Soil Fertility

Technology Priorities to Ensure Food Security

Presented by

Amit Roy

President & CEO, International Fertilizer Development Center

at

Future of Food Seminar

November, 16-17, 2011

Lausanne, Switzerland

Soil Fertility - Many Important Facets

- Soil Fertility (SF) and fertilizers (mineral and organic) are critical to agricultural productivity
- SF will become even more critical for food security, given magnitude of demand increase and role of Small Holder Farmers (SHFs) in highest demand regions
- Priorities clear for evolution of future fertilizers to deliver SF where most needed – yield and micronutrient assurance for SHFs, better economic and environmental impact and more self-reliant sourcing
- Private sector must re-invest in fertilizer enhancements, but must also tackle other aspects of food security

SF - Many Important Facets

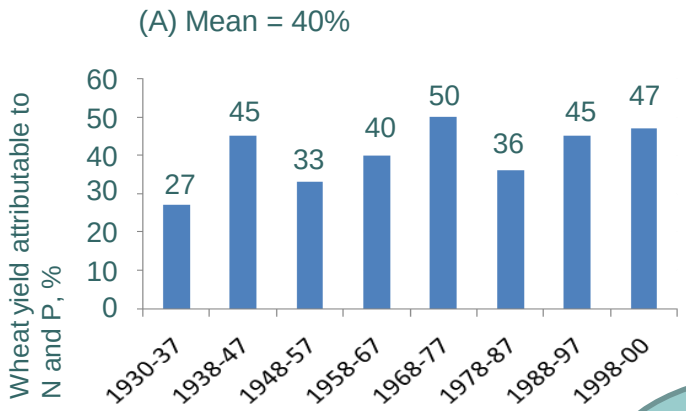
- Soil Fertility (SF) and fertilizers (mineral and organic) are critical to agricultural productivity

- SF will become even more critical for food security, given magnitude of demand increase and role of Small Holder Farmers (SHFs) in highest demand regions

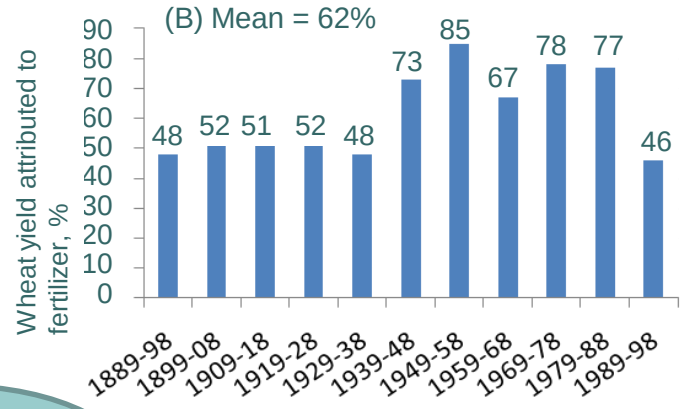
- Priorities clear for evolution of future fertilizers to deliver SF where most needed – yield and micronutrient assurance for SHFs, better economic and environmental impact and more self-reliant sourcing

- Private sector must re-invest in fertilizer enhancements, but must also tackle other aspects of food security

Cereal Yield Attributable to Fertilizers

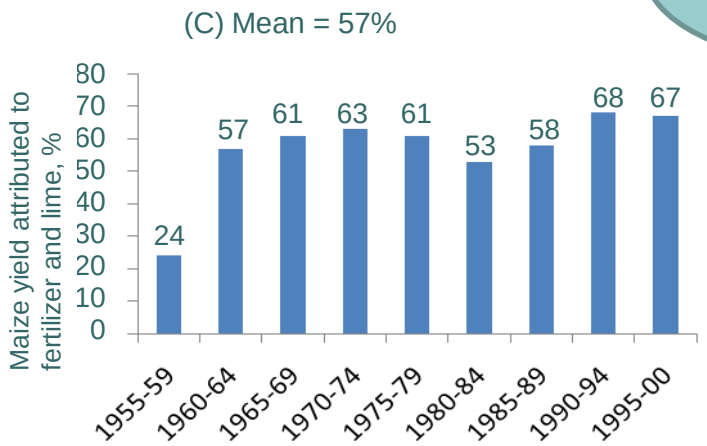


Magruder Plot, Oklahoma (A)

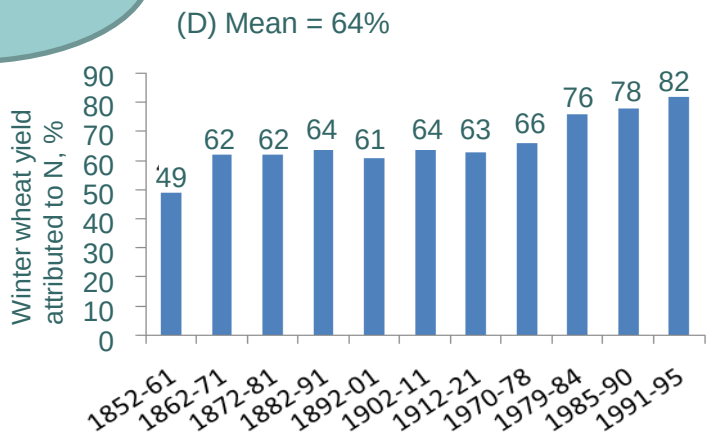


Sandborn Field Plot, Missouri (B)

