More Crop per Drop for Universal Food Security

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Physical and economic water scarcity

Areas of physical and economic water scarcity

- Little or no water scarcity
- Physical water scarcity
- Approaching physical water scarcity
- Economic water scarcity
- Not estimated

Source: International Water Management Institute
Geography of water stress

Sources: Smakhtin, Revenga and Döll, 2004.
Relationship of crop water productivity to grain yield

\[ Y = 0.259X - 0.016X^2 \]

\[ R^2 = 0.88 \]

Source: Musick et al. 1994
The higher the crop yield, the lower drop per crop

Source: ‘Water footprints of nations: Water use by people as a function of their consumption pattern’ Hoekstra and Chapagain in Water Resource Manage (2007); SFSA
So how to raise yields?
Plant breeding, genetic modification

Teasing out drought tolerance is complicated
Crop enhancement chemistry

Triggers natural pathways for improved **vigor, water use efficiency** and **drought tolerance**

**Soil Additives: facilitate root water uptake**
- Acrylic soil polymers
- Myccorhizae: symbiotic fungi

**Plant Chemicals: delay onset of water stress**
- 1-Methylcyclopropene: Blocks ethylene production
- Trinexapac: Growth regulator (roots)
- Thiomethoxam: Insecticide, protein biosynthesis

Source: Syngenta
## Solutions beyond chemicals, seeds

**Agronomy and management are key!**

<table>
<thead>
<tr>
<th><strong>On farm water use</strong></th>
<th>Optimized use and re-use of available water</th>
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<tbody>
<tr>
<td><strong>Water delivery systems</strong></td>
<td>Targeted and effective delivery of water to plants</td>
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<td><strong>Water intelligence</strong></td>
<td>Synthesizing and applying information, know how</td>
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<td><strong>Physical protection</strong></td>
<td>Avoid evaporation, leaching of water from plant root zone</td>
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<tr>
<td><strong>Soil additives</strong></td>
<td>Facilitate water uptake in root area</td>
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<td><strong>Plant chemicals</strong></td>
<td>Delay onset of water stress, optimized formulations for CP</td>
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<td><strong>Plant genetics</strong></td>
<td>Enhance robustness of plants under water stress</td>
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<tr>
<td><strong>Agricultural practices</strong></td>
<td>Growing plants under water agronomical aspects</td>
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</tbody>
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### Innovation examples

- Water harvesting
- Mobile desalination units
- Micro irrigation systems (e.g. DI)
- Pervaporation using brackish water
- Decisions based on forecast, measure
- Application of integrated know how
- Mulch as plastic cover & flooring
- Nanotechnology as coatings
- Acrylic soil polymers
- Myccorhizae
- INVINSA
- ACE and other chemical agents
- Drought tolerant crops
- Saline water tolerant crops
- Minimum tillage
- Dryland rice
Closing yield gaps (1/3)

‘The difference between realized productivity and the best that can be achieved with current genetic material and available technologies and management’

Yield gap dynamics:

- Regional and inter-temporal variation
- Evolution of biotic / abiotic stresses
- Natural resource degradation / rehabilitation
- Expansion of yield frontier (biotech, bio-engineering, genetics x chemistry)

Yield a function of farmers’ capacity to access and use seeds, water, nutrients, pest-disease-weed management, soils, biodiversity, knowledge

Other determinants of investment and yield:

- Market conditions
- Government policies
- Farmer health
- Finance
- Risk tools / insurance
- Post-harvest technology
- Profitability of alternative uses of land, capital and labour
Closing yield gaps (2/3)

Farm capability as an additive progression

Productivity

Low-capability smallholders
- Agronomy
- Soil/water management
- ‘Robust’ seeds: good open-pollinated varieties (OPVs)
- Manure use

Semi-commercial smallholders
- Basic crop protection (e.g. herbicide)
- Better OPVs
- Synthetic fertilizer

Commercial smallholders
- Hybrid seeds, GM
- Seed treatment
- More sophisticated crop protection

Advanced farmers
- Multi-trait hybrid seeds (incl. GM traits): insect resistance, herbicide tolerance, drought tolerance
- Integrated solutions
- Post-harvest storage

Return on investment the decision paradigm from enhanced basics to ‘sophistication’

Source: Syngenta Foundation
Closing yield gaps (3/3)

Productivity

Low-capability smallholders
- Public sector: Governments; NARS; CG centers
- NGOs & Foundations
- Other civil society organizations

Semi-commercial smallholders
- Private for-profit sector through BOP sales
- Private not-for-profit sector (e.g. Foundations)
- Public sector
- Civil society organizations

Commercial smallholders
- Private for-profit sector: input industry, agro-dealers, processors and buyers of produce
- Public sector
- Civil society organizations

Advanced farmers
- Private for-profit sector
- Public sector
- Civil society organizations

Stakeholders a function of farm capability

Public goods called for at each stage
- R&D partnerships
- Extension partnerships
- Seed systems
- Financial services
- Connectivity
- Contract farming
- Market access

