Sustainable agriculture - our future survival

and the need for an expanded paradigm

Mpoko Bokanga, PhD
African Agricultural Technology Foundation (AATF)

IAEA Tenth Scientific Forum,
18 & 19 September 2007, Vienna, Austria

better tools, better harvests, better lives

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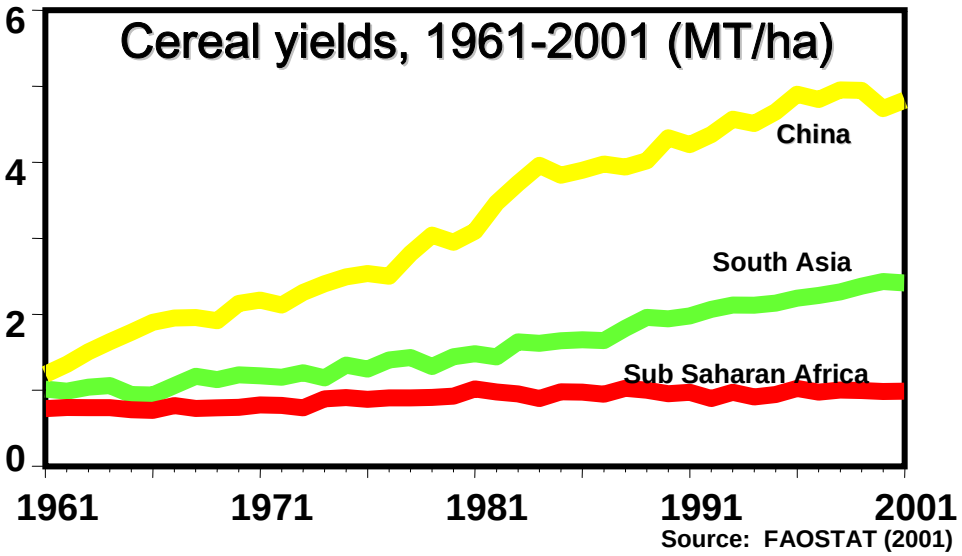
African agriculture is under-performing

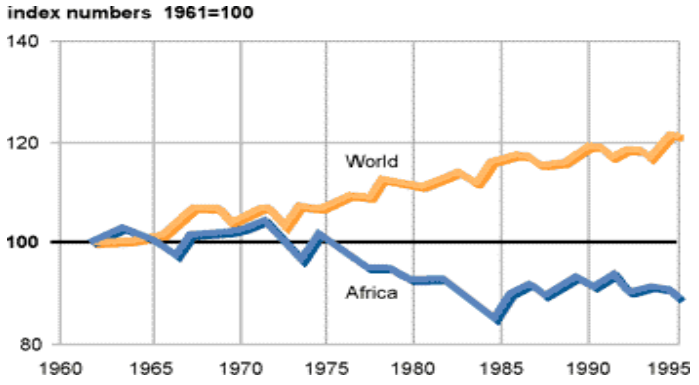
- Yields are stationary or declining
- Production keeps up with population by expanding land under agriculture
- Productivity per capita is declining

- Support for public research is declining
- Private research is increasing → IPR regimes are increasingly an issue



Food Production per Capita:

Africa vs. rest of World



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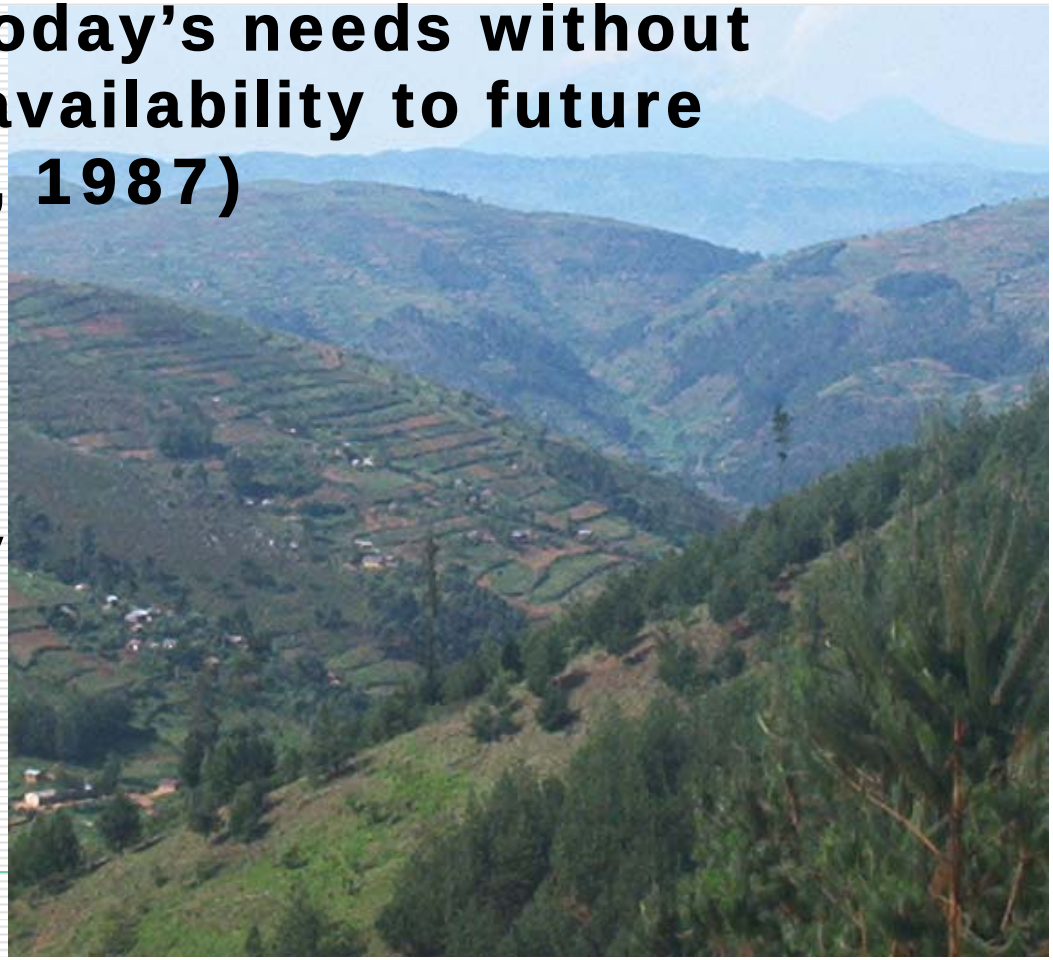
Sustainability refers to …

- **the "enlightened use of natural resources in a manner that meets today's needs without compromising their availability to future generations" (WCED, 1987)**
- **A philosophy that …**
  - Practices resource conservation
  - Accelerates recovery and renewability
  - Fosters biodiversity
  - Requires knowledge and information



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Agricultural sustainability in developing countries focuses on

- **Soil conservation and erosion control**
- **Watershed management**
- **Nutrient replenishment and recycling**
- **Social forestry**

- **Now mainstreamed in rural development agenda as:**
  - National soil and water conservation programs
  - Community water catchment committees
  - Environmental youth groups
  - Tree planting campaigns
  - Farmer Field School

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Sustainable small farm economy:
a legitimate developmental objective?

- Food and nutritionally secure
- Relying on traditional and "green" skills
- Practicing sound environmental stewardship
- Independent of external farm inputs and market forces

- This may be a reasonable aspiration for development planners, donors, and NGOs

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Is agro-ecological sustainability sufficient?

