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Nutrients for Life … Food Security and Nutrition

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International Plant Nutrition Institute, Norcross, GA

III Congresso Brasileiro de Fertilizantes – ANDA
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Renaissance São Paulo Hotel
São Paulo SP

The Economist | World politics | Business & finance | Economics | Science & technology | Culture

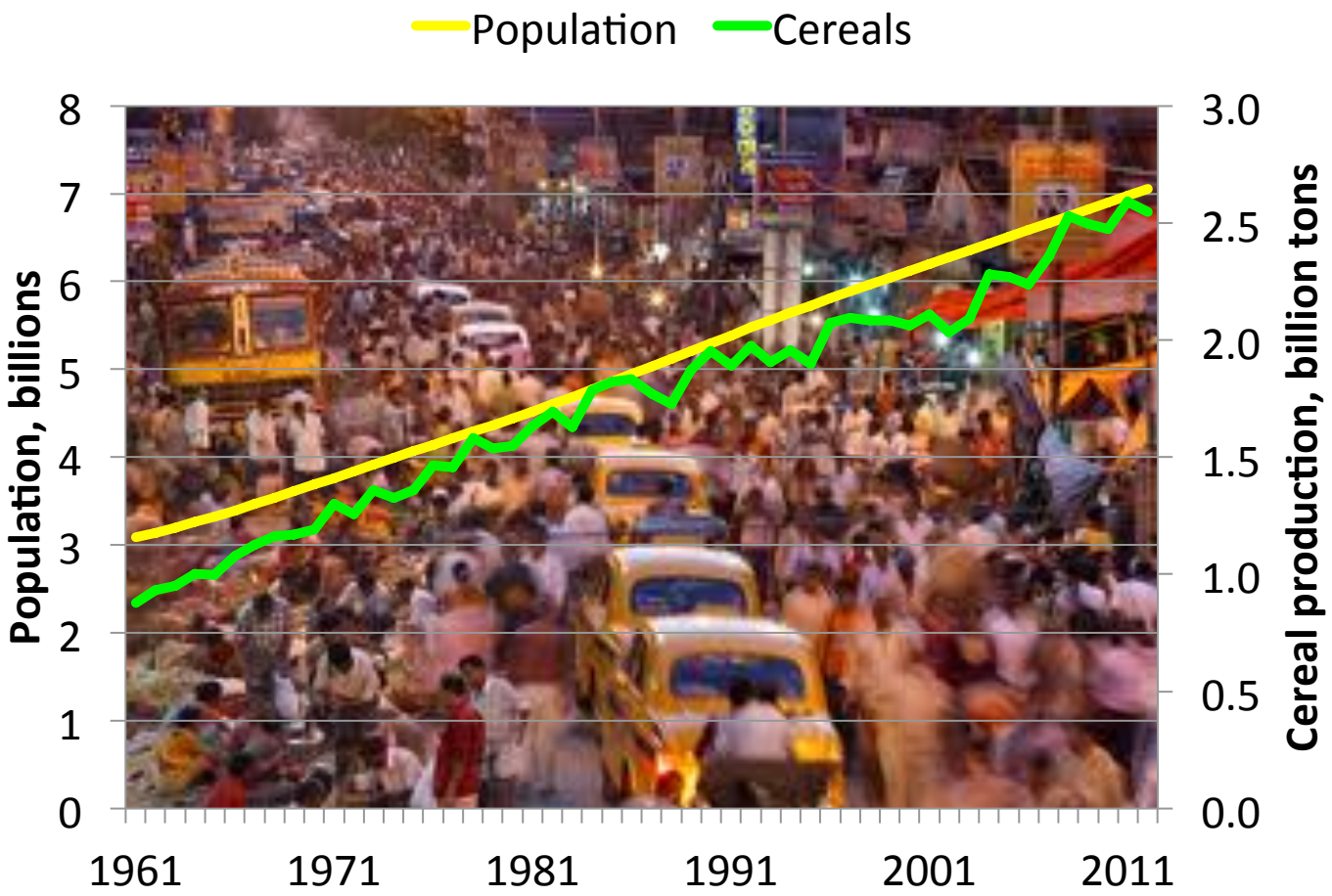
Special report: Feeding the world

The 9 billion-people question

Rice Today October-December 2011

The world needs to produce more food

Change in global cereal production and population, 1961-2012

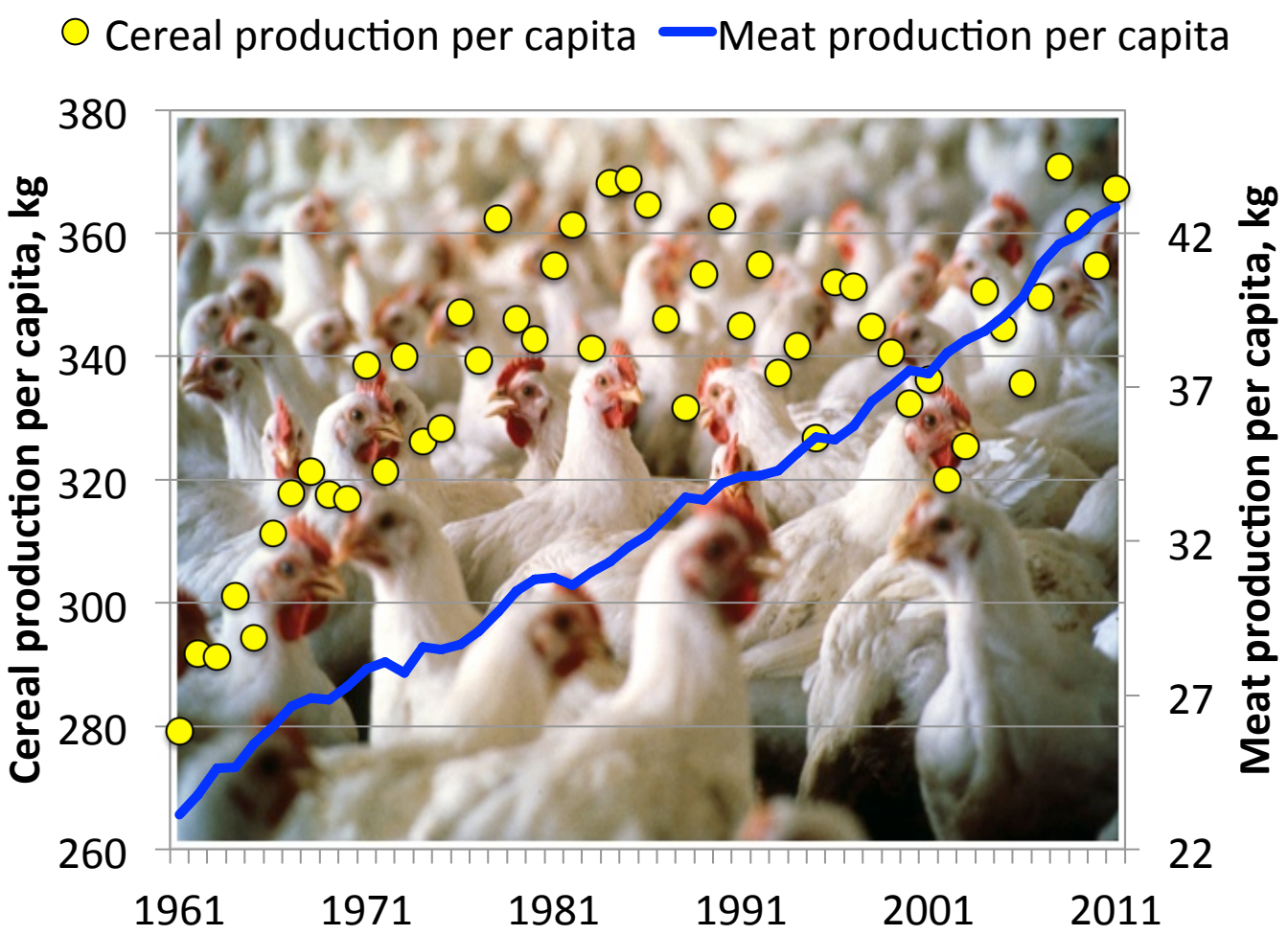


Source: FAOSTAT, 2013

The world needs to produce more food … one-sixth are chronically hungry

The world needs to produce more food, while diets are changing …

Change in cereal and meat production per capita, 1961-2011



Source: FAOSTAT, 2013

The world needs to produce more food …
50 to 70 % increase by 2050

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Food security depends on
wheat, rice, and corn

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Source: FAO, 2009, Fischer et al., 2009

The world needs to produce more food …
50 to 70 % increase by 2050

Options:

1. Increase harvested area
2. Increase yield

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Current vs. attainable yields

- Global yields of wheat, maize, and rice average 64%, 50%, and 64% of their yield potential (Neumann et al., 2010)
- Closing the yield gap depends on understanding region-specific constraints:
  - Biophysical limitations … inadequate climate, lack of irrigation, poor genetics, and low soil fertility
  - Socio-economic factors … lack of credit, market access, government support policies, and lack of agronomic knowledge

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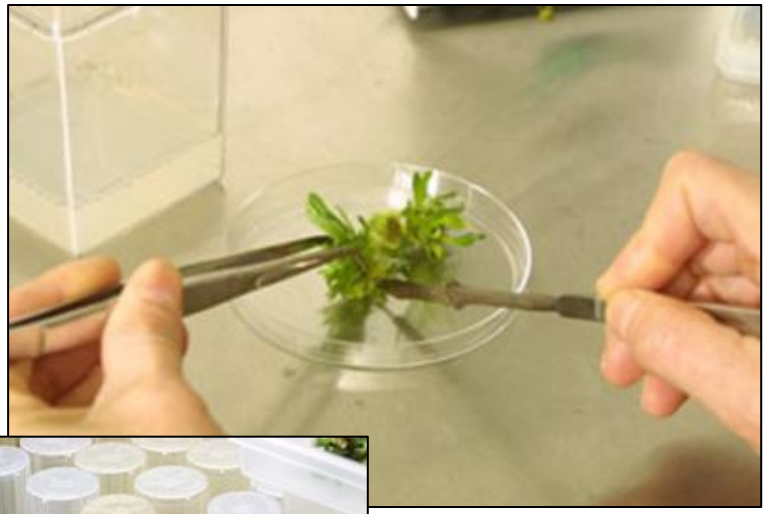
Will biotechnology ensure food security?

