Perspectives on non-food applications of biotechnologies

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- ✓ **Biotechnologies - definition**
- ✓ **European/OECD position**
- ✓ **Situation in Sub Saharan Africa**

Biotechnologies

Field of application:

- Primary production through agriculture, forestry, fishing: ***'green'***
- Health and pharmaceutical sector: ***'red'***
- Industry/environment: ***'white'***

Methodology used:

-'Modern' biotechnologies use rDNA techniques

- 'Traditional': plant tissue culture, fermentation, etc

The European/OECD position*

Moving Towards a Knowledge-Based BioEconomy

Drivers – global challenges

- Increased demand for healthcare, food, feed, fiber and energy due to population growth / increased life span

- Unsustainable exploitation of ecosystems resulting in environmental degradation (exacerbated by climate change effects)

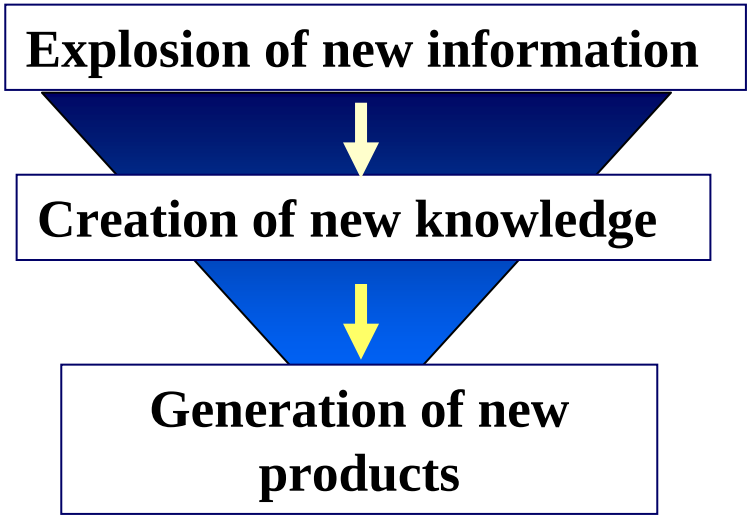
→ Biotechnology, integrated with other disciplines, offers technical solutions to the production of food, feed, fiber and energy

*The Bioeconomy to 2030. Designing a policy agenda. 2009. OECD.

New vision fuelled by recent advances in life sciences

Systems biology

Illumina HiSeq 2000 sequencing system



Health sector: 'genome-based healthcare: personalized medicine' (G Venter; PAG XVII, USA. 2009)