- **How about meeting the other necessities of life besides food?**
  - Education
  - Health care
  - Social needs (wedding, etc.)
  - Bicycle, radios, telephone, TV
  - Clean water
  - Electricity
  - Better housing
- **Is it a "higher order" poverty trap?**

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Sustainability needs to include the pursuit of prosperity

- Surpluses of staple crops
- Access to fair markets
- Access to farm inputs
- Options for livestock rearing
- Options for production of cash crops
- Value addition

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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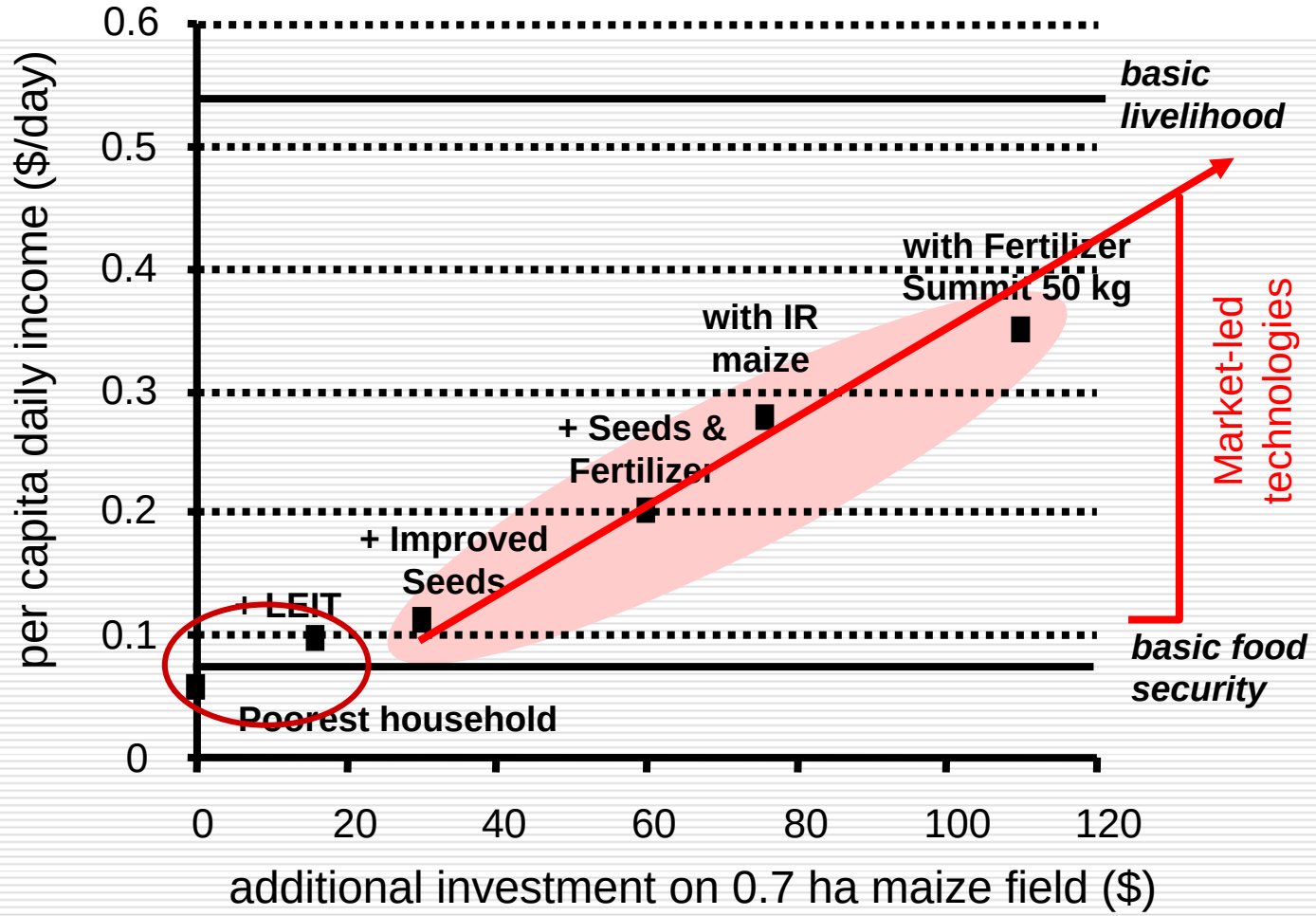
Impact of investment in technology on per capita daily income



West Kenya: Six person household on 1.2 ha farm with 0.7 ha maize enterprise

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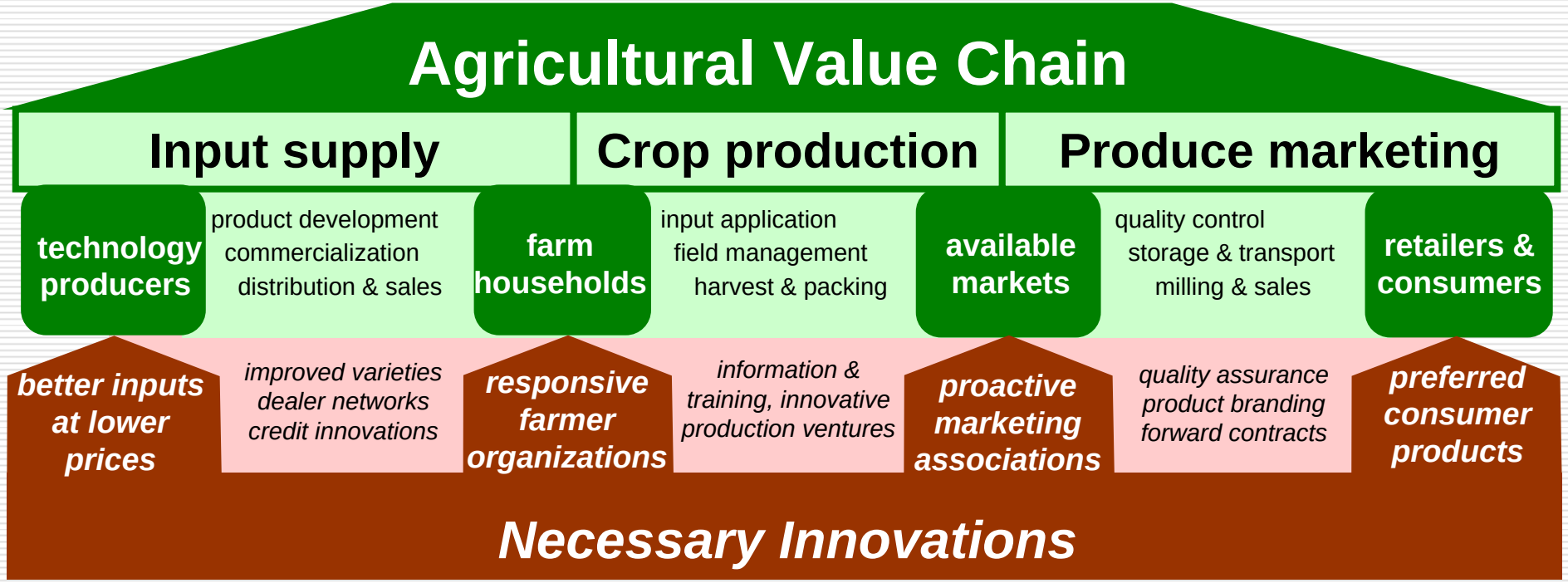
The economic dimension:
sustainable systems must also be profitable



Through agricultural value chains, economists and agricultural ecologists become partners in sustainable agriculture, and institutions acquire more holistic and participatory approaches.

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African Agricultural Technology Foundation (AATF)

Mission
Why we Exist

Access and deliver proprietary agricultural technologies for sustainable use by African smallholder, and in particular resource-poor farmers, through innovative partnerships and effective technology/product stewardship along the entire food value chain

Vision
What We Want to Achieve

Prosperous farmers and a food secure Africa, enabled through AATF's catalytic role in bringing innovative technologies to smallholder farmers

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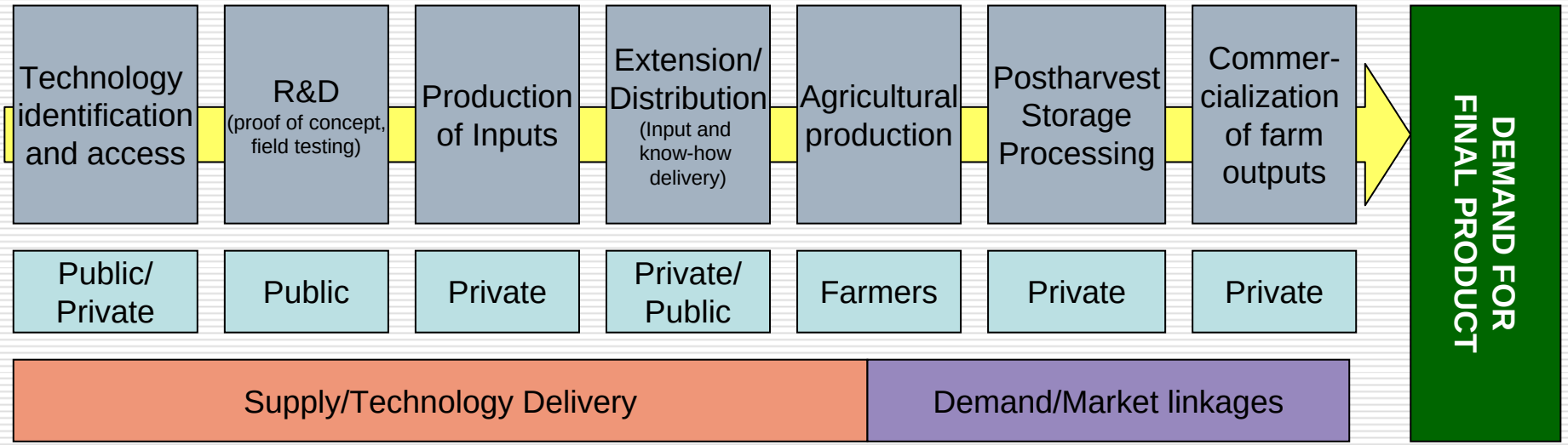
Technology / product value chain



We seek to improve the efficiency of the value chain, not only by developing better products, but also through innovative synergy between all the players in the value chain.

