The *Fertilizer Industry Round Table* DISCUSSION

FOTC Fertilizer Outlook & Technology Conference

MODERATOR

Dave Downey
Executive Director,
Center for Food and Agricultural Business
Purdue University

The Fertilizer Institute
Nourish, Replenish, Grow

Fertilizer Industry Round Table

PERSPECTIVES ON . . .

FOTC Fertilizer Outlook & Technology Conference

ADAPTING TO A CHANGING CLIMATE

Scott Angle

President and CEO
International Fertilizer Development Center

Sees The World As A...

- **Scientist & Academic**
- **Food Security Crises**
- **Huge Opportunity**
  For Technology To Impact Poverty and Human Health

The Fertilizer Institute
Nourish, Replenish, Grow

Fertilizer Industry Round Table

The Fertilizer Industry Roundtable

J. Scott Angle
President and Chief Executive Officer
International Fertilizer Development Center
Muscle Shoals, Alabama (U.S.A.)
November 16, 2016

IFDC
Developing Agriculture from the Ground Up

International Fertilizer Development Center

The International Fertilizer Development Center (IFDC) is an autonomous, nonprofit, public, international organization (PIO).

MISSION STATEMENT

IFDC enables smallholder farmers in developing countries to increase agricultural productivity, generate economic growth, and practice environmental stewardship by enhancing their ability to manage mineral and organic fertilizers responsibly and participate profitably in input and output markets.

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Muscle Shoals

The Home of the U.S. Fertilizer Industry

National Fertilizer Development Center

↓

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70% of all fertilizers sold worldwide today were developed in Muscle Shoals

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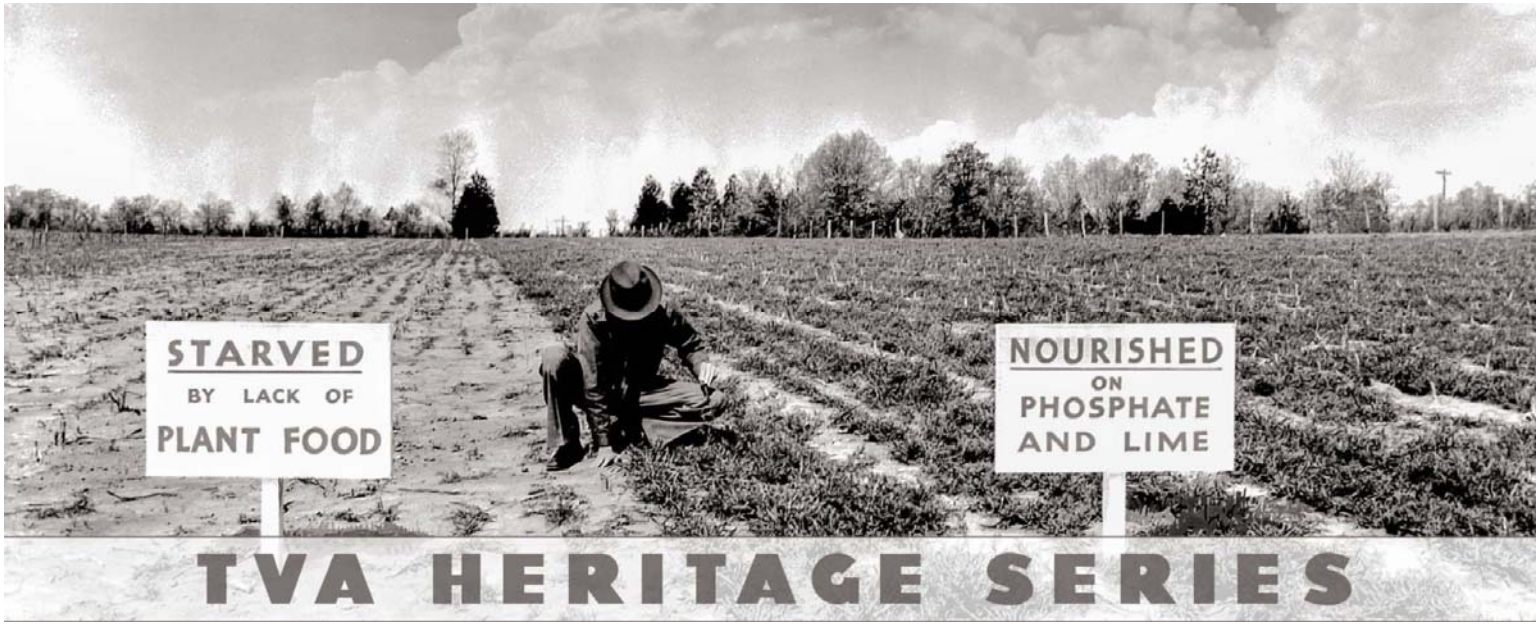
Post-War Legacy:

Born Here, Incubated Here, Pioneered Here, Developed Here



This was the Green Revolution, 1930s ➡1980s

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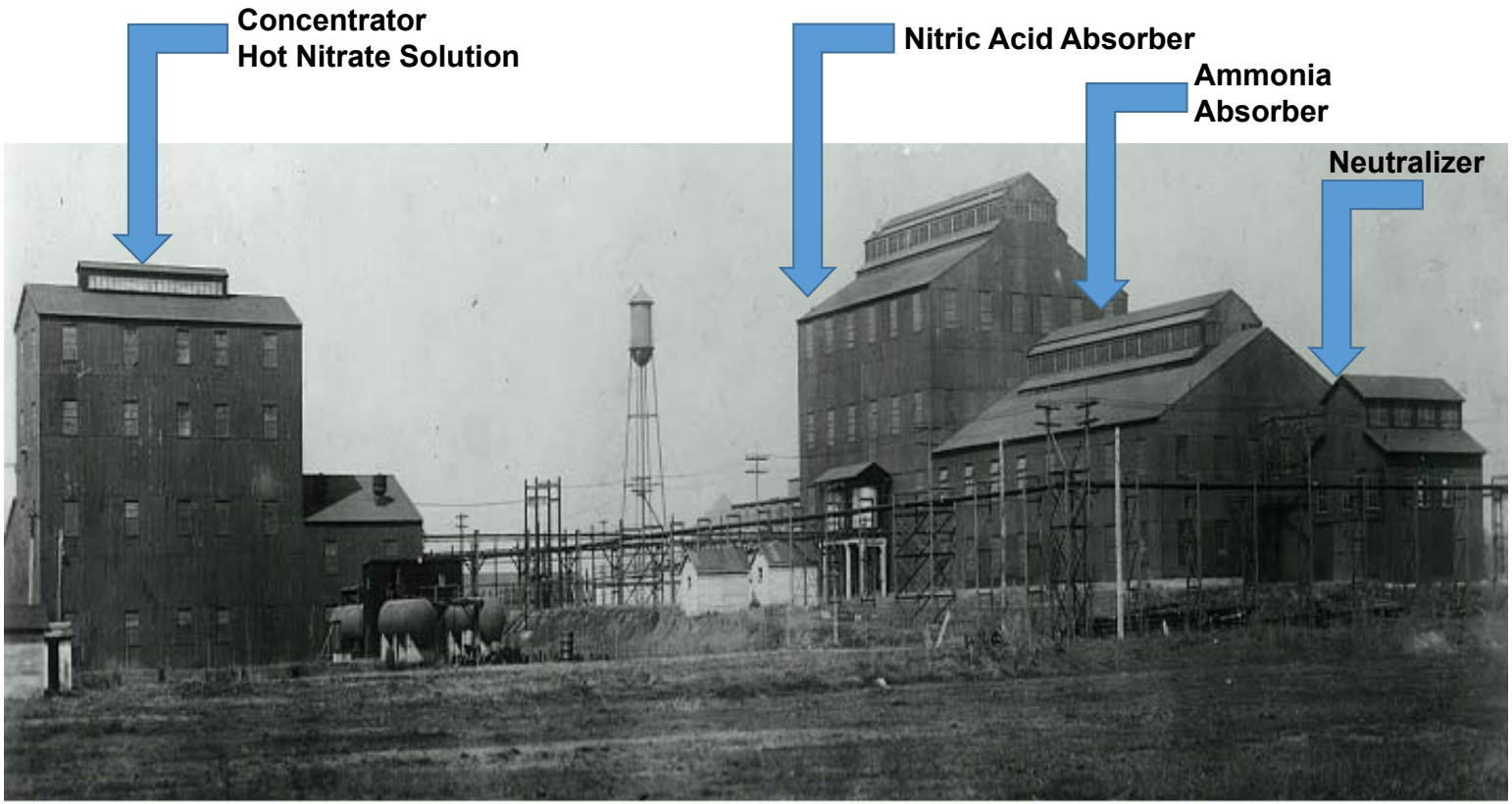

