

**Working Party of National Experts on Science and Technology
Indicators**

OECD – Paris, 11 December 2006

**Socio-economic impact of non-
transgenic crop biotechnologies
in developing countries**

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Socio-economic impact of non-transgenic crop biotechnologies in developing countries



- **Introduction**
- **Review of literature**
- **Case study on plant micropropagation in Africa**





Biotechnology definition



“Any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products of specific use” (Art. 2, Convention on Biological Diversity)





Non-transgenic techniques in crop production and plant breeding



- **Micropropagation**
- **Reproductive cell biology techniques (anther culture, embryo-rescue)**
- **Use of microorganisms for soil fertility enhancement and plant protection**
- **Molecule marker-assisted selection (MAS)**





The need for impact assessment



Decision-makers need to

- **decide whether to invest in specific technologies**
- **tackle social problems**

Decision-makers and researchers need to

- **set priorities when allocating research budgets**
- **decide whether to use biotechnology**
- **design appropriate development projects**





Methodologies for Impact Assessment



- **Ex ante and ex post studies**
- **Impact on different levels**
 - micro
 - sector
 - macro
- **Different kinds of impact**
 - Agronomic, financial, socio-economic, social effects
 - Poverty reduction -> Sustainable livelihoods approach
- **Indicators**





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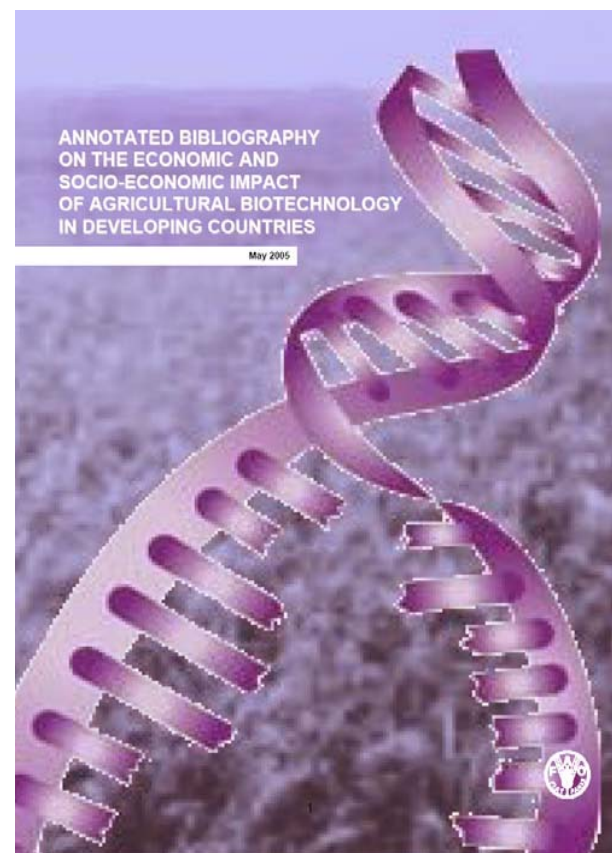