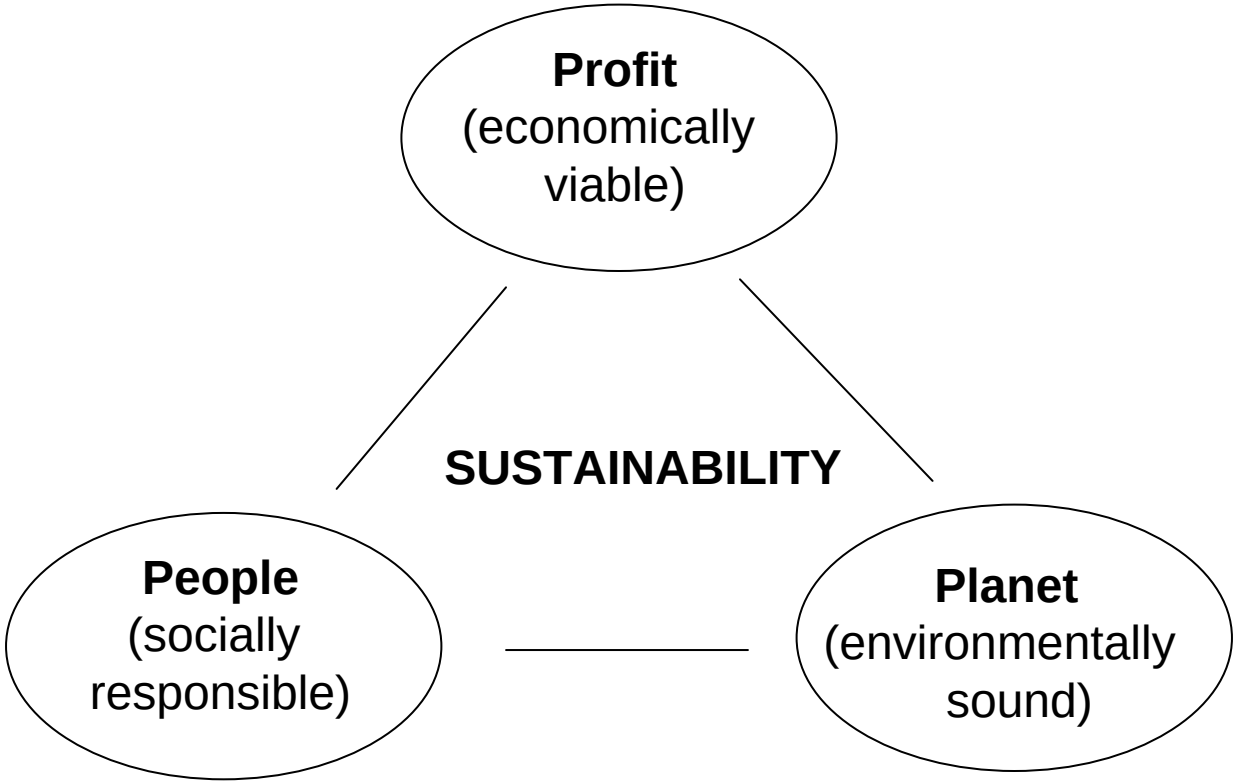
Plant sciences: 'transgenics transformed'

Using recombinant mini-chromosomes multiple genes have been introduced and stably inherited in maize (PLoS Genetics. 2007)

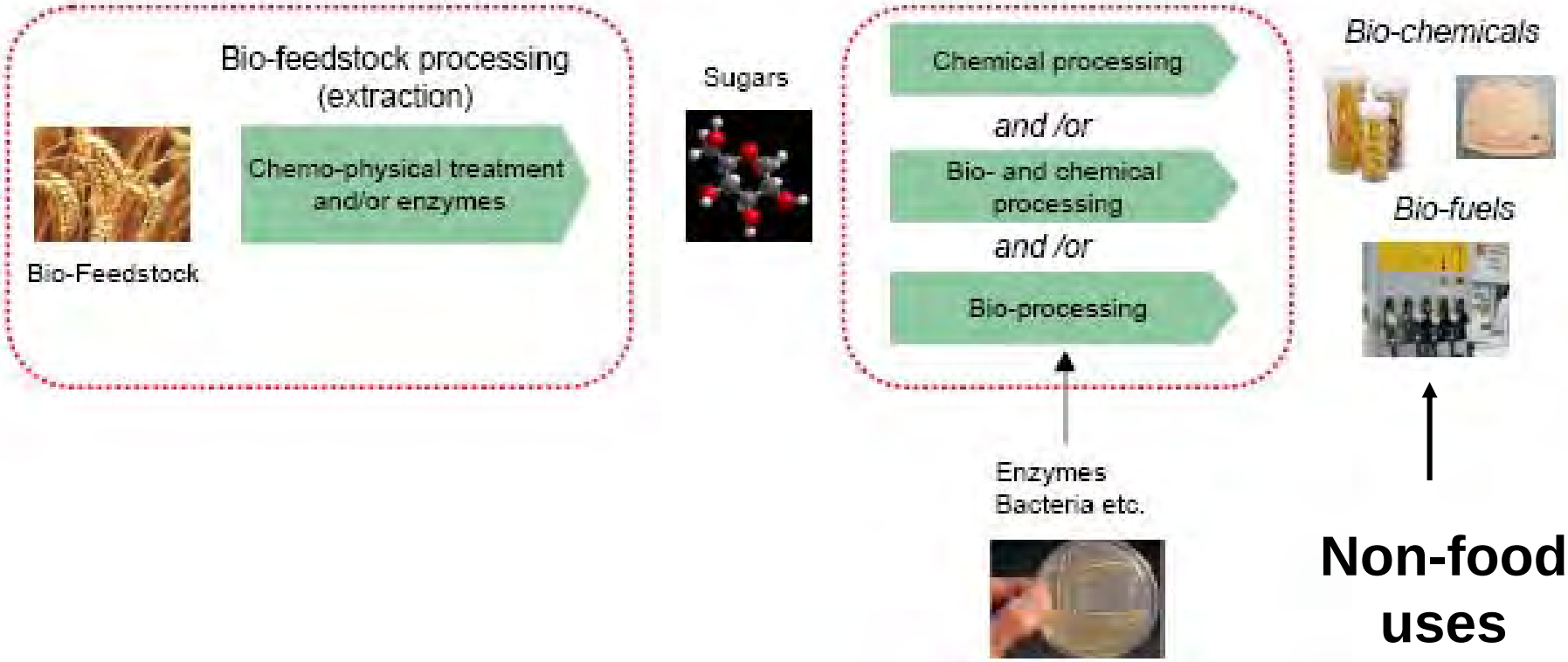
GM crops to become a 'conventional' technology?