Nitrate Formation by Combining Ammonia and Nitric Acid

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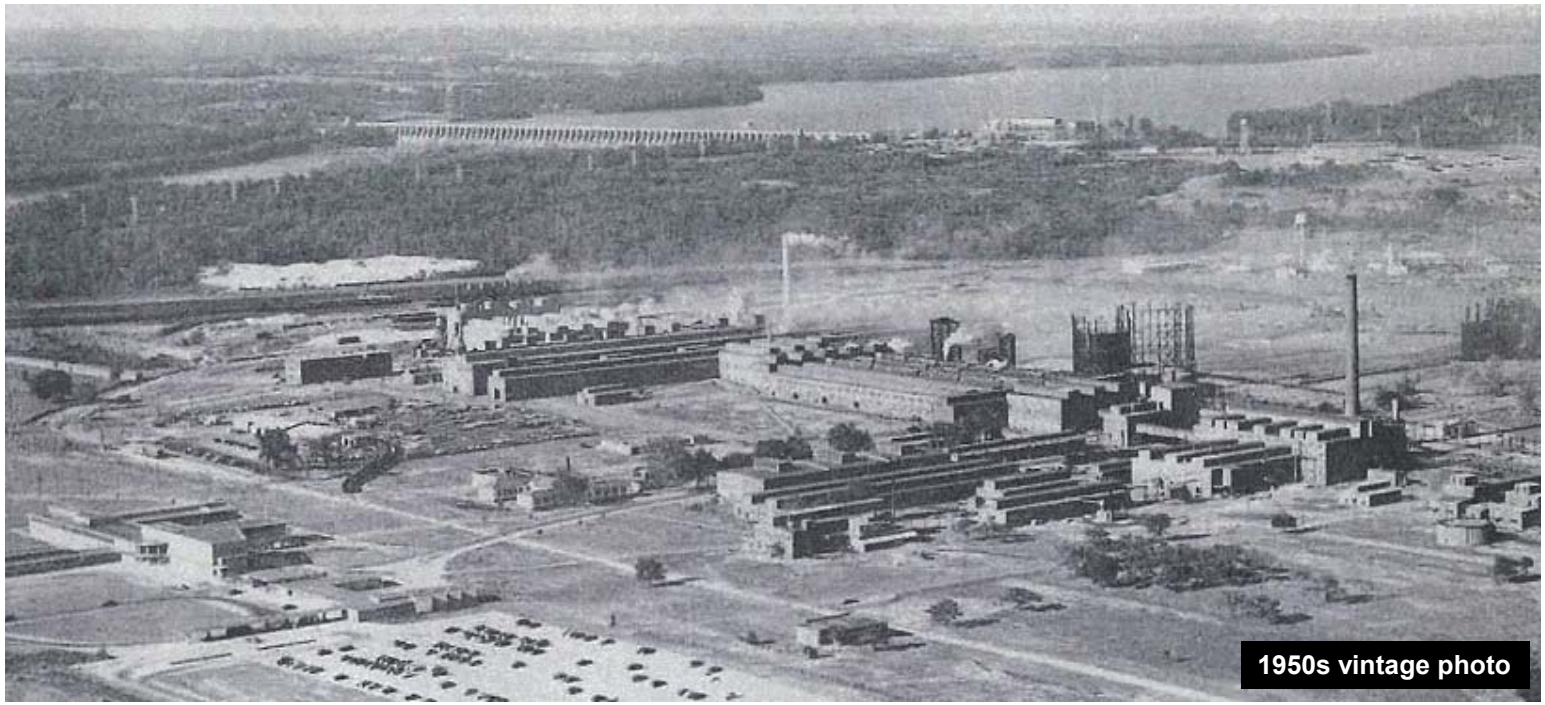
Wilson Dam and Nitrate #2, Anchor Legacy Assets



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IFDC and Muscle Shoals Continue as Thought Leaders for the Fertilizer Industry

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What are the drivers for new fertilizer development?

- **Political**
- **Societal**
- **Environmental**
- **Economic**

African Needs for Nutrients

On average, Africa used 10% of needed fertilizers to achieve global crop averages.

Health Impacts of Deficiencies

Region	Zn	Fe	I	Vitamin A
North America	8-11	18-29	11	2-16
Latin America	13-37	18-29	11	2-16
Europe	6-16	19-25	52	12-20
Sub-Saharan Africa	13-43	48-66	44	14-44
Southeast Asia	27-39	46-66	30	17-50
South Asia	18-36			
Global	**10-32**	**30-47**	**32**	**15-33**

Bouis, Boy-Gallego and Meenakshi (2011)

Micronutrient Malnutrition (% prevalence)

Interventions

- Supplementation
  - Medical/Dietary
- Fortification
  - Food Processing
  - Breeding
- Dietary diversity

