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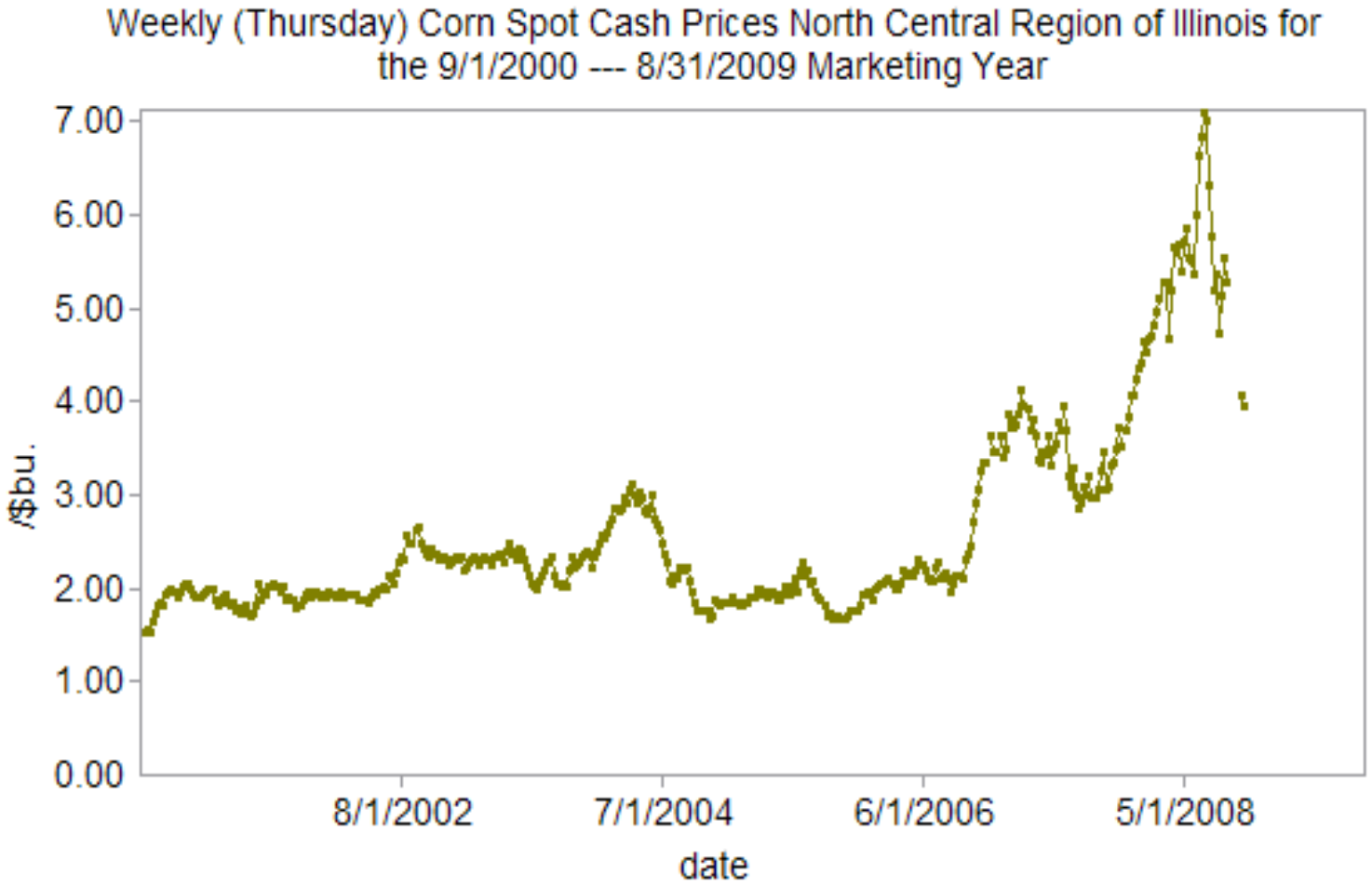
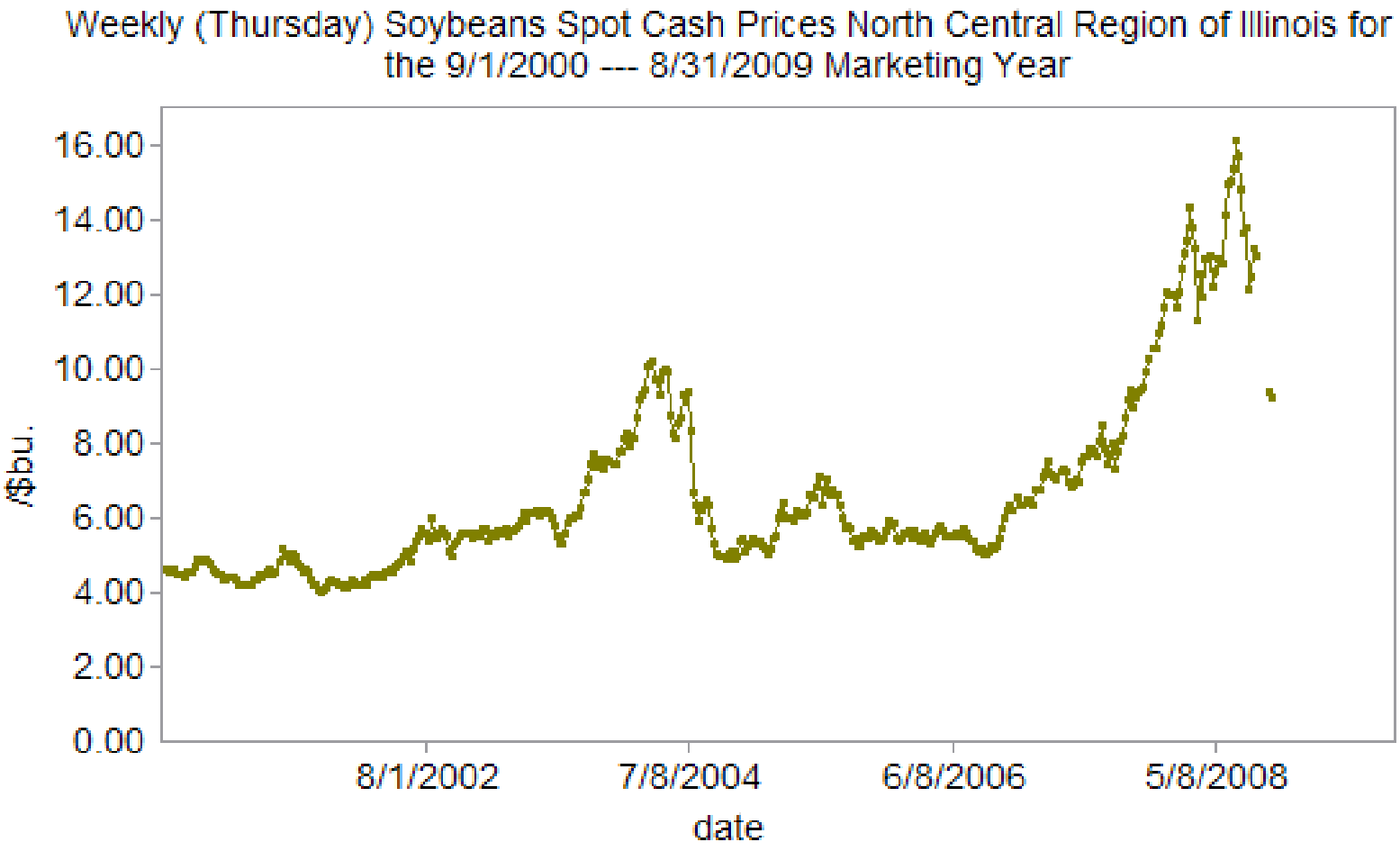
Information Resources For 21st Century Crop Production Decisions

Illinois Corn Prices – 2000-2008



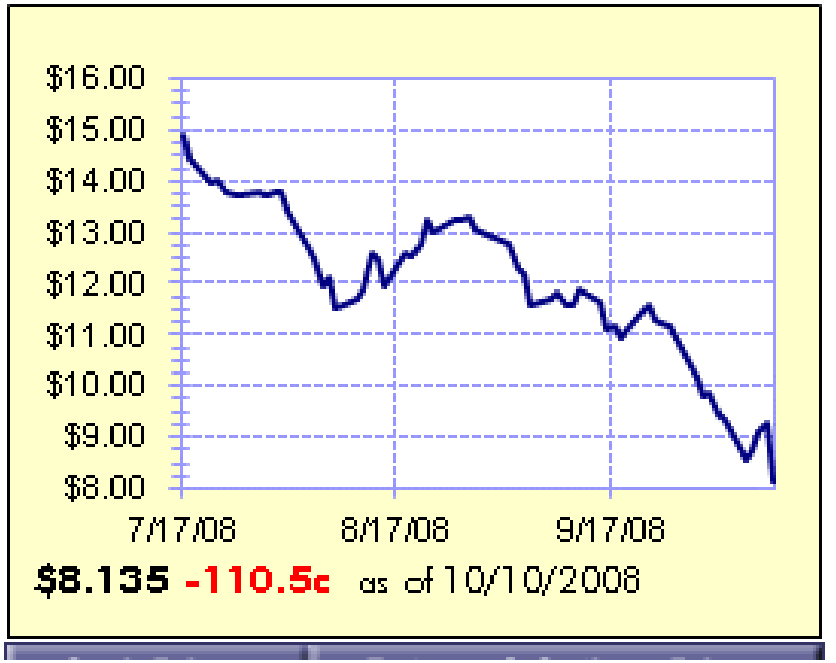
Source: http://www.agstats.state.il.us

Illinois Soybean Prices – 2000-2008

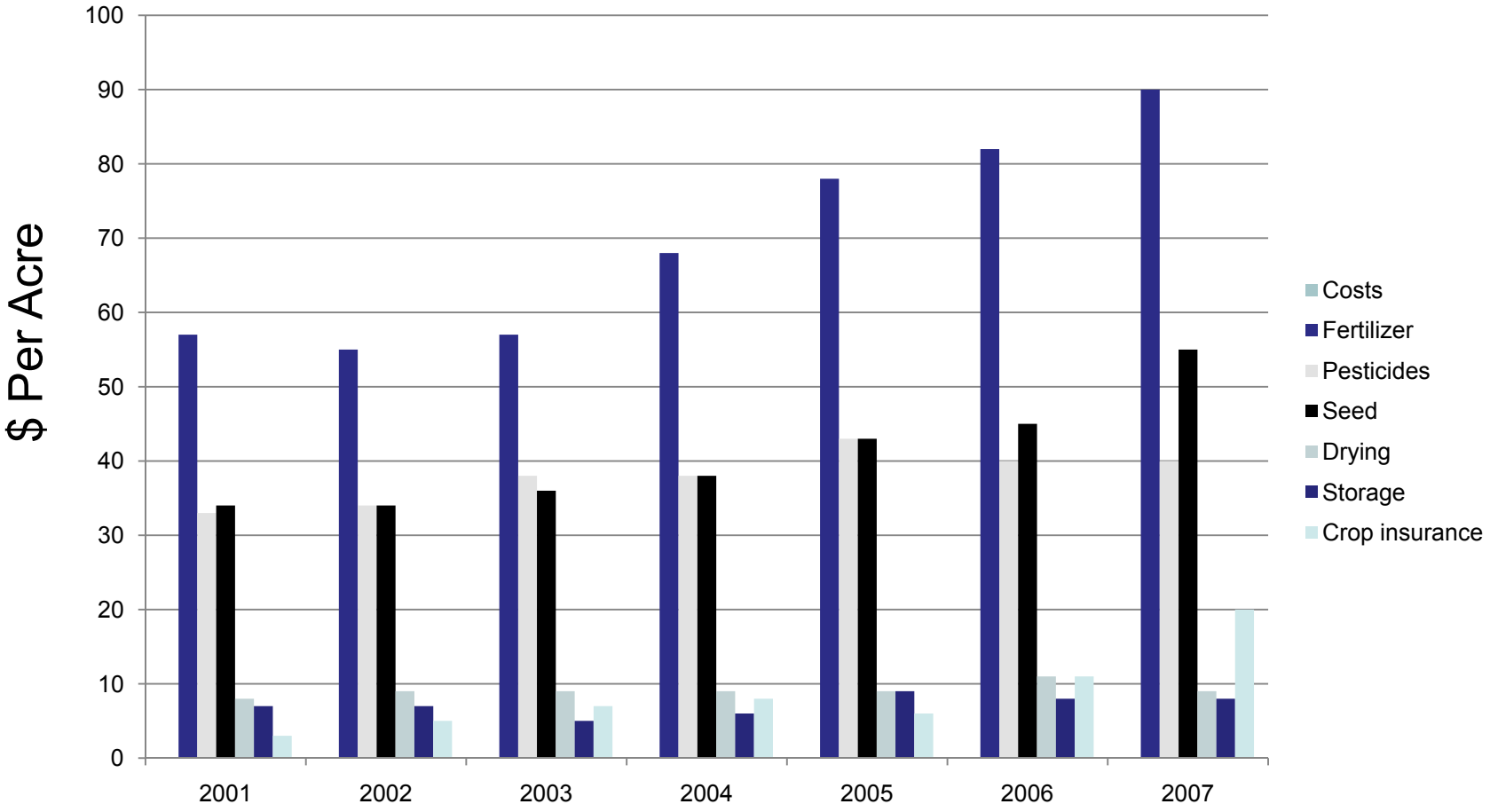


Source: http://www.agstats.state.il.us

Central Illinois Corn & Soybean Prices



Crop Input Costs—Central Illinois



$4 corn/$0.40 N vs $2 corn/$0.20 N

- Price ratio the same … optimum rate the same
- But the economic penalty for over or under estimating need or for nutrient loss is much greater with today's higher prices
- Greater economic justification for:
  - Precision input application, enhanced efficiency products
  - Guidance systems
  - Soil testing and plant analysis, soil or plant imaging
  - On-farm strip trials, omission plots
  - Other forms of decision support
- Investing in determination of right **source**, **rate**, **time** and **place** for inputs is the right response for the pocket book and the environment

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Increased demand for agricultural products has caused a remarkable transformation

We have left a **25-year era** dominated by the mindset that **production** (over) is a **problem** …

and entered an era with new enthusiasm for **sustainable** development of the real **potential of modern agriculture** to harness the sun's energy in **meeting human needs**.

That spells **opportunity**, provided the steps taken are not only good short-term business moves, but are grounded in **science-based sustainable practices** leading to **efficient and effective** resource utilization.

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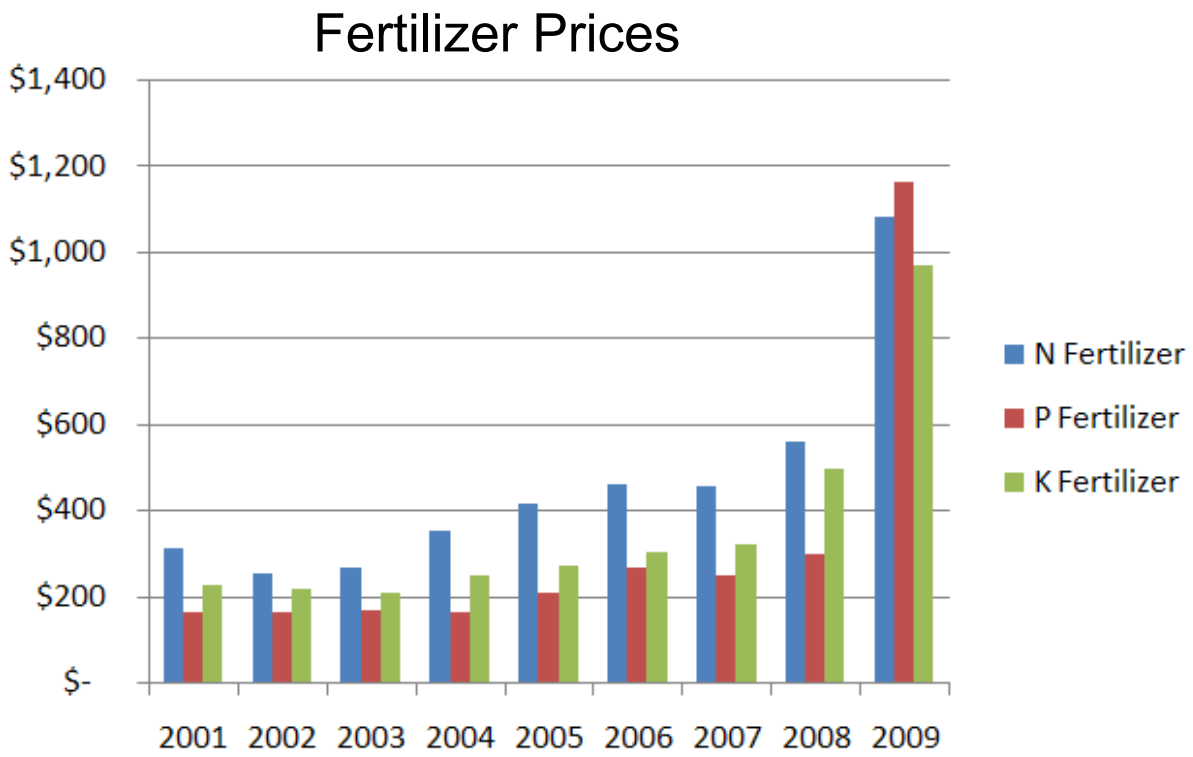
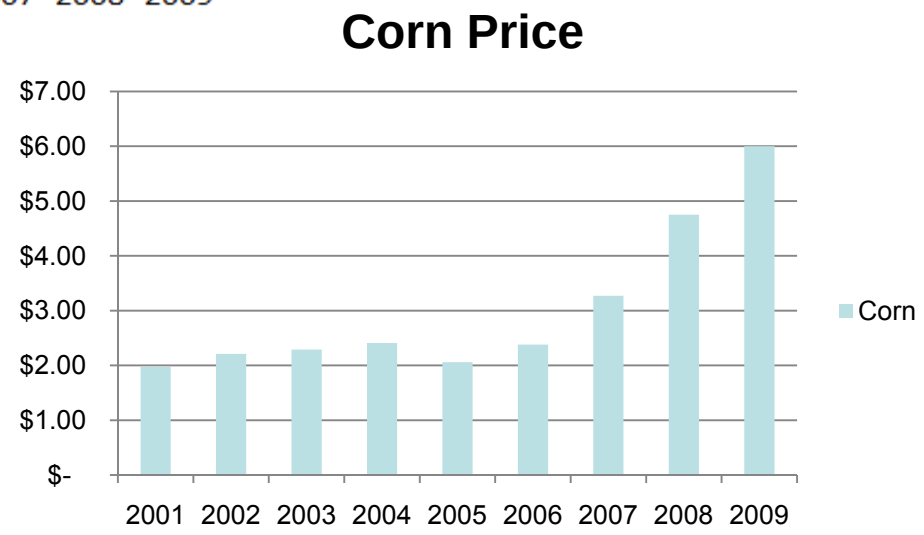
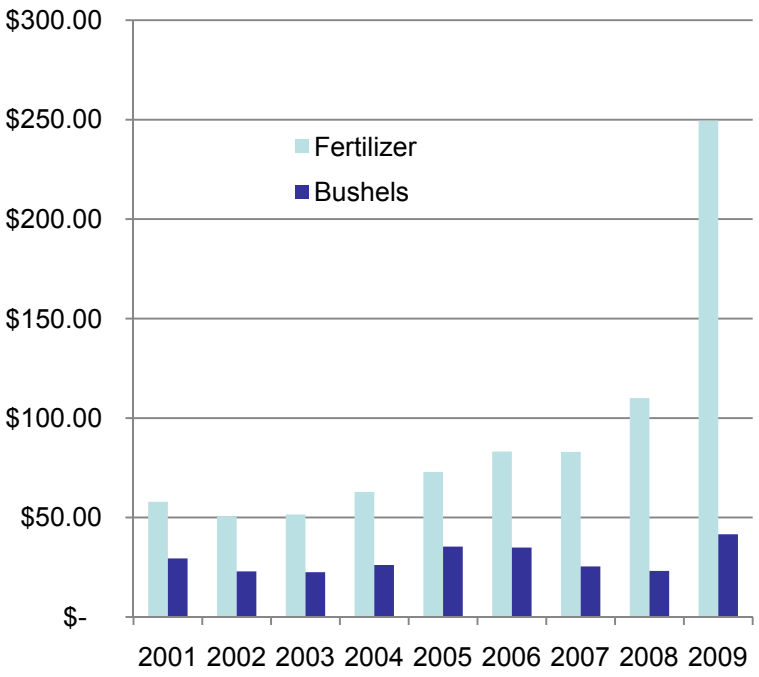


Price Trends Central Illinois



Cost of Fertilizer - Central Illinois

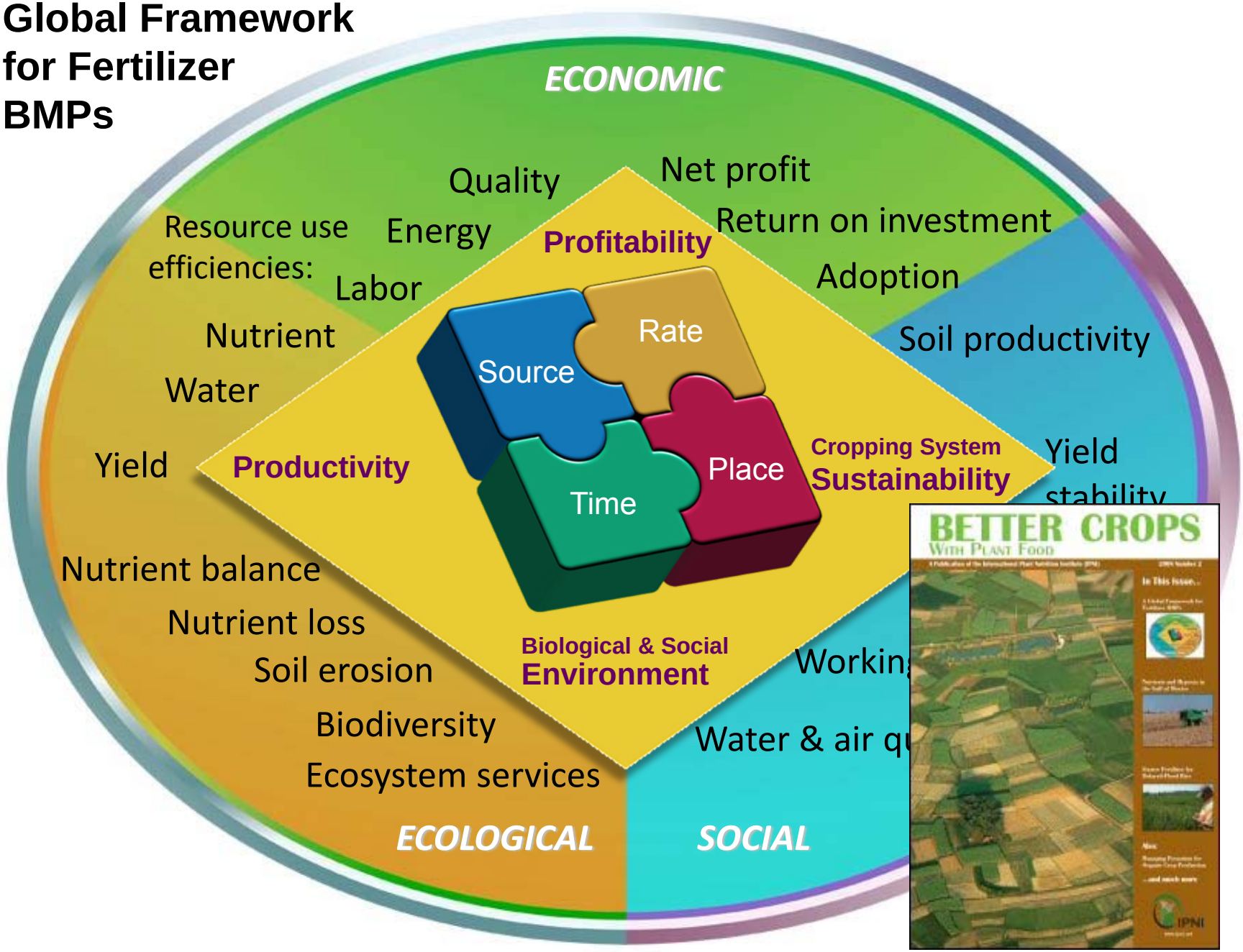


Year	Fertilizer	Bushels
2001	$ 57.89	29.4
2002	$ 50.62	22.9
2003	$ 51.52	22.5
2004	$ 62.87	26.1
2005	$ 72.96	35.4
2006	$ 83.15	34.9
2007	$ 82.99	25.4
2008	$ 110.00	23.2
2009	$ 249.50	41.6

