton has increased cotton yields and income.

It also allowed for a significant reduction in the number of applied pesticides sprays, from 6 or 8 to 2.

Specific country case studies GMOs adoption in Africa

Burkina Faso

Although Bt cotton is generally adopted by cotton farmers, some civil societies still oppose to the introduction of GM crops in the Country.

Most recently in April 2016, the government of Burkina Faso has decided to suspend the use of Bt cotton for this year. The reason behind this decision is that the fiber from Bt cotton is shorter than the wild type, which impair its commercial value for exportation. Nevertheless, the debate is still going on because some cotton breeders have a preference for the Bt cotton. Thus the application of this decision is still a controversy.

Specific country case studies GMOs adoption in Africa

Kenya

The first institutional biosafety guidelines in Kenya were developed in 1992 by the Kenya Agricultural Research Institute (KARI) with help from the United States Agency for International Developments (USAID) and the new Agricultural Biotechnology for Sustainable Development (ABSD) project.

Kenya is the first country in the world to sign the CPB in May 2000. The country was selected as one of the pilot projects for the UNEP Global Environmental Facility (UNEP-GEF) biosafety project in 2001.

Specific country case studies GMOs adoption in Africa

Kenya

The Biosafety Act allows the marketing and release into the environment of approved GMs and their products. This is controlled by the Biosafety (environmental release) Regulations.

Until now, there has been no release into the environment of any GM crops in Kenya but several crops are in the pipeline for release with the confined field trials on Bt cotton, Bt maize and virus resistant cassava at an advanced stage.

Confined field trials have also started on bacterial wilt resistant banana, nematode resistant yam, and bio-fortified sorghum.

There is still an interest in the Government to exploring all possible strategies to food sufficiency using GM crops.

Specific country case studies GMOs adoption in Africa

Nigeria

Although Nigeria derives about 80% of its income from oil, agriculture contributes about 38% of the Gross Domestic Product. About 70% of the population derives its livelihood from agriculture, and the national economy is characterized by a large rural-based traditional sector.

The country signed (2002) and ratified (2003) the **CPB** which is intended to conserve biological diversity from the adverse impact of GMO.

The country has several biosafety instruments (policy, protocols, guidelines, etc.) to monitor GM crops.

Specific country case studies GMOs adoption in Africa

Nigeria

-A National Biotechnology Development Agency (**NABDA**) became established in the latter part of 2001 to promote modern biotechnology activities in the country.

- The National Biosafety Bill has led to an Act (2015) to regulate the practice of modern Biotechnology, handling and use of its products (genetically modified organism).

Specific country case studies GMOs adoption in Africa

Nigeria

Confined field trials on GM crops are ongoing in several research institutions such as National Root Crops Research Institute (Umudike), and at Institute for Agricultural Research (Zaria).

The experiments focused on bio-fortified cassava with increased pro-vitamin A, bio-fortified cassava with an increased bio-availability of iron, sorghum with increased bio-availability of zinc, iron, protein, pro-vitamin A, and cowpea resistant against the soybean pod borer, *Maruca vitrata*.