Source: Syngenta Foundation
Being open-minded when it comes to technology

Issues we need to contend with (mostly in rich countries):

- Doomsaying
- Environment versus technology: a false choice
- Food sovereignty
- The poverty rhetoric leading us astray
- Peasant romanticism
- Rejection of ownership (IP!)
- Disdain for the private sector in agriculture
Enabling farmers to access what they are looking for

What farmers want (large or small, women or men, everywhere)
Recognizing that only the private sector can deliver *en masse*

- But the business climate must be right
- Role of:
  - **Public sector**: public goods
  - **Private sector**: value-adding technology, services, market uptake
  - **Farmers**: part of the private sector – production and livelihoods
  - **Foundations, ‘third sector’**: patient money; early-stage; provide common platforms to governments, NGOs, private-public groups
  - **Partnerships**: 1) Synergies in R&D; 2) Tweak markets into existence
- Markets and hence the private sector are the only way to massively scale up
Great scope in disruptive technologies:

- Information technology
- Mobile applications
- Advanced crop science
- Advanced animal science
- Nanotechnology, engineering
- New business models for service delivery
# Working towards innovation commons and PPPs in ag R&D

<table>
<thead>
<tr>
<th>Public mindset</th>
<th>Private mindset</th>
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<tr>
<td><strong>Research stage:</strong></td>
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<tr>
<td>• Public good goals, funding- and publications-driven, donor preferences</td>
<td>• Targets and priorities gleaned from market</td>
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<tr>
<td>• Knowledge generation (as opposed to exploitation)</td>
<td>• Multidisciplinary project teams eyeing development and commercial functions</td>
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<tr>
<td><strong>Development stage:</strong></td>
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<tr>
<td>• Not well developed</td>
<td>• Shift into different mode; change project leader at this stage</td>
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<tr>
<td>• Incentives and mindset don’t lend themselves to ‘development’; better to enter partnerships</td>
<td>• Partnerships throughout: in-sourcing, out-sourcing, delivery</td>
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The goals, however, are the same: food security, sustainability, and ‘growing more from less’
Developing input markets: A private seed industry is essential for rapid and widespread productivity gains

US since the 1930s (private sector’s seed market share today: +/- 100%); Europe from the 1950s; Asia from the late 1960s; LATAM from the 1970s

Time for Africa is NOW

Source: Adapted from Vivek, CIMMYT
Stylistic representation of the Indian seed market

A half century of public-private partnership!

Source: Syngenta Foundation
Building the seed market: Potato in Kenya

- New aeroponics technology increases seed quality and yields, reducing cost and the number of field generations from 7 to 3
- Public-private partnership: CIP – KARI – USAID – local seed companies
- Reinforces quality seed production and private seed industry
- Already reaching >10K smallholders in long rain season 2010

Source: USAID, CIP
Index insurance to kick-start input markets

The case of *Kilimo Salama* in Kenya

Purchase
Farmers buy inputs and pay 5% extra to insure the inputs at selected stockists.

Registration
Farmers receive a card from the stockist on which they fill their details received by SMS.

Measurement
During the season the weather station measures the rainfall.

Compensation
In case of a payout farmers receive compensation via MPESA.

Source: Syngenta Foundation
Building the value chain: The Beira corridor as an example

Agricultural potential by 2030

2010

- <20,000 ha irrigated commercial agriculture
- Smallholders almost exclusively subsistence production
- High production and marketing costs

2030

- >210,000 ha irrigated commercial agriculture
- Smallholders have access to irrigation infrastructure and markets
- Economies of scale → increased competitiveness

Source: Beiracorridor.com

Yield gains driven by links to output markets
Beekeeping in Uganda

Herein lies food security!

Ever wanted to eat something Sinlessly Sweet? Well organic, fruity - Sweet wild flower honey is as close as you can get. And combine organic, fruity - sweet wild flower honey from the Pearl of Africa, with farmer - oriented ethical business practices and you are on to a winner.

We at Bee Natural™ Products, realise our potential as a major poverty alleviation initiative in the rural areas of Uganda, East Africa and are proud of our contribution to Uganda's poverty eradication programme.

Go to our Products Page and make you online order for uniquely packaged honey products in handicrafted containers. For commercial purposes we offer beeswax foundation and for the bee keeper we have pure beeswax block.

The results of our partnership with rural subsistence farmers in an area devoid of commercial farming is an European Union-certified, 100% organic, pure natural honey that has a taste unlike any other in the World.

Uganda is now licensed to export their honey to the European Union!

..Truly Ugandan!
The fabric of food security and agricultural growth lies in the value chain, the key to which is held not by farmers, but buyers, processors, traders, wholesalers, retailers and consumers.

- It is the creation of value post-harvest that shapes the fate of the input industry and farmers.
- But entrepreneurship post-harvest is not possible without the empowerment and the development of farmers.
Thank you!

Parting thought: Consider lowering your