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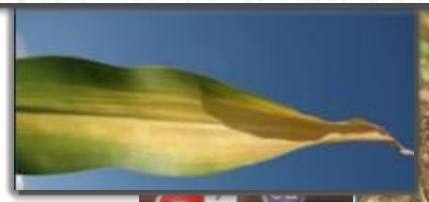
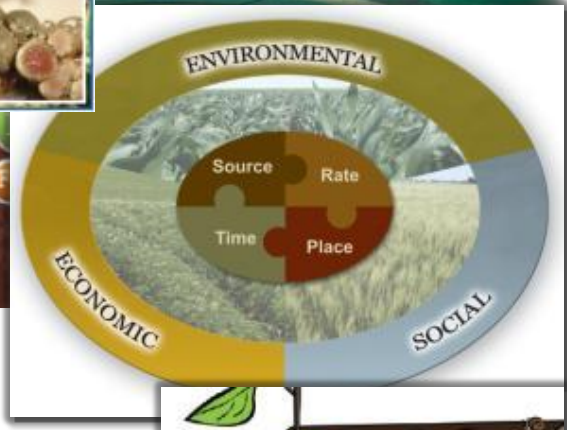
INSTITUTE





Soils, Fertilizer and Food Security

Paul Fixen
Sr. Vice President, IPNI
President Elect, ASA

IPNI Member Companies

Agrium Inc.

Arab Potash Company

Belarusian Potash Company

BHP Billiton

CF Industries Holdings, Inc.

Compass Minerals Plant Nutrition

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LUXI Fertilizer Industry Group

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PhosAgro

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Shell Sulphur Solutions

Simplot

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Brazil Staff

Dr. Luís Prochnow

Diretor Geral do IPNI Brasil

Dr. Valter Casarin

Diretor Adjunto do IPNI Brasil

Dr. Eros Francisco

Diretor Adjunto do IPNI Brasil

American Society of Agronomy

- International scientific and professional society
- Professional home for:
  - 8,000+ members
  - 14,000+ certified professionals (CCAs and CPAs)

CERTIFIED CROP ADVISER

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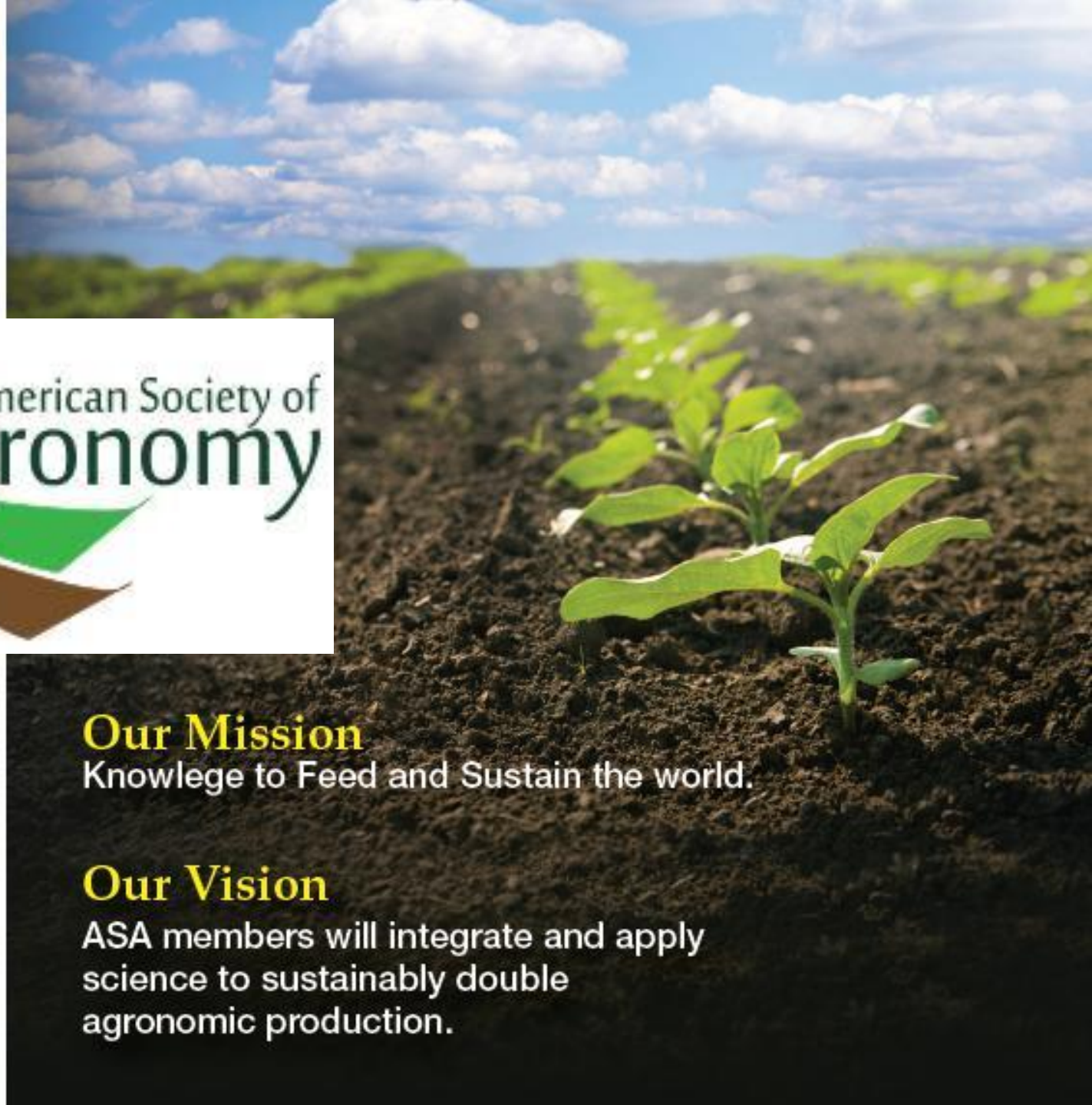

American Society of Agronomy

Our Mission

Knowlege to Feed and Sustain the world.

Our Vision

ASA members will integrate and apply science to sustainably double agronomic production.

Institutions with much in common

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American Society of
Agronomy

Combine science and fertilizer to:

Combine science and agronomy to:

Make life better for human kind through the food we eat, water we drink, air we breath, the beauty we see in our surroundings

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Food and Agriculture Organization
of the United Nations

2015

Ano Internacional
dos Solos

An opportunity for each of us to tell our own **soil** story

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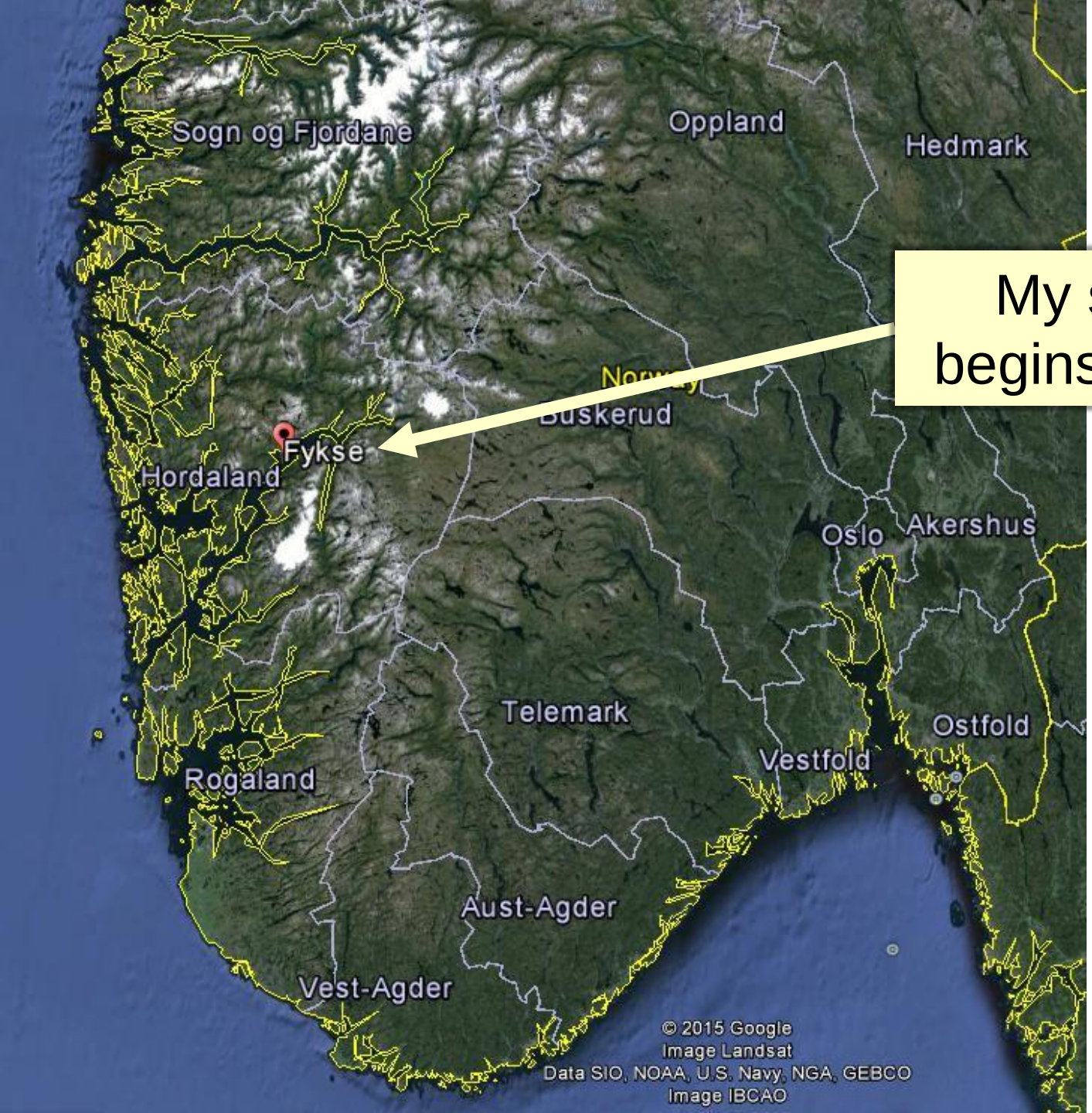
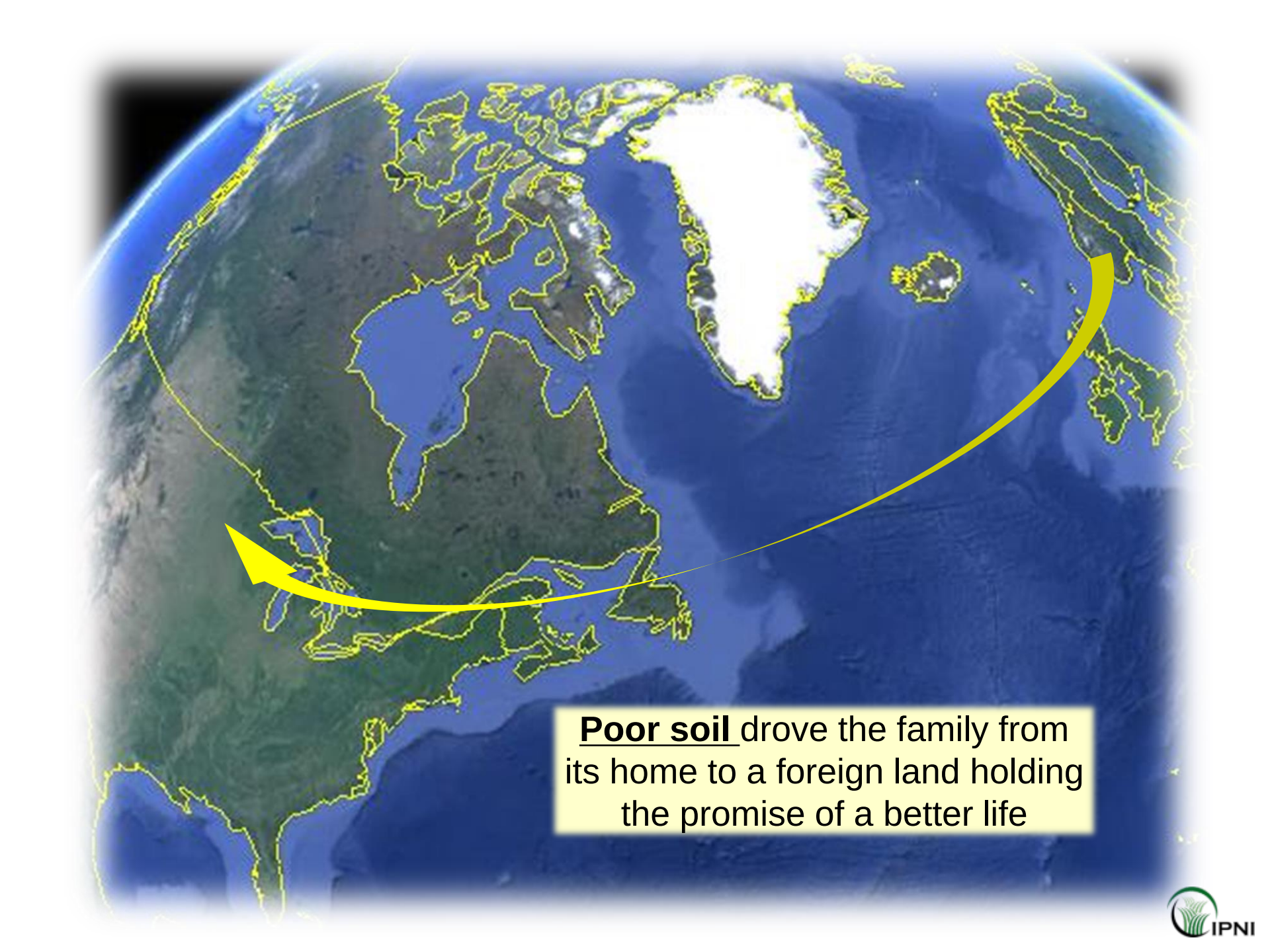


