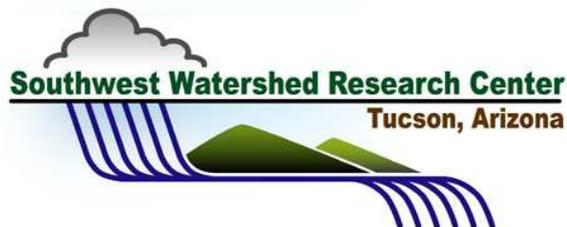
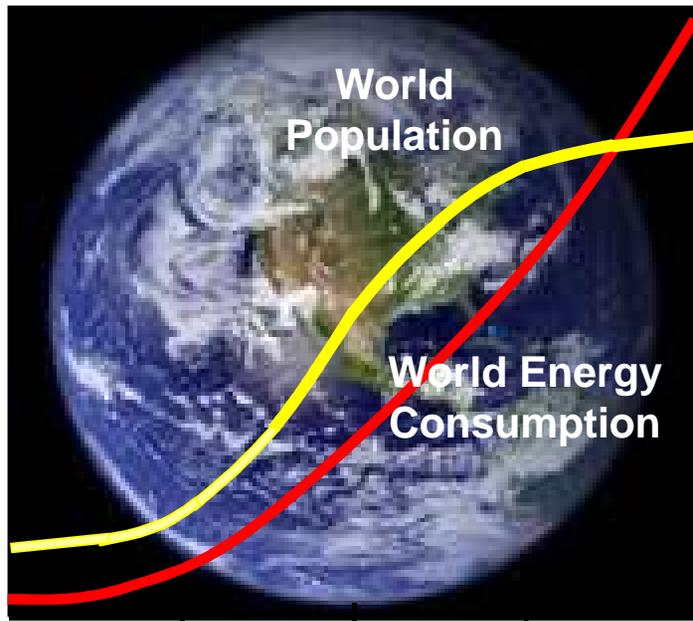


# Walnut Gulch Experimental Watershed and the Long-Term Agroecosystem Research (LTAR) Network

Phil Heilman  
10/13/2012



# Challenges Facing Agriculture in the 21<sup>st</sup> Century



1900 1950 2000 2050 2100  
Year

-Provide sufficient food, fiber, and fuel to support a growing global population – 9 billion by 2050.

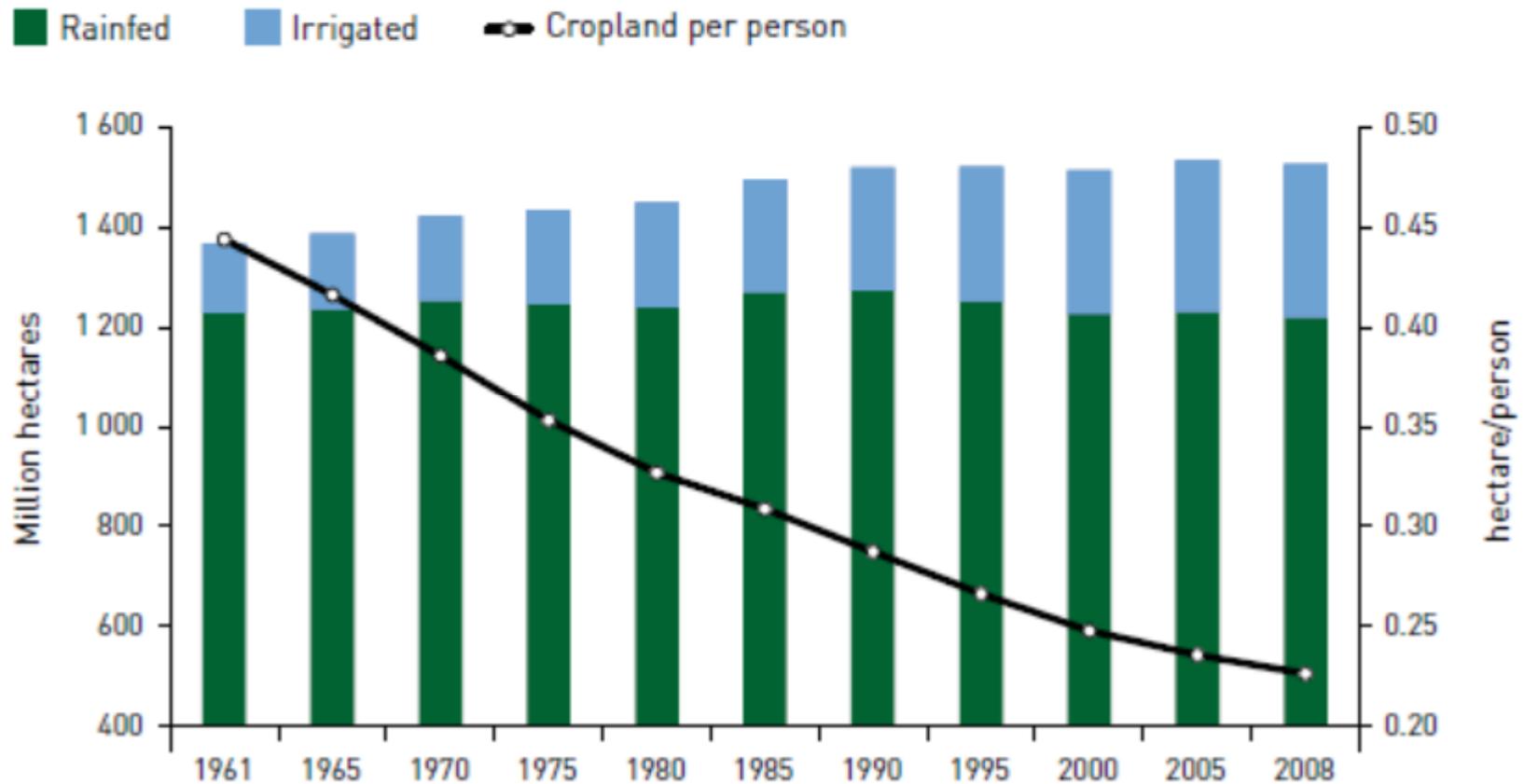
-Declining natural resource base, environmental health, and available arable land.

-Reduced water availability, increasing drought, and declining water quality.

-Maintaining production and food security in a changing climate.