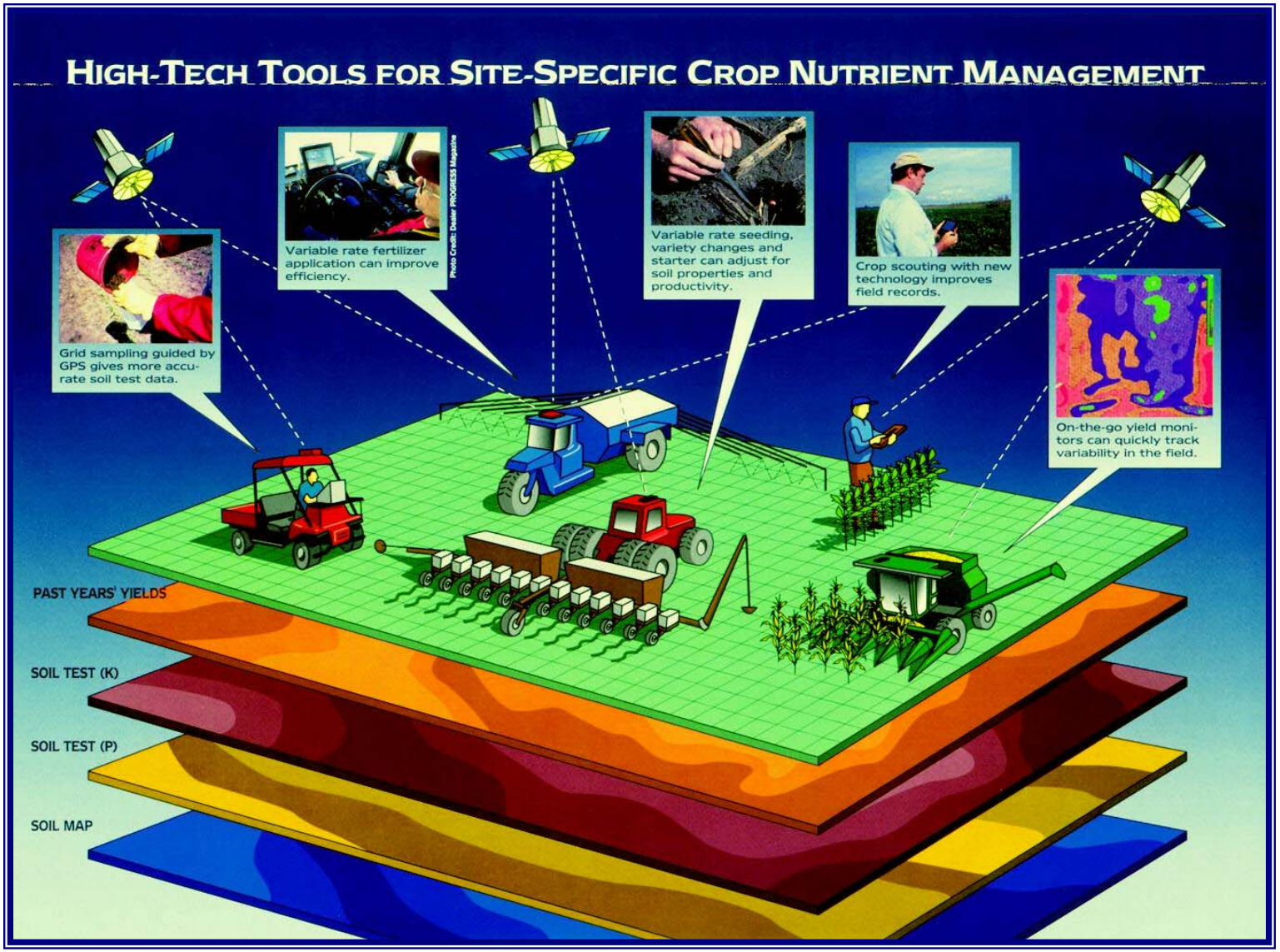
Value of Information

- Site-specific information on an individual field has never been more valuable.
  - Rising input costs
  - Declining grain prices
- Fine-tuning management decisions.

Global Framework for Fertilizer BMPs



Site-Specific Management Systems



Automatic Guidance by RTK GPS

High Resolution (RTK) GPS Guidance Systems

Hands-Free Farming

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International Conference on Precision Agriculture

9th International Conference on
Precision Agriculture
JULY 20-23, 2008 • Hyatt Regency Tech Center Denver Colorado USA

- Biennial research conference
- IPNI & FAR Cooperating with Colorado State University
- Close to 500 participants from 48 countries
- Scientific presentations—oral and poster
- A to Z applied sessions (CIG project outreach)
- Exhibits
- Tours
- www.icpaonline.org

10th ICPA – July 18-21, 2010
Denver, Colorado

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InfoAg 2007

Information Agriculture Conference

FAR INTO THE FUTURE
Foundation for Agronomic Research

IPNI
International Plant Nutrition Institute

CropLife Media Group
CropLife Media Group

InfoAg 2009
July 13-15 ,2009
Springfield, Illinois

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InfoAg 2009 Conference

Springfield, Illinois
July 14-16, 2009

- Latest ideas on collecting, managing, and utilizing information in crop decisions.
- Latest decision tools.
- Latest technology.
- Valuable networking opportunity.

www.infoag.org

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IPNI Website

www.ipni.net

Working with Farmer Yield Data

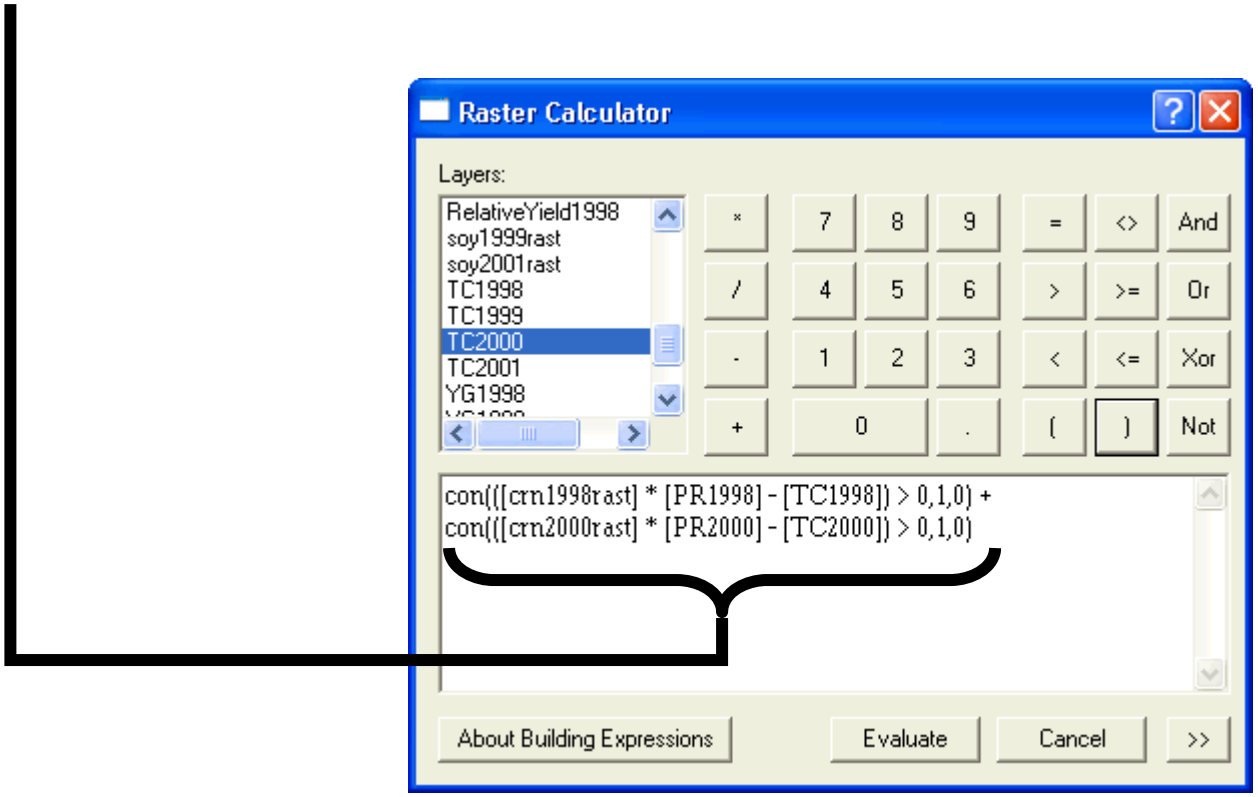
Yield Data Analysis

Investigating consistency

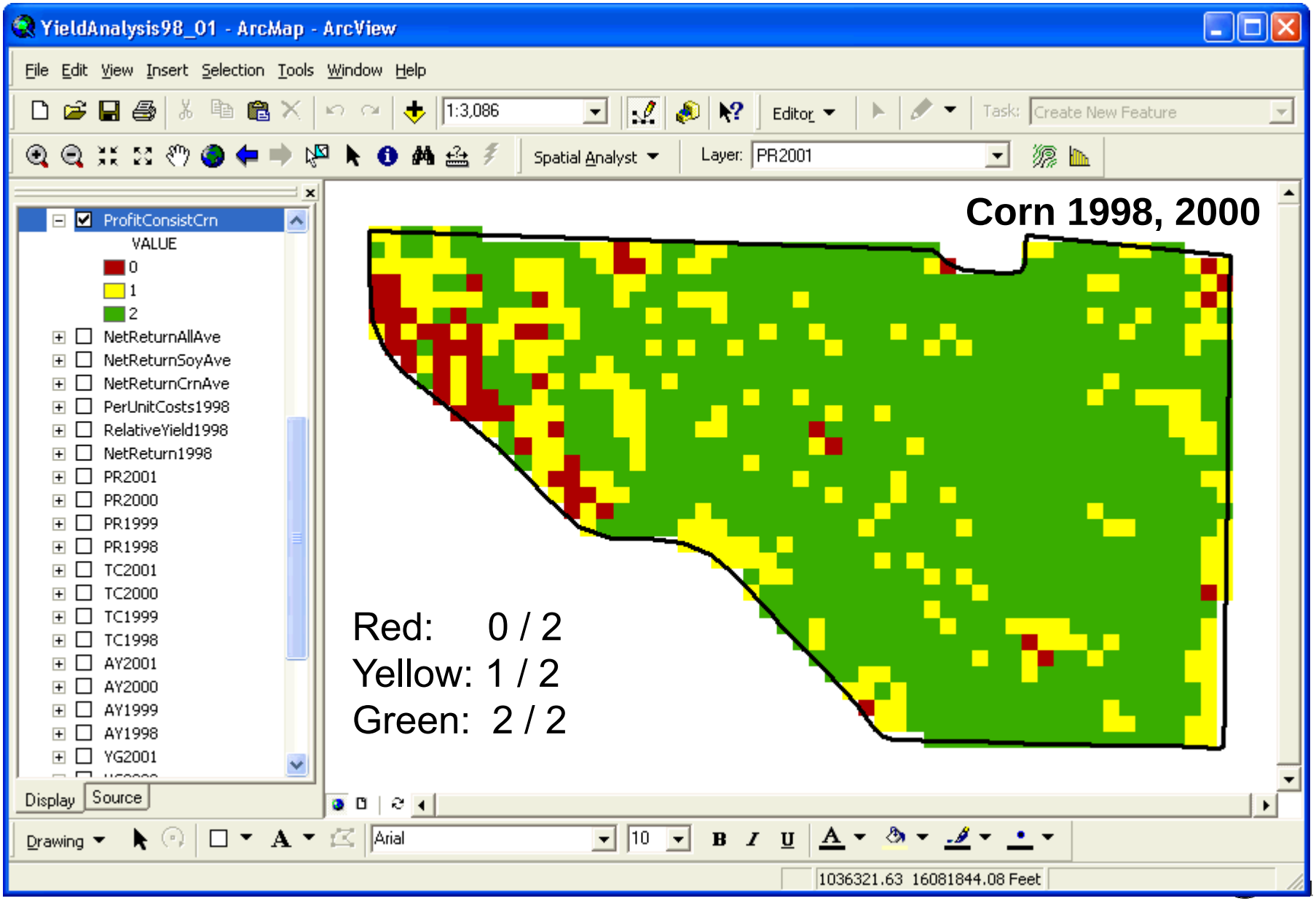
- Binary grids created for each year
- Binary grids added together
  - Example: 2 years of corn net returns
  - (0,1) grid 1998 + (0,1) grid 2000
  - Interpretation of results:
    - 0 = corn not profitable in either year
    - 1 = corn profitable in 1 of 2 years
    - 2 = corn profitable in 2 of 2 years

In what areas of the field has corn been consistently profitable?

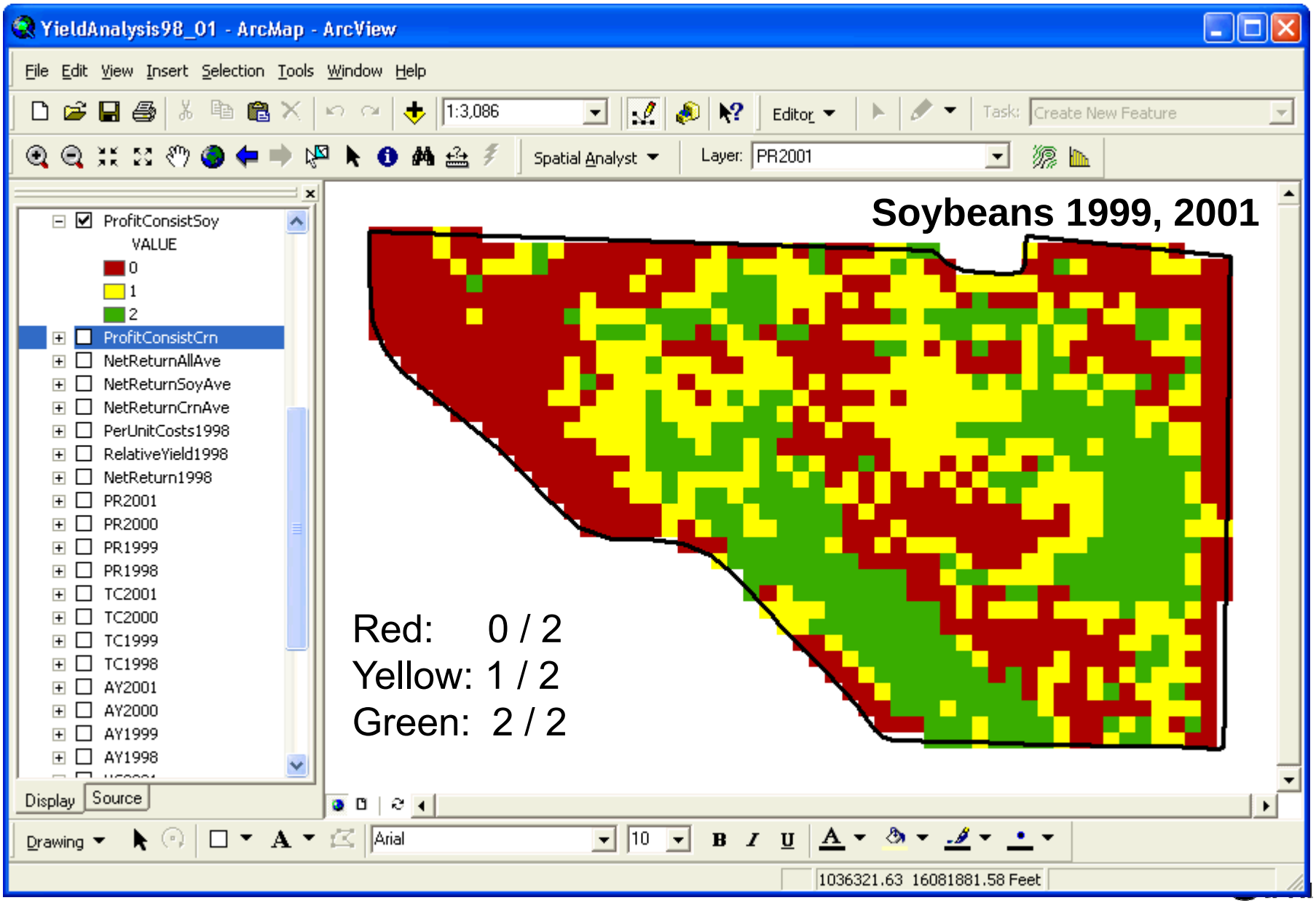
con([net profit 1998] > 0, 1, 0) +
con([net profit 2000] > 0, 1, 0)



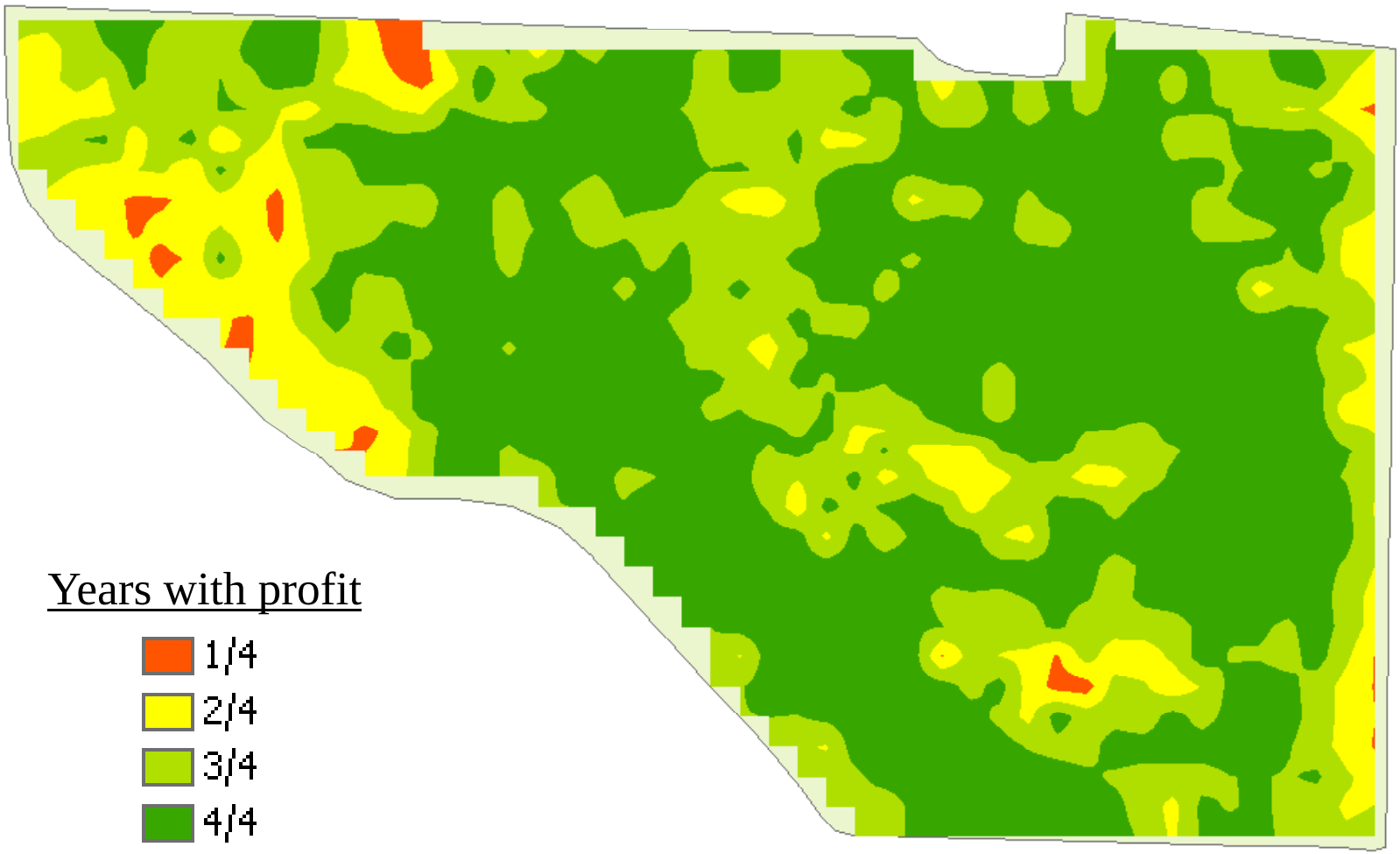
In what areas of the field has corn been consistently profitable?



In what areas of the field have soybeans been consistently profitable?



What areas of the field are consistently profitable?



All Crops

Are Our Soil Test Goals Adequate for Current Systems?

Treatment	P_1 Soil Test (ppm)	K Soil Test (ppm)	Corn Yield (bu/A)	P_1 Soil Test (ppm)	K Soil Test (ppm)	Soybean Yield (bu/A)
Standard P and K Soil Tests	20	161	152	32	184	57
High P and K Soil Tests	32	237	190	41	222	57

38 bu/A more corn!!

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Building on the Best Agronomic Science

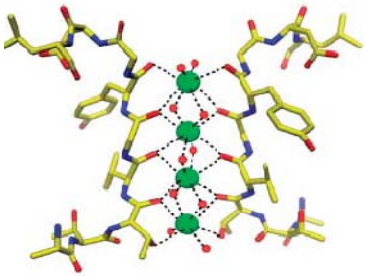
Our Best Agronomic Science …

- What is it?
- Where is it?
- Is it good enough?

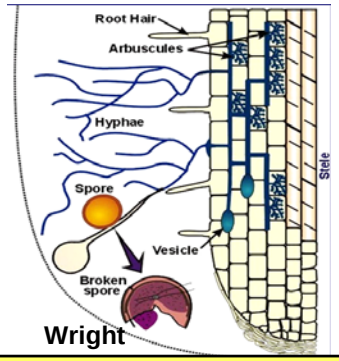
What is it?

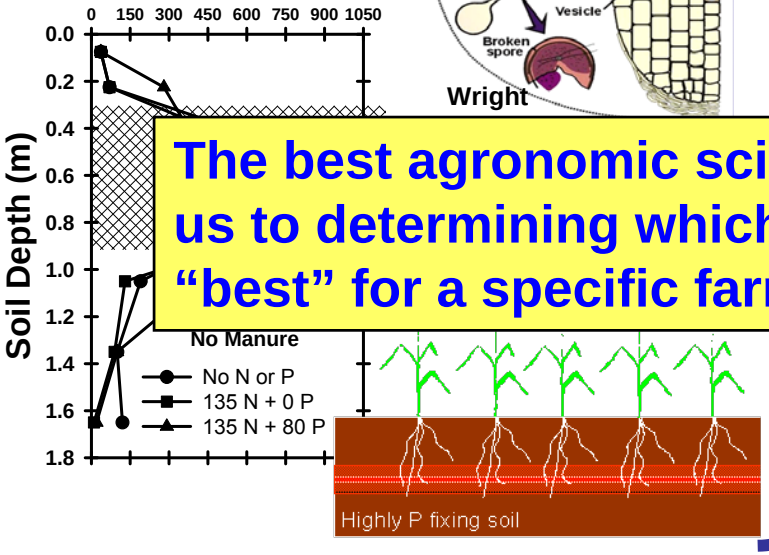
Science has never had a more complete set of "knowledge nuggets".

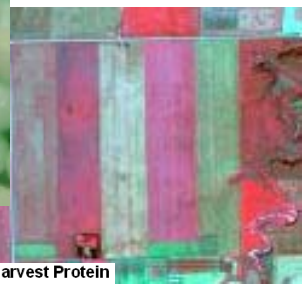
Industry has never had a more impressive set of technologies.

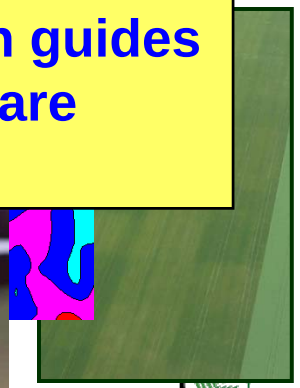


Google Scholar BETA









The best agronomic science might well be that which guides us to determining which practices and technologies are "best" for a specific farm or field.