My soil story begins in Norway

The original Fixen Farm: near Fykse, Norway


Poor soil drove the family from its home to a foreign land holding the promise of a better life


Minnesota
Minneota, MN
Where the clan landed
Minneota, MN
Iowa

Deep dark high organic matter prairie soils … a farmer's heaven!

High school soil judging in FFA

- Soil has 3 dimensions
- What's below the surface explains much of what happens on the surface
- Soil is important to farming … and complex

Led to a PhD in soils and career in soil fertility


We study and manage soils not just for us … but for those that follow
Measuring plant height and residue cover
1992

Food and Agriculture Organization
of the United Nations

2015

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What's your **soil** story?

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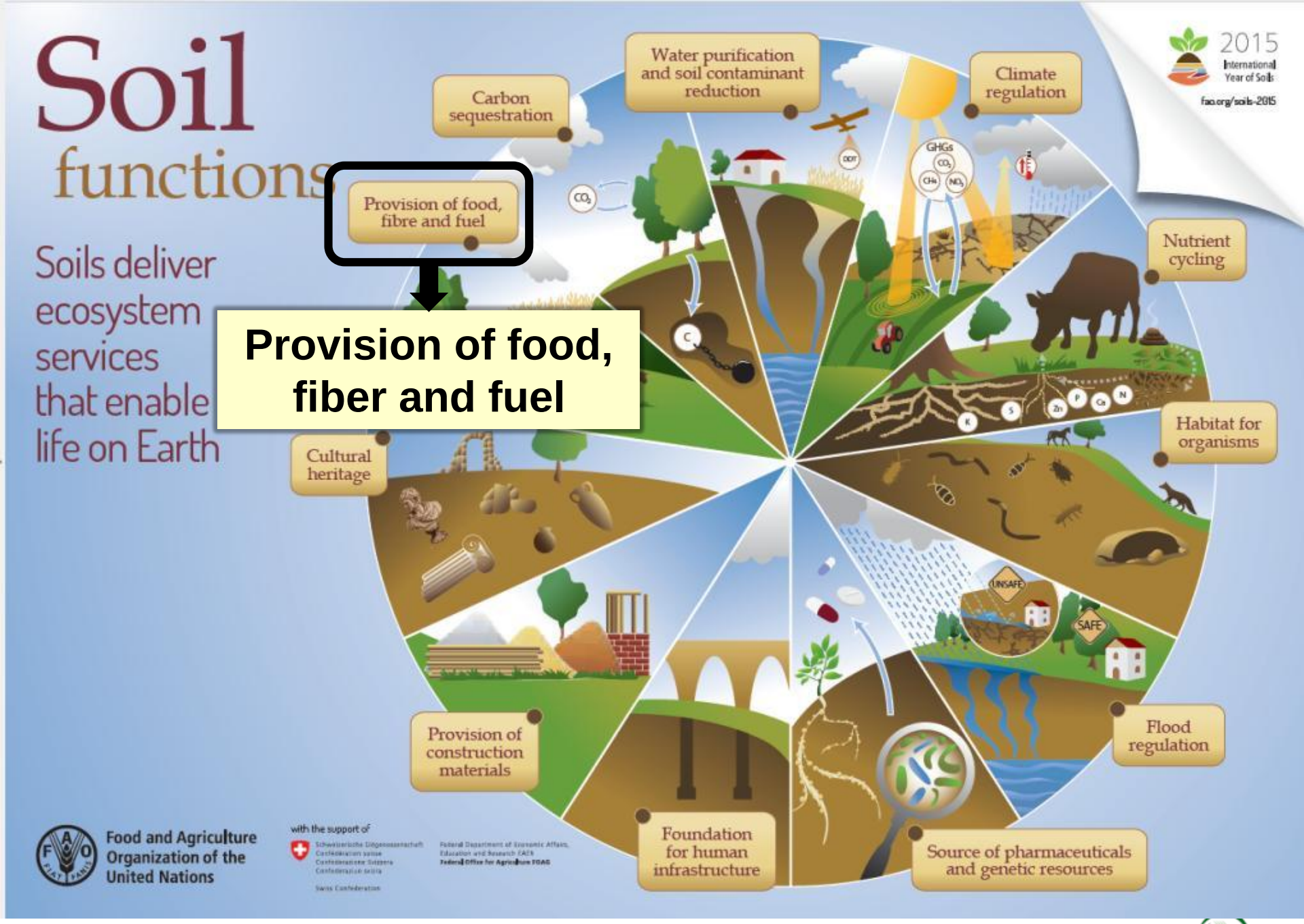
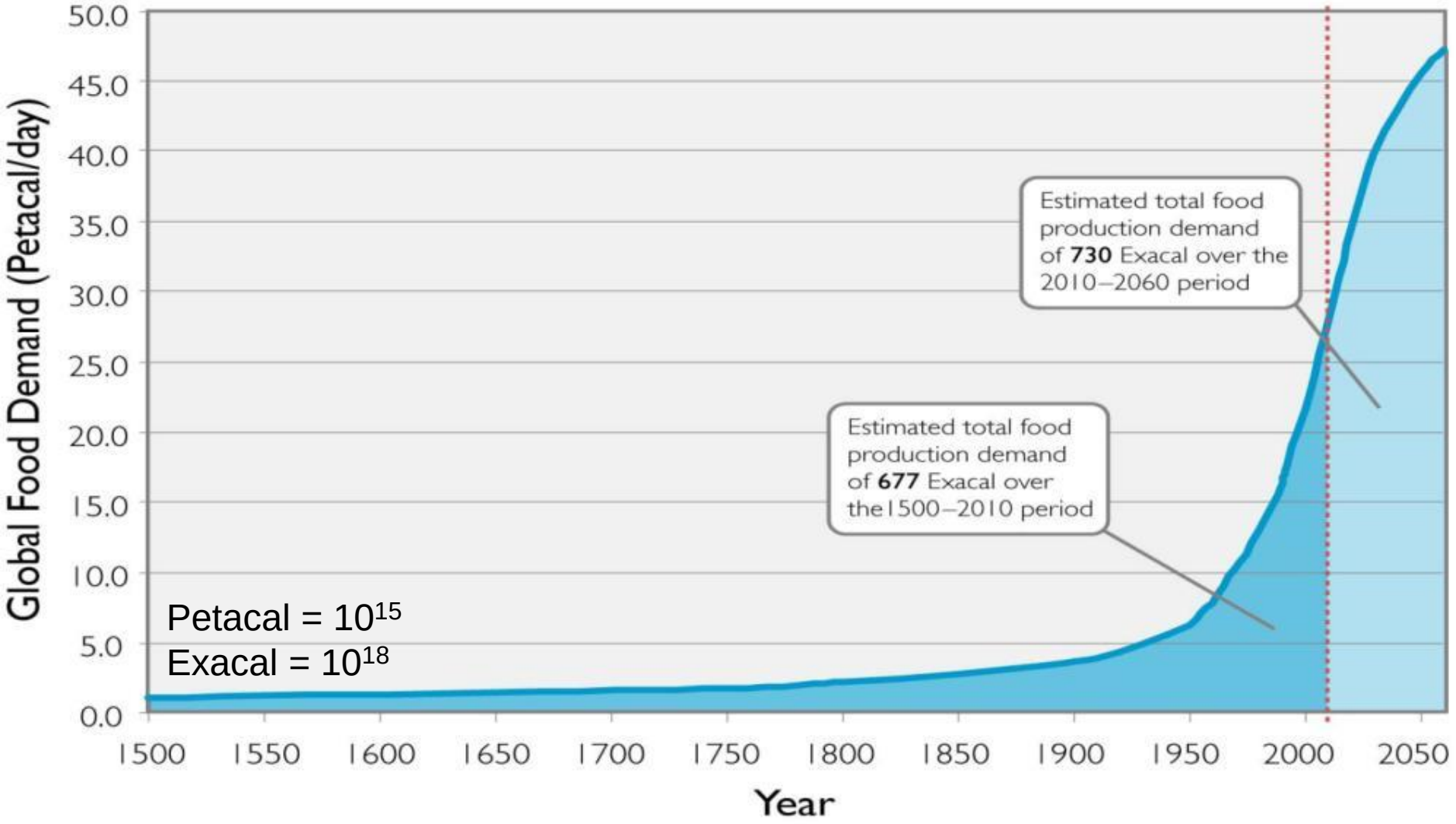
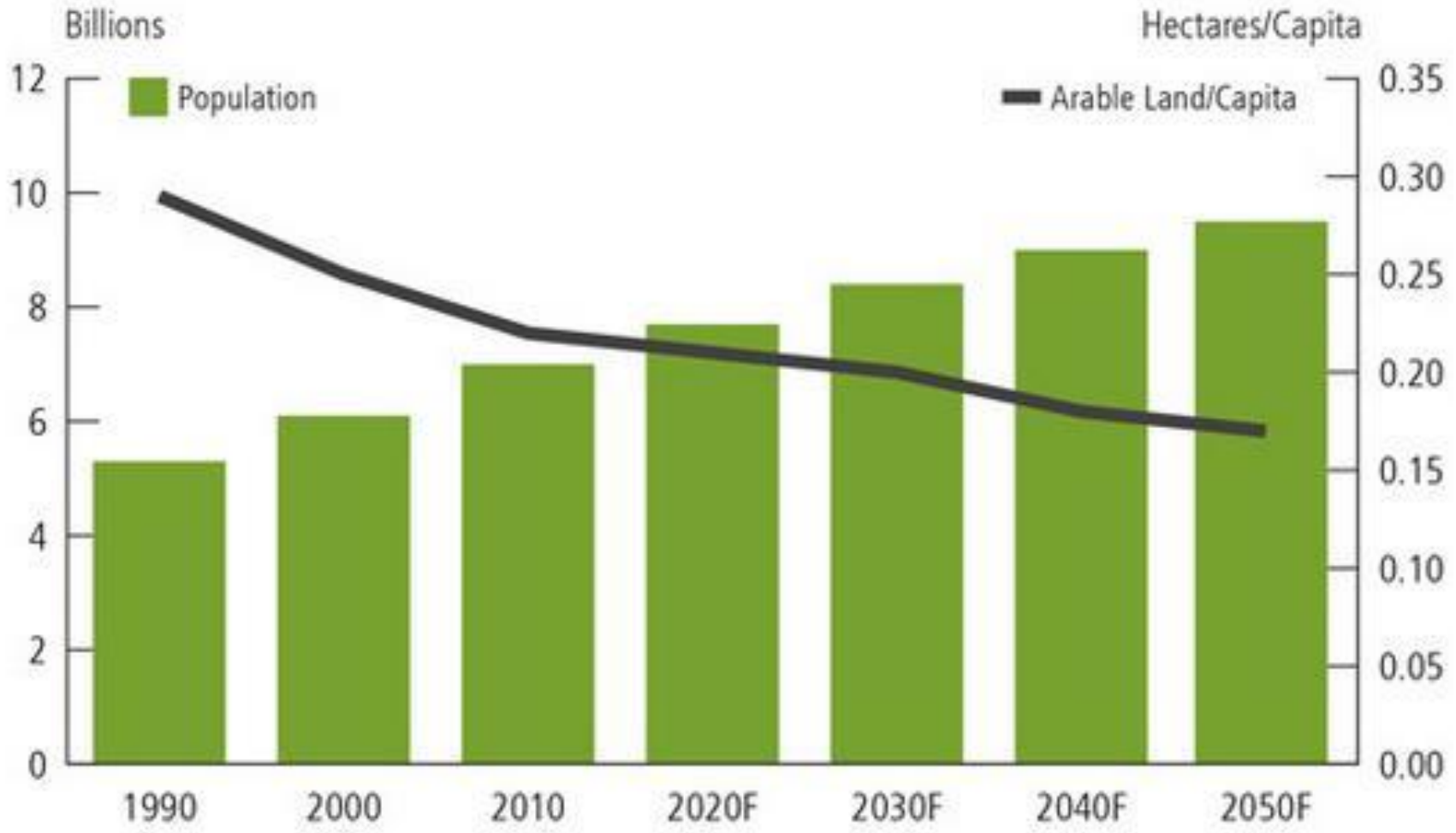