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Agricultural Innovation Platforms

- **Steps in the value chain**
  - Technology identification and access
  - Research & Development
    - Proof of concept
    - Field testing
  - Input production
  - Input delivery
  - Use of inputs
  - Surplus marketing

- **AATF Roles**
  - IP management
  - Regulatory compliance
  - R&D management
  - Monitoring and facilitation
  - Communication
  - Stewardship
  - Impact assessment
  - Partnership Management

➡ **Products for increased productivity**

➡ **Pathways for technology delivery to smallholder**

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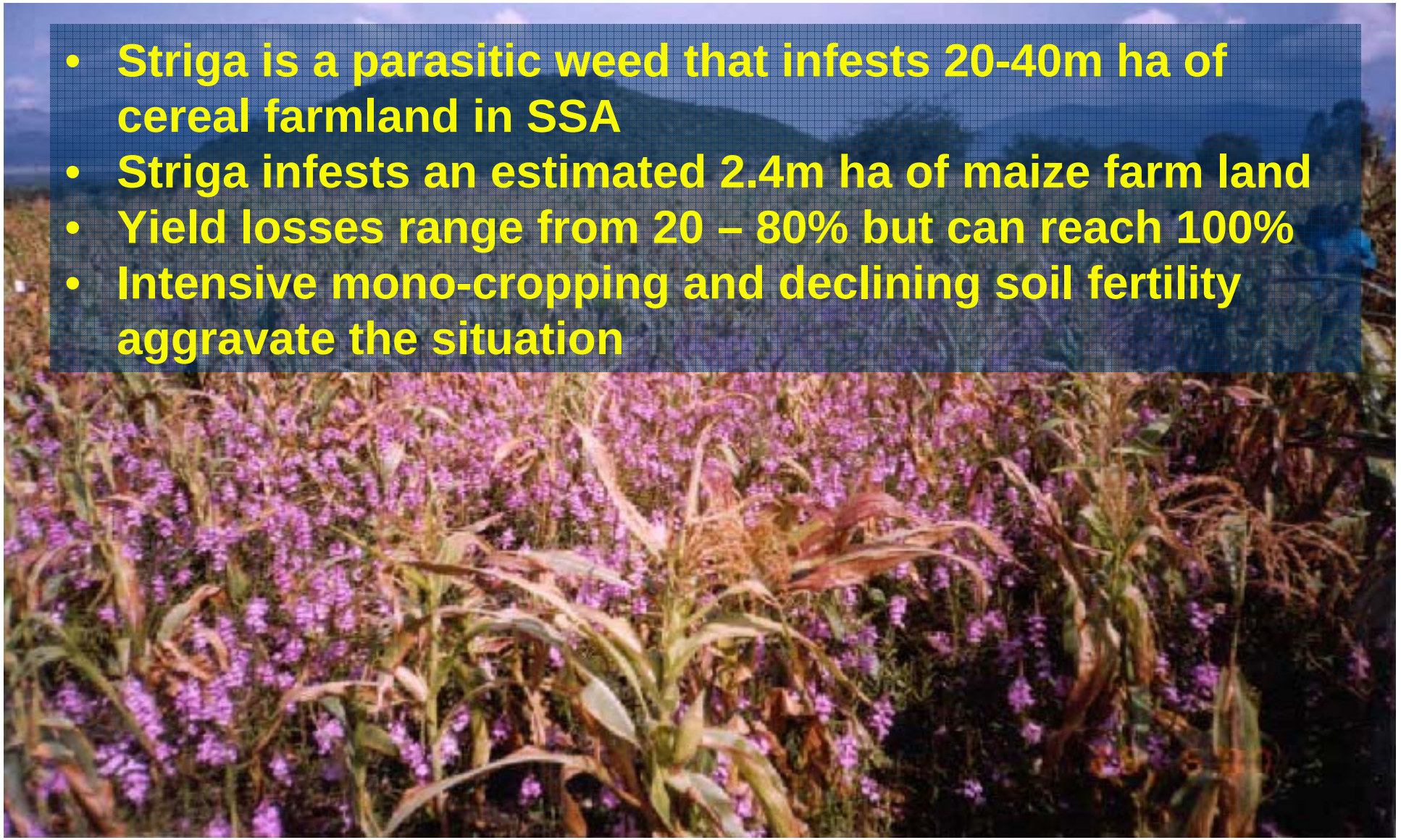
Control of Striga in African Maize Fields



- Striga is a parasitic weed that infests 20-40m ha of cereal farmland in SSA
- Striga infests an estimated 2.4m ha of maize farm land
- Yield losses range from 20 – 80% but can reach 100%
- Intensive mono-cropping and declining soil fertility aggravate the situation

Twin technology: *herbicide resistance and seed coating with herbicide Was developed by CIMMYT and KARI using germplasm owned by BASF*

Photo courtesy of CIMMYT

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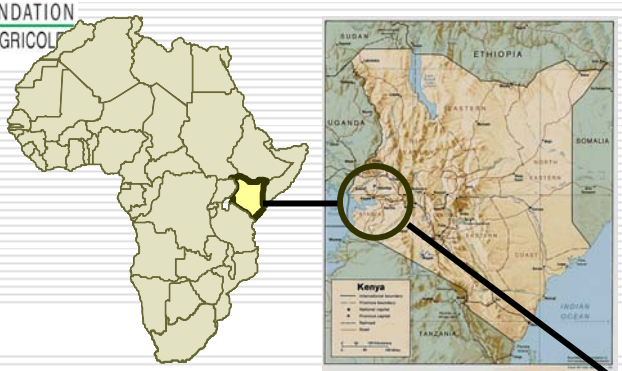

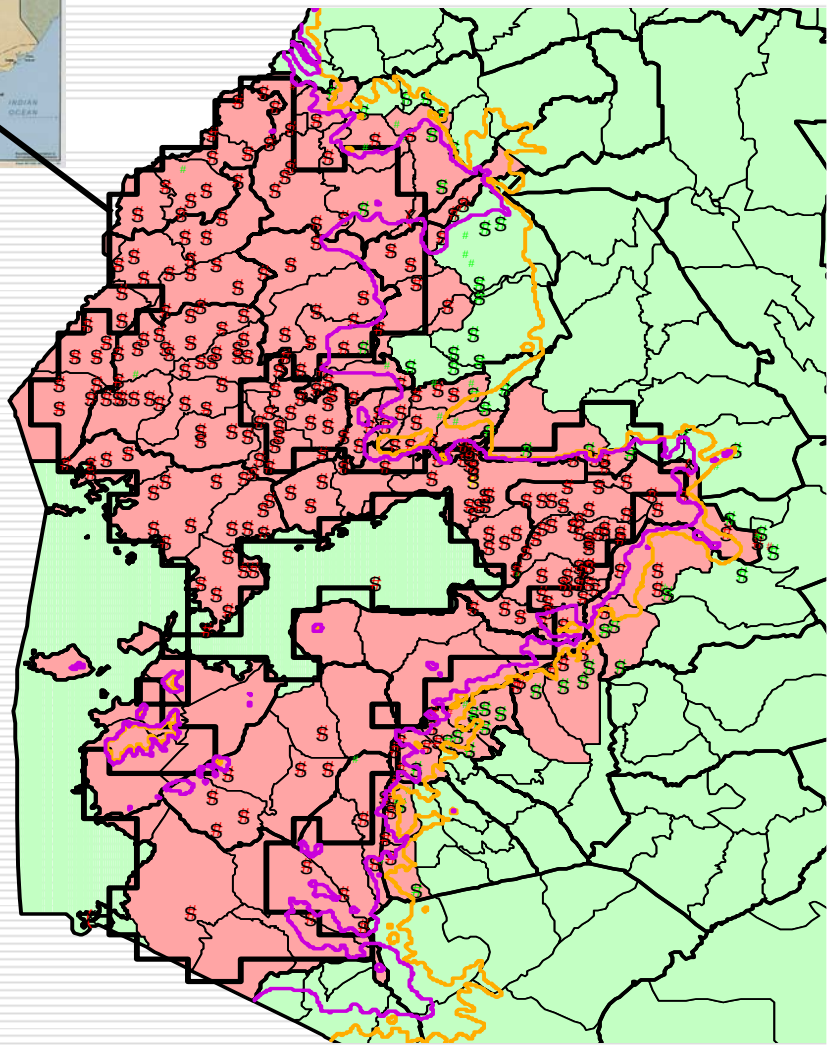

Striga in west Kenya

- affects 5.3 million people
- on 211,000 ha
- 397,000 t crop loss
- worth $80 million/yr