- Biotech industry says they can increase crop yield potential by 3 to 4% per annum?
  - e.g. Monsanto pledged to double yields of corn, soybeans, and cotton using ⅔ the water and less N by 2030
- Genetic advances alone likely be insufficient …



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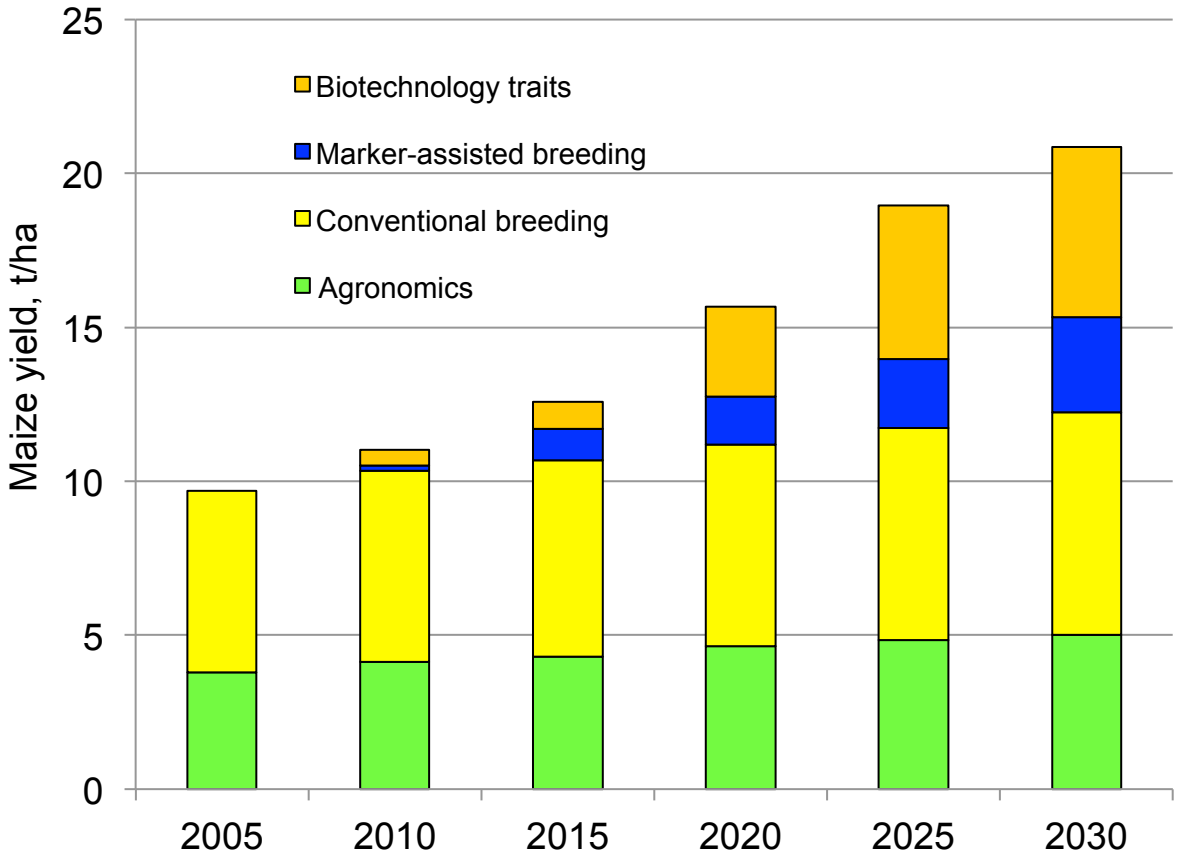
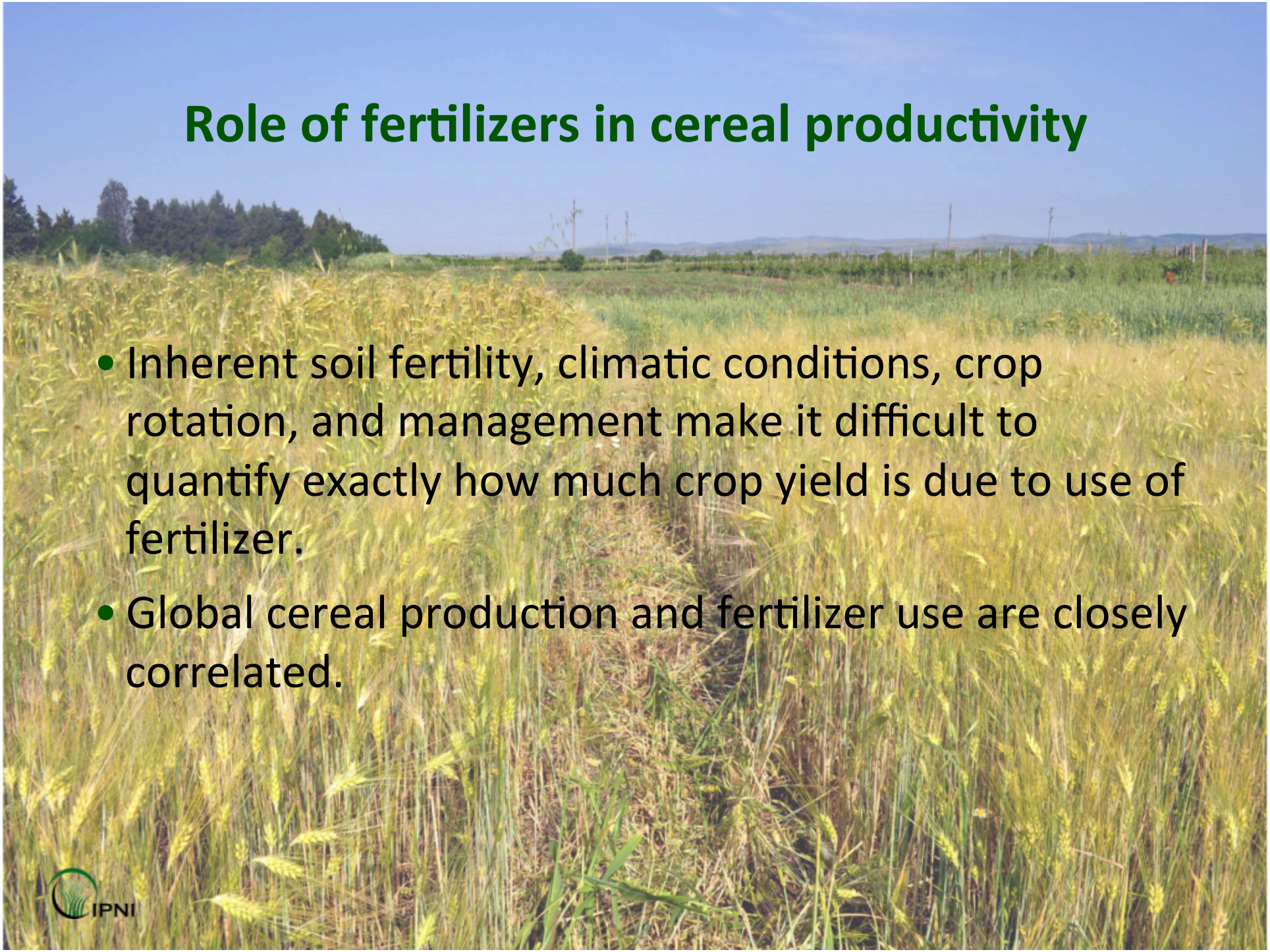
Genetic advances alone will be insufficient … improvements in biotechnology, breeding, and agronomic practices will be required to increase productivity.



Source: Edgerton, 2009

Role of fertilizers in cereal productivity



- Inherent soil fertility, climatic conditions, crop rotation, and management make it difficult to quantify exactly how much crop yield is due to use of fertilizer.
- Global cereal production and fertilizer use are closely correlated.