Specific country case studies GMOs adoption in Africa

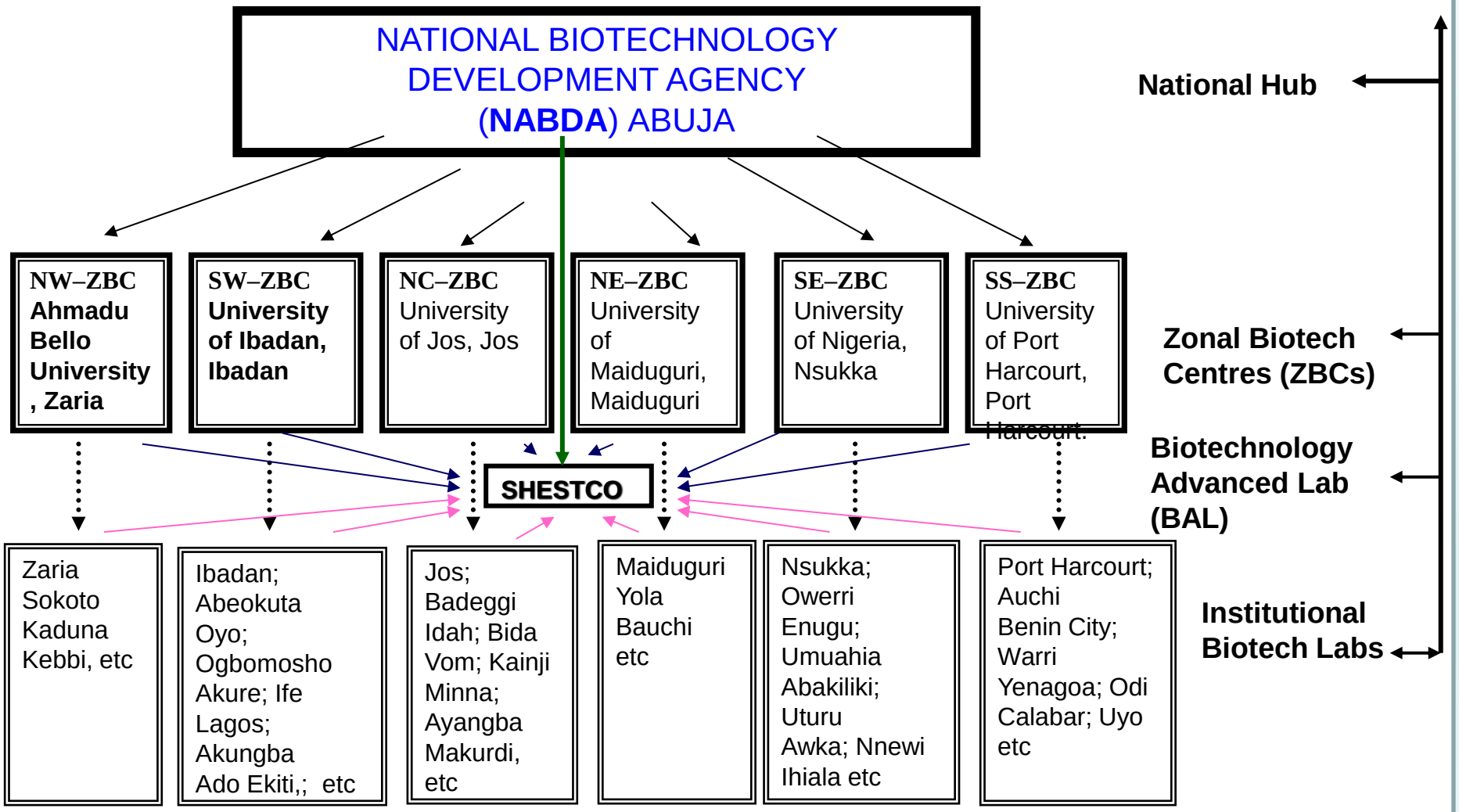
Nigeria

The commercialization of GM is not yet effective and hampered among others the following factors:

- Inadequate qualified human resource and capacity building;
-Inadequate knowledge of biosafety by the public,
-Misconceptions about modern biotechnology and GMOs,
-Control of the distribution of GMOs
-Inadequate funding of biosafety and research activities,
-Issues surrounding liability and redress, etc.

Specific country case studies GMOs adoption in Africa

Nigerian National Biotechnology Network (NABNET)



Specific country case studies GMOs adoption in Africa

- Potential areas of Biotechnology application in Nigeria,
  - Agriculture,
  - Environment,
  - Medicine,
  - Food and
  - Industry
- The potentials in these field require investments in-
  - Research,
  - Capacity building,
  - Legislation,
  - Awareness and
  - Entrepreneurship

Specific country case studies GMOs adoption in Africa

Egypt

Egypt takes a permissive approach to genetically modified organisms (GMOs), and its public policy does not oppose growing, importing, and exporting genetically modified crops.

Egypt ranks third in Africa in planting and importing genetically modified crops, after South Africa and Burkina Faso.

In 2008, Egypt became the first North African country to grow genetically modified crops.

Since December 2010, genetically modified crops have been planted without restrictions in ten different Egyptian provinces, including one thousand hectares of genetically modified maize in 2012.

Specific country case studies GMOs adoption in Africa

Egypt

Egypt does not have any restriction on researching, producing, or marketing genetically modified crops and food products. In March 2008, the Ministry of Agriculture approved the domestic cultivation of GM corn, and the Ministry of Agriculture allowed the importation of GM corn seeds into markets. Since 2011, Egypt commercialized Bt cotton. Activists have voiced their rejection of GM-crops. Since November 2011, the draft legislation was approved by the council of ministers. However, the measures have not been approved by the parliaments (lower and up ones). Thus the process is of GM is temporarily suspended.

Specific country case studies GMOs adoption in Africa

Egypt

Currently the following field trial (FT), green house trial (GHT) or lab experiments are conducted for traits of several GM crops.

Maize	Insect resistance	FT
Cotton	Salt tolerance	GHT
	Drought tolerance	FT
Wheat	Fungal resistance	GHT
	Salt tolerance	Lab
Potato	Viral resistance	FT
Banana	Viral resistance	Lab
Cucumber	Viral resistance	FT
Melon	Viral resistance	FT
Squash	Viral resistance	Lab
Tomato	Viral resistance	Lab

Specific country case studies GMOs adoption in Africa

South Africa

South Africa has ratified the Cartagena Protocol on Biosafety. The country has a fully functional regulatory framework to manage the use of genetically engineered organisms.

The total area planted to soybeans increased from 500, 000 ha in 2012 to 520, 000 ha in 2013. Of this, the adoption rate of HT soybeans was 92% (478, 000 ha). The total cotton area was

8 000 ha, with the adoption rate of GE cotton reaching 100%, 95% of which was the stacked Bt/HT traits and the remainder the HT trait which was used as a mandatory refuge..