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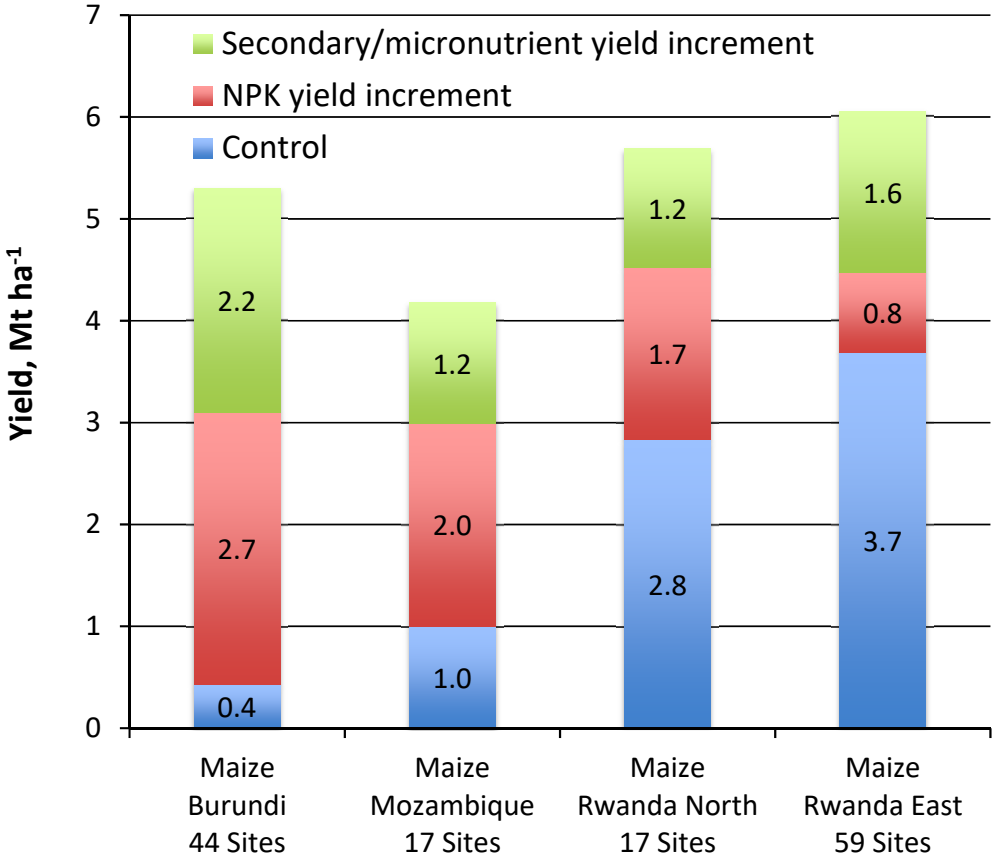
Maize:

Impacts of Secondary and Micronutrients Relative to NPK



- ✓ ***Extra 1.2-2.2 Mt/ha due to SMN addition.***
- ✓ Burundi sites include dolomitic lime.
- ✓ ***SMNs comprise a large portion of the total fertilizer response***, but are less expensive than NPKs.

