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The sustainable utilisation of GM technology

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GM sustainability discussion, Stellenbosch University, 3 Sep 2012

technology innovation AGENCY

science & technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

OVERVIEW

- What is GM technology and do we need it?
- Why are GMOs regulated?
- Risk analysis as the basis of decision making.
- A few important RA concepts.
- Sustainability defined (and integrated).
- Some thoughts on innovation.

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GOAL
BRAND CAMP
by Tom Fishburne
LET ME PLAY DEVIL'S ADVOCATE AND PASSIVE AGGRESSIVELY ROAST YOUR IDEA WITH INFERNAL DAMNATION
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TOMFISHBURNE.COM
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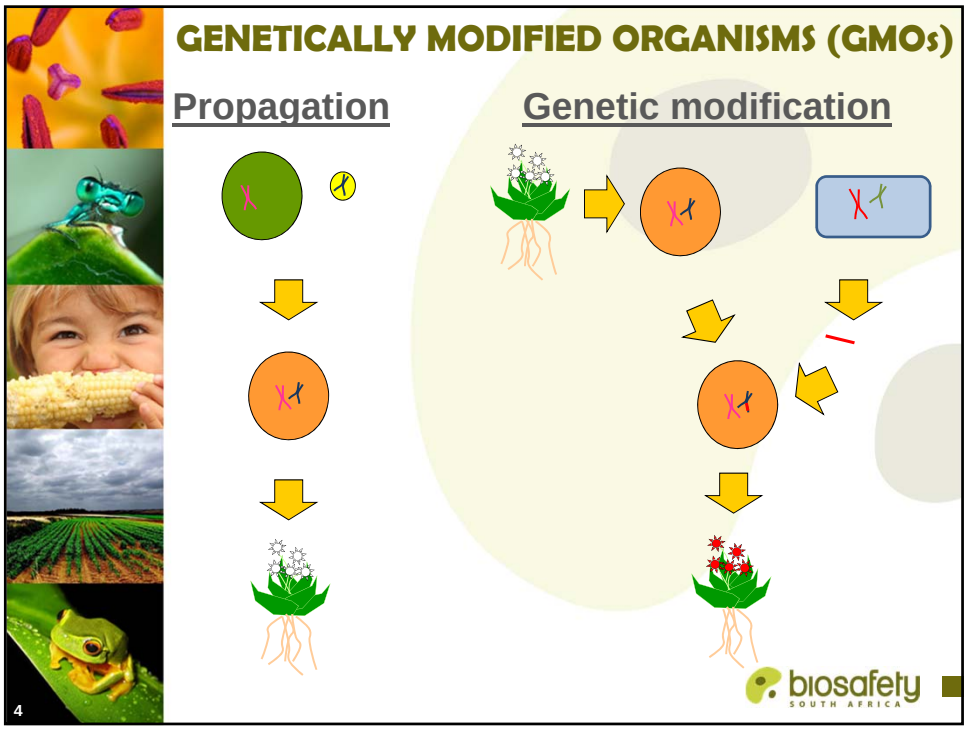
GENETICALLY MODIFIED ORGANISMS (GMOs)
Propagation
Genetic modification
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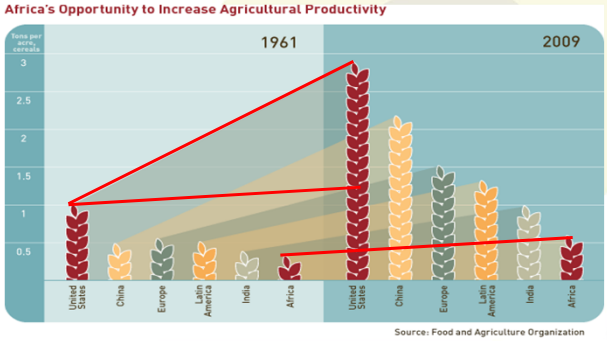
DOES AFRICA NEED (AGRI)BIOTECH INNOVATION?



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WHY THE NEED FOR REGULATION?

- The products of modern Biotechnology are novel and often living modified organisms (LMOs).
- During research and development, these organisms are contained and their distribution is restricted.
- When released, as living organisms, LMOs can spread, multiply and integrate into the environment.
- It is therefore important to assess a LMO's potential impact on biodiversity, health, the environment and socio-economics before it is released.