Specific country case studies GMOs adoption in Africa

South Africa

Although small-scale farmers cultivating GM maize in South Africa have to pay 35% more for seed than non-GM maize producers, they achieve high yields and pay 42% less per hectare for labor (Regier et al., 2013).

In addition, in this country it is found inverse relationship between number of local hospital admissions classified as related to cotton production, and adoption of Bt cotton.

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Specific country case studies GMOs adoption in Africa

Nevertheless GMO still have controversial advantages and disadvantages which should be thoroughly addressed according to specific country needs.

Overal known positive aspects of biotechnology

- Improved resistance to drought and salt stress, pests and diseases;
- Higher yields &/or reduced input use;
- Increase of nutritional quality
- Increase delay of ripening ;
- Enhanced environmental protection;
- domestication of forest trees;
- Reduction of pesticide treatements
- Reduction human labor;

Overal known positive aspects of biotechnology

•Fruits with vaccines

- Increase food production;
- Reduce post-harvest losses;
- Increase of micronutrient contents;
- Edible vaccines;
- Increased farm profitability;
- Molecular farming where microbes or plants are used to produce biopharmaceuticals;

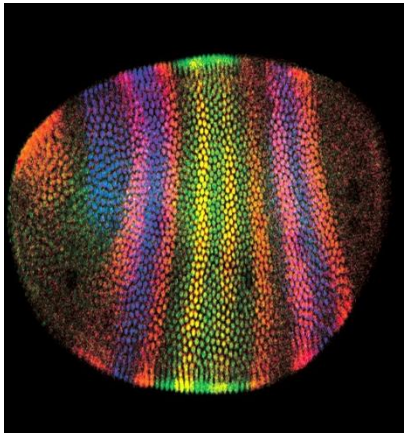
Overal known positive aspects of biotechnology

- Molecular farming where microbes or plants are used to produce biopharmaceuticals;
- Biological recovery of heavy metals from mining and other industrial sources;
- Bioremediation of soil and water polluted with toxic chemicals
- Production of biomaterials (bioplastics), biofuel, etc.
- Sewage and other organic waste treatment;
- Greater access to export mark (this is controversial), etc.

Grains with improved nutrition

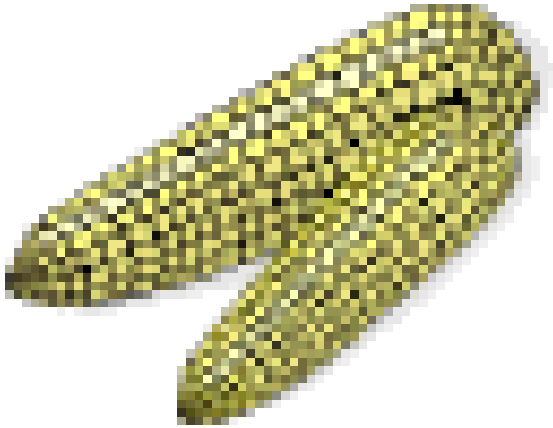
Overal concerns if any of GMOs

Concerns if any of GMOs



Fruit insect (fluorescent)

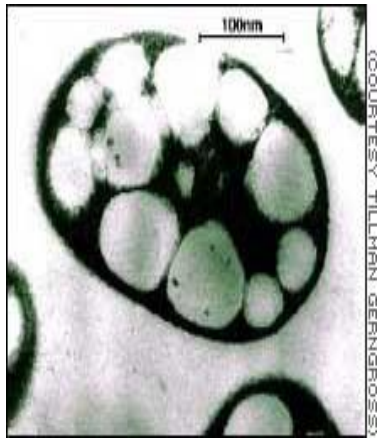
- Lack of appropriate GM crops/cash crops only
- Loss of export markets;
- Endangers indigenous crops/loss of biodiversity;
- Creation of superweeds;
- Higher seed costs / licensing agreements;
- Fear of “terminator” gene technology;
- Low input use already in place;
- Introduction of new proteins into foods;
- Plants used to make nonfood substances.
- Undesired gene flow



Undesired Gene Flow

Overal concerns if any of GMOs

- Increases of known toxins, decreases in nutrients;
- Activation of dormant pathways;
- Allergenicity;
- Antibiotic and other insects resistance;
- Gains to wealthy landowners and multinationals;
- Dependance on genomic databases;
- Unknown disease and future health consequences;
- Weak public trust in government since the problem of mad cow (bovine spongiform encephalopathy, prion protein disease or Creutzfeldt-Jakob disease);
- Consumer concerns, etc.



Discussion of unit 5

- What is the local societal impression of biotechnology?
- What are the negative impacts that biotechnology may have?
- What are the potential ethical issues associated with biotechnology adoption?
- Why are biotechnology companies targeted by anti-globalisation protesters in Africa?
- How can the image of biotechnology to the public be improved? Should it be improved?
- What are the potential dangers of biotechnology?
- How the African stakeholders can be involved for the adoption of Biotechnology?.