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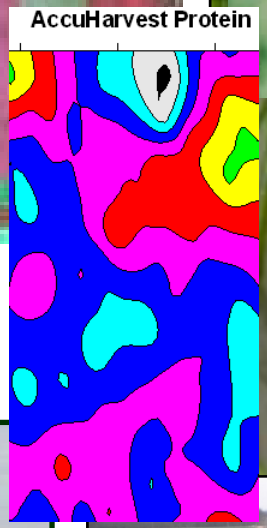
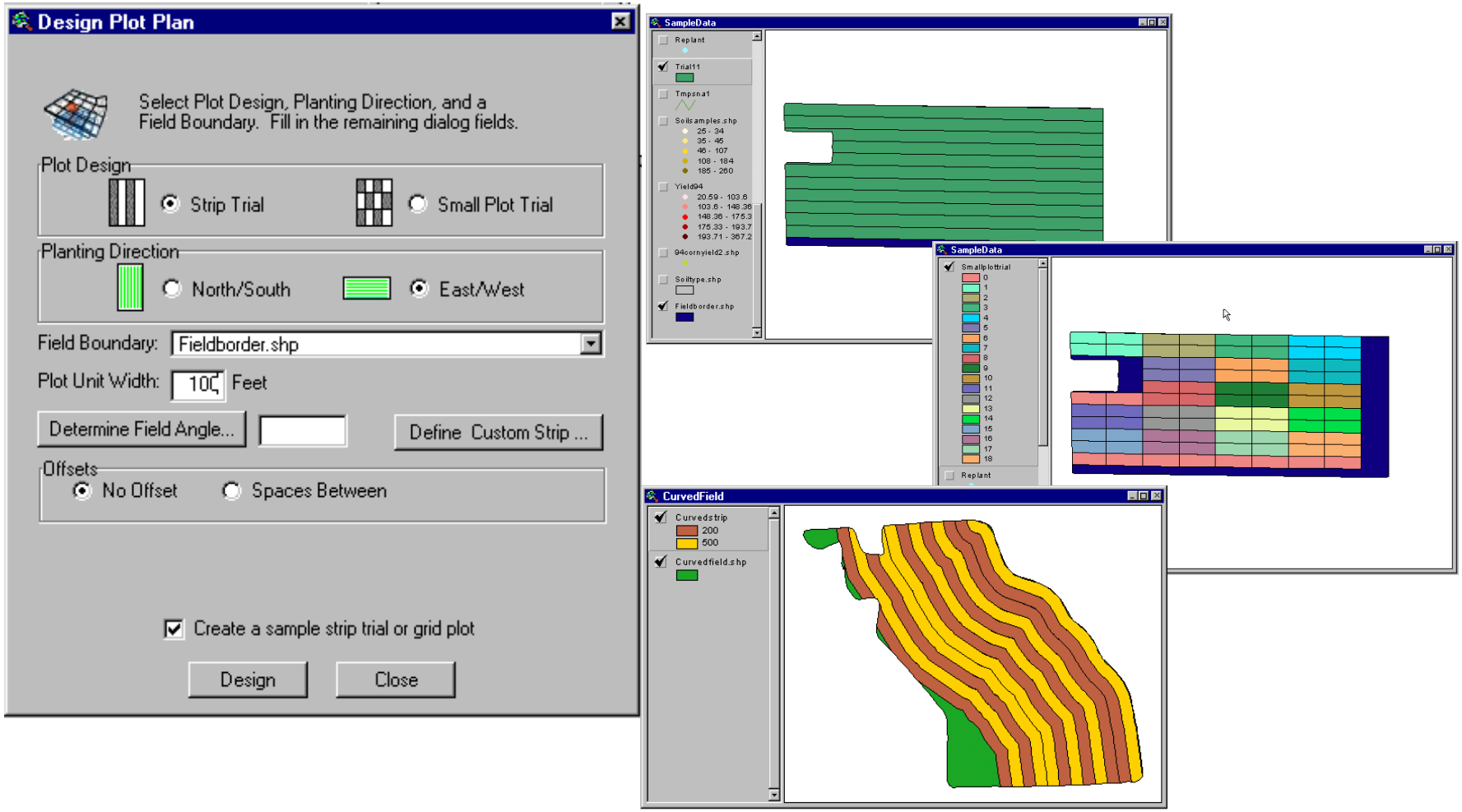
Decision support and risk management tools



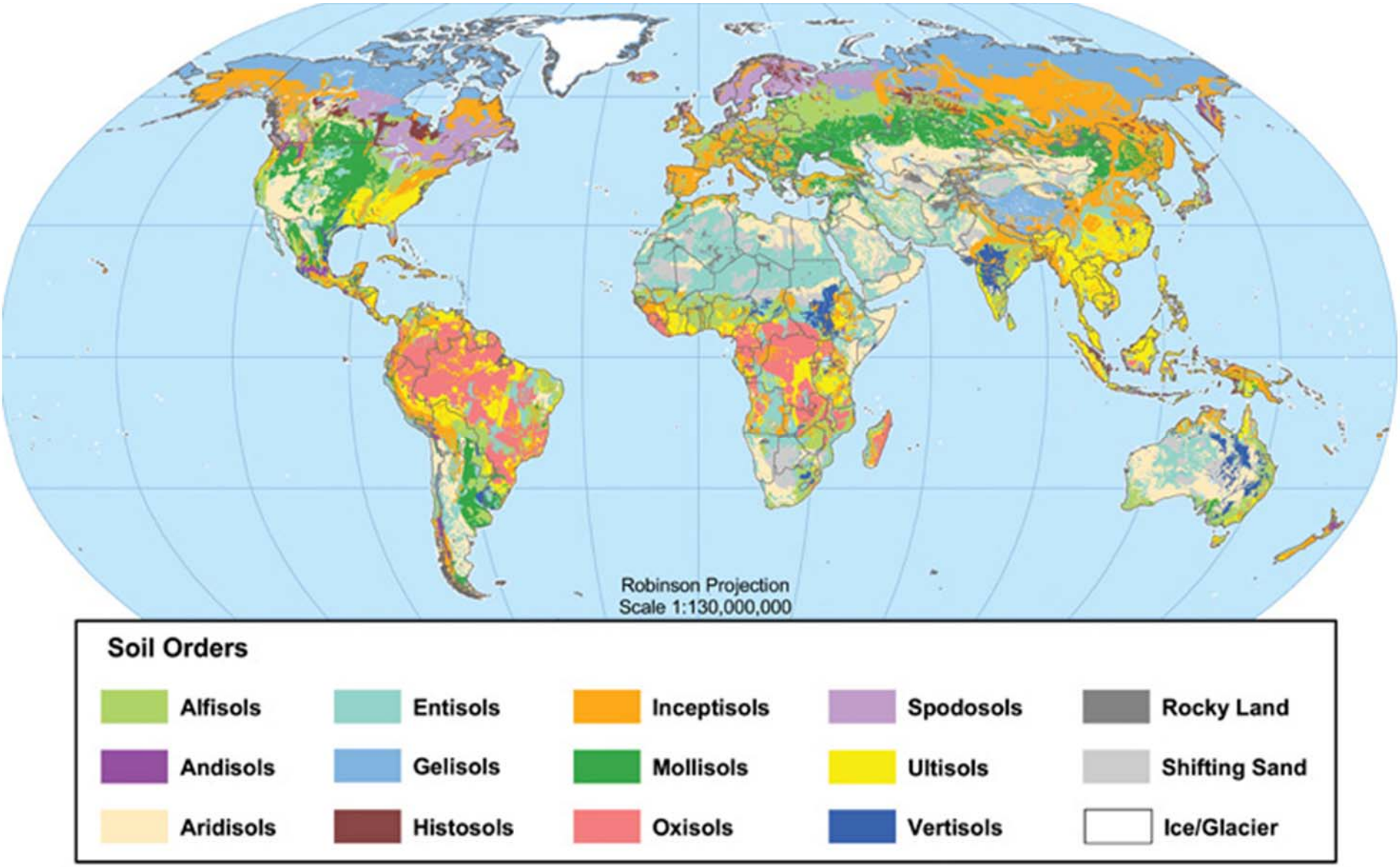
Farm Research Analyst



Our best agronomic science …

- What is it?
- **Where is it?**

Potential source of relevant agronomic science?



Our best agronomic science …

- What is it?
- **Where is it?**
  - **Could be anywhere in the world**
    - **“The world is flat.” - *Thomas Friedman***
  - **Could be from your own farm**
    - **Published science not always clear … answer may only be found through on-farm testing**
  - **Sound agronomics fits globally**

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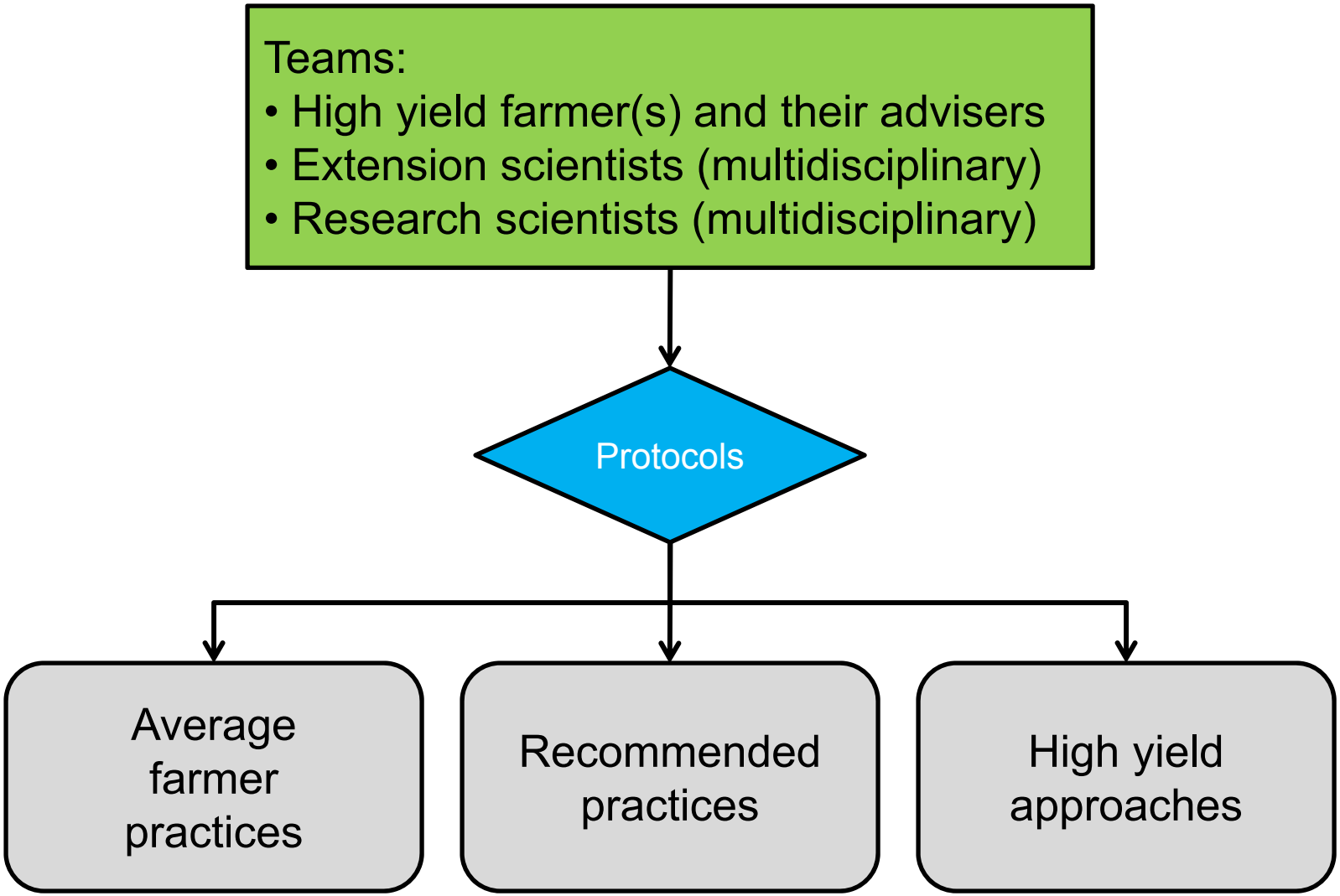
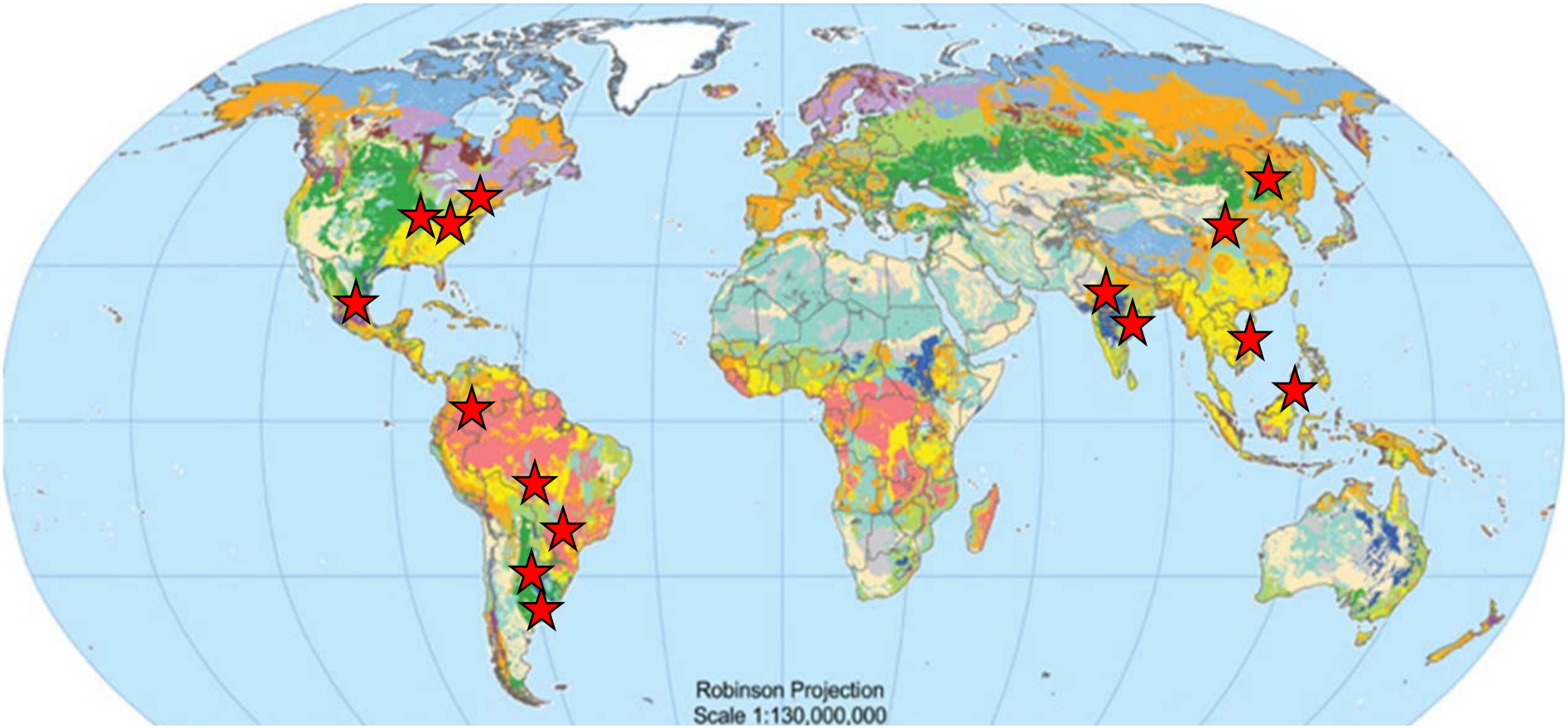
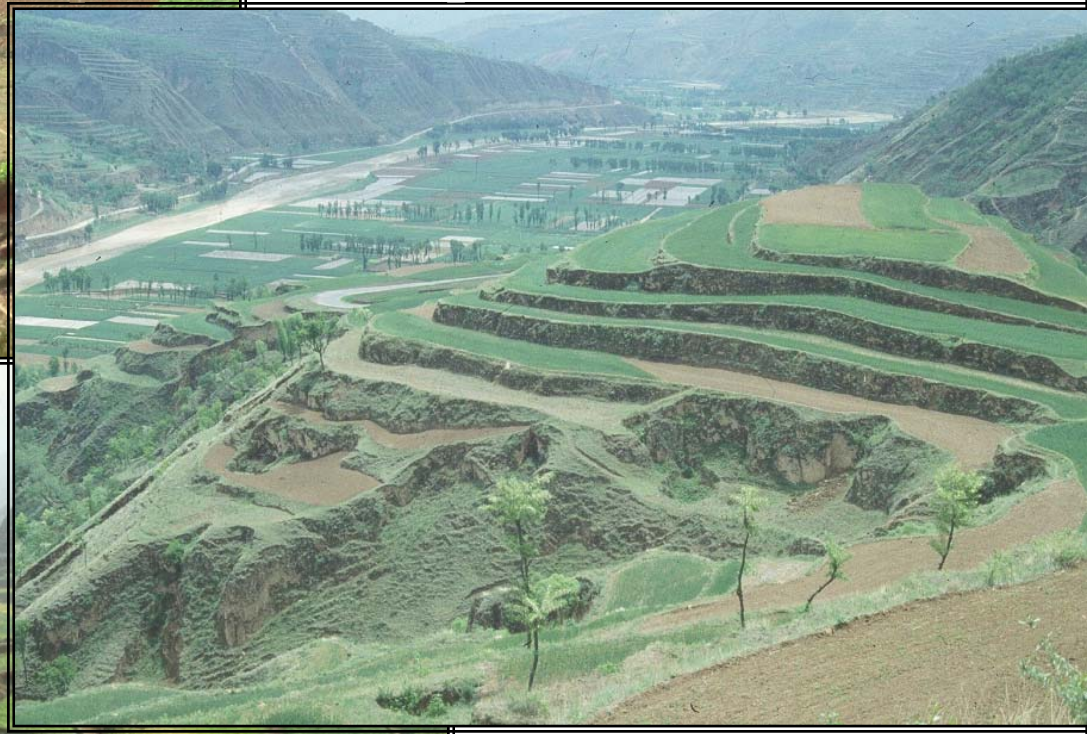
Global Maize


Teams:
• High yield farmer(s) and their advisers
• Extension scientists (multidisciplinary)
• Research scientists (multidisciplinary)
Protocols
Average farmer practices
Recommended practices
High yield approaches

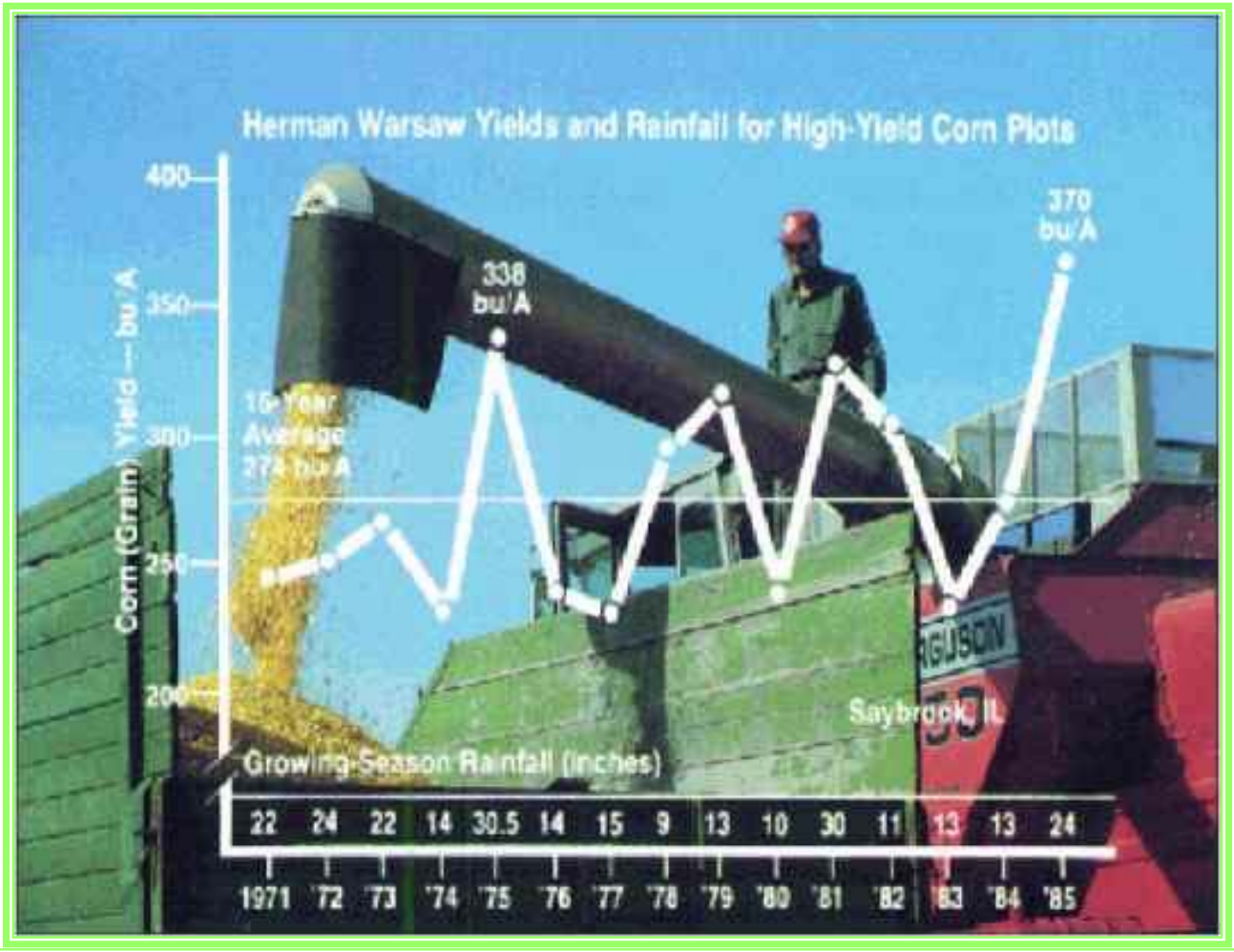
Global Maize



Land availability is most often the primary limiting resource



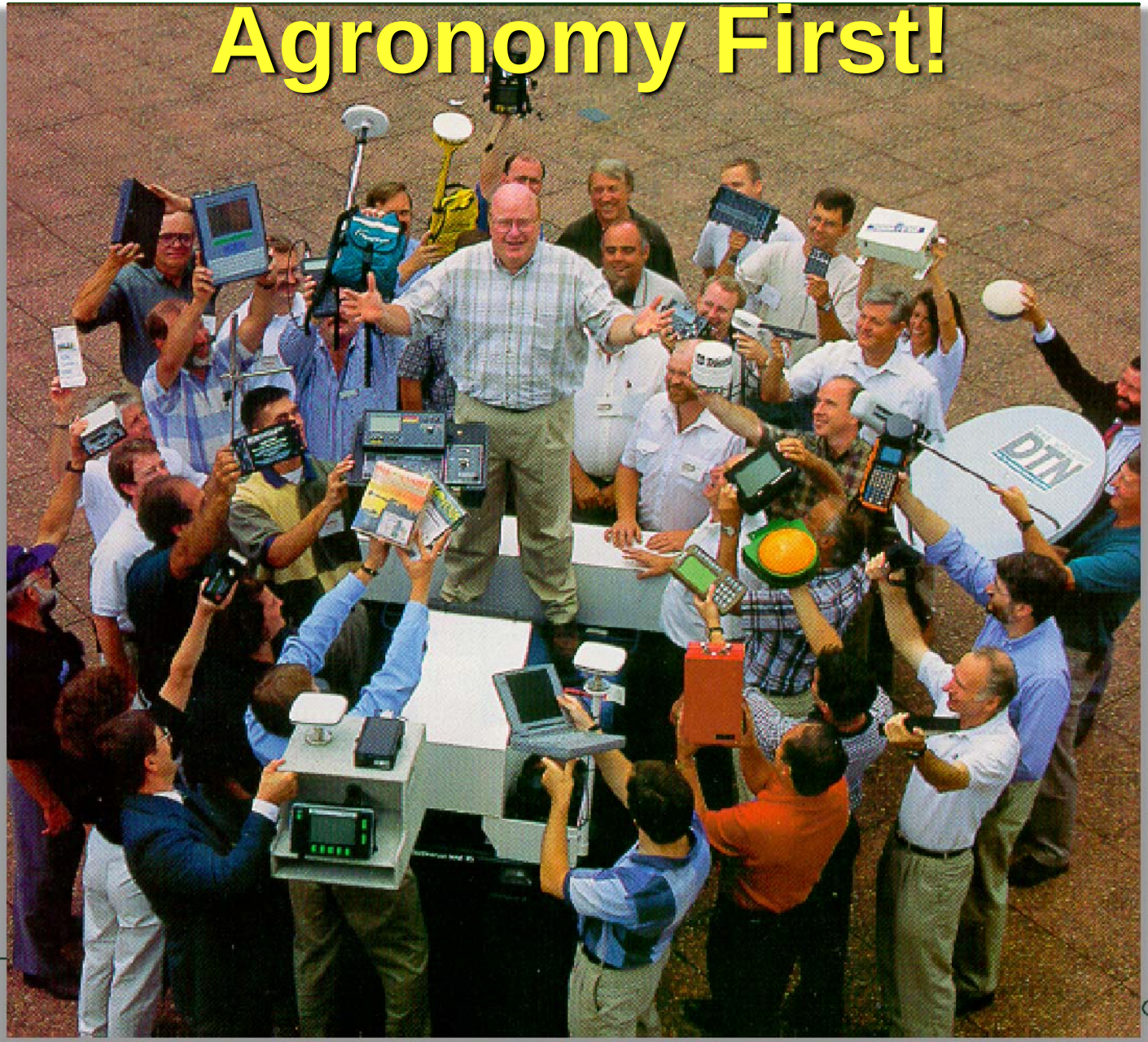
Herman Warsaw---
---World Record Corn Producer