Review of literature of studies on biotechnology socio-economic impact



Focus on GMOs

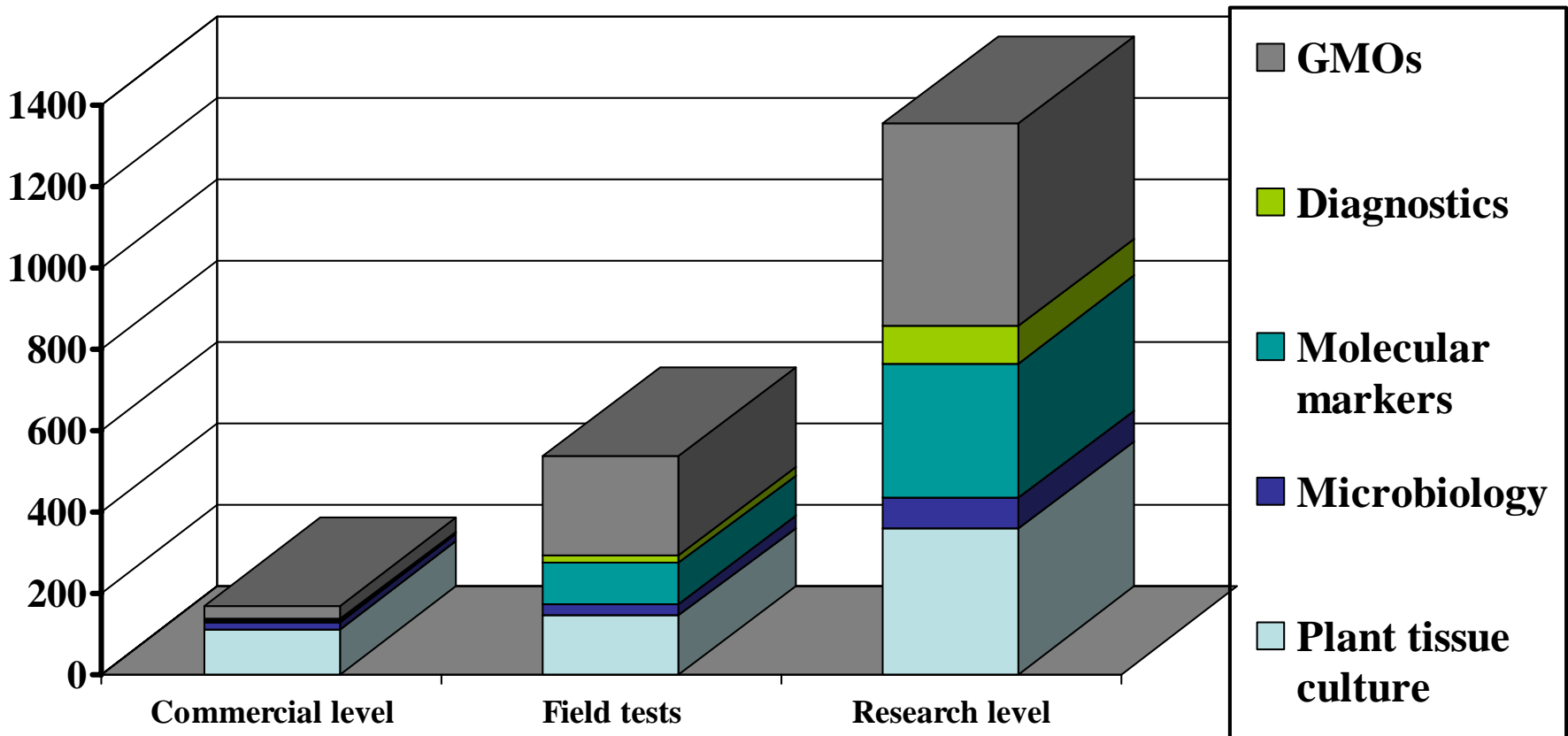
Cellular biology	4
MAS	8
Micropropagation	22
Biofertilizers	8
Veterinary biotechnology	3
Miscellanea	5
Total non-GM	50
GMO	199



Fonte: Mayer-Tasch, 2005



Biotechnology in Developing Countries



Source: FAO-BioDeC



Banana micropropagation in Kenya



Ex ante impact assessment:

- **benefits for all farm types**
- **higher and quicker adoption and more substantial benefits at lower plantlet price**
- **40% of benefits go to consumers**
- **Total economic gains more than 8 times higher with lower plantlet price**





Sweetpotato micropropagation in China



Results of impact study

- High adoption rate among poor and rich farmers
- No additional inputs required
- Stronger income effects on poor farmers than on rich farmers

