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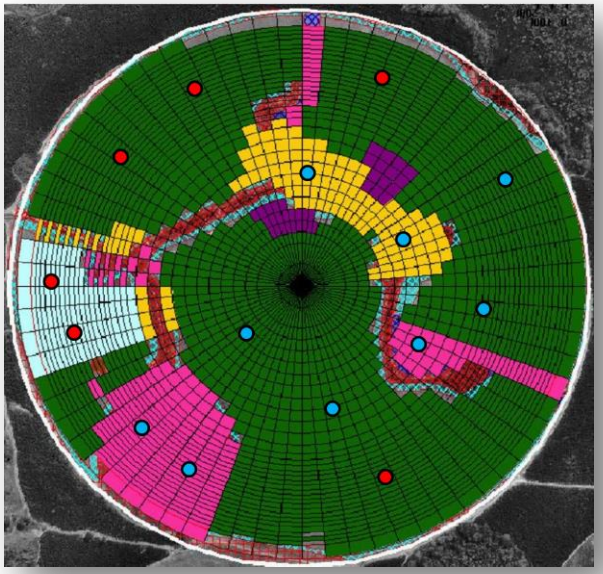


Agricultural Water Management Best Practices - Irrigation -

Matt C. Smith, Ph.D., P.E.
Professor and Director
Pee Dee Research and Education Center

SC Water Resources and Agriculture

- **Agriculture (including forestry) is SC's largest industry, returning more than $41 billion to the state economy and employing 98,000 direct jobs statewide**

- Competition for water resources for agricultural and other uses is increasing - even in states like South Carolina that have abundant water. This makes it all the more essential to use water as efficiently as possible.

- **Irrigation water management** primarily aims to control the volume and frequency of irrigation water applied to crops, so as to meet crop needs while conserving water resources.

Reducing Agricultural Water Withdrawals

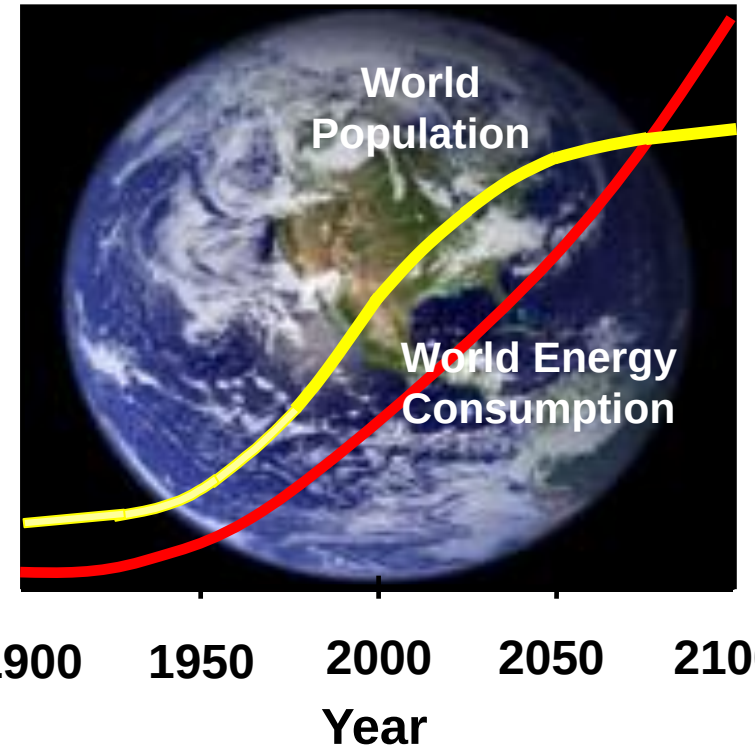
- **Improving irrigation practices**
- Planting drought-tolerant crops
  - Markers for water use
- On-farm water storage
- Cover crops
- Increasing soil quality
- Conservation tillage

Soil Health

- Dryland farming
- Improved Confined Animal Feeding Operation(CAFO) management – including aquaculture

People, Resources, Trends, and Challenges to Agricultural Sustainability

Increasing Numbers, Increasing Demand



- Human influence seen on 83% of the earth's land surface.
- World demand for cereals will increase 40% by 2020.
- World meat demand will double by 2050.
- Energy use by non-OECD countries will increase 2.6% annually through 2030.

USDA Economic Research Service
United Nations Population Division

Energy Information Administration
National Geographic Society

People, Resources, Trends, and Challenges to Agricultural Sustainability

Development and Loss of Agriculture, Atlantic States Region Example

- 2000: 67-million people, 24% of U.S. population,
- 2030: 76-million people 8.6-million more people, and 37% of U.S.
- 80% reduction in the number of farms since 1965*.
- 65% of vegetables and 80% of fruits are now imported.

* Pennsylvania & New York

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People, Resources, Trends, and Challenges to Agricultural Sustainability

