Public-private partnerships: An imperative for African Agriculture

AIARD Meeting 2008

2 - 3 June 2008

Washington, DC, USA

etter lives

From Promises To Practice:

Rising To The Challenges Of The 21st Century

Ismail Serageldin

BioVision Alexandria

13 April 2008

The First Revolution: Agriculture and Sedentarization

The Second Global Revolution: The Industrial Revolution

The Third Global Revolution: The Knowledge Revolution

- Data
- Information
- Knowledge
- Wisdom

The Speed of Change

- Amount of knowledge in some new fields is doubling every 18 months
- The capacity to process vast amounts of knowledge is growing
- Raising new fears about how we cope with that speed..

ICT:
Connecting People to Information

DO YOU SEE
THE TRILLION
DOLLAR MARKET?

Different Regions Will Need to Address Different Problems… But All Will Require the Best of Science!

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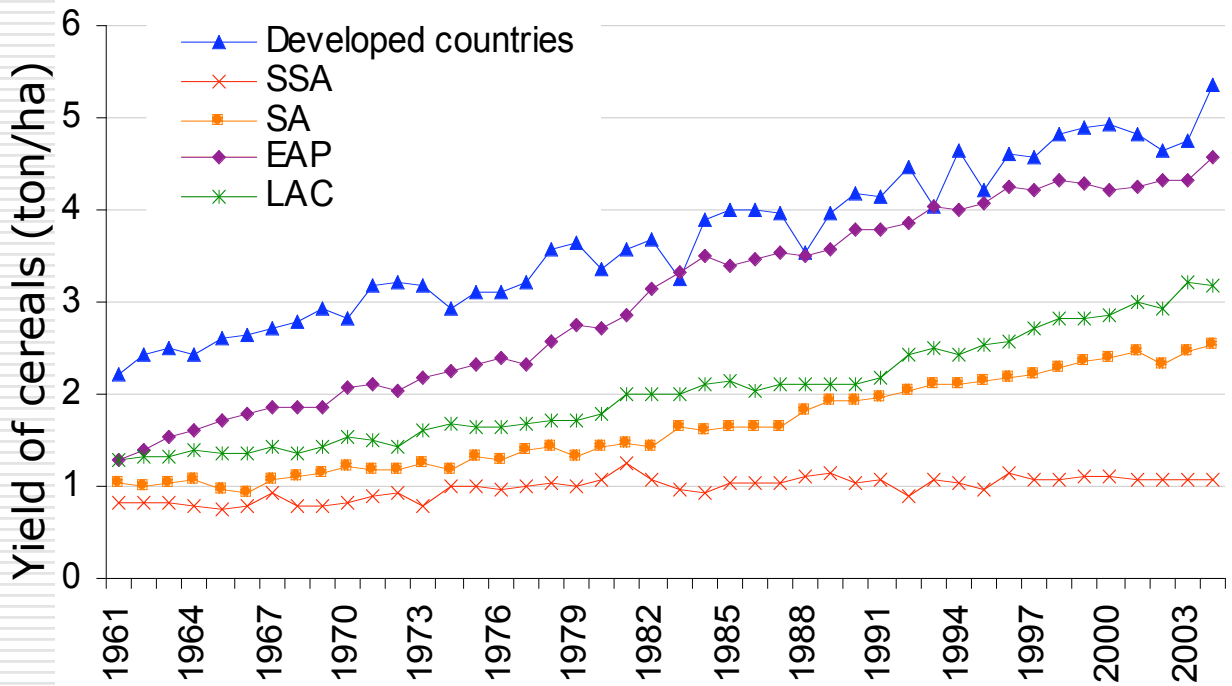
The central challenge for SSA:

Managing all three revolutions at the same time



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Additional challenges

Recognize The Gender Dimension

Food Or Feed?

BIOFUELS
10
B20
E85
E10

I WANT YOU
TO USE BIODIESEL
BEND BIOFUELS COOPERATIVE

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The future of African Agriculture is under serious threat

- Only 4% of cropped land has access to irrigation
- 33% of cropped land is subject to moderate drought, 25% subject to severe drought
- Climate change is predicted to make things even worse
- 60-70% of the African population depends on agriculture for their livelihoods
- According to Harvard's Prof. Calestous Juma: "Africa should declare a state of ecological emergency"
- Rising food prices make it hard to make up for food shortages through importations: increasing food productivity is the only sustainable option

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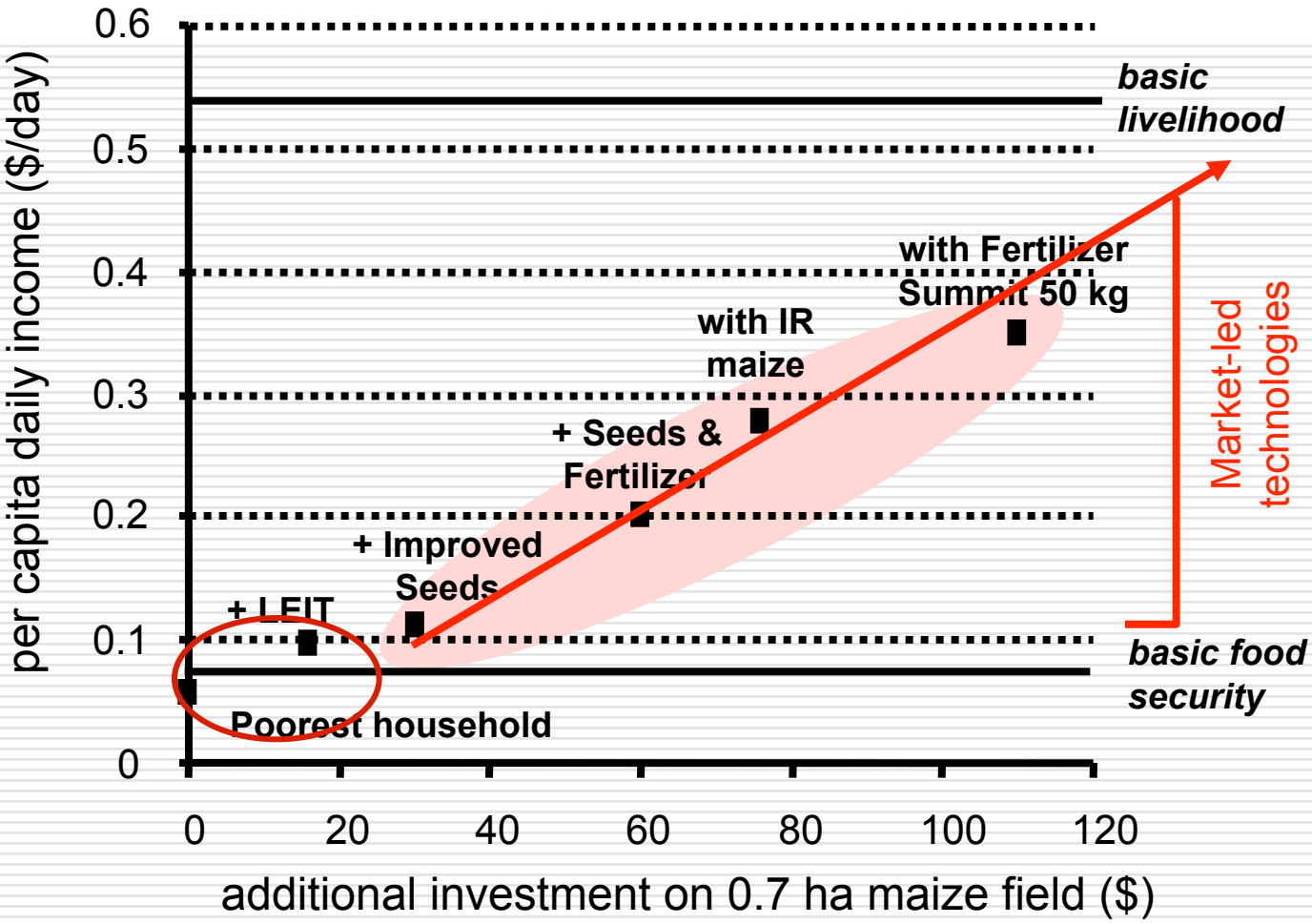
Impact of investment in technology on per capita daily income