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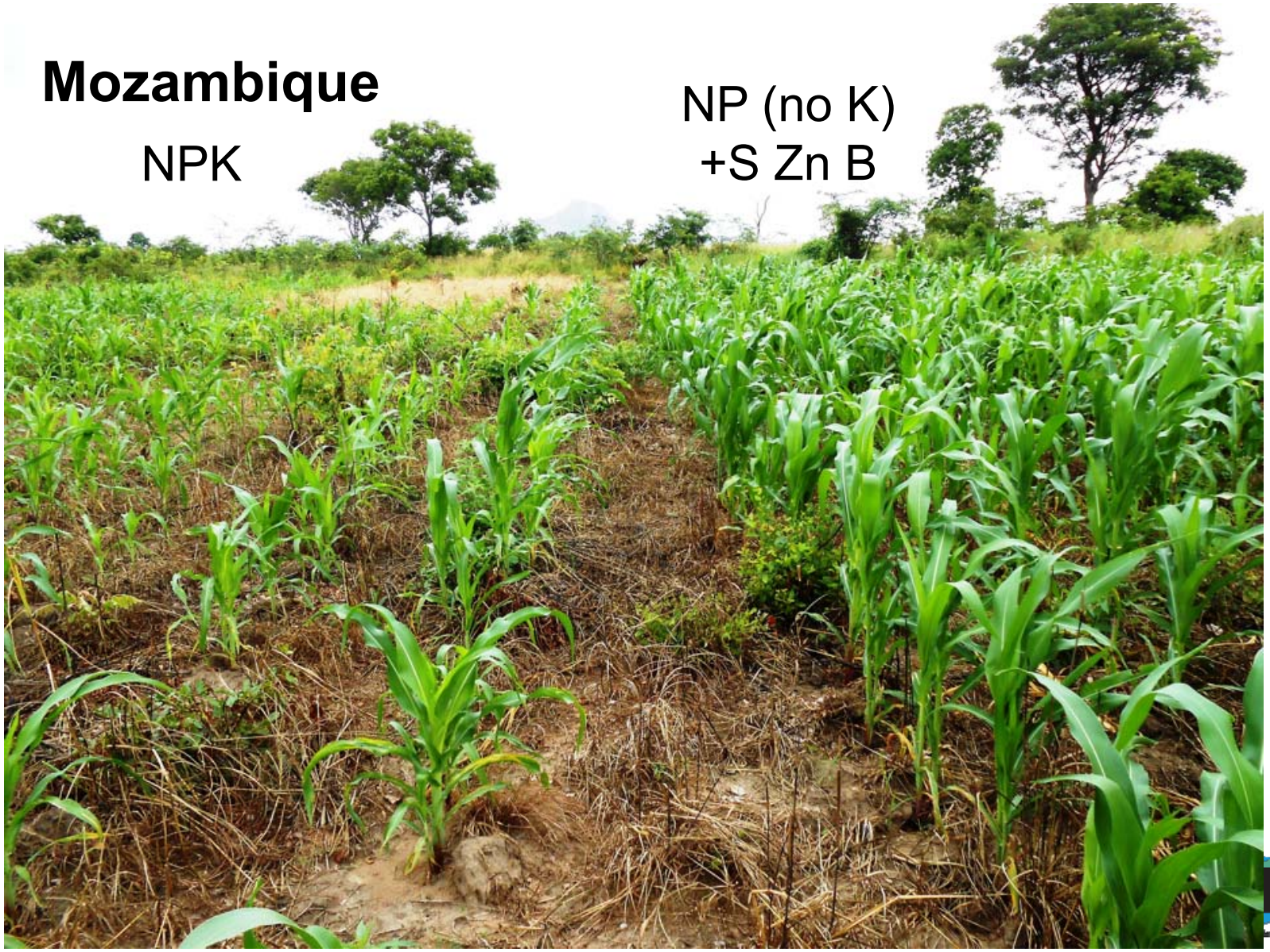
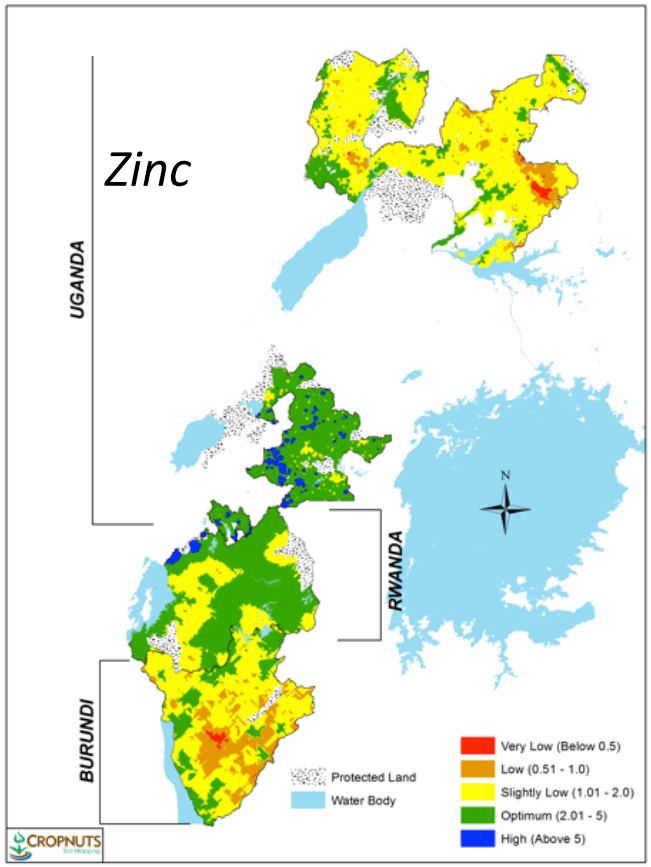
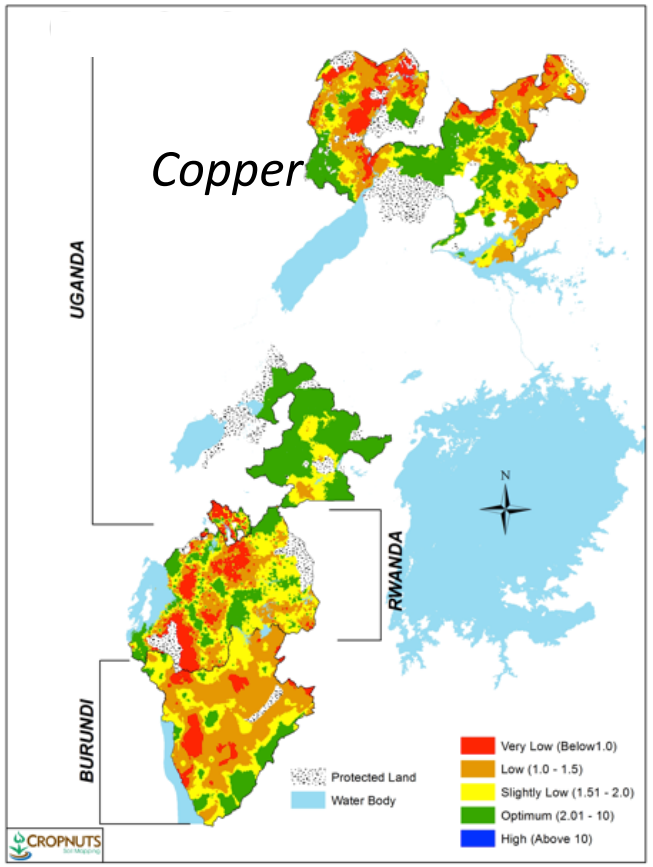
Mozambique



