Fertilizers and Food Security

Presented by
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Overview

- Fertilizer is vital to ensuring global food security

- New fertilizers must be developed to minimize the significant economic and environmental costs of current fertilizers

- VFRC has been established to facilitate the development of new ‘intelligent’ fertilizers which harness technological advances in multiple disciplines
Cereal Yield Attributable to Fertilizers

**Source:** IPNI

(A) Mean = 40%  
Magruder Plot, Oklahoma (A)

(B) Mean = 62%  
Sandborn Field Plot, Missouri (B)

(C) Mean = 57%  
Morrow Plot, Illinois (C)

(D) Mean = 64%  
Broadbalk Experiment at Rothamsted, England (D)

**40-60%**

Wheat yield attributable to N and P, %

Morrow Plot, Illinois (C)

Wheat yield attributed to fertilizer, %

Sandborn Field Plot, Missouri (B)

Winter wheat yield attributed to N, %

Broadbalk Experiment at Rothamsted, England (D)
Cereal Production and Fertilizer Use

Source: Derived from FAO data.
Global Population and Food Demand

Developing region urbanization

- Increased rural migration (rural population decline)
- Increasing affluence, ‘richer’ diet
- Virtually entire population (and food demand) growth

Developing Regions - 2050 vs. 2010

- Food demand: + 88%
- Nearly 90% of future global demand by 2050
- Greater absolute increase than in past 50 years
Food Supply in Developing Regions

IFDC Modelling

2010
• 300+ MM commercial SHFs
• ~20 MM large farms

2050
• 200+ MM commercial SHFs
• ~25 MM large farms

• Modest land use increase – fewer larger farms

![Developing Regions Food Supply](chart1)

![Yield](chart2)

+1.47% per year
Overview

- Fertilizer is vital to ensuring global food security

- New fertilizers must be developed to minimize the significant economic and environmental costs of current fertilizers

- VFRC has been established to help develop new ‘intelligent’ fertilizers which harness technological advances in multiple disciplines
There are only 3 ways to “fix” Nitrogen into a form that can be used by plants.

- Lightning and legumes account for a percentage of all nitrogen production.
- Reactive nitrogen production comes from natural gas and coal conversion.

**Closer Look at Nitrogen (N)**

**STEP 1**
- Air + Energy
  - Form ammonia

**STEP 2**
- Ammonia + CO₂ and Energy
  - Form urea (Urea Fertilizer)
Phosphates

1 Ton Sulfur Produces ~ 2 Tons of DAP
Economic and Potentially Economic Phosphate Deposits of the World

- Igneous Deposits
- Sedimentary Deposits
- Island Deposits
Potash

Sylvanite or Carnallite → Beneficiation → Potassium Chloride (Potash)
Global Fertilizer Usage

Global NPK Consumption 2008/09
161.8 mmt

Asia
Rest of The World
Latin America
Africa

Global NPK Consumption 2010
$ Billions

128
K, 16

P, 42

N, 70

Global NPK Trading
% Exported/Imported

K
35%

P
35%

N
30%

95%

www.ifdc.org
Nitrogen – Urea example

2 out of 3 bags of urea go unused in wetland rice production

ANNUAL UREA CONSUMPTION = 125 mmt

- Used: 60 mmt
- If 50% lost: 65 mmt
- If 10% of runoffs, cost ~$6 billion

NOx into atmosphere ~ 360 mmt of global CO2 equivalent GHG = $9 billion

50% lost urea market value: ~$30 billion, incl. natural gas $6 billion

IFDC est.
Phosphate Losses in Processing
40%-50%
Micronutrients
Overview

- The fertilizer industry is vital to ensuring global food security

- New fertilizers must be developed to minimize the significant economic and environmental costs of current fertilizers

- VFRC has been established to help develop new ‘intelligent’ fertilizers which harness technological advances in multiple disciplines
“Farmers are paying way too much for fertilizers…much of the nutrients in applied fertilizers are never used by the crop. Nutrient losses to the environment are high with consequences for global warming and water pollution.

"Work should begin now on the next generation of fertilizer products using advanced techniques such as nanotechnology and molecular biology, especially in conjunction with plant genetics research. 'Smart' fertilizer products that will release nutrients only at the time and in the amount needed should be developed."

– Dr. Norman Borlaug, August 2008
We must take a global approach to solving this problem.

We must invest in new fertilizer research.

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

Develop and commercialize the next generation of fertilizers

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

- Managed by IFDC
- Led by Global Board of Advisors
- Supported by Global Advisory Committees
Over the next decade:

- Focus on N & P; 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 fertilizer sourcing costs by improvements or alternatives to current production processes

New ‘intelligent’ fertilizers

- Fail-safe
- Adaptive
- Eco-sensitive
- Economic
Example of A Technology  
Urea Deep Placement

- 1-3 g briquettes, in root zone at transplanting
- Slower release = nutrient use efficiency improves
- Expanded in Bangladesh, and Introduced in Central and West Africa
Comparison Yields Between Broadcast and Urea Deep Placement — Bangladesh

![Bar Chart]

- **Broadcast**
  - N fertilization rate: 125 kg/ha
  - Paddy Yield: 6,432 kg/ha

- **Deep Placement**
  - N fertilization rate: 77 kg/ha
  - Paddy Yield: 7,676 kg/ha
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.
Thank You