# A Need for “Sustainable Intensification”

**FIGURE 1:** EVOLUTION OF LAND UNDER IRRIGATED AND RAINFED CROPPING (1961–2008)



Source: FAO (2010b)

Source:

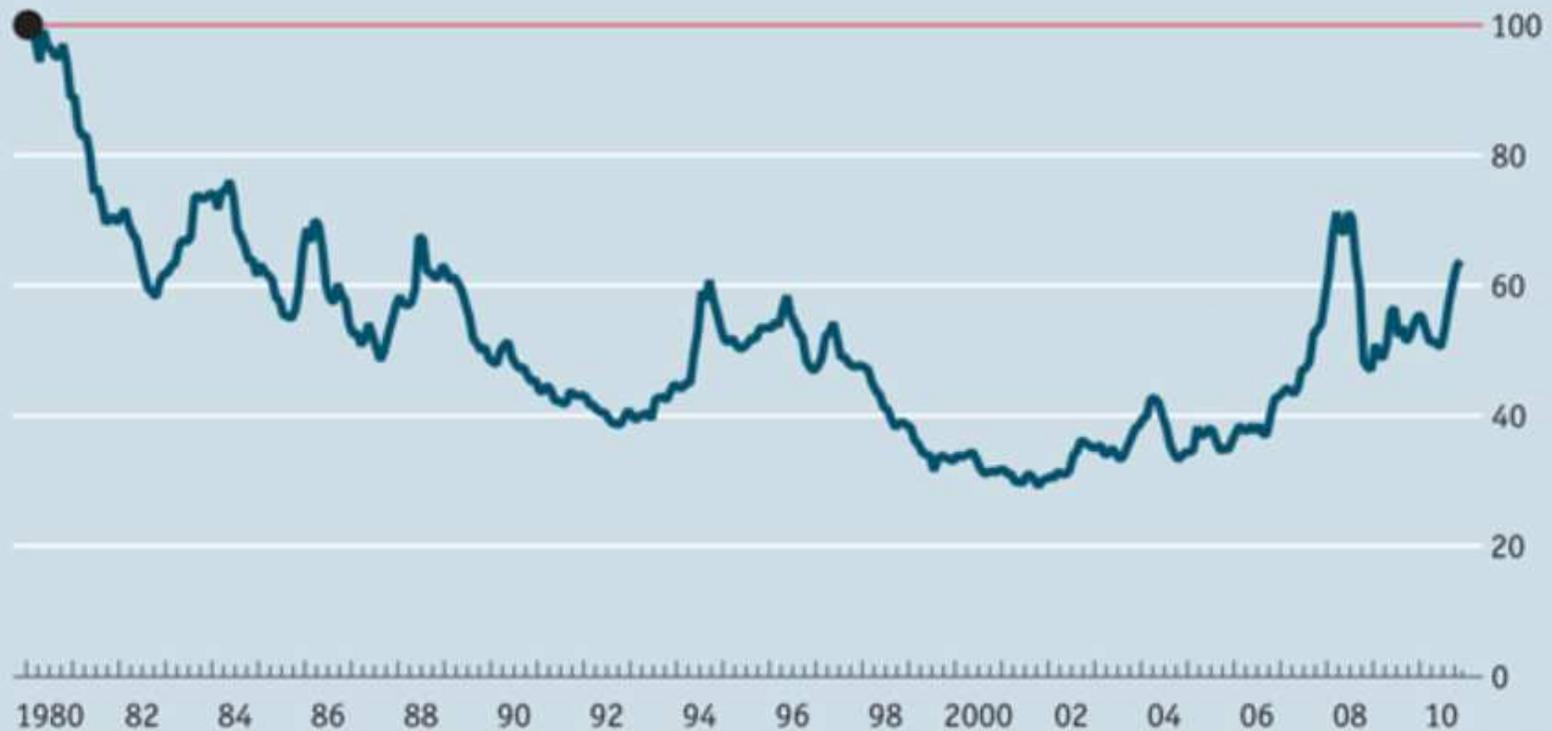
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS  
ROME, 2011

THE STATE OF THE WORLD'S  
LAND AND WATER RESOURCES  
FOR FOOD AND AGRICULTURE

Managing systems at risk

## The Economist food-price index

Real terms\*, January 1980=100



Sources: *The Economist*; Thomson Reuters

\*Deflated using US CPI

See [http://www.economist.com/blogs/dailychart/2010/11/economist\\_food-price\\_index](http://www.economist.com/blogs/dailychart/2010/11/economist_food-price_index)

*Robertson et al. 2008. BioScience 58(7):640-645:*

The critical mass needed to establish an inaugural LTAR program requires:

1. A capacity for field-scale experimentation at the site level;
2. Stakeholder involvement that exploits existing data sets & regional infrastructure.

The key element for networking is common measurements at multiple sites that provide:

The foundation for scaling up to regional and national levels;  
The basis for cross-site syntheses, allowing theories to be developed across gradients of climate change, management intensity, & etc.

To start the initial Long-Term Agroecosystem Research Network, the ARS got an independent panel to select locations that met the following criteria:

- 1) Research Team Productivity
- 2) Infrastructure Capacity
- 3) Data Richness
- 4) Data Availability (Accessibility)
- 5) Geographic Coverage at Various Scales
- 6) Partnerships
- 7) Institutional Commitment

