

# **Landscape Agriculture: A Strategic Biomass Resource Strategy**

Presented to the Biomass Research and Development  
Technical Advisory Committee  
August 27, 2015

Douglas L. Karlen<sup>†</sup> & David J. Muth, Jr.<sup>‡</sup>

<sup>†</sup> USDA-ARS, National Lab, for Ag. & the Environment, Ames, IA

<sup>‡</sup> Senior Vice-President, Ag-Solver Inc., Ames, IA

# Presentation Overview

- Landscape Agriculture – a timeline from vision to trans-disciplinary public-private partnership for continual improvement of bioenergy enterprises
- How landscape agriculture provides sustainable biomass supplies and protects ecosystem services
- Why landscape agriculture does not threaten food security
- Will landscape agriculture will help ensure national security?

# A Bioenergy – Landscape Agriculture Timeline

- 1970's – OPEC energy crisis results in feedstock specific research
- 2005 – DOE and USDA issue Billion Ton Study (BTS)
- 2006 – USDA-ARS scientists form the Renewable Energy Assessment Project (**REAP**) team in response to the BTS [now Resilient Economic Agricultural Practices (REAP) team]
- 2008 – Sun Grant **Regional Partnership** Corn Stover team links ARS-REAP, DOE, and university scientists; focus remains feedstock specific
- 2009 – National Academy of Sciences Alternative Liquid Transportation Fuels **report introduces** the Landscape Vision
- 2010 – ARS-REAP & DOE propose “**Balancing limiting factors and economic drivers** for sustainable biomass production”
- 2010 – ARS-REAP, DOE, & university scientists propose “Methodologies for the Design and Assessment of Watershed-Scale Energy Crop Production Systems” – (highest rated proposal but too costly)
- 2011-2013 – Development of **LEAF** and formation of **AgSolver Inc.**
- 2014 – Public-Private Partnership concept paper on “Sustainable Landscape Design” submitted in response to DOE FOA
- 2015 – Full proposal submitted, reviewed and selected for \$9M funding