Position document: 'Industrial (White) Biotechnology. An effective Route to Increase EU Innovation and Sustainable Growth'

Social, environmental and economic benefits of bio-economy can go hand-in-hand



Plants as feedstocks:
combining green with white biotechnology



A growing market

The value for industrial crop-derived materials globally is estimated at **US$ 28 billion**

Examples today

Energy:

Production of biofuels as alternative to fossil fuels

All major oil companies now invest in biofuel production; eg ExxonMobil $US 600 M to produce biofuels from algae (Science 2009. 325: 379)

Primary production (food/feed):

Suite of modern biotechnologies are now used in plant and animal breeding/protection forestry and fisheries (GM, MAS, diagnostics, etc)

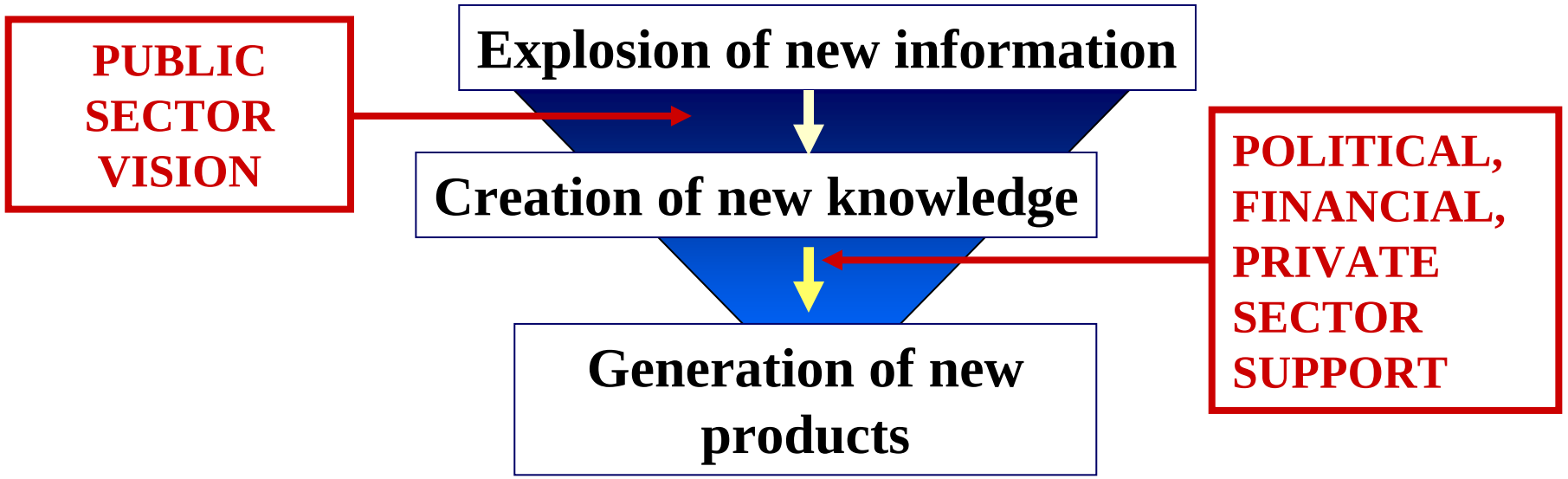
Industry:

Production of plastics, enzymes via biotechnological processes from renewable sources

Health:

Production of recombinant vaccines, diagnostics using modern biotechnologies

Policies and support will be critical for success



Example: GM crop technology

Robert Fraley – Monsanto

‘A new trait costs between US$100 million and US$150 million and can take up to 10 years from formulation to launch’

Price tag due to regulation and extensive testing delay or prevent

- Small / Medium Enterprise
- Public sector

to introduce a GM crop.

Only multinationals can proceed!

Biotechnology applications in Sub Saharan Africa*

*excluding South Africa

Constraints to using modern biotechnologies

- Basic infrastructure often lacking/unreliable (water, electricity, procurement) as well as national policies: affects research, development, commercialization

- Investment mostly external
  different sources: pockets of success but lack coherent strategy
  agenda subject to external changes in policy/priority

'development has to come from within'

- Human potential is there but limited incentives to pursue career in agricultural or biological sciences

- Education:
  facilities for hands-on training largely absent
  need to encourage problem solving
  is gap in knowledge narrowing or widening?

'what separates developed and less developed countries
Is not just a gap in resources, but a gap in knowledge'

Calestous Juma & Ismail Serageldin (2007)

On the positive side

- African leaders have put science and agriculture on their agenda and pledged to commit 10% of national budget (NEPAD)

- Sustained economic growth in Africa in 2000-2009 (4 to 6.1%) keeping pace with other developing countries (except India, China)

- ICT greatly improved

- National programs are gaining strength and started to take the lead in externally-funded agricultural development programs

Biotechnology and non-food applications

- Modern biotechnologies: in SSA predominantly used for primary production (green biotech) addressing food security, also for human & animal health (red biotech)

- Industrial (white) biotechnology:

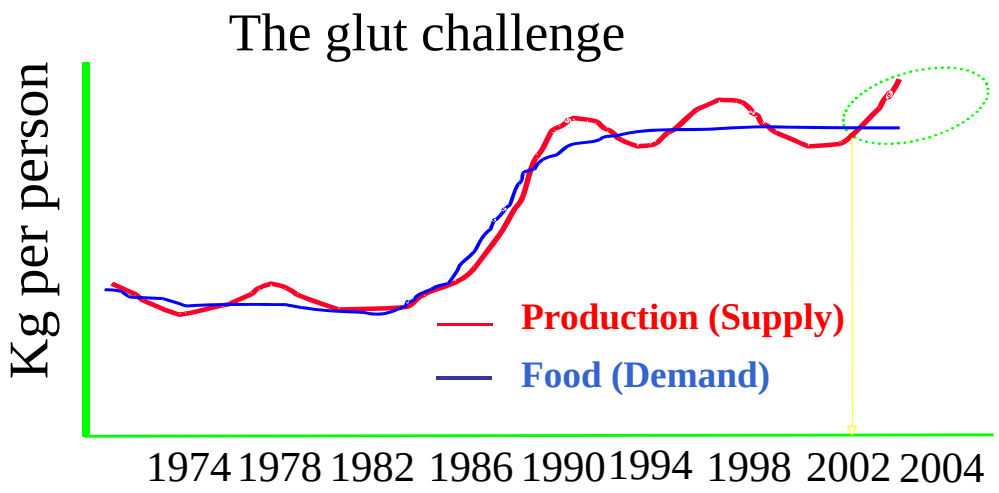
  a. the manufacture of biochemicals, bioplastics, biofuels from vegetable biomass (waste, byproducts) or fermentation media

