Innovation

Global Research and Development Opportunities to Advance Technologies

Presented at the
Fertilizer Industry Round Table Conference
Innovation: Growing Solutions Through Technology

by
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Today's Discussion

- **Past accomplishments in food production**
- **Technology opportunities for fertilizers**
- **An agenda for moving forward**

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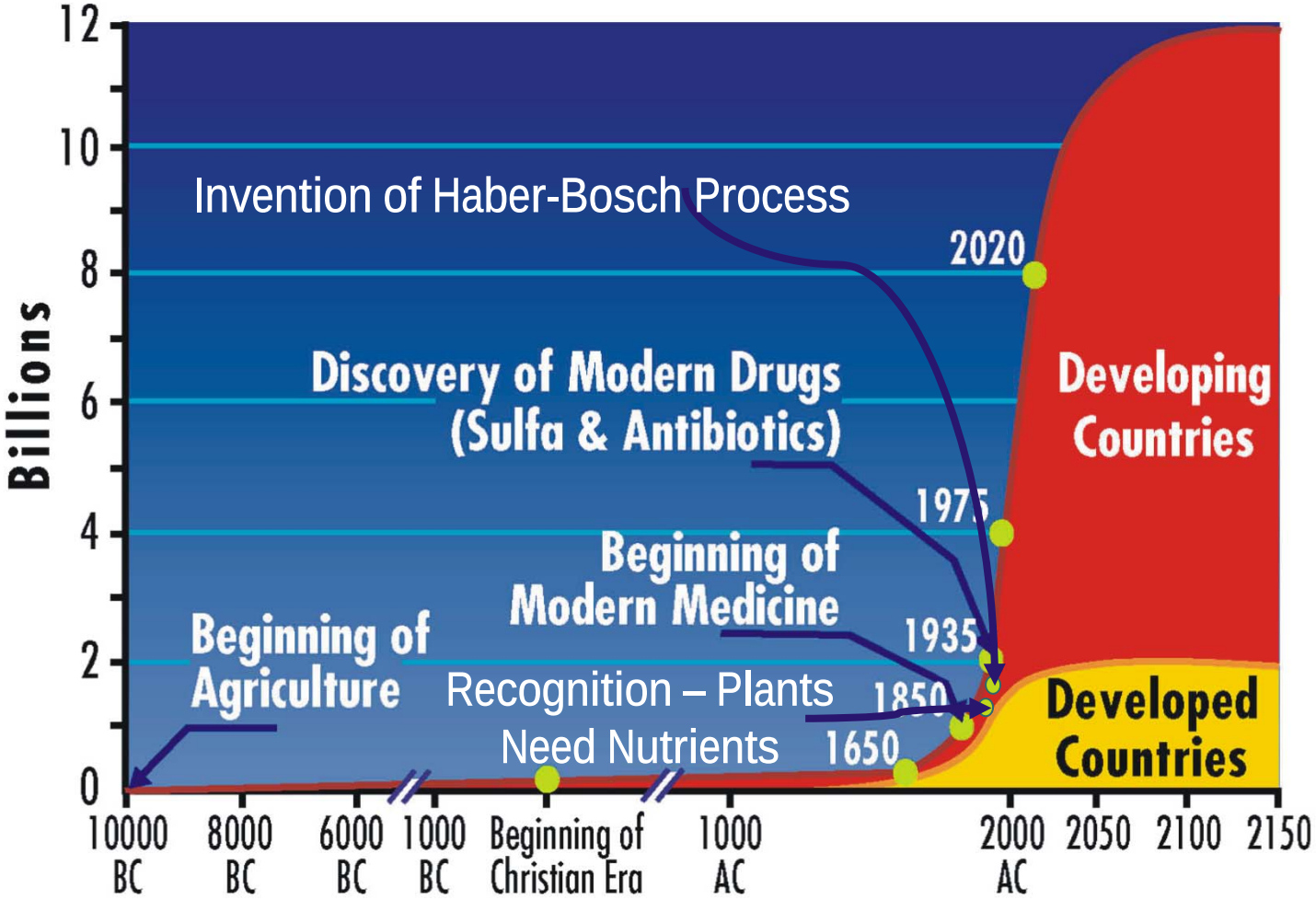
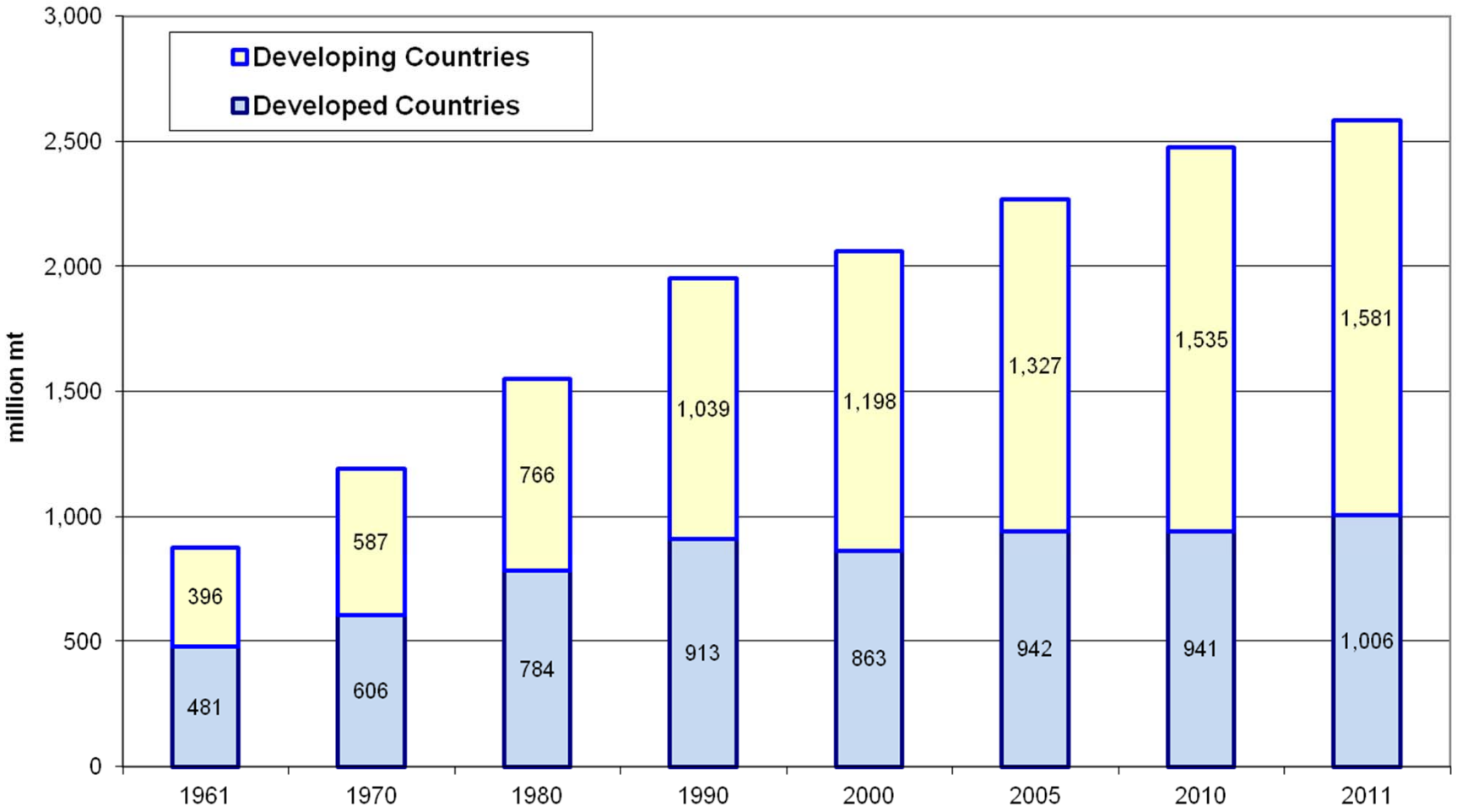
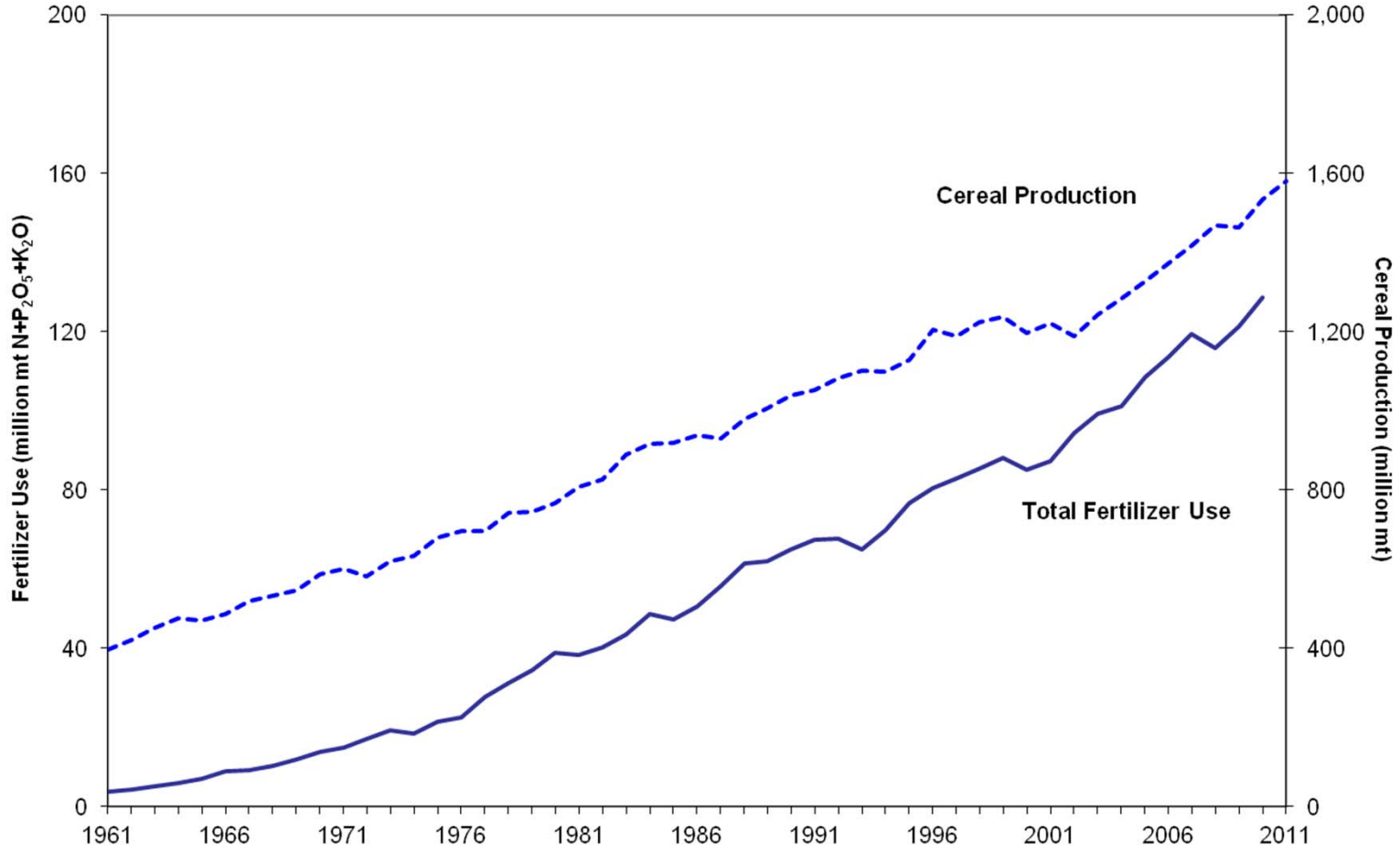
World Population Growth