Soil functions
Soils deliver ecosystem services that enable life on Earth
Provision of food, fibre and fuel
Provision of food, fiber and fuel
Carbon sequestration
Water purification and soil contaminant reduction
Climate regulation
Nutrient cycling
Habitat for organisms
Flood regulation
Source of pharmaceuticals and genetic resources
Foundation for human infrastructure
Provision of construction materials
Cultural heritage
2015 International Year of Soils
fao.org/soils-2015
Food and Agriculture Organization of the United Nations
with the support of

The food security challenge: to produce more food over the next 50 year than in all of human history



Graph provided by J. Hatfield, USDA-ARS

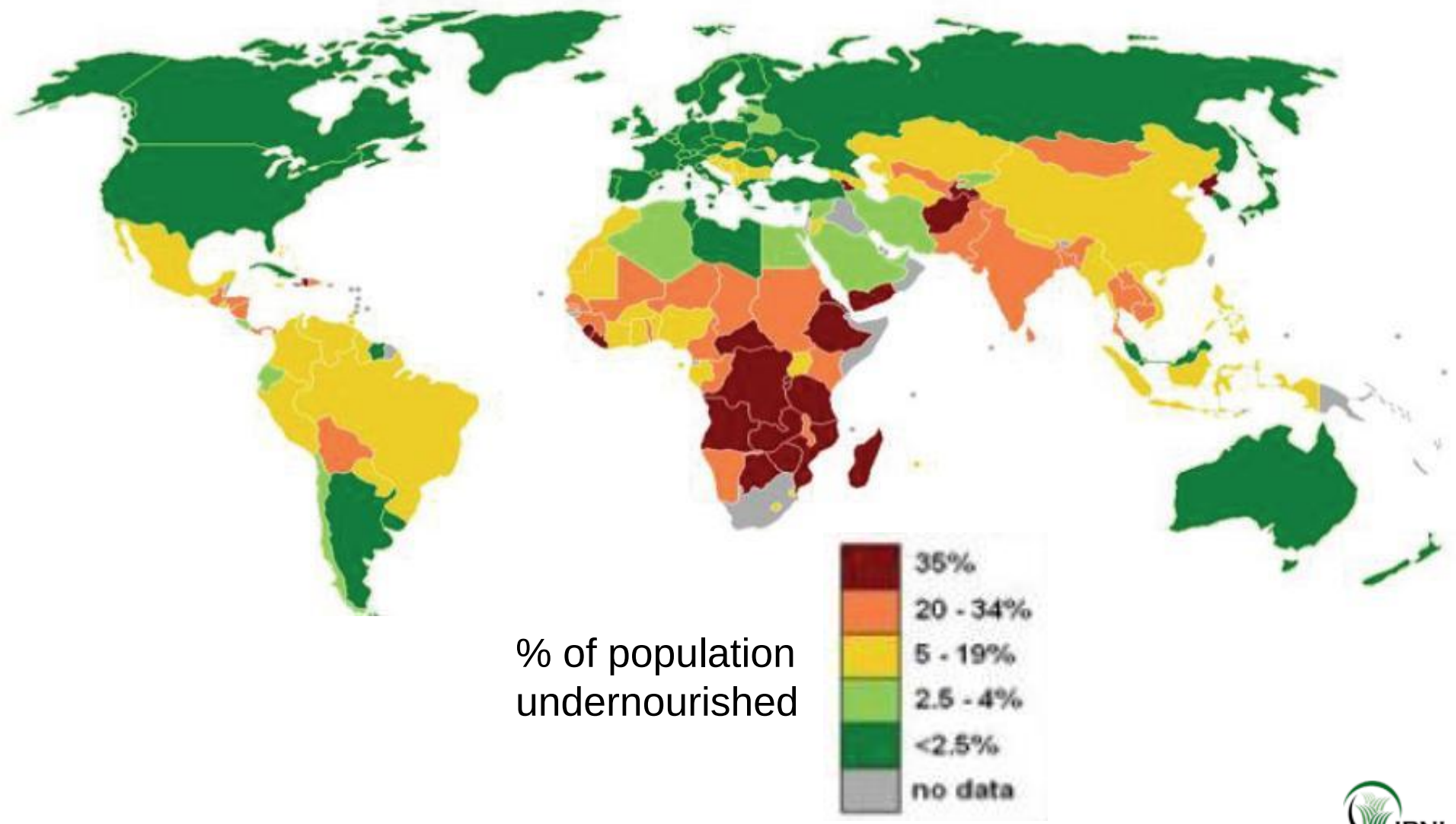
Global population and arable land per capita

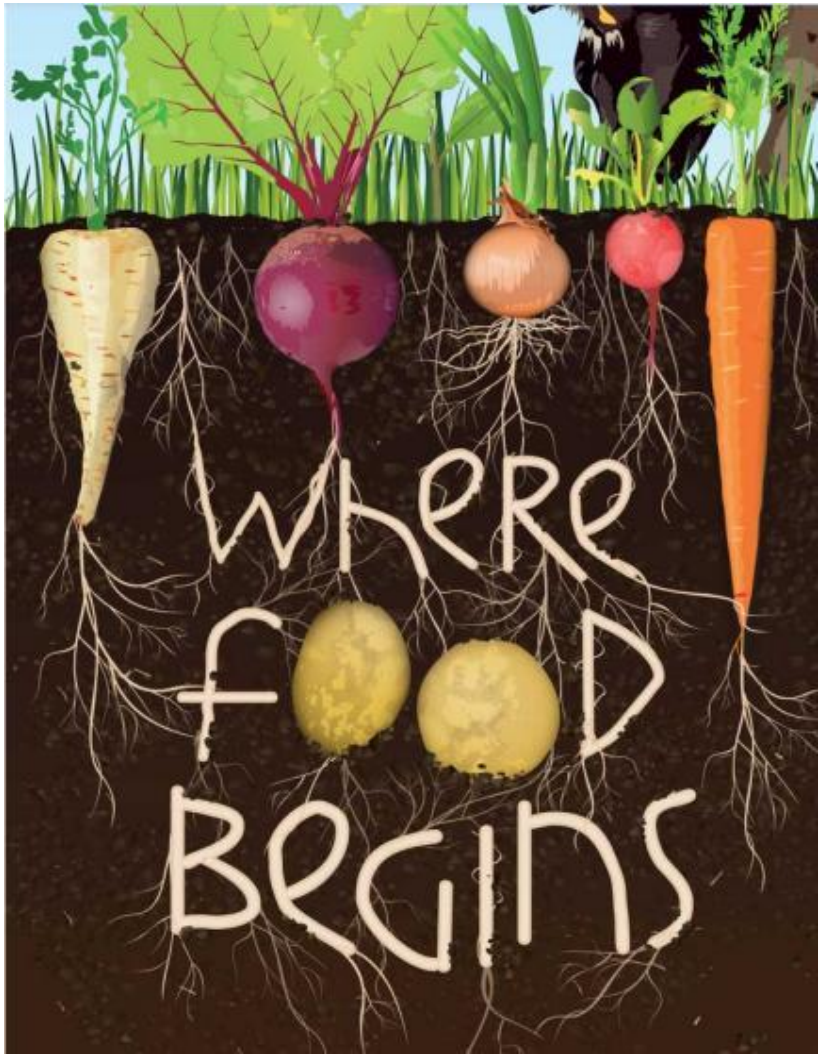


Source: FAO, United Nations, PotashCorp

Last updated: Aug 31, 2014

Our biggest challenge: the permanent "greening" of this map




where
food
begins


95%
OF OUR FOOD COMES FROM OUR SOIL


??
SUSTAINABLE SOIL MANAGEMENT
COULD PRODUCE UP TO 58%
MORE FOOD

iStockphoto/Son-Ha

Terraced soils supporting intensive rice production in Mu Cang Chai, Yen Bai, Vietnam.

Scenes that are far too common

- Food crops come from only **12%** of earth's land area
- Approximately **40%** of agricultural soils are degraded … **65%** in sub-Saharan Africa
- **Half** of earth's topsoil has been lost during the last 150 years

Photos from J. Hatfield, USDA-ARS

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Soil conserving/building practices are essential components of sustainable systems

SOIL HEALTH

SOIL HEALTH WORKSHOP

DATE: February 27, 2014

TIME: 12:30 - 5 p.m.

PLACE: University Inn - Best Western
1516 W. Pullman Rd.
Moscow, Idaho

Featured Speakers- –

- *Mathew Slaughter,* Earthfort
  Biological Analysis Lab, Corvallis OR
  -Soil Microbiology & Biological Ana
- *Dave Huggins,* ARS & Latah S
  -"New methods to address soil h
- *Tabitha Brown,* Latah SWCD
  -pH liming reasearch update
- *Pamela Pavek ,* Pullman Plant
  -Cover Crops & National Soil H
- *John Hammel,* U of Idaho, Soil
  -Impacts of Field equipment on
- Marlon Winger, NRCS State A
  -Soil Health:

unlock the SECRETS IN THE SOIL

Hosted by:
Natural Resources Conservation Service
Latah Soil & Water Conservation District
Questions? Call NRCS (208) 882-4960 x 118

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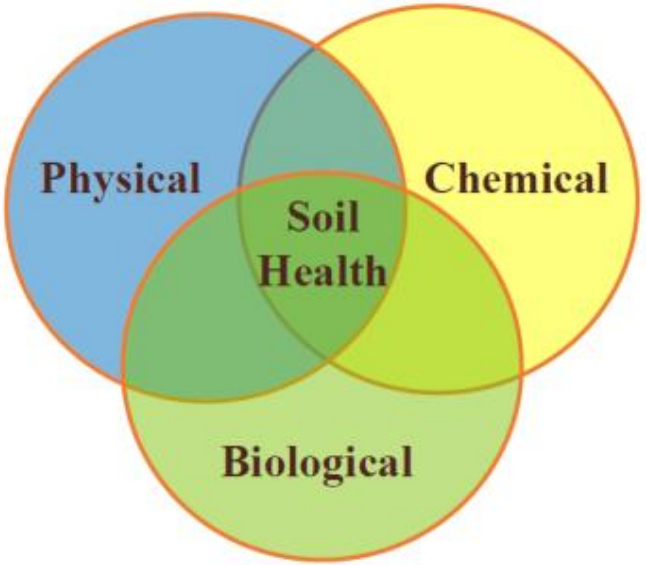
Soil health

- **Soil health** (USDA-NRCS): the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals, and humans
- **Soil health** management requires an integrative approach that recognizes the physical, biological and chemical processes in soils.