  b. bioremediation: use of micro-organisms and plants for waste treatment

  c. screening of microbes from various environments for new bioactive compounds

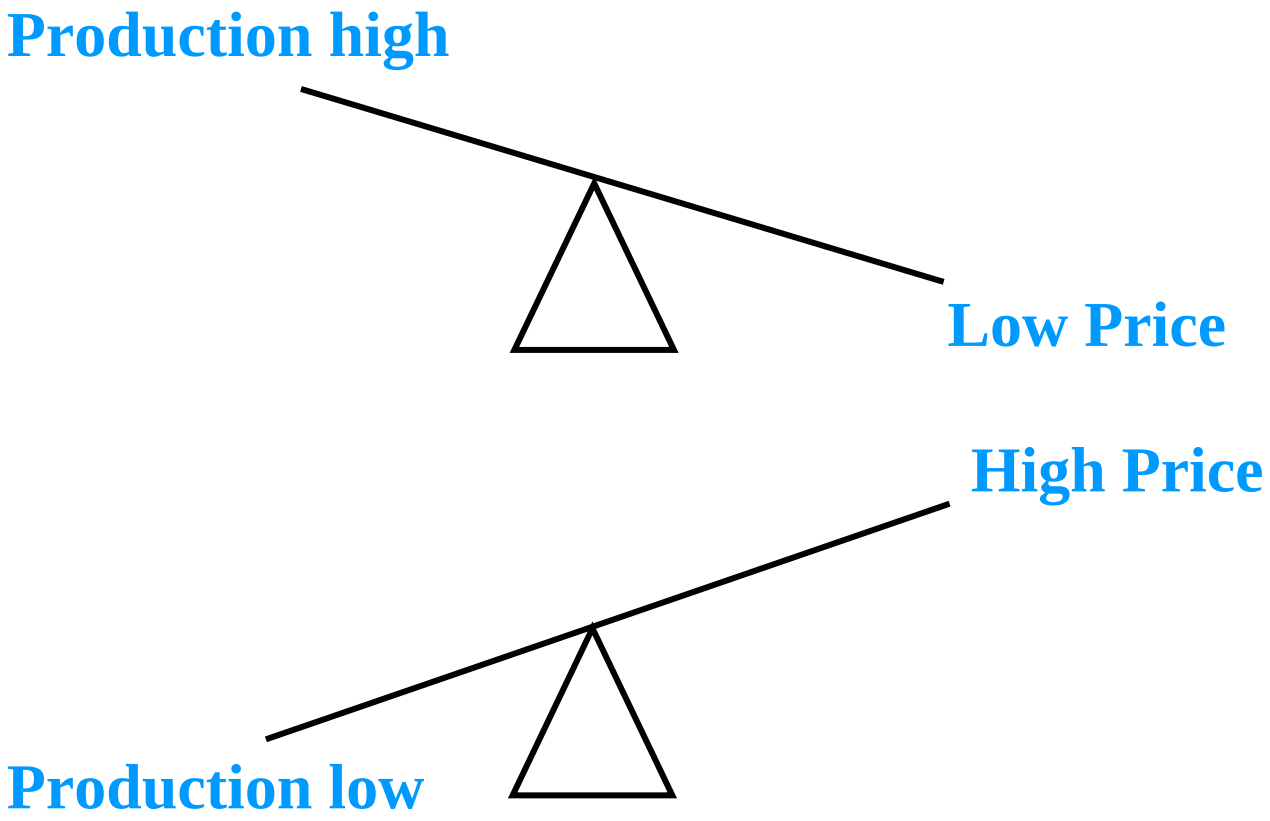
→ activities in all areas, opportunity to strengthen using latest advances in life sciences

- Cassava production in Nigeria



(from A. Dixon, IITA, Nigeria. 2006)

AVOIDING the SEESAW



(from A. Dixon, IITA, Nigeria. 2006)

Increasing crop production only part of the solution to reduce poverty

The challenge today is to increase market opportunities and profitability

Shift from

Production-Oriented R&D

to

Market-Oriented R&D

(from A. Dixon, IITA, Nigeria. 2006)

- Where conditions of subsistence farming has been reached, need to move to the next level to make agriculture attractive and profitable for higher standards of living, better health

- Also applies to ‘biotech’ crops

- Technological innovations in area of non-food could make important contributions to crop value addition and income generation for end-users