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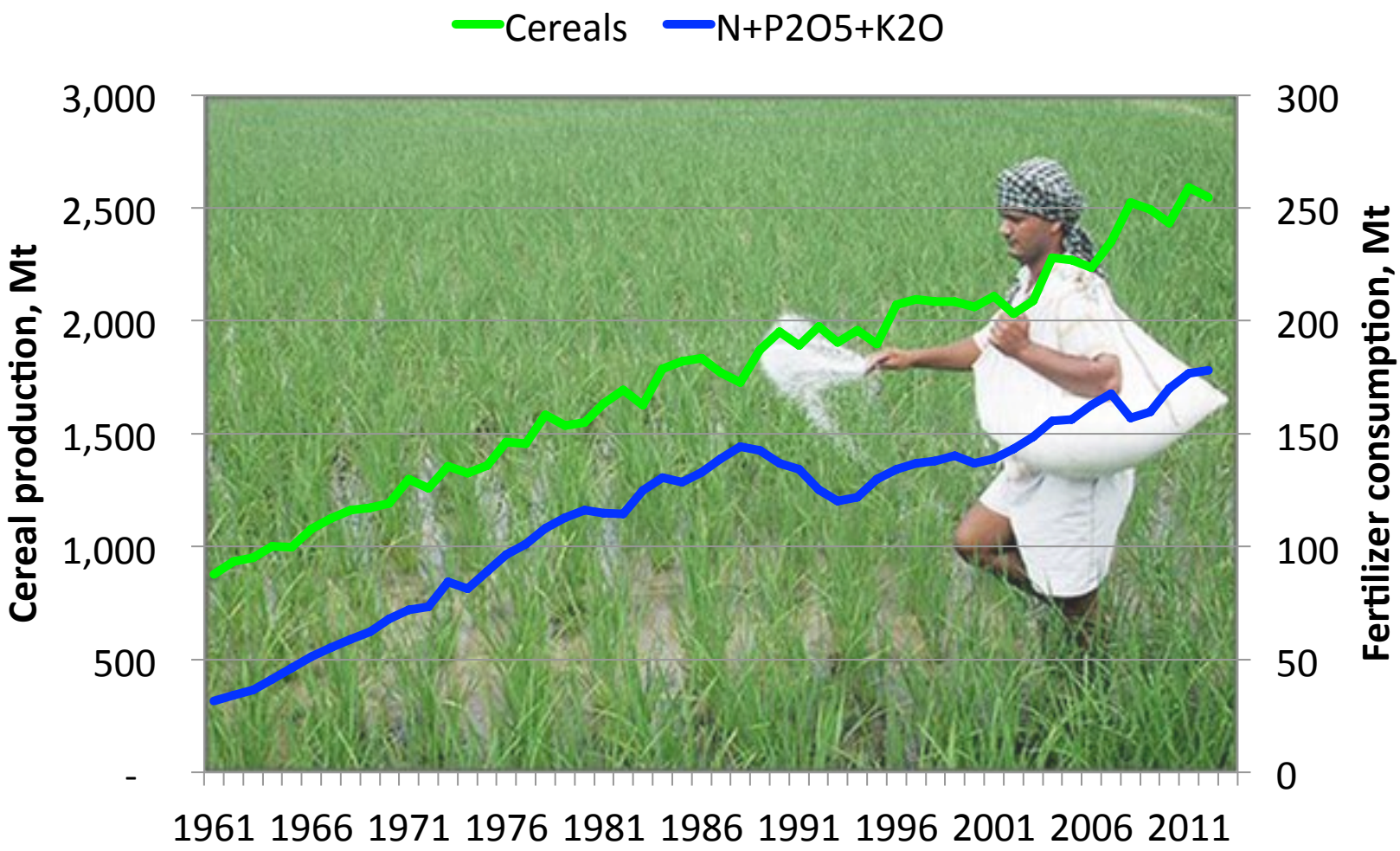
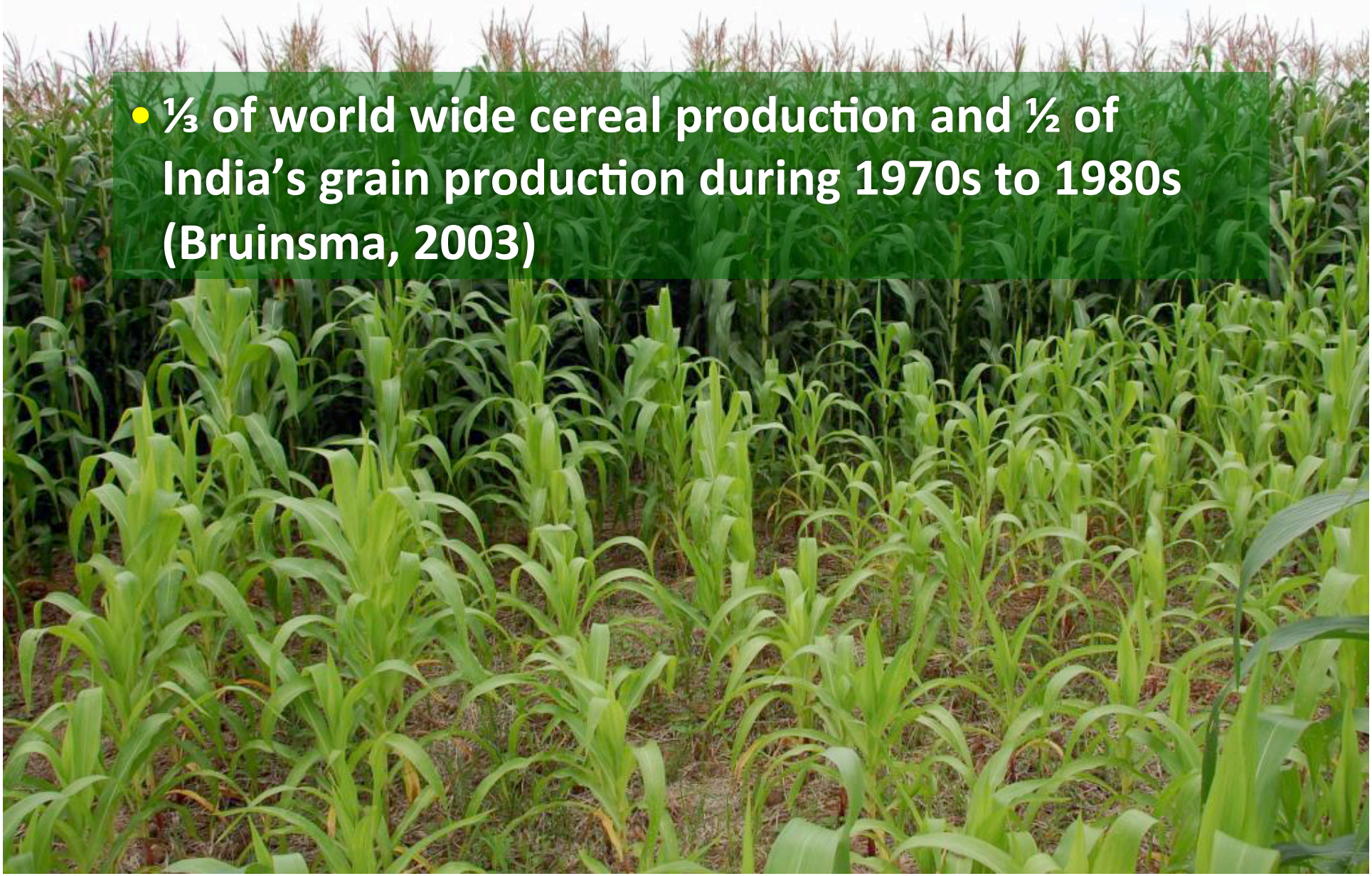
Global cereal production and total fertilizer consumption, 1961-2012.



Source: FAOSTAT, 2013 and IFA, 2013

How much yield response comes from fertilizers?



- ⅓ of world wide cereal production and ½ of India's grain production during 1970s to 1980s (Bruinsma, 2003)

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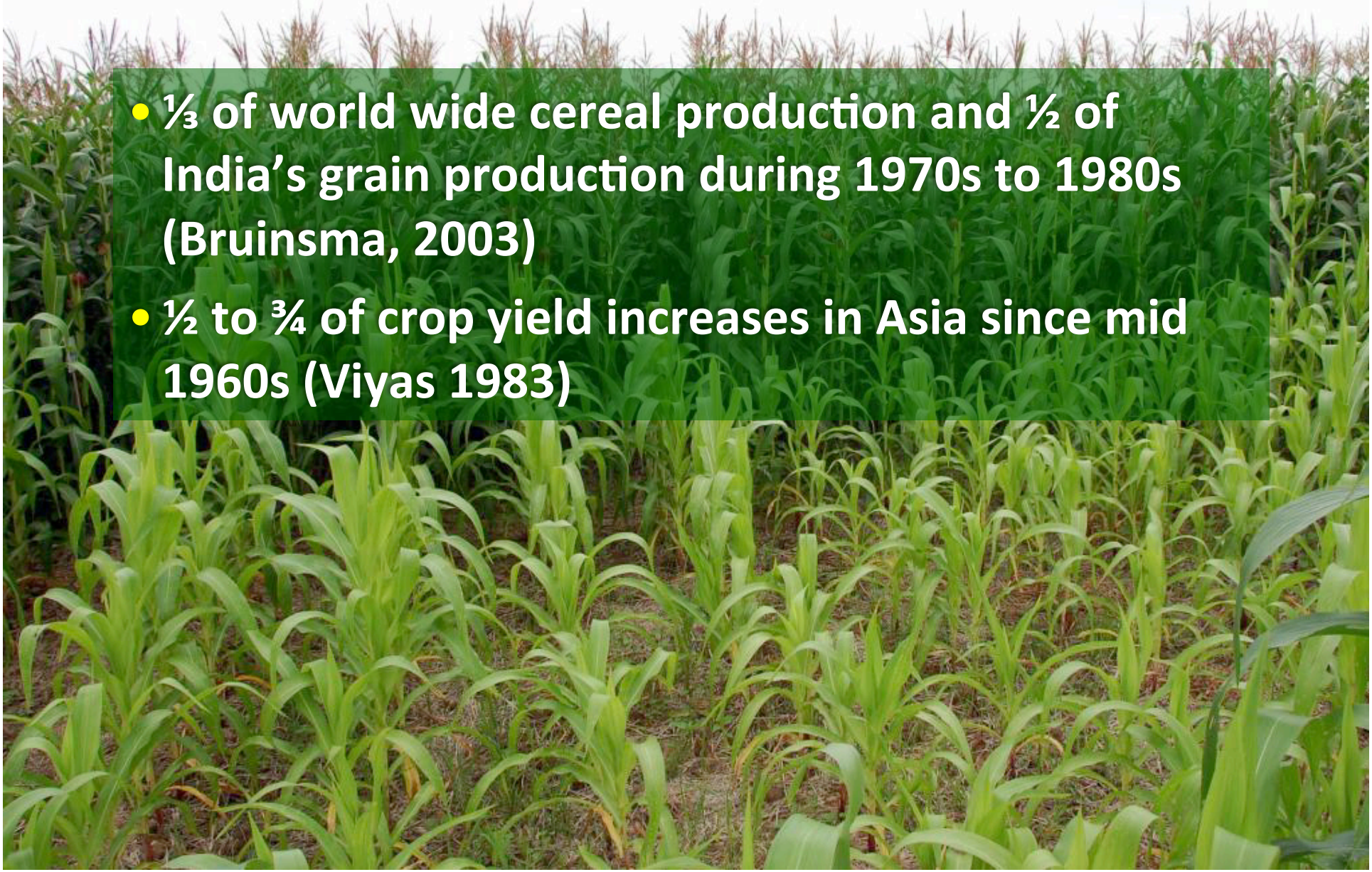

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- ½ to ¾ of crop yield increases in Asia since mid 1960s (Viyas 1983)

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- 40 to 60% of crop yield in long-term studies (Stewart et al., 2005)

Estimated effect of omitting N fertilizer on cereal yields in the USA

Crop	Baseline yield with N, t/ha	Yield, without N, t/ ha	% reduction from no N
Maize	7.65	4.52	41
Rice	6.16	4.48	27
Barley	2.53	2.04	19
Wheat	2.15	1.81	16