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

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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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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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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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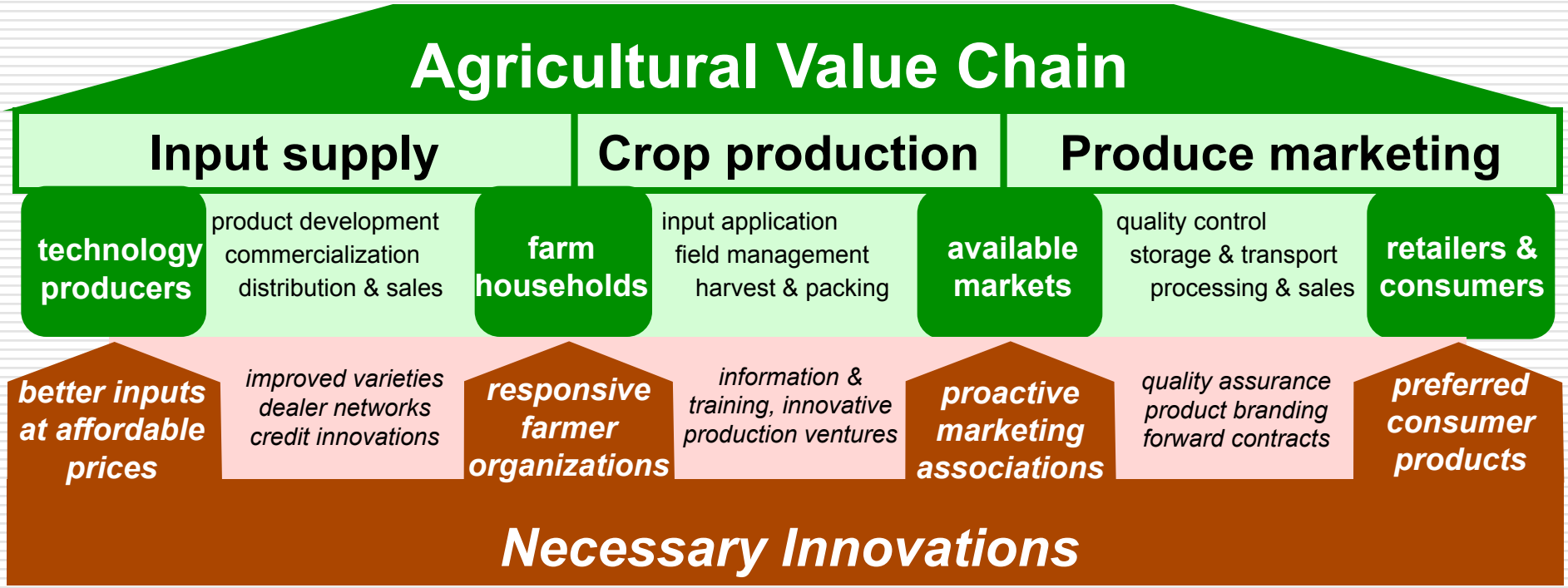
Technologies must be part of agricultural innovations systems



- **AATF focuses on**
  - Getting productivity tools to smallholder African farmers
  - Uncovering pathways to technology delivery

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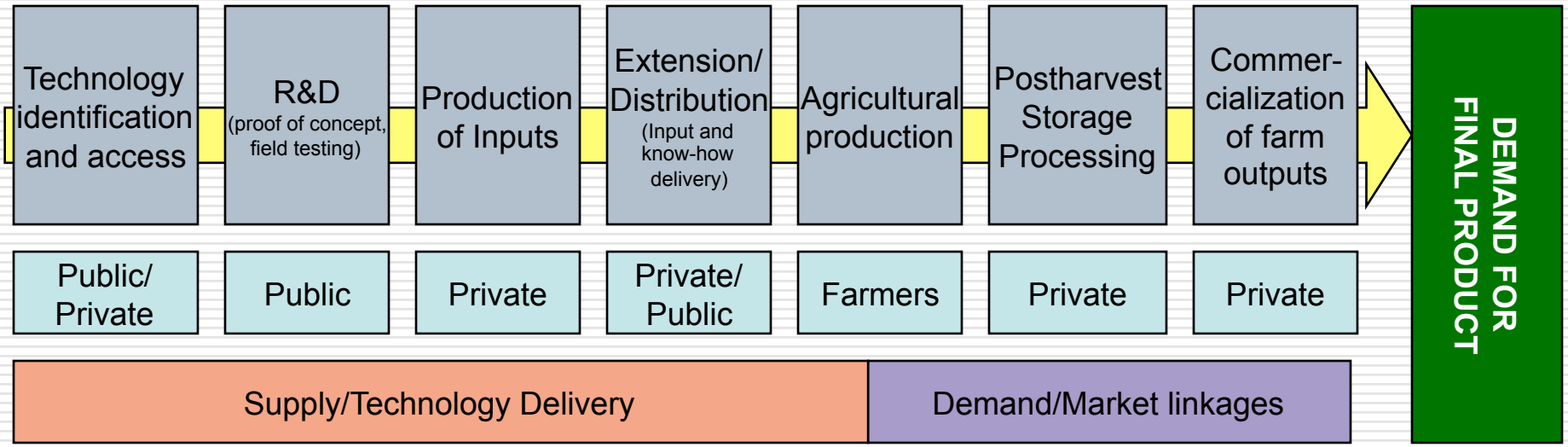
Technology/product value chain



- **AATF seeks innovative ways of**
  - Bringing to smallholder farmers tools that will increase their productivity
  - Creating synergies between all the players in the value chain to enhance efficiency and sustainability.

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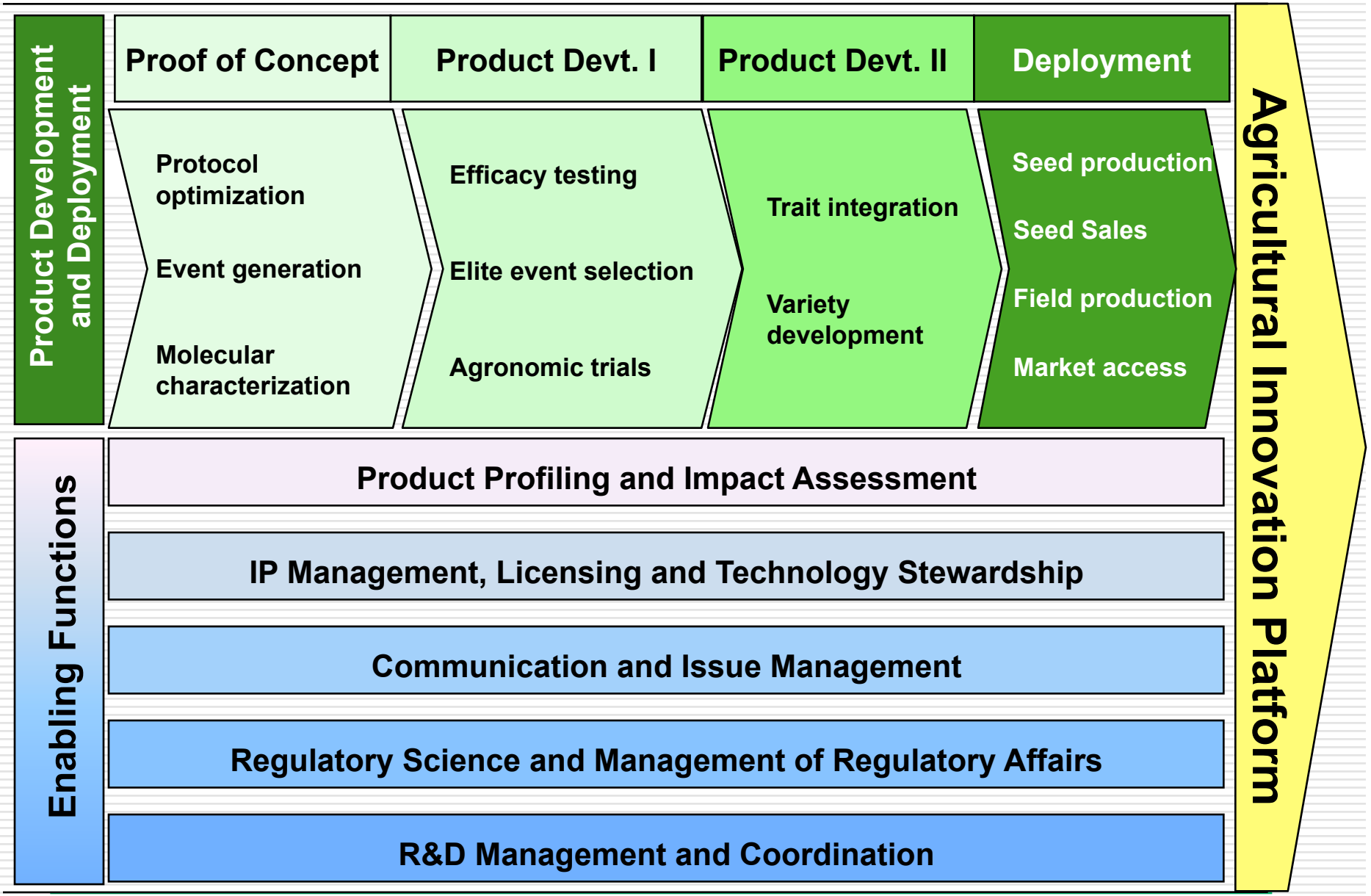
Product Development and Deployment