History of save use

vs.

novelty

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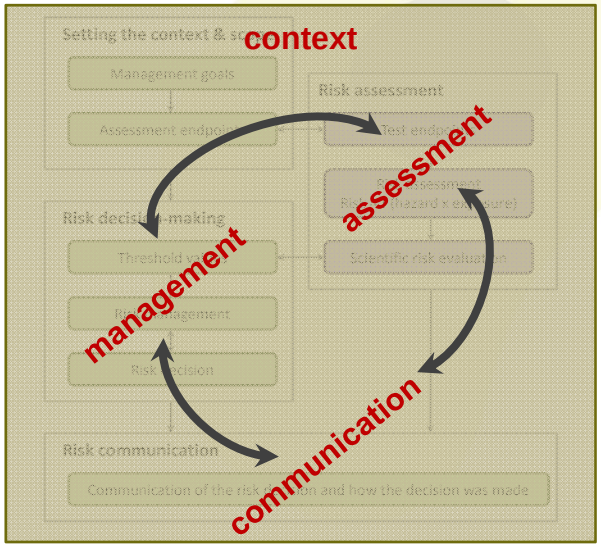
RISK ANALYSIS AS BASIS FOR DECISION MAKING



Adapted from Johnson et al. 2007. Trends in Plant Science 12(1): 1-5.

Stages of risk analysis:
Progression through the different risk analysis steps is iterative and non-linear.

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RA CONCEPT 1: TIERED APPROACH

Tier 1:
Is any NTO species sensitive to (a) purified protein or (b) GM plant?

NO → No additional data required

YES

Tier 2:
Any adverse effects on ecosystem functions or development of focal NTOs compared to conventional counterpart under semi-field conditions?

NO → No additional data required

YES

Tier 3:
Any adverse effects on ecosystem functions or development of focal NTOs compared to conventional counterpart under field conditions?

NO → No additional data required

YES

Risk management:
Can risk be reduced to acceptable levels?

YES → Describe risk management strategies

NO → Fully characterise risk to focal NTO

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RA CONCEPT 2: LIMITS OF CONCERN

- Important to put risk analysis into perspective.
- Define your protection goals, e.g. “environmental quality” to be preserved.
- Place possible hazards in context:
  - (i) Harm should be measurable (i.e. should be able to quantify effects).
  - (ii) Difference between variability and definite change (P = G x E).
  - (iii) Significance of harm should be defined (e.g. in terms of population size and potential to recover).
  - (iv) Representativeness of harm should be determined (i.e. consequences for protection goals).
- Always evaluated on a comparative and case-by-case basis (choice of comparator important).

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RA CONCEPT 3: CONTEXT

Benefit vs. Risk

- Responsible utilisation of technology - “no risk” activities not realistic.

GM vs. Other technologies

- No technology/product can be evaluated in isolation.

Africa vs. Europe

- Variable frames of reference and requirements/needs.

1995 vs. 2012

- Knowledge base – now large body of additional knowledge available & still increasing.

GMOs vs. Bt maize

- Risk analysis and regulatory decisions taken one event at a time.

GMOs have been politicised

- Regulatory decisions not made in “scientific isolation”.

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ASPECTS OF THE SUSTAINABILITY OF GMOs

Safety of food and animal feed

Food related risks: Toxic materials, allergens, nutritional value, unwanted interaction between food components. **S**ubstantial equivalence. **L**abeling of GMO-foods. **D**etection of the transgene and/or protein in agricultural products.

Environmental safety

Direct or indirect impact of toxic transgenes on non-target organisms. Interactions and effects of transgenes and GM plants on biodiversity and ecosystem function including target organisms. **T**ransgene escape to landraces, wild relatives and non-GM counterparts via gene flow and the potential ecological effects. **P**otential risks associated with the development of resistance to biotic resistance-transgenes in target organisms. **C**hanges in agricultural practices.

Socio-economic considerations

The impact of GMOs goes further than the health and ecological dimensions; it has a significant impact on society, including cost of living, production systems, trade, culture and ethics.