# LTAR Description

## A Long-Term Agro-Ecosystem Research (LTAR) Network for Agriculture

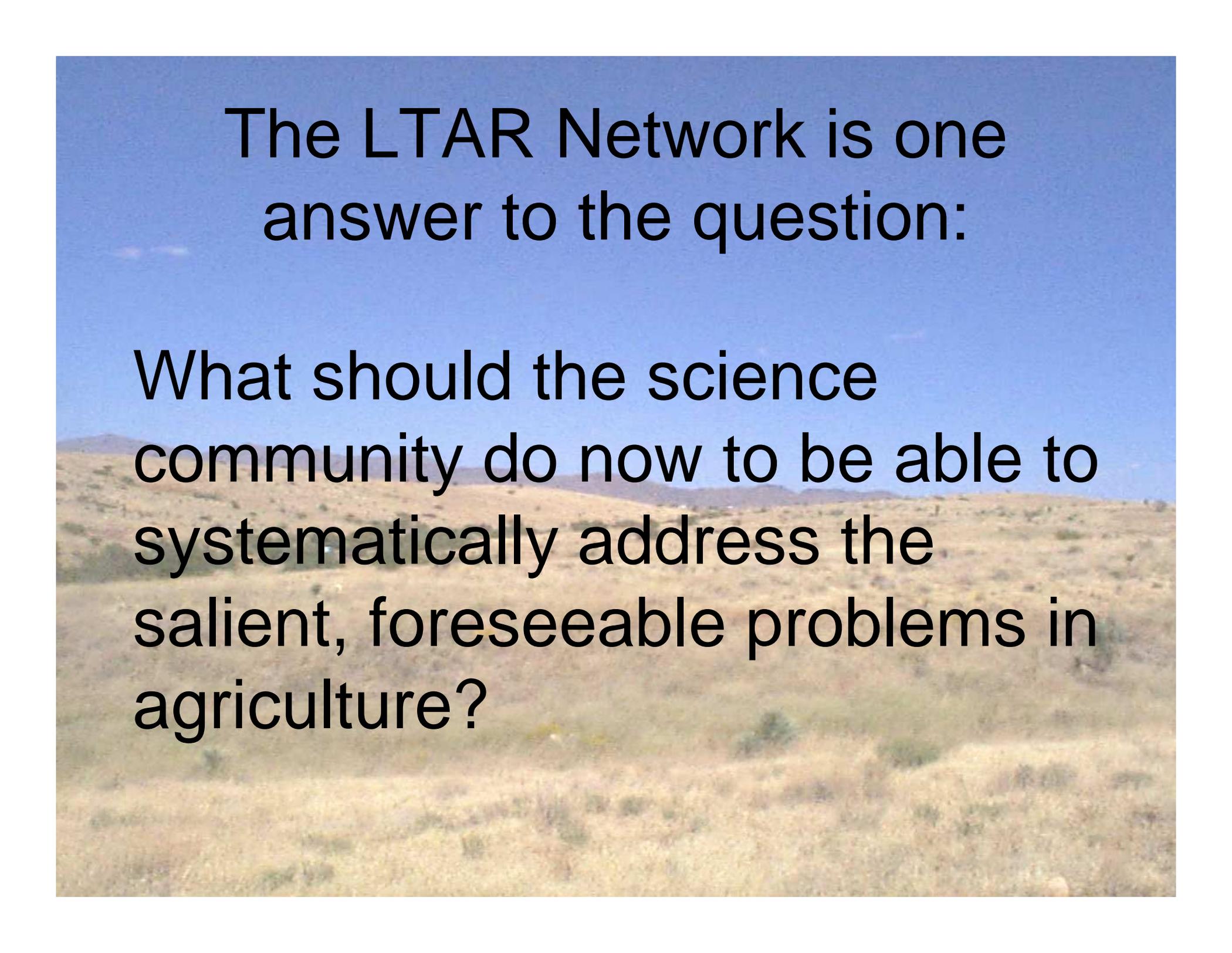
Mark R. Walbridge, Steven R. Shafer

### Abstract

As the 21<sup>st</sup> century unfolds, agriculture will face a series of challenges—in the United States and globally—in providing sufficient food, fiber, and fuel to support a growing global population while our natural resources, environmental health, and available arable land decline and climate changes. The unprecedented nature of these challenges creates a growing sense of urgency for transformative changes in agriculture to accelerate progress towards achieving sustainable agricultural systems that maximize

services, and natural resource conservation at the watershed or landscape scale. Some of these sites have been collecting data for nearly a hundred years. Here we present a vision for how a subset of these sites could be used to form the core of an LTAR network. Eventually, such a network would link ARS sites with partner sites operated by universities, other research institutions, and (or) other Federal agencies to support multidisciplinary research and funding efforts addressing regional- and national-scale questions using shared research protocols. Such a long-term agro-ecosystem research network would provide the

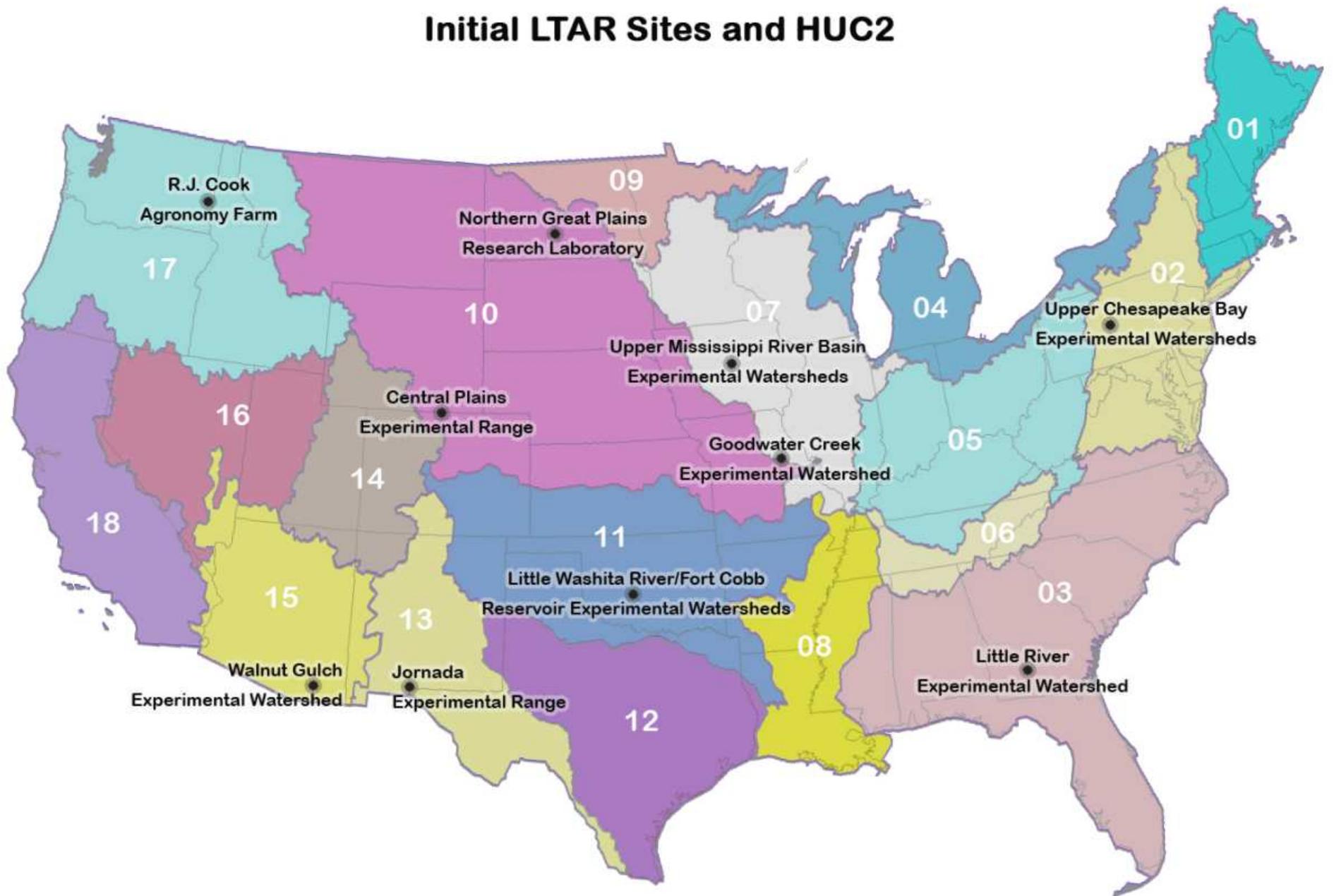
Google “ltar” and “ars”