de Groote *et al*., 2001

Kenya is home to

- AATF
- KARI
- CIMMYT Maize Program
- TSBF-CIAT
- ICIPE

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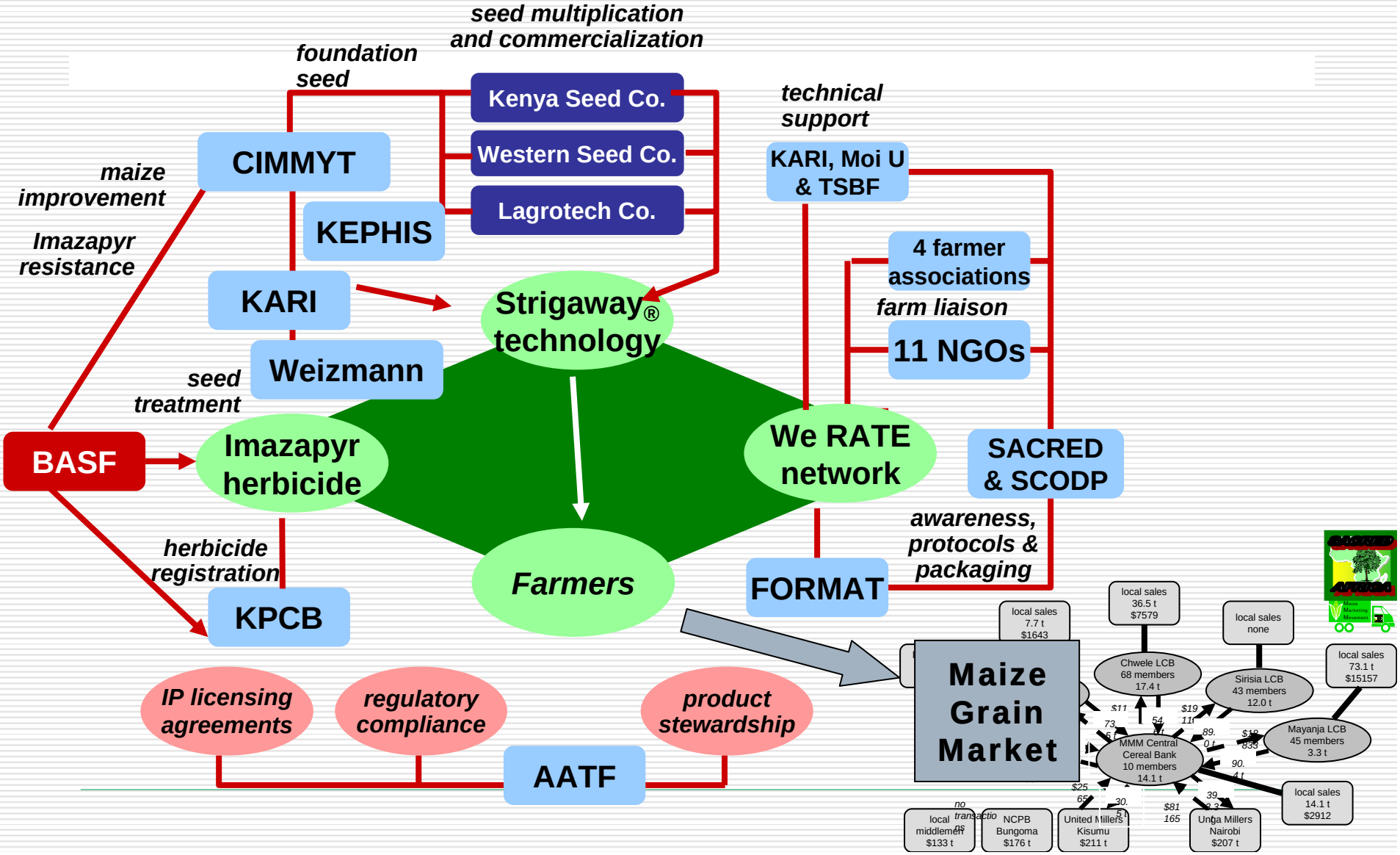
Innovation Platform for IR maize for Striga control



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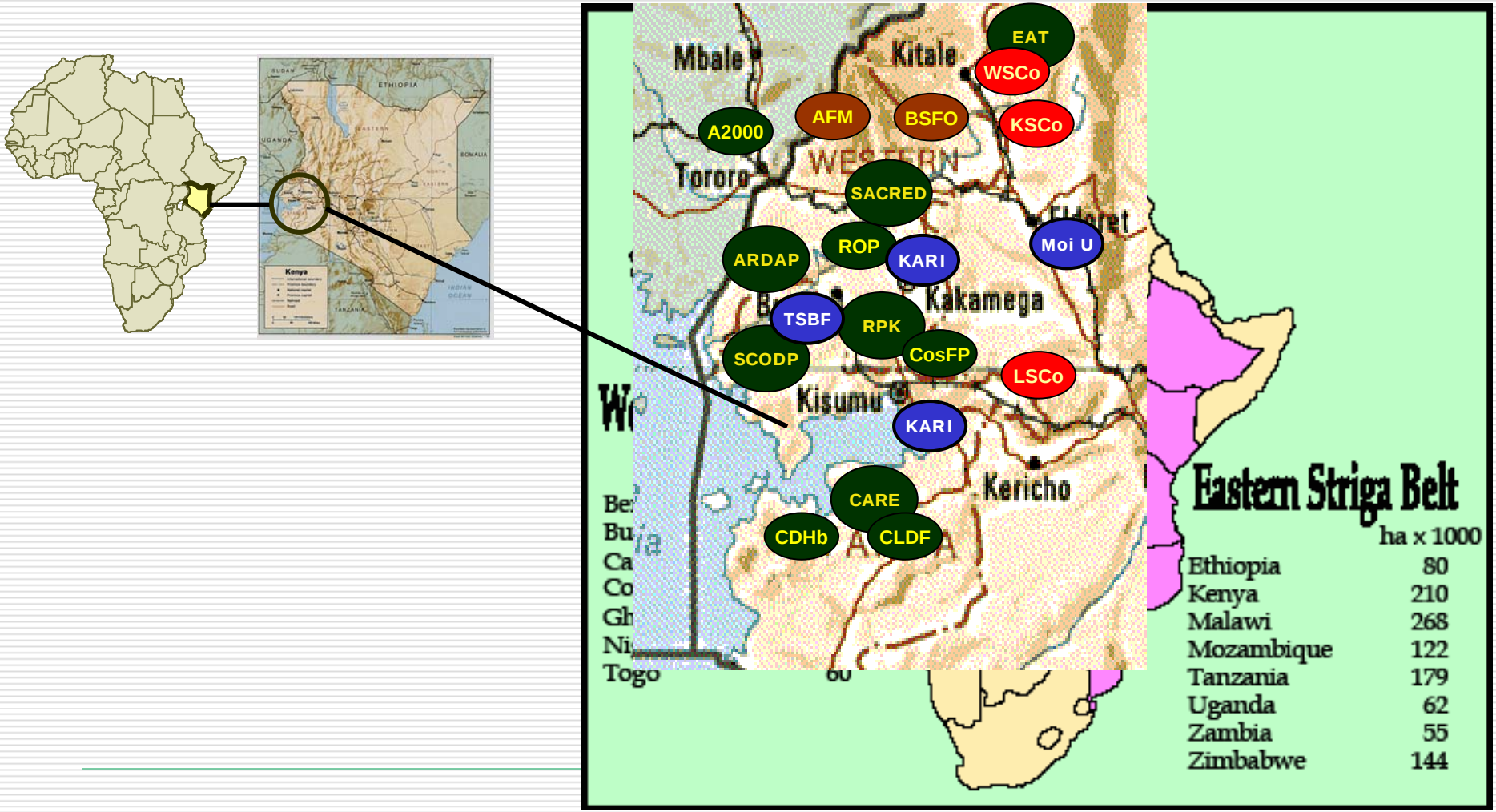
Striga eradication in African maize fields is possible