370 bu/A = 23.2 metric tons/ha

Warsaw's Resources

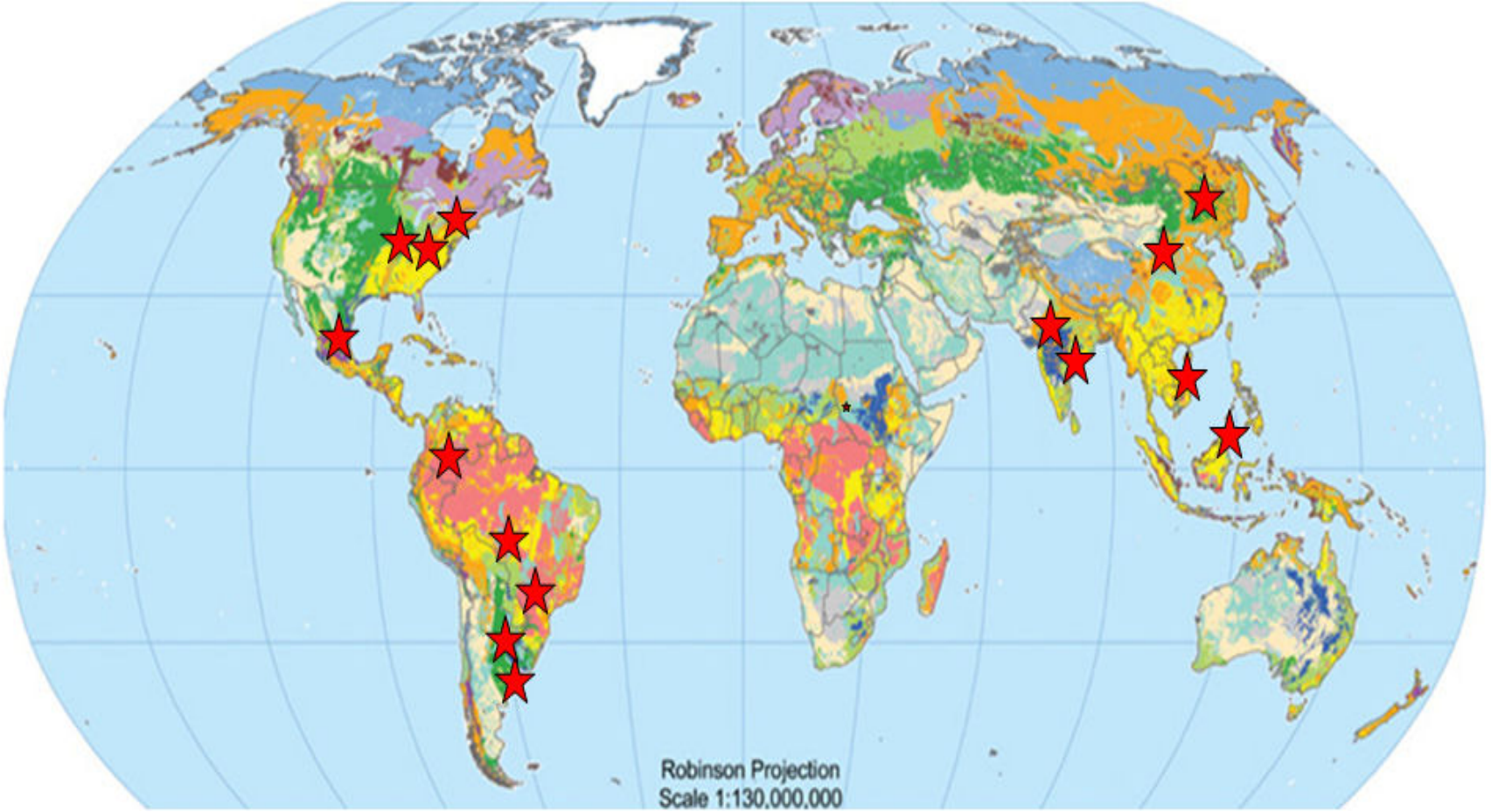
Agronomy First!




“Fine tuning . . . removing the next limiting factor”
W. L. Nelson

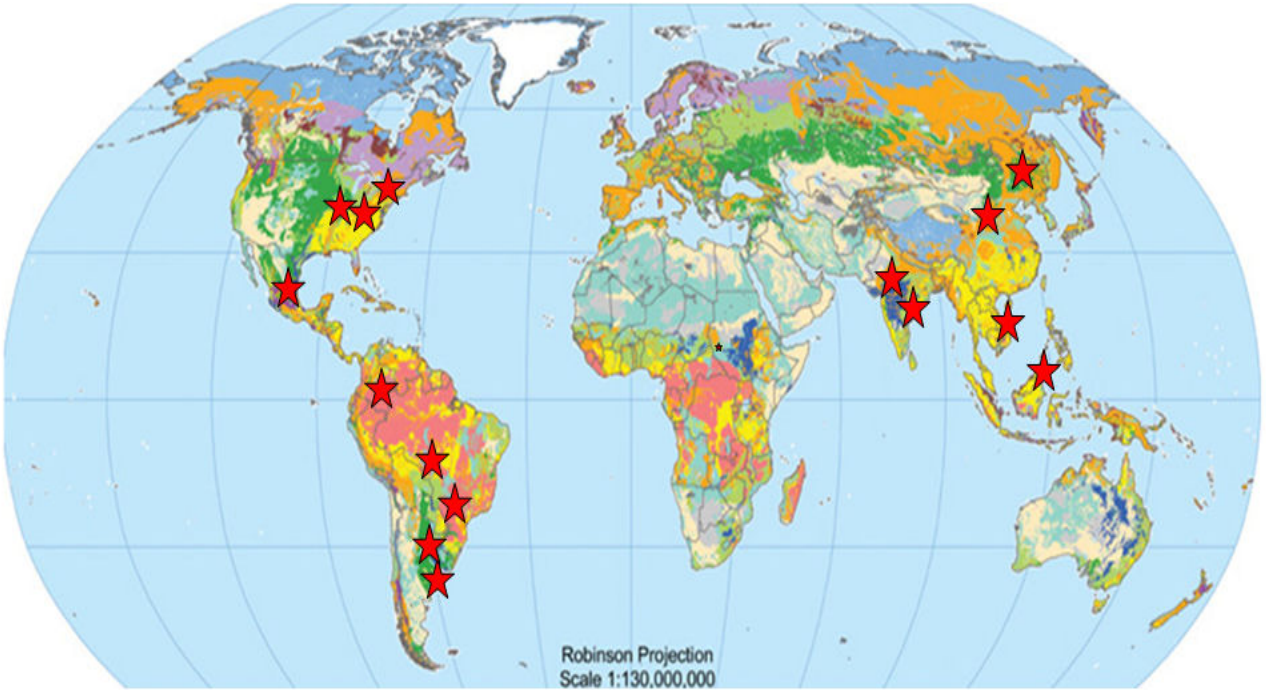
Global Maize Long-Term Sites

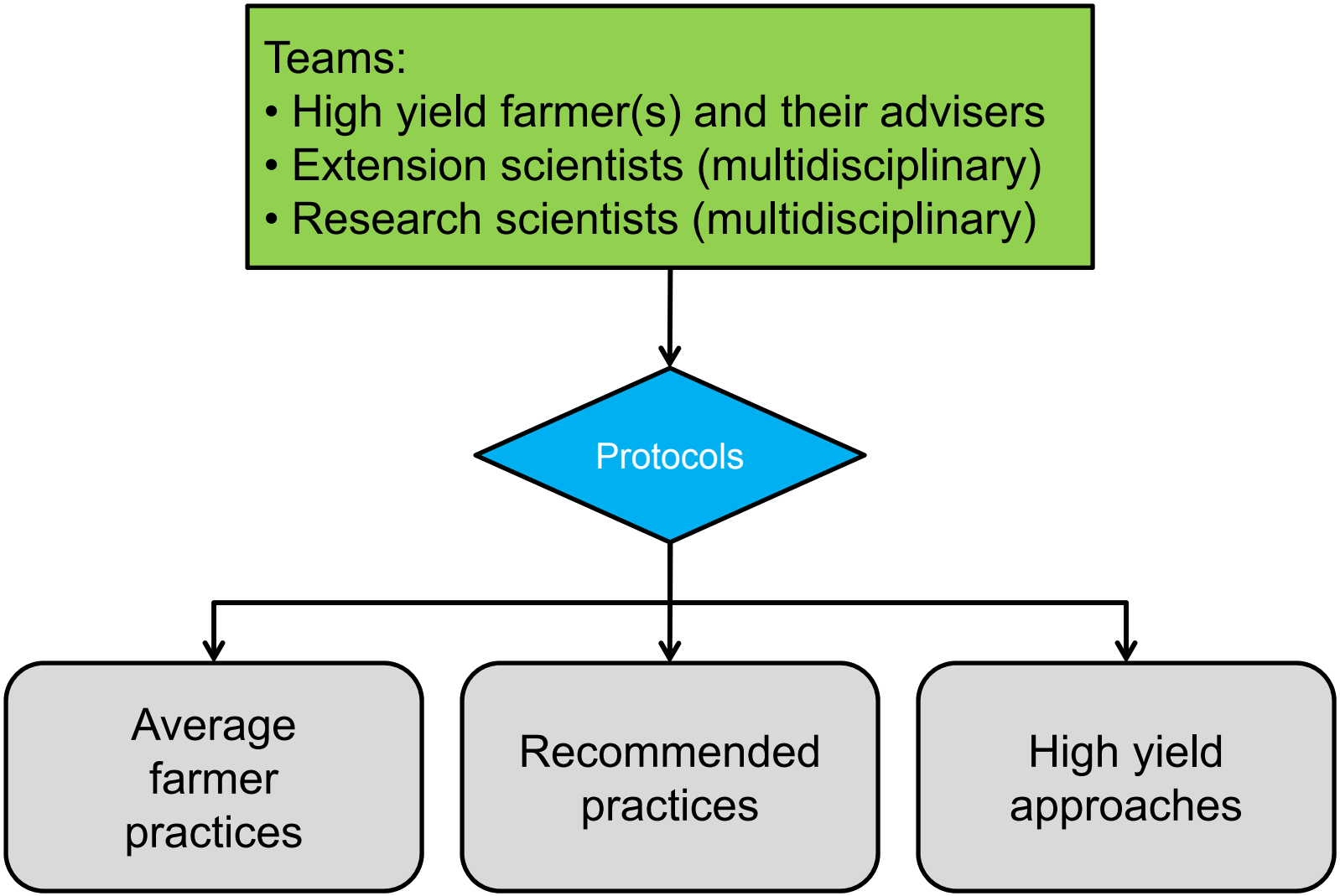
Comparison of Management Systems



Global Maize Long-Term Sites
Comparison of Management Systems

- **Average Farmer Practice**
- **Current Official Recommendations (university or government)**
- **Intensive (High Yield) Management**

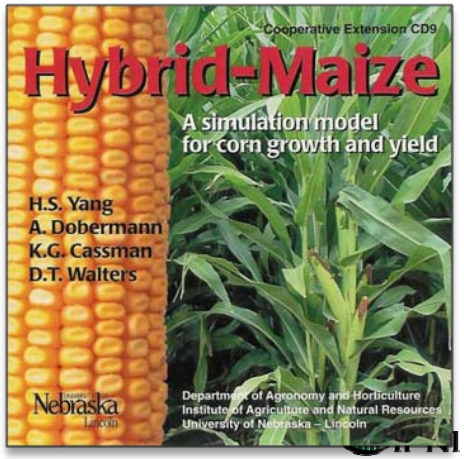



Teams:
• High yield farmer(s) and their advisers
• Extension scientists (multidisciplinary)
• Research scientists (multidisciplinary)
Protocols
Average farmer practices
Recommended practices
High yield approaches

Global Evaluation of *Hybrid -Maize*

Ecological Intensification of Maize

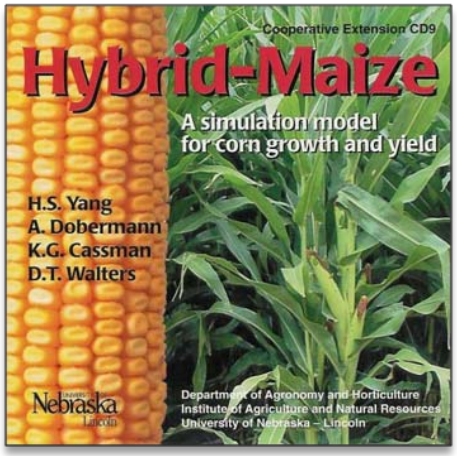
- To test predictability of maize growth and yield at all scales
- Adapt model to local climate, soils, cultural practices, scale
- To define current yield and yield potential in major maize-growing areas of the world
- Build and test nutrient management components (N)



Global Evaluation of *Hybrid -Maize*

- Local adaptability
  - *Climate*
  - *Soil*
  - *Cultural practices*
  - *Scale*
- Guide ag industry
  - *Right product, rate, time, place*
  - *Technology adaptation*

- Mechanistic approach
  - *Process-oriented*
  - *Site-specific parameters*
- Define yield potential
- Define research needs
- Focus research results
- Guide management decisions



Global Evaluation of *Hybrid Maize* -- On-Farm Testing --

- **Research Sites**
  - Institution location
  - Long-term
  - Monitoring capability
    - *Crop*
    - *Soil (nutrients, water, erosion, etc.)*
    - *Environment (air, water)*
  - Multi-Nutrient interactions
  - Refine the science
- **On-Farm Sites**
  - Omission plots (N, P, K, S)
  - Partner with local agency or dealer
  - Field-scale equipment
  - Adapted to local culture and technology
  - Demonstrations and field days
  - Data collection protocol
  - Implement the science

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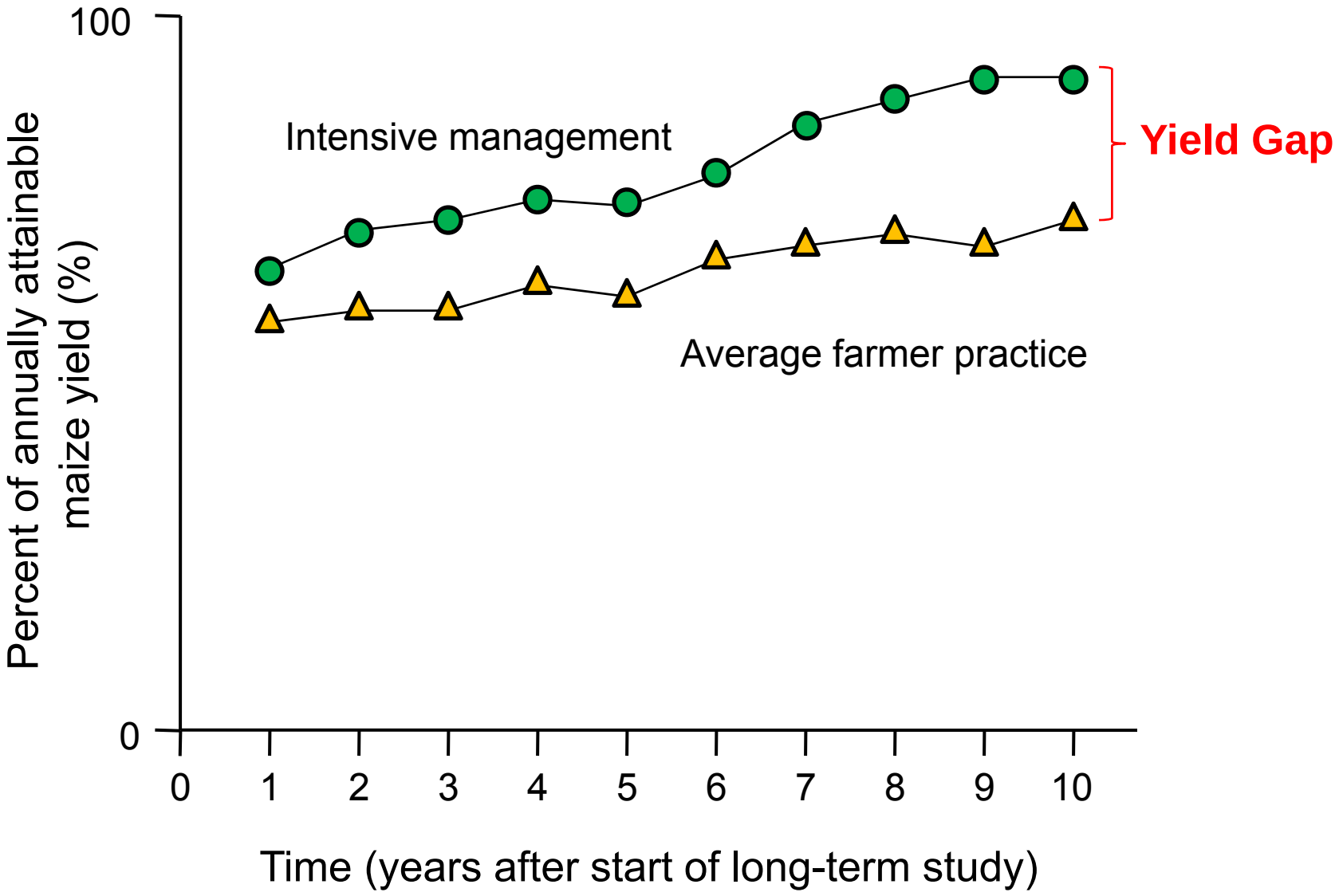
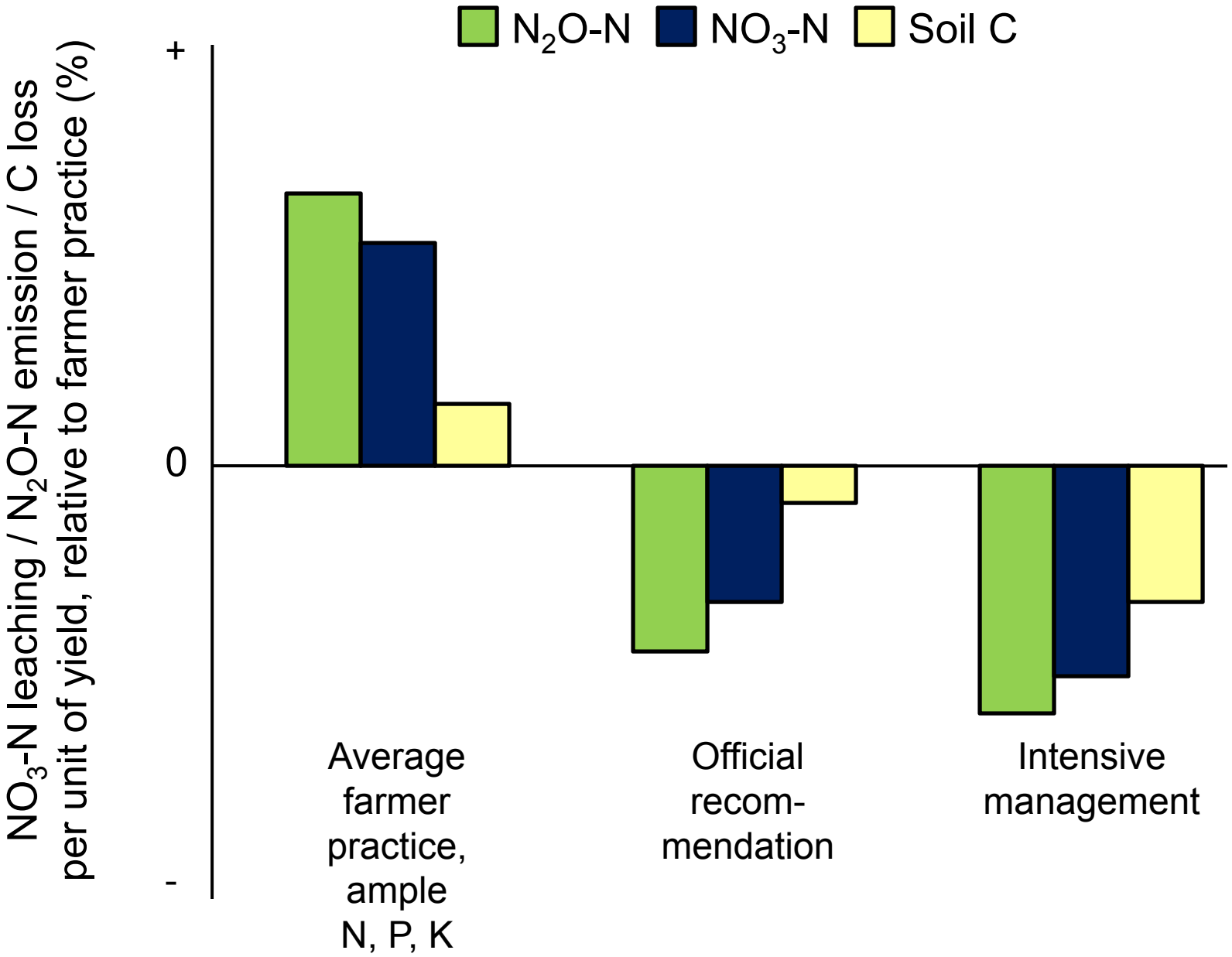
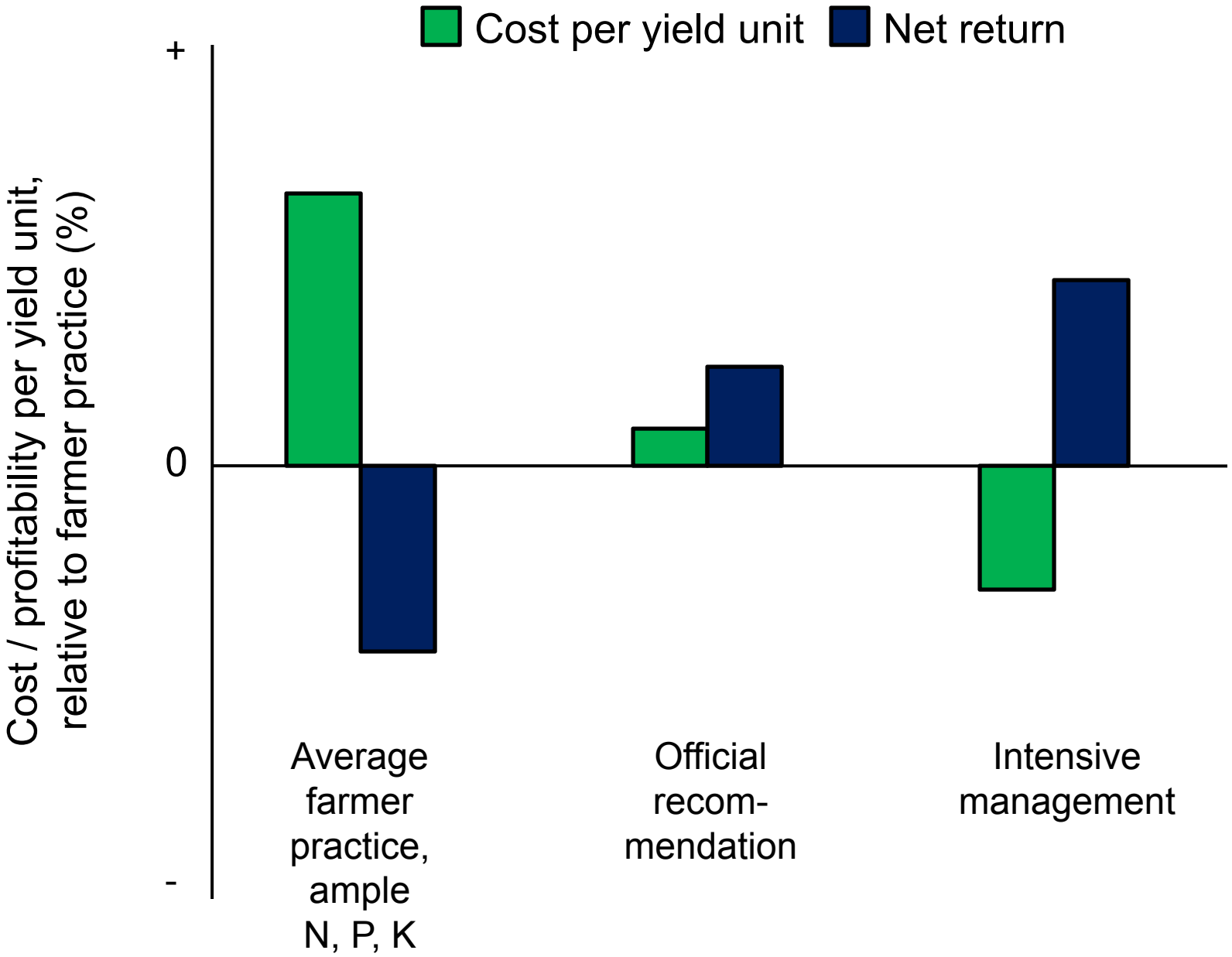
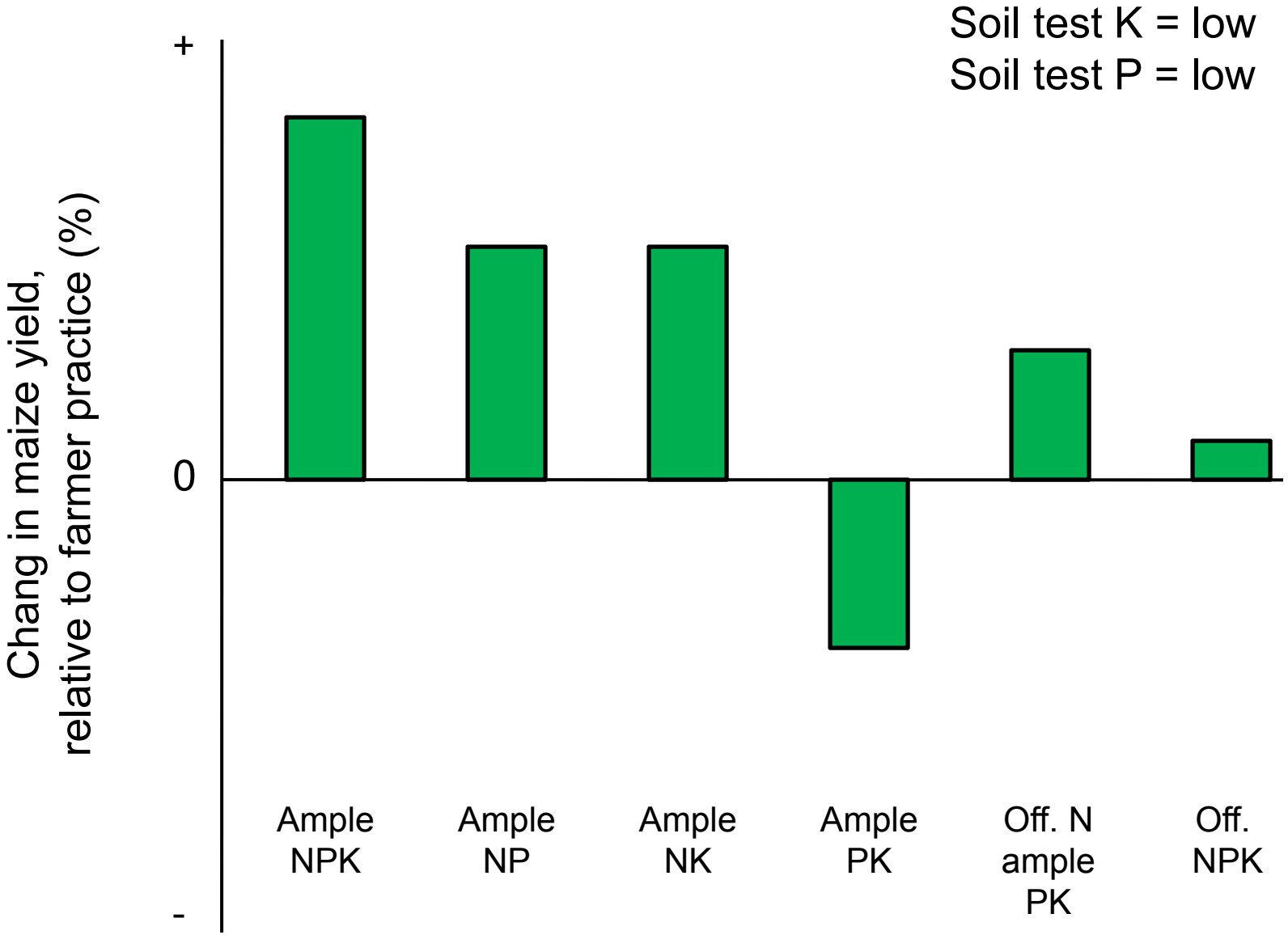
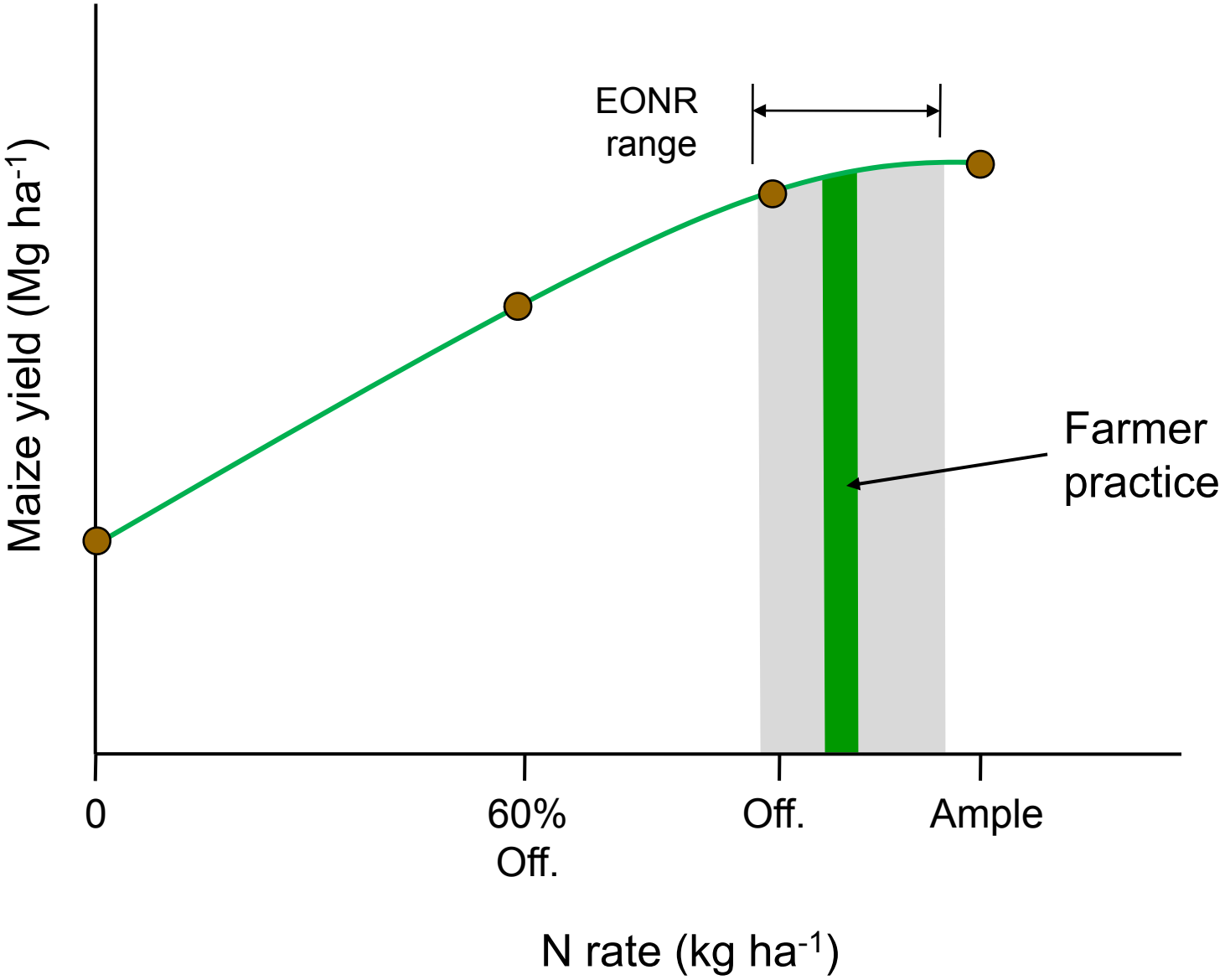
Data Analysis (Hypothetical Data)