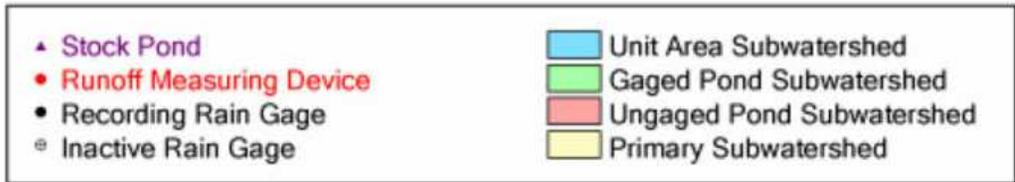
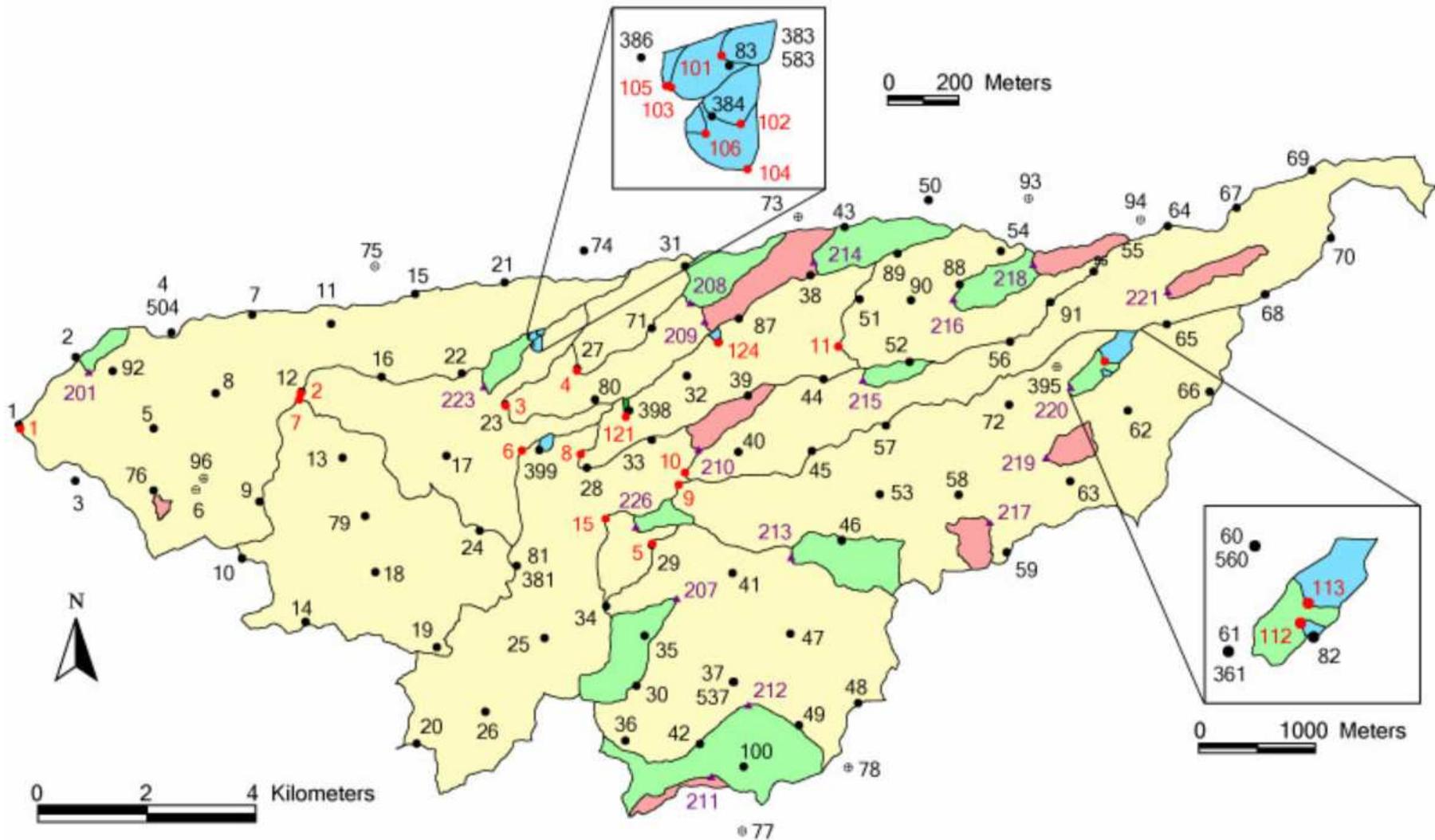


The LTAR Network is one  
answer to the question:

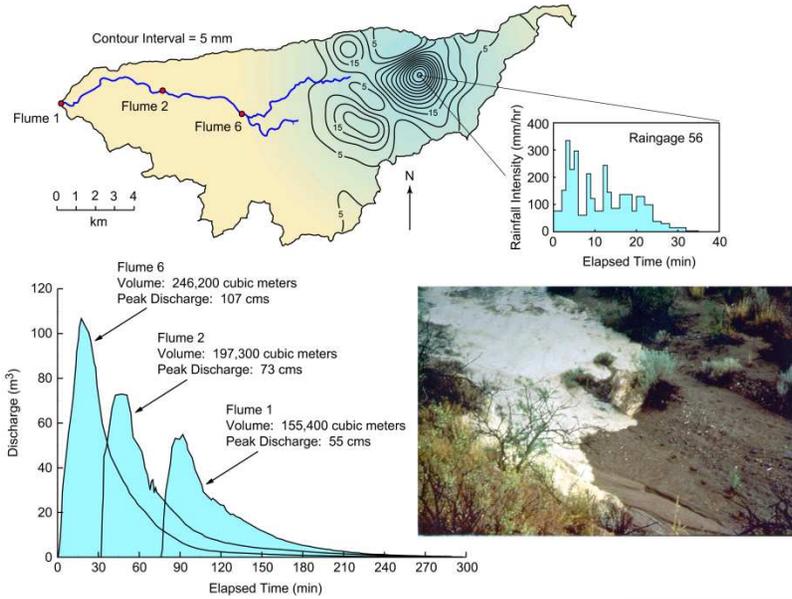
What should the science  
community do now to be able to  
systematically address the  
salient, foreseeable problems in  
agriculture?