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Expected annual impact of reducing constraints in smallholder's fields

Technology	Anticipated Yield Improvement (million ha)	Anticipated Increased Value (million US $)
I-R maize	2.4	496
Nitrogen efficient rice	0.7	184
Saline tolerant rice	0.6	145
Drought tolerant maize	8.5	1,751
Total	12.2	2,576

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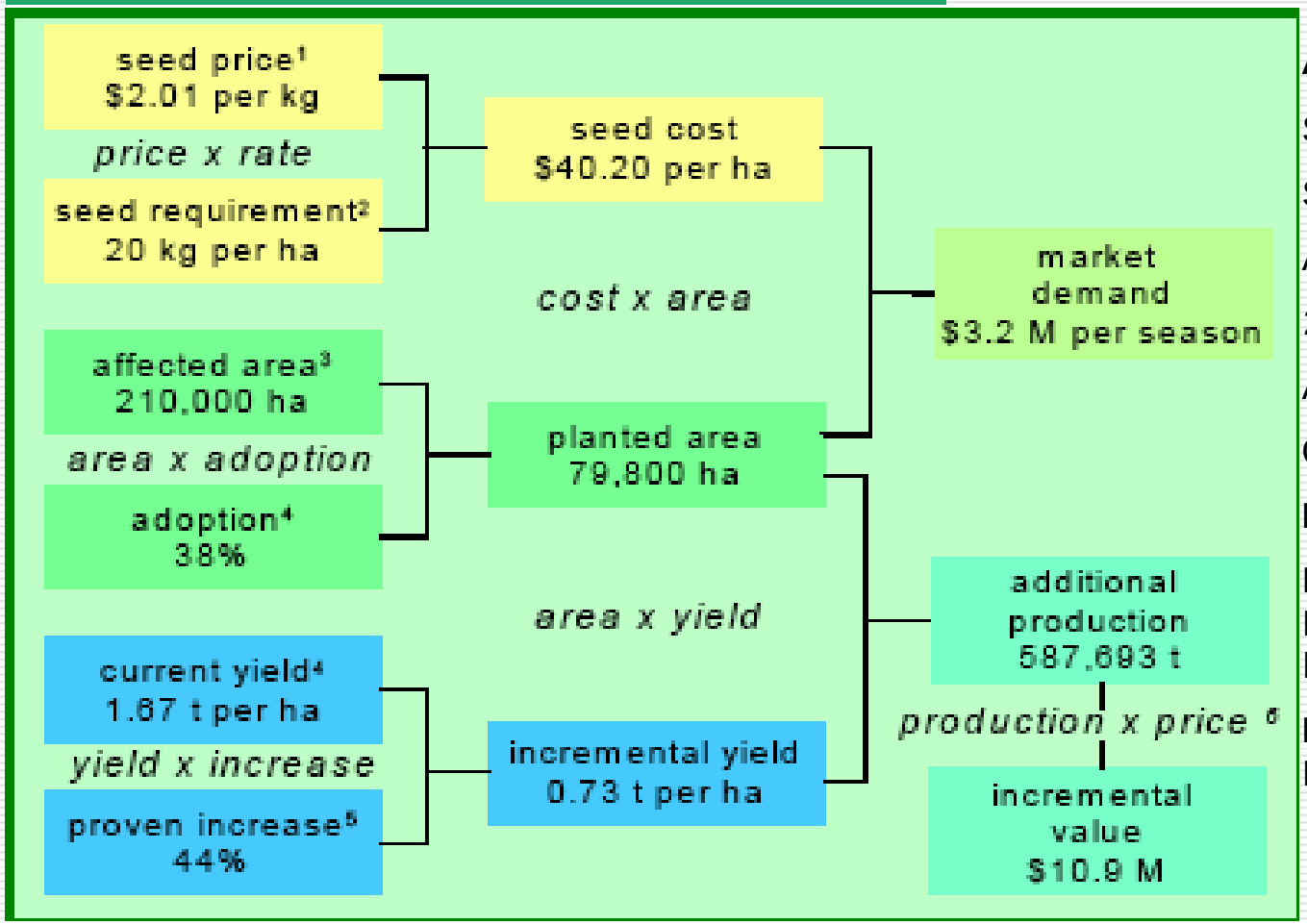
Expected market demand and impact in Kenya



Assumptions:

Seed cost: $2.01/kg

Seeds/ha: 20kg

Affected area:

210,000 ha

Adoption rate: 38%

Current maize yield:

Proven yield increase:

Maize price:
KSh 1200 per 90kg bag

Exchange rate:
KSh 72/US$ 1

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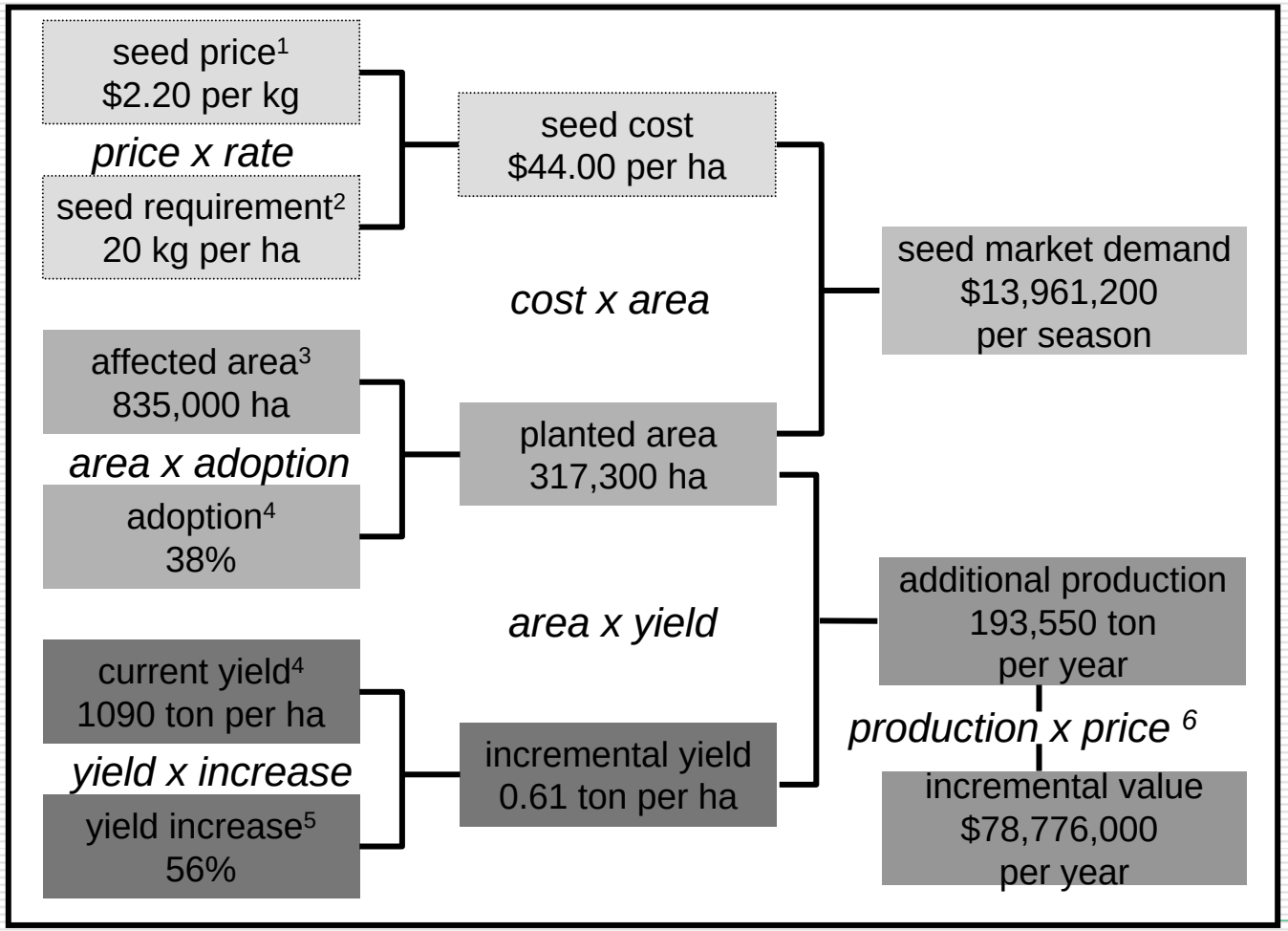
Expected market demand and impact in Nigeria