Soil organic matter is a primary factor in all three processes

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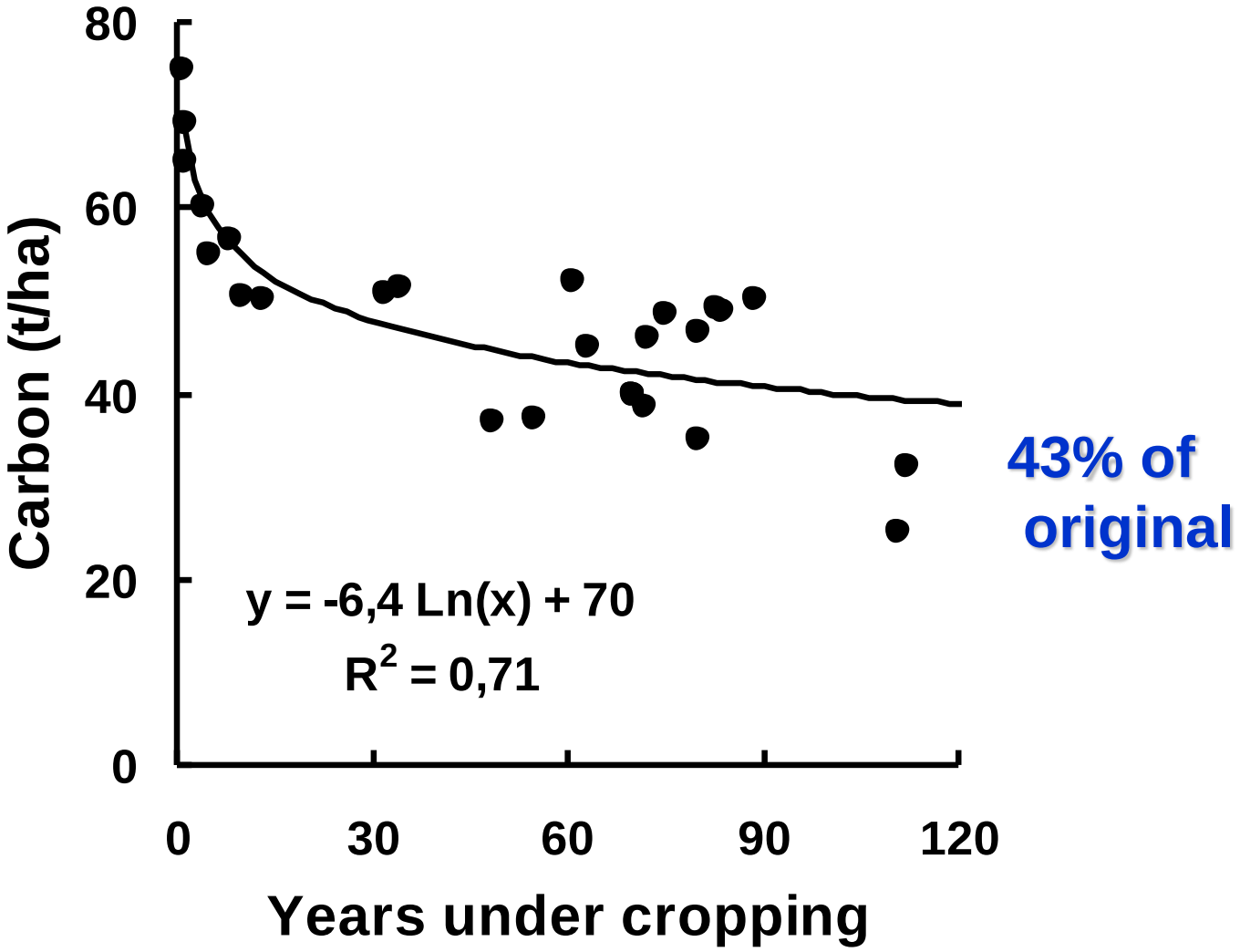
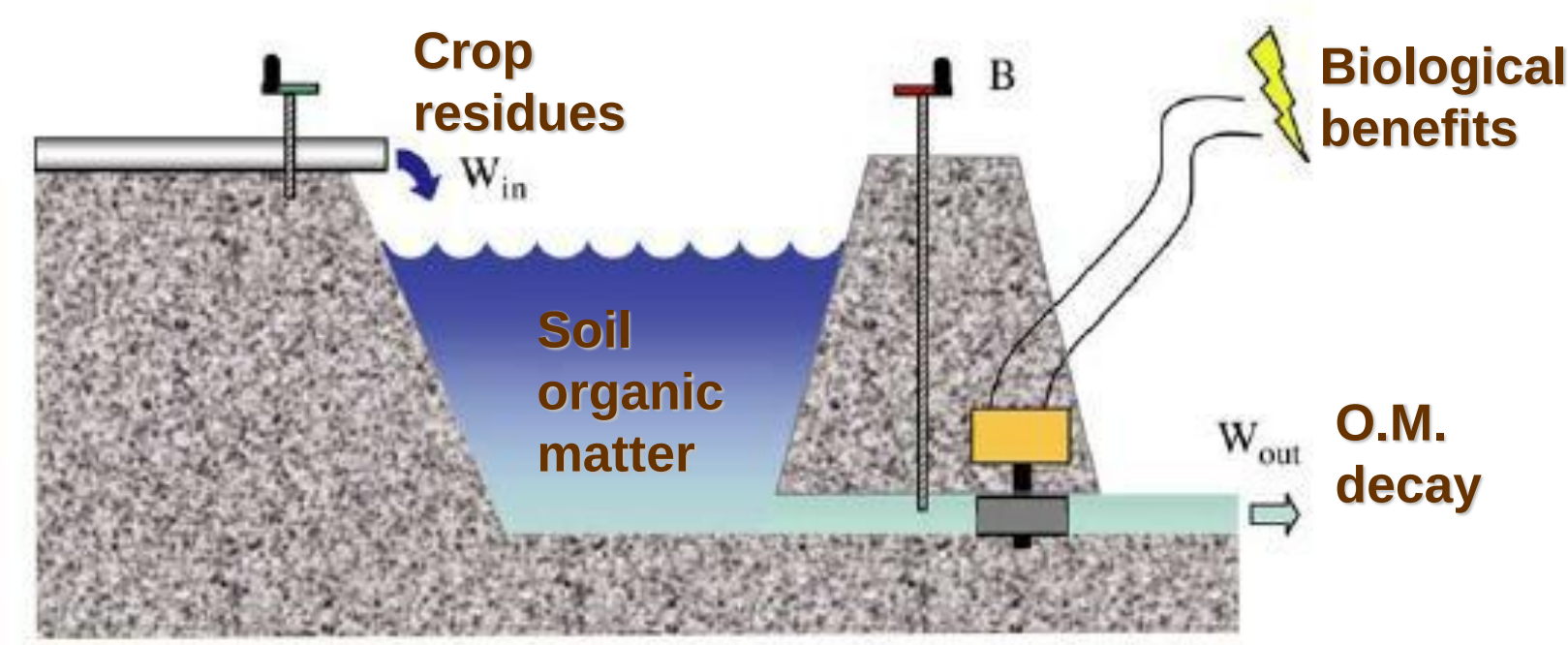
Organic C levels in soils of the northern Pampas since beginning of agriculture

(Argiudolls)



Source: Alvarez y Steinbach (2006) from data of Andriulo and Cordone

Hypothetical hydroelectric plant



- Opening valve B temporarily increases power generation, but at the expense of water storage.
- Closing valve B increases water stored, but reduces power generation.
- Increasing both storage and power requires an **increase in water inflow**.

More residue production

Janzen, 2006

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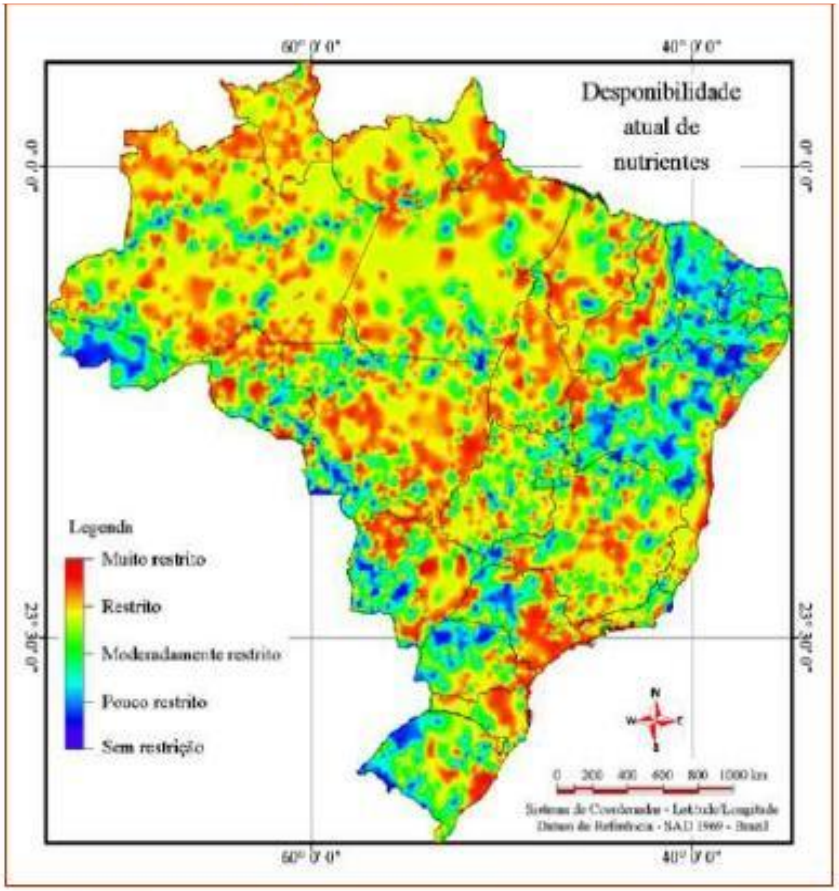
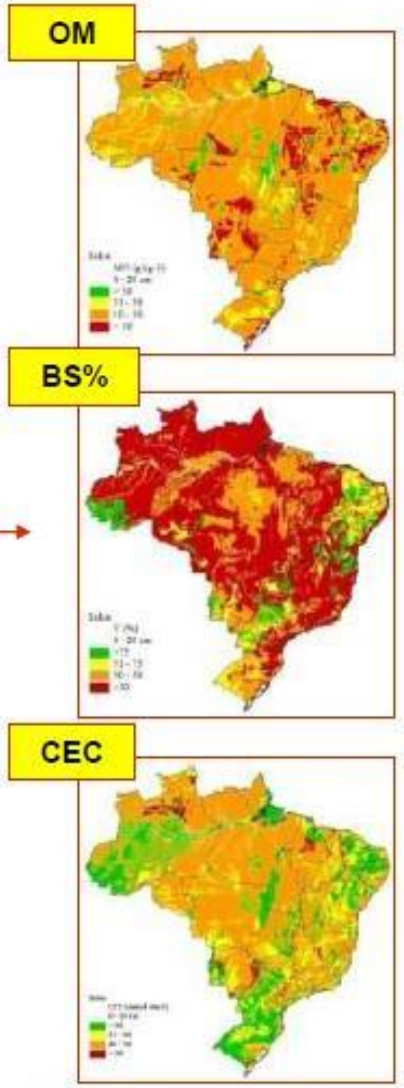
Soil fertility restrictions in Brazil





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Fonte: Sparovek et al.