Cereal Production in Developed and Developing Countries, 1961-2011



Developing Countries: Total Cereal Production and Total Fertilizer Use, 1961-2011



Developing Regions – Majority of Global Fertilizer Usage

Fertilizers

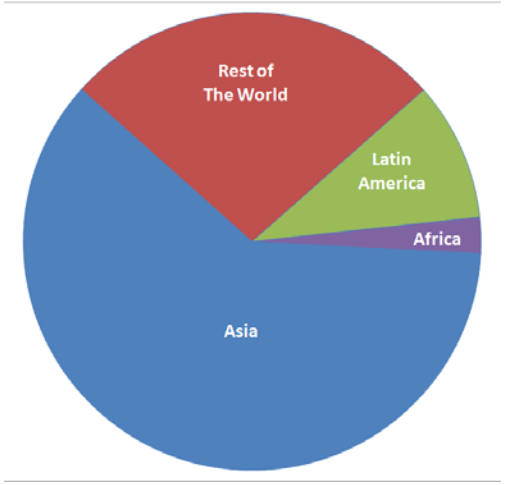
45-50% of yield

US 11%

China 32%

India 16%

Global NPK Consumption 2011
200 MMT

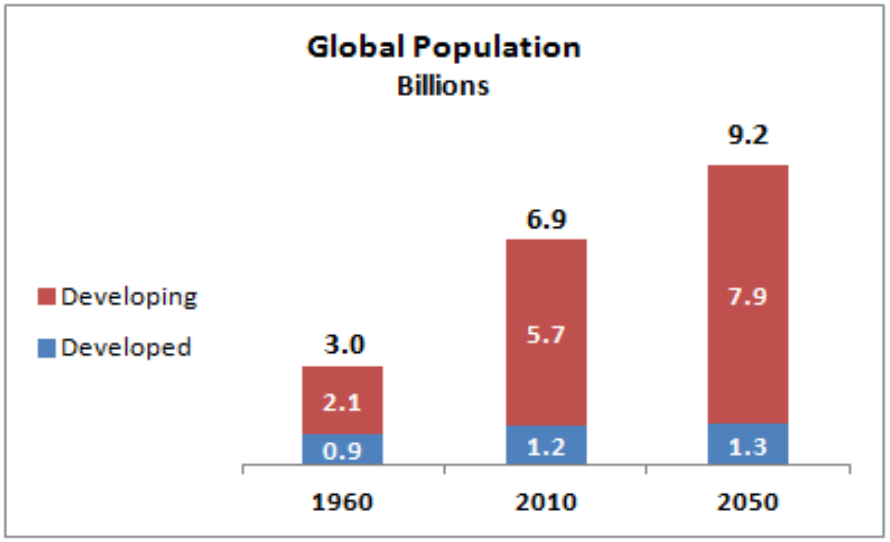


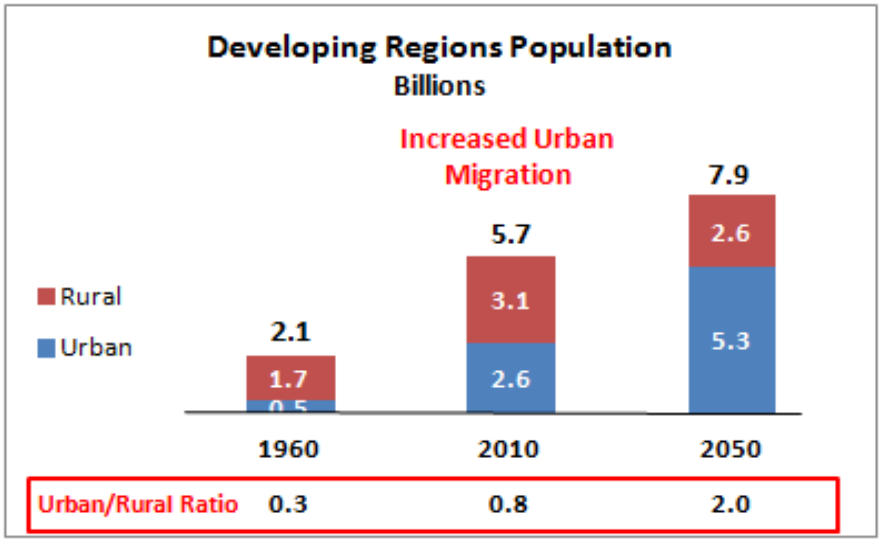
Brazil 6%

Africa 3%

Role of the fertilizer industry has been crucial to achieving this level of food production.

Population in Developing Regions – Urban Doubling, Rural Slowdown

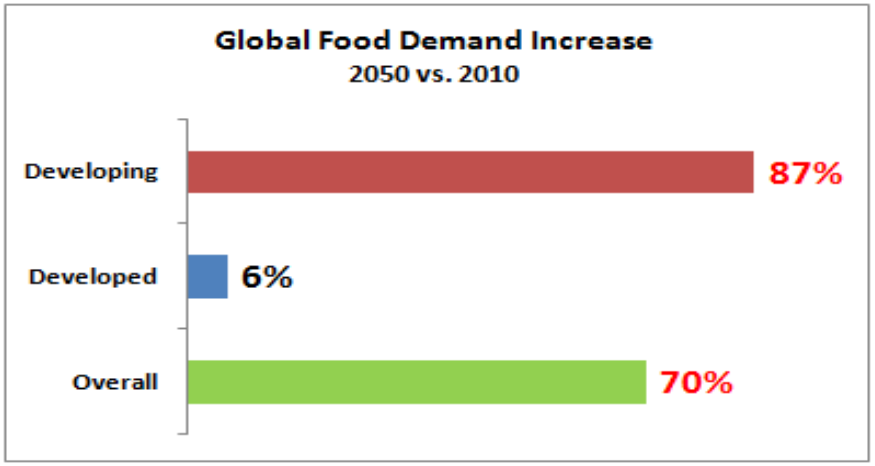


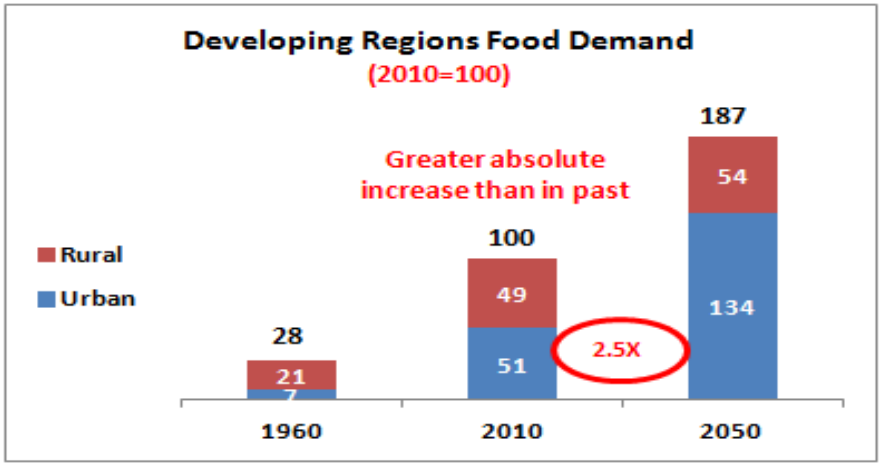


Implications:

- **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:

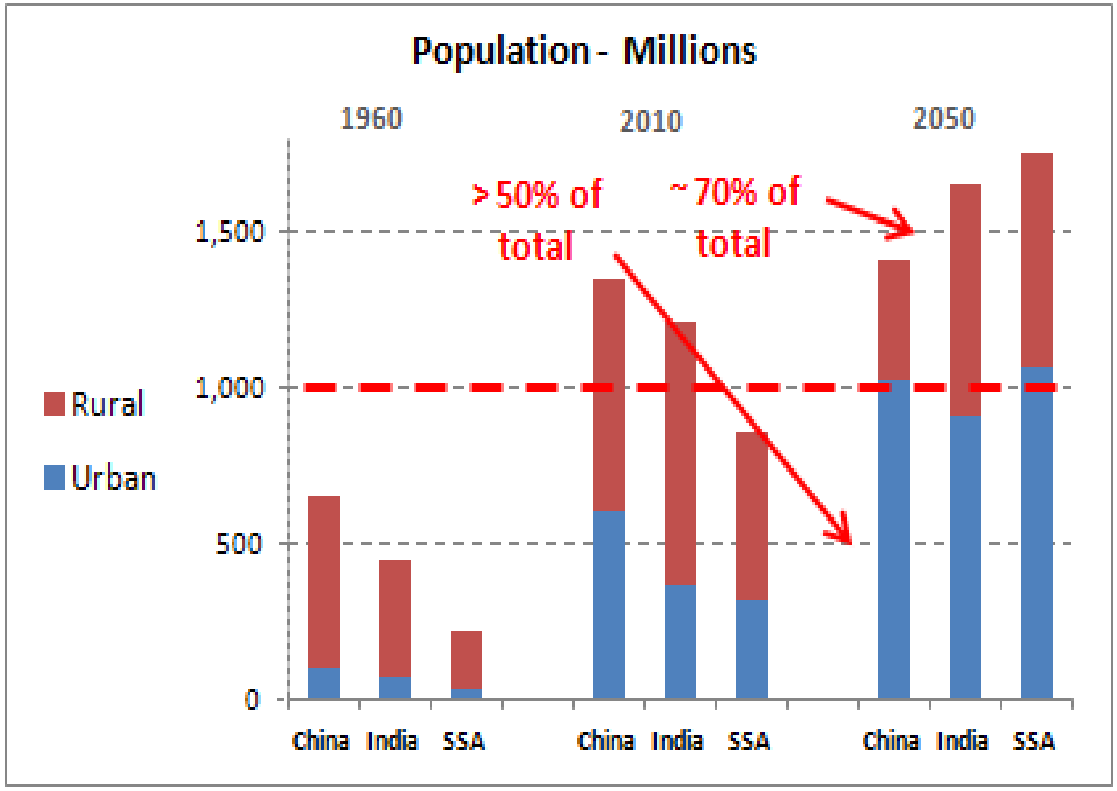
- **Near doubling of food output under tougher conditions – land, water, climate**
- **Absolute increase greater than achieved with 'Green Revolution'**
- **Large infrastructure expansion to move 1.5x more food to urban markets**

To meet demand, global food production must **increase by 60-70% by 2050** using less land and water resources without polluting the environment.

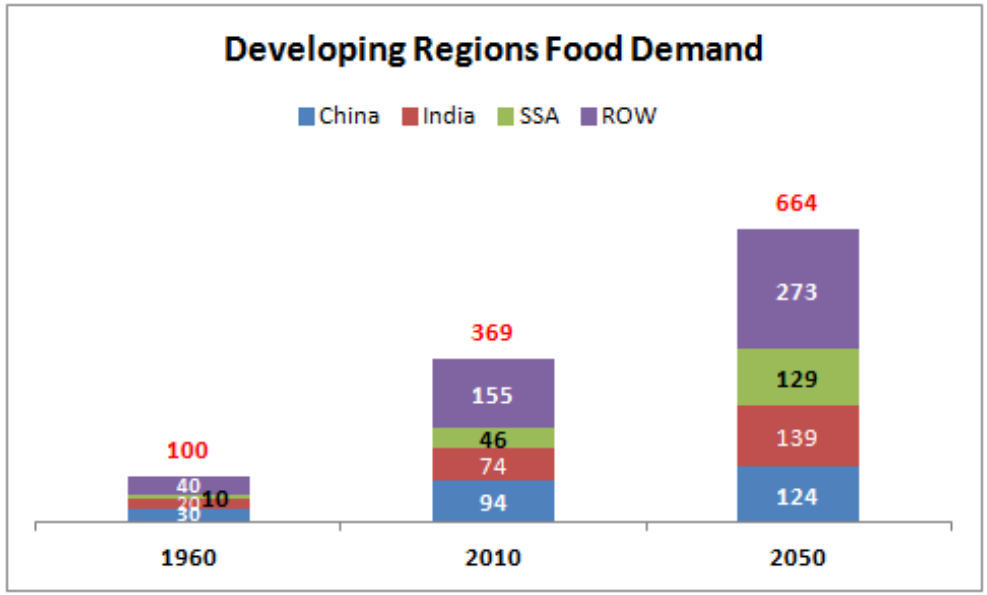
‘Billion Plus Club’ – Key to Developing Regions

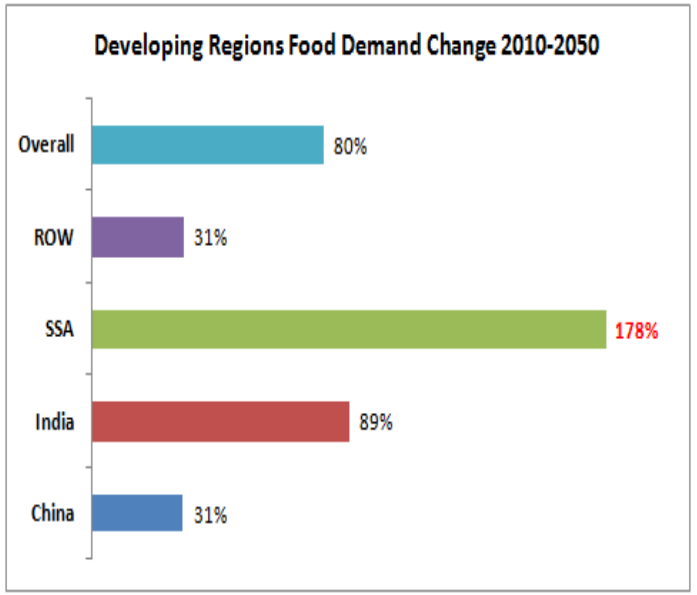
Different challenges:

- China – Rapid urbanization, already high urban/rural population
- India, Sub-Saharan Africa – large urban shift, large marginal population