Assumptions:

Seed cost: $2.20/kg

Seeds/ha: 20kg

Affected area:

835,000 ha

Adoption rate: 38%

Current maize yield:

Proven yield increase:

Maize price:
Naira 55/kg

Exchange rate:
Naira 135/US$ 1

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Innovative approaches to enable farmers' access to breakthrough technologies

- Streamlined licensing, registration, testing and commercialization
- Appropriate packaging and fair pricing
- Facilitated access to input and output markets
- Innovative credit mechanisms (vouchers, revolving funds, etc.)
- Charitable deployment to the poorest (provision of means of production is cheaper and more effective than food aid)

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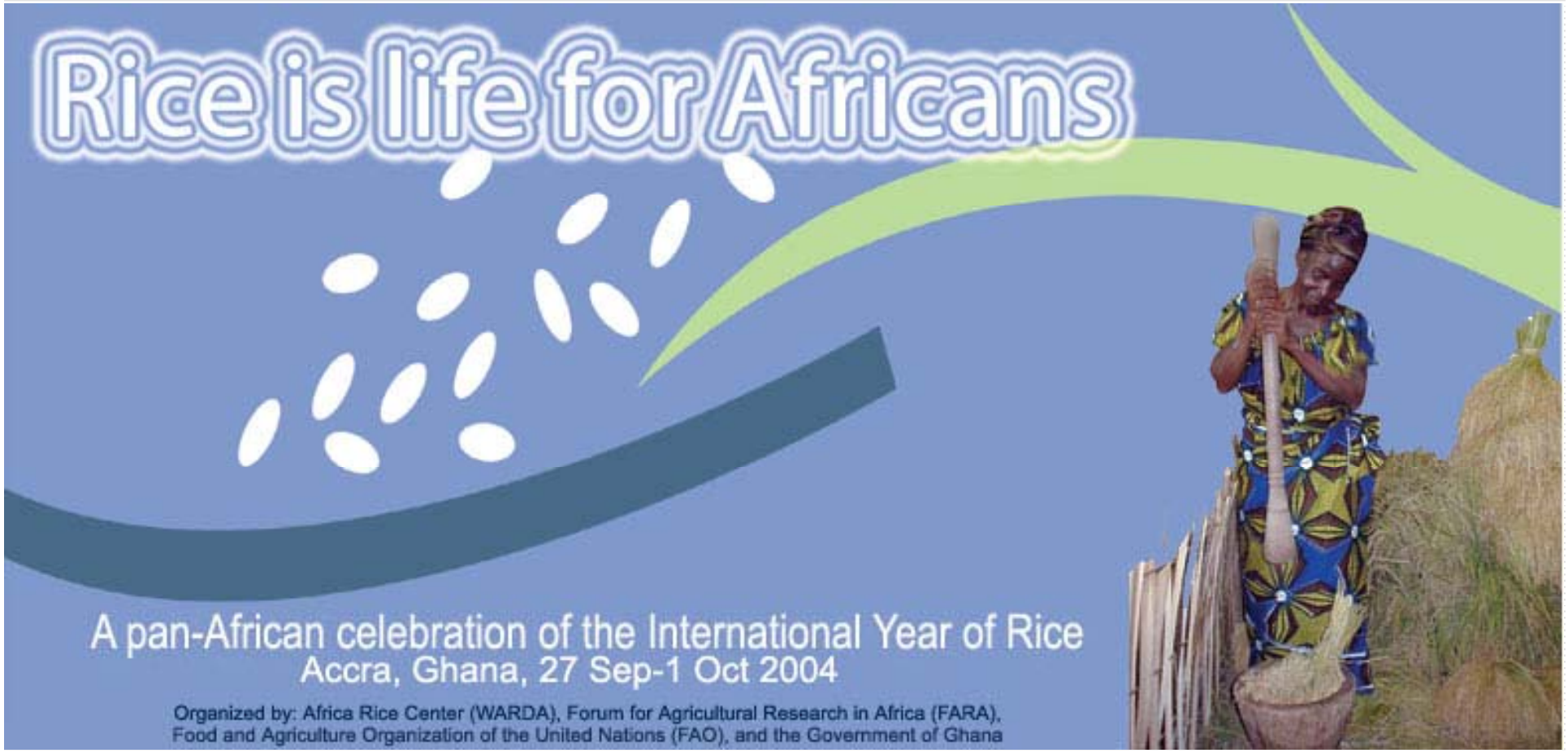
Rice is a basic African staple



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Rice supply and demand projections for Africa

- **Production**
  - 12 to 17 million MT (FAO, 2004)
  - Annual increase: 3.7%
- **Consumption**
  - 23.5 million MT (FAO, 2005)
  - Annual increase: 6.0% (WARDA, 2005)
- **Rice deficit:**
  - 6.5 million MT worth US$ 1.7 billion (FAO, 2004)
  - Imports growing at 9.3% per year

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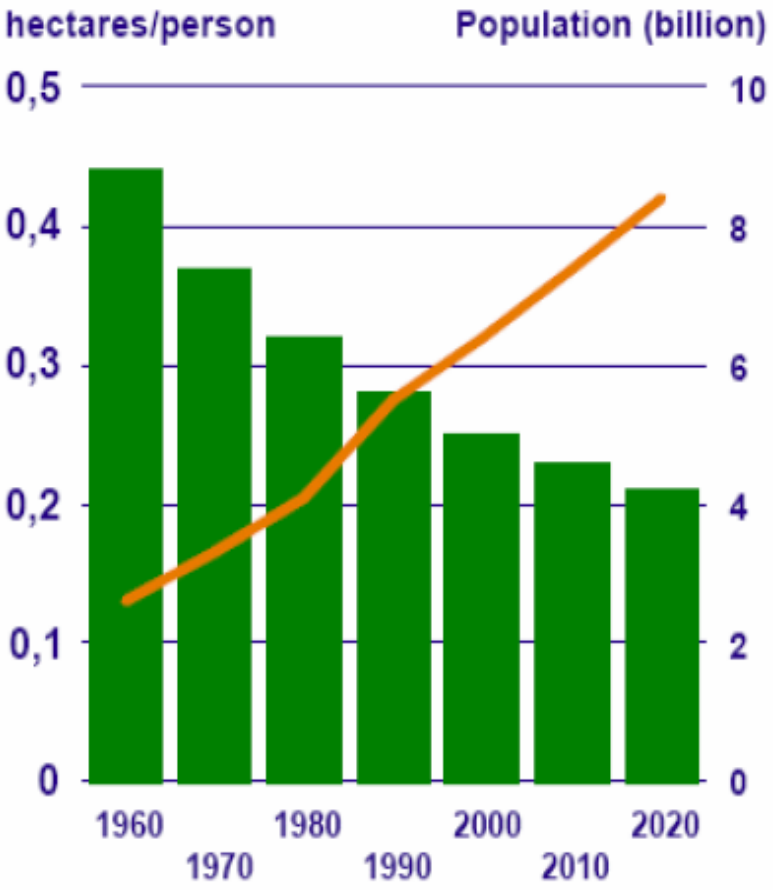
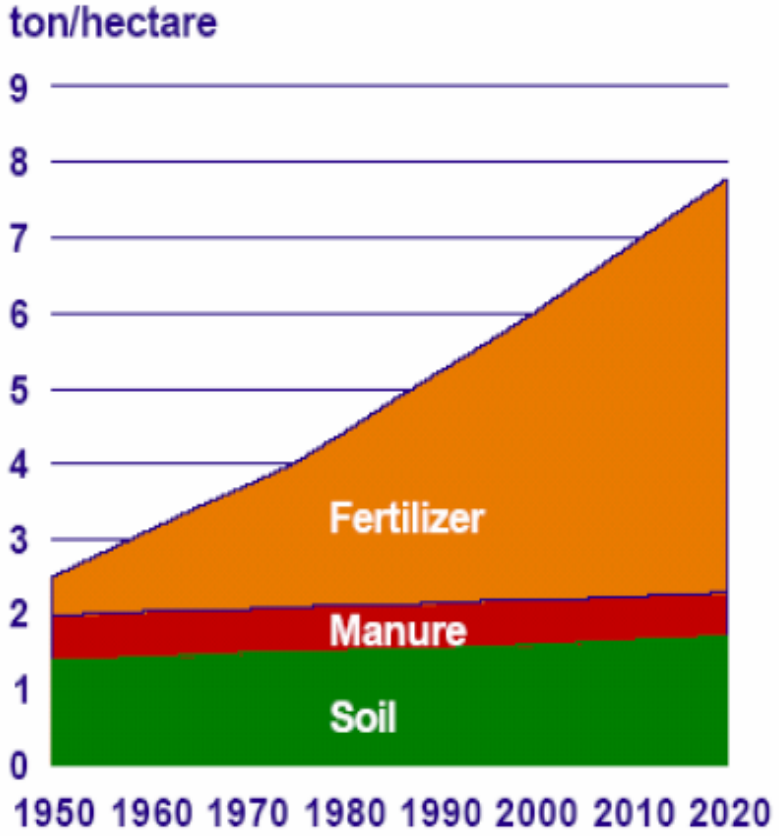
Expanding Agriculture Productivity will require more mineral fertilizers

Hectares per person decreasing...