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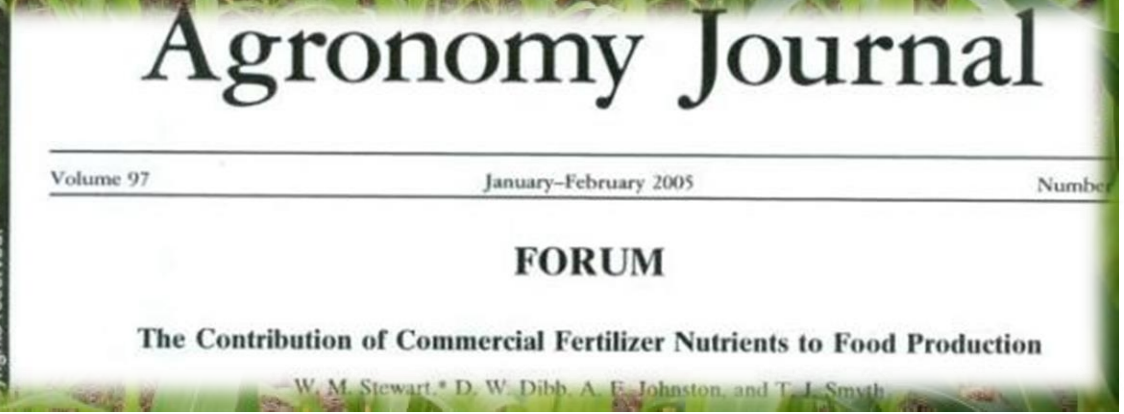
Response to P & K fertilization in the cerrado of Brazil

Yield attributed to fertilizers

- Temperate soils: 40-60%
- Tropical soils: much higher


Agronomy Journal

Volume 97 January–February 2005 Numbe

FORUM

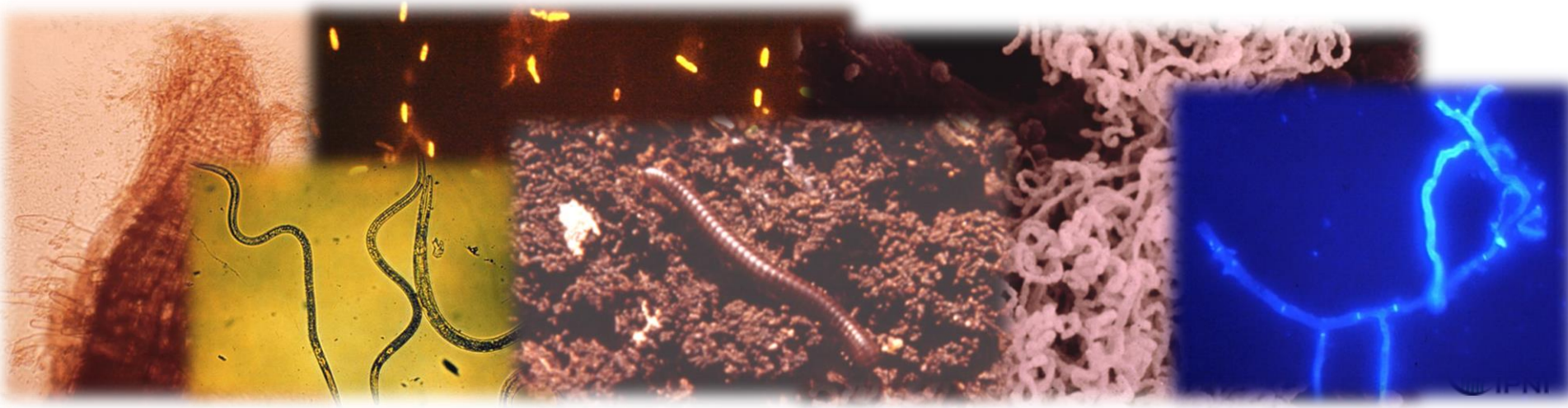
The Contribution of Commercial Fertilizer Nutrients to Food Production

W. M. Stewart,* D. W. Dibb, A. E. Johnston, and T. J. Smyth

Stewart et al., 2005.

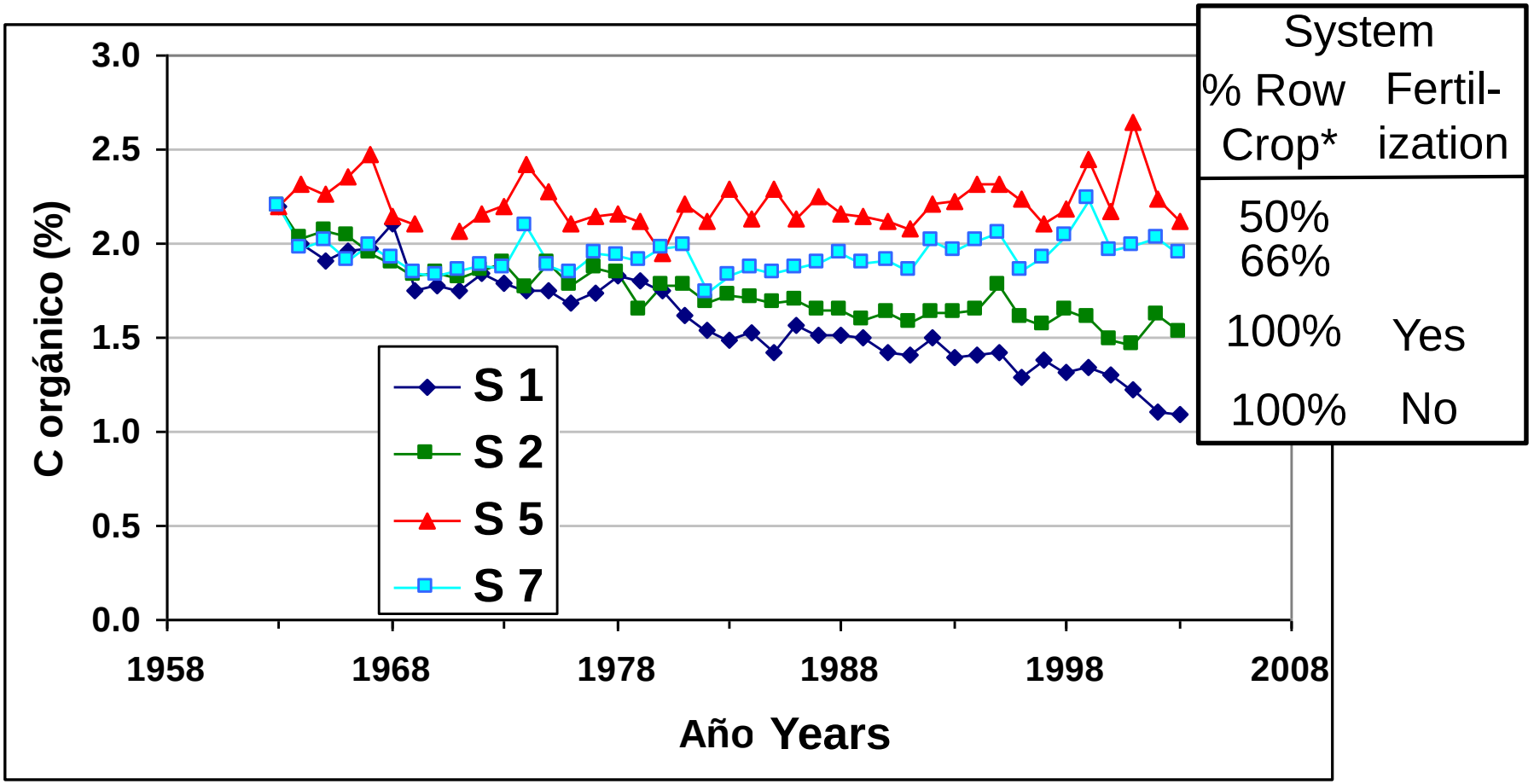
Crop residue you do not see - roots

And much additional biota below the soil surface



Organic C evolution during 40 years

Rotations Study INIA La Estanzuela (Uruguay)



*Other crop in rotation is pasture

Source: A. Morón (2003)

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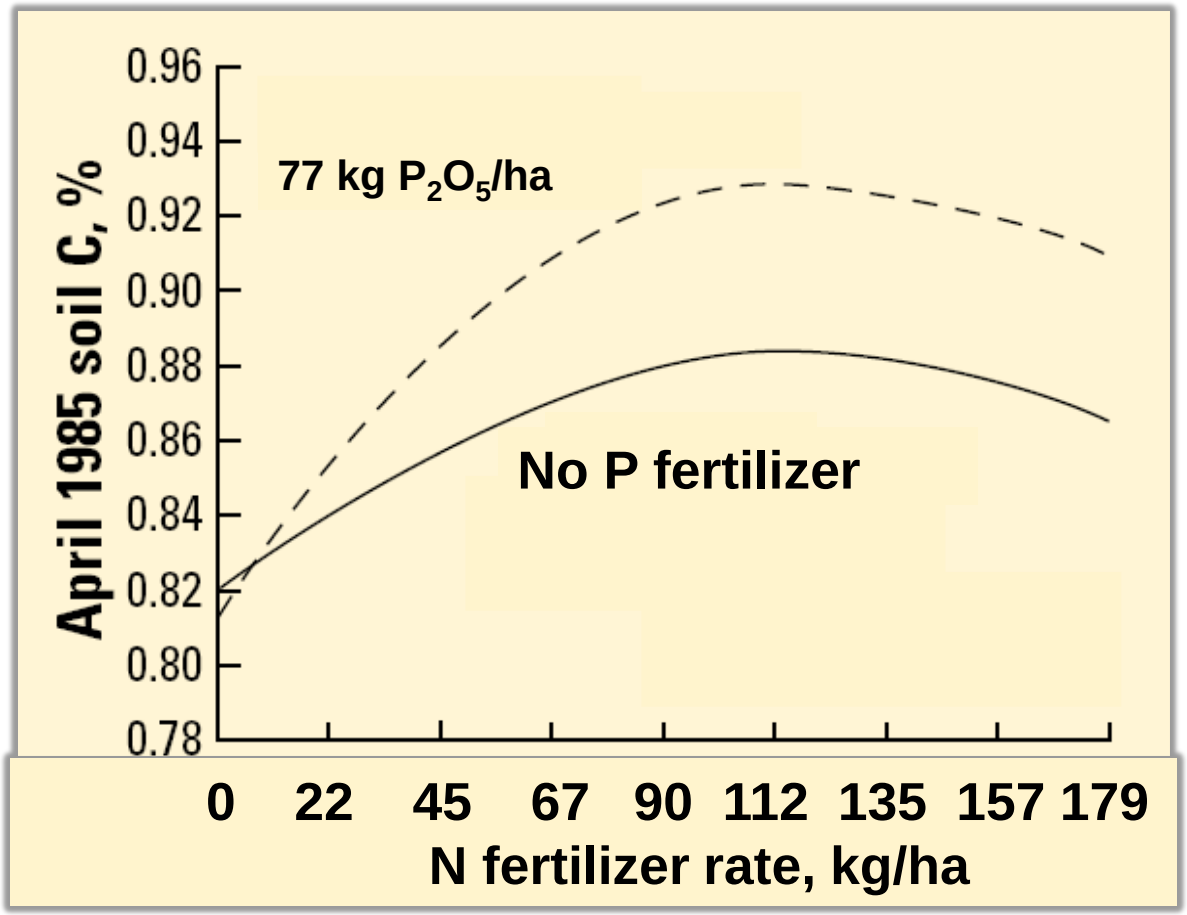
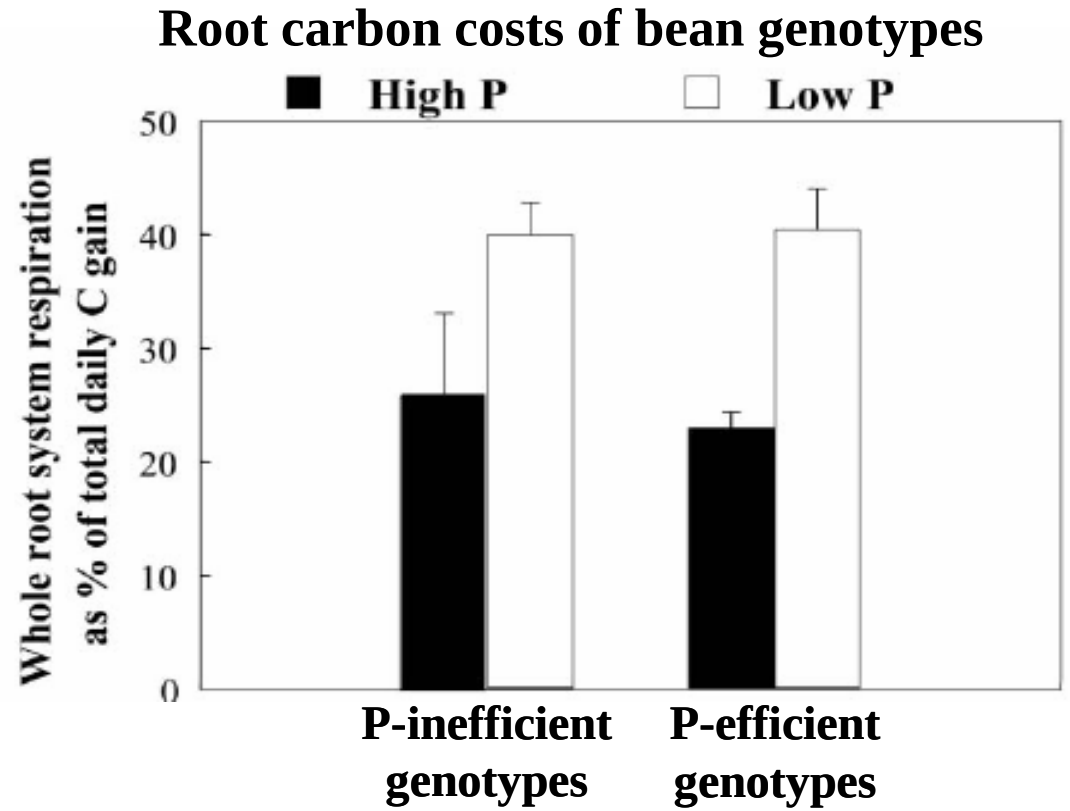
Soil carbon in 0-7.5 cm soil depth as a function of N and P fertilizer rates.