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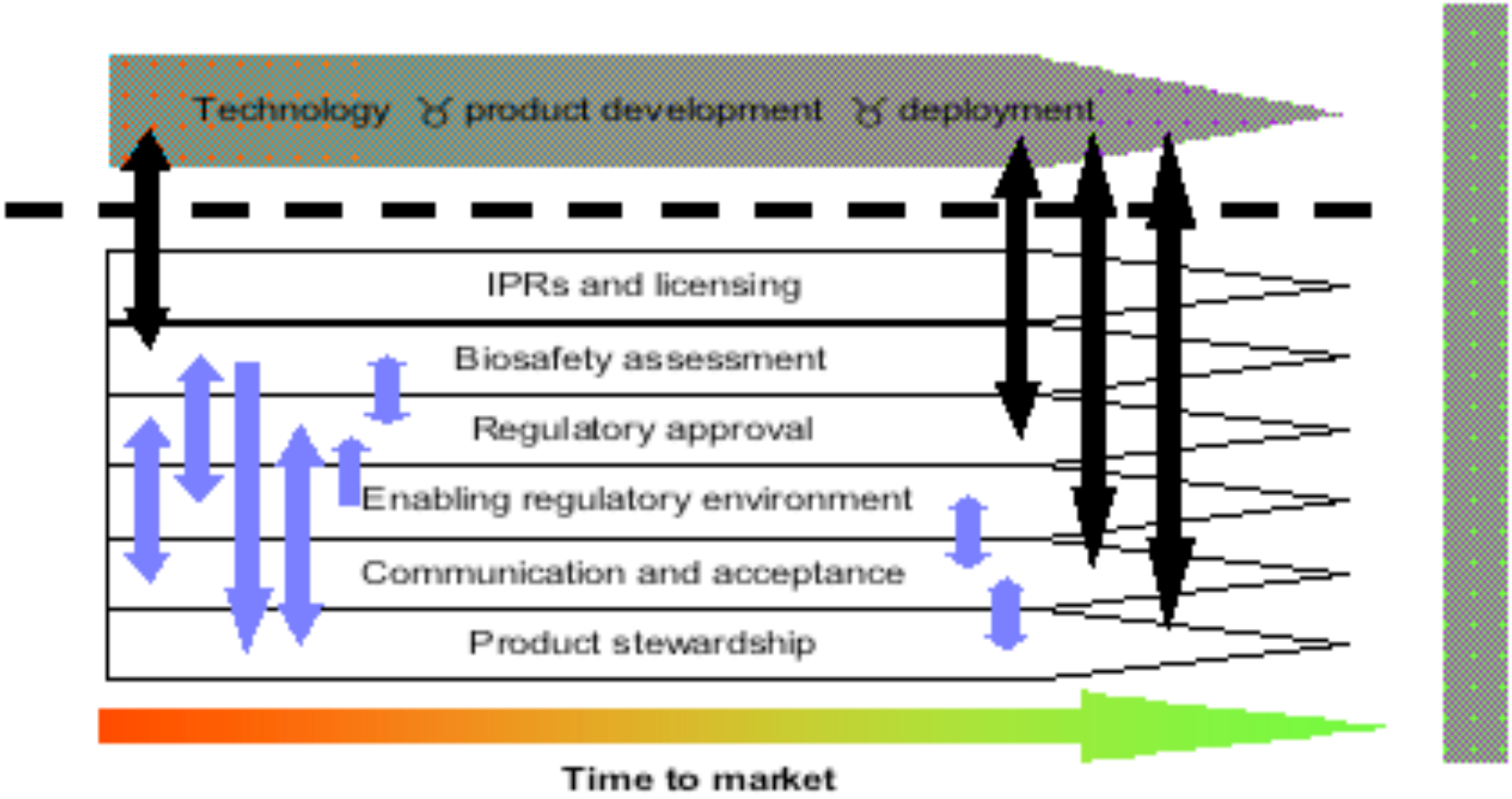
Product Development and Deployment

Enabling Functions	Proof of Concept	Product Devt. I	Product Devt. II	Deployment
PPIA	Crop value chain Baseline data Feasibility study Business plan	Farmers' perceptions Seed systems studies Exit strategy development	Farmers and traders' perceptions Deployment strategy	Marketing and distribution pathways
IPLSM	Technology inventory FTO assessments Project policy docs. License negotiations	FTO report update Tech inventory update License negotiations Patent filing	FTO report update Tech inventory update Policy and quality control manuals	Identification of seed producers Licensing of products and other project's IPRs
CIM	Situational analysis of products perceptions Communication plan	Issue management plan Outreach strategy Communication network	Update communication and outreach strategy Marketing strategy	Marketing strategy implementation
RAM	Biosafety assessm't Permit application for efficacy testing Detection kits	Permit application Allergenicity testing Toxic'l evaluation Compos'l analysis	Permit for agronomic trials, variety testing and seed bulk-up IRM plans	Permit for comm'l release Special detection kits; IRM plans
RDMC	Technical review of proof of concept Planning of way forward Monitoring of activities	Monitoring of activities Periodic review and planning	Monitoring and evaluation Periodic review and planning	Monitoring deployment Feedback to technical teams

Workstream interactions



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Control of Striga in Africa

- Striga is a parasitic weed that infests 20-40m ha of cereal farmland in SSA
- 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*

Photo courtesy of CIMMYT

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Performance of IR maize varieties in Striga infested fields

AEZ	Lake Basin		Midlands		Upper Midlands		overall[a]
District	Bondo	Siaya	Busia	Bungoma	Teso	Vihiga	
Technology	---------- maize yield (kg ha^{-1}) ----------						
H513	2,467	1,763	1,959	2,354	3,556	1,025	2,137
Untreated IR	2,028	1,614	4,259	2,996	3,730	1695	2,735
Treated IR	2,855	1,922	4,401	3,674	3,632	2,527	3,202
IR yield increase	388	159	2,442	1,320	76	1,502	1,065

Maize yields of the currently recommended hybrid (H513) and STRIGAWAY® *Ua Kayongo* maize that was treated and untreated with herbicide on 120 farms in three agroecological zones (AEZ) of western Kenya during the 2006 long rains

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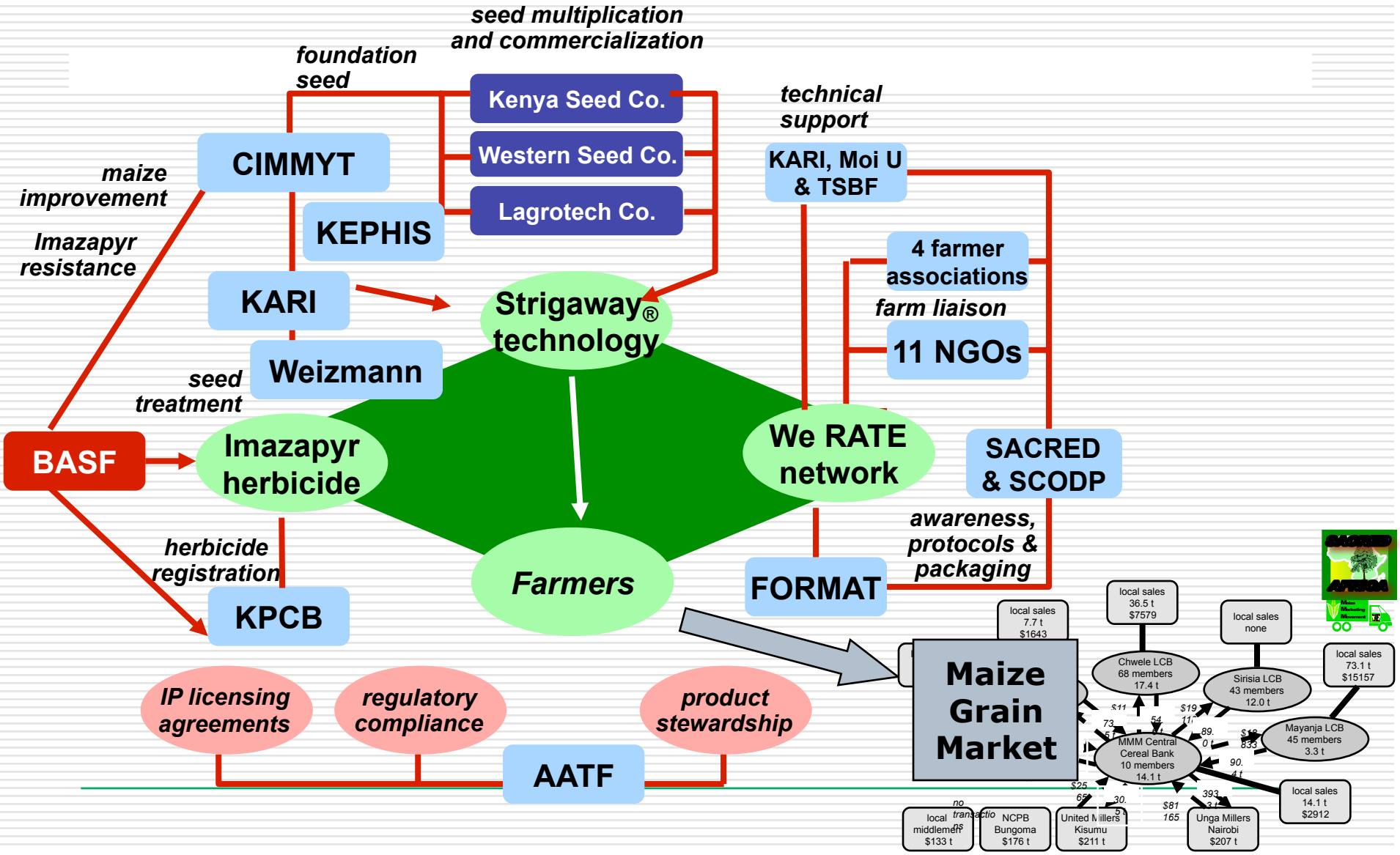
Innovation Platform for IR maize for Striga control