# What the Regional Partnership Learned

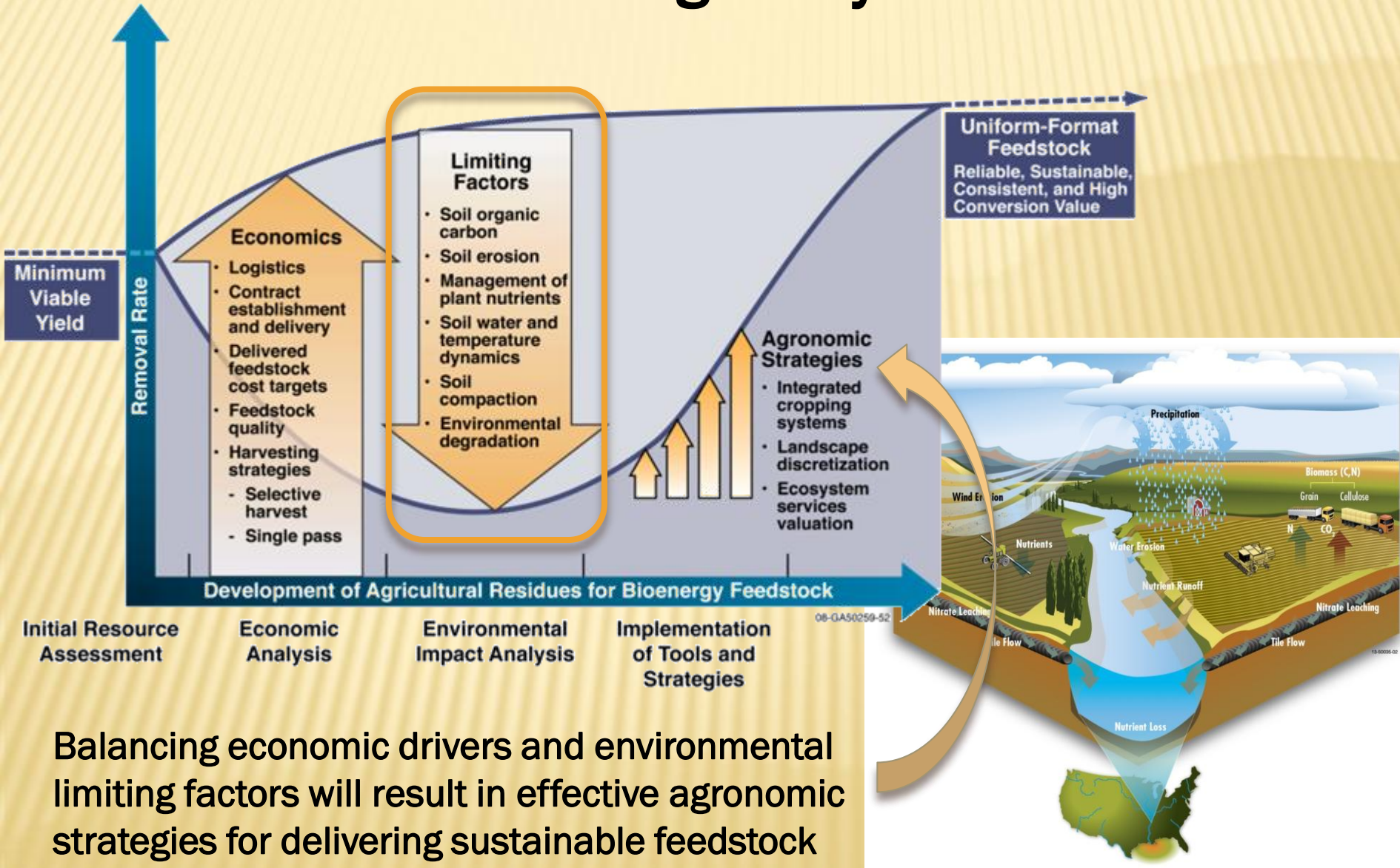
- **Average** corn grain yield **response** to moderate 3.9 Mg ha<sup>-1</sup> (1.7 tons ac<sup>-1</sup>) or high 7.2 Mg ha<sup>-1</sup> (3.2 tons ac<sup>-1</sup>) stover harvest **was minimal**:
- **HOWEVER – Averages are meaningless**  
Sustainable stover harvest rates are site specific
- **Diversifying** the Midwest landscape (*i.e.*, adoption of landscape agriculture) **could** significantly **increase** sustainable quantities of harvestable stover, **provide** other viable bioenergy feedstock materials, and **protect** ecosystem services

# So what is Landscape Agriculture?

*Recognizing and Working With Nature's Diversity!*



# The Landscape Agriculture Goal: Providing Biomass & Protecting Ecosystem Services



Balancing economic drivers and environmental limiting factors will result in effective agronomic strategies for delivering sustainable feedstock supplies and protecting ecosystem services

# What Does Landscape Agriculture Provide?

- **Multiple ecosystem services**
  - **Feedstock for bioenergy**
  - **Enhanced nutrient cycling**
  - **Multiple pathways for sequestering C**
  - **Food, feed & fiber resources**
  - **Filtering and buffering processes**
  - **Wildlife food & habitat**
  - **Soil protection & enhancement**
  - **Economic opportunities for humankind**



# Landscape Agriculture: It Does Not Have to be Complex

- Living mulches
- Oilseeds
- Double or relay cropping
- Cover Crops
- Sub-field mgmt.