Halvorson and Reule, 1999

Insufficient P leads to reduced C sequestration … bad for soils, bad for climate

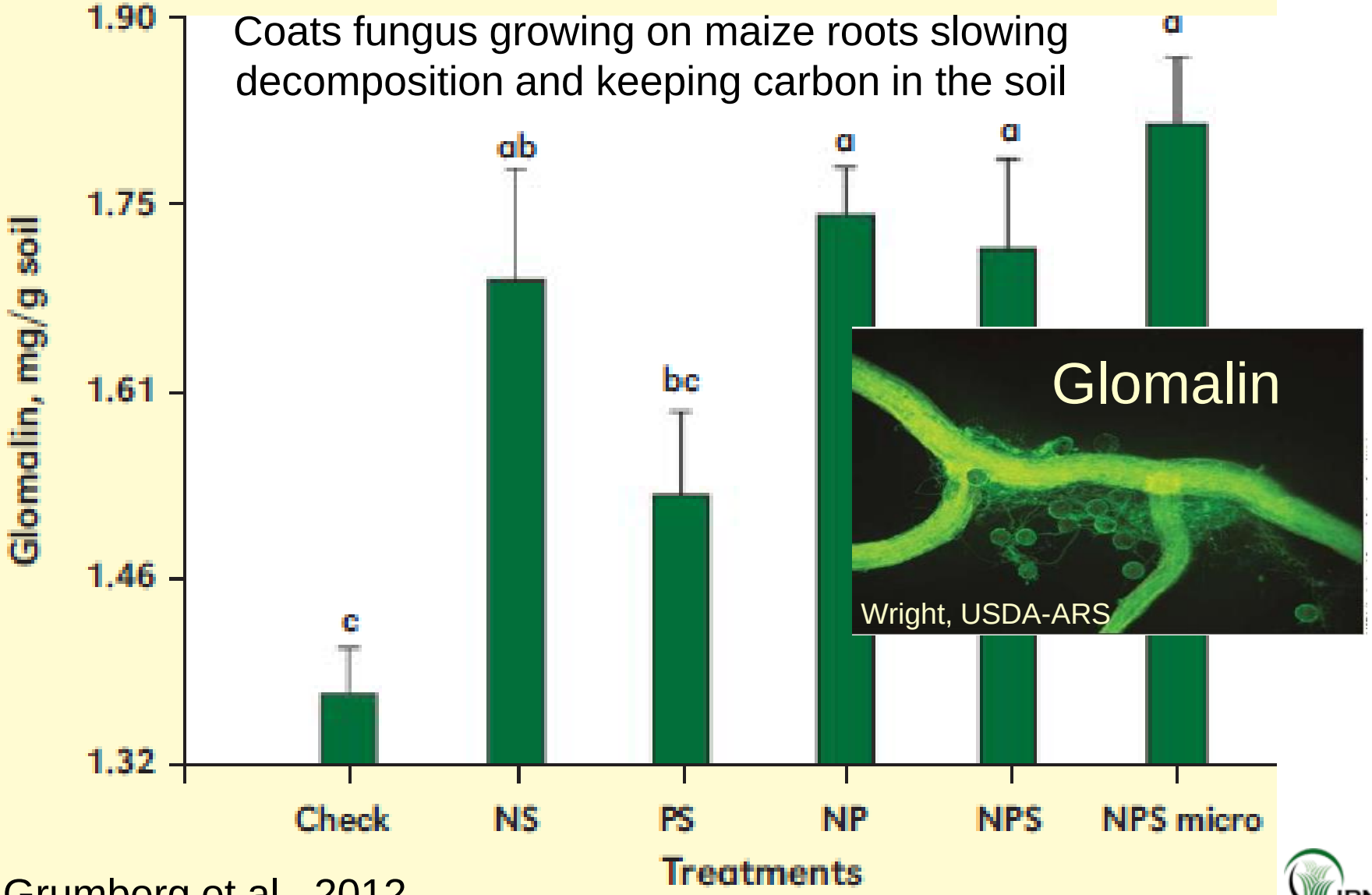
- **Low P plants:**
  - Lose more C through root respiration
  - Have increased root exudation of C
  - Often have increased physiological C costs



Lynch and Ho, 2005

Soil glomalin concentration under different fertilization treatments (Argentina)

Coats fungus growing on maize roots slowing decomposition and keeping carbon in the soil



Grumberg et al., 2012

Integrated management of fertilizers and organic nutrient sources

Treatment		Avg	Soil org. C
N-P-K	**Manure**	**yield (9yrs)**	**after 9 yrs**
kg/ha	*t/ha*	*t/ha*	*t/ha*
0-0-0	0	1.3	14.1
0-0-0	10	1.7	15.4
120-26-33	0	2.4	16.9
120-26-33	10	3.0	**18.6**
$LSD_{0.05}$		0.2	1.9

Irrigated wheat/soybean system in sub-temperate region of North India.

Singh and Ryan, 2015.

Nutrient removal by the 18 leading crops of Brazil

Factor	N	P_2O_5	K_2O
	Million tons		
Crop removal	6.50	1.84	3.03
Legume fixation	4.35		

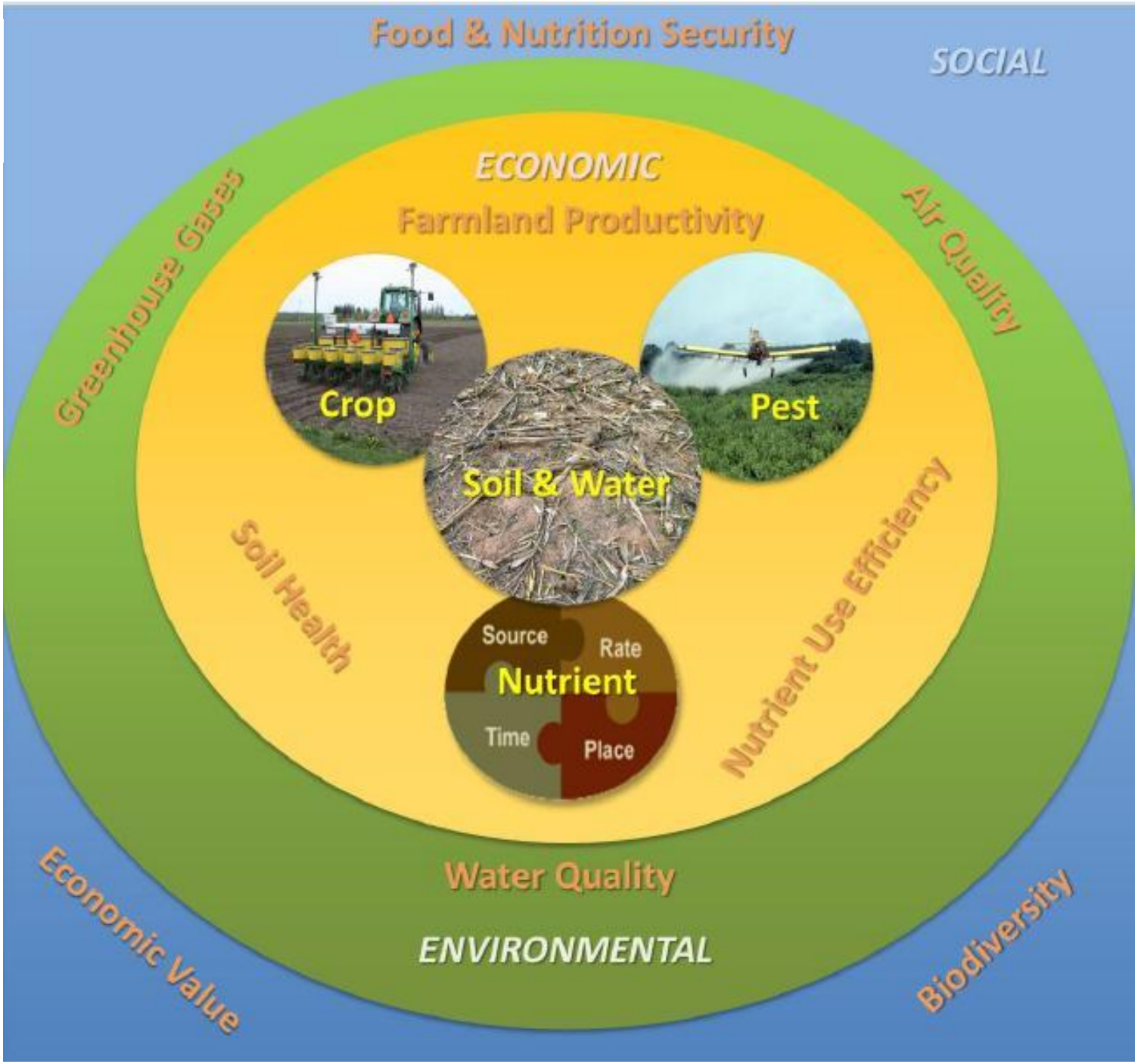
Average of 2009-2012.