... and mineral fertilizer only sustainable large scale nutrient source



Expected global fertilizer growth 2-3% per year

(Arcadia, 2004)

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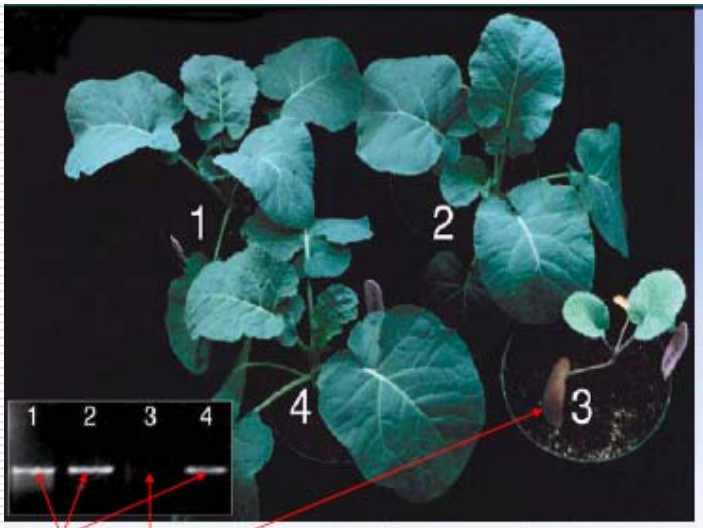
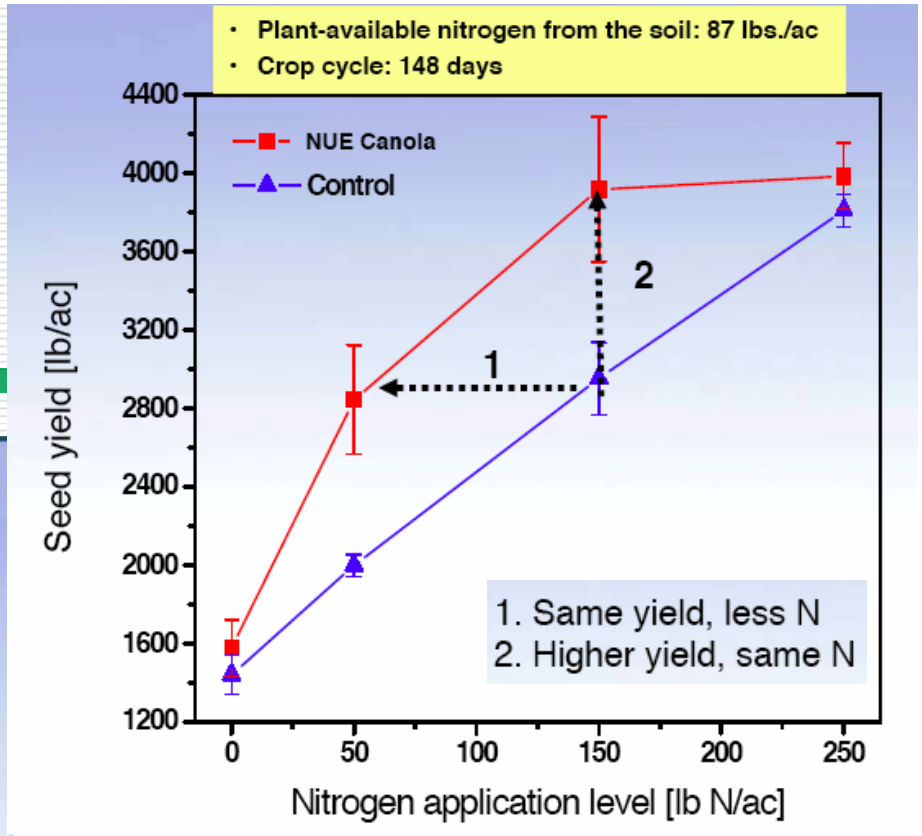
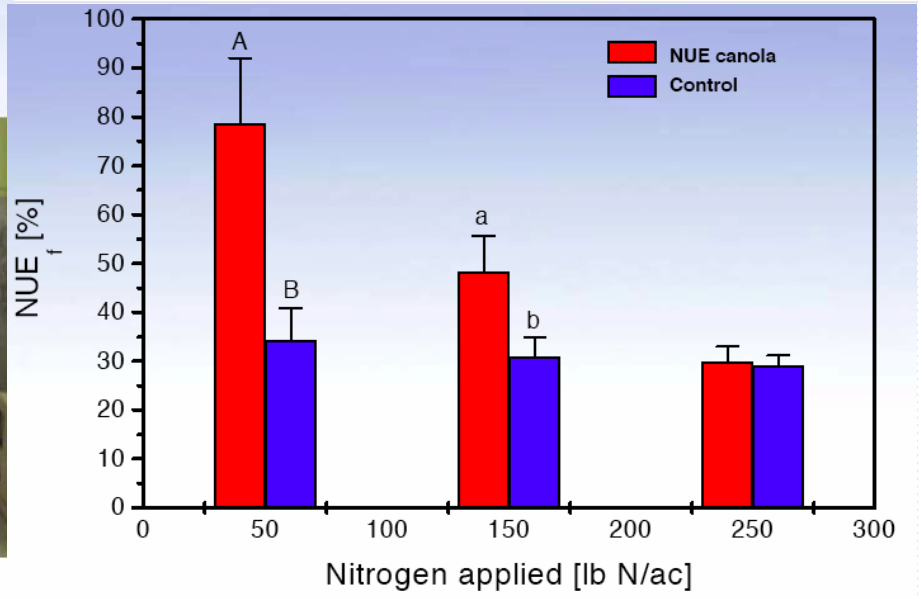
Nitrogen Use Efficiency

- Tested in canola, rice and maize
- Potential for rice, cassava, banana



Control NUE Rice





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Improving Rice Productivity in Saline Environments of Sub-Saharan Africa