100
0
Percent of annually attainable maize yield (%)
Intensive management
Average farmer practice
Yield Gap
0
1
2
3
4
5
6
7
8
9
10
Time (years after start of long-term study)


N_2O-N
NO_3-N
Soil C
+
0
-
NO_3-N leaching / N_2O-N emission / C loss per unit of yield, relative to farmer practice (%)
Average farmer practice, ample N, P, K
Official recom-mendation
Intensive management


Cost per yield unit
Net return
+
0
-
Cost / profitability per yield unit, relative to farmer practice (%)
Average farmer practice, ample N, P, K
Official recom-mendation
Intensive management


Soil test K = low
Soil test P = low
Chang in maize yield, relative to farmer practice (%)
+
0
-
Ample NPK
Ample NP
Ample NK
Ample PK
Off. N ample PK
Off. NPK


EONR
range
Farmer
practice
Maize yield (Mg ha-1)
0
60%
Off.
Off.
Ample
N rate (kg ha-1)

Training Sessions Sessions

- Everyone needs regular updates!!

- **Certified Crop Advisers**
  - **Continuing education**

- New agronomic information
- New genetics
- New fertilizer & pest management products
- New technology
- New software
- New knowledge on local systems

Training Packages

- Developing training in three areas identified in Needs Assessment
  - Using Soil Test Data
  - Using Yield Data
  - Using On-Farm Research
- Packages include:
  - Sample Data Sets
  - Exercise workbooks
  - Slide Presentations
  - Trainer's Manual
  - CD with all materials

On-line CEU Module for CCAs

Scientific Terminology for Efficiency

- Purpose:
  Develop standard terminology for reporting nutrient use efficiencies
  - Field measurements:
    - Yield vs. fertilizer use
    - Nutrient uptake vs. fertilizer use
  - Research measurements
    - Yield response vs. fertilizer use
    - Change in nutrient uptake vs. fertilizer use

Nutrient Use Efficiency and Effectiveness in North America:
Indices of Agronomic and Environmental Benefit

By C.S. Snyder and T.W. Bruulsema, International Plant Nutrition Institute

MINERAL FERTILIZERS have made it possible to sustain the world's growing population, sparing millions of acres of natural and ecologically-sensitive systems that otherwise would have been converted to agriculture[1]. Today, economic and environmental challenges are driving increased interest in nutrient use efficiency. Higher prices for both crops and fertilizers have heightened interest in efficiency-improving technologies and practices that also improve productivity. In addition, nutrient losses that harm air and water quality can be reduced by improving use efficiencies of nutrients, particularly for nitrogen (N) and phosphorus (P).

The world's population, growing in both numbers and purchasing power, is projected to consume more food, feed, fiber, and fuel—increasing global demand for fertilizer nutrients[2]. Since fertilizers are made from non-renewable resources, pressure to increase their use efficiencies will continue. At the same time, efforts should increase to enhance fertilizer use effectiveness for improved productivity and profitability of cropping systems.

System Efficiency

Efficiencies are generally calculated as ratios of outputs to inputs in a system. The "system" can be defined in many ways, depending on the interest of the observer.

Agricultural cropping systems contain complex combinations of components, including: soils, soil microbes, roots, plants, and crop rotations. Improvements in the efficiency of one component may or may not be effective in improving the efficiency of the cropping system. Efficiency gains in the short term may sometimes be at the expense of those in the long-term. Short-term reductions in application rates increase nutrient use efficiencies, even when yields decline. However, in the long-term, lower yields reduce production of crop residues, leading to increased erosion risks, decreased soil organic matter, and diminished soil productivity. Sustainable system efficiency demands attention to the long-term impacts.

Best management practices (BMPs) focus on the effectiveness of fertilizers and keeping them in the field for use by the intended crop in adapting cropping systems to the economic and environmental challenges noted above. Effectiveness is maximized when the most appropriate nutrient sources are applied at the right rate, time, and place in combination with conservation practices such as buffer strips, continuous no-till, cover crops, and riparian buffers within intensively managed cropping systems that achieve both increasing yields and diminishing nutrient losses[3]. This approach ensures that improvements to the nutrient use efficiency of the components contribute toward improving the efficiency of the entire system.

Many components contribute to the efficiency of a cropping system.

Because a cropping system includes multiple inputs and outputs, its overall efficiency depends on the science of economics. To maximize profit is to obtain the maximum value of outputs per unit value of all inputs. At the rate where the net return to the use of one input peaks, the input is making its maximum contribution to increasing the efficiency of all other inputs involved. Rates of nutrient application optimal for economic yields often minimize nutrient losses[4].

Component Efficiencies

A recent review identified no fewer than 18 different definitions and calculations of nutrient use efficiency[5]. Even the most useful component efficiencies require careful interpretation if they are to contribute to effective nutrient use in cropping systems. In **Table 1**, we

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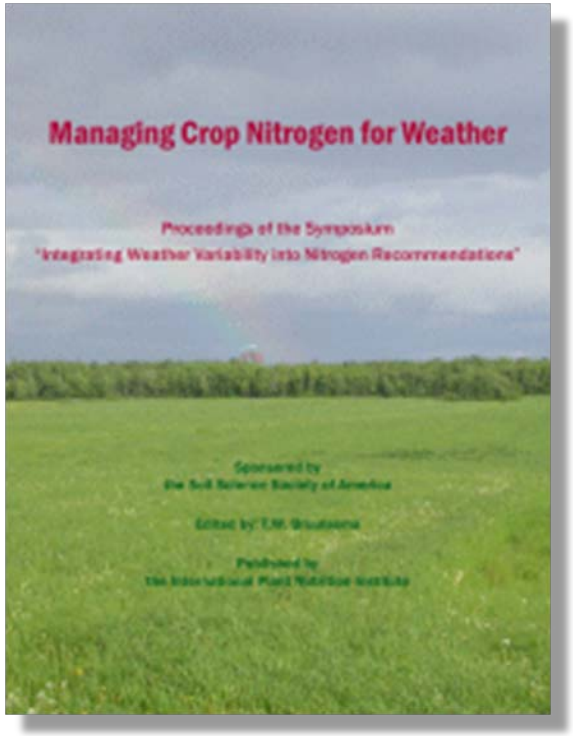
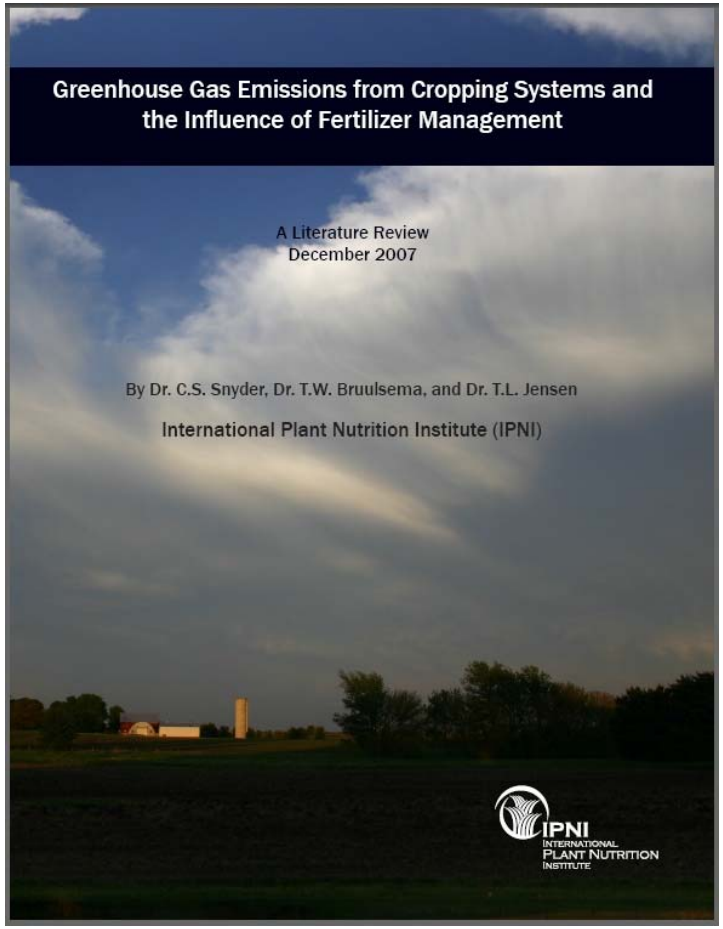
Managing Crop Nitrogen for Weather

- Purpose:
  Improving nitrogen recommendation models to account for weather variability
- Venue:
  Symposium at the annual meeting of the American Society of Agronomy



Review of Greenhouse Gas Emissions

- Agriculture's contribution to GHG emissions
- Effects of N rate, timing, and placement
- Enhanced N efficiency fertilizers
- Ecologically intensive production systems



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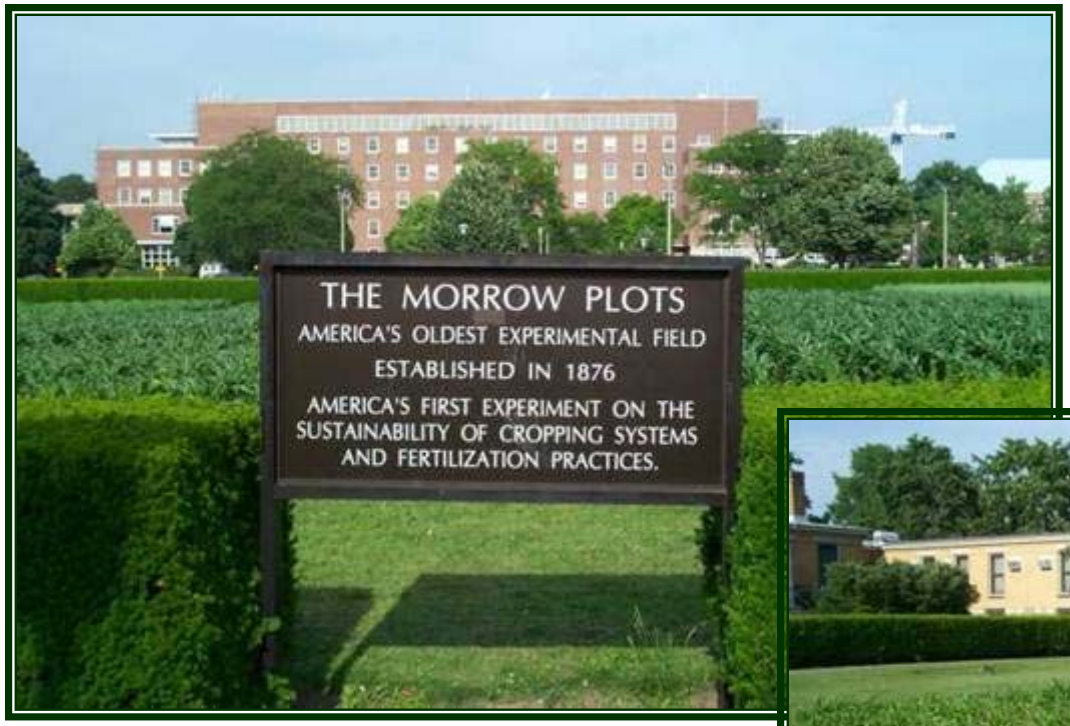
Long-Term Research -- Morrow Plots, etc.



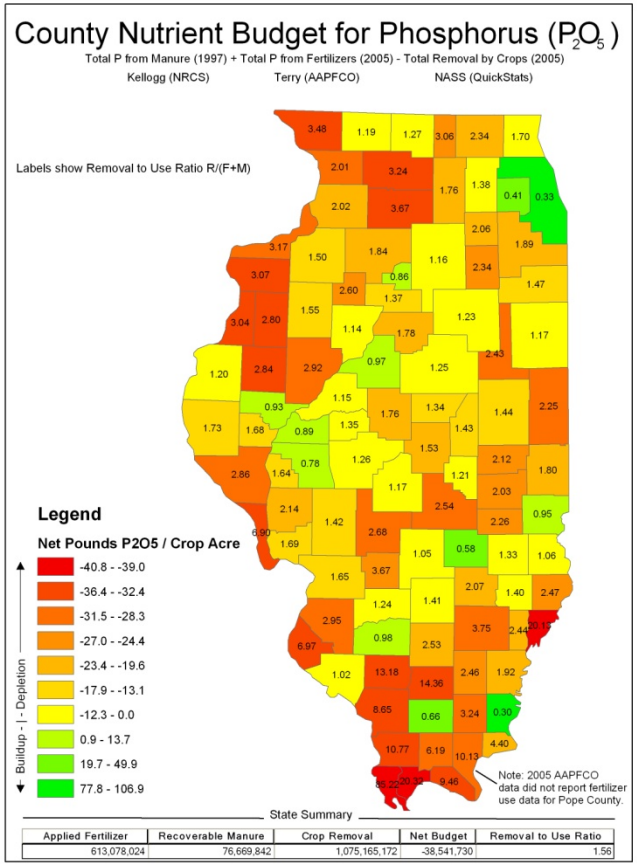
RECORD YIELD

2003 – 264 bu/A

Long-term studies are an important scientific resource that should be protected…
…and used.

Example GIS Data Analysis for Illinois

- County P_2O_5 Budgets
- 3 sources: NRCS, AAPFCO, NASS
- Manure Applied
- Fertilizer sold
- Crop Removal
  - Actual yield of major crops
- Computations on county basis
- Aggregation to watershed basis

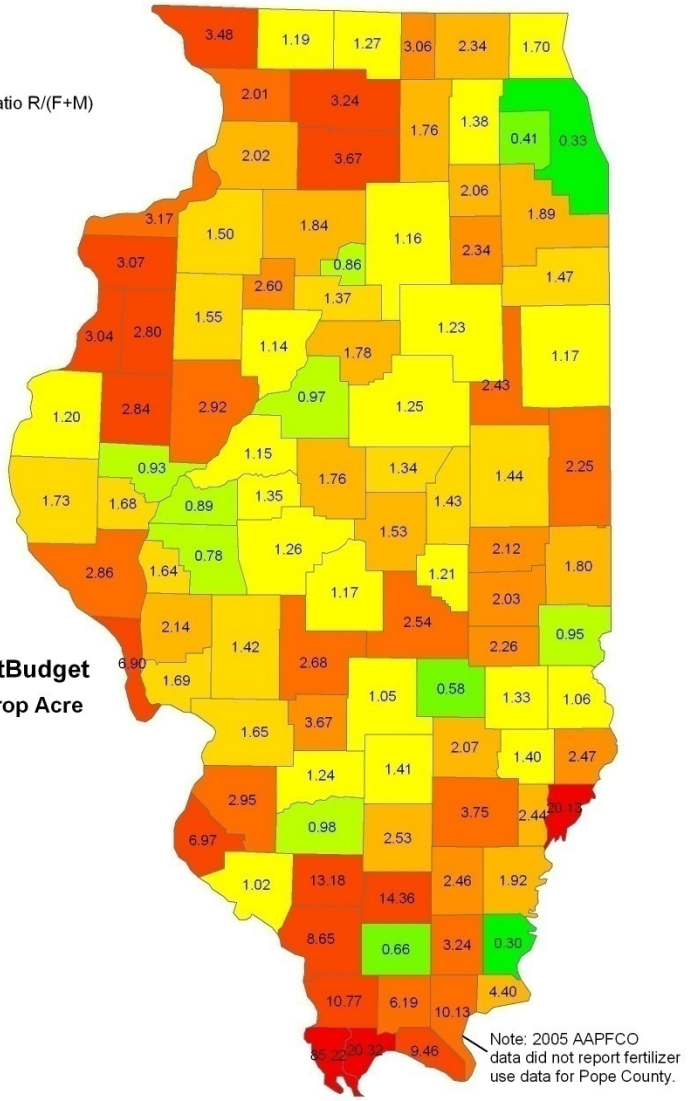


County Nutrient Budget for Phosphorus (P_2O_5)

Total P from Manure (1997) + Total P from Fertilizers (2005) - Total Removal by Crops (2005)

Kellogg (NRCS) Terry (AAPFCO) NASS (QuickStats)

Labels show Removal to Use Ratio R/(F+M)



Note: 2005 AAPFCO data did not report fertilizer use data for Pope County.