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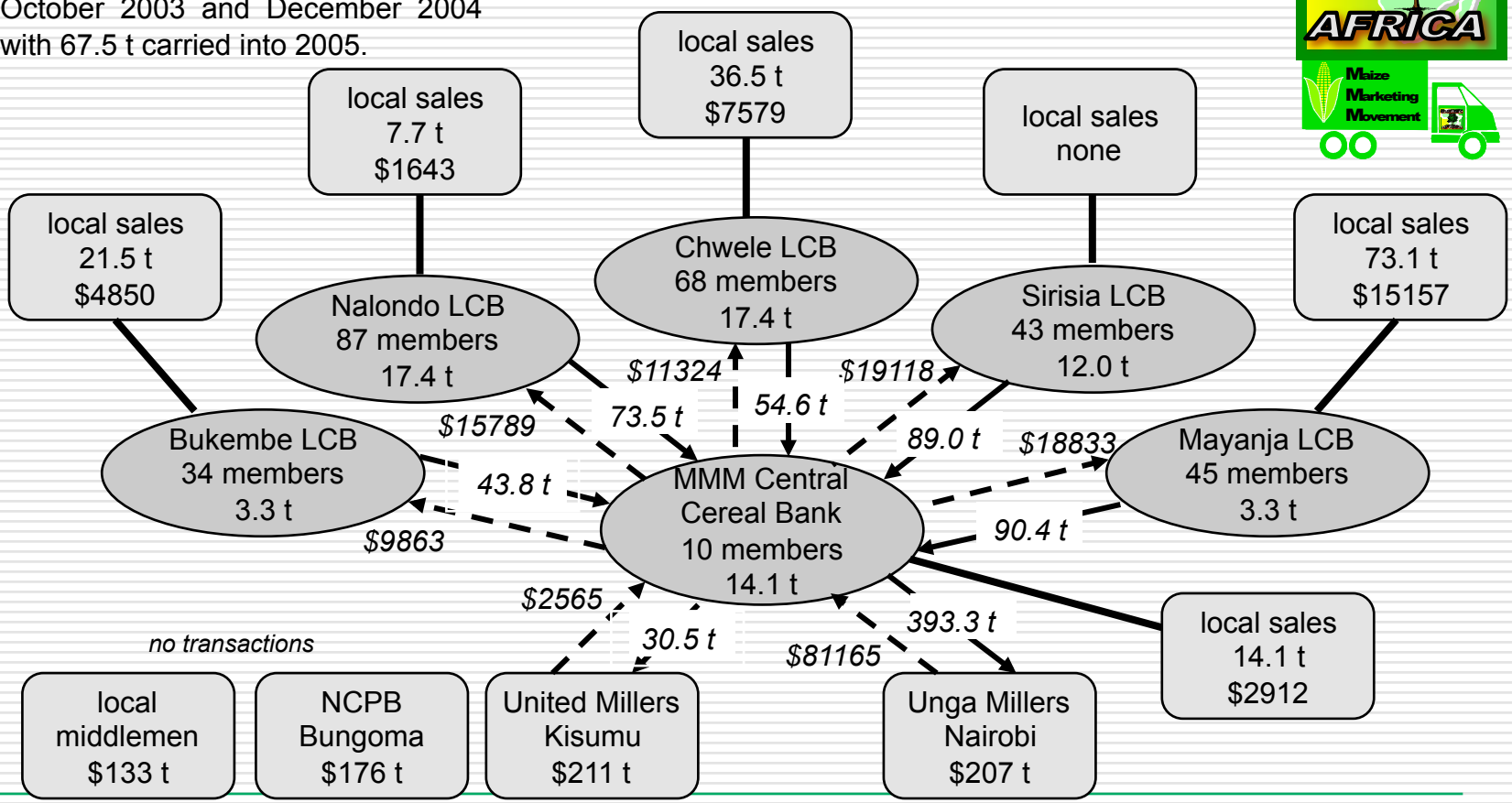
Market access: driving force for technology adoption

Summary: 576.4 t of maize were sold by the Maize Marketing Movement for $115871 between October 2003 and December 2004 with 67.5 t carried into 2005.



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Develop high quality insect resistant cowpea varieties

Constraint: *Maruca* Pod Borer
Product: Bt-Cowpea

Figure 7. Pod damage by *M. vitrata*

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Innovation Platform for Insect-resistant cowpea

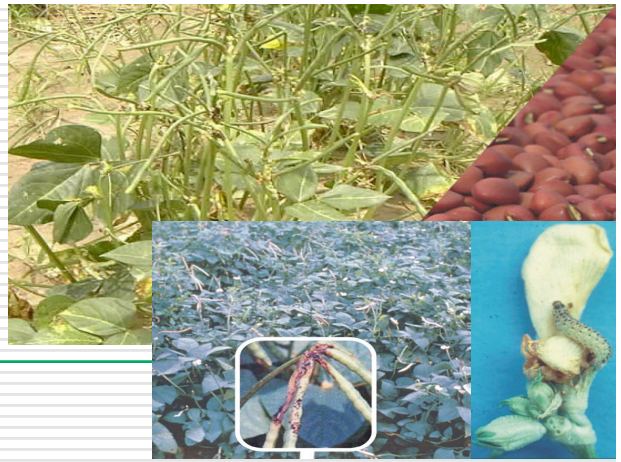
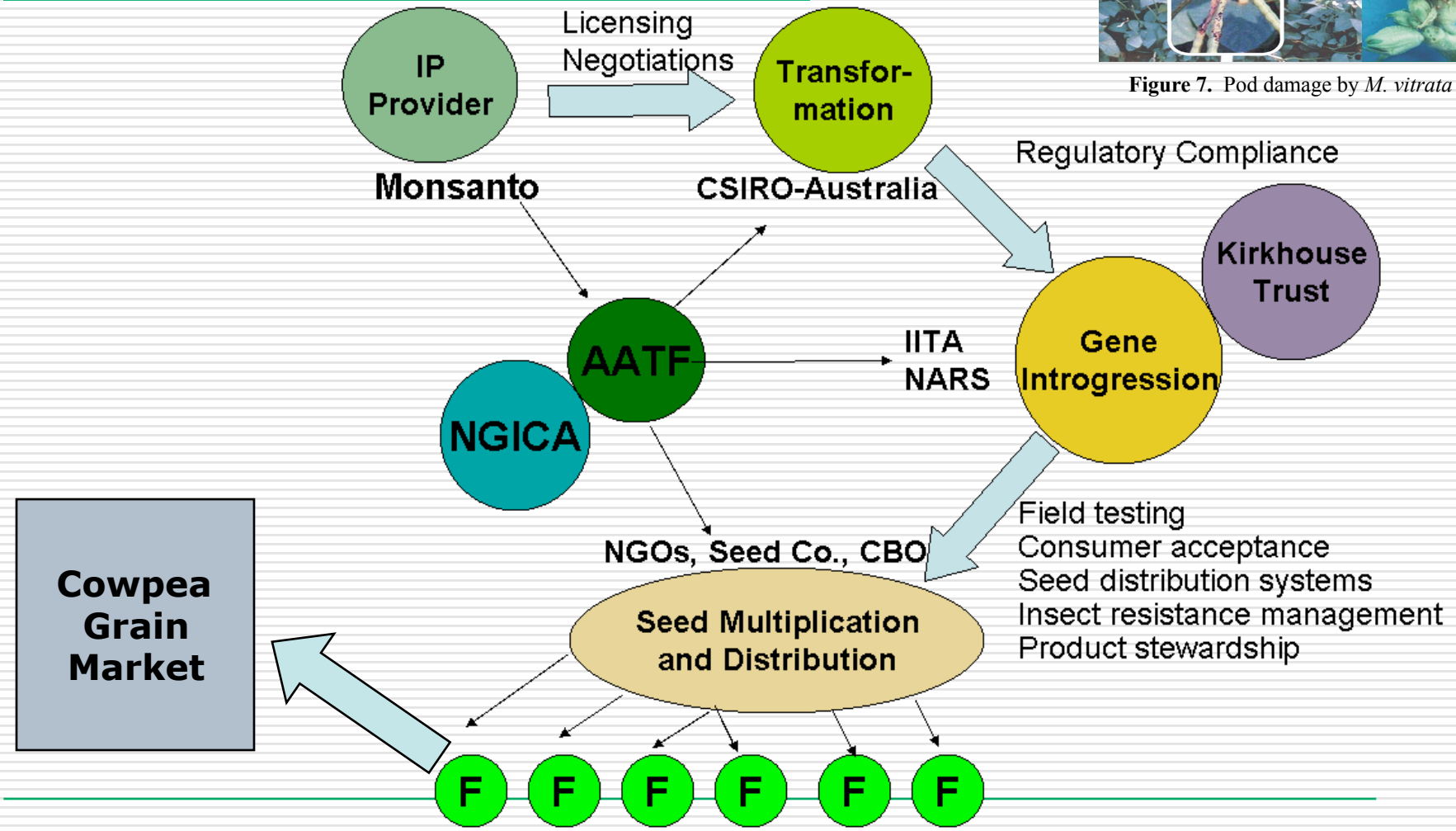


Figure 7. Pod damage by *M. vitrata*



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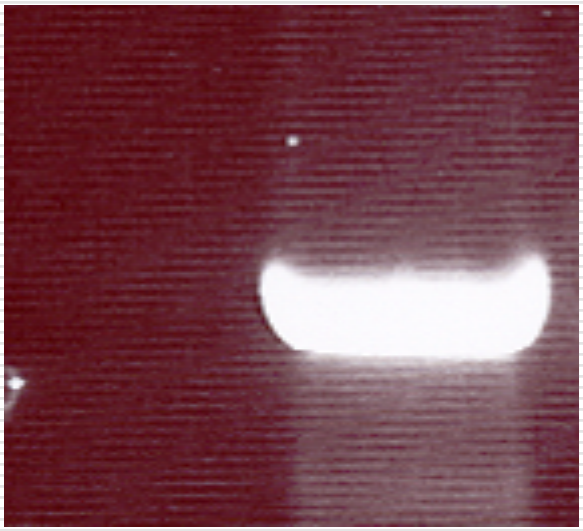
Transgenic (Cry1Ab) cowpea plants have been obtained

PCR analysis of cowpea DNA for Cry1Ab gene



Non-transgenic

Transgenic

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Bt-cowpea is highly toxic to *Helicoverpa armigera*

		% Mortality	(Instar Stage of Survivors)
Non Transgenic	IT86D-1010	16%	III
Transgenic Line	81A	100%	-
Transgenic Line	631B1	100%	-
Transgenic Line	632A1	84%	I
Transgenic Line	632A2	100%	-
Transgenic Line	632B5	86%	I
Transgenic Line	632D5	100%	-
Transgenic Line	632E1	100%	-
Transgenic Line	632F1	75%	I