Source: Stewart et al., 2005

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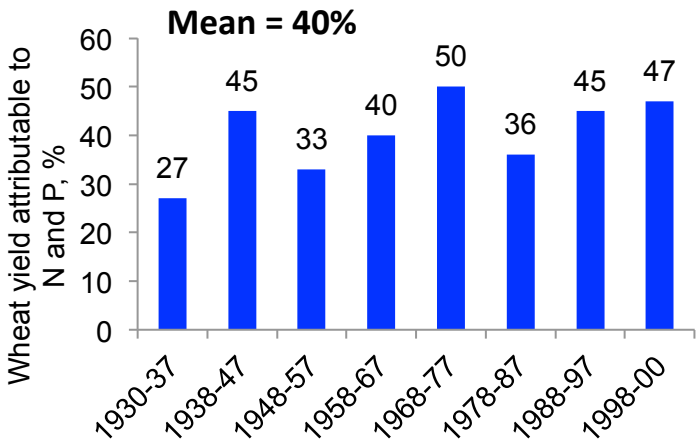
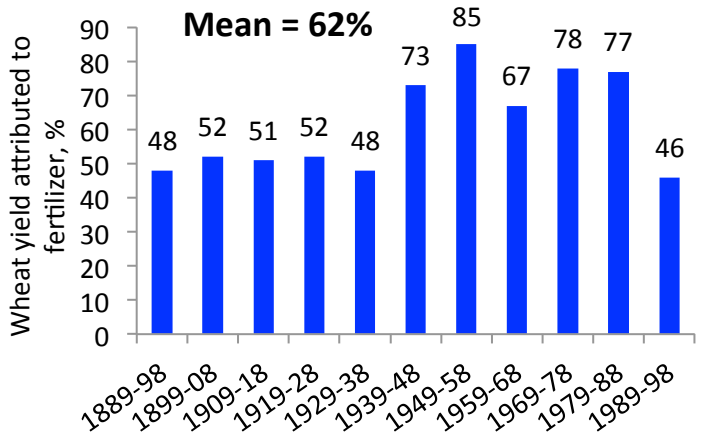
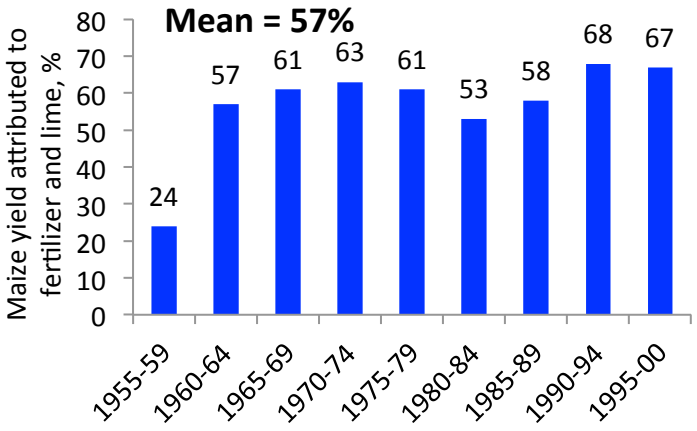
Magruder plots, OSU, 1930-2000



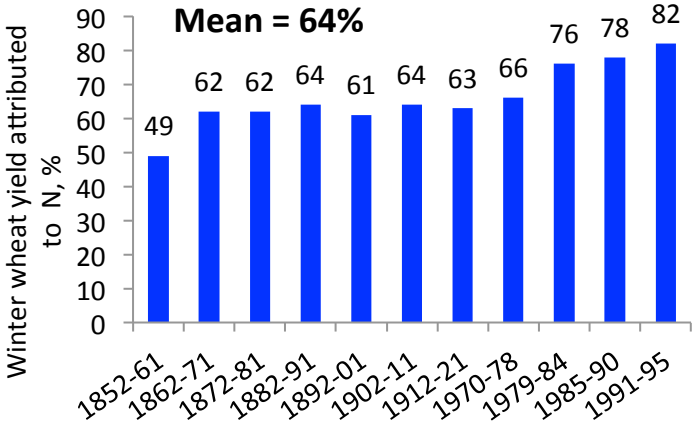
Sanborn Field plots, U of MO, 1889-1998



Morrow plots, U of IL, 1955-2000



Broadbalk Experiment, Rothamsted, England, 1852-1995.



Source: Stewart et al., 2005

Organic nutrient sources are needed

- Optimal nutrient management utilizes all on-farm sources of nutrients … e.g. Integrated soil fertility management (ISFM)
- Best yields are often achieved when organic and inorganic nutrients are applied together

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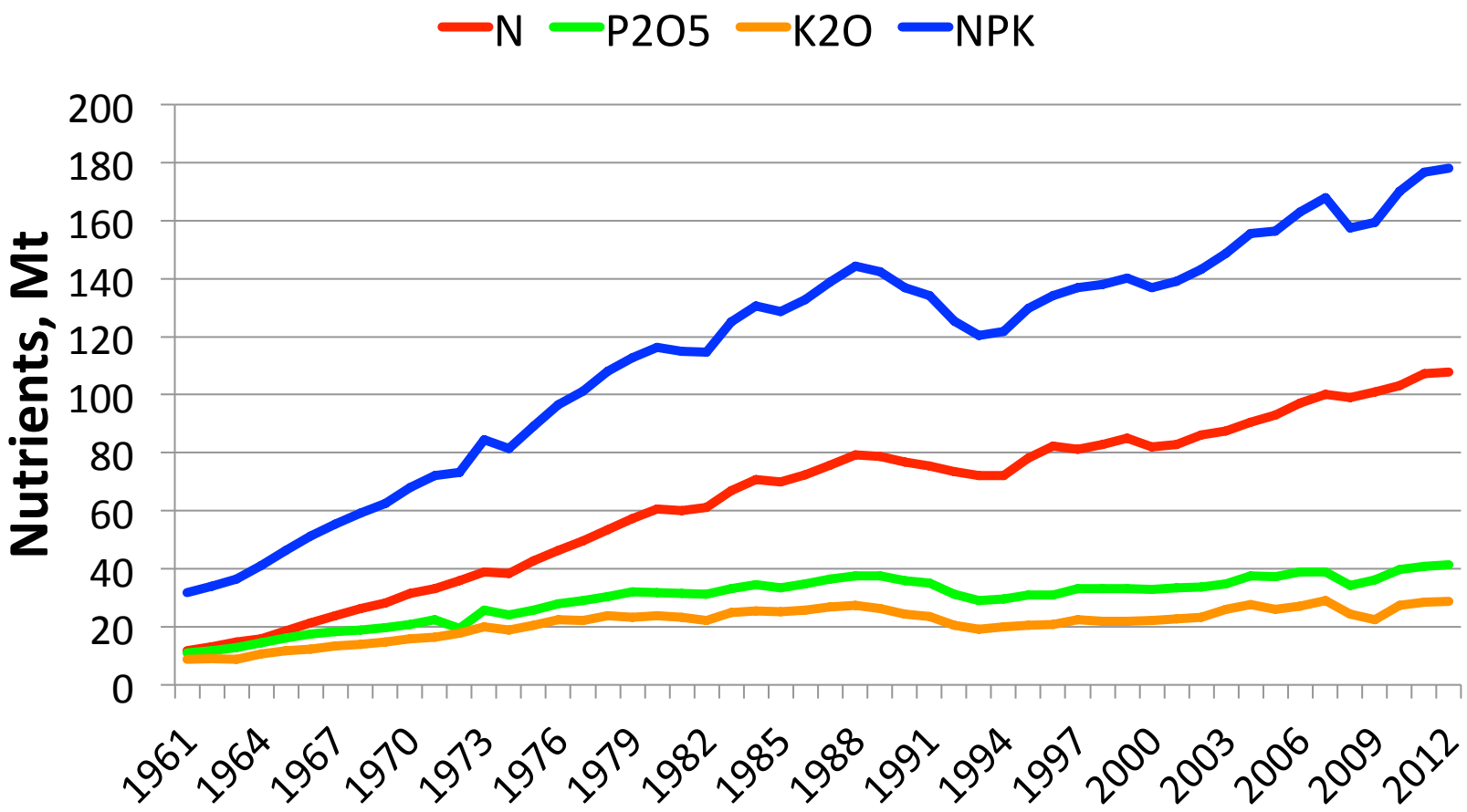
Effect of fertilizer (NPK) and farmyard manure (FYM) on millet yield and yield stability over 9 years in Bangalore, India.

		Number of years in which grain yield (t/ha) was:			
Annual treatment	Mean yield, t/ha	<2	2-3	3-4	4-5
Control	1.51	9	0	0	0
FYM	2.55	1	6	2	0
NPK	2.94	0	5	4	0
FYM + NPK	3.57	0	1	5	3