Legend

IL_County_NutrientBudget

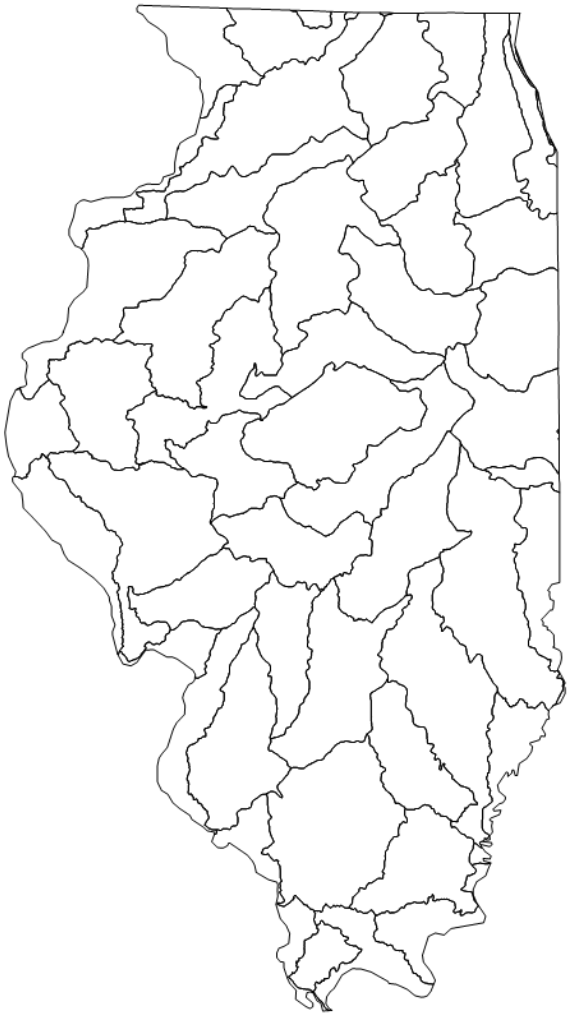
Net Pounds P2O5 / Crop Acre

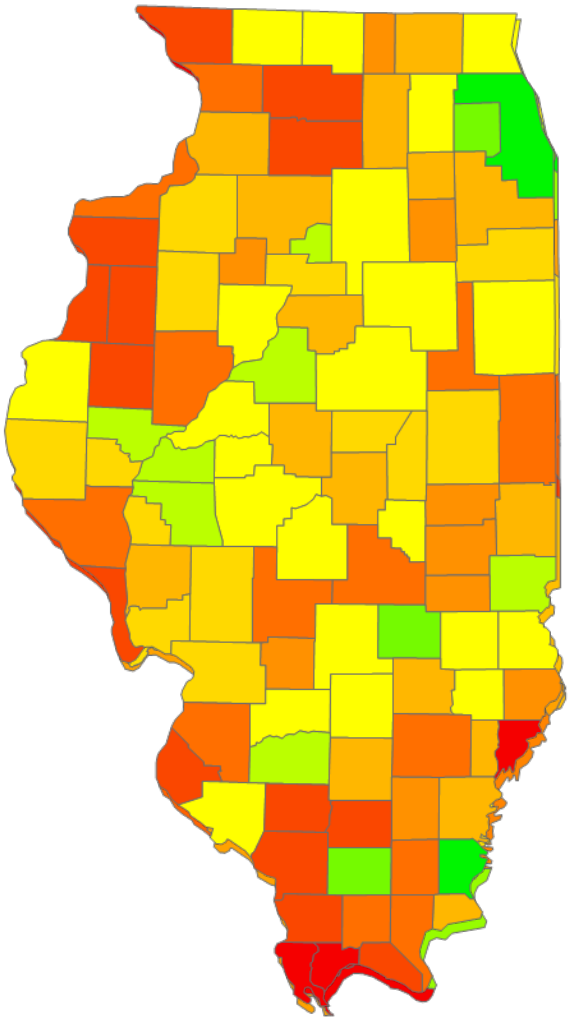
Buildup - | - Depletion

- -40.8 - -39.0
- -36.4 - -32.4
- -31.5 - -28.3
- -27.0 - -24.4
- -23.4 - -19.6
- -17.9 - -13.1
- -12.3 - 0.0
- 0.9 - 13.7
- 19.7 - 49.9
- 77.8 - 106.9

State Summary

Applied Fertilizer	Recoverable Manure	Crop Removal	Net Budget	Removal to Use Ratio
613,078,024	76,669,842	1,075,165,172	-385,417,307	1.56

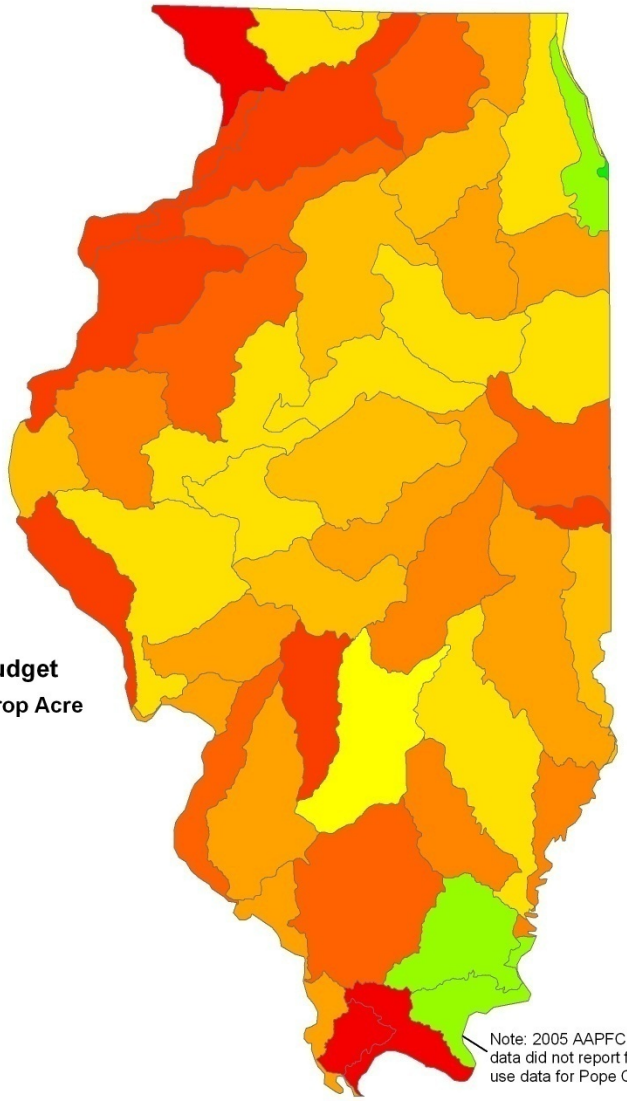




Watershed Nutrient Budget for Phosphorus (P_2O_5)

Total P from Manure (1997) + Total P from Fertilizers (2005) - Total Removal by Crops (2005)

Kellogg (NRCS) Terry (AAPFCO) NASS (QuickStats)



Legend

IL_HUC_NutrientBudget

Net Pounds P2O5 / Crop Acre

- -38.1 - -31.1
- -29.2 - -25.7
- -25.0 - -22.2
- -21.8 - -19.4
- -18.2 - -15.6
- -15.0 - -12.3
- -11.1 - -7.1
- -5.7 - 0.0
- 7.5 - 19.2
- 77.4

Buildup - | - Depletion

Note: 2005 AAPFCO data did not report fertilizer use data for Pope County.

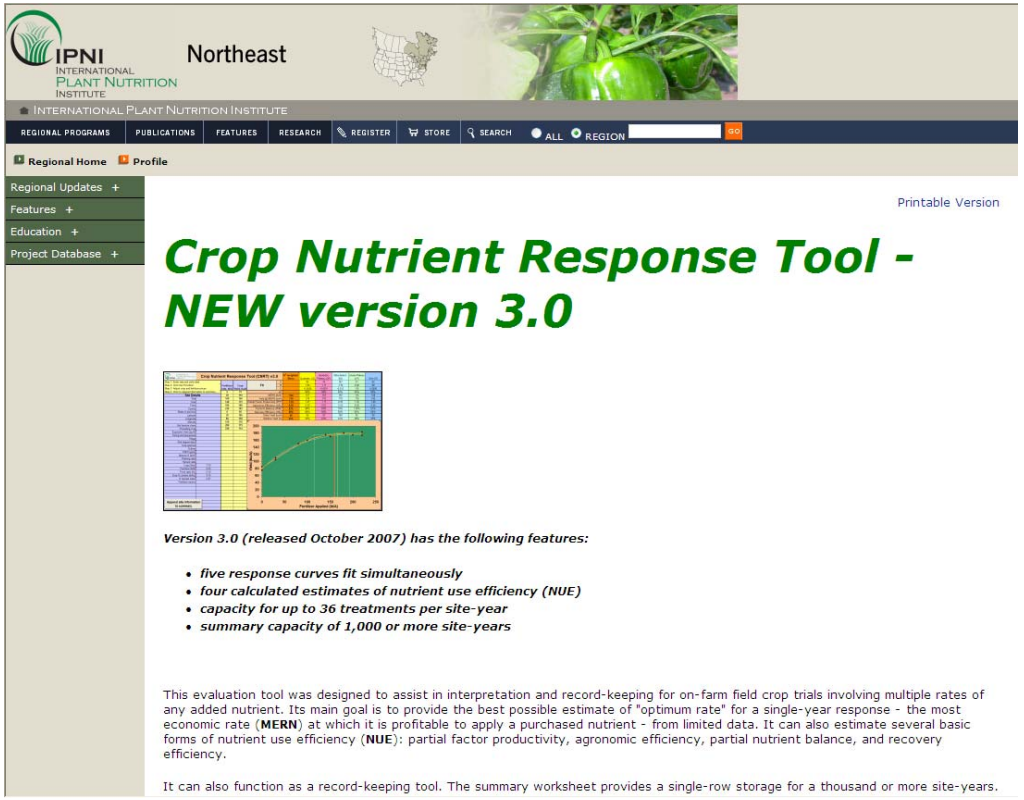
State Summary

Applied Fertilizer	Recoverable Manure	Crop Removal	Net Budget	Removal to Use Ratio
613,078,024	76,669,842	1,075,165,172	-385,417,307	1.56

Nutrient Response Tool

www.ipni.net/northeast

- Excel Spreadsheet
- Fits several models
  - Linear-plateau
  - Quadratic
  - Quadratic-plateau
  - Mitscherlich
  - Sine



Examining Nutrient Budgets at Different Spatial Scales

Calculating nutrient budgets with Raster Calculator

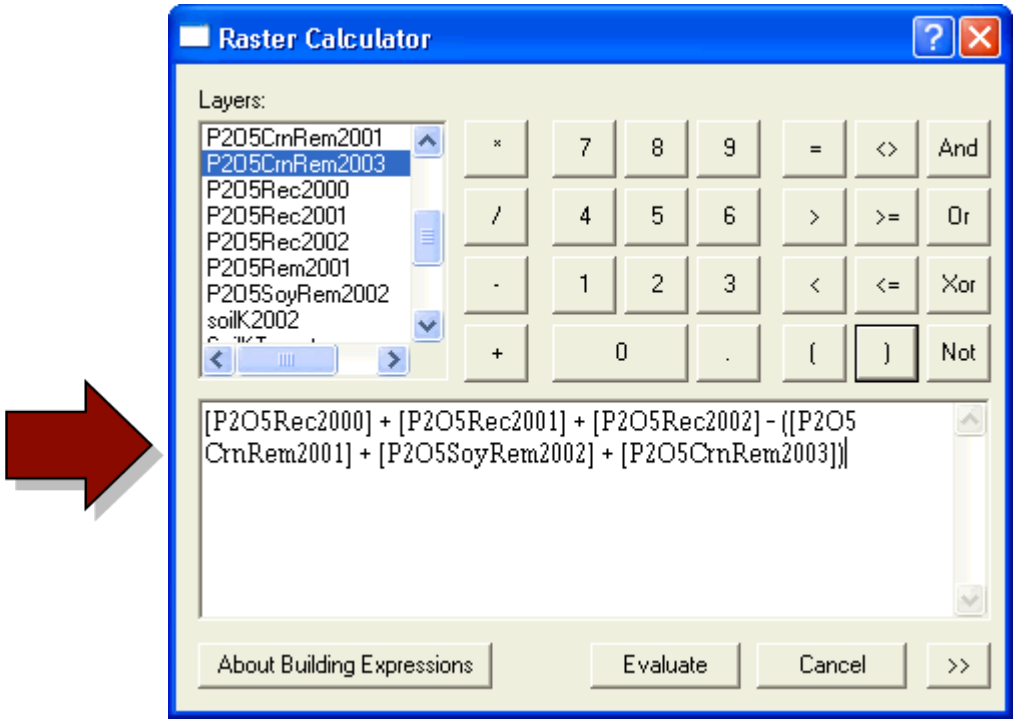
- Total added – total removed

Recommendations
(2000 + 2001 + 2002)

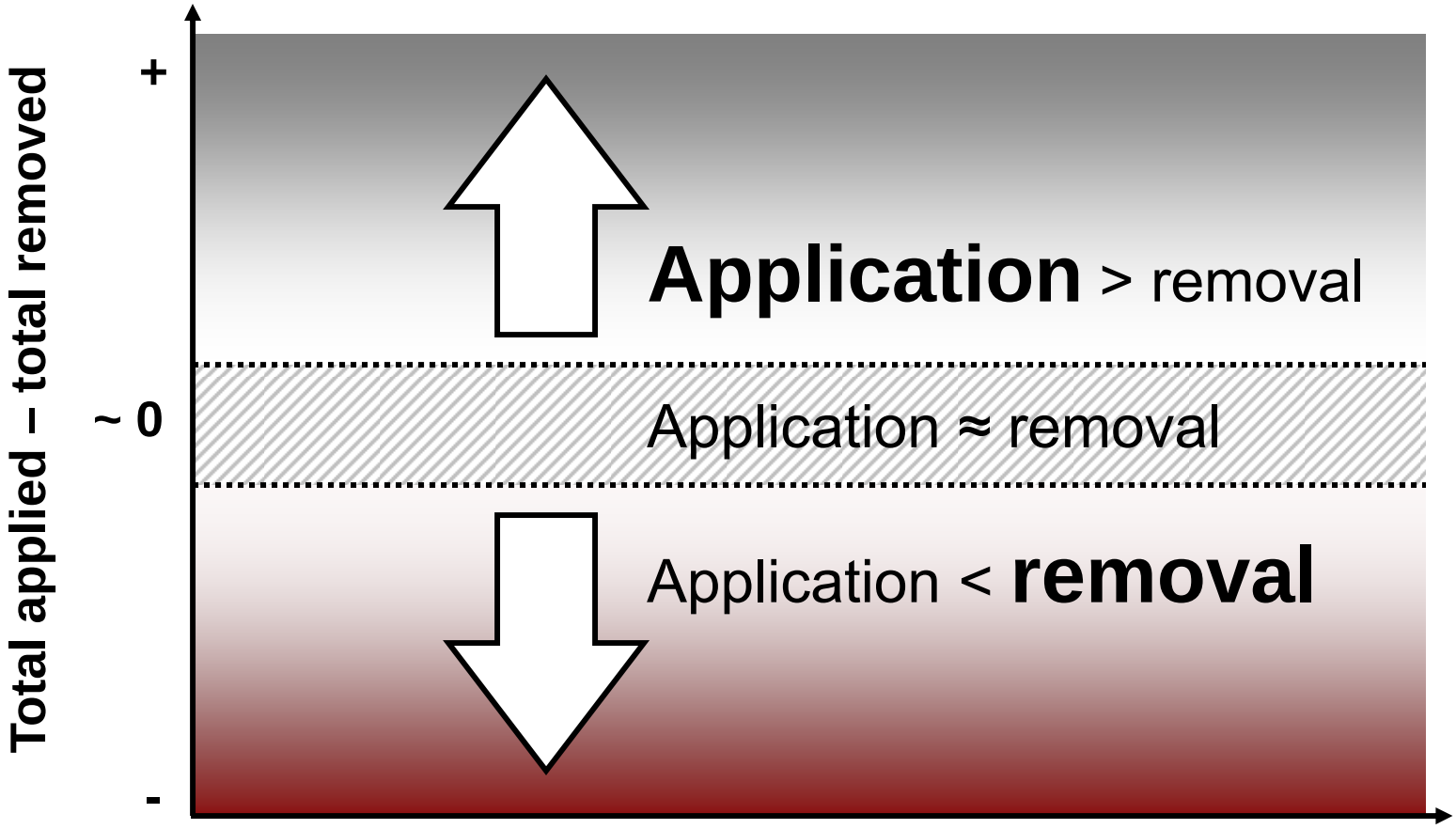
-

Estimated removal
(2001 + 2002 + 2003)

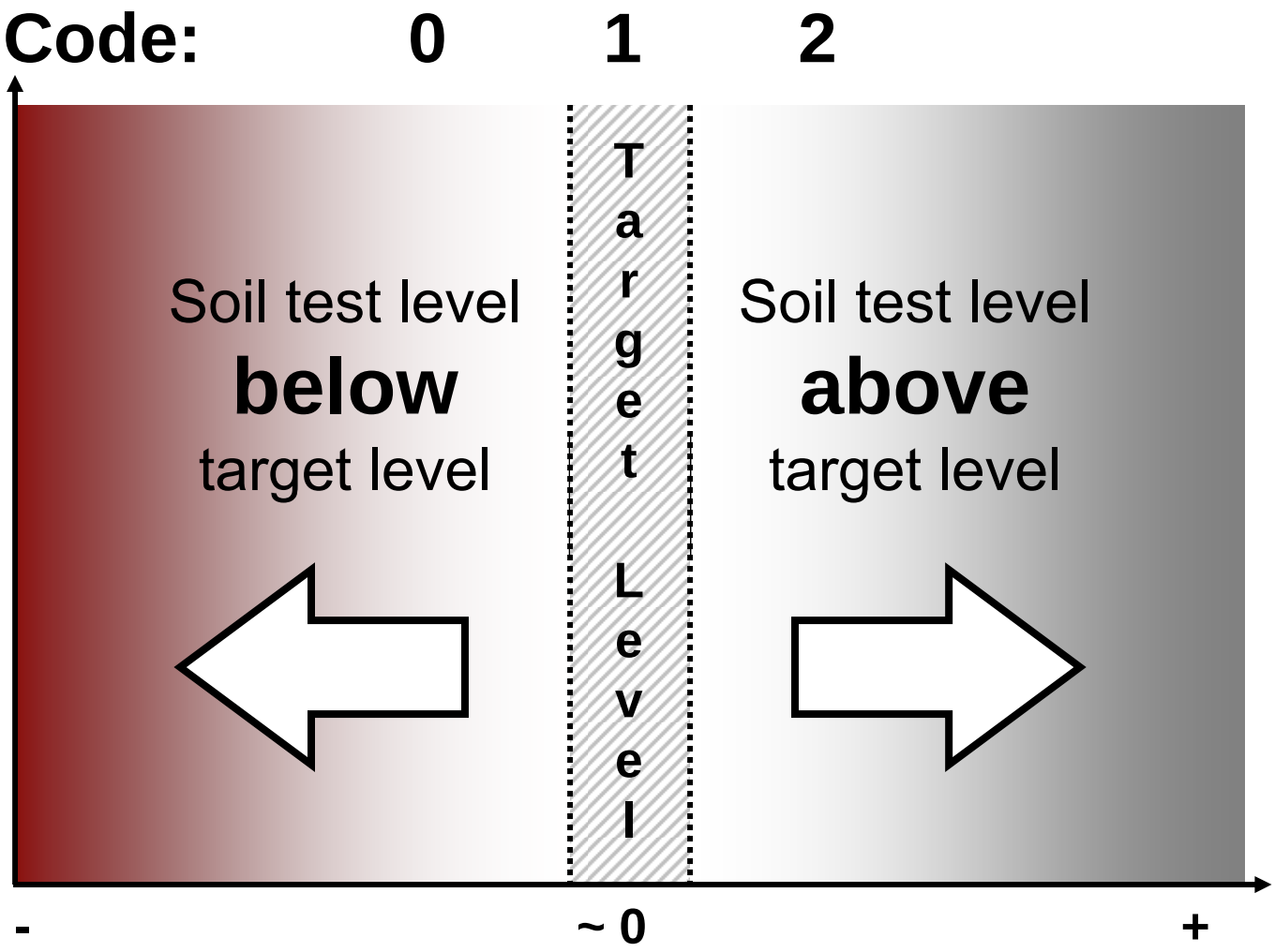
Budget
(2001 – 2003)