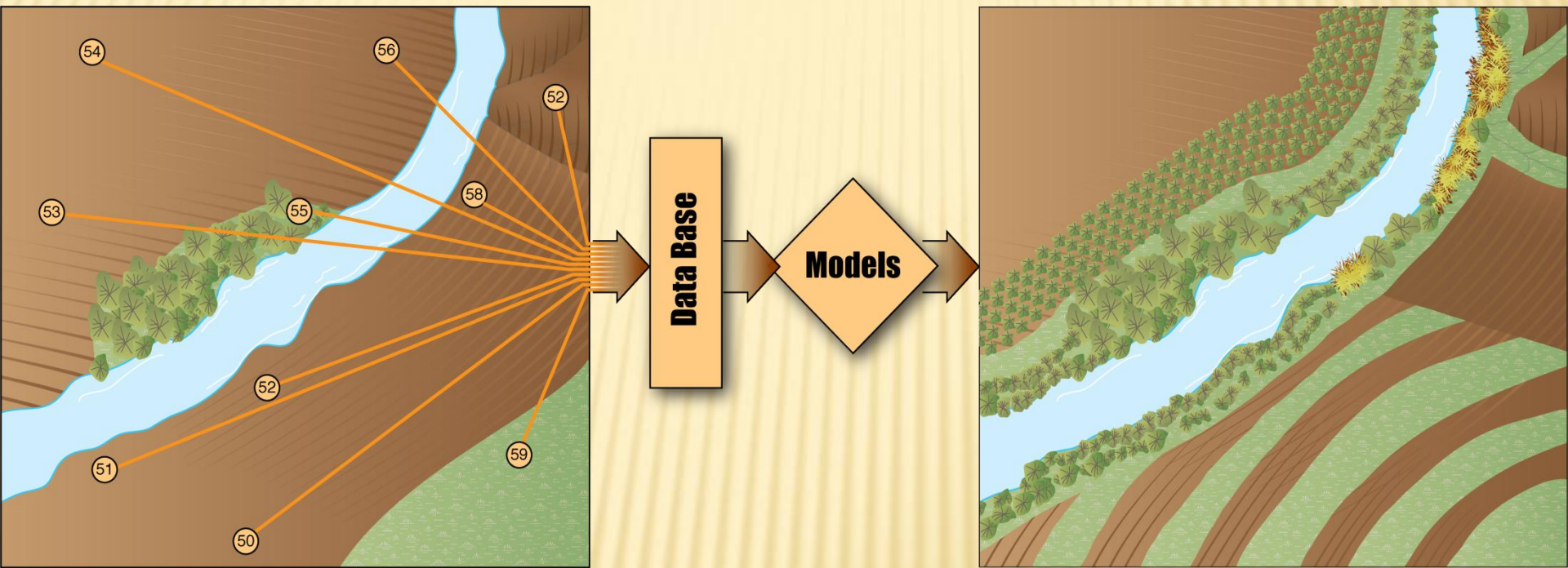




# Initial Research Needs For Landscape Agriculture

- Effective and efficient strategies for incorporating cover crops into fields where stover is being harvested
- Low-disturbance or no-tillage technologies for incorporating animal manures, implementing real-time seeding and seedbed adjustments and strategies to encourage the adoption of those practices
- Strategies to incorporate agricultural residuals, waste materials, and other under-utilized resources into biomass feedstock supplies
- Innovative harvest methods and new uses for perennial crops to diversify crop rotations for improved soil health, increased yield, and sustainable stover supplies