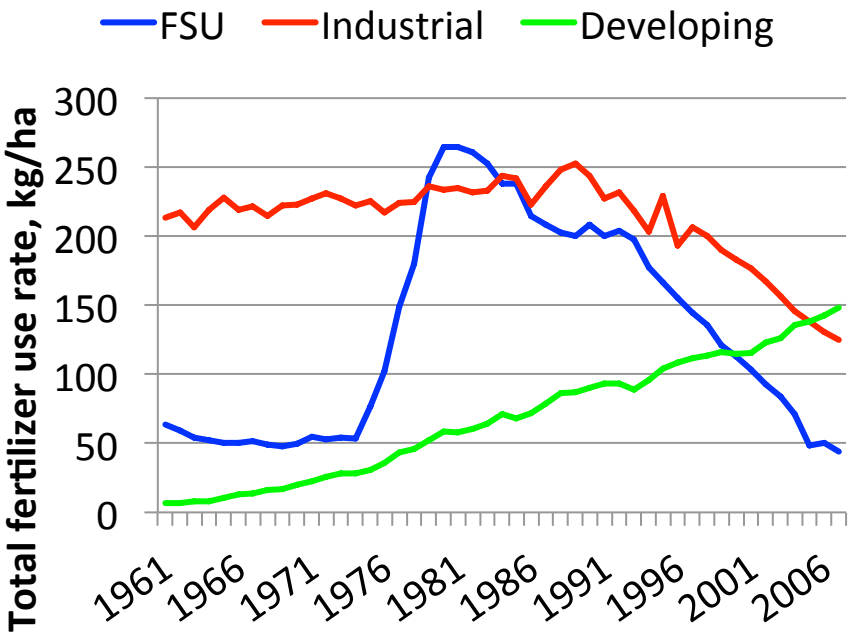
Source: Roy et al., 2006

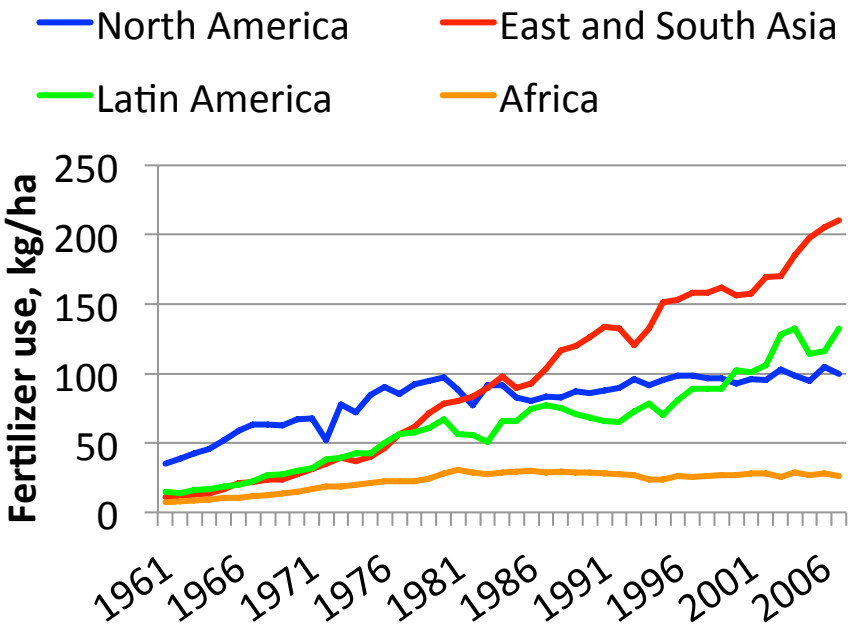
Global fertilizer consumption, 1961-2012



Source: IFA, 2013

Regional trends in fertilizer use (application rate), 1961-2007





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Source: FAO, 2010

Fertilizer best management practices and nutrient stewardship

- Nutrient removal in harvested cereal grain in 2012 was estimated at 46.6 Mt N, 19.3 Mt P_2O_5, and 13.4 Mt K_2O
  - Doubling yields does not mean a doubling of removal
- Nutrient use efficiency is a dynamic indicator of nutrient management … applicable at country, regional, and farm levels

NUE can be confusing because of multiple definitions …

Term	Calculation
Partial Factor Productivity (PFP)	Y/F
Partial Nutrient Balance (PNB)	U_H/F
Agronomic Efficiency (AE)	$(Y-Y_0)/F$
Recovery Efficiency (RE)	$(U-U_0)/F$

F = fertilizer applied Y = yield harvested
Y_0 = yield from control U_H = nutrient content of harvested crop
U = nutrient uptake with fertilizer N_0 = nutrient uptake without fertilizer

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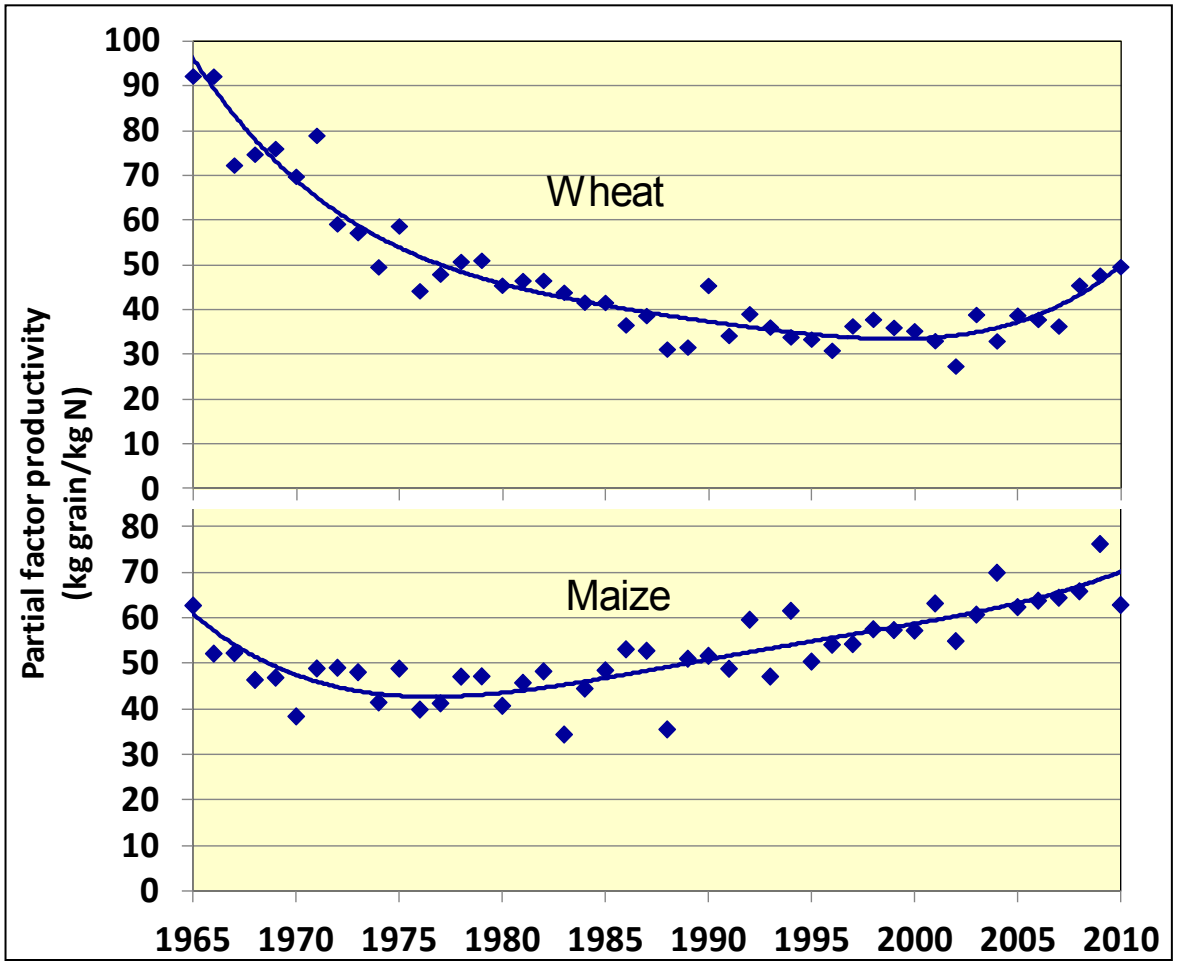
Example: Partial factor productivity in the U.S. for fertilizer N used on maize and wheat from 1965 to 2010.



Source: Fixen et al., 2012

Fertilizer BMPs … impact NUE by matching nutrient supply with crop requirement and minimizing nutrient losses from fields.

Source, rate, time, and place describe any nutrient application

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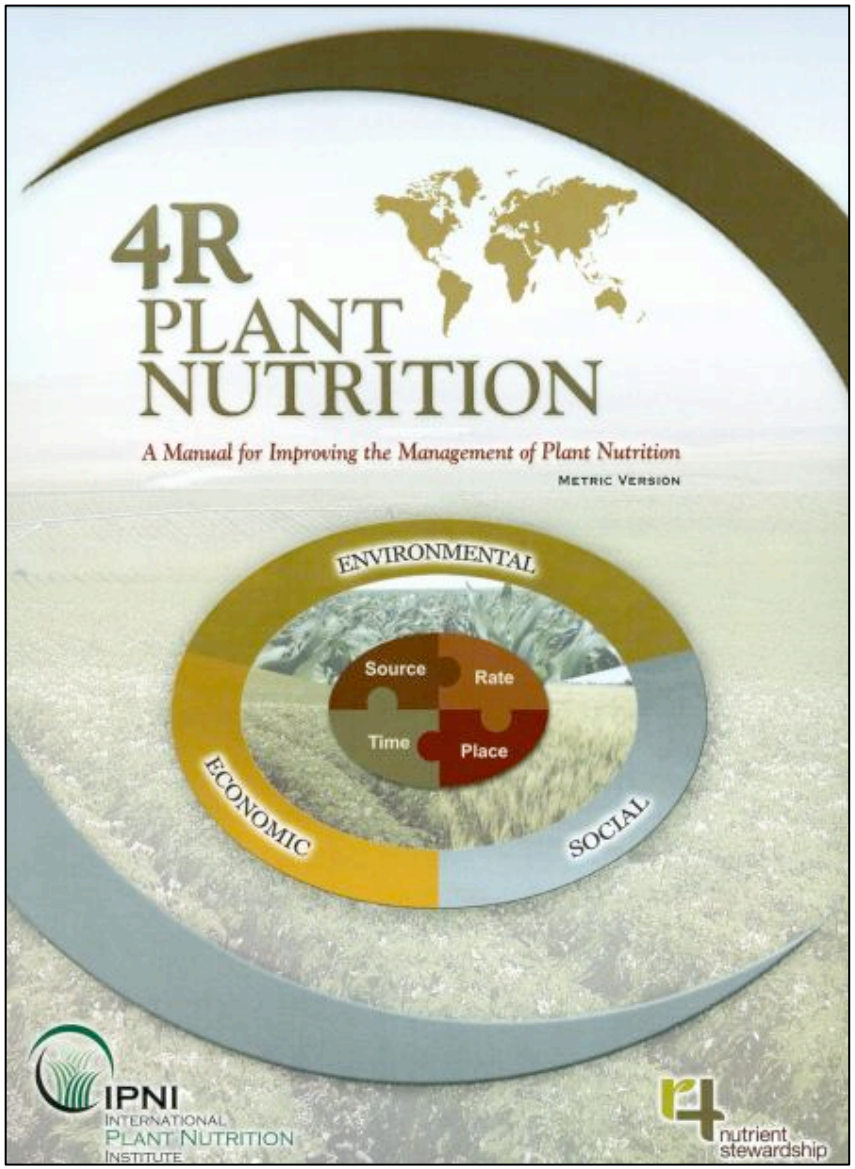
Global framework … 4R Nutrient Stewardship

"Four rights" broadly describe fertilizer management, but … right practice for a farm depends on climate, crop, management conditions, and other site-specific factors.

The framework guides the application of scientific principles to develop and adapt global BMPs to local conditions, while meeting economic, social, and environmental goals of sustainability.