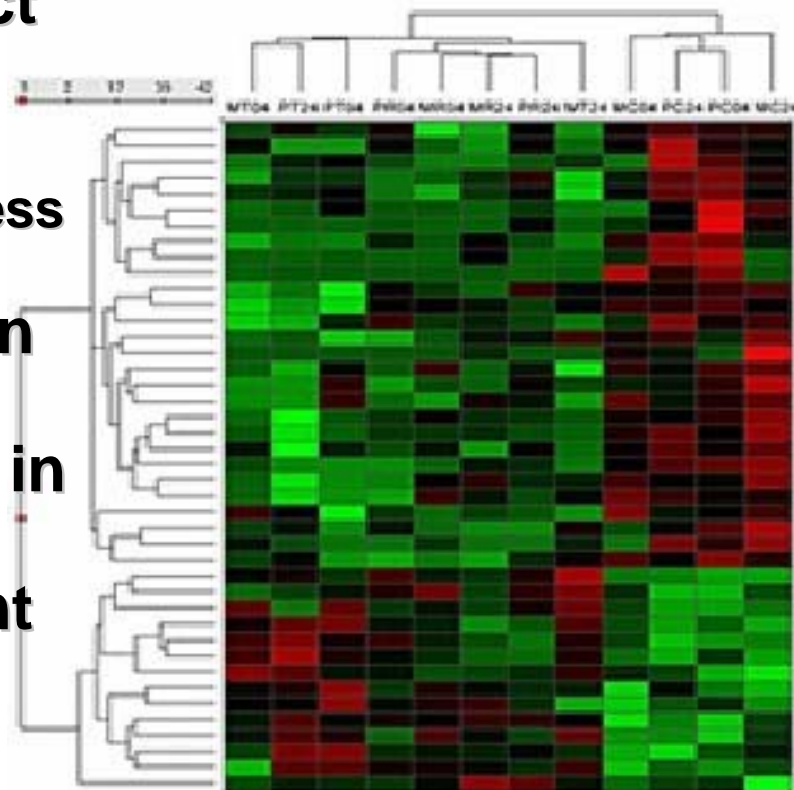




Marker-assisted selection



- **Hardly any information on impact**
- **Locally adapted varieties of Quality Protein Maize (QPM)**
 - **Studies comparing cost-effectiveness of MAS and conventional selection**
- **Disease-resistant rice varieties in China and Indonesia**
- **Disease resistant bean varieties in Central America**
- **Study on downy mildew resistant pearl millet variety released in India in 2003**
 - **Grown on > 1 mio. ha**
 - **Reduces yield losses by around 14%**





Embryo rescue: New Rice for Africa (NERICA)



- **Substantially higher yields**
- **Released in 12 African countries**
- **No thorough impact study**
- **Ex ante assessment of adoption in Côte d'Ivoire**
 - **76% return in the long run**
- **Estimation of import savings (Guinea 13 mio. US\$ in 2003)**





Impact of other biotechnologies



- **Impact of use of Rhizobial Inoculants in Kenya and Thailand**
 - **high potential benefits**
 - **effectiveness highly location-specific**
 - **necessity of functional distribution system, access to extension services etc.**
- **Anther culture used in rice and wheat breeding, but no impact assessments**





Results of the literature review



- **Very few thorough impact assessments**
- **In most cases use of simple methodologies**
- **Focus on agronomic and economic impact**
- **Micropropagation is the most studied non-transgenic technique**
- **Available studies: positive or very positive impact**





Socio-economic impact of non-transgenic crop biotechnologies in developing countries



- Introduction
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- **Case study on plant micropropagation in Africa**





Case study on plant micropropagation impact in Africa



- **Holistic approach:**
 - interrelations among ecological, agricultural, economic, social, cultural, and political factors
- **Sustainable livelihoods analysis focused on changes in:**
 - household capital assets
 - household capacity to cope with vulnerability factors and to take advantage of opportunities;
 - household livelihood strategy (including sustainability).





Research objectives and data collection methods



- Geographic, environmental, socioeconomic, cultural and institutional context
- Rationale, objectives and outcomes of the program

- MP planting materials adoption rate

- Characters of adopters and non-adopters in the light of selected household capital assets and vulnerability factors;
- Describing farmers' perception of livelihoods changes related to MP adoption.

- Desk study + Interviews to key informants

- Survey of 210 randomly selected households in 30 village clusters

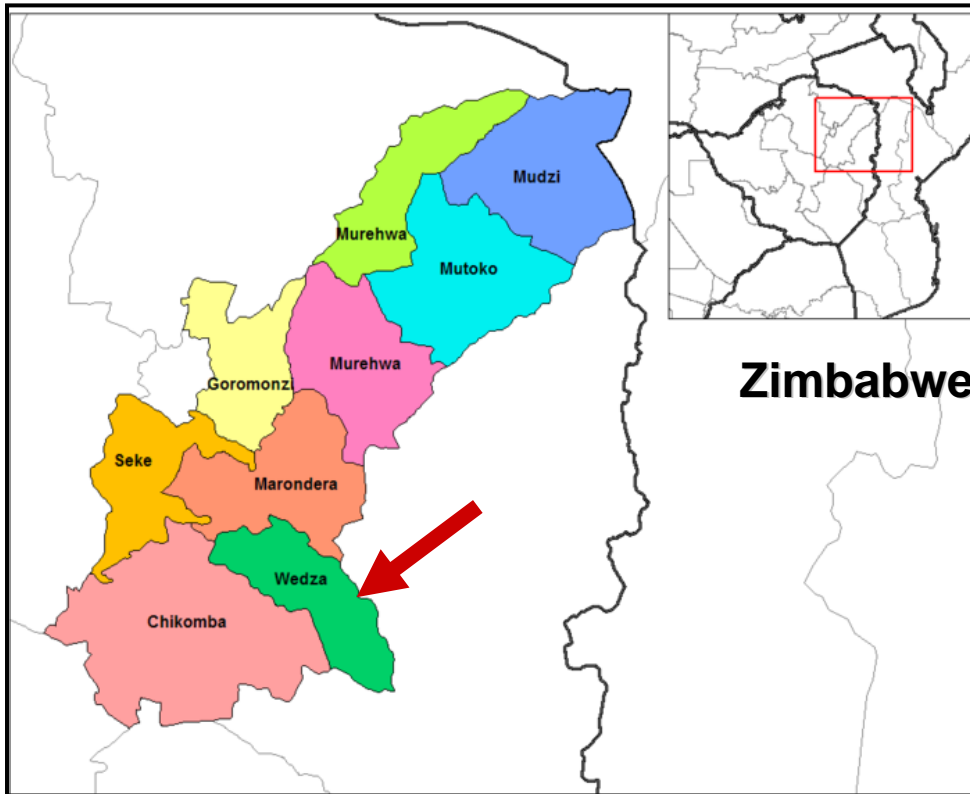
- In depth open-ended interviews to farmers