And many African soils are micronutrient deficient





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Adapting to the Climate

Climate-smart agriculture is an important U.S./EU priority. Discussions are well underway to "require" climate-smart fertilizer.

Fertilizers that release less NO_x into the atmosphere.

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Fertilizer Deep Placement

Prilled Urea

Urea Briquettes

NPK Briquettes

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Rice Intensification: UDP

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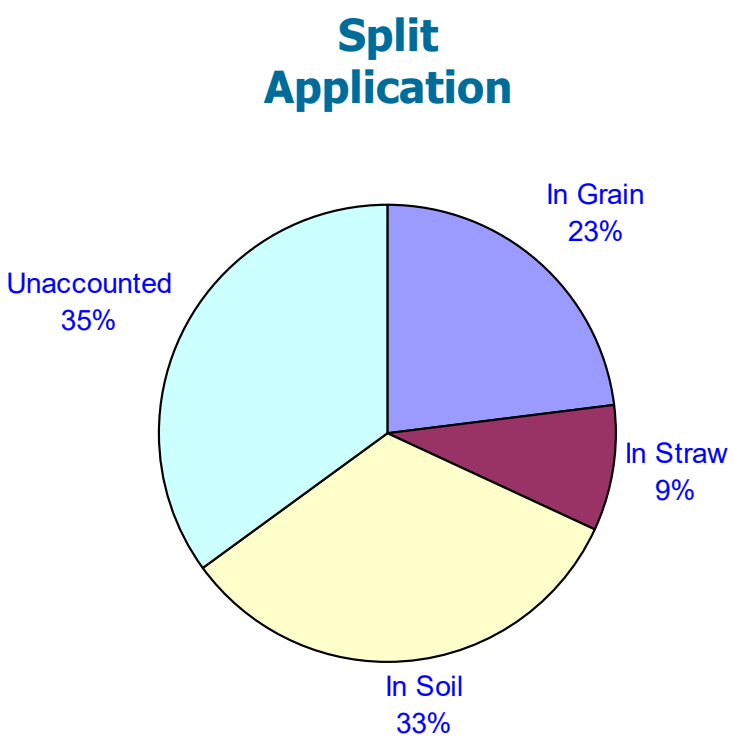
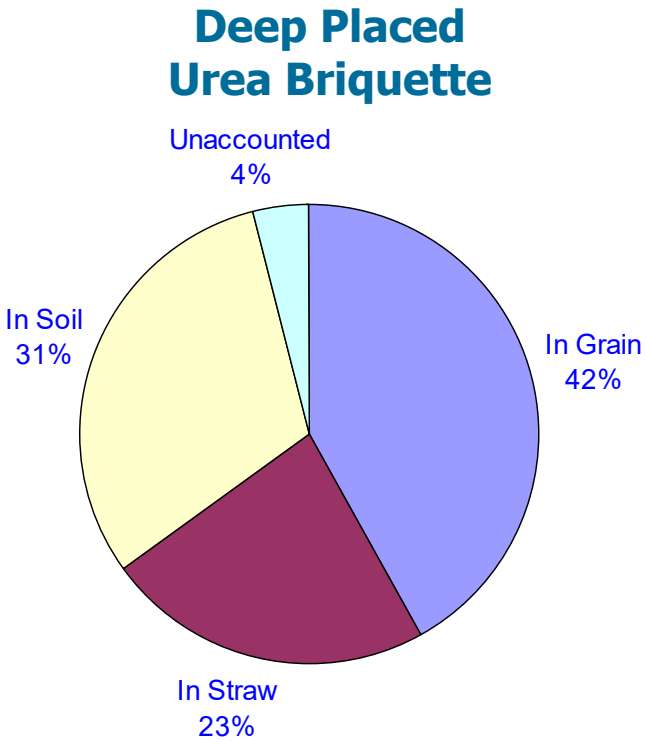
N Balance for UDP and Split Applied Urea in Wetland Rice. IRRI-IFDC