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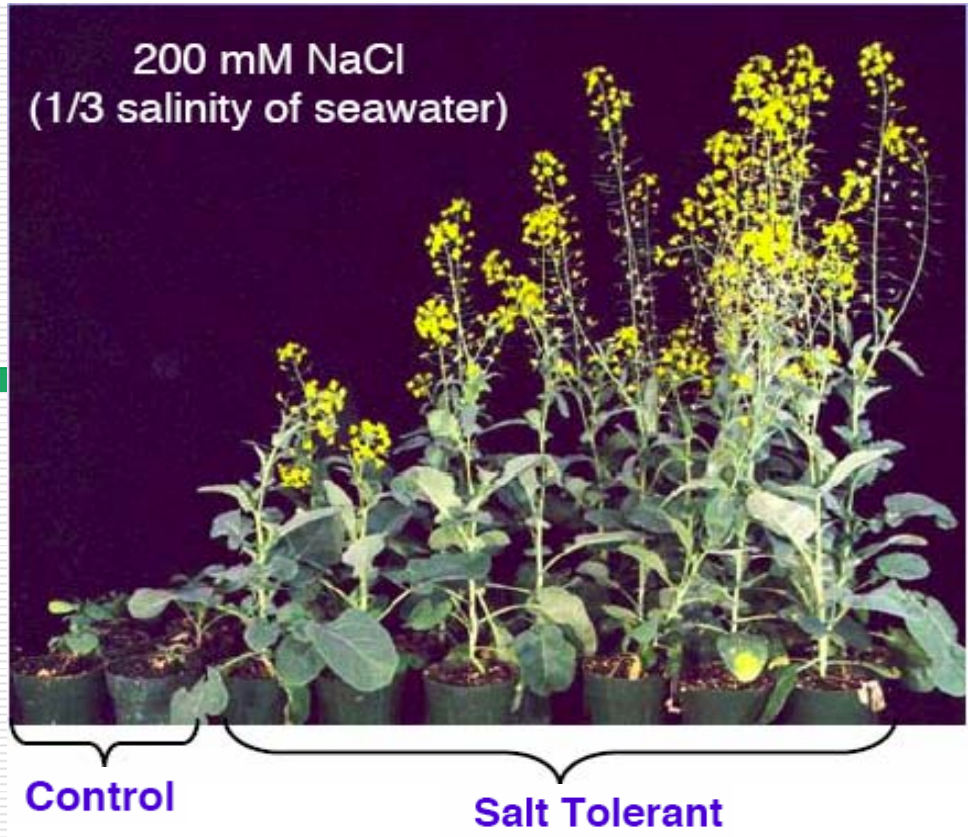
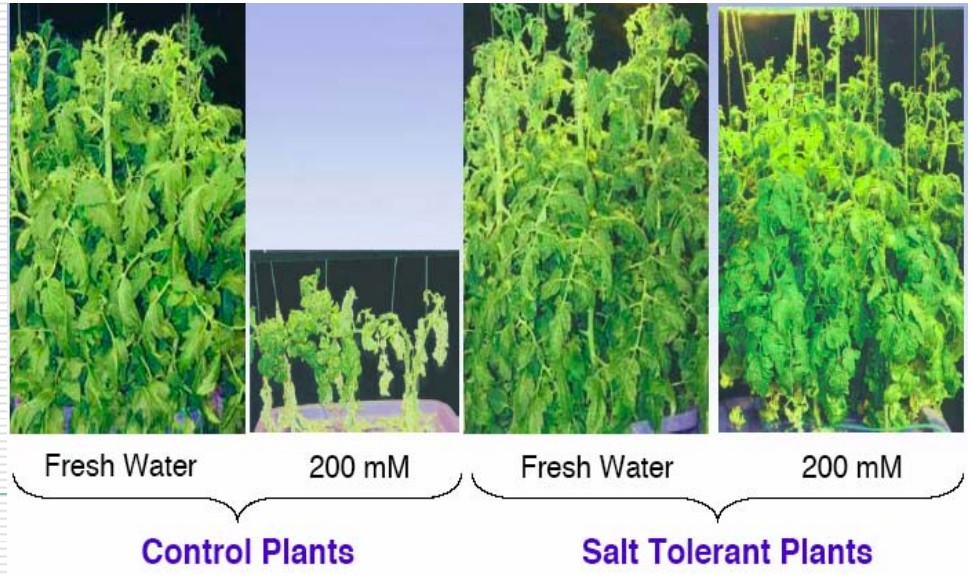
Salt Tolerance

- Salt tolerance has been enhanced in rice, tomato, alfalfa, canola and cotton
- This technology gives the opportunity to increase yield in salty conditions and to reduce the use of fresh water for irrigation
- Potential for mangrove rice





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Expected annual impact of reducing constraints in smallholder's fields

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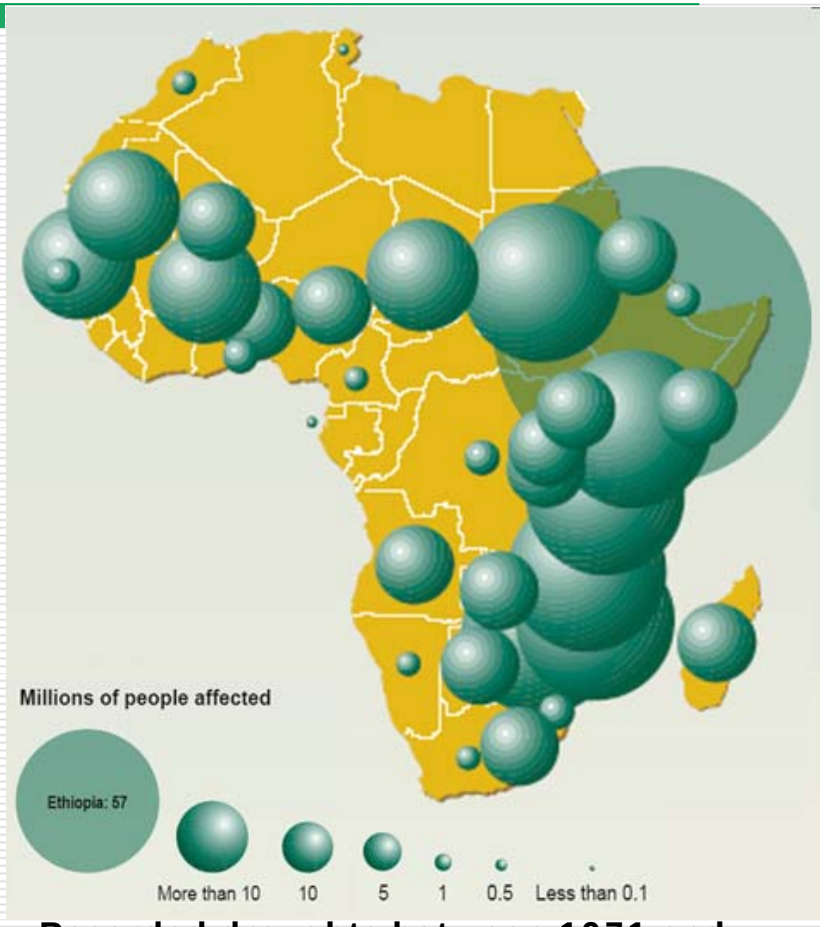
Relevance of Drought-Tolerance Technology to African Agriculture

- Africa is a drought-prone continent
- The WFP spent $0.565B of food emergency to respond to drought in SSA in 2003
- Meeting global food production will require more "crop per drop"
- Over 95% of cropland in SSA is rain-fed
- The risk of drought prevents investment in improved agricultural products
- ***Yield stability is key to unlocking the value of basic inputs***



Recorded droughts between 1971 and 2000, and the number of people affected

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Crop biotechnology research expenditures (Byerlee and Fischer, 2002)

	Biotech R&D (million US$/year)	Biotech as share of sector R&D
Industrialized countries	**1,900-2,500**	
Private sector	**1,000-1,500**	**40**
Public sector	**900-1,000**	**16**
Developing countries	**165-250**	
Public (own resources)	**100-150**	**5-10**
Public (foreign aid)	**40-50**	**n.a.**
CGIAR centres	**25-50**	**8**
Private sector	**n.a.**	**n.a.**
World Total	**2,065-2,730**	

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Access to Intellectual Property by resource-poor farmers

Many private and public institutions in rich countries wish to donate technologies to Africa's poor farmers but are uncertain how to do so.

AATF mission is to make these donations possible

Technology	IP Partners	Goal
I-R maize	BASF/CIMMYT	Overcome *Striga in maize fields*
Insect resistant cowpea	Monsanto/CSIRO	Control *Maruca* pod borer
Disease resistant banana	Academia Sinica/IITA	Control banana bacterial wilt
Nitrogen efficient rice	Arcadia/WARDA	Improve response to N fertilizer
Saline tolerant rice	Arcadia/WARDA	Extend paddy production
Biofortified sorghum	Pioneer/Africa Harvest	Improve human nutrition
Mycotoxin control	USDA/CircleOne	Reduce peanut aflatoxins
Cassava industrialization	Brazilian industries	Mechanize cassava operations
Drought tolerant maize	Monsanto/CIMMYT	Reduce impact of drought

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Adaptation to climate change and global warming

- **Will be facilitated by**
  - Increased productivity in response to elevated CO_2 and temperature
  - Greater carbon sequestration in agricultural lands
  - Higher crop yields during more frequent droughts
  - Moderated distortion in world food supply
  - Larger crop surpluses available for industrial processing into biofuels

- **Greater agricultural productivity will be essential to strengthen the resilience of smallholder farmers' agro-ecosystems**

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Conclusions

- Greater farm yields are necessary for a “sustainable small-farm economy”.
- The sustainability paradigm needs to include better access to environmentally-friendly breakthrough technologies and access to input and output markets
- The “green” sensitivities that helped define and nurture sustainability must be relaxed toward stress-adapted crops improved using state-of-the-art methods.

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Conclusions

- **The expanded paradigm sustainability needs:**
  - Strengthening of regulatory and monitoring capacities,
  - Access to intellectual property rights of others,
  - Strategic partnerships for product development and deployment
  - Streamlined processes of product registration and commercialization,
  - Fair access to input and output markets
  - Integrated production and marketing ventures,
  - And charitable deployment of inputs to the poorest farmers.
- **Sustainable agriculture must help smallholder farmers overcome poverty, improve their livelihoods and move towards prosperity, otherwise it will not be sustainable**

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Thank You