40-60%



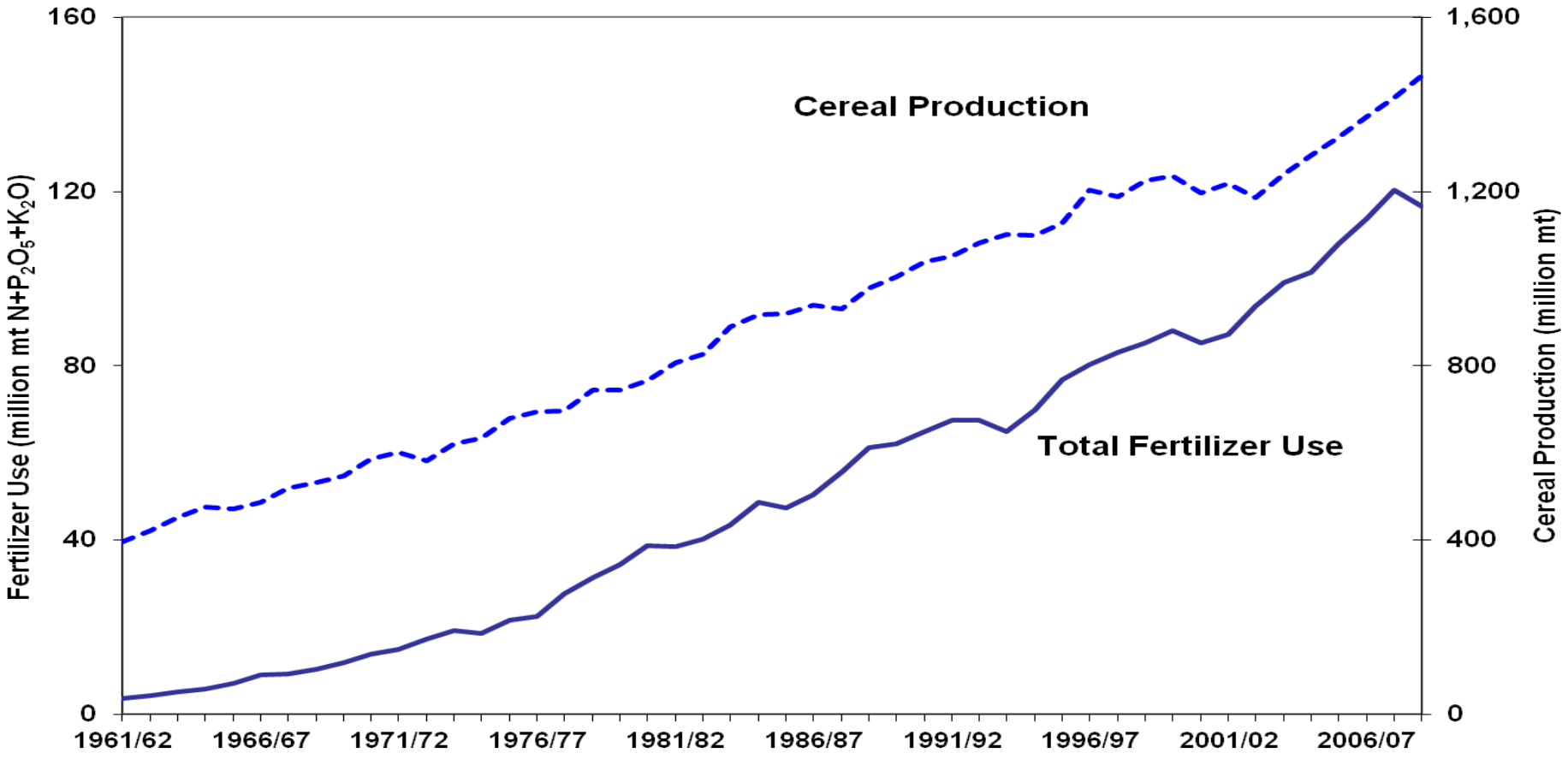
Morrow Plot, Illinois (C)



Broadbalk Experiment at Rothhamsted, England (D)