Research sites



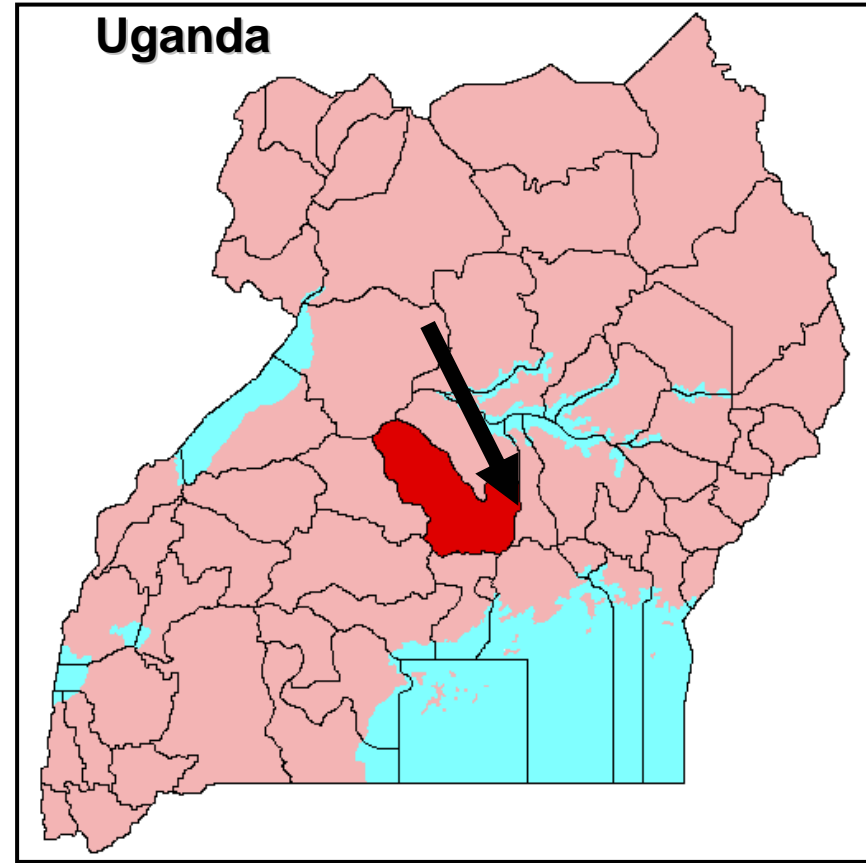
Banana micropropagation



Chigodora ward (Hwedza District)

Sweetpotato micropropagation

Uganda



Bamunanika parish (Luwero district)



Local contexts



	Chigodora (Zimbabwe)	Bamunanika (Uganda)
Agro-ecology	Semi- arid savannah	Tropical forest environment
Prevailing farming system	Animal powered maize, groundnut and pulse farming.	Machete and hoe plantain, tuber and roots farming.
Role of crop	Sweetpotato is a secondary gardening, diet diversification crop.	Cooking-banana porridge and beer are every-day foods.
Local market	Poorly developed	Burgeoning
Social environment	Increasing poverty and HIV incidence	Decreasing poverty and HIV incidence



Project interventions



	Chigodora (Zimbabwe)	Bamunanika (Uganda)
Programme objective	Increasing sweetpotato production	Improving cooking-banana yields, income and livelihoods.
Target group	Farmers with land in irrigated areas	Better off-farmers, with implementation capacity
Extension strategy	Participatory	Participatory
Planting material	Vines from MP plants (several cultivars)	MP plantlets and suckers of local MP generated plants (several cultivars)
Services provided	Assistance in nursery development, training	Training, technical assistance, marketing events
Subsidies delivered	In-kind (planting materials, fertilizers, nursery equipment)	In-kind (planting materials)