- Fertilizer nutrients replace those removed by crop harvest to avoid soil nutrient exhaustion **AND …**
- To maintain or build soil organic matter

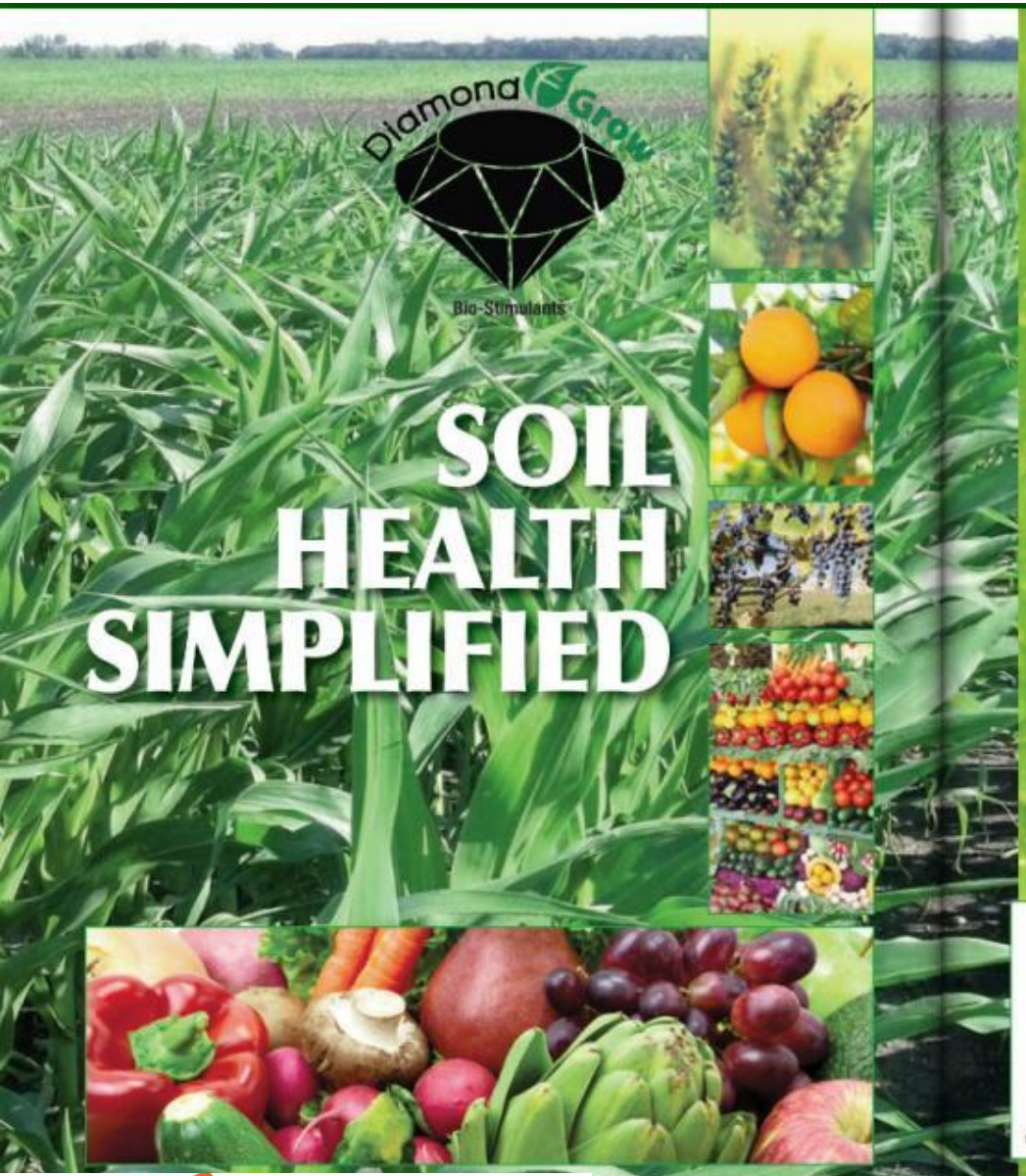
Francisco et al., 2015.

nutrient stewardship

Outcomes of **4R Nutrient Stewardship** are greatly influenced by **crop and pest management** and by **soil and water conservation practices**



Soil Health in a Jug?



100% Soluble Potassium Humate Granules
The same purity and 95% Humic acid content as our 100% soluble powder.

Benefits:
- BIOLOGICAL: Biologically active components
- 100% SOLUBLE: Completely dissolves in water
- SPREADABLE: Sized for easy application
- BLENDABLE: Compatible with most fertilizers
- RELIABLE: 99% Humic Acid content with no fillers

Organic Liquid Humic Concentrate
Proprietary Micro-Quad Filtered for clog-free application.

Benefits:
- High concentrations of both Humic and Fulvic acids.
- Benefits the plant now, and improves soil conditions over time.
- Low in heavy metals and other impurities.
- Reduced the settling (sludge) = fewer clogged spray tips

100% Soluble Potassium Humate Powder
95% Humic Acid Content. Diamond Grow® 100% Soluble Potassium Humate Powder is the highest quality humic product on the market.

Benefits:
- 100% Water Soluble
- 95% Humic and Fulvic Acids Contents
- NPK 1-0-12 Nutrient Content
- Use as Dry or Liquid
- Great for Fertigation or Seed Treatment
- Reduced Shipping Cost
- Natural Chelating Agent

FUL-GROW GOLD Liquid Fulvic Extract
Ful-Grow Gold Fulvic Acid is made with the finest organic materials available.

Benefits:
- Boosts cation exchange Stimulates plant metabolism
- Positive effect on plant DNA and RNA
- Increases enzyme activity
- Acts as catalyst in plant respiration
- Enhances permeability of cell members
- Enhances cell division and cell elongation
- Aids Chlorophyll synthesis
- Increases drought tolerance and prevents wilting
- Restores electrochemical balance
- Detoxifies various pollutants

COST EFFECTIVE REDUCED SHIPPING COST
REDUCED WAREHOUSE SPACE

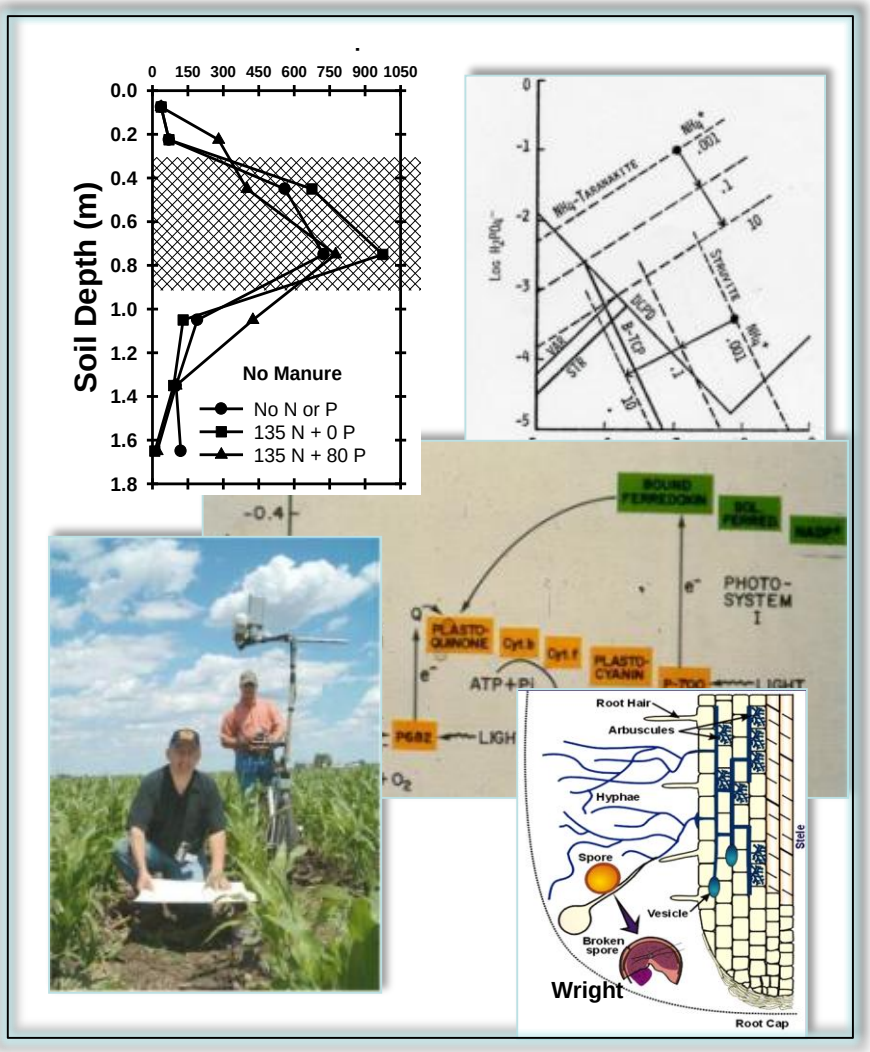
NEW AG INTERNATIONAL
SEPT/OCT 2014
THE WORLD'S LEADING PUBLICATION ON HIGH TECH AGRICULTURE
Dec, 2014

humic growth solutions

4R Practices are found at the intersection of:

The rigorous world of science …

and the practical world of real farms.



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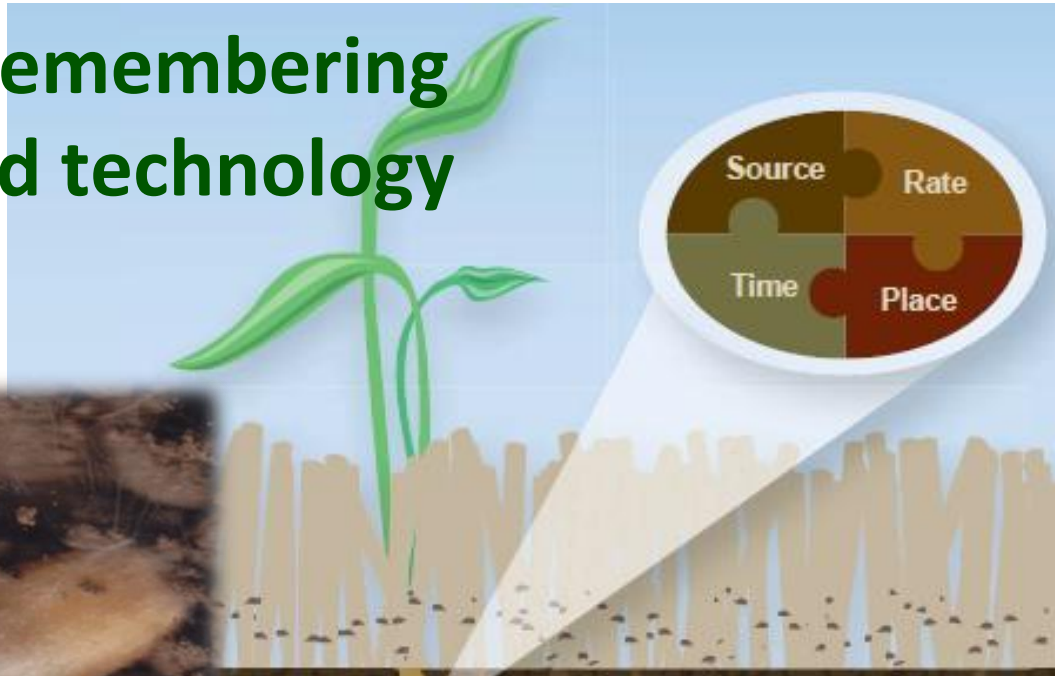
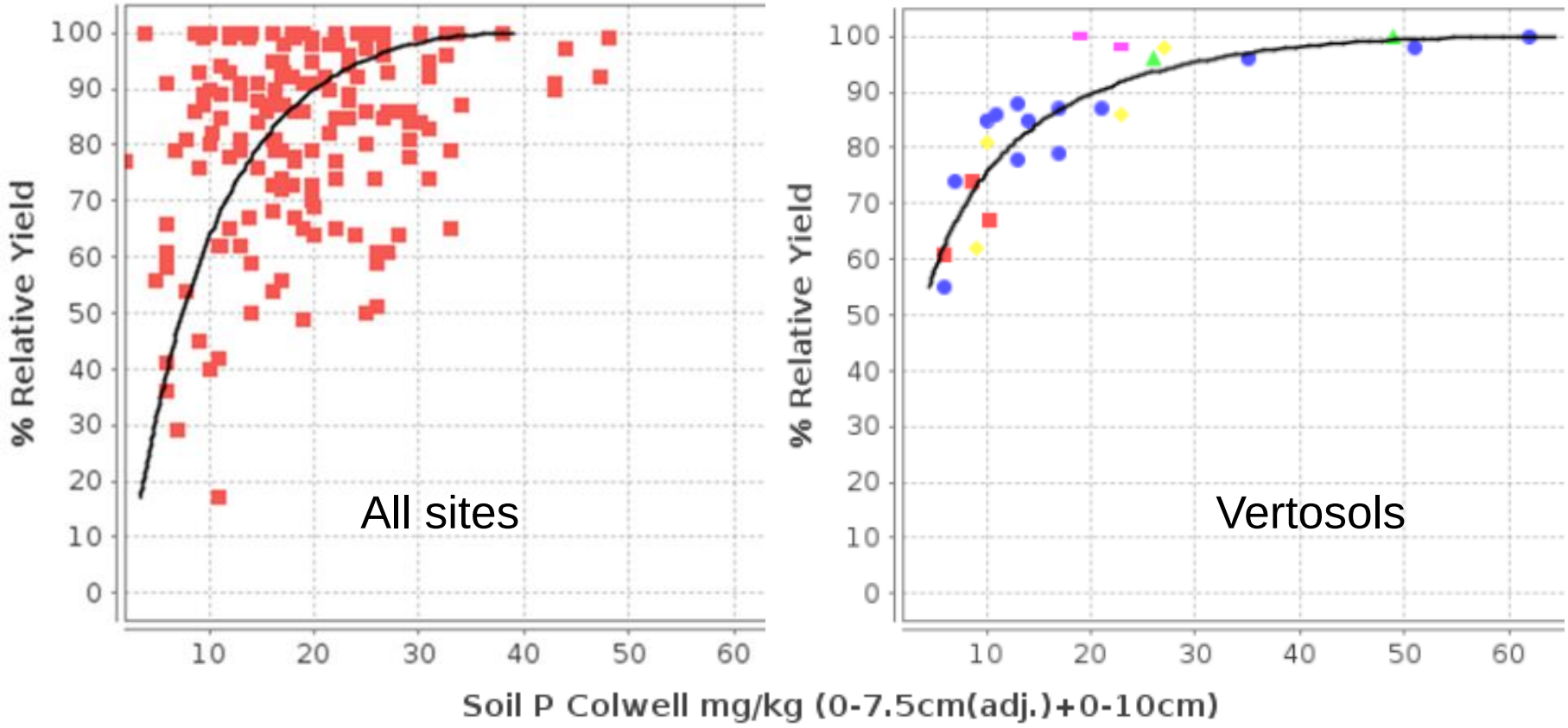
Scale down to the environment of individual plants … remembering genetics, culture, and technology