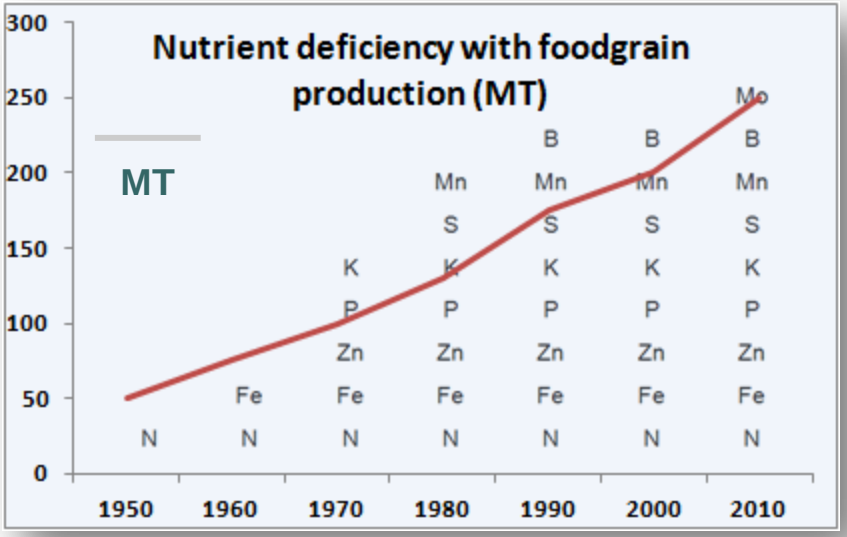
Source: IPNI

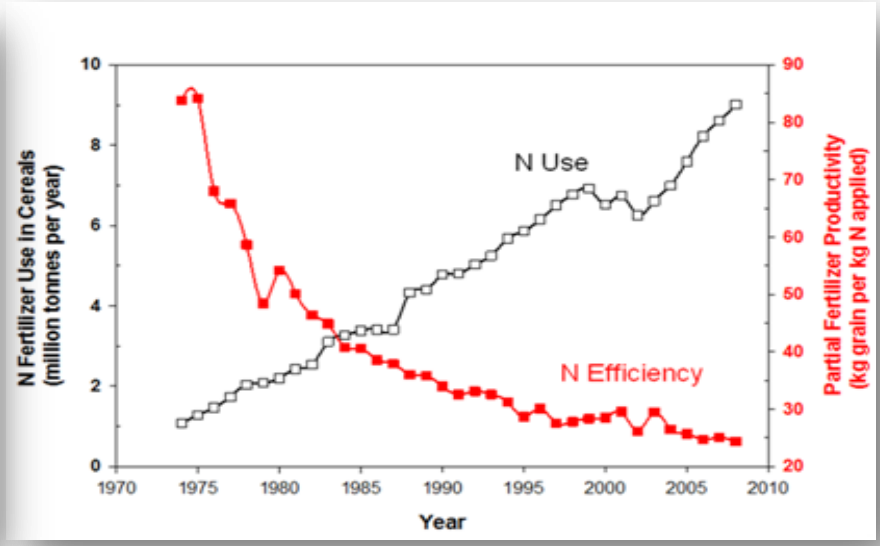
Cereal Production and Fertilizer Use



Micronutrients – health and yield implications

INDIA

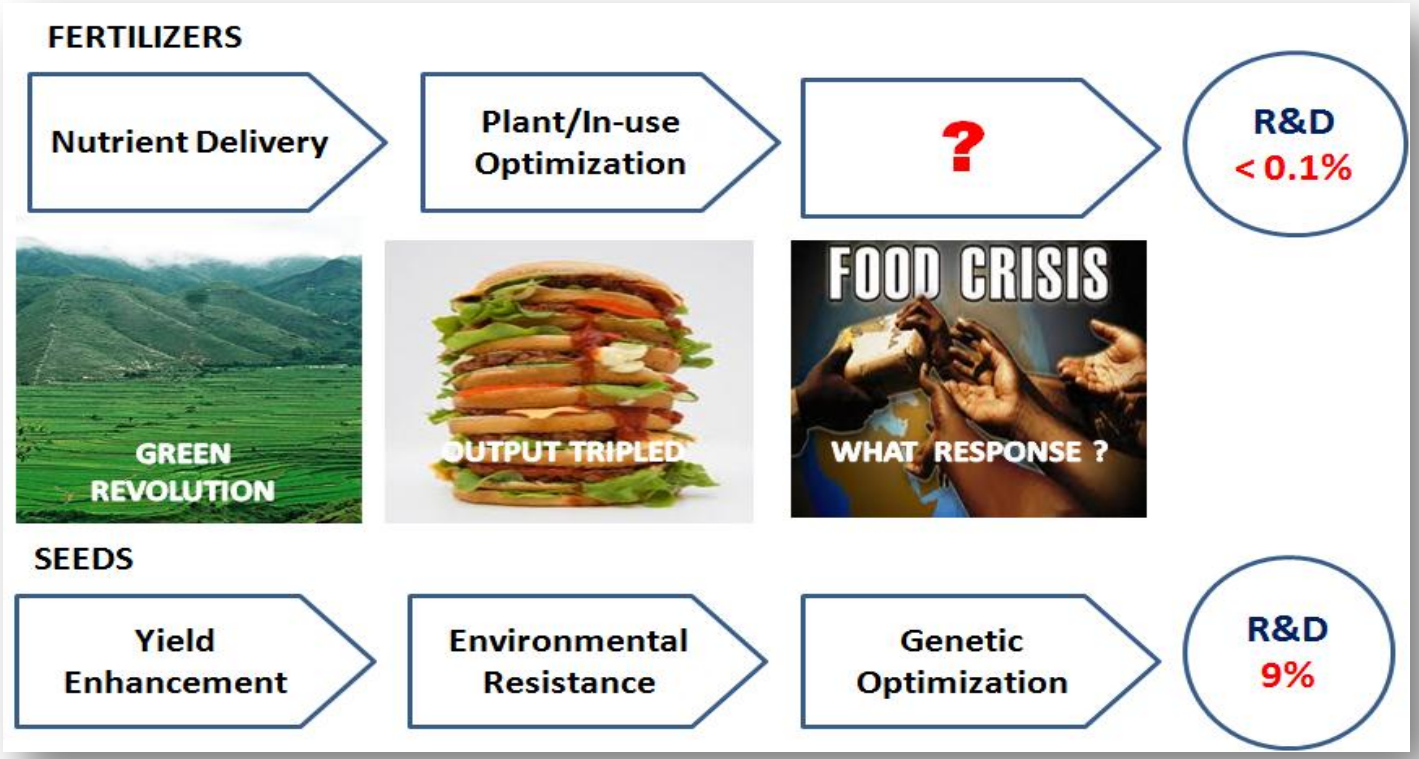




But intensive and extensive crop production has depleted agriculture's natural resource base

SOIL FERTILITY

Industry's technology focus - optimization



Fertilizers, mostly developed by the Tennessee Valley Authority, USA, essentially unchanged since early 1980s

SF - Many Important Facets

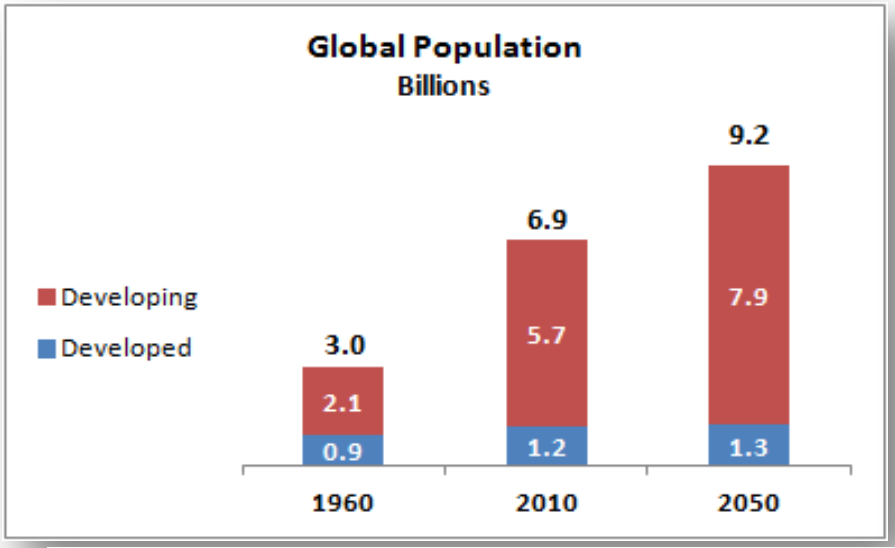
- Soil Fertility (SF) and fertilizers (mineral and organic) are critical to agricultural productivity

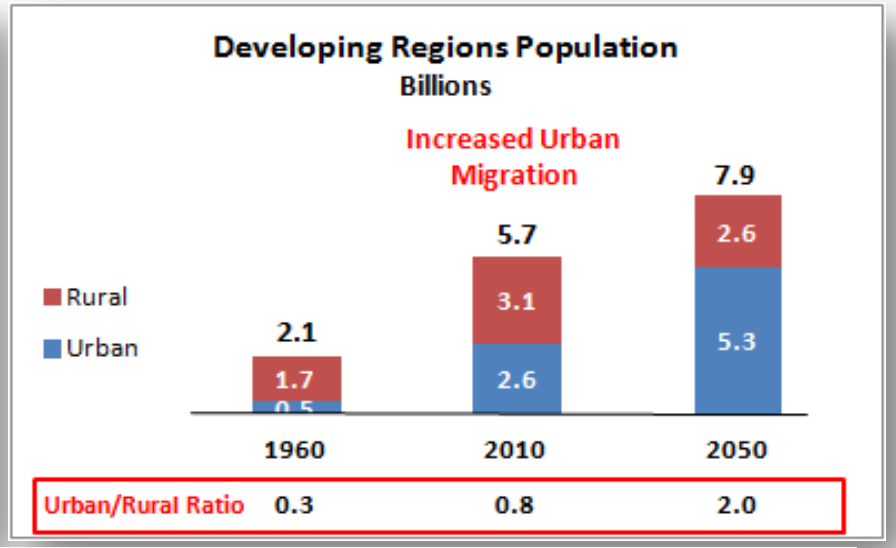
- SF will become even more critical for food security, given magnitude of demand increase and role of Small Holder Farmers (SHFs) in highest demand regions

- Priorities clear for evolution of future fertilizers to deliver SF where most needed – yield and micronutrient assurance for SHFs, better economic and environmental impact and more self-reliant sourcing

- Private sector must re-invest in fertilizer enhancements, but must also tackle other aspects of food security

Population in developing regions - urban doubling, rural slowdown

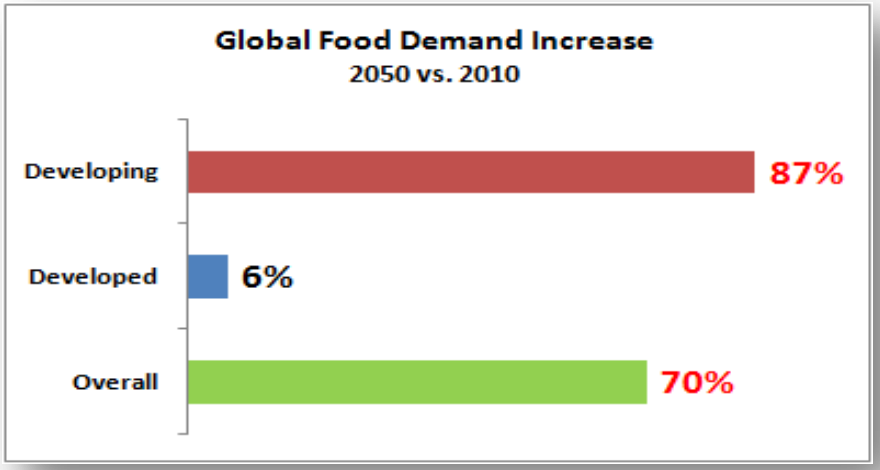


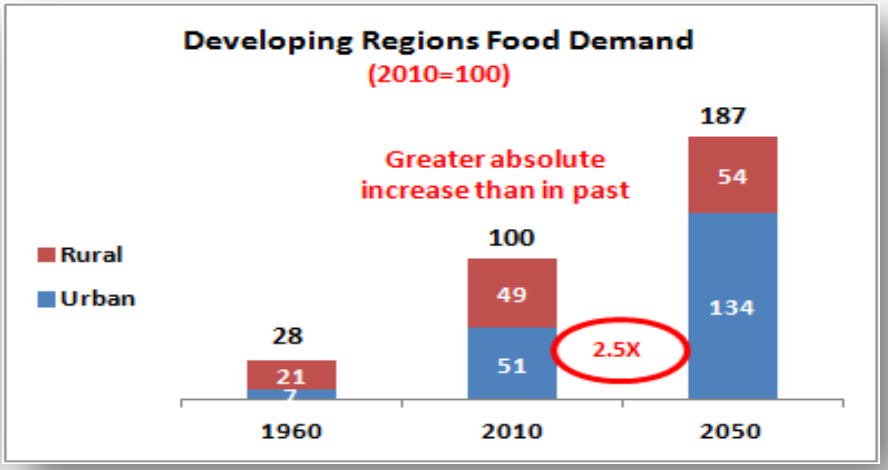


Implications:

- Increased competition for already scarce resources – land, water
- Challenging farmer productivity - 1.5x more urban mouths per farmer

Demand increase - urban growth in developing regions

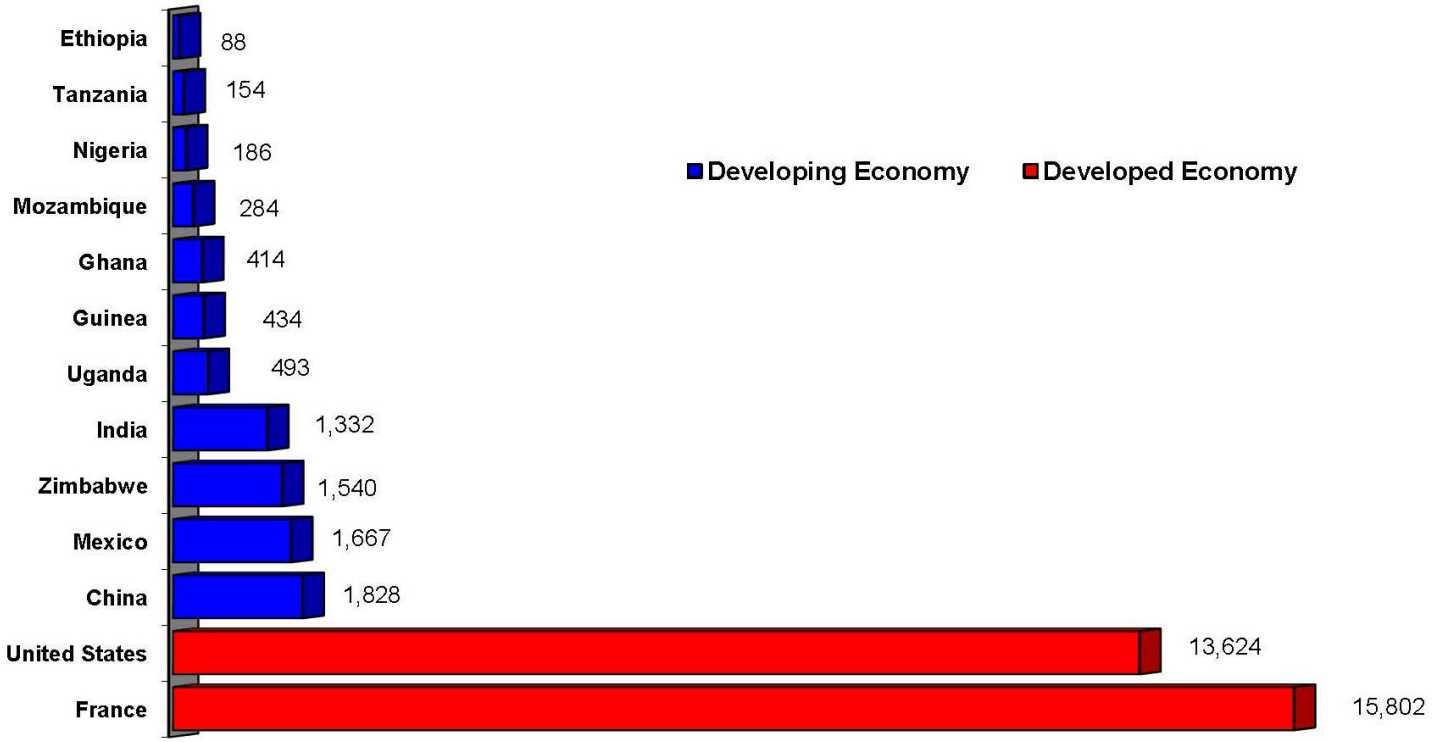




Implications:

- Near doubling of food output under tougher conditions – land, water, climate
- Absolute increase greater than achieved with 'Green Revolution'
- Large infrastructure expansion to move 1.5x more food to urban markets

Paved Roads per Million People (km/million capita)

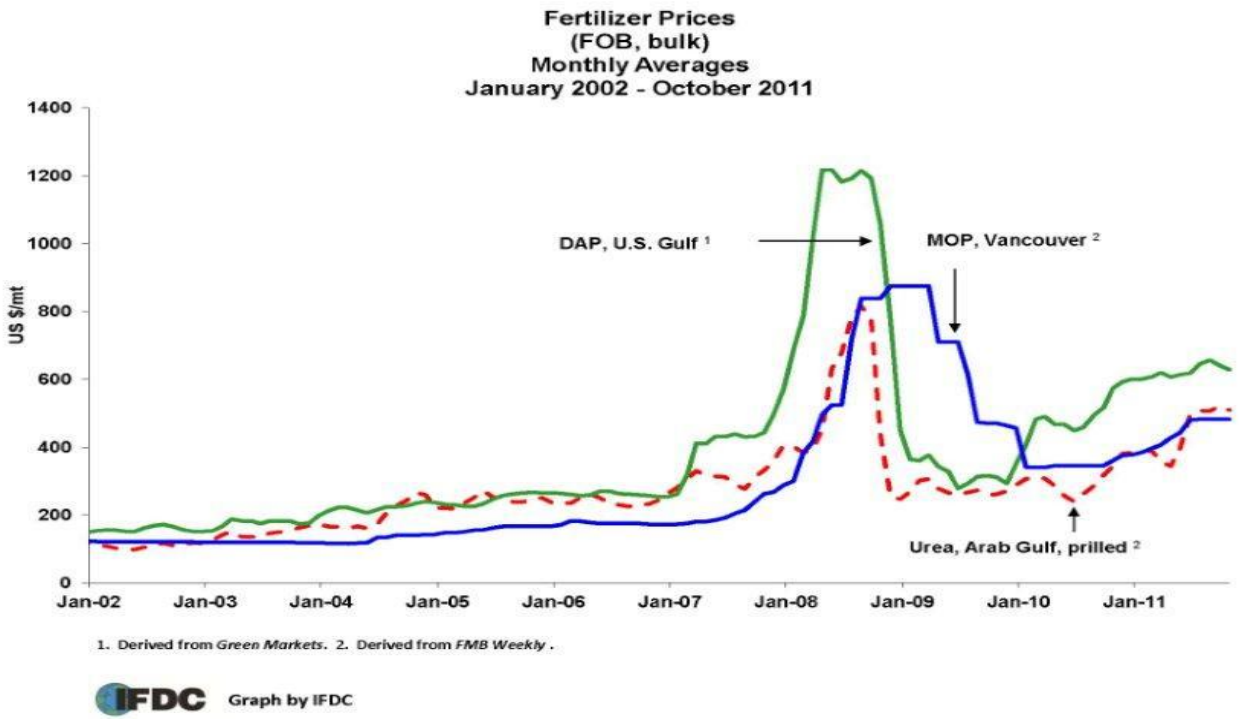


Population figures: http://en.wikipedia.org/wiki/List_of_countries_by_population
Asia paved roads: http://www.adb.org/Documents/Books/Key_Indicators/2009/pdf/Key-Indicators-2009.pdf
US, Africa and Europe road data: https://www.cia.gov/library/publications/the-world-factbook/fields/2085.html

SF - Many Important Facets

- Soil Fertility and fertilizers (mineral and organic) are critical to agricultural productivity
- SF will become even more critical for food security, given magnitude of demand increase and role of Small Holder Farmers (SHFs) in highest demand regions
- Priorities clear for evolution of future fertilizers to deliver SF where most needed – yield and micronutrient assurance for SHFs, better economic and environmental impact and more self-reliant sourcing
- Private sector must re-invest in fertilizer enhancements, but must also tackle other aspects of food security

Fertilizer Price Trend
January 2002-October 2011



Developing regions - majority of global fertilizer usage

Fertilizers

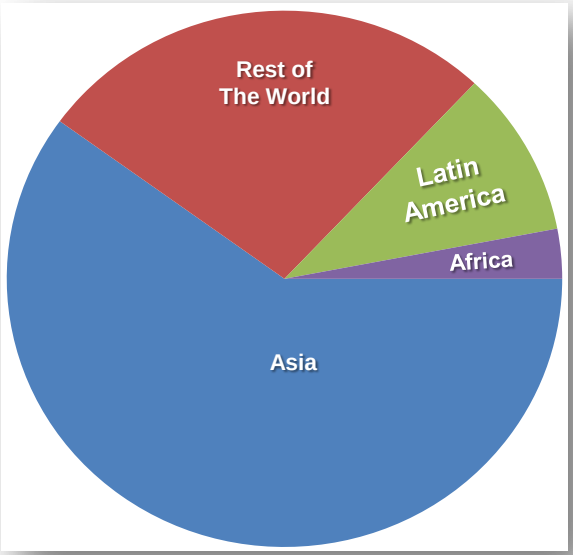
45-50% of yield

US 11%

China 31%

India 13%

Global NPK Consumption 2008/09
162 MMT

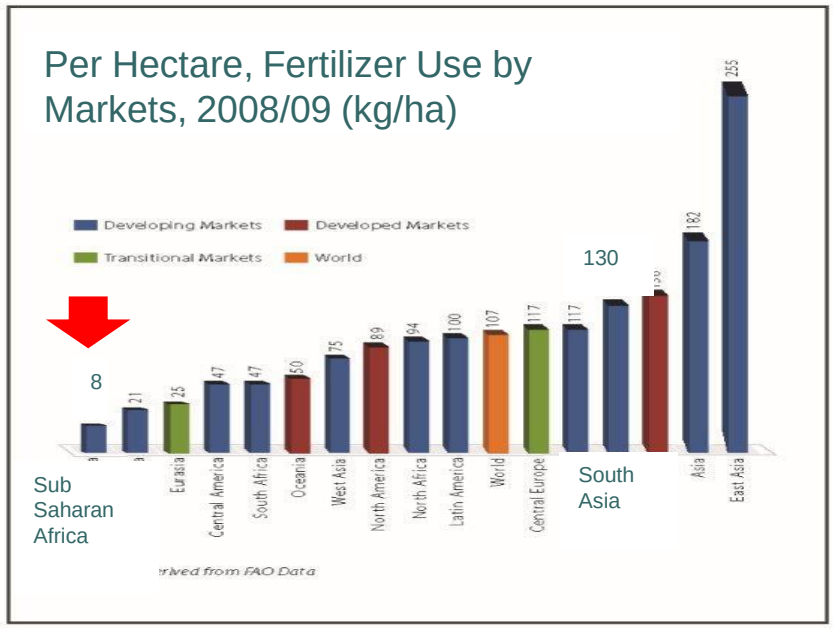


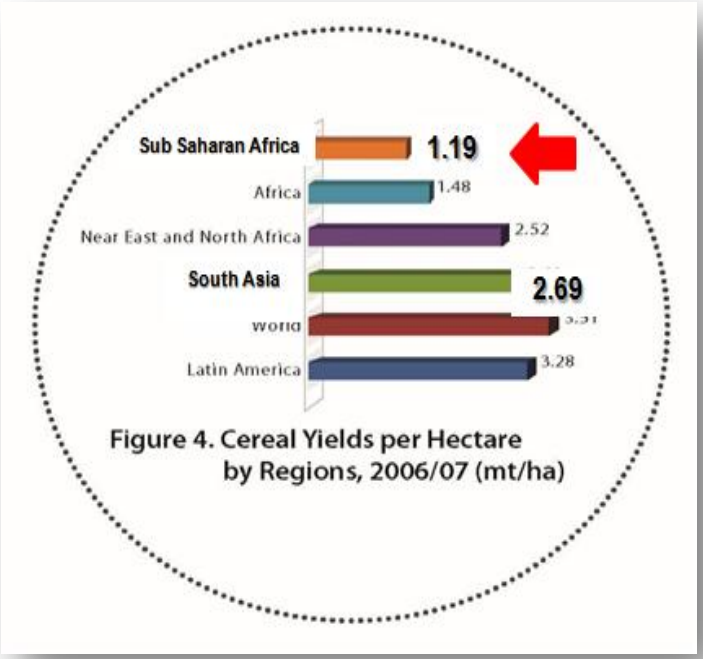
Brazil 6%

Africa 3%

	Millions MT 2009		$ Billions
	Nutrient	Fertilizer	FOB 2010
Nitrogen	105	263	144
Phosphorous	38	95	62
Potassium	21	36	18
Total NPK	**164**	**393**	**224**

Sub-Saharan Africa .... a new fertilizer opportunity

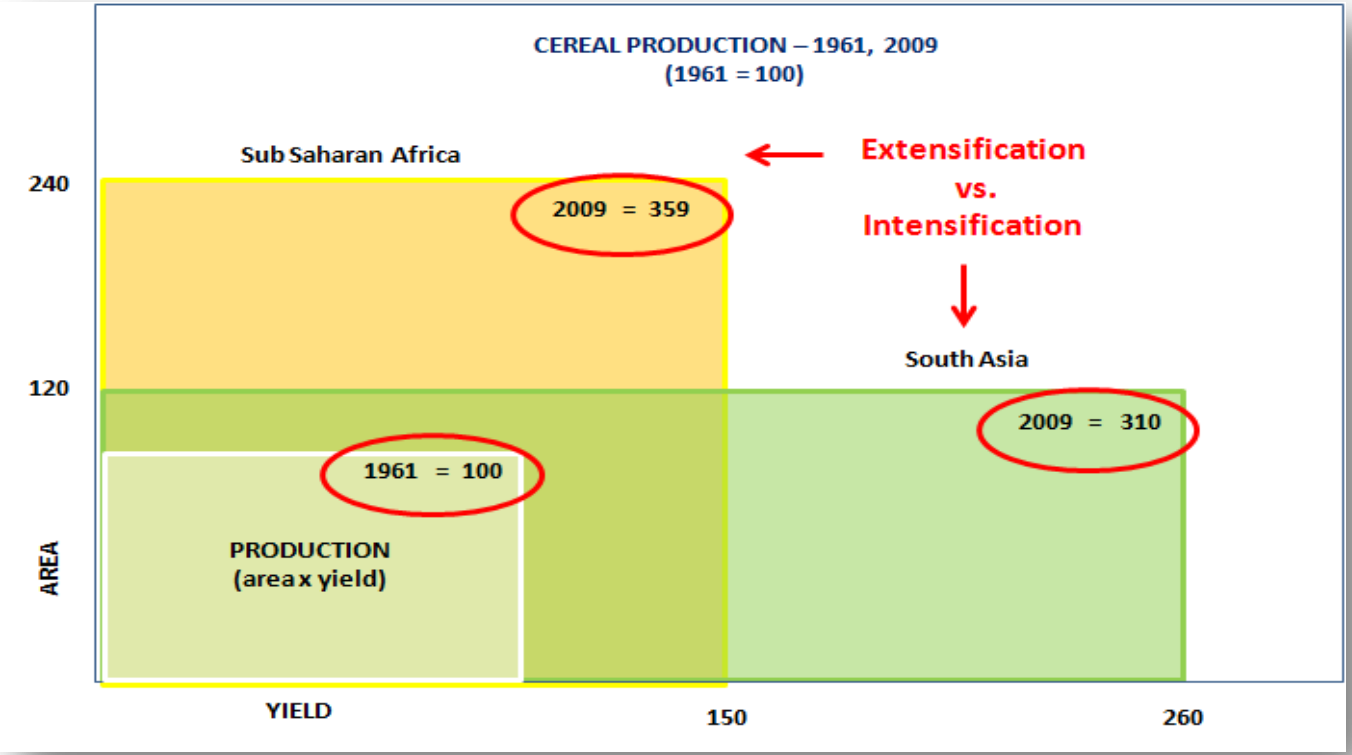




- increased fertilizer usage needed in Sub-Saharan Africa - to reverse historical 'soil nutrient mining' impact, increase yield

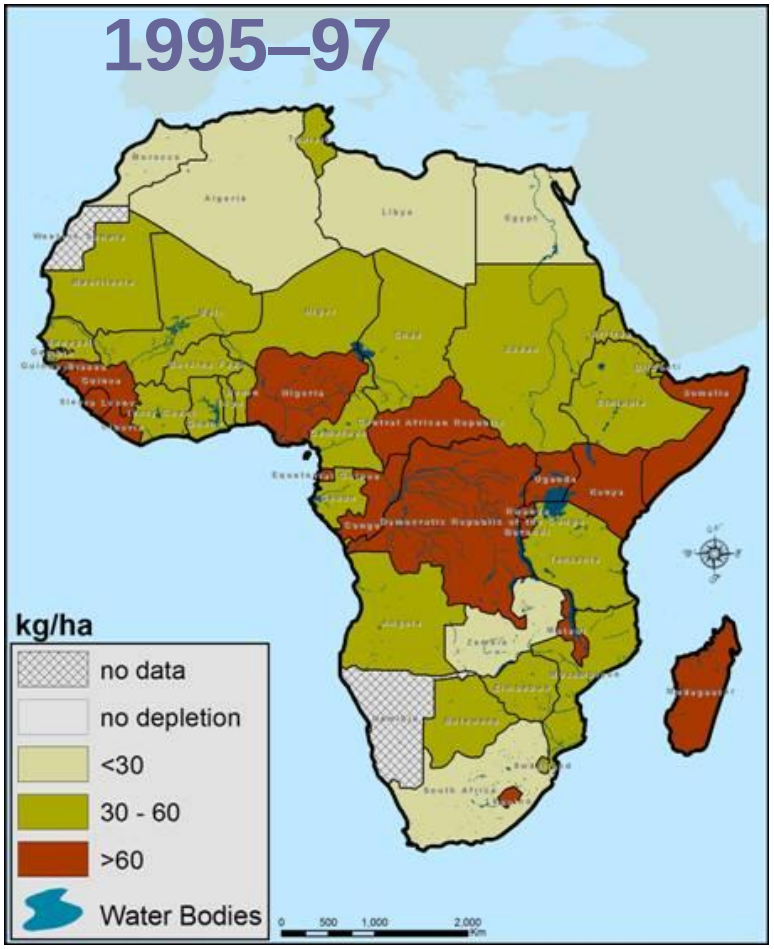
- "Africa Fertilizer Summit" target (50kg/ha) = +25 MMT NPK/ $35 billion FOB per year

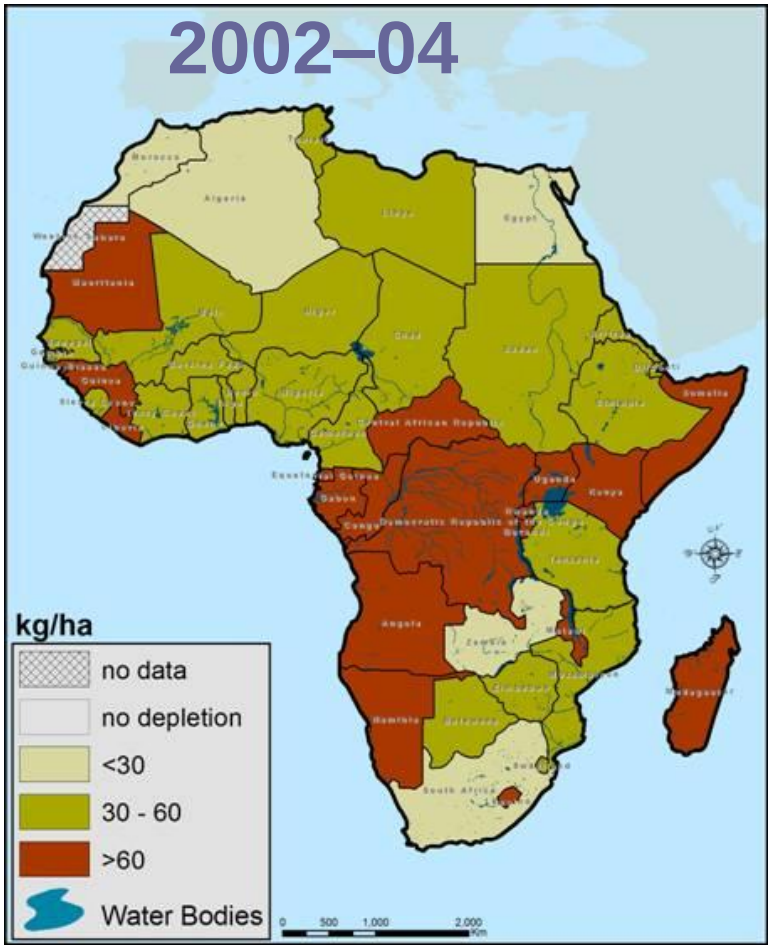
Sub-Saharan Africa .... a special challenge...



Extensification no longer viable in Sub-Saharan Africa – depleted land, diminishing per capita land advantage

Nutrient Mining in Agricultural Lands of Africa



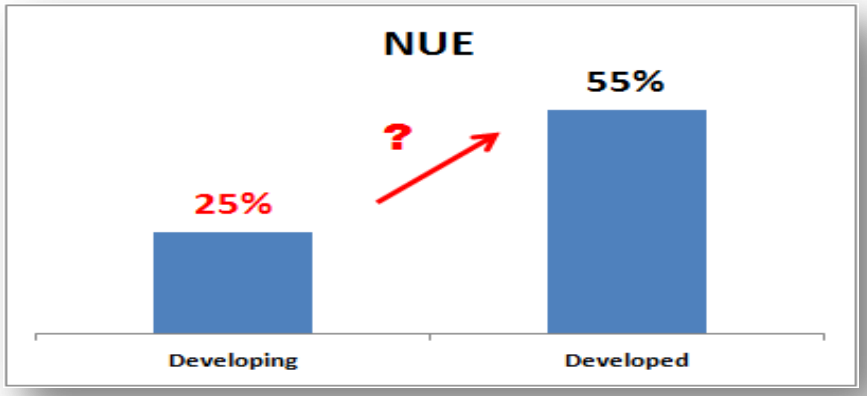


NUE – difficult challenge for smallholder farmers

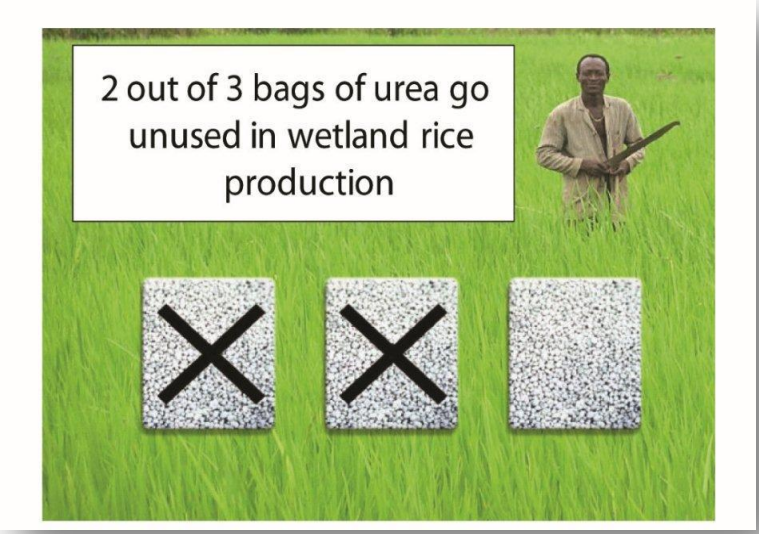
Developing Regions	Developed Regions
• Generally tropical zones – unfavourable for NUE management	• Generally temperate zones – favourable for NUE management
• Unskilled farmers (SHFs), with rudimentary agricultural practices	**• Skilled farmers, with sophisticated agricultural practices**
• Struggle to get NUE above 30%	• Can get NUE in 55-60% range

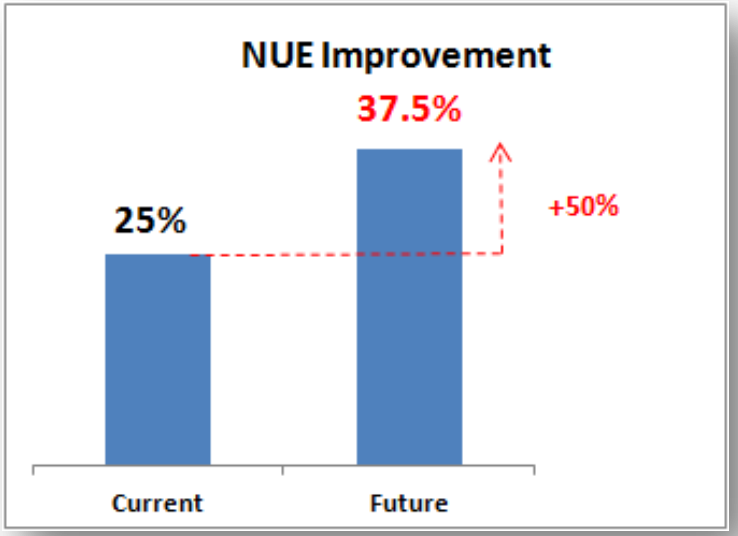
Developing Regions

- **Sub-optimal yield**
- **Loss of fertilizer investment**
- **Large environmental impact**
  - **NOx (N) emissions**
  - **Water pollution**



NUE opportunity example – Urea in developing regions



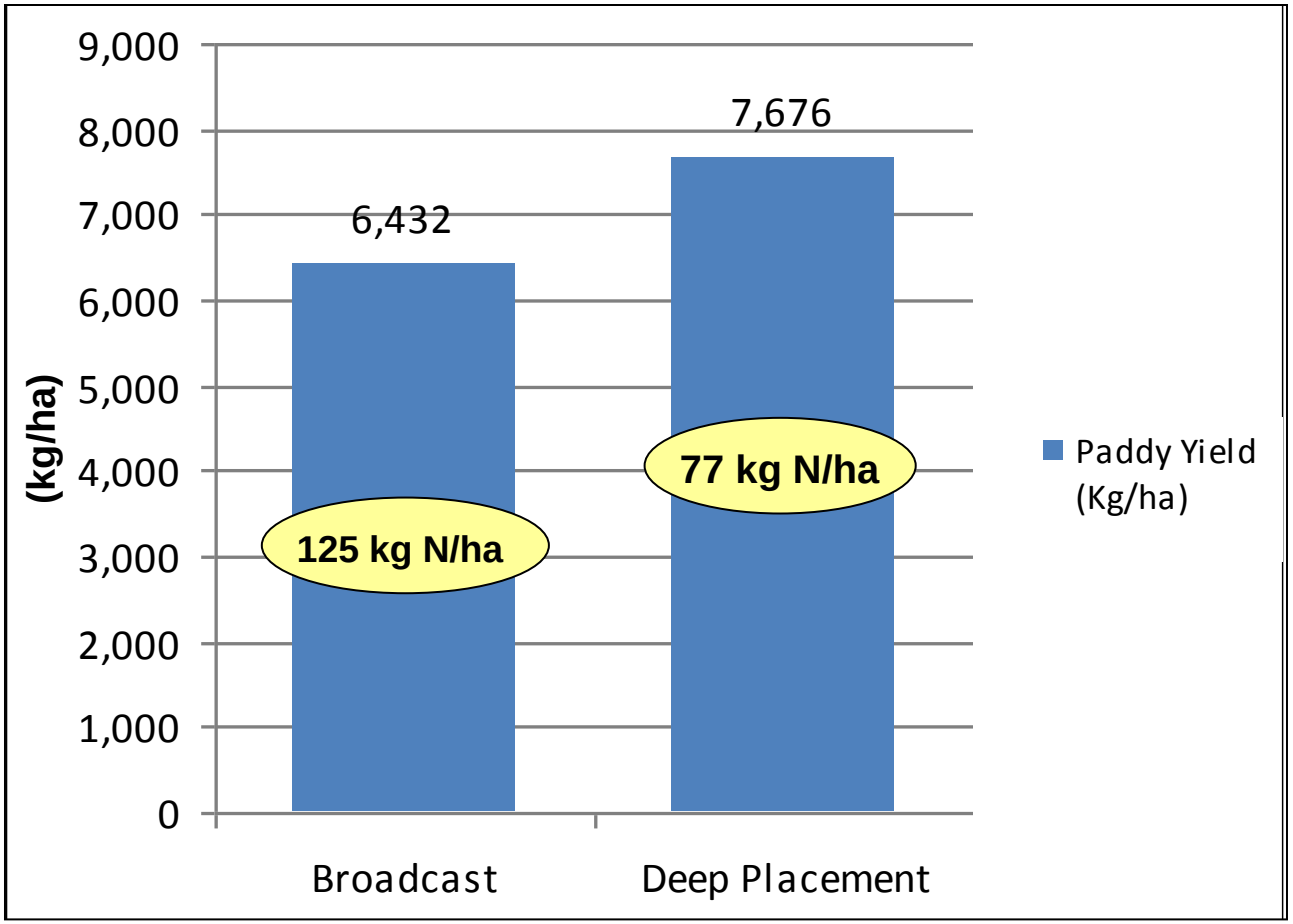


Improved Yield	Investment Productivity	Environmental sensitivity
+15%*	**$7-8 billion per year****	**$1.5 billion/yr carbon tax offset*****
**IFDC UDP experience*	*** @100 MMT urea per year currently*	**** $25/MMT CO2 GHG equivalent*

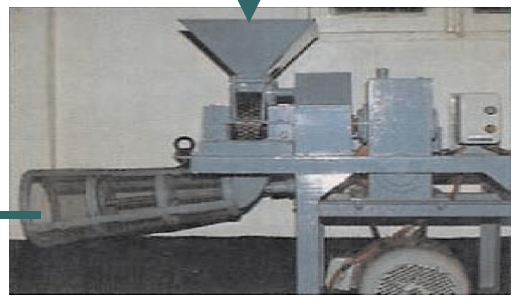
A Simple Technology

Urea Deep Placement

Bangladesh



Prilled Urea



Briquette Machine for USG

USG

Opportunities in fertilizer sourcing

N fertilizers

- **Prevalent Haber-Bosch method** uses natural gas for H feedstock
  - Ties pricing to globally traded non-renewable fossil fuel
  - 'Forces' importation by gas-poor countries (e.g. India)
- **Complex capital-intensive facilities** disallow dispersed production points closer to markets

P fertilizers

- **Prevalent phosphoric acid method** uses high-grade phosphate rock
  - 50% nutrient recovery
  - Inefficiencies imbedded in fertilizer price
  - Large waste streams
- **Locally available phosphate rock** (e.g. In Africa) generally uneconomic with current technology

- **Greater self-reliance – local feedstock (hydrogen, phosphate rock)**
- **Improved economics – higher recovery efficiencies, lower capital intensity**
- **Smaller environmental footprint – lower waste streams**

Fertilizer Technology Priorities

New 'intelligent' fertilizers

- Fail-safe
- Adaptive
- Eco-sensitive
- Economical

Over the next decade: Focus on N&P in South Asia and Sub-Saharan Africa

- Improve NUE by 25-50%
- Reduce the risk of failed yields for Smallholder Farmers
- Increase the convenience and accuracy of delivering secondary and micro nutrients
- Reduce sourcing costs, increase self-reliance with improvements or alternatives to current production processes

Responsible, sustainable food security

- Higher, more assured yield at lower cost
- Smaller environmental footprint
- Improved human health
- Greater nutrient self-reliance

SF - Many Important Facets

- Soil Fertility and fertilizers (mineral and organic) are critical to agricultural productivity
- SF will become even more critical for food security, given magnitude of demand increase and role of Small Holder Farmers (SHFs) in highest demand regions
- Priorities clear for evolution of future fertilizers to deliver SF where most needed – yield and micronutrient assurance for SHFs, better economic and environmental impact and more self-reliant sourcing
- Private sector must re-invest in fertilizer enhancements, but must also tackle other aspects of food security

Foster broad co-operation

- **Multi-disciplinary expertise**
  - Agri- and non-agri- sciences
  - Production, sourcing
  - Commercial operations
- **Current and potential stakeholders**
  - Academia, research institutions
  - Industry, other businesses/entrepreneurs
  - Governments, extension agencies, farmers
- **Public-private partnerships**
  - Supportive priorities and policies
  - Funding and incentives

Facilitate a co-ordinated program

- **Multiple initiatives** over time supporting a common agenda
- **Multiple 'partner teams'** in several locations
- **Differing timelines** for development and commercialization
- **Many distinct jurisdictions** for 'review and approval'
- **Many financing sources** and approaches (funding, in-kind)

Virtual Fertilizer Research Center (VFRC)

- Managed under IFDC
- Led by global Board of Advisors
- Supported by Advisory Committees

VFRC VISION

The world's smallholder farmers have ready access to sustainable, affordable, efficient and environmentally friendly fertilizers.

VFRC MISSION

Through collaborative research and development, the VFRC will help develop and introduce the next generation of the world's fertilizer products and technologies necessary to benefit smallholder farmers in the developing world.

Fertilizers and Soil Fertility

New 'intelligent' fertilizers

- Fail-safe
- Adaptive
- Eco-sensitive
- Economical

Goal for developing regions

Responsible, sustainable soil fertility management and food security

Issues for Dialogue

- Private Sector - Future business model
  - Partnership with research institutions to develop next generation of fertilizers - suited to crops and agro climatic conditions for smallholder farmers
  - Support infrastructure development – agro-inputs, market access
  - Market development facilitation, especially credit and adoption support

Issues for Dialogue

- Public Sector
  - Infrastructure
    - Roads to efficiently move inputs to farms and output to markets
    - Communication networks for timely access to market information
  - Policies
    - Price regimes for inputs and outputs
    - Credit facilitation
    - Quality assurance and specification for inputs

Thank You