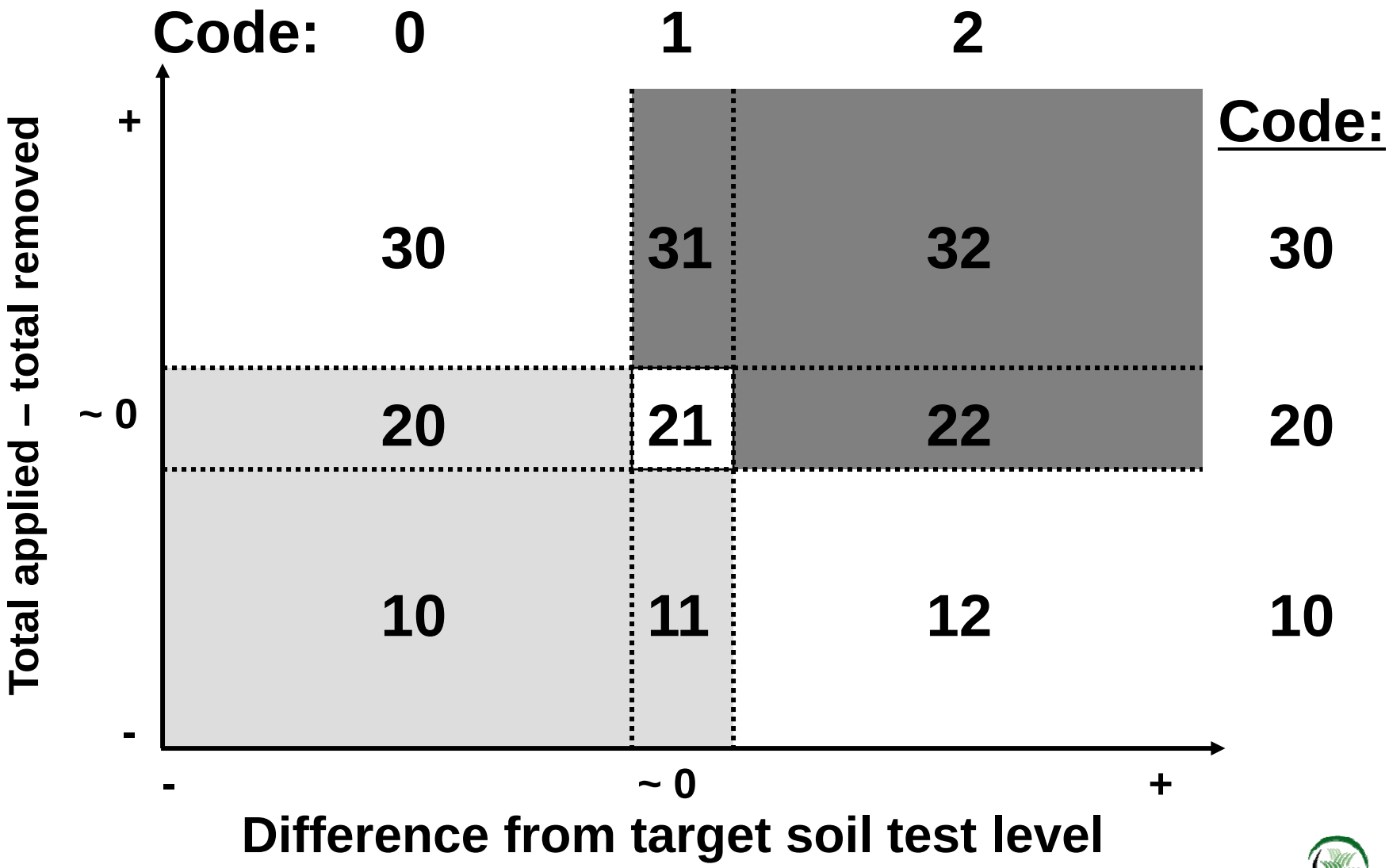
Interpreting nutrient budgets



Interpreting soil test levels



Evaluating nutrient budgets with soil test levels

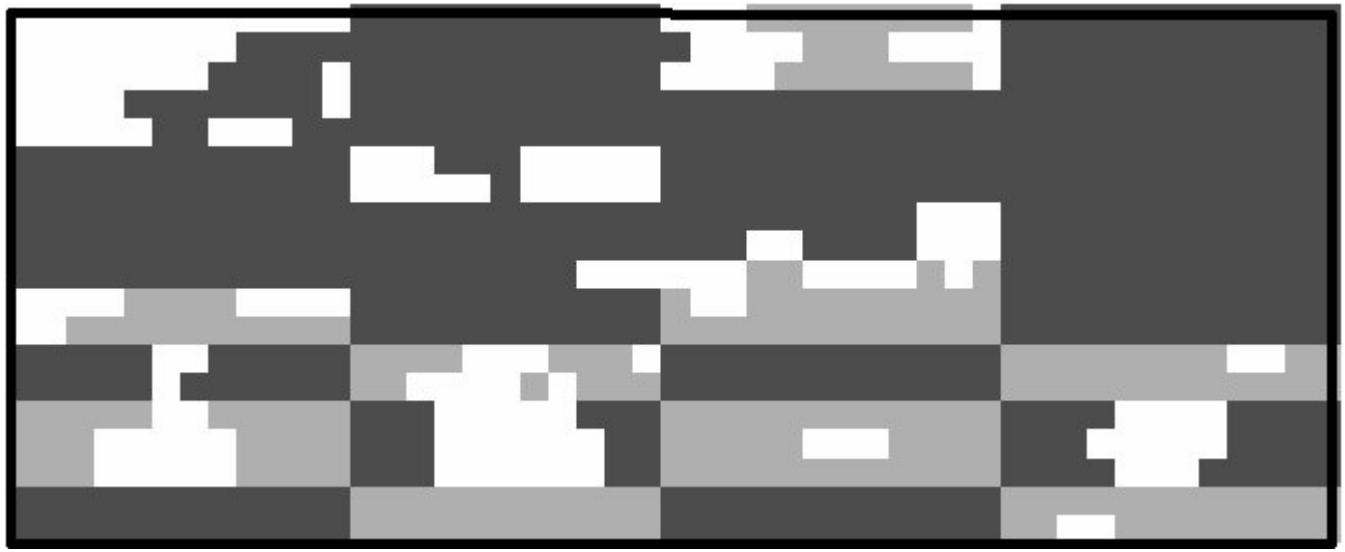


Spatial evaluation of nutrient budgets

No alteration

Input increase needed

Input reduction needed

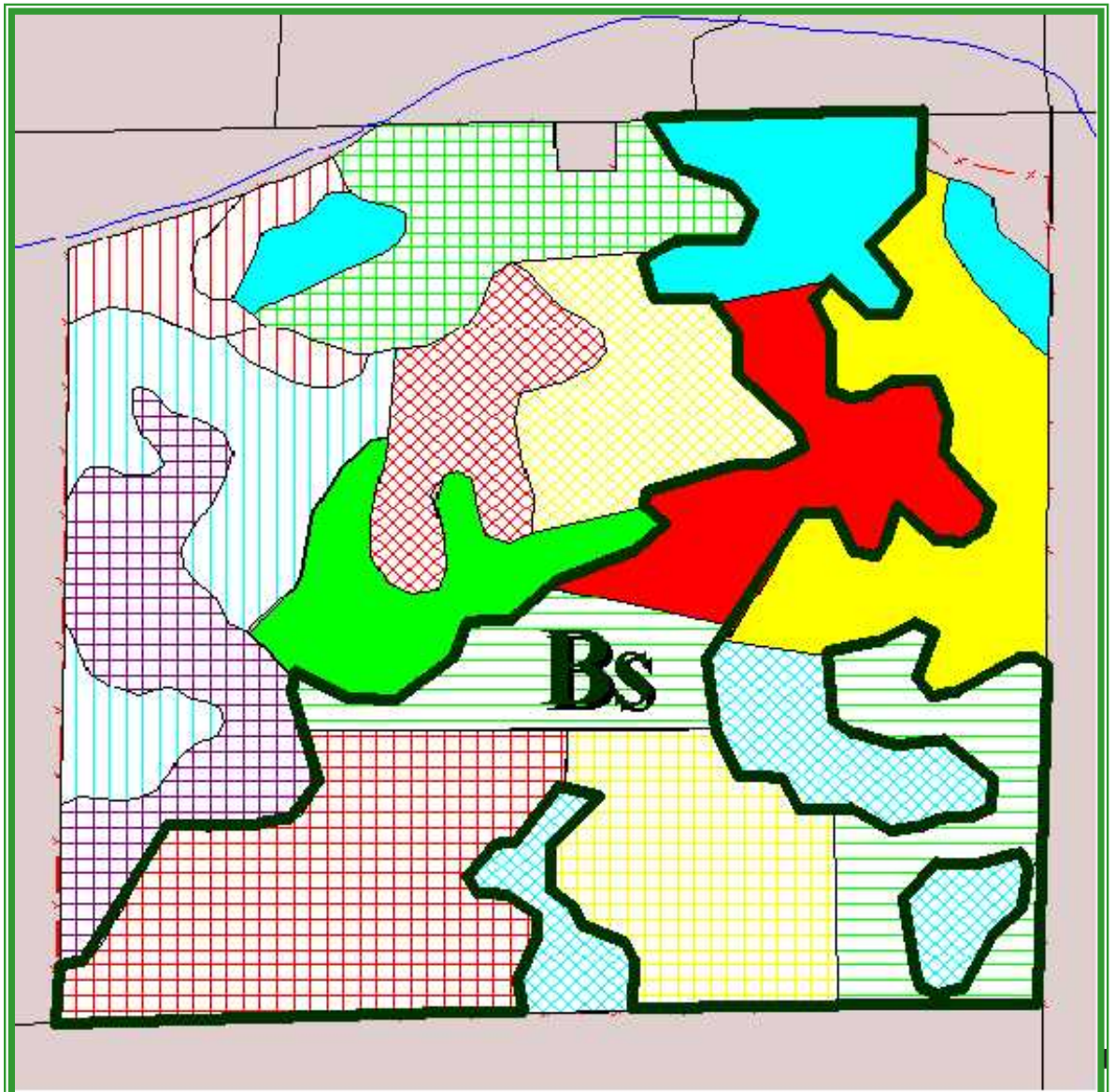


Zone Management of P and K

Slides from Lance Murrell's plots

Management Zones for an Indiana Field

- Soil mapping units divided into smaller areas
- Composite soil sample taken from each area
- Location of each core recorded
- Zone size range: 1 – 20 acres



Corn Yield

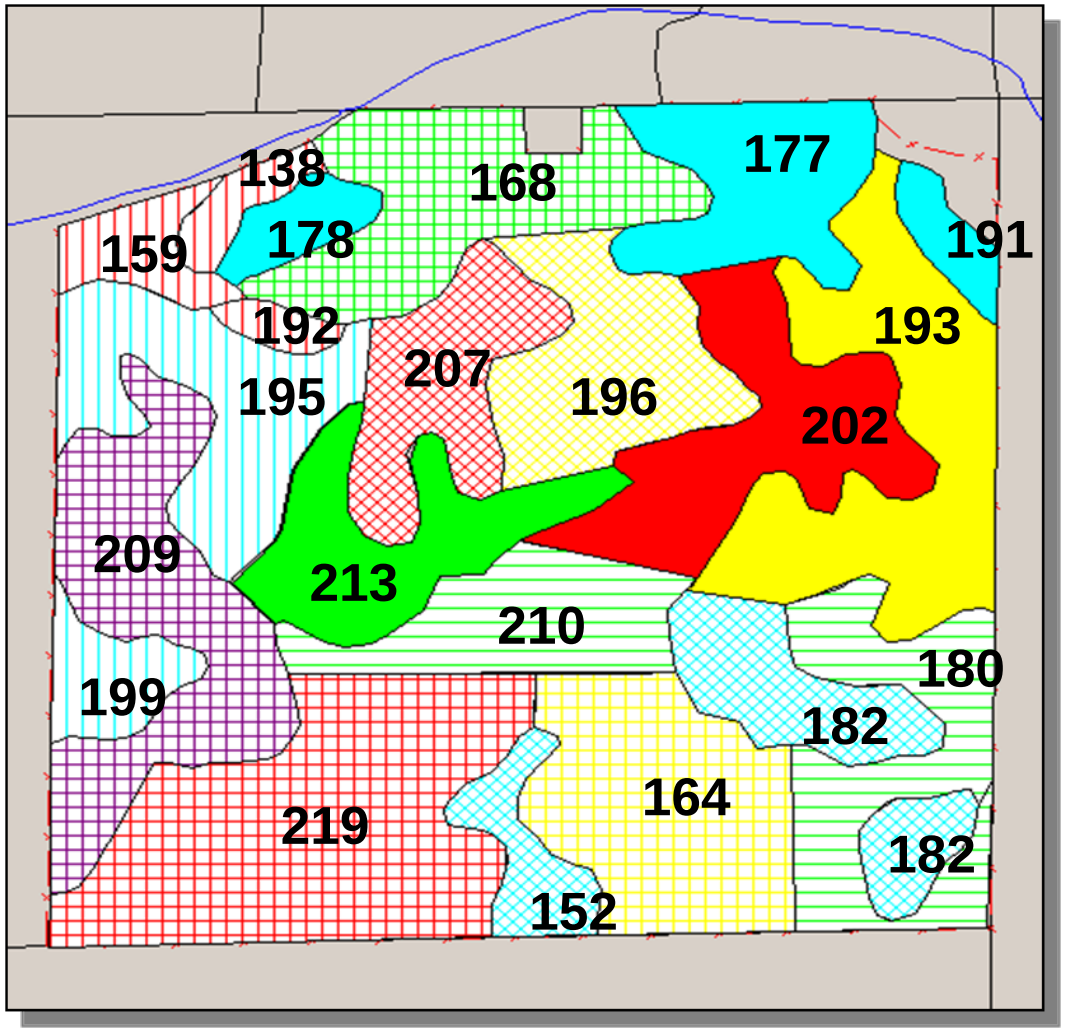
147-acre Field

Field Average (3 yr)

189 bu/A

Range by Zone

138-219 bu/A



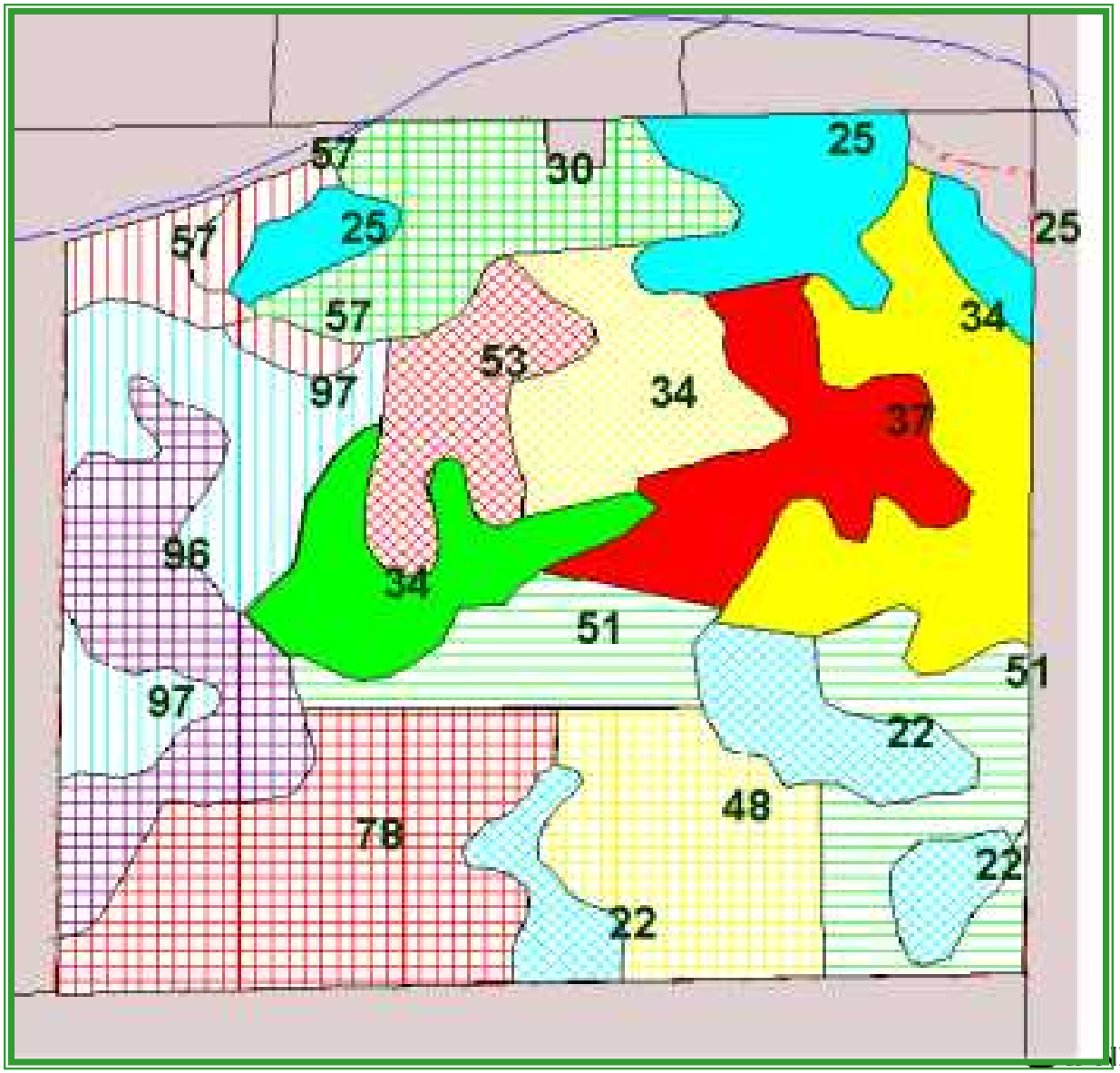
Bray P1 Soil Test by Sampling Area

- **Site-Specific** Soil Test Range:
  22 – 97 ppm

  Total P Applied:
  5113 lb P

- **Field Average** Soil test:
  52 ppm

  Total P Applied:
  None



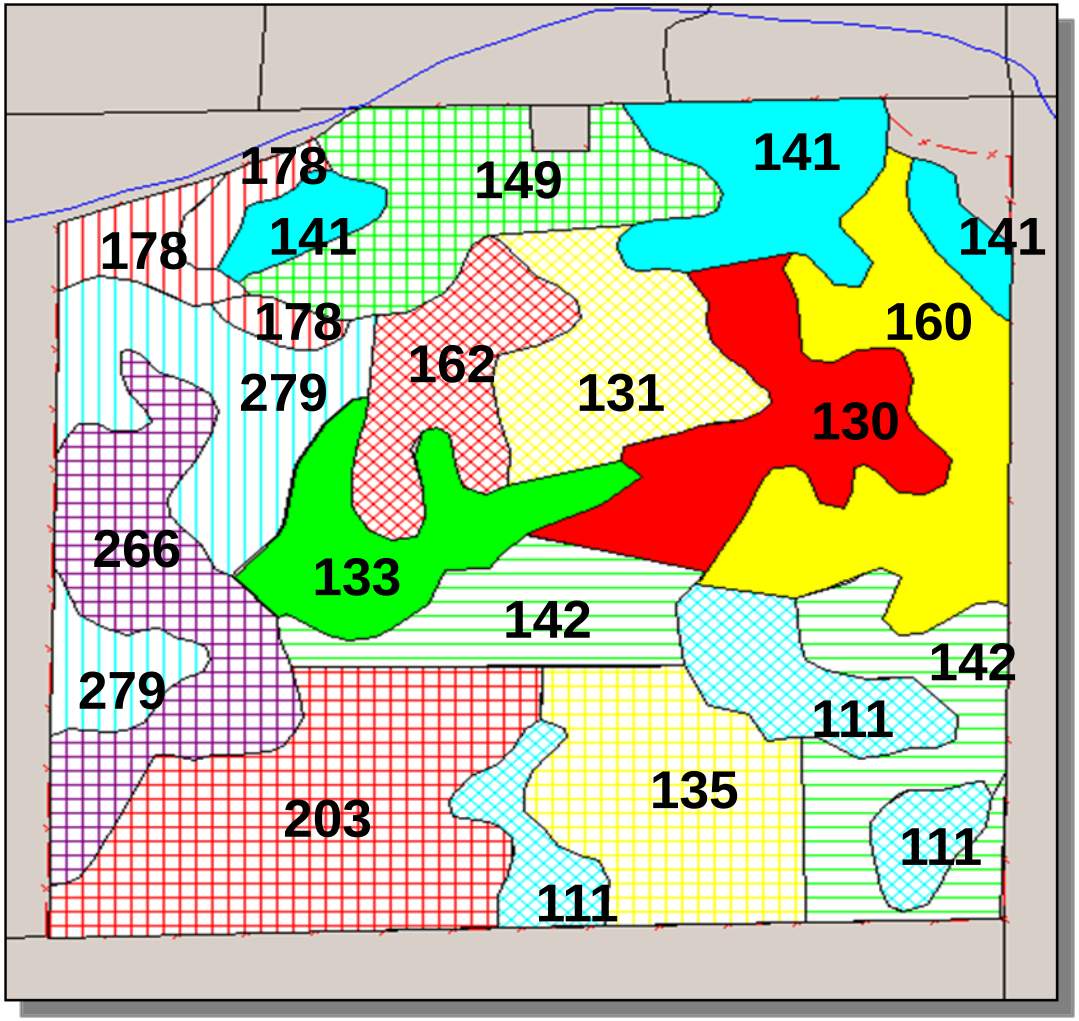
K Test (Mehlich III)

Field Average

K = 170 ppm

Zone Range

111-279 ppm



K Recommendation

Field Average

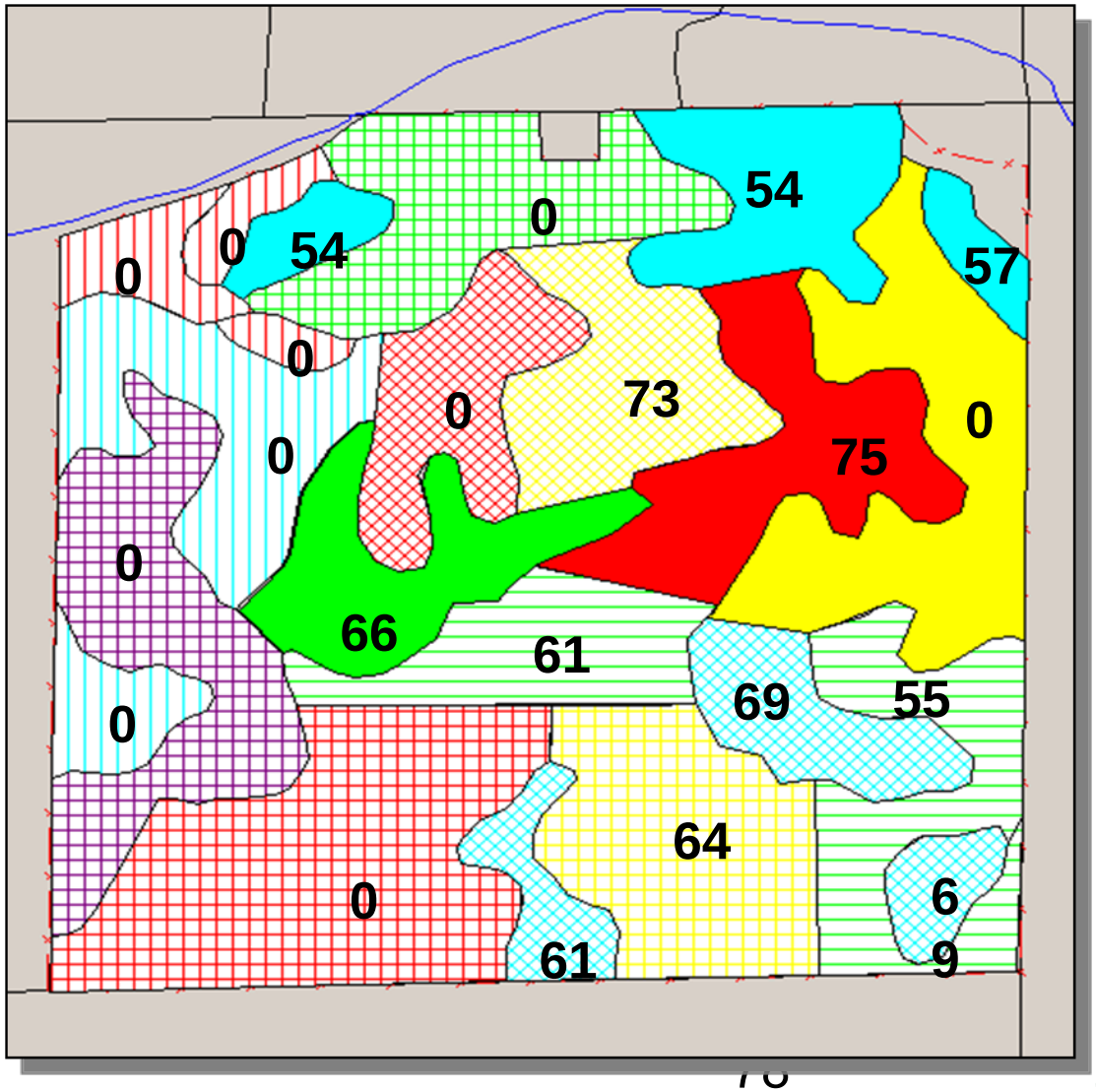
0 K_2O

Management Zones

76 Acres

4895 lb K_2O

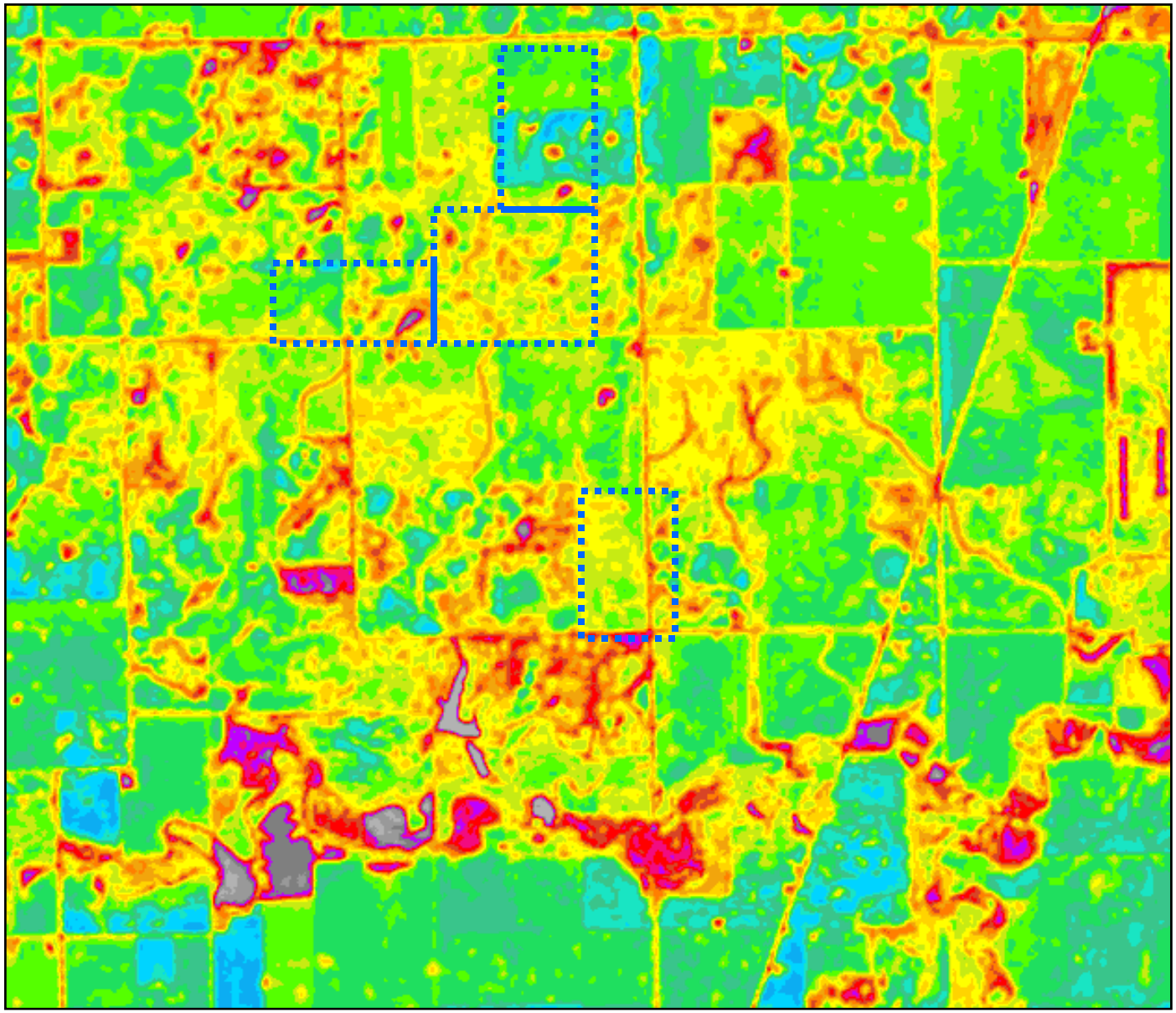
4+ Tons of Potash



Gain from Technology

- Nearly **10 tons of P and K fertilizer** sales
- *Corn Yield increase*

  ---— ***35 bu/A***
- More efficient use of N and manure
- *A well-managed farm in a "mature market"---*
- ***There are many like it!***