Think about how we manage **soil** conditions and **nutrition** of each plant

Soil type matters - wheat response to P fertilizer in Australia

"Better Fertilizer Decisions for Crops in Australia"



Soil type and condition can significantly influence nutrient response

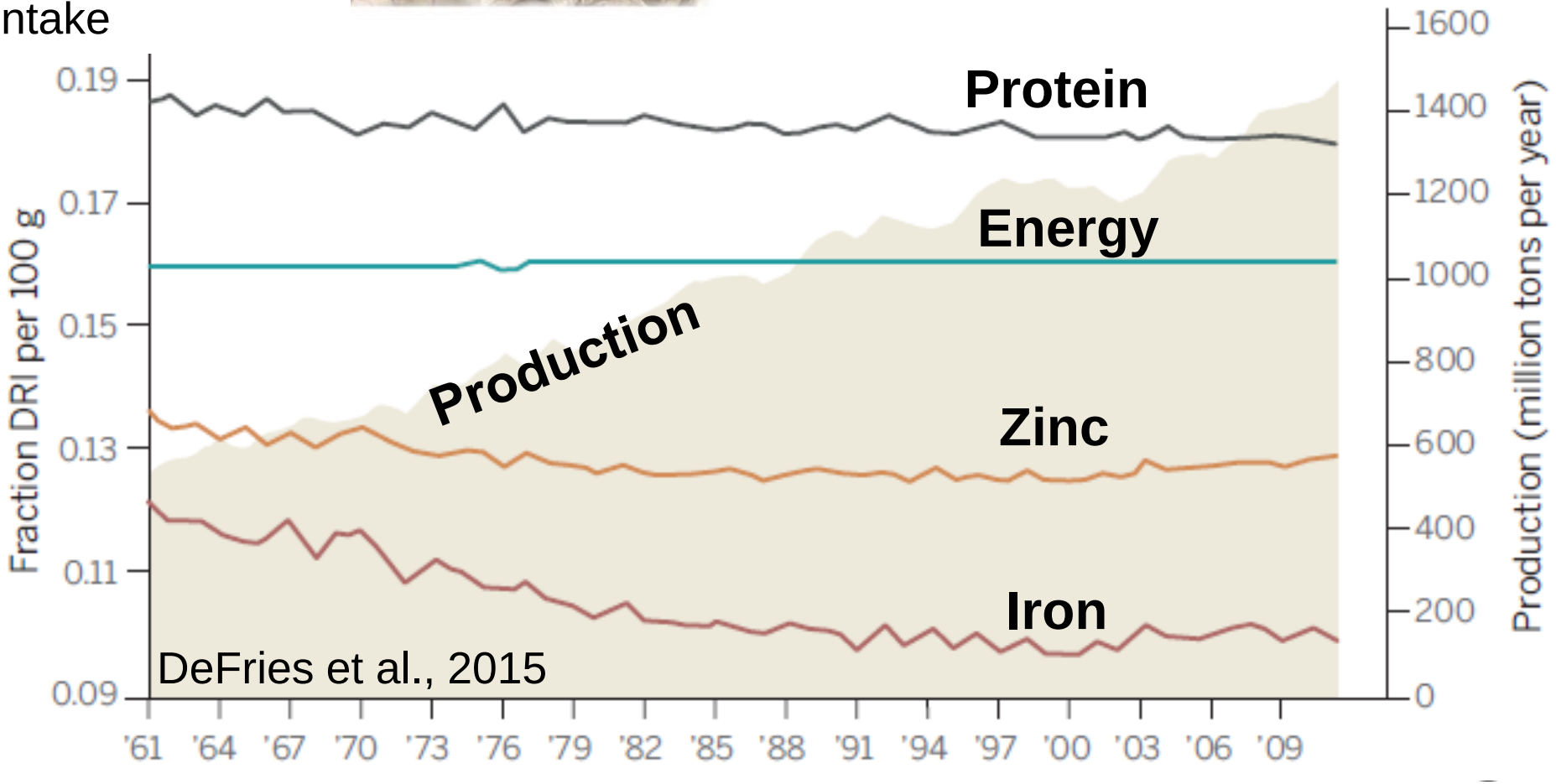
Negative effects on soil health resulting from above optimum nutrient use

- Soil acidification
- Altered microbial composition

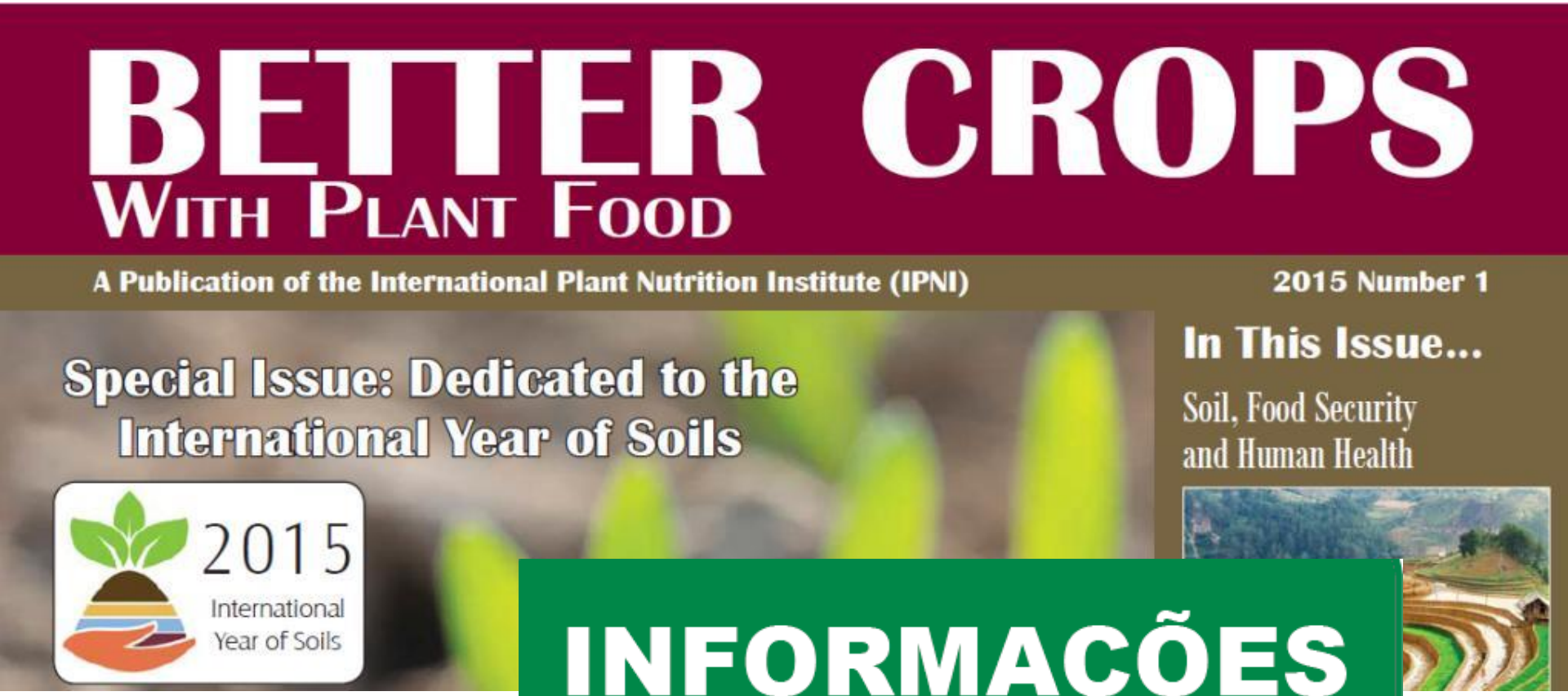
Food or nutritional Security?

Nutrient content of global cereal supply has declined as production increased

Dietary reference intake



Learn more about soils and food security …



Reprinted in:

Learn more about soils and food security …

IPNI Plant Nutrition TODAY
Better Crops, Better Environment...through Science

2015 Ano Internacional dos Solos

Quarterly Series on IYOS

- Spring 2015: Modifying Soil to Improve Crop Productivity
- Summer 2015: Nutrients and Soil Biology
- Fall 2015: Soil Degradation Destroys Productivity
- Winter 2015:

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Learn more about soils and food security …

International Fertilizer Industry Association

Nutrients4Soils

www.nutrients4soils.info

Soil Science Society of America

Soils Sustain Life

2015

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https://www.soils.org/iys

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Synergy in Science: Partnering for Solutions

2015 Annual Meeting | Nov. 15-18 | Minneapolis, MN
with the Entomological Society of America

American Society of Agronomy | Crop Science Society of America | Soil Science Society of America

Soil Health Highlights

- **Symposia**
  - Restoring soil health - local actions, global implications (7)
  - Soils and Human Health (10)
  - Field Management for Improved Soil Health and Environmental Quality (4)
  - Connecting Phytobiomes with Soil and Plant Health (6)
  - Public Private Partnerships to Improve Soil Health and Agronomic Resiliency (6)
- **Oral sessions**
  - Soil Health Research for Agroecosystems (10)
  - Strategies for Managing Microbial Communities and Soil Health: I & II (17)

60 Presentations on Soil Health

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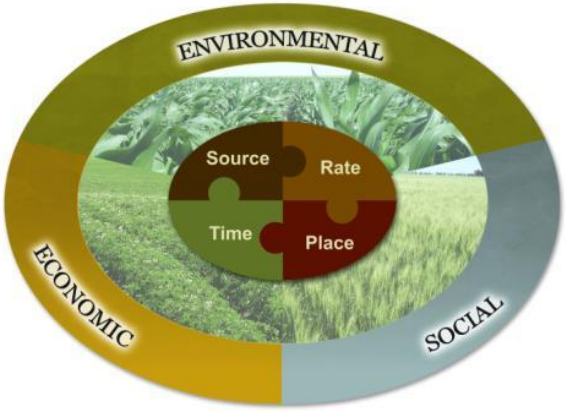
4R: “right” means sustainable



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Tell your **soil** story and include the critical role of **fertilizers** in **soil health**

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4R nutrient stewardship

"Upon this handful of soil our survival depends. <u>Husband</u> it and it will grow our food, our fuel, and our shelter and surround us with beauty. Abuse it and the soil will collapse and die taking man with it."

Sanskrit literature from between 2000 and 1500 BC

<u>Fertilizer nutrients</u> used according to the concepts of **<u>4R Nutrient Stewardship</u>** are a critical component of that **<u>husbandry</u>**.

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