# The Original Landscape Vision

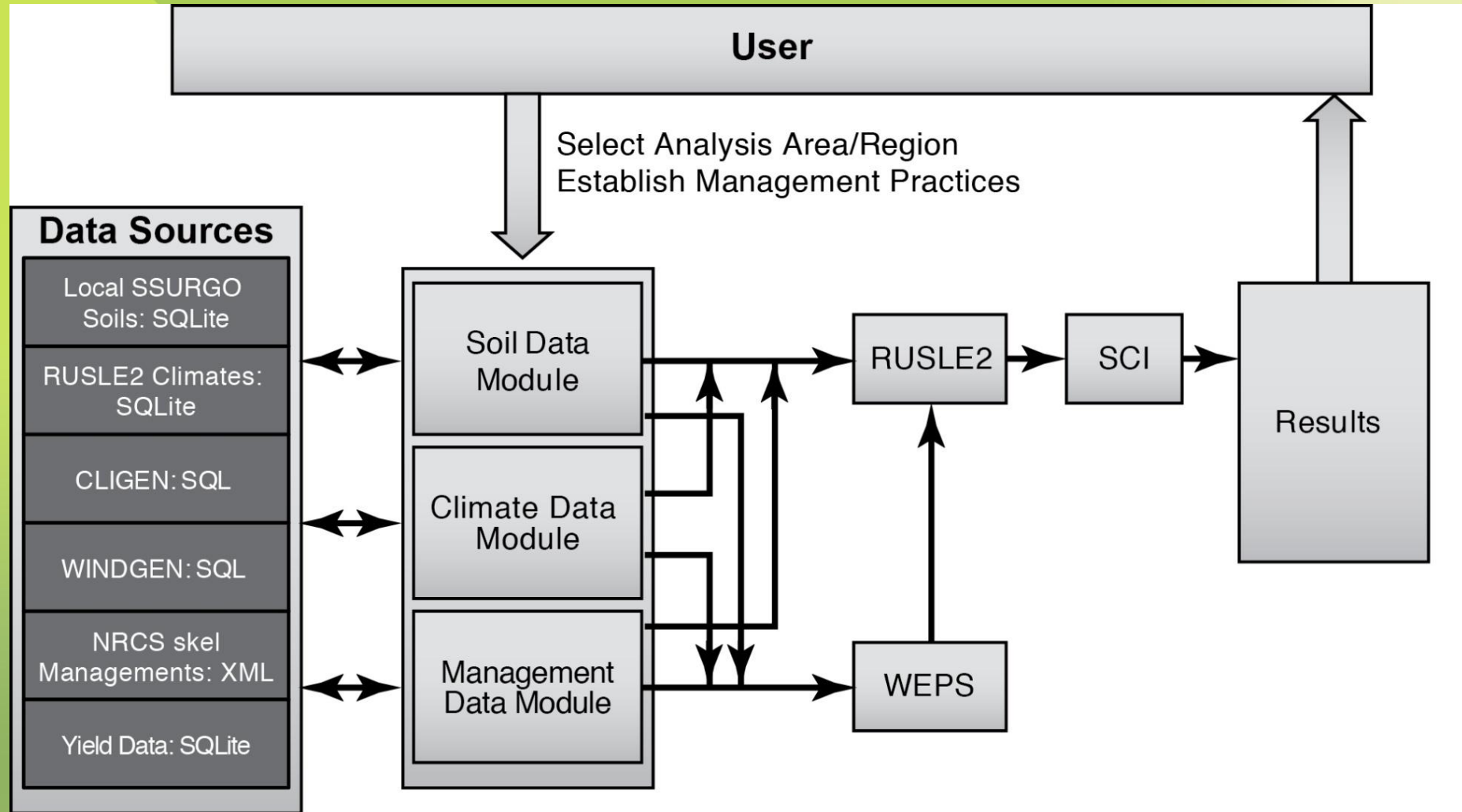


10-GA50663-02

- Utilizing existing USDA-NRCS Conservation Stewardship Program (CSP), Environmental Quality Incentive Program (EQIP), and USDA-FAS Biomass Crop Assistance Program (BCAP) programs to create a more diversified, ecosystem friendly landscape



# LEAF<sup>†</sup> – A First Generation Landscape Agriculture Planning Tool



<sup>†</sup> LEAF – Landscape Environmental Assessment Framework

# LEAF Projections of Cover Crop Effects

(For a field of ~140 acres)

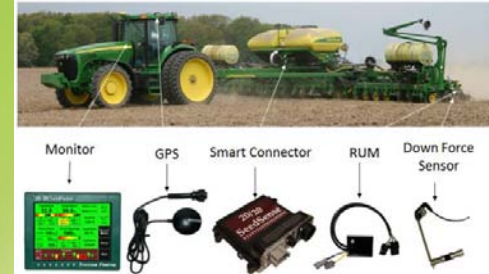
Management Practices	Residue Available for Sustainable Stover Harvest	Percentage of the Field Managed Sustainably	Estimated Annual Soil Erosion Loss
Reduced Tillage with Rake and Bale Stover Collection Methodology	No Cover Crop		
	39 tons (0.28 tons ac <sup>-1</sup> )	21%	336 tons (2.4 tons ac <sup>-1</sup> )
	Winter Rye Cover Crop		
	297 tons (2.12 tons ac <sup>-1</sup> )	83%	194 tons (1.4 tons ac <sup>-1</sup> )