# Initial LTAR Sites and HUC2

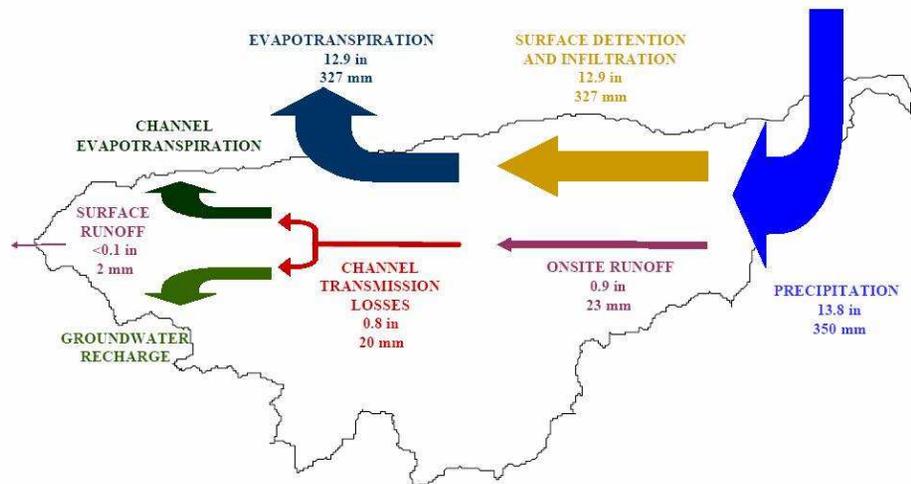


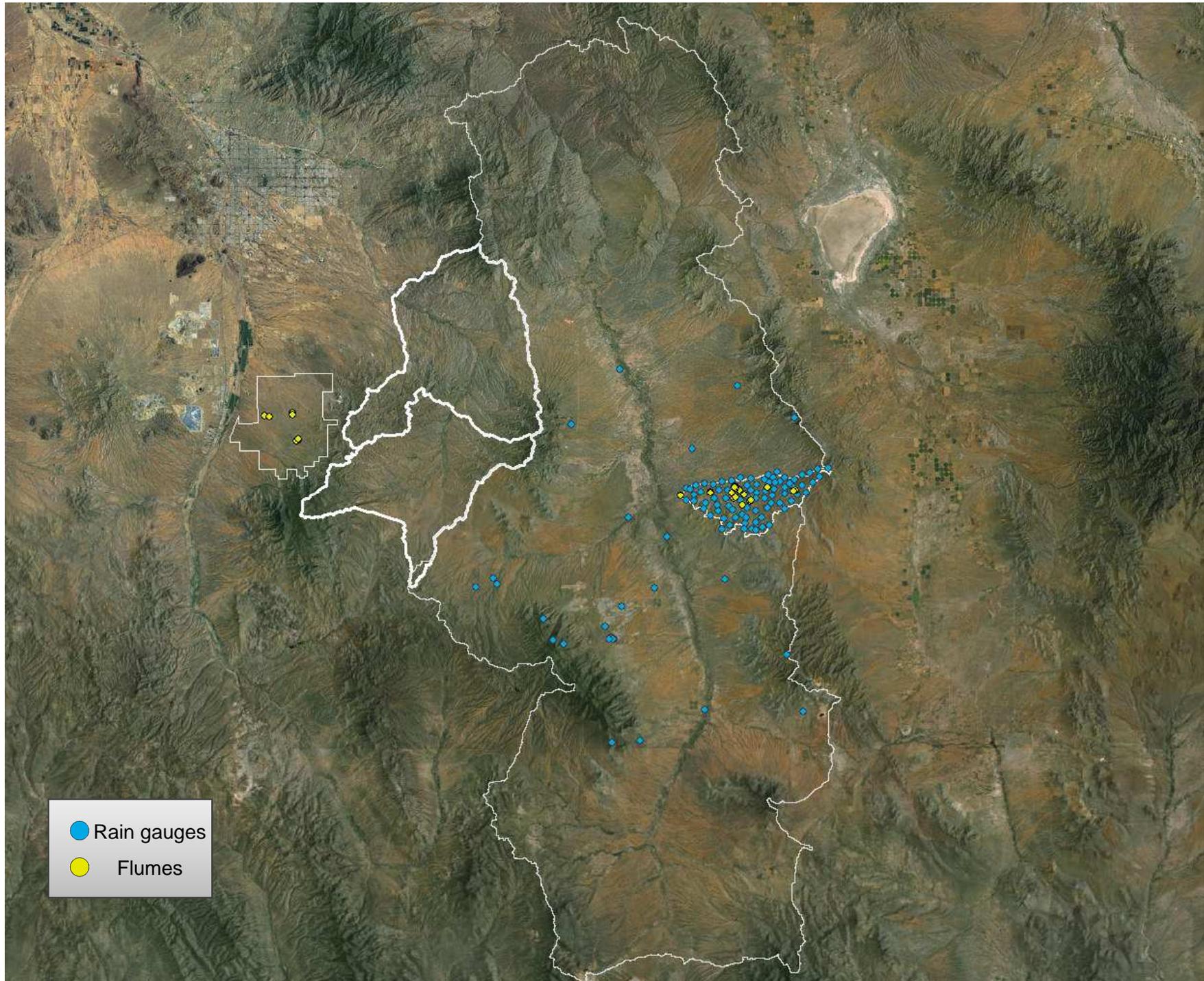


# Improved Quantification of Semiarid Water Budget Components

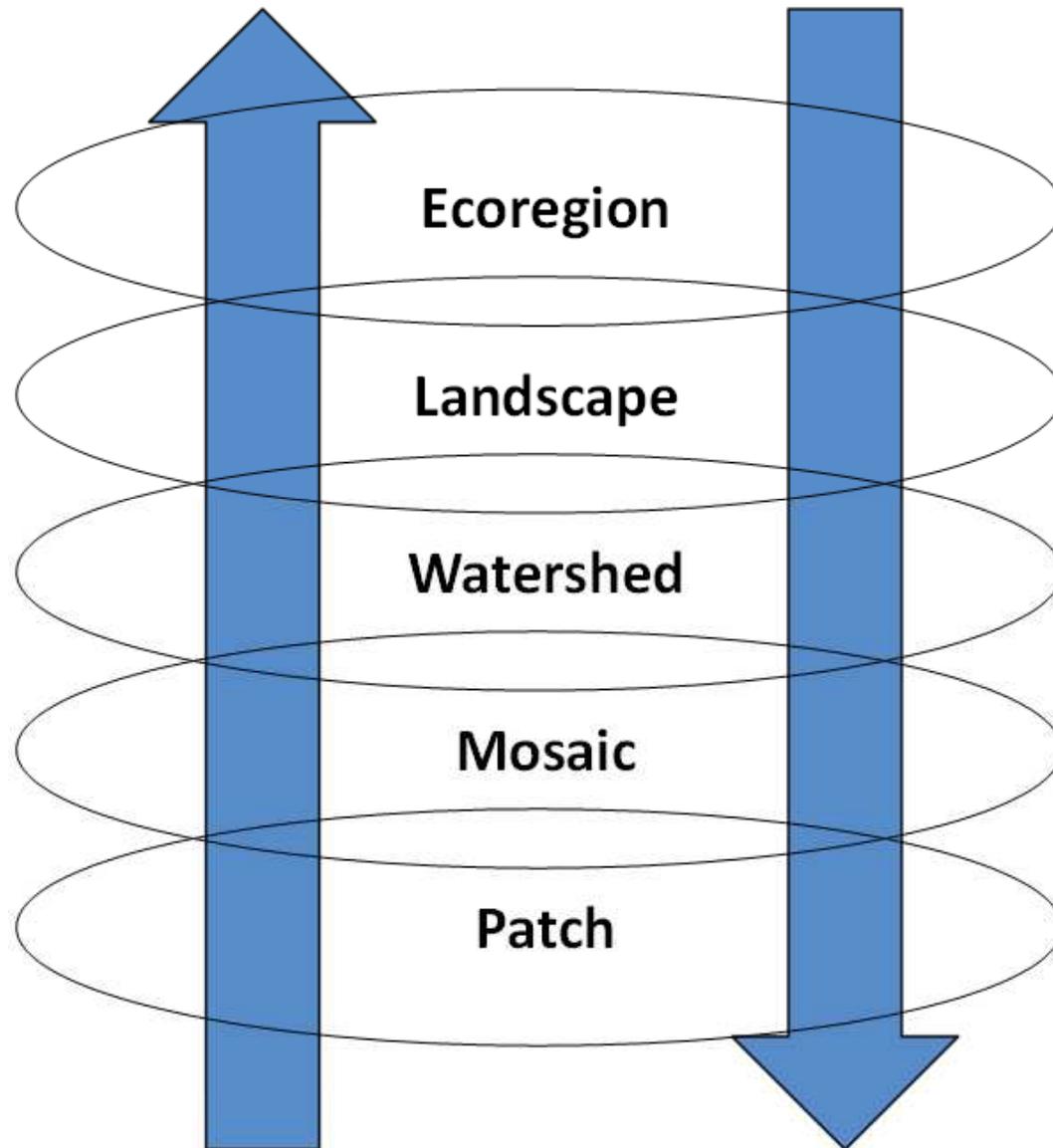


WALNUT GULCH EXPERIMENTAL WATERSHED  
ANNUAL WATER BALANCE

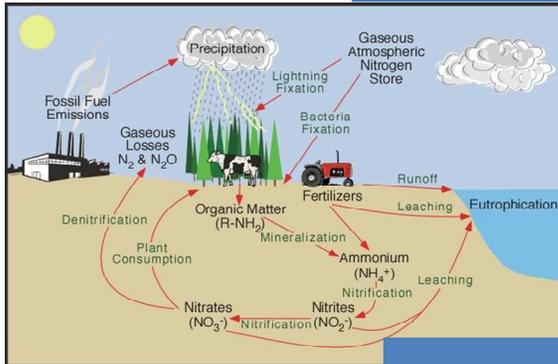




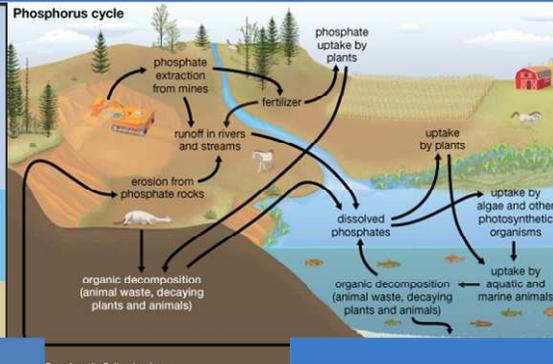
# Hierarchical Organization of Ecosystem Structure and Matter/Energy Flow