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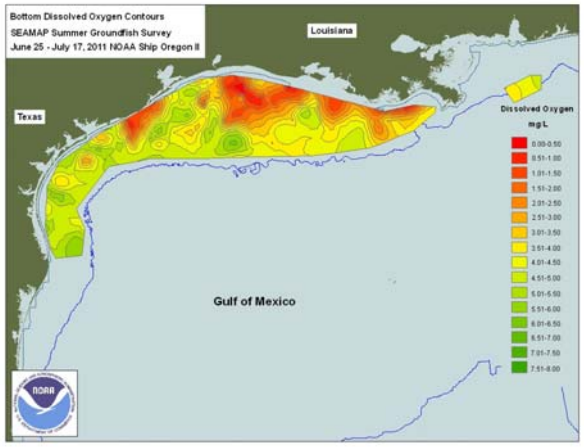
Aquatic Nutrient Enrichment (Hypoxia)

Gulf of Mexico
Chesapeake Bay



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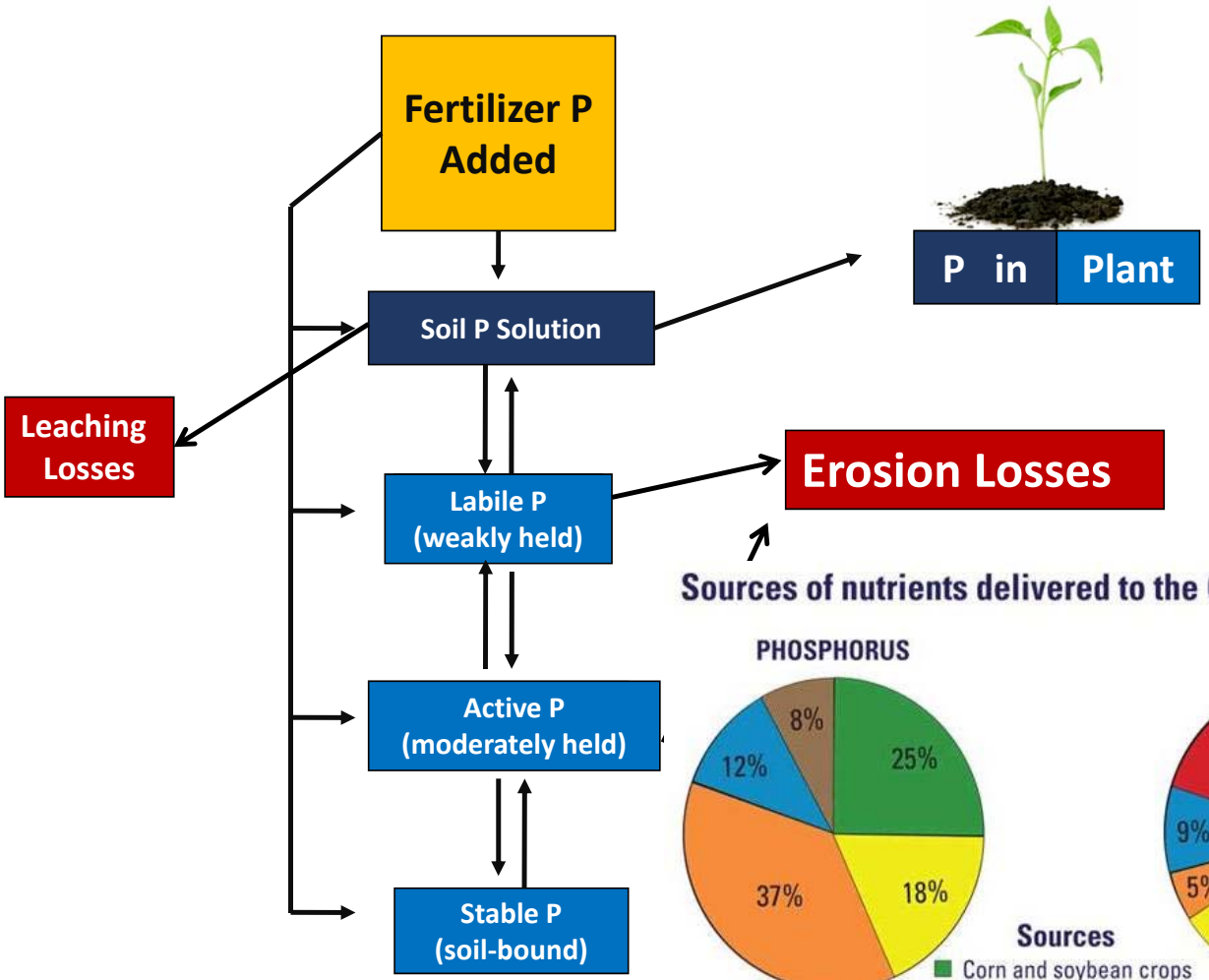
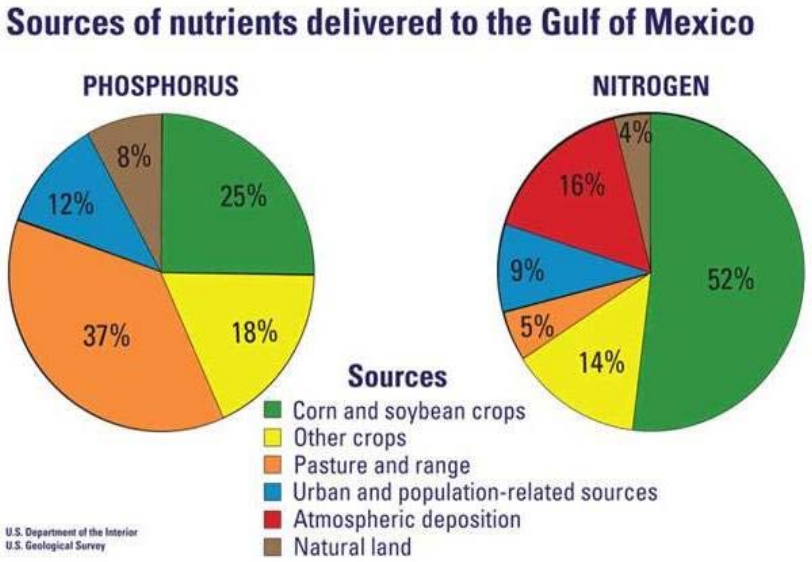