Scientific principles outlined in IPNI's manual



www.ipni.net/4r

QR Code

Global food security … one of the greatest challenges of the 21st century

- 70 % increase in food production is needed in next 40 years to meet population growth.
- Biotechnology and genetic advances are essential to increasing yield, but … not sufficient.
- Fertilizer is critical accounting for about half of current production.
- 4R nutrient stewardship — underpinning principles of nutrient management — adaptable to all cropping systems to ensure productivity is optimized.

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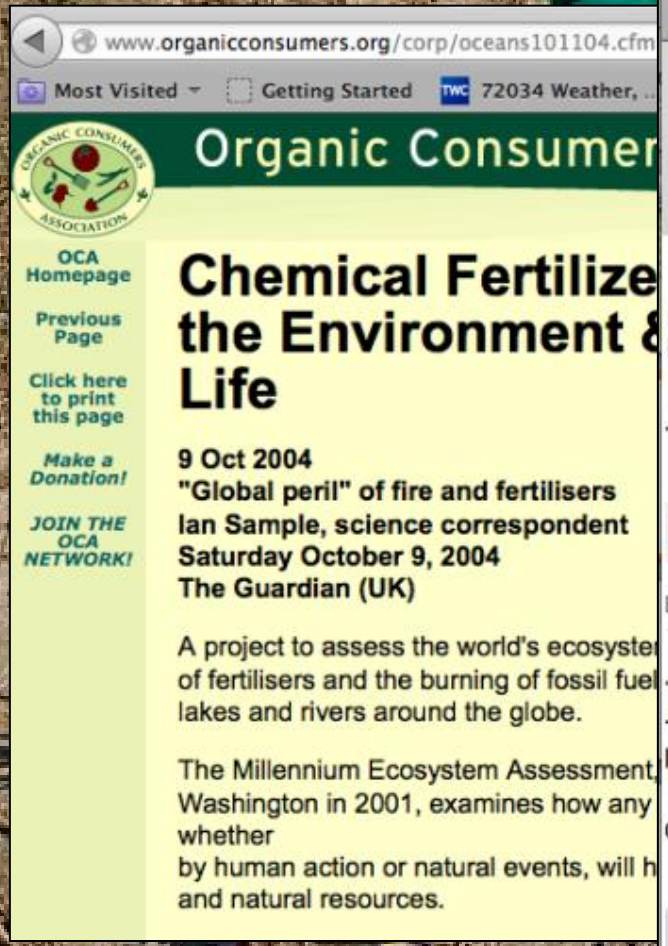
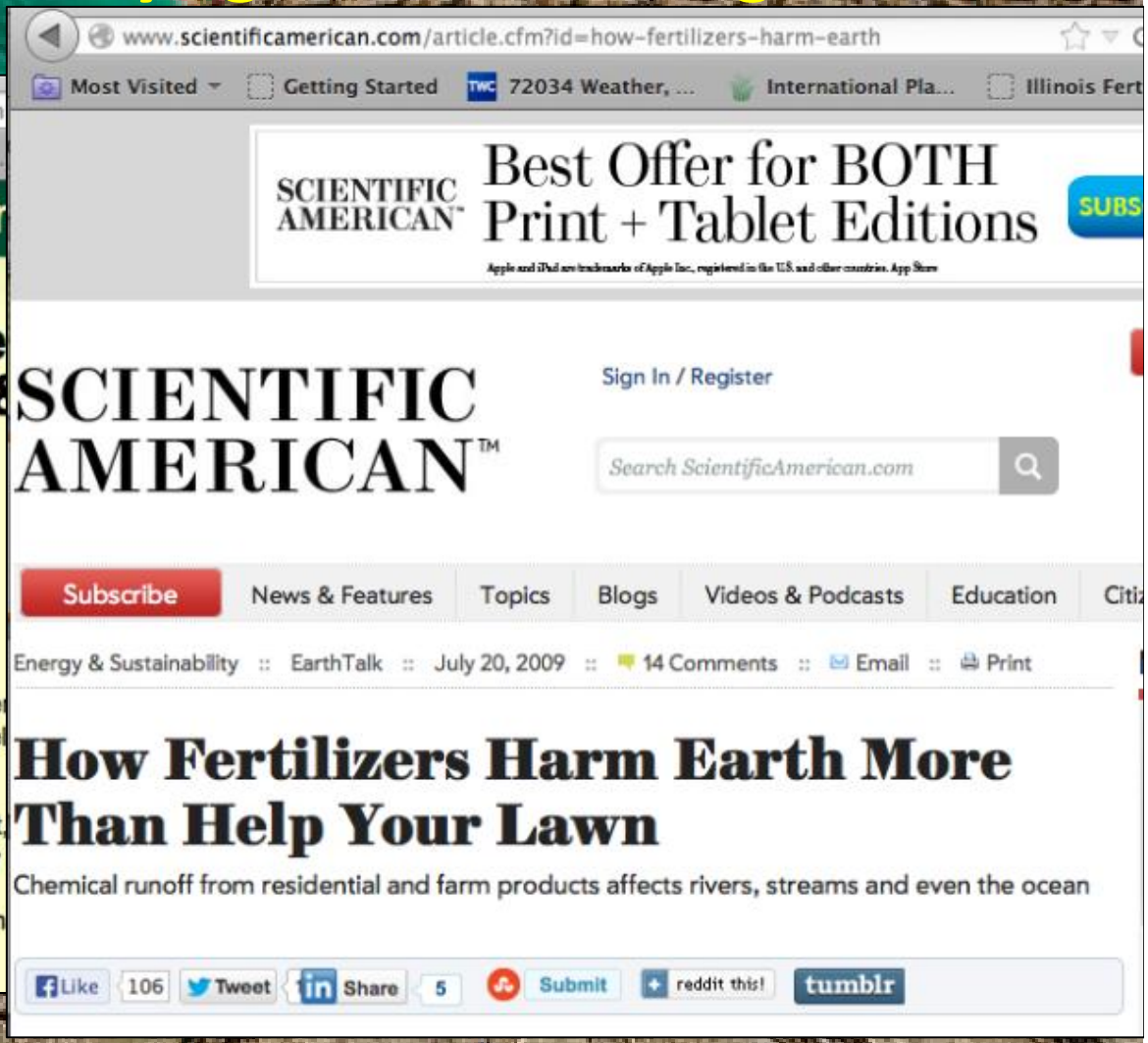
Nutrients are critical to global food security, but society does not always get that message …





Nutrients are critical to global food security, but society does not always get that message …

"The study … estimates that the annual cost of damage caused by excess nitrogen across Europe is €70 - €320 billion, more than double the extra income gained from using nitrogen fertilizers in European agriculture"

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news.sciencemag.org/2010/02/fertilizer-acidifying-chinese-land

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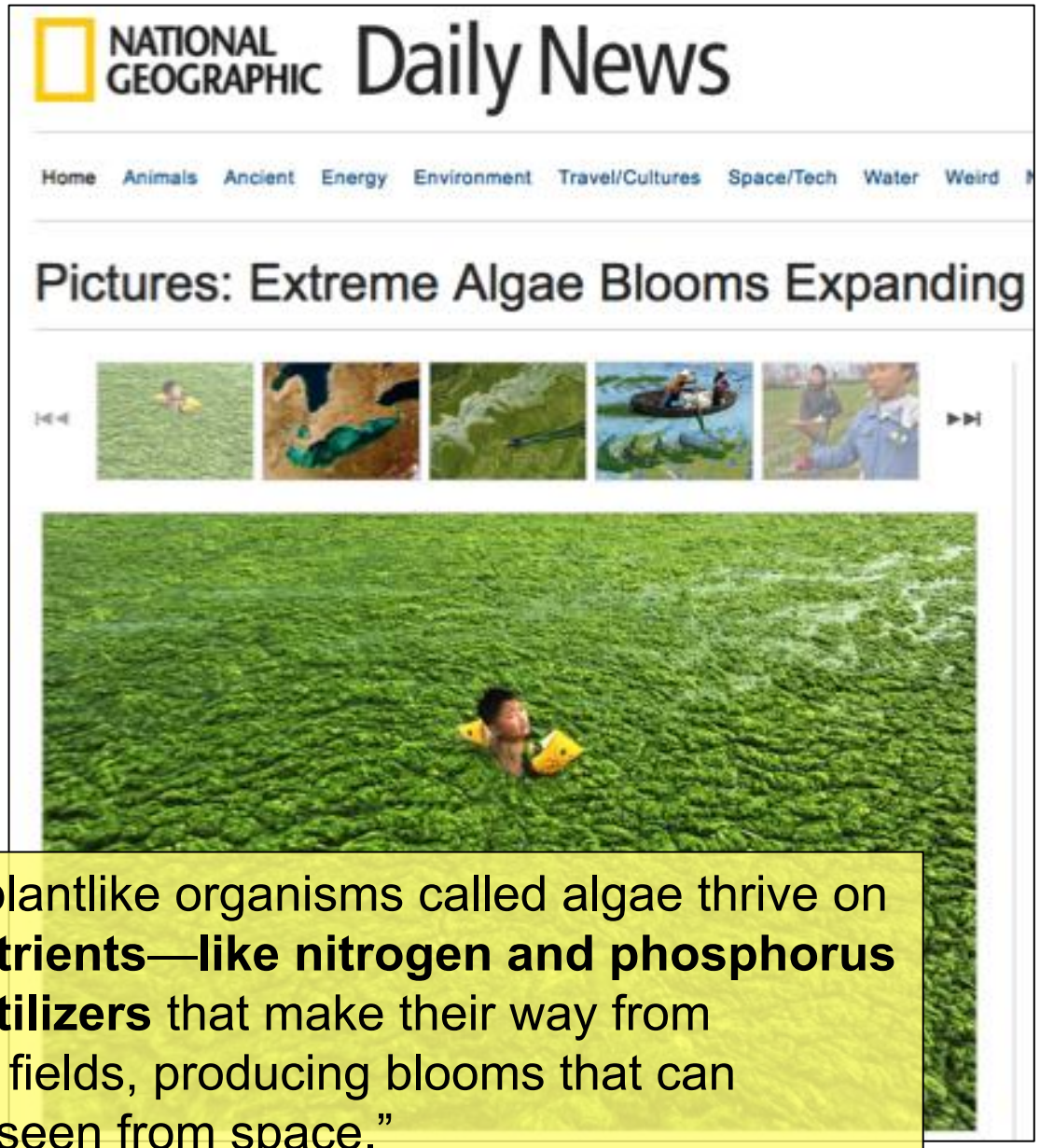
Dying Coral Reefs Linked to Chemical Fertilizers and Factory Farms

Tags: Algae, algae and coral reefs, bleaching coral reefs, chemical fertilizers, coral reefs, dead zones, nitrogen, organic farming

While coral reefs are dying off at a faster rate, new research has determined that ocean pollution is largely responsible for ruining the health of the symbiotic algae species that keep the coral reefs healthy.