February 6-10, 2006

Illinois Regional Tillage Seminars

John Ahlrichs, Digital Globe

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Pará
Brazil
Salvador
Brasilia
Belo Horizonte
Rio de Janeiro
São Paulo
Bolivia
La Paz
Paraguay
Asunción
27 33 14.02 S, 52 46 53.39 W
Uruguay
Montevideo
Buenos Aires
Chile
Argentina


Minas Gerai
ta Cruz
Mato Grosso do Sul
São Paulo
Paraguay
Curitiba
Asunción
27 33 14.02 S, 52 46 53.39 W
State of Rio
Grande Do Sul
Image NASA
© 2007 Europa Technologies
Image © 2007 TerraMetrics
©2007 Google™
S 52°31'46.76" W
Streaming 100%
Porto Alegre
Eye alt 1101.38 mi


27 33 14.02 S, 52 46 53.39 W


Faxinalzinho
Votouro
Sete de Setembro
Benjamin Constant do Sul
Entre Rios do Sul
São Valenti
ndade do Sul
27 33 14.02 S, 52 46 53.39 W
Souto Neto
Três Palmeiras
Cruzaltense
Alto Recreio
Campinas do Sul
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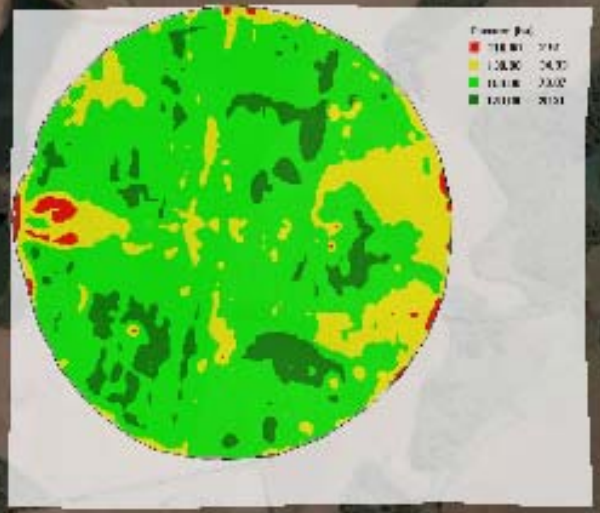
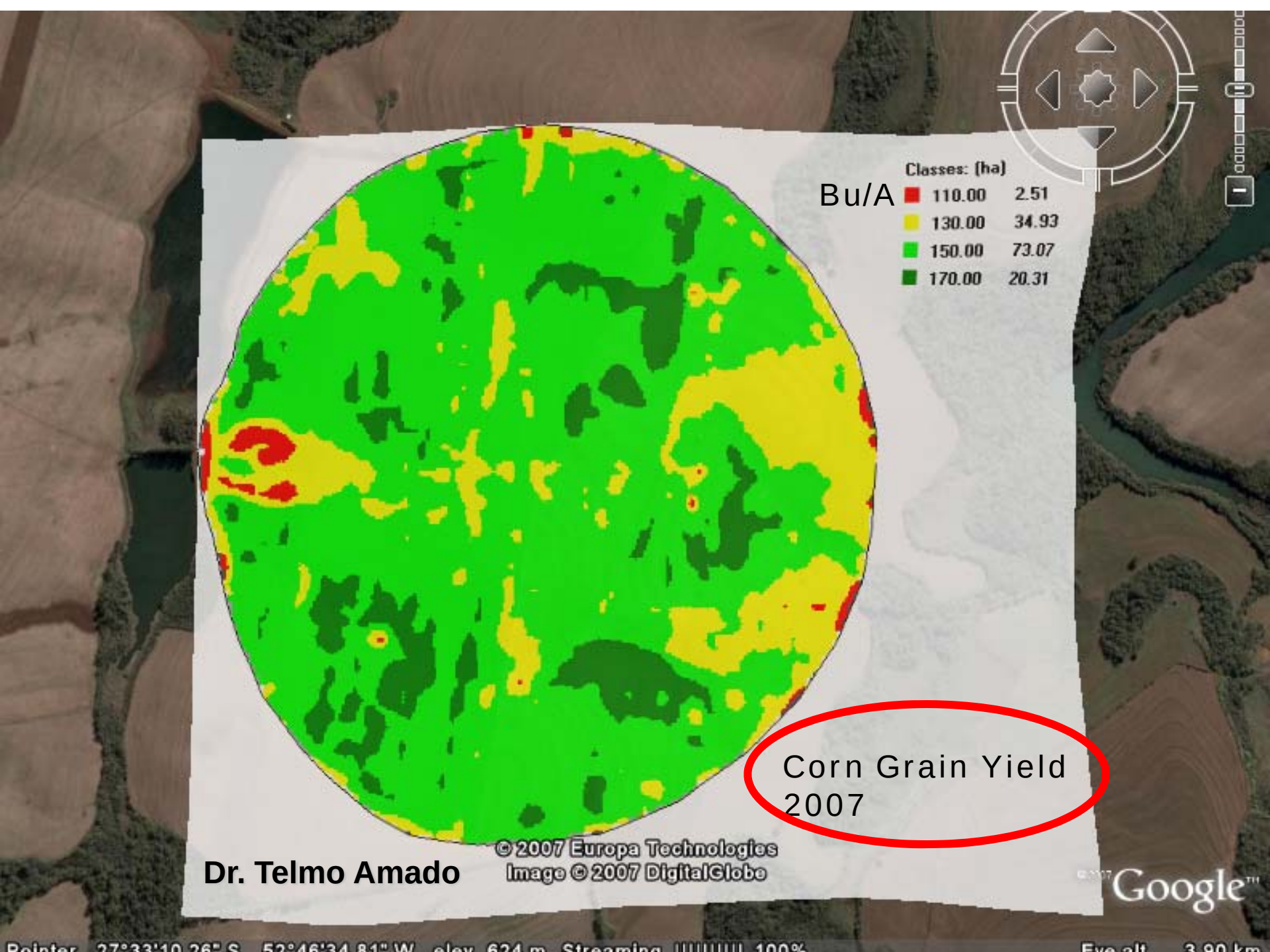
27 33 14.02 S, 52 46 53.39 W

Ongoing Research by Dr. Telmo Amado
Univ. of Santa Maria




Bu/A
Classes: (ha)
110.00 2.51
130.00 34.93
150.00 73.07
170.00 20.31
Corn Grain Yield
2007
Dr. Telmo Amado
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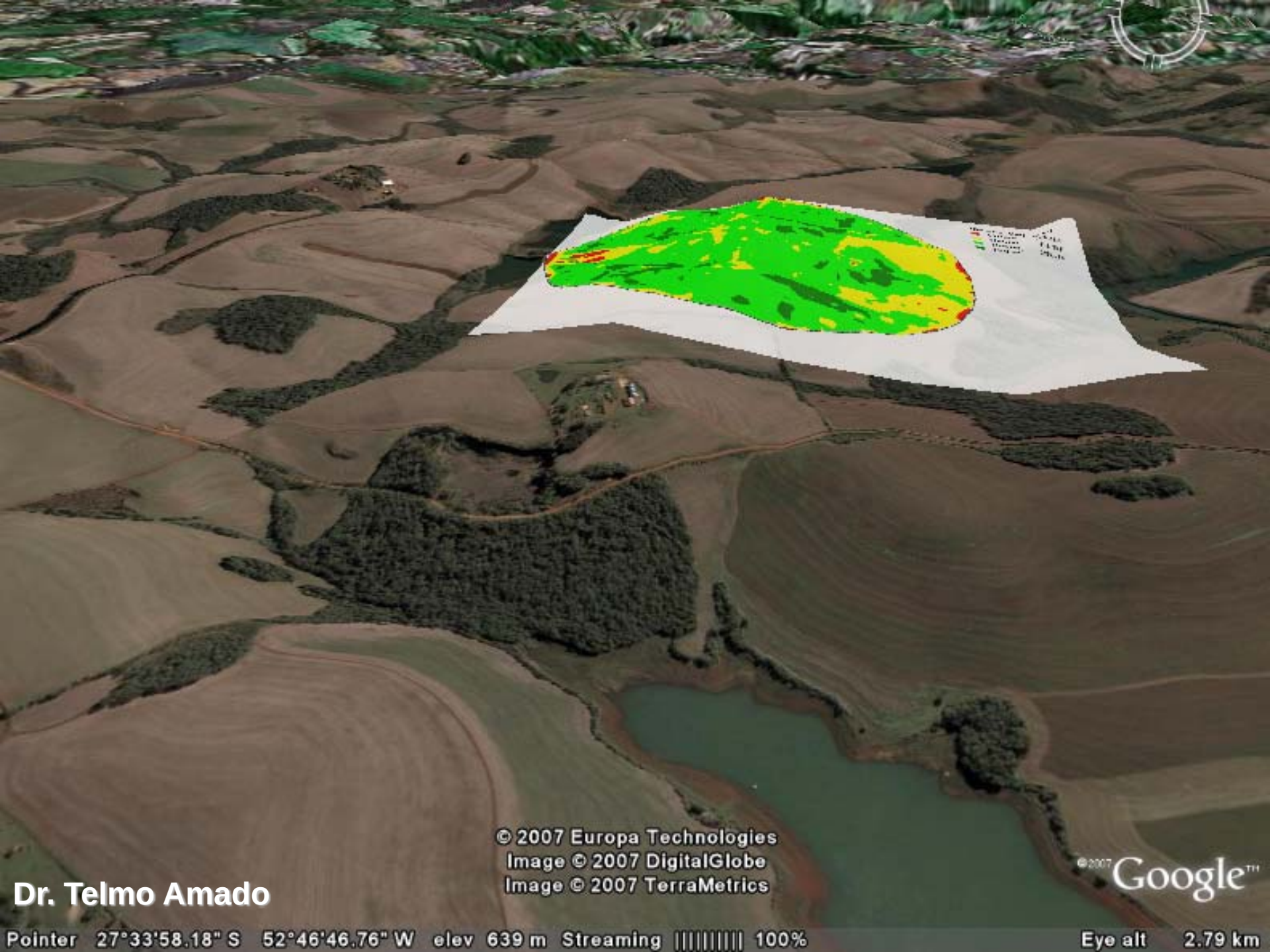
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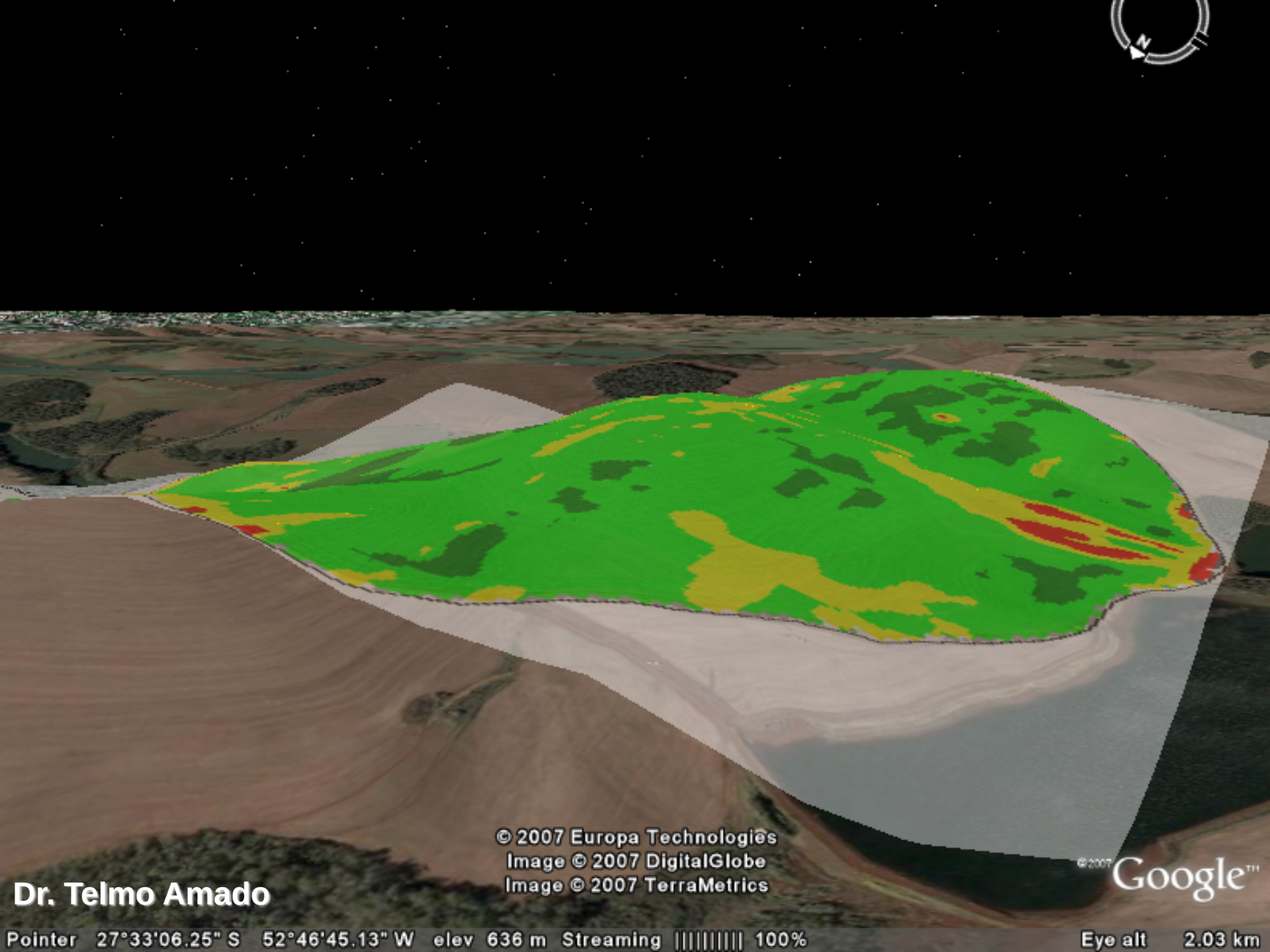
Dr. Telmo Amado
Pointer 27°33'58.18" S 52°46'46.76" W elev 639 m Streaming 100%
Eye alt 2.79 km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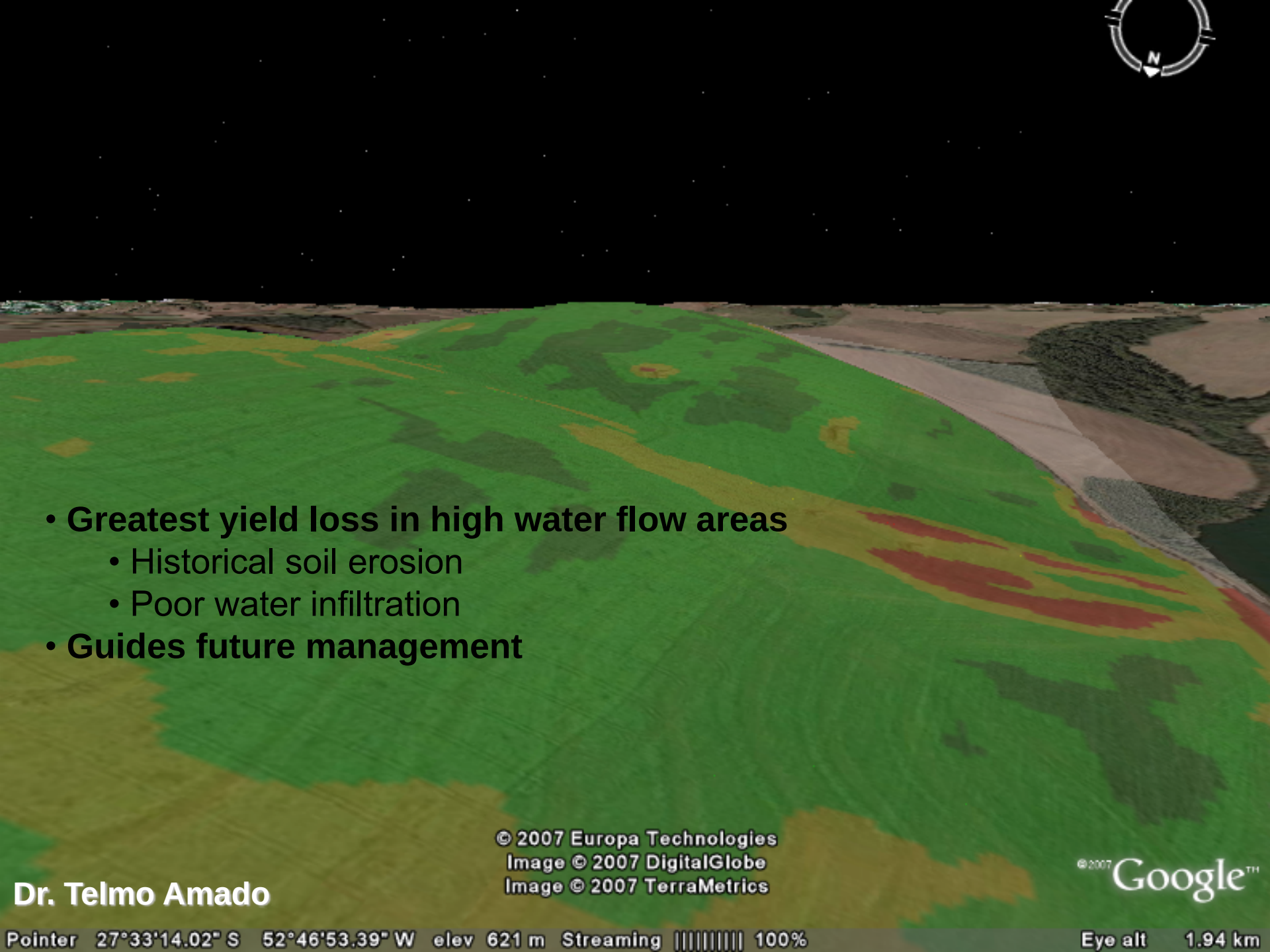
Dr. Telmo Amado
Pointer 27°33'06.25" S 52°46'45.13" W elev 636 m Streaming 100%
Eye alt 2.03 km


N
• Greatest yield loss in high water flow areas
• Historical soil erosion
• Poor water infiltration
• Guides future management
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Dr. Telmo Amado
Pointer 27°33'14.02" S 52°46'53.39" W elev 621 m Streaming 100%
Eye alt 1.94 km

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Where do you fit in the flattening world?

International Society for Precision Agriculture

- Better Coordination & Communication
- International Board—July 2008
- Academic, Industry, Government

- Precision Ag Journal
- Precision Ag Website

- Conferences
  - International Conference on Precision Agriculture
  - European Conference on Precision Agriculture
  - InfoAg
  - Other ???

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Take Home Summary

- Precision Ag is a **Tool**---*use it!*
- Data management and usage is the key
- Have office software or a consultant to help use all data, from all sources, to make decisions.
- Get a return on your technology investment
  - *Use variable-rate technology to adjust input rates*
  - *Record **as-applied** data to document actual applications*
  - *Use yield maps to document responses*
  - *Check results*
- Make better-informed decisions.
- **Get more than just pretty maps**.

The Future of Agriculture????

- The most exciting period we have ever seen is just ahead.
- Major changes --- but great opportunities for those who stay in tune.
- Rapid research turnaround.
- Unprecedented Extension needs.
- Unprecedented education / continuing education demands.
- Partnering / cooperation

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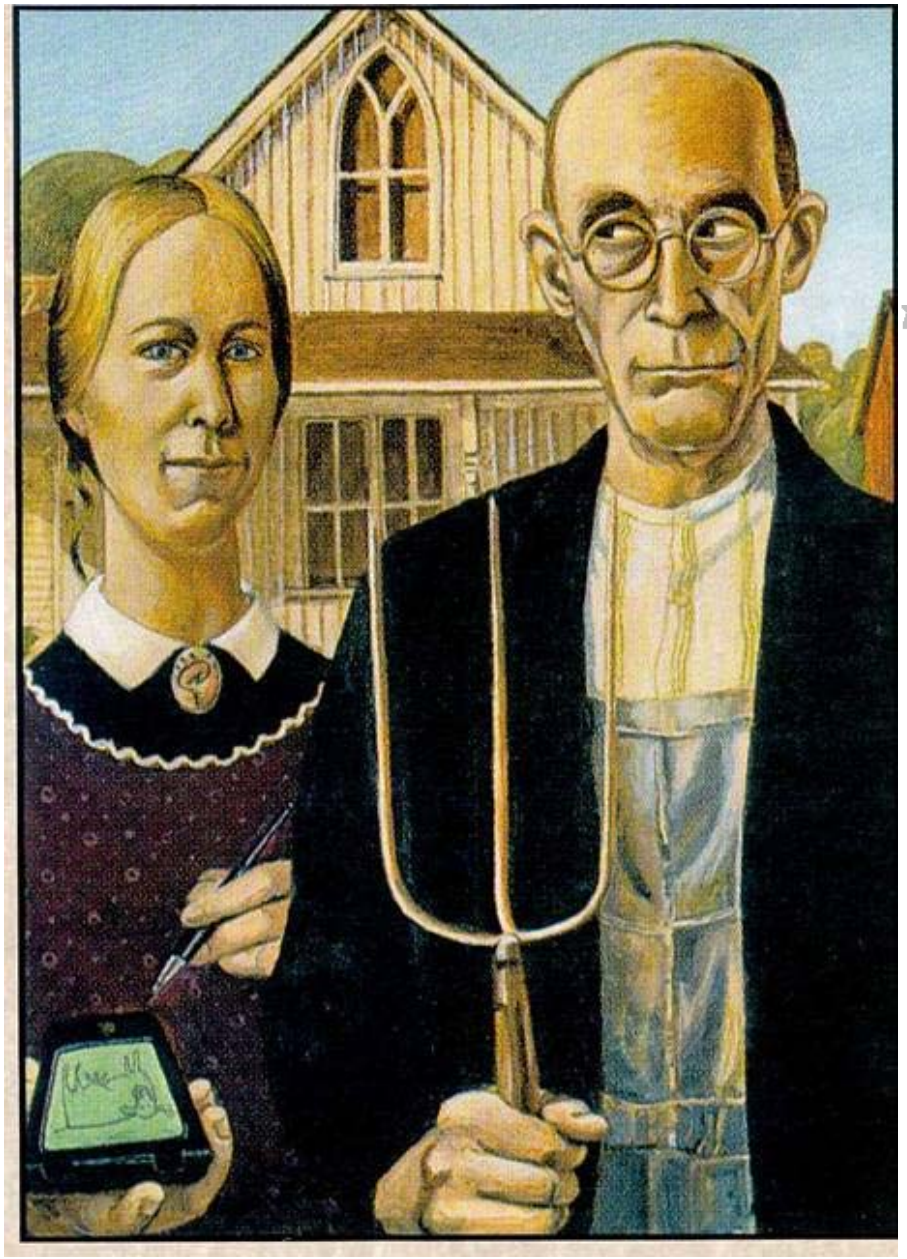
PLANT NUTRITION
INSTITUTE

"…whoever makes two ears of corn,
or two blades of grass to grow
where only one grew before,
deserves better of mankind,
and does more essential service to his country than the whole race of politicians put together."

--- from Gulliver's Travels



Thank You!!

Dr. Harold F. Reetz, Jr.
Director of External Support and FAR

International Plant Nutrition Institute
107 S. State Street
Monticello, Illinois 61856

Phone: 217-762-2074

e-mail: hreetz@ipni.org