Fertilizer P Added
Soil P Solution
P in Plant
Leaching Losses
Labile P (weakly held)
Erosion Losses
Active P (moderately held)
Stable P (soil-bound)


Sources of nutrients delivered to the Gulf of Mexico
PHOSPHORUS
NITROGEN
25%
18%
37%
12%
8%
52%
14%
5%
9%
16%
4%
Sources
Corn and soybean crops
Other crops
Pasture and range
Urban and population-related sources
Atmospheric deposition
Natural land
U.S. Department of the Interior
U.S. Geological Survey

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Increasing Nutrient Use Efficiency

- **Synchrony of Nutrient Supply with Crop Nutrient Demand**
- **Balanced Fertilization**
- **Integrated Crop Management**
- **Nutrient Efficient Genotypes**

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Improve Efficiency – Product Modification and Amendments

Slow and controlled-release sources

- Low water solubility – urea formaldehydes, phosphate rocks
- Coated: S, rubber, polyurethane, polyolefins, etc.
- Reacted layer technology
- Inhibitors: PPDA, NBTPT, Boric acid, DCD, DMPP, nitrapyrine
- Protectants/solubilizers: natural, synthetic

Surface application (no-till farming), single application (labor and energy)

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Improve Efficiency – Practice

- Knifed into the soil
- Dribbled (banded) on the soil surface
- Banded at planting
- Sidedressed or topdressed during the growing season
- Fertigation
- Foliar spray
- Deep placement (urea, NPK briquettes)

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The “Argument” for Organic Fertilizers

Today, fertilizers are responsible for between 40 and 60 percent of the world's food supply.

'a few billion people would have to die if we hadn't come up with fertilizer'
….**Bill Gates**

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Yet, much of the developed world is seeking alternatives to commercial inorganic fertilizers.

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Biosolids are the most likely source of organic nutrients

Sludge from municipal sewage waste processed to reduce environmental impact

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Biosolids

Advantages

- Macronutrients
- Micronutrients
- Organic Matter

Disadvantages

- Pathogens
- Heavy Metals
- Toxic Organics
- Odors
- Water Pollution
- High Cost
- EPA Restrictions

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