Recent research from the UK's University of Exeter has determined in a study of 19 Caribbean reefs, that the reefs' production of carbonate – a measure of their health – is down by over 50%. They also found that 37% of the reefs were eroding – dying. Other studies of other reef systems around the world have found similar rates of decline and bleaching of coral reefs.

Nutrients are critical to global food security, but society does not always get that message …



"Microscopic, plantlike organisms called algae thrive on the **excess nutrients—like nitrogen and phosphorus—found in fertilizers** that make their way from backyards and fields, producing blooms that can sometimes be seen from space."

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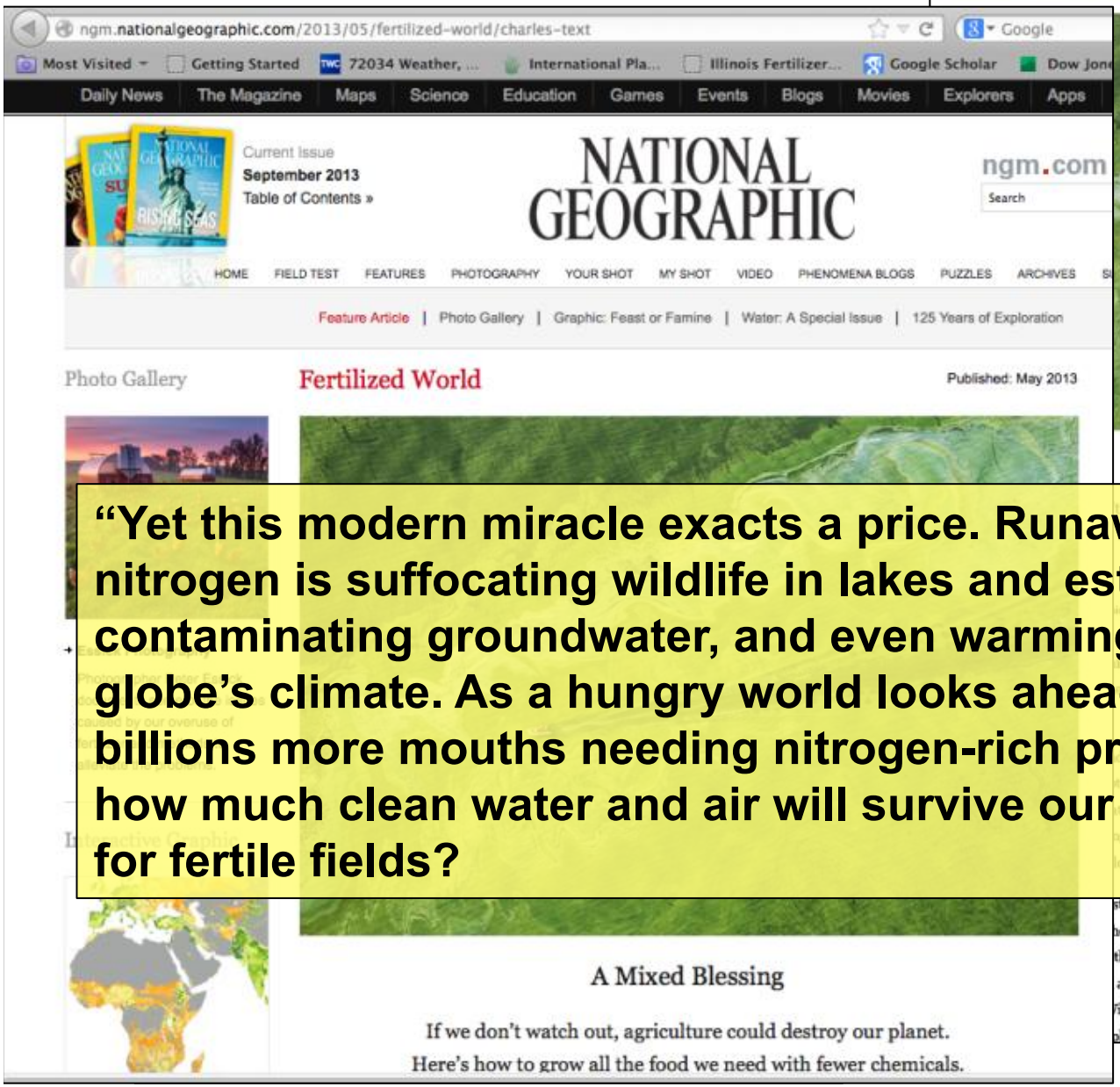
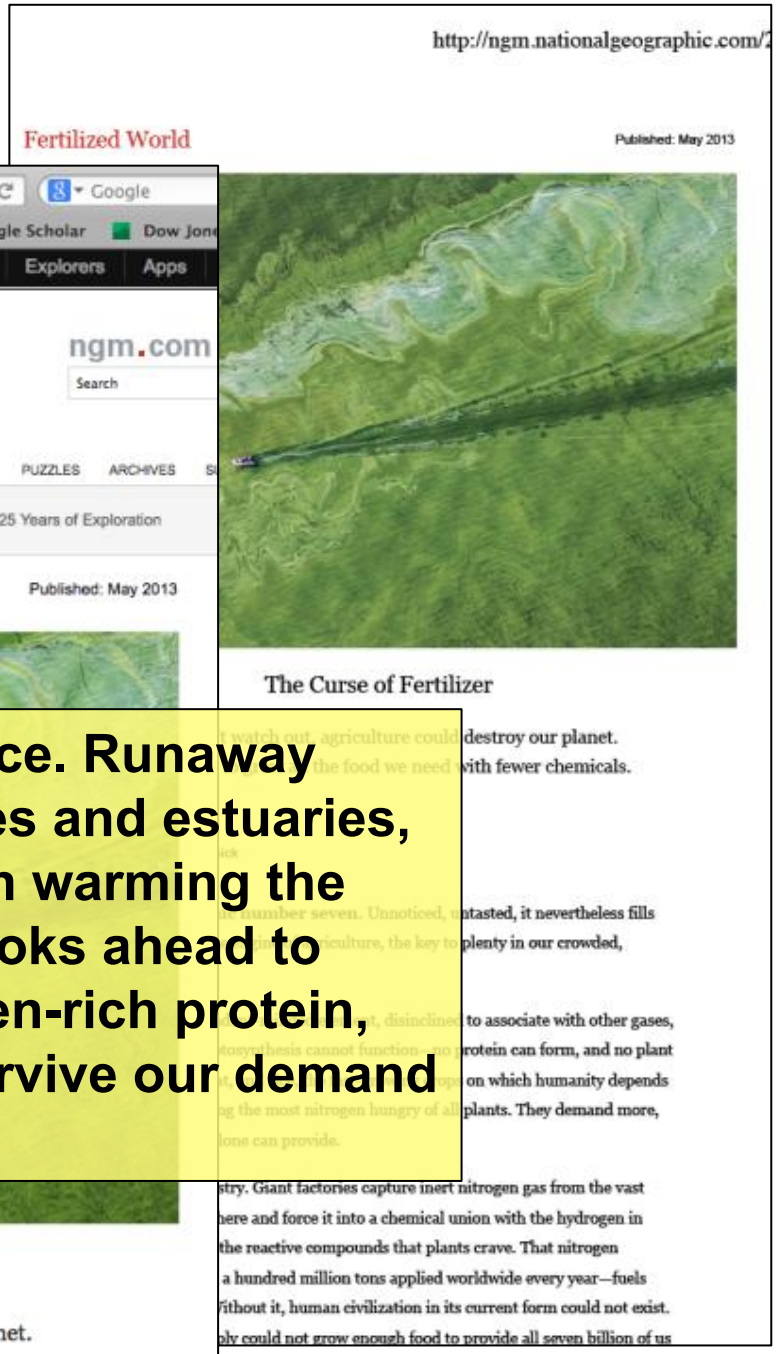
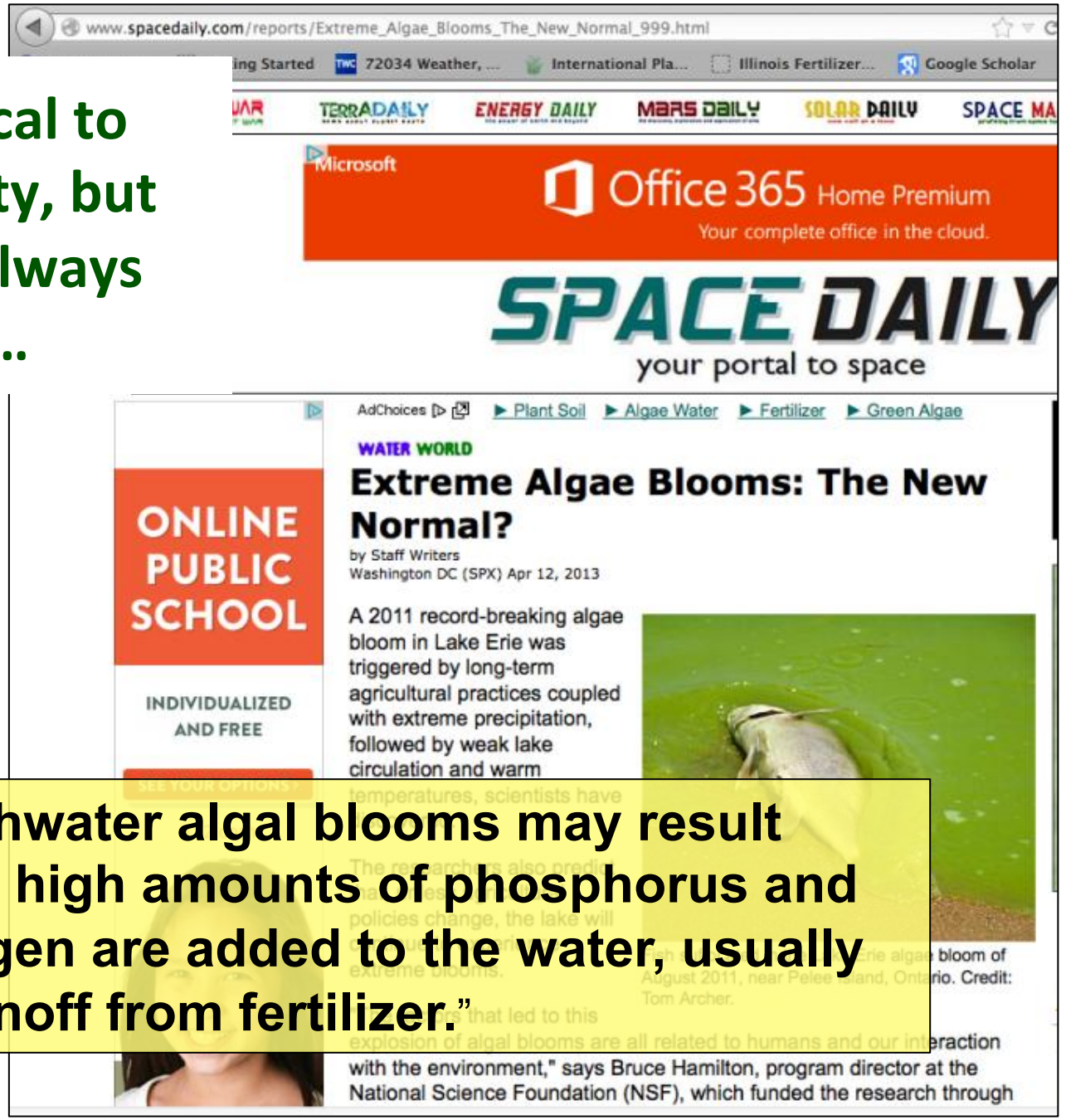
Nutrients are critical to