Adoption patterns



	Chigodora (Zimbabwe)	Bamunanika (Uganda)
Adoption rate	96% of sweetpotato growers	36% of banana growers
Better-off/worst-off	No statistically significant difference	Better-off 58% of adopters
3 most important commercial crops	39% of farmers	88 % of farmers
3 most important food security crops	44% of farmers	55% of farmers
Land allocated to MP (20004-2005)	Family landhold: 5 acres size of sweetpotato gardens: 0.5 acres (12% of the family land)	Family landhold: 5 acres size of banana plantation: 0.4 acres (8% of the family land)
Main aim of adoption	Improve livelihood resilience	Generate income



Impact



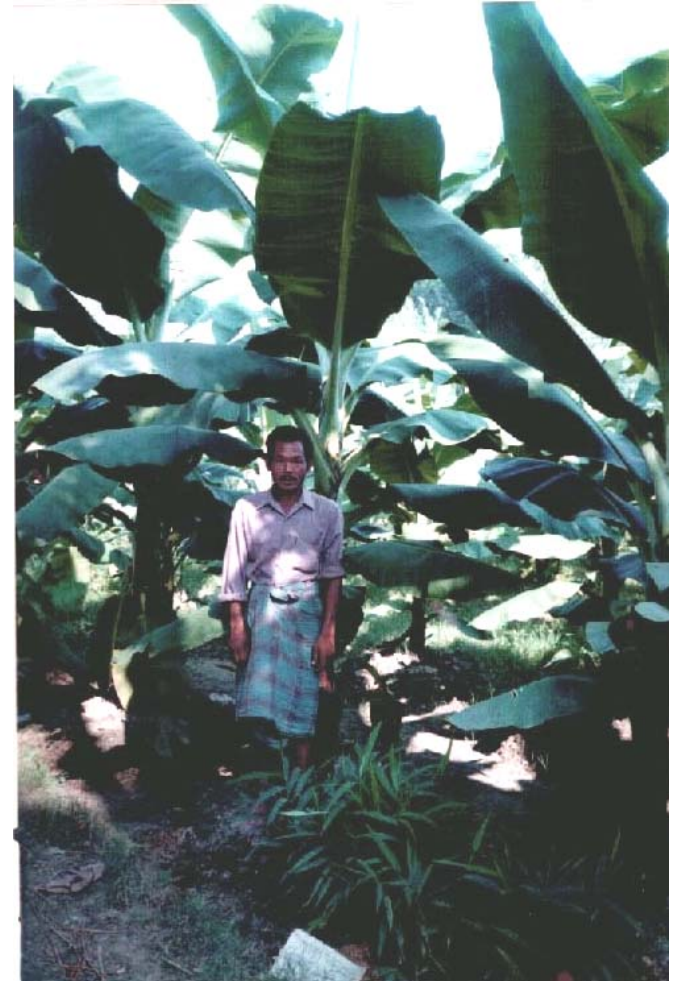
Impact Indicator	Chigodora (Zimbabwe)	Bamunanika (Uganda)
Benefit/cost ratio	<ul style="list-style-type: none"> • 1.71 (1st year) • 1.87 (2nd year) 	<ul style="list-style-type: none"> • 1.01 • 1.73 (including suckers)
Changes in livelihoods	<ul style="list-style-type: none"> • Diet diversification and food security • Increased capacity to buy commodities, equipment and animals • Increased capacity to afford school fees and ritual expenses 	<ul style="list-style-type: none"> • Food security and improved nutritional status • Increased capacity to buy commodities and amenities • Increased capacity to afford health service and education fees • Enhanced social capital, personal development and gender relationships
Labour and input	Moderate recurrent (annual) cost	High capital (first year) investment and recurrent (annual) cost



Conclusions of the field study



- **Adoption pattern is influenced by the context**
- **Impact determined by mediation between immediate benefits and systemic changes in livelihood strategies**
- **Adoption decisions made by balancing costs and benefits against ('hidden') opportunity costs and risks**
- **Development projects have to include service packages**
- **Adoption pattern and impacts should be considered in project design.**





Credits



- **Scientific coordination**
 - Andrea Sonnino
 - Zeph Dhlamini
- **Litterature review**
 - Lucius Mayer-Tasch
- **Field Study**
 - Patrizio Warren
 - R. Maphosa (Zimbabwe)
 - J. W. Ssenyonga (Uganda)
- **Other scientists from Gabon, Mali, Nigeria, Uganda and Zimbabwe**

FAO-BiotechNews

An e-mail newsletter containing news and events items that are relevant to applications of biotechnology in food and agriculture in developing countries. The items' main focus is on the activities of FAO, of other UN agencies/bodies and of the 15 CGIAR research centres. Available also in French, Russian and Spanish

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