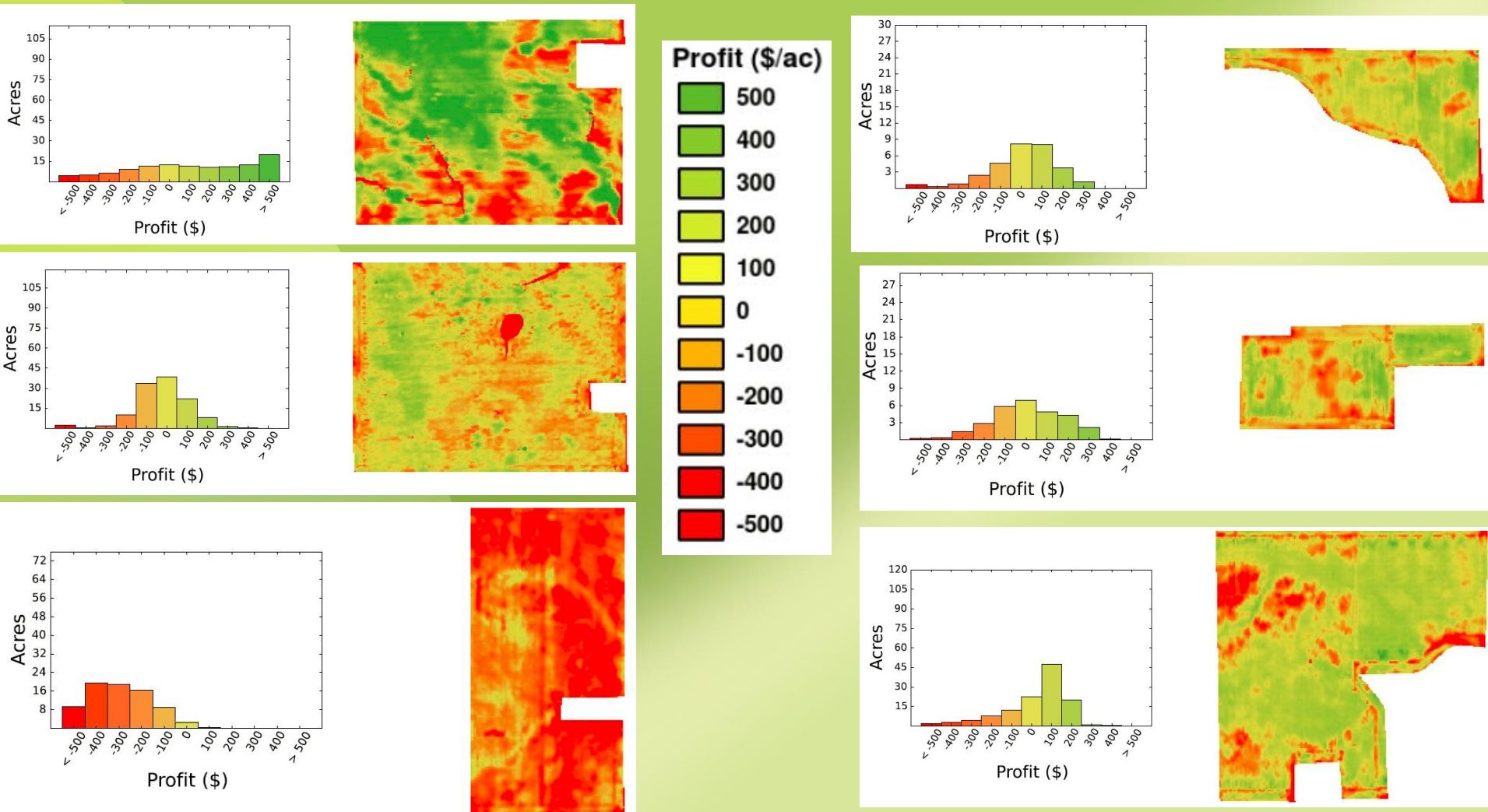
# Emerging Ag Information Services are Making Landscape Agriculture Easier to Adopt