"Yet this modern miracle exacts a price. Runaway nitrogen is suffocating wildlife in lakes and estuaries, contaminating groundwater, and even warming the globe's climate. As a hungry world looks ahead to billions more mouths needing nitrogen-rich protein, how much clean water and air will survive our demand for fertile fields?

Nutrients are critical to global food security, but society does not always get that message …



"Freshwater algal blooms may result when high amounts of phosphorus and nitrogen are added to the water, usually as runoff from fertilizer."

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Nutrients are critical to global food security, but society does not always get that message …

Explosion Rips Through West, Texas, Fertilizer Plant

Homes and business were completely destroyed around the West, Texas, plant.

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West, Texas Fertilizer Plant Explodes 1 of 39

Fertilizer Shows Its Deadly Side

by DAN CHARLES

April 19, 2013 4:05 PM

orkers at a cooperative farm near Shanghai scatter fertilizer across fields of winter wheat. Image from the May issue *National Geographic* magazine.

Essick/National Geographic

My first reaction when I heard details of this week's deadly fertilizer explosion in Texas was horror.

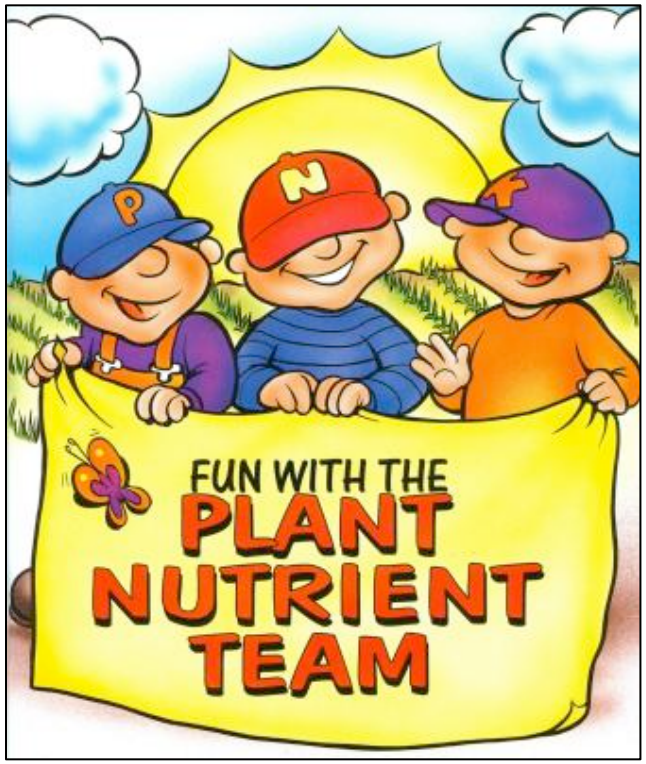
My second thought was, "Maybe I shouldn't have pushed to change that headline."

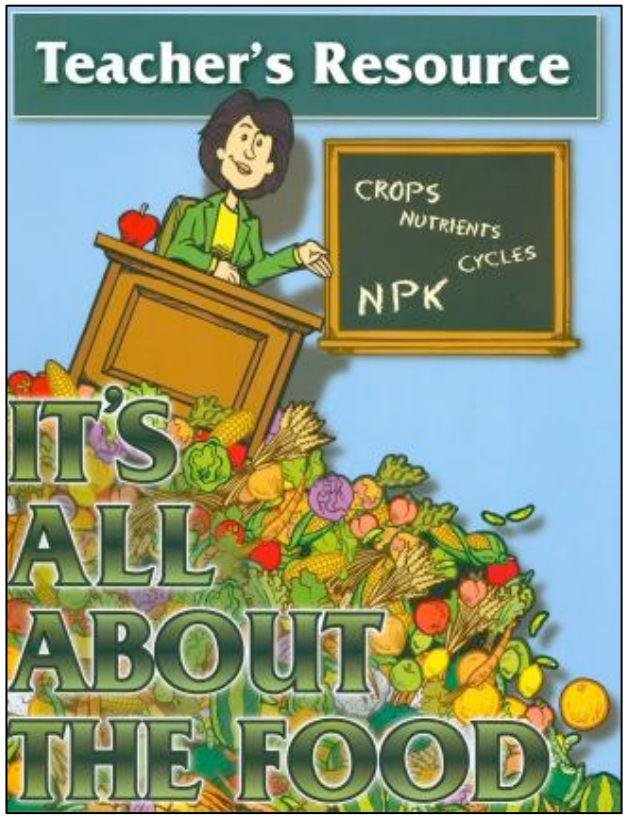
National Geographic magazine just published in its May issue my article about how nitrogen fertilizer has shaped our planet. The article, with Peter Essick's beautiful pictures, describes

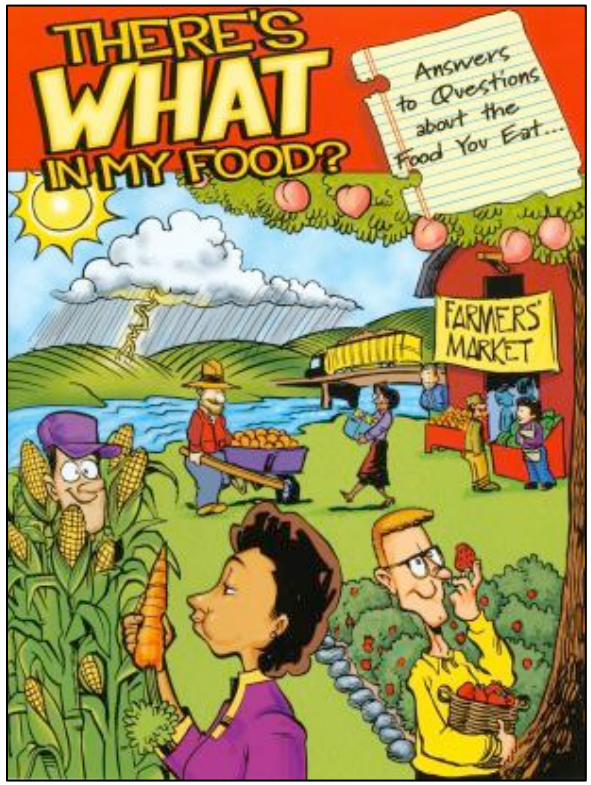
… Nutrients for Life Foundation

The Nutrients for Life Foundation … provides science-based information to help educate people about the benefits of fertilizer

IPNI provides scientific support to the Foundation







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- IPNI provides scientific support to the Foundation

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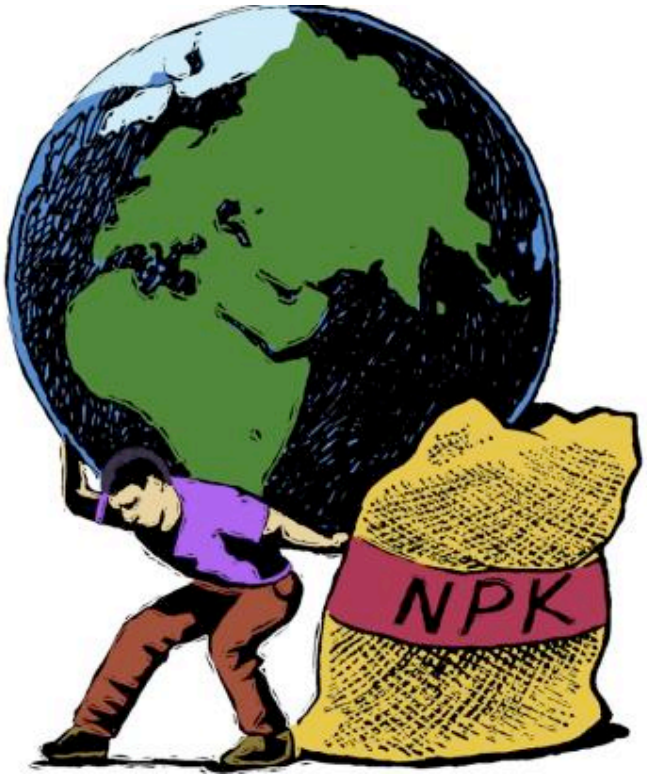

Thank You

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