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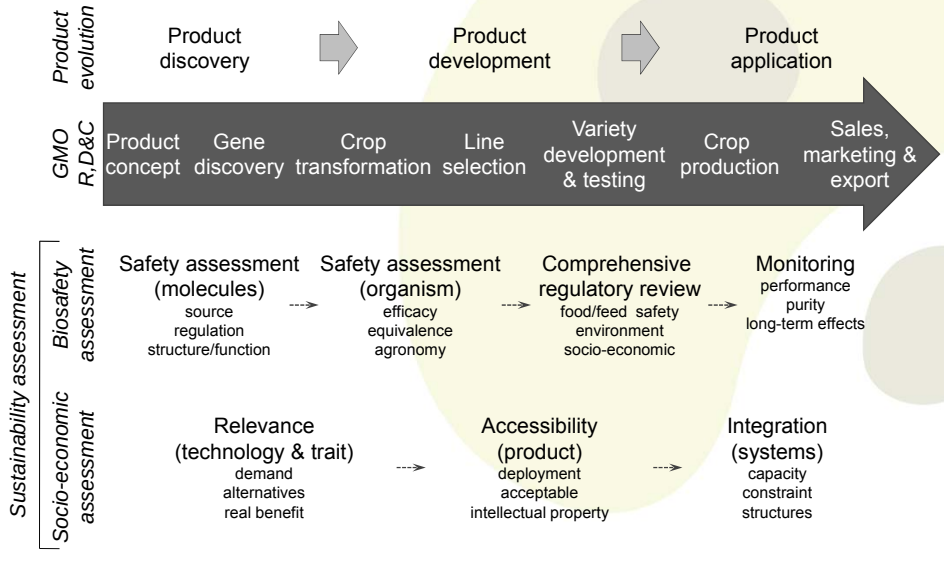
INTEGRATED SUSTAINABILITY ASSESSMENT



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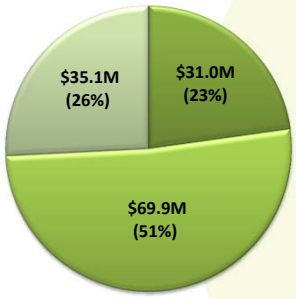
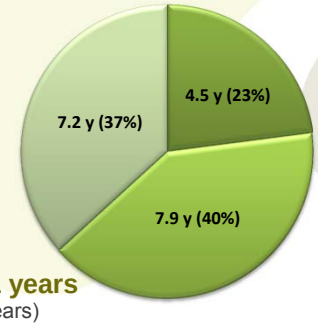
CONSIDER GM'S UNIQUE BARRIERS

- The **complexity, cost** and **time frames** associated with GM technology developments are huge barriers…



Source: McDougall 2011.

(i) Total cost = $136 million



(ii) Overall time = 13.1 years
(total time of 19.6 years)

(iii) > 6,200 "discovery units" per product

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ASSESSING THE RISKS OF A CONTROVERSIAL TECHNOLOGY

Contents lists available at ScienceDirect
Reproductive Toxicology
journal homepage: www.elsevier.com/locate/reprotox

Maternal and fetal exposure to pesticides associated to genetically modified foods in Eastern Townships of Quebec, Canada

Aziz Aris[a,b,c,*], Samuel Leblanc[c]

February 2011

- Glyphosate in 5% of non-pregnant women at 73.6ng/ml.
- Gluphosinate in 18% of non-preganant women at 28.7ng/ml.
- Cry1Ab in 69% & 93% of non- & pregnant women at ~0.16ng/ml.

"As for glyphosate, it is interesting to note that the gluphosinate concentrations used in these tests are very high (10ug/ml) compared to the levels we found in this study (53.6ng/ml)." [186x]