## Components



# Ag-Solver Inc. Advanced Landscape Agriculture by Developing Tools to Identify Subfield Profit and Return on Investment (ROI) Business Plans





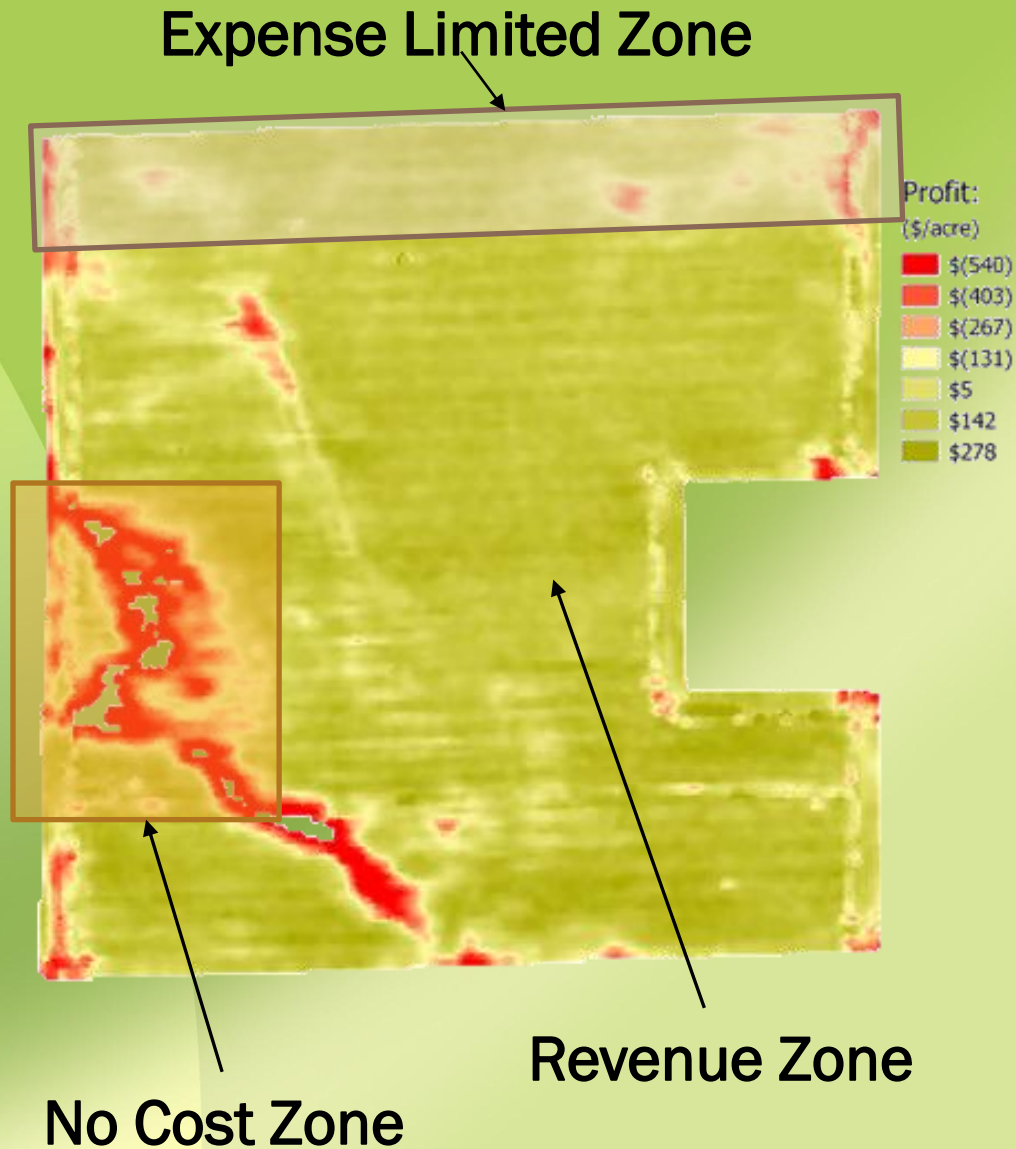
# Why Landscape Agriculture Is A Desirable Goal