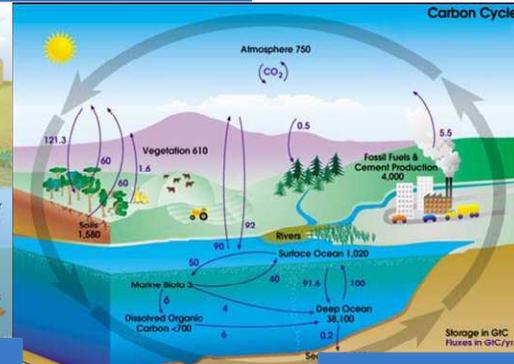
# Nutrient cycles



**Nitrogen**

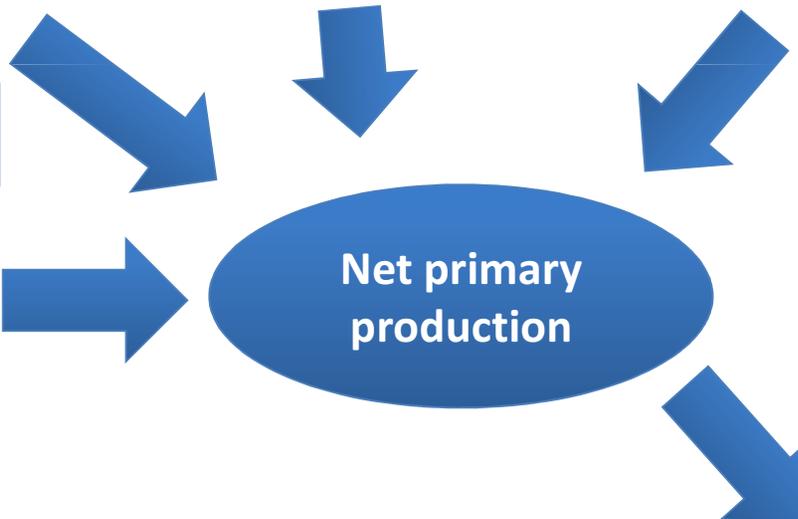


**Phosphorus**

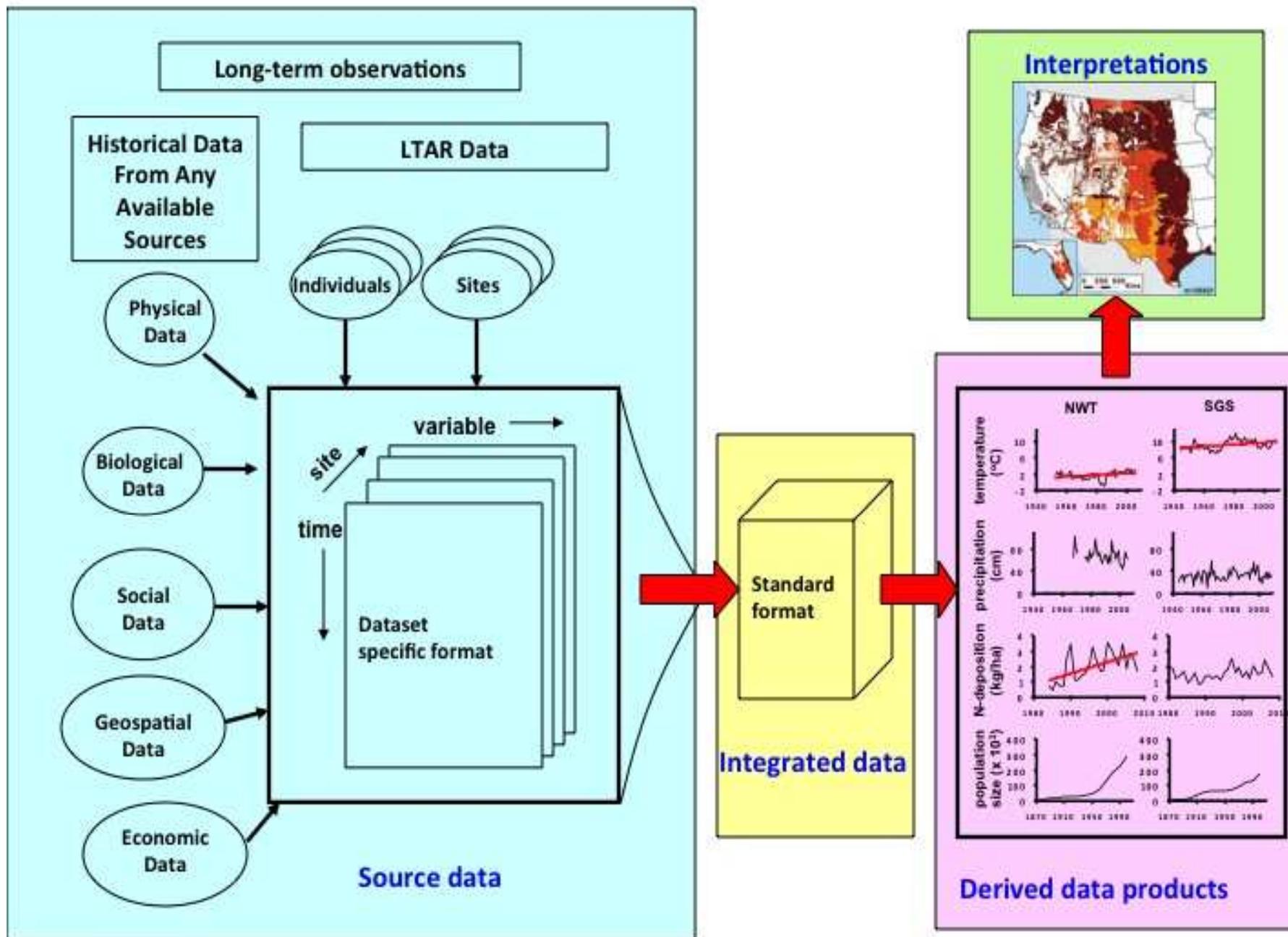


**Carbon**

## Hydrologic cycle and energy budget



## Crop and Livestock Production



# How does WGEW fit into LTAR?

Productivity

Remote sensing and ecophysiology

Climate Variability and Change

hydrology, erosion, modeling

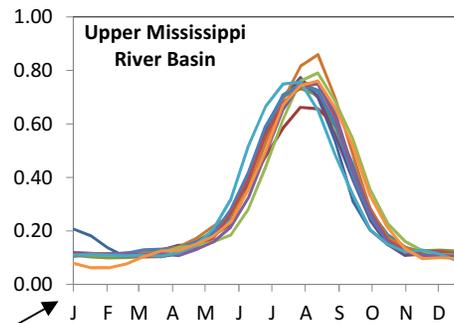
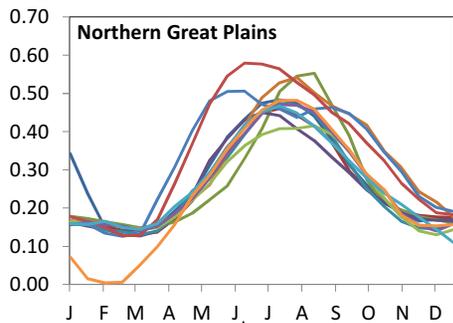
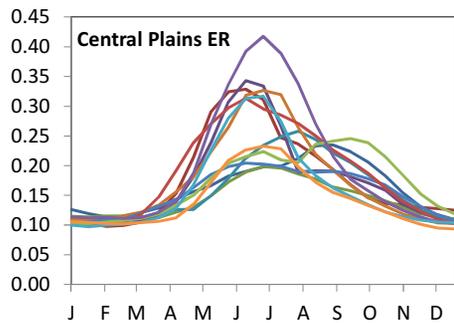
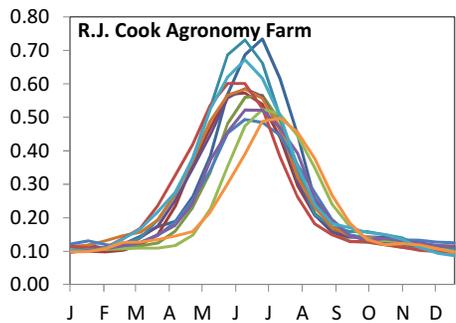
Conservation and environmental quality