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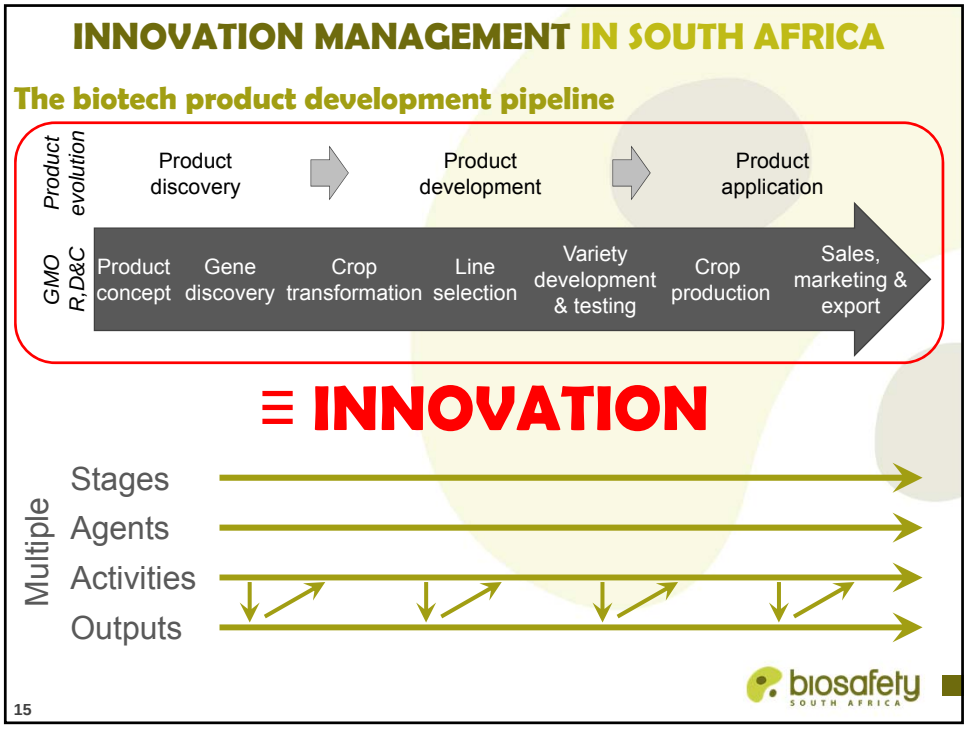
INNOVATION MANAGEMENT IN SOUTH AFRICA
The biotech product development pipeline
Product evolution
Product discovery
Product development
Product application
GMO R,D&C
Product concept
Gene discovery
Crop transformation
Line selection
Variety development & testing
Crop production
Sales, marketing & export
≡ INNOVATION
Multiple
Stages
Agents
Activities
Outputs
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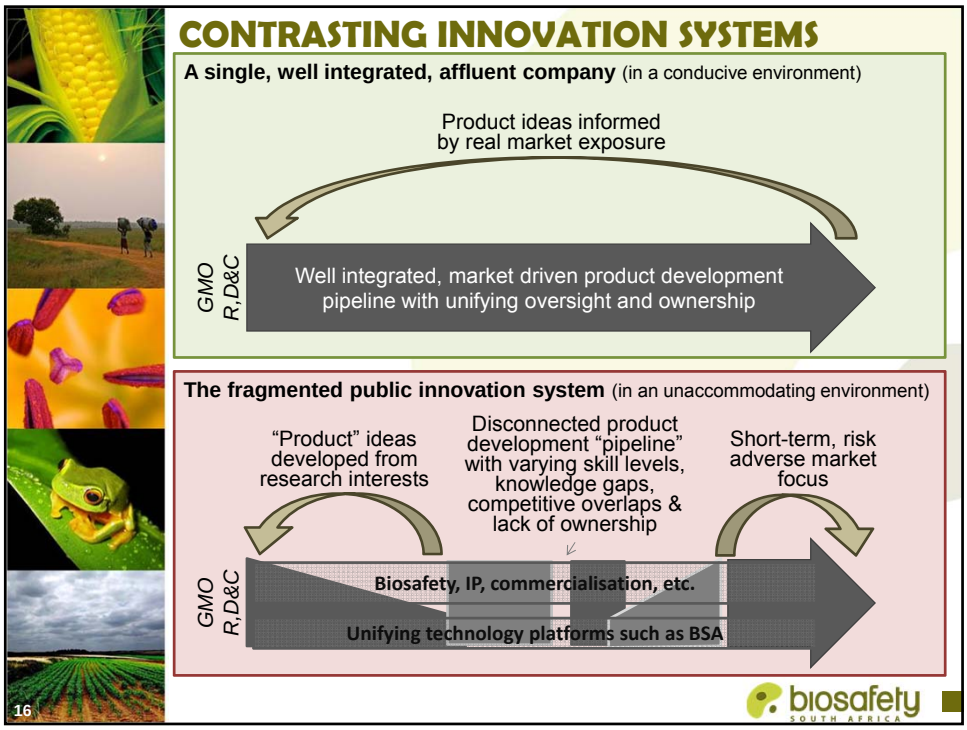
CONTRASTING INNOVATION SYSTEMS
A single, well integrated, affluent company (in a conducive environment)
Product ideas informed by real market exposure
GMO R,D&C
Well integrated, market driven product development pipeline with unifying oversight and ownership
The fragmented public innovation system (in an unaccommodating environment)
"Product" ideas developed from research interests
Disconnected product development "pipeline" with varying skill levels, knowledge gaps, competitive overlaps & lack of ownership
Short-term, risk adverse market focus
GMO R,D&C
Biosafety, IP, commercialisation, etc.
Unifying technology platforms such as BSA
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TAKE HOME MESSAGES

- GM technology holds huge potential if utilised sustainably.
- The potential risks of GM products have to be managed - regulations will therefore always be part of product development (and this will complicate matters).
- Regulatory frameworks and the environment in which GMOs are regulated are complex, but with risk analysis as basis it is manageable.
- Sustainable GM technology = safe + relevant + accessible
- Finding facts is not always that easy when dealing with a controversial technology.
- Sustainability should be an integrated focus in any biotechnology innovation system to ensure safe products and an efficient system.

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Thank You!

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