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Resistance to Banana Bacterial Wilt for East African Highland bananas

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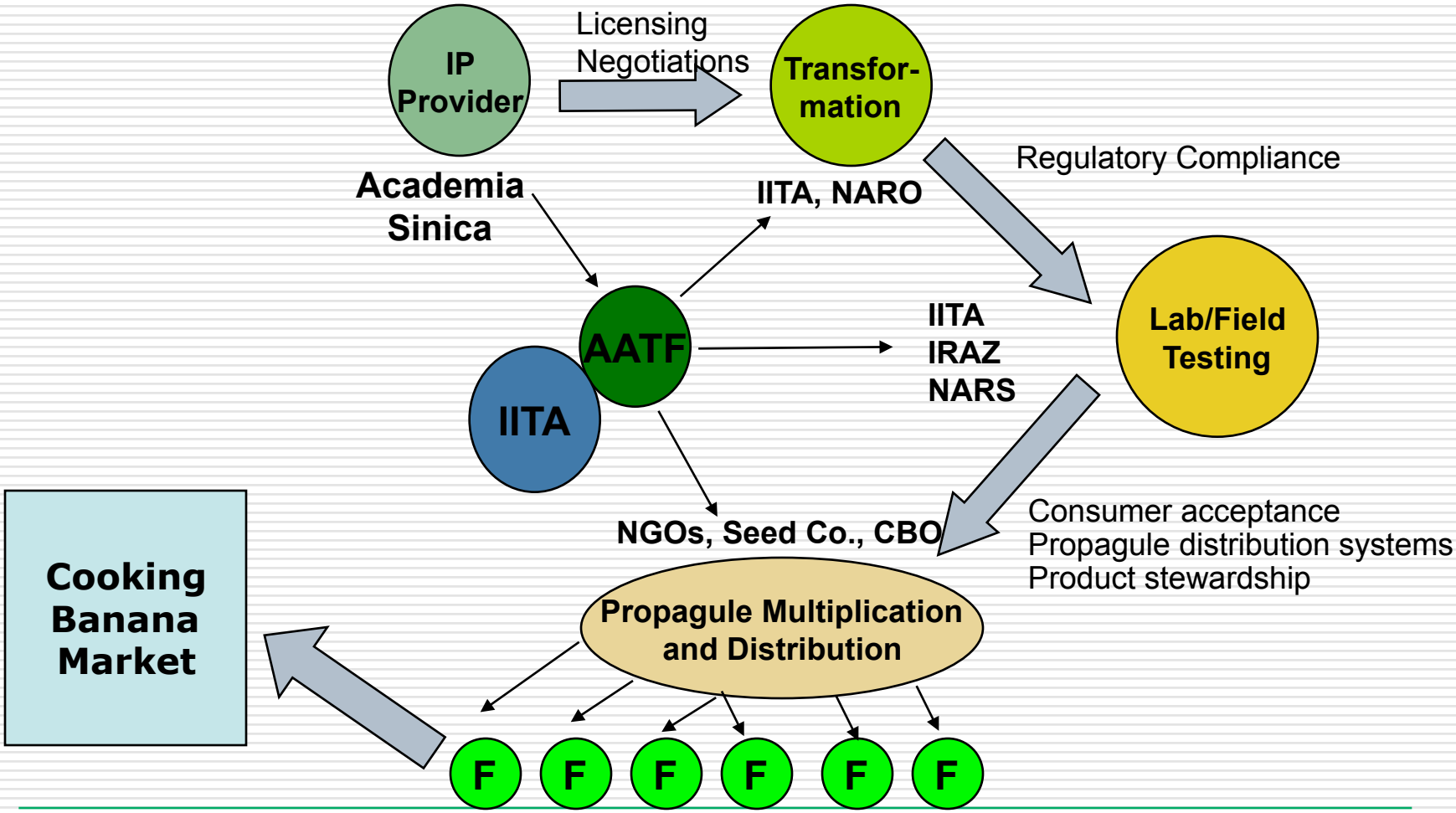
Innovation Platform for Banana resistant to BBW



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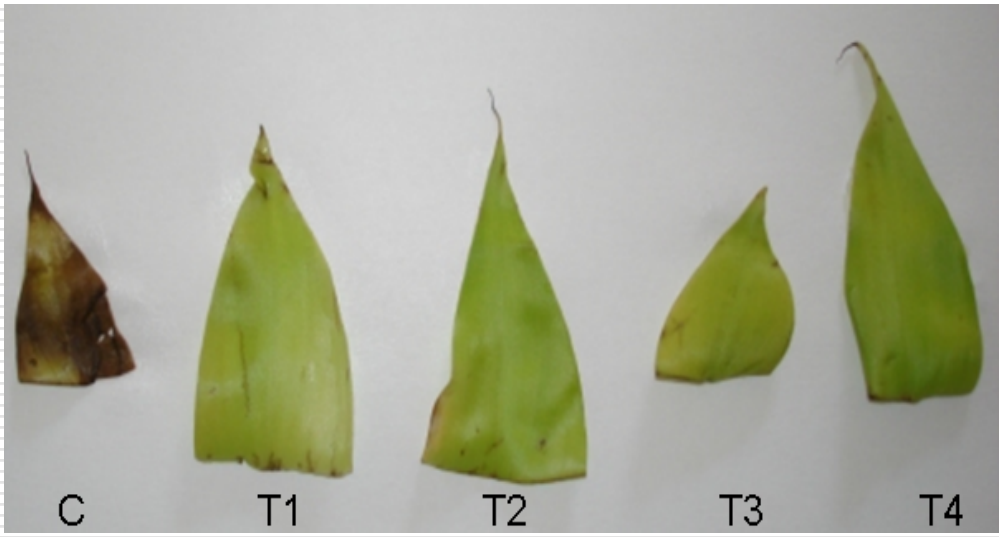
Proof of concept

- **Putative transformed banana plantlets have been obtained**
- **When challenged with *Xanthomonas cm*, transformed banana plantlets show resistance to wilt for 60 days while the control shows wilting in 4 days and necrosis in 10 days**



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Transgenic banana plants in CFT, Kawanda, Uganda (courtesy F. Shotkoski)

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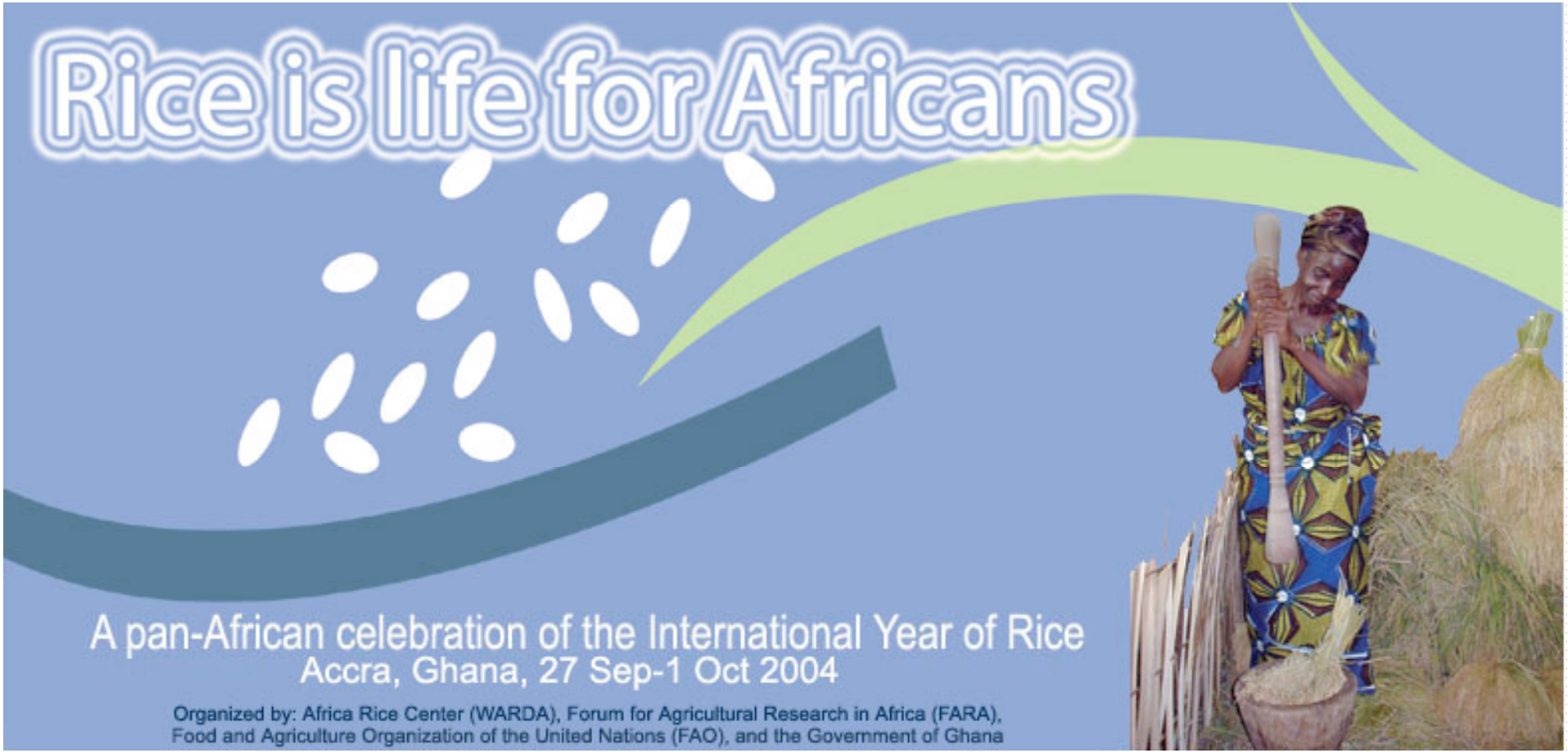
Rice is a basic African staple