Rangeland Conservation Effects

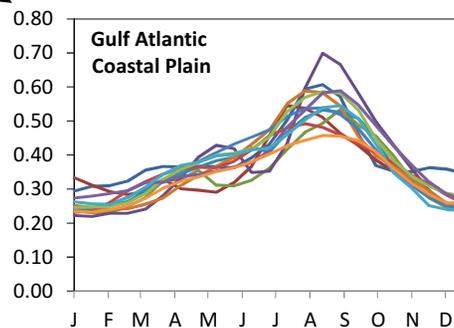
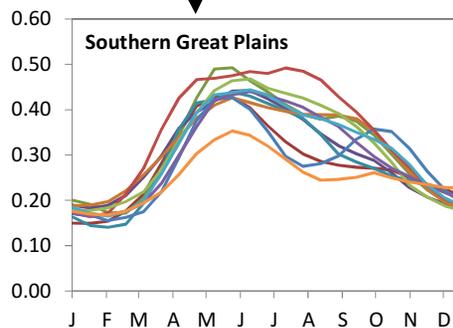
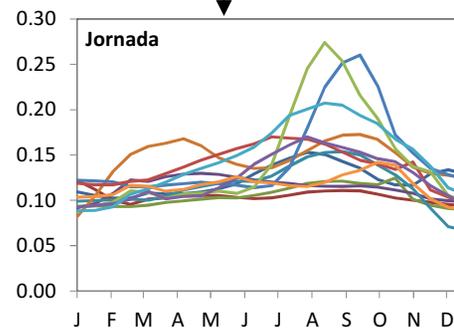
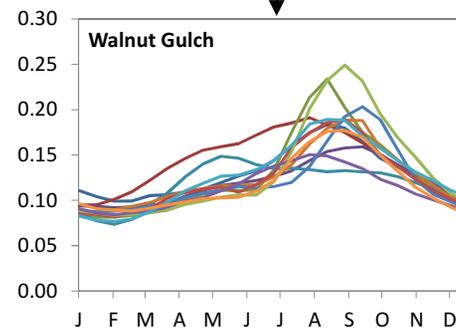
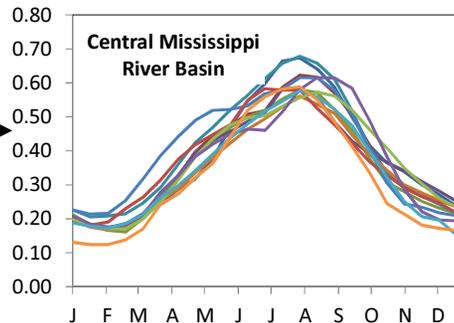
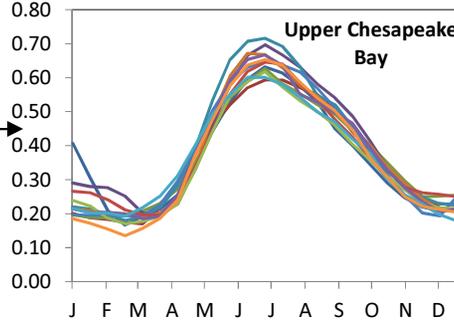
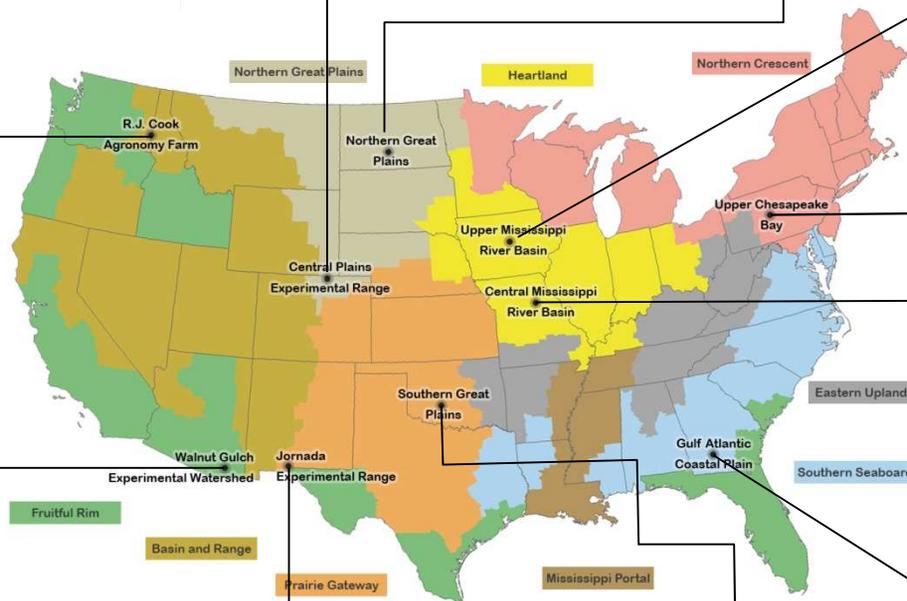
Assessment Program

Socio-economic ties to productivity, climate  
and environment

# MODIS EVI TIME SERIES ACROSS LTAR SITES



- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
- 2010
- 2011



# Take Home on LTAR

- 10 locations selected to start, including Walnut Gulch Experimental Watershed
- A Shared Research Strategy is under development (speed and scale of LTAR will depend on funding)
- After an initial establishment period, LTAR will expand to other agricultural research sites



# Walnut Gulch Experimental Watershed

Tombstone, AZ



USDA-ARS