Developing Regions Food Demand Scoping

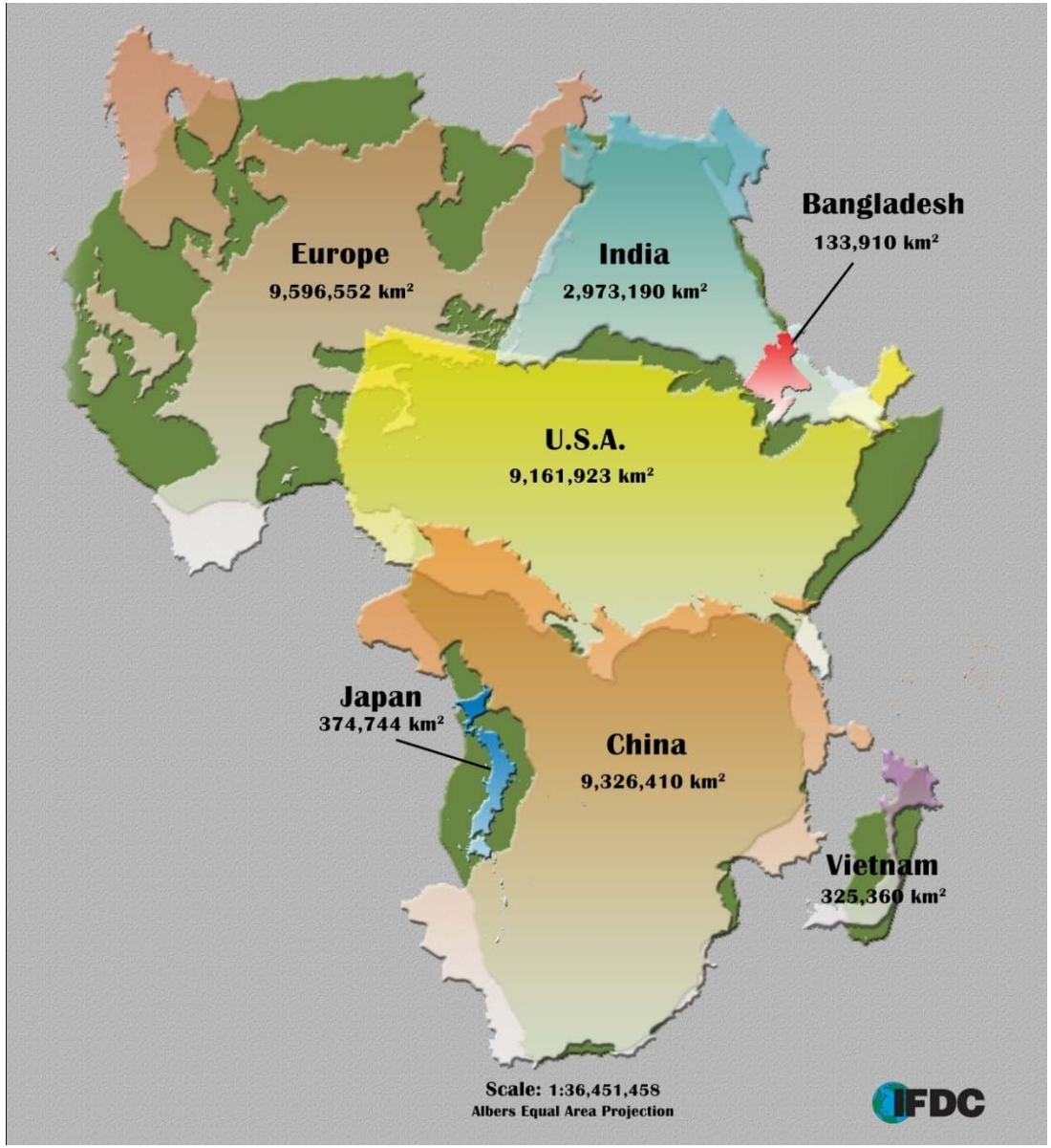




SSA's food demand – could match China and India by 2050?

SSA and India – major productivity challenges if land is scarce

The Enormity of Africa



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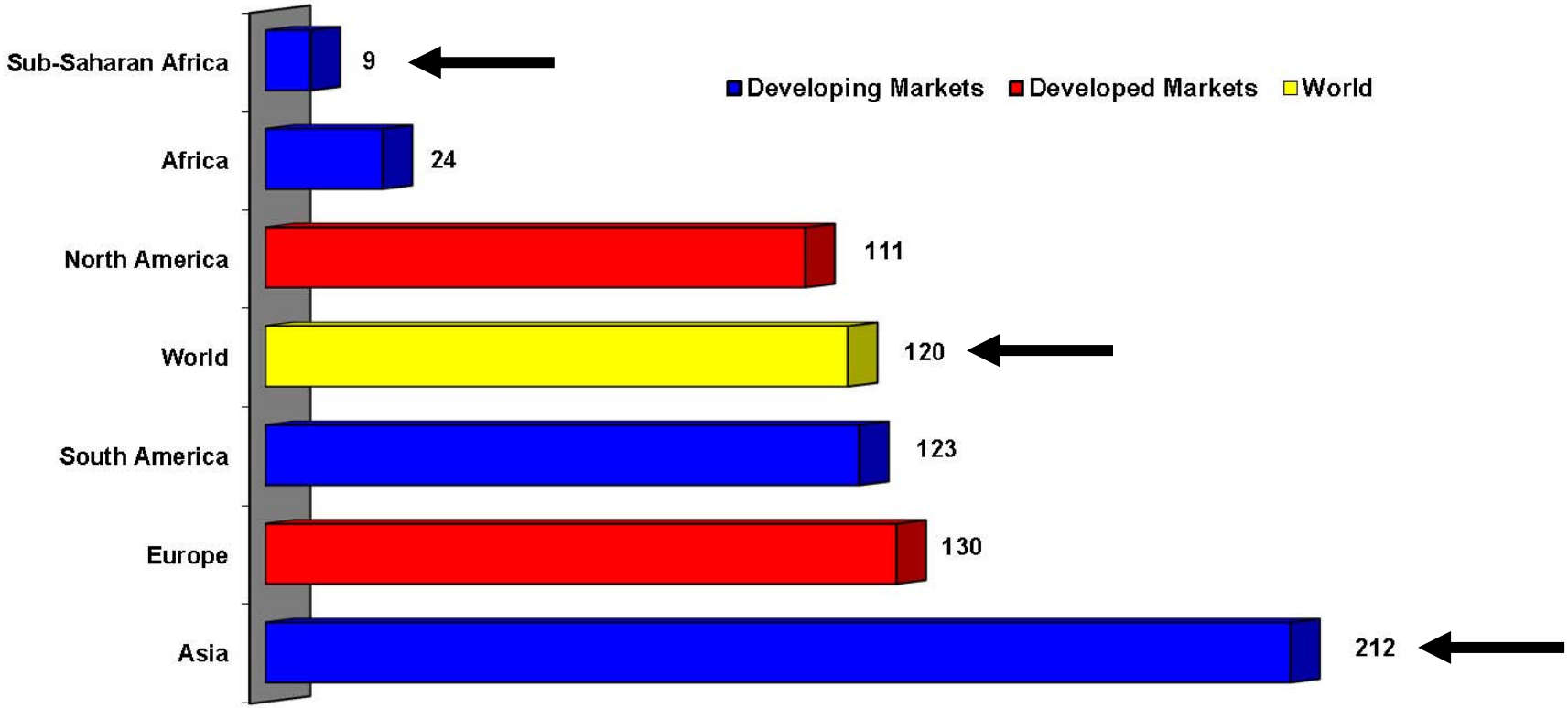
Today's Discussion

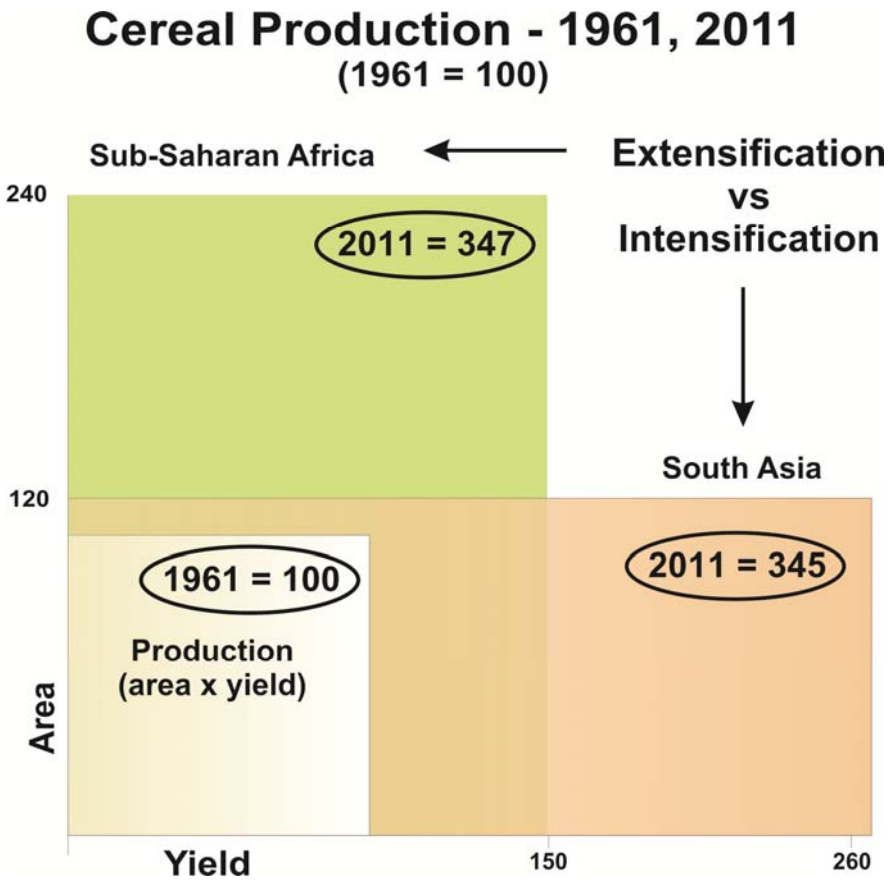
- Understanding the food challenge – 2010-2050
- Technology opportunities for fertilizers
- An agenda for moving forward

Per Hectare Fertilizer Use by Markets 2011 (kg/ha)



Source: Derived from FAO data.