Environmental and Economic Performance  
are driven by the same goal:

Maximize the output per unit of input

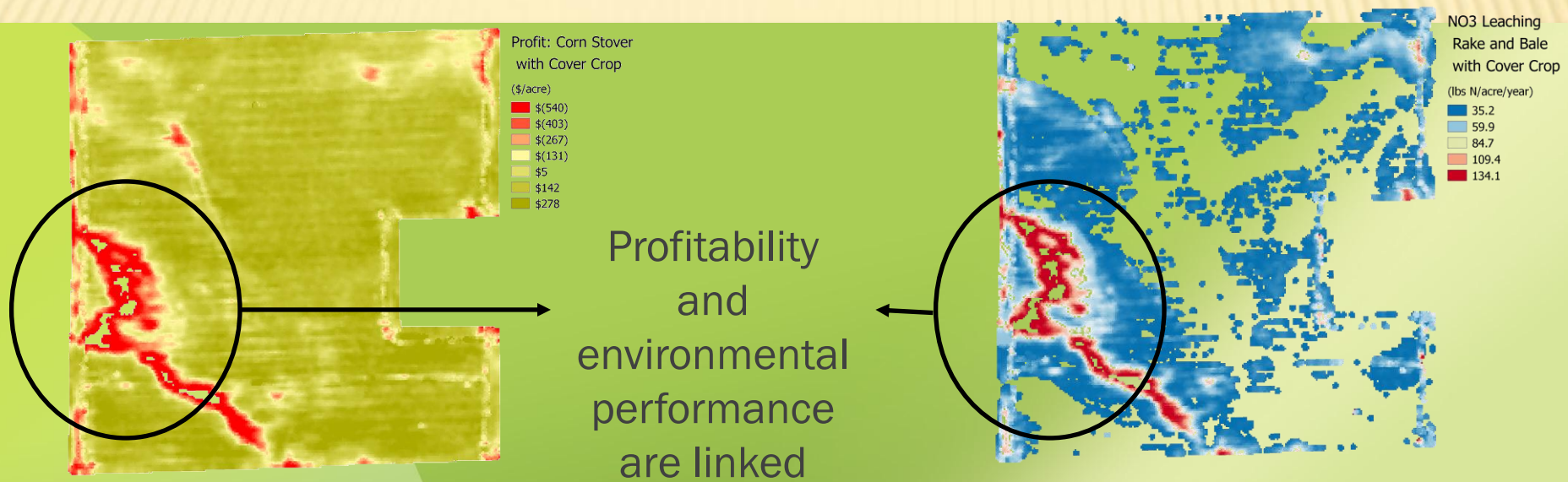


# ROI Zones Are the Key





# Landscape Agriculture Provides Both Financial and Environmental Benefits



## Nutrient Reduction Strategy Implications

- First set of improvements through improved business performance
- Fast actions to slow down regulation
- Buffered production systems

# Landscape Agriculture Can Help Mitigate Food vs Fuel Debates

Although many people believe that biofuel production will inevitably conflict with food production, the reality is that most of the agricultural land in the U.S. and other developed countries (*i.e.*, Argentina, Australia, Brazil, Canada, and the European Union) is used to produce animal feed, not crops for direct human consumption.



# Landscape Agriculture Can Help Promote National Security

Implementing landscape agriculture will help protect national security by providing food, feed, fiber, and fuel resources for a global population projected to reach 9.5 Billion by 2050, while also protecting ecosystem services by addressing sub-field variability, replacing environmentally leaky annual crops with perennial crops, and increasing profit



# Any Questions?