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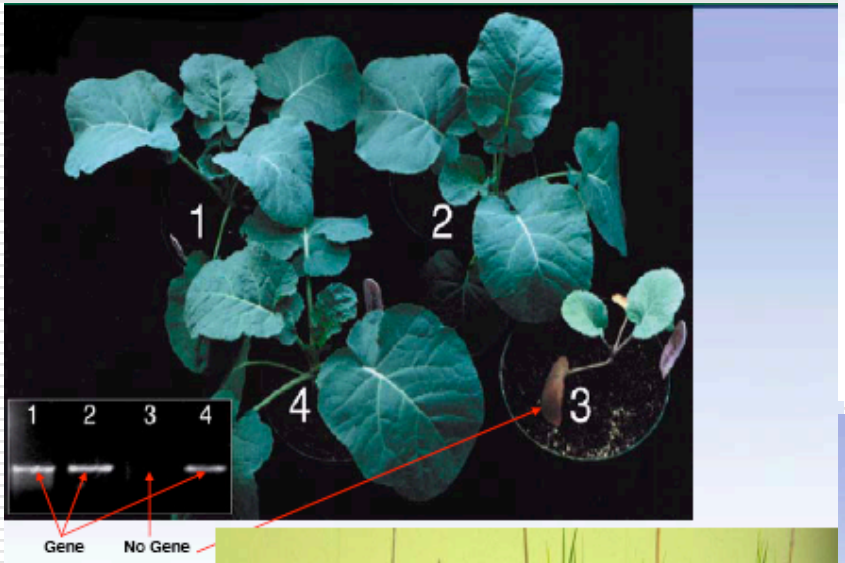
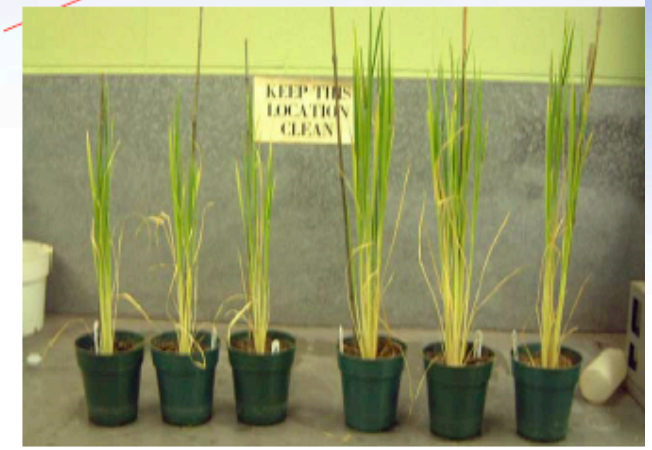
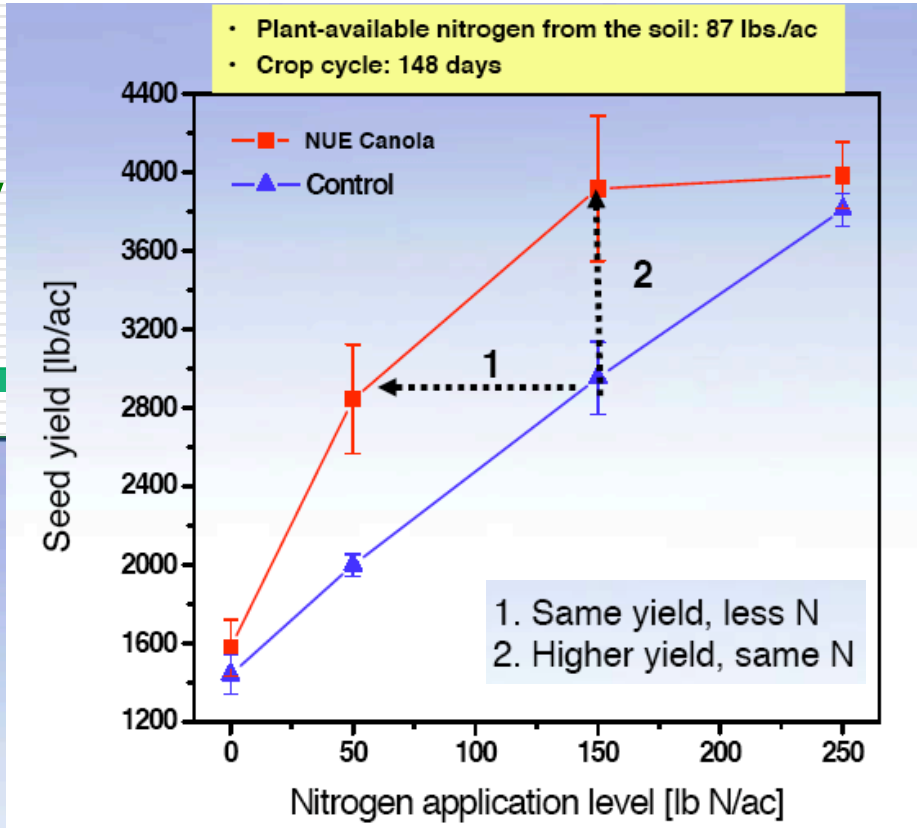
Nitrogen Use Efficiency

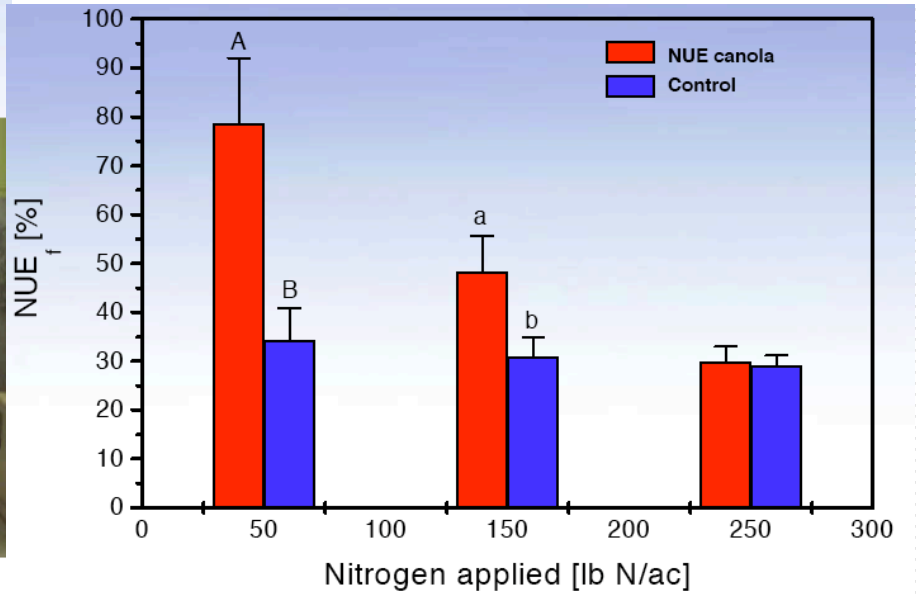
- Tested in canola, rice and maize
- License for use in rice





Control NUE Rice





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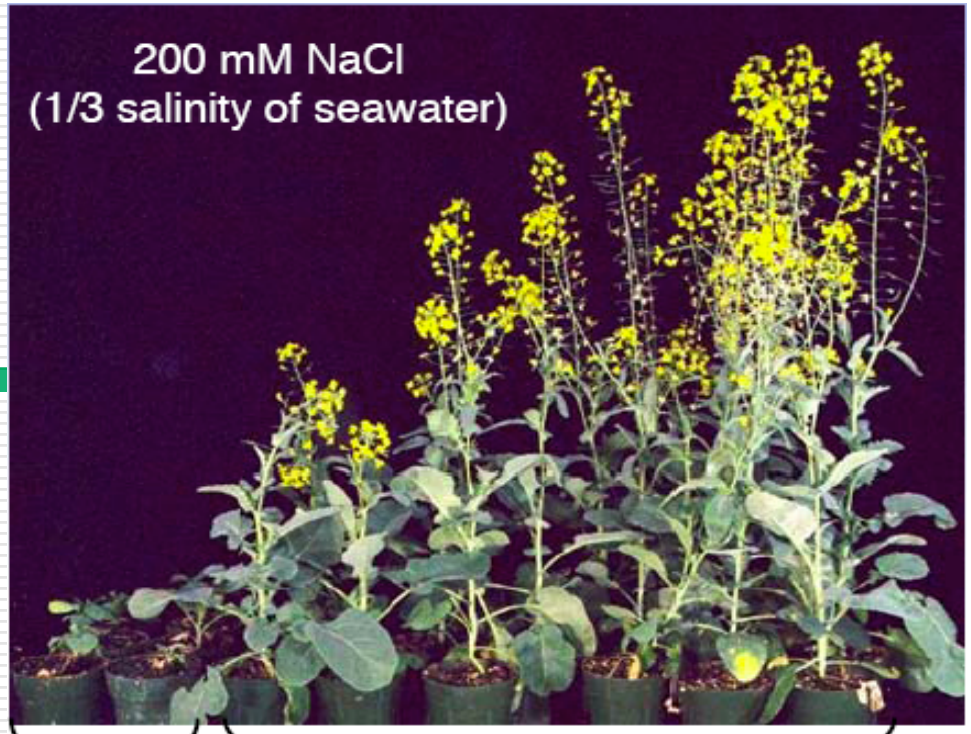
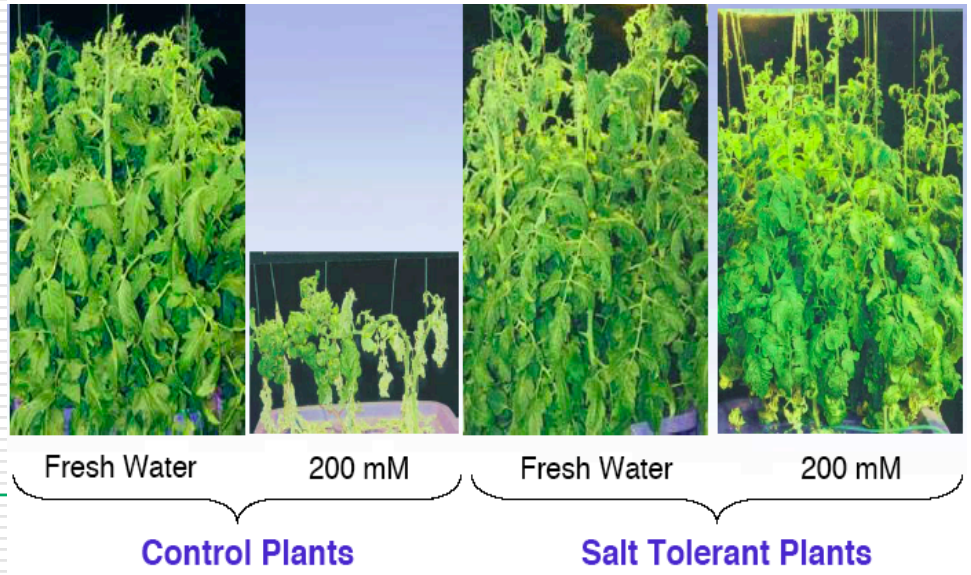
Salt Tolerance

- 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
- A license has been obtained from Arcadia Biosciences, inc. to use the gene in rice





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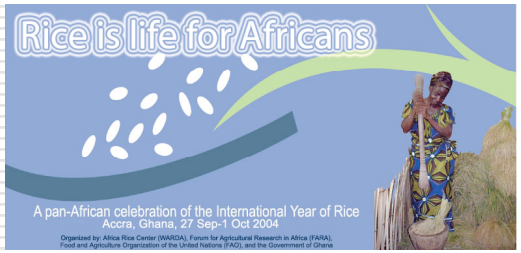
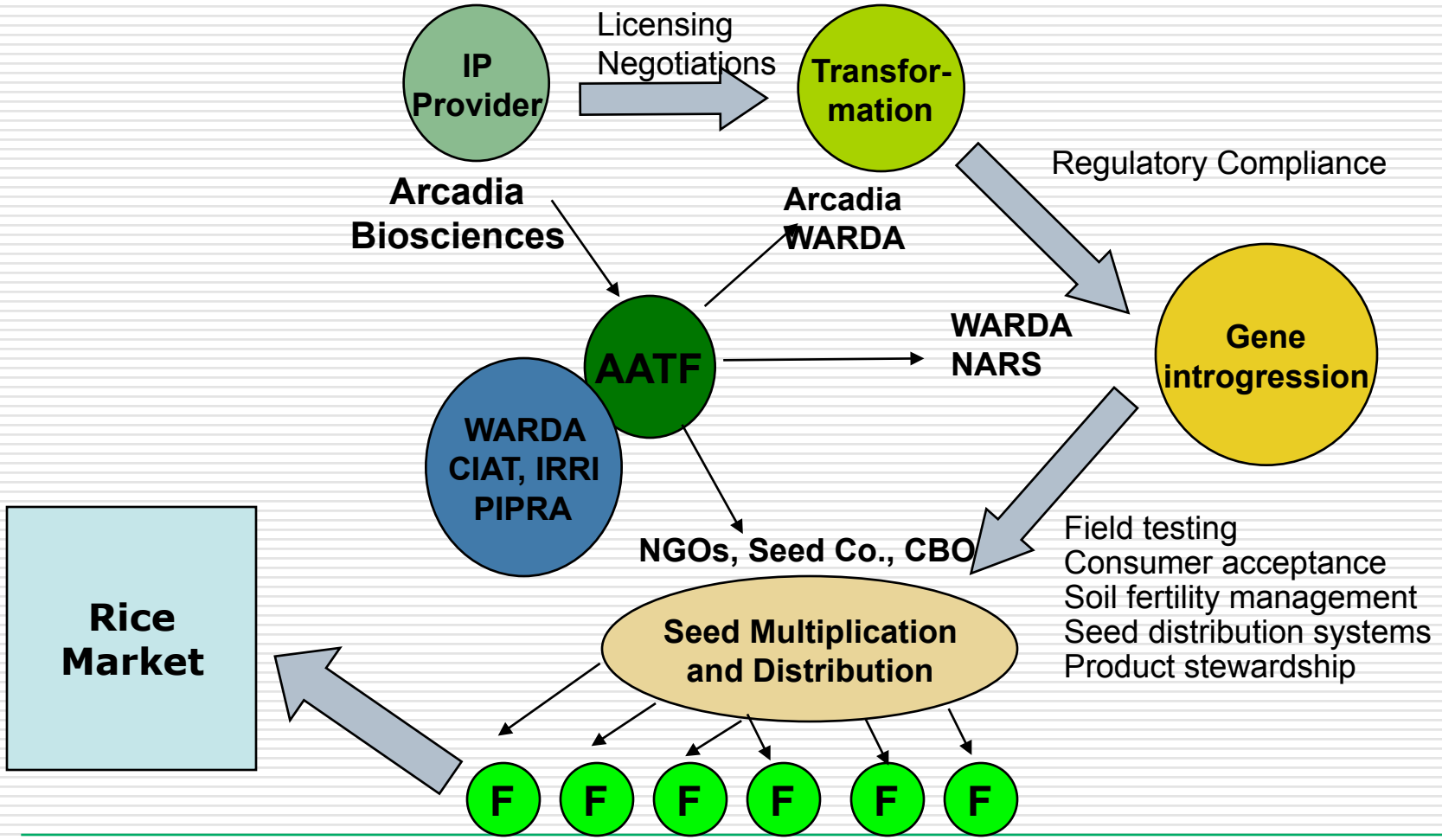


Innovation Platform for NUE and ST Rice (NUERICA)



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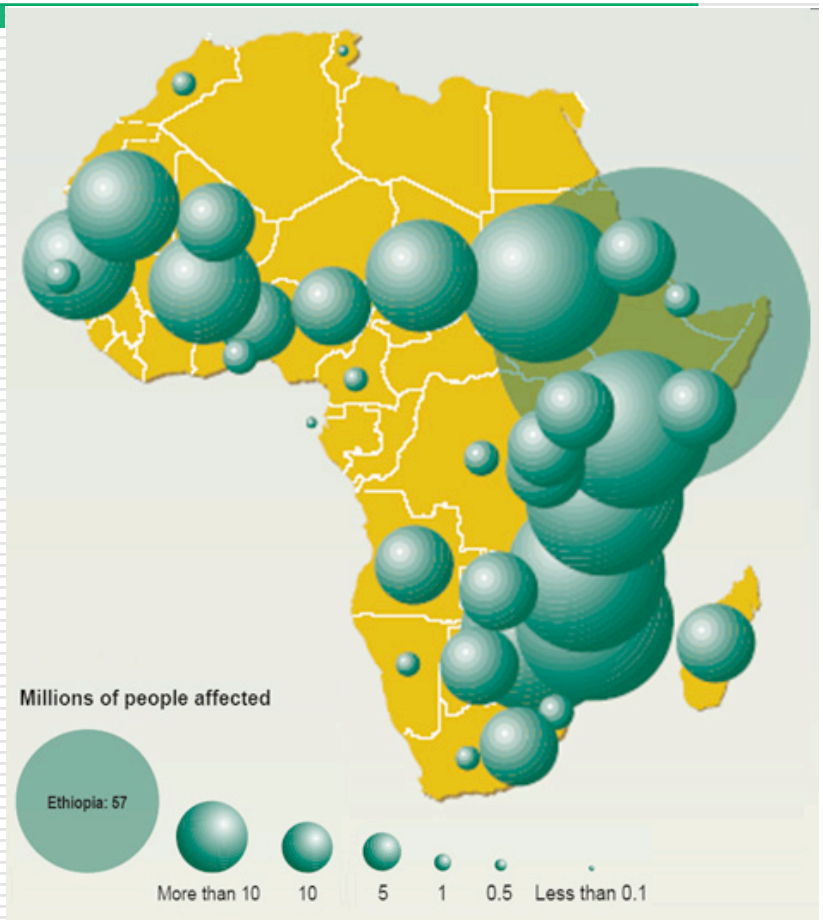
Relevance of Drought-Tolerance Technology to African Agriculture

- 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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Maize in the African diet

Crop	Origin	g day^{-1}	Calorie	Protein (g)	Fat (g)
Cassava	America	103.1	275	1.9	0.4
Maize	America	40.1	350	8.9	3.2
Musa	Asia	28.5	65	0.7	0.1
Yam	Africa	28.2	77	1.2	0.2
Milk	-	27.1	49	2.6	2.8
Sorghum	Africa	23.7	195	5.8	1.9
Wheat	Asia	19.6	156	4.6	0.6
Rice	Asia/Afr	17.7	174	3.6	0.4
Millets	Africa	17.4	137	3.3	1.3
Sweet potato	America	13.9	36	0.5	0.1

Source: Ortiz and Hartmann, 2003

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Calculated benefits of DT and accompanying BMPs

drought category	**none**	**moderate**	**severe**	**total**
drought frequency	0.42	0.33	0.25	1.00
drought area (ha)	6,140,400	4,824,600	3,655,000	14,620,000
drought yield effect	1.00	0.67	0.33	
maize yield (kg/ha)	1,535	1,029	507	
maize prodn estimate (t)	9,426,427	4,962,340	1,851,620	16,240,387
maize price ($/t)	178	178	178	
maize value ($/yr)	**1,677,903,945**	**883,296,577**	**329,588,275**	**2,890,788,797**
+DT effect	0.15	0.25	0.20	
+DT yield (kg/ha)	230	257	101	
+DT production (t)	1,413,964	1,240,585	370,324	3,024,873
+DT value ($/yr)	**251,685,592**	**220,824,144**	**65,917,655**	**538,427,391**
+DT +BMP effect	0.40	0.20	0.10	
+DT +BMP yield (kg/ha)	706	257	61	
+DT +BMP production (t)	4,336,156	1,240,585	222,194	5,798,936
+DT +BMP value ($/yr)	**771,835,815**	**220,824,144**	**39,550,593**	**1,032,210,552**

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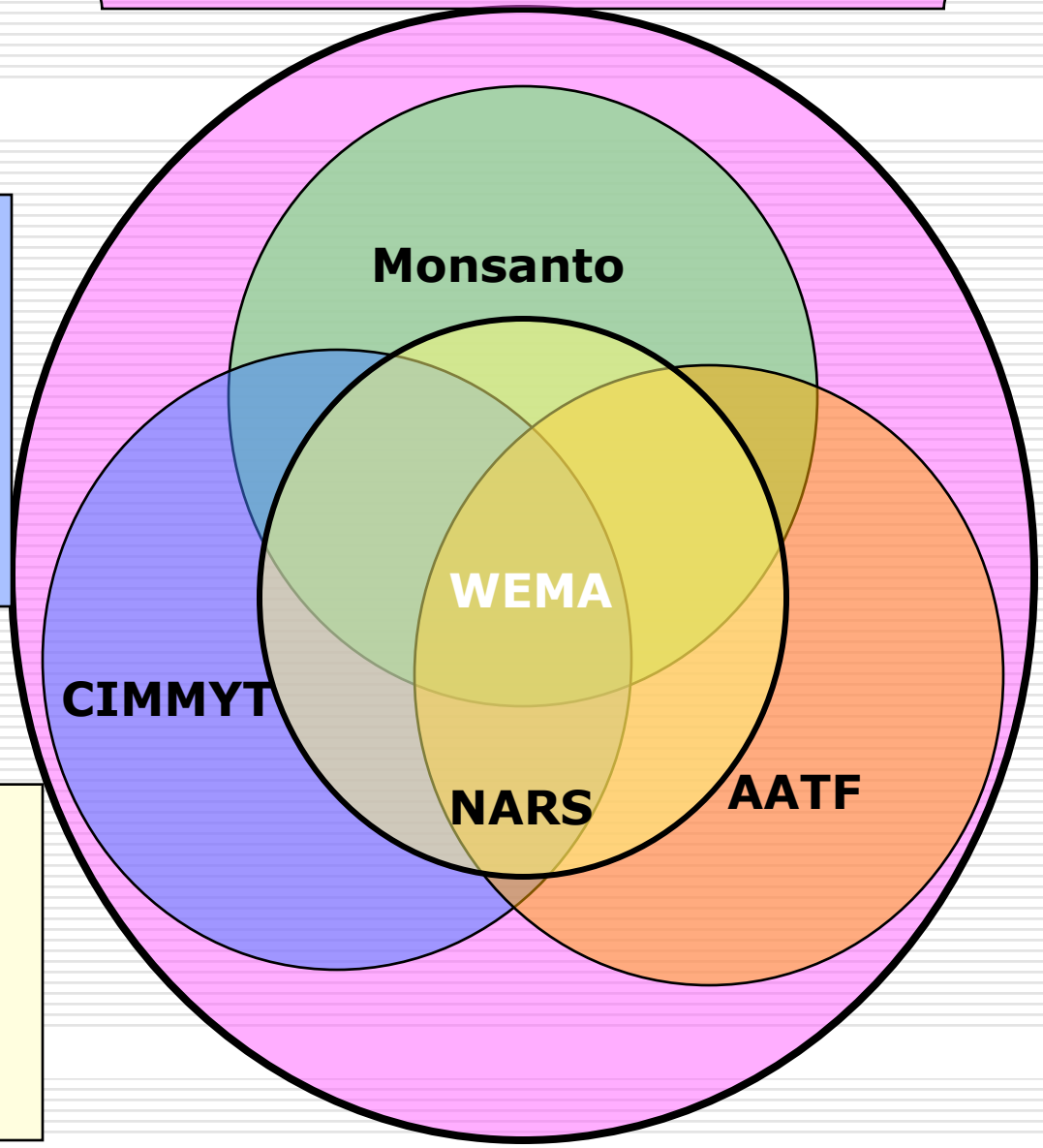
Bill & Melinda Gates Foundation
Howard G. Buffett Foundation

CIMMYT:
World leader for breeding maize for African agro -ecological zones



Monsanto: World leader in MAB, gene discovery, trait development and trait licensing

NARS:
Field trials expertise
Capacity building opportunities

AATF: Unique African institution mandated to access and deliver proprietary technologies to smallholders African farmers

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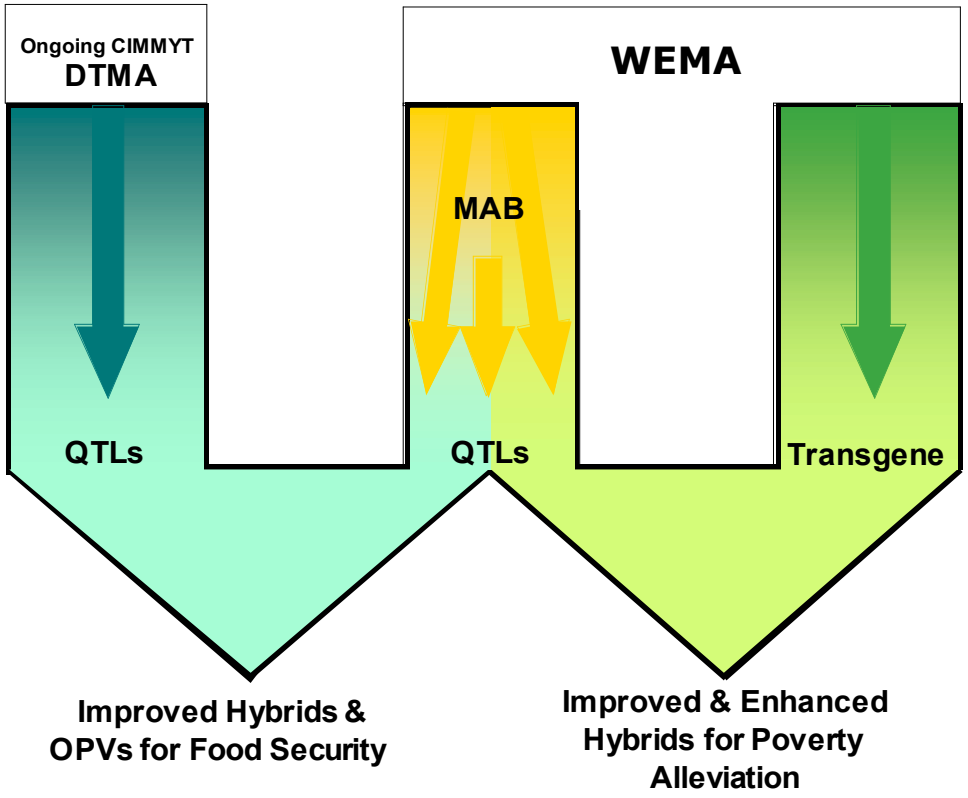
Molecular breeding and transgenic approaches to be used



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Regulatory Compliance Costs: *IR Maize*

National Performance Trials/DUS	30,000 – 60,000
Application for variety release	500 – 1,000
Seed increase	15,000 – 30,000

Total (US $) 50,000 – 100,000

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Regulatory Compliance Costs: *Bt Maize*

Preparation for hand-off of events into regulatory	20,000–50,000
Molecular characterization	300,000–1,200,000
Compositional assessment	750,000–1,500,000
Animal performance and safety studies	300,000–845,000
Protein production and characterization	162,000–1,725,000
Protein safety assessment	195,000–853,000
Nontarget organism studies	100,000–600,000
Agronomic and phenotypic assessments	130,000–460,000
Production of tissues	680,000–2,200,000
ELISA development & expression analysis	415,000–610,000
EPA expenses for PIPs (e.g., EUPs, tolerances)	150,000–715,000
Environmental fate studies	32,000–800,000
EU import (detection methods, fees)	230,000–405,000
Canada costs	40,000–195,000
Stewardship	250,000–1,000,000
Toxicology (90-day rat)—when done	250,000–300,000
Facility & management overhead costs	600,000–4,500,000

Total (US $) 7,000,000–15,000,000

Source: Kalaitzandonakes et al. 2007

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Conclusion

- There are no quick fixes for African agriculture
- Innovative approaches are required to combine the benefits of the agricultural, industrial and knowledge revolutions
- No single institution has all that is required to make a significant impact
- Partnerships between institutions of the public and private sectors, North-South, East-West, etc. are essential
- But Africans must take the lead to find and implement solutions to their problems

Thank you!

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