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



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

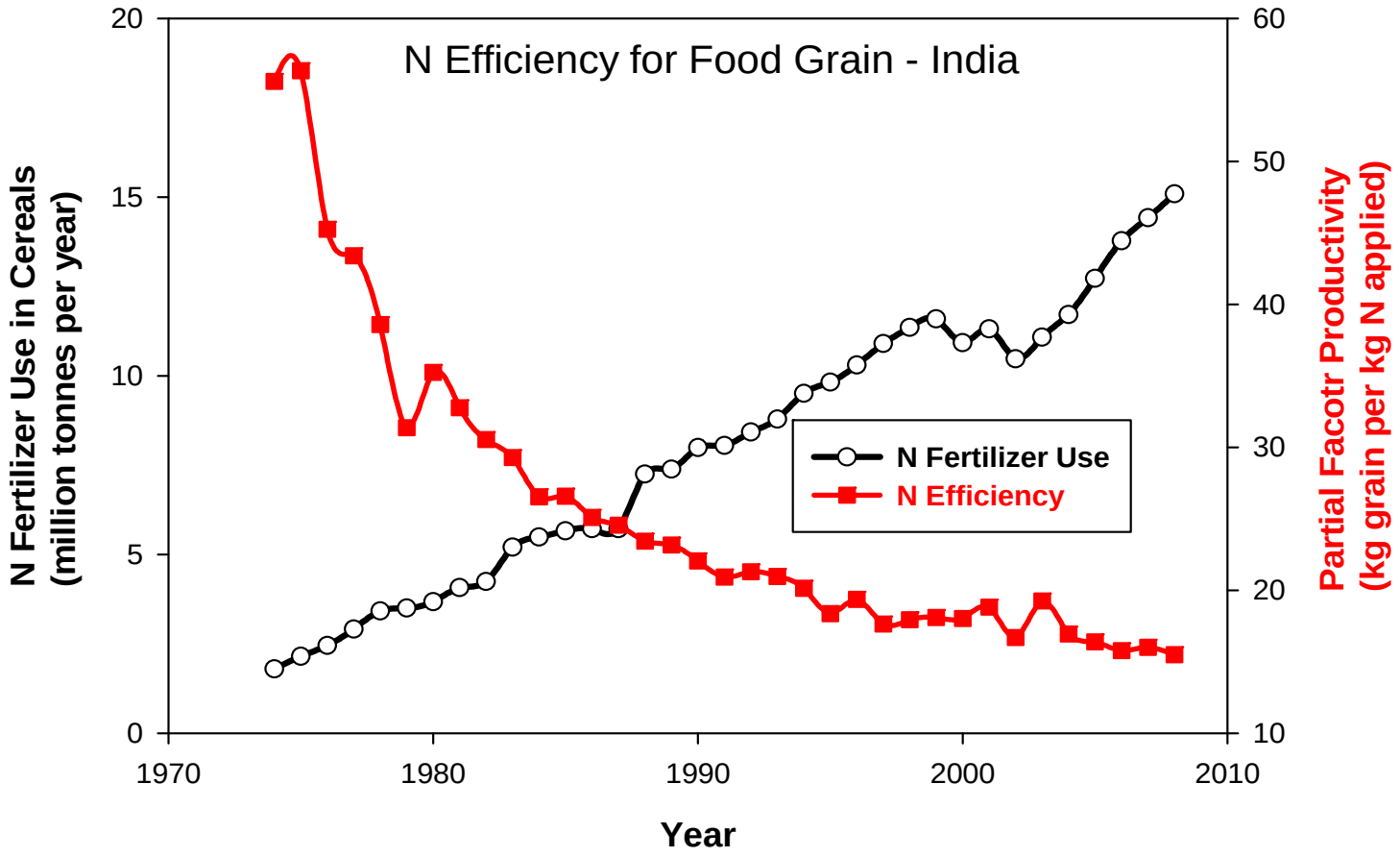
To Reach Yield Targets

Appropriate and more fertilizers

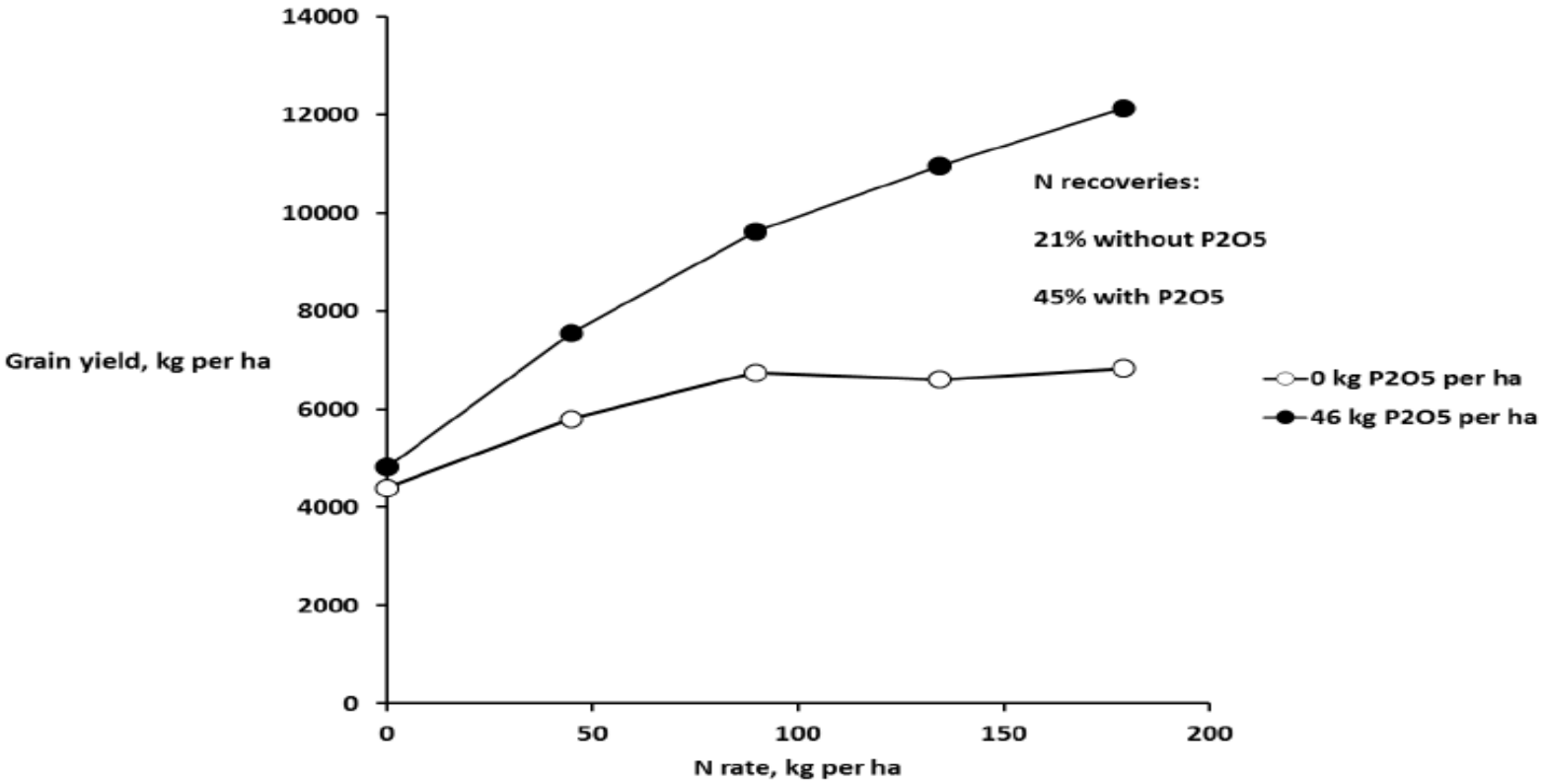
Better seeds

Better resources management

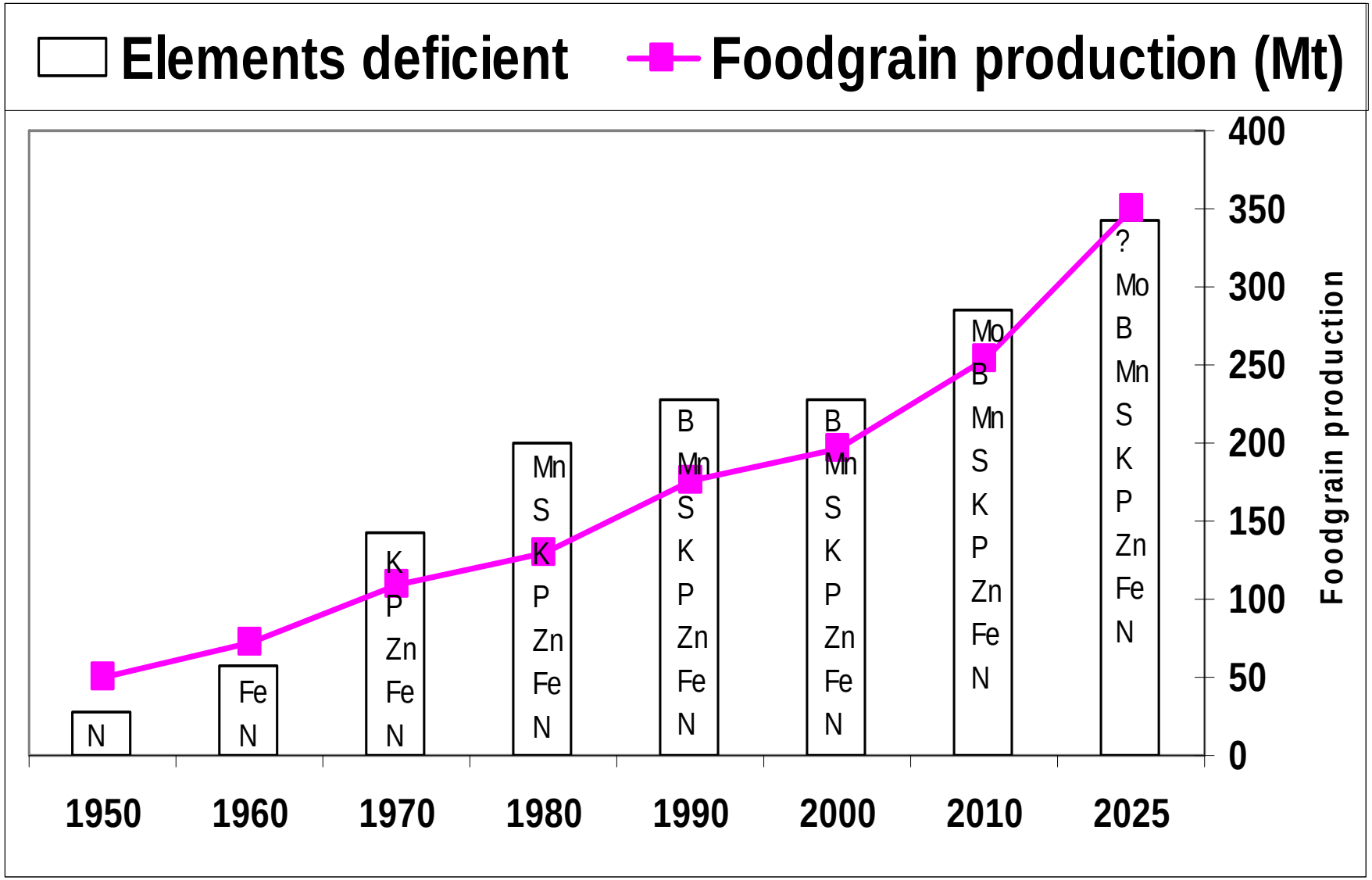
Nitrogen Consumption and Efficiency India



Synergy



Interaction between N and P application rates in irrigated continuous corn production in the Great Plains (Schlegel and Havlin, 1995)



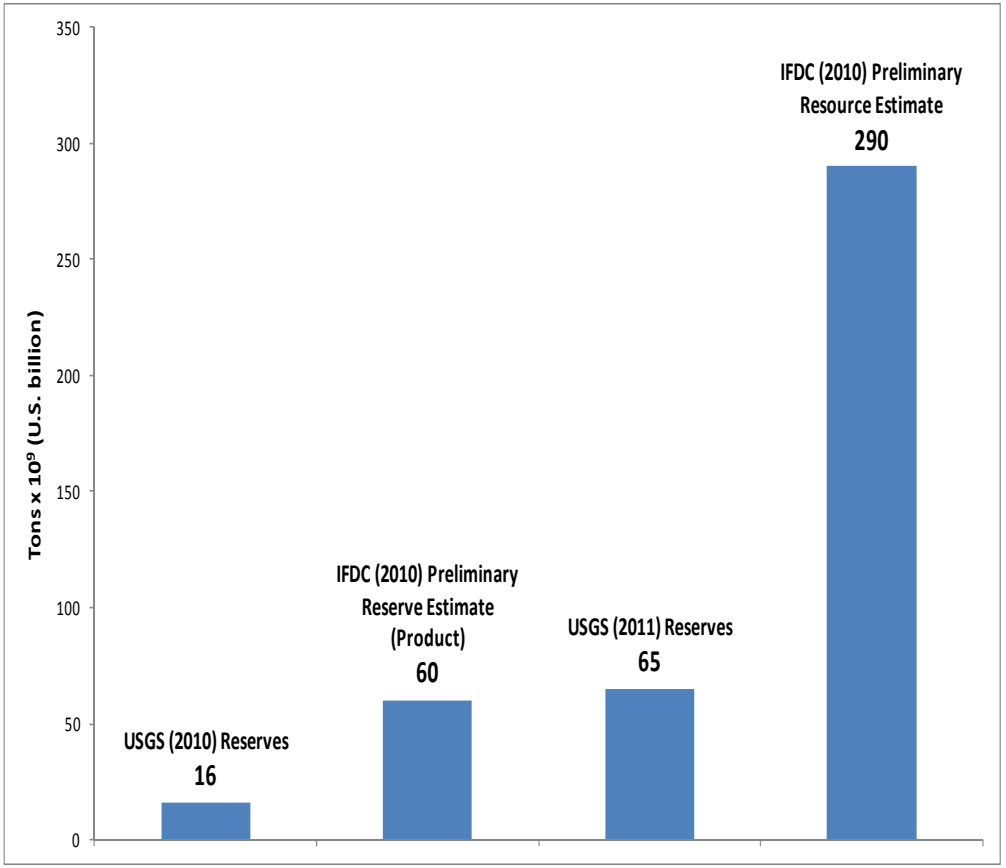
Source: Singh, A.K., 2011

Consequences

- Lower productivity
- Economic loss for the farmers
- Economic burden to the government
- Waste of energy
- Air and water pollution
- Loss of biodiversity

Phosphate Rock Reserves and Resources

- Phosphate Rock is a finite resource
- Current estimates indicate 300-400 years
- Need to improve efficiency of extraction of P from ore and recycle P from wastes



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- **Technology opportunities for fertilizers**
- **An agenda for moving forward**

The world needs new ways to deliver nutrients to crops:

- More economical
- More efficient
- Better for environment

What are the Bottlenecks?

To developing new fertilizers

Lack of investment in fertilizer research

Industry's Technology Focus – Optimization

FERTILIZERS

Nutrient Delivery → Plant/In-use Optimization → ? → R&D 1%-2%

SEEDS

Yield Enhancement → Environmental Resistance → Genetic Optimization → R&D 9%

Fertilizers essentially unchanged since early 1980s

A Simple Technology with Multiple Benefits

Urea Deep Placement

UDP: Background and Benefits

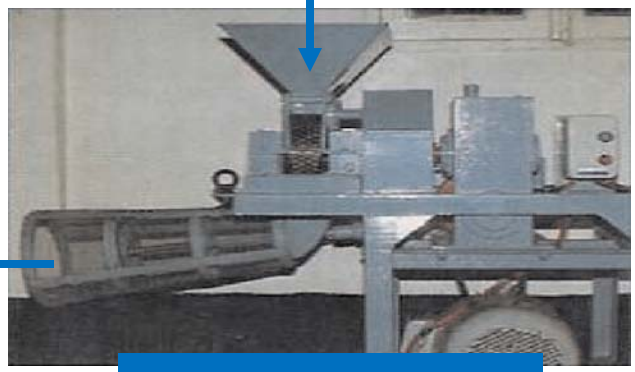
- **1-3 g briquettes (USG)*, in root zone at transplanting**
- **Slower release = nutrient use efficiency improves**
- **Rapidly expanding in Bangladesh, and introduced in several sub-Saharan Africa countries**

*** USG—Urea Supergranule**

How to Prepare USG

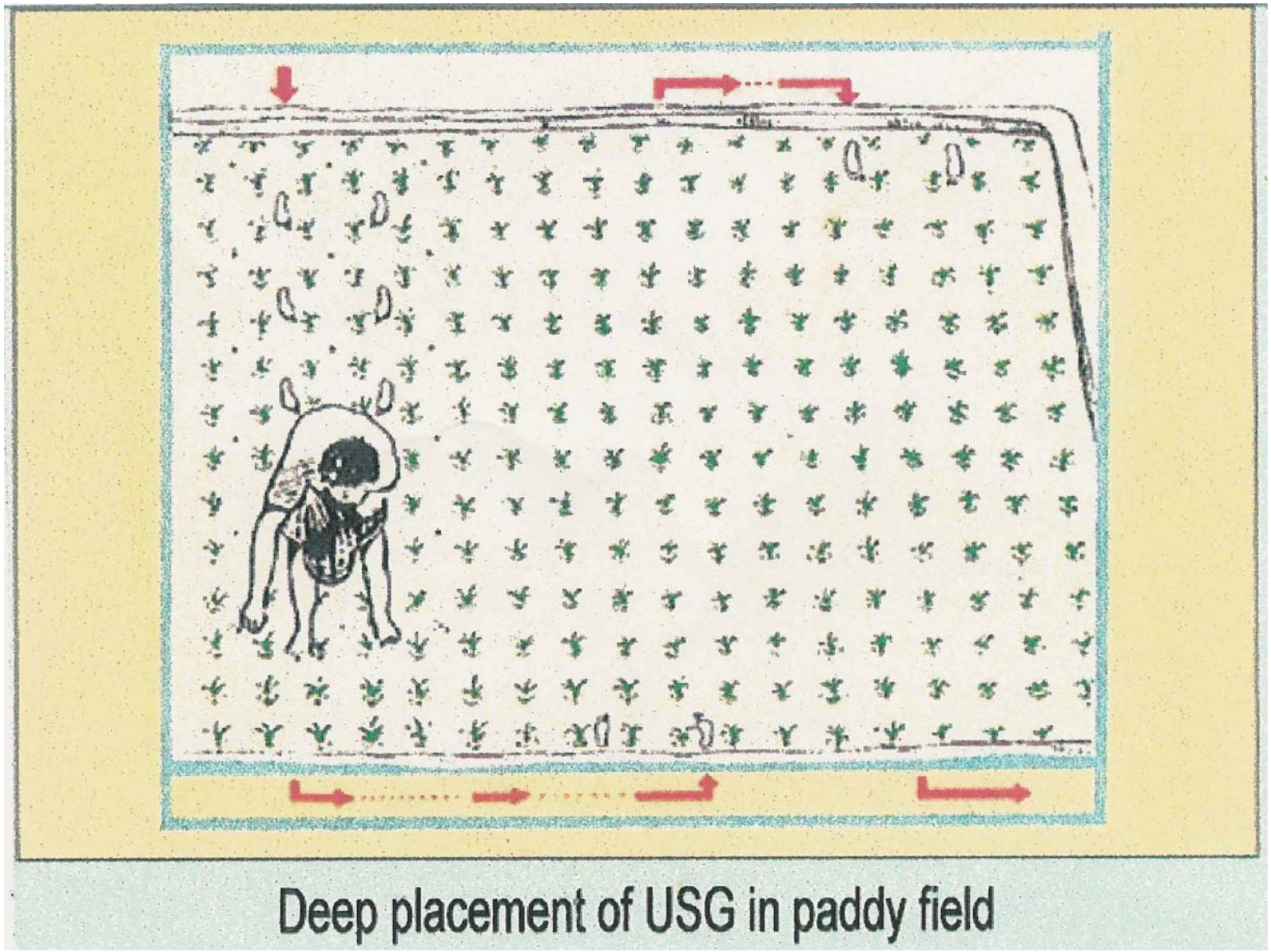
USG is produced from prilled or granular urea by pressing with rollers in a briquette machine to produce granules 1.8 and 2.7 grams

Prilled Urea



Briquette Machine for USG

USG

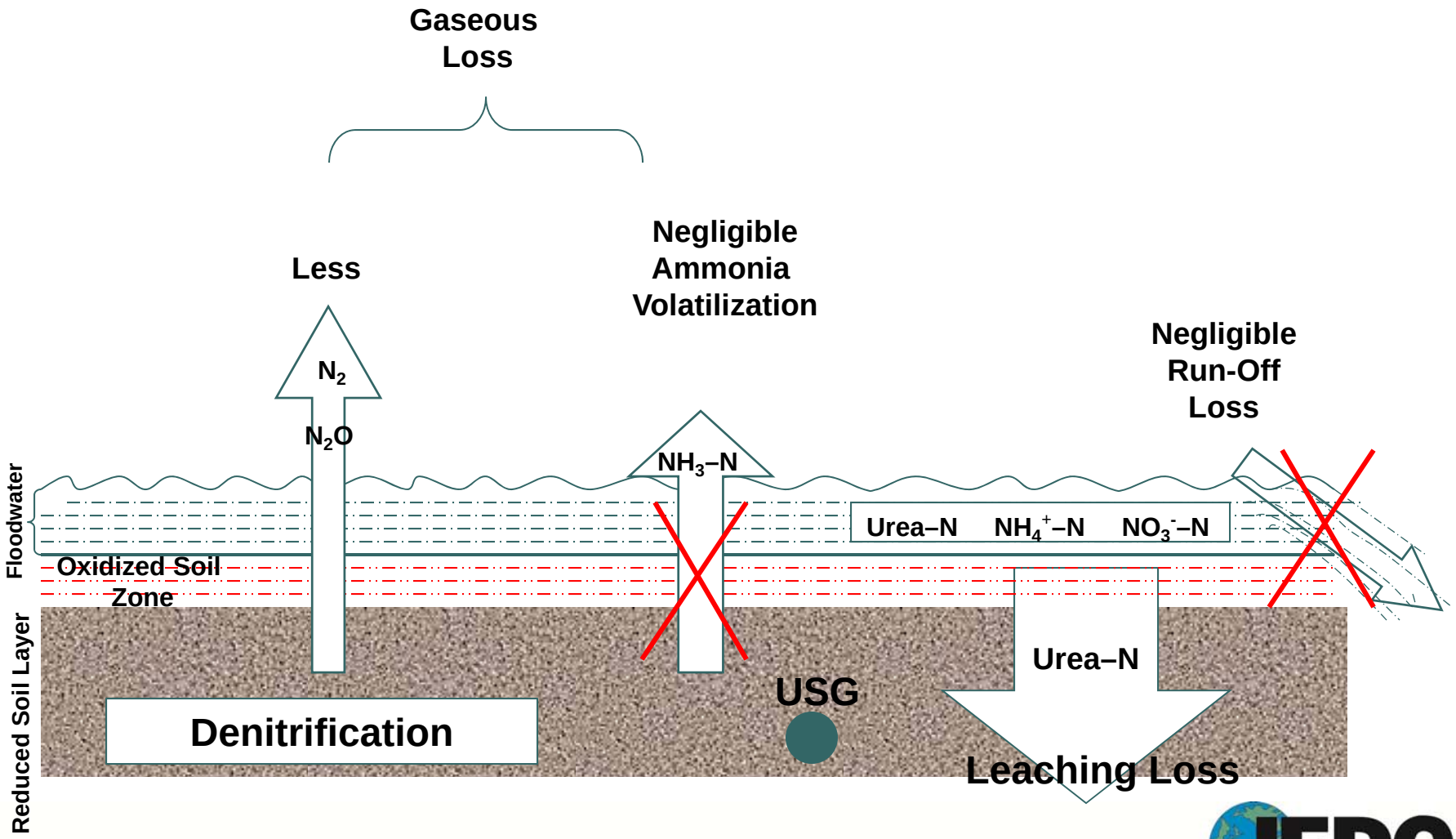


Deep placement of USG in paddy field

Injector-Type Self-Loaded Applicator

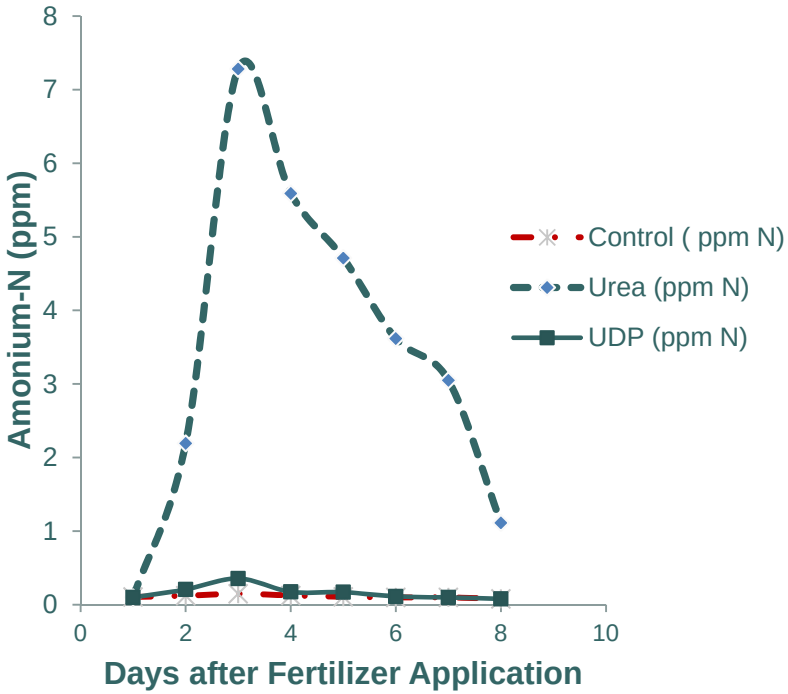
Applicator in Field Operation

Urea Deep Placement

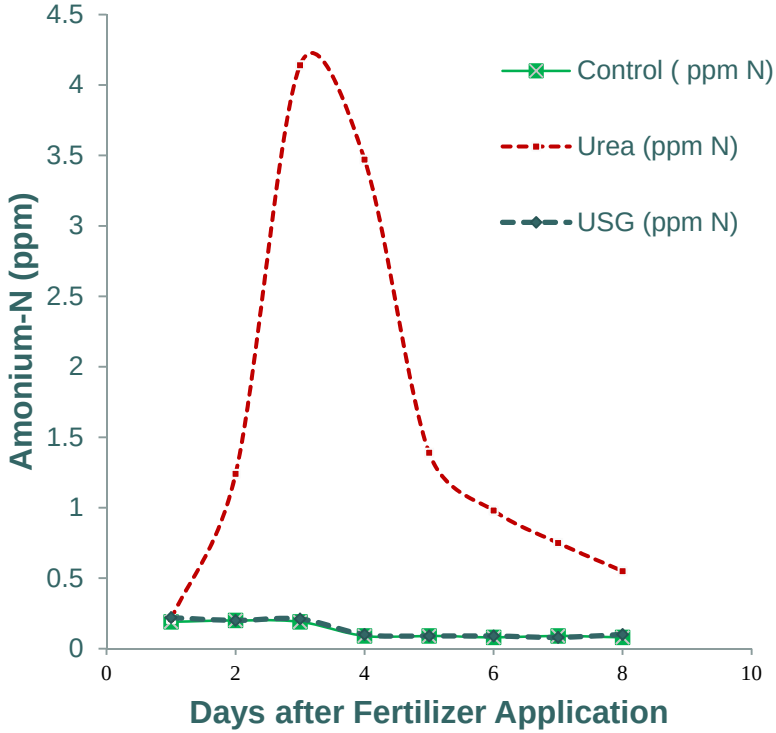


Ammonium N in Water in Rice Field after Application of Urea

First Application



Top Dress



UDP Reduces Farmer Fertilizer Costs

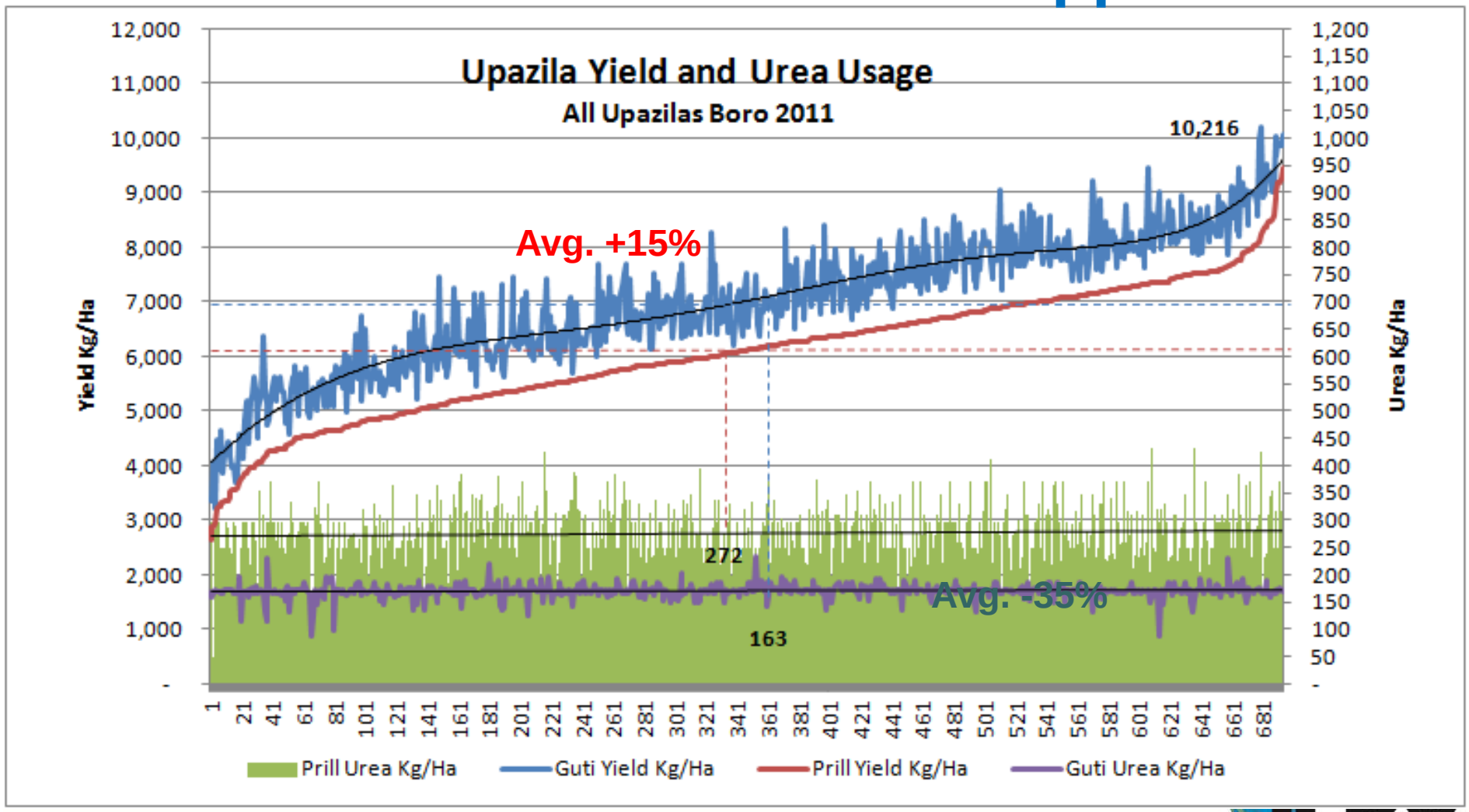
Currently recommended broadcast urea rates per hectare in Bangladesh versus application rates using FDP

Current practice with multiple applications of surface-applied urea:
5.2 bags of 50-kg urea

Recommended practice, deep-placing UDP briquettes:
3.4 bags of 50-kg briquettes

Cost savings:
US $18 per hectare

Urea Deep Placement: 15% Yield Increase With 35% Less Nutrient Applied



The Scale of the Development in Bangladesh

Indicator	Result
Area under UDP – last 3 seasons	1,500,000 ha
Farmers trained over 3 years	650,000
Farmers using UDP in the last year	2,800,000
Small businesses producing briquettes	932
Urea briquette production in the last year	183,000 MT

Impacts of Development in Bangladesh

Impact Indicator	Result
Increased yield of rice	500 kg/ha (16%)
Gross Margin	$560/ha under UDP $430/ha under broadcast
Incremental rice production over 3 years	1.35 million Tons
Estimated value of incremental production	$477 million
Urea savings over 3 years	200,000 Tons
Estimated savings in government subsidy on urea	$65 million

We must take a global approach to solving this problem.

We must invest in new fertilizer research.

IFDC launched Virtual Fertilizer Research Center with the Vision: The world's smallholder farmers have ready access to sustainable, affordable, efficient and environmentally friendly fertilizer technologies.

IFDC

VFRC
Global reserach to nourish the world

- Virtual Fertilizer Research Center
- Managed by IFDC
- Led by Global Advisory Committees

VFRC Strategic Priorities

New 'intelligent' fertilizers

- Fail-safe
- Adaptive
- Eco-sensitive
- Economic

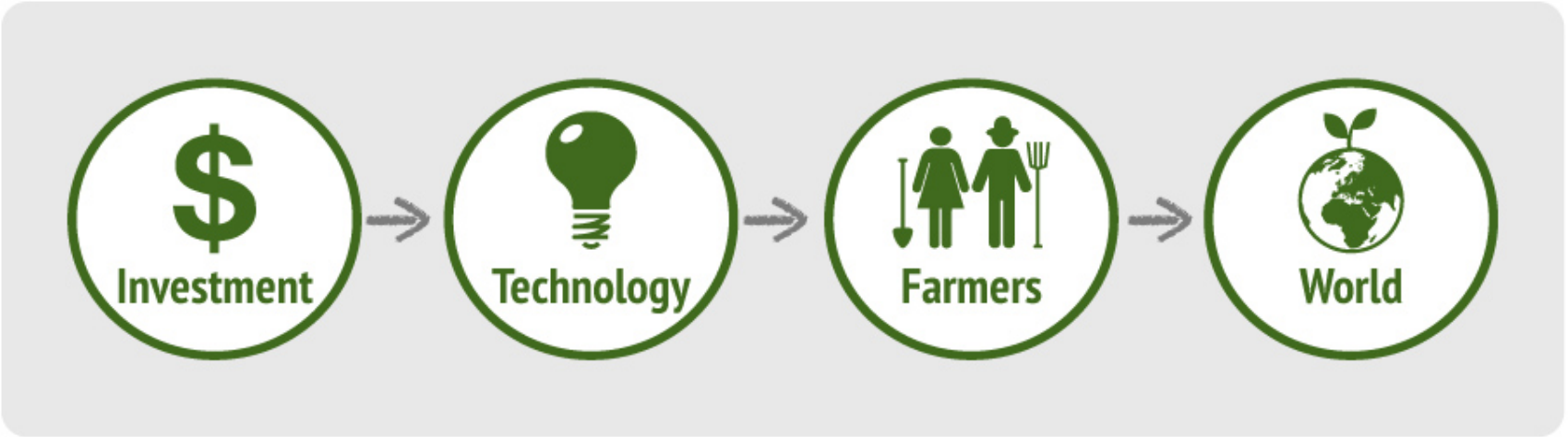
Over the next decade:

- Focus on N and P; improve NUE by 25-50%; recycle nutrients
- Reduce the risk of failed yields for Smallholder Farmers
- Increase the convenience and accuracy of delivering secondary and micronutrients
- Reduce fertilizer sourcing costs by improvements or alternatives to current production processes

Exploit the biochemical pathway of nutrient movement and uptake

Summary

Fertilizers are vital to **Global Food Security and** investing in the development of **Next Generation Fertilizers** will improve efficiency and productivity of agriculture while conserving **Natural Resources** and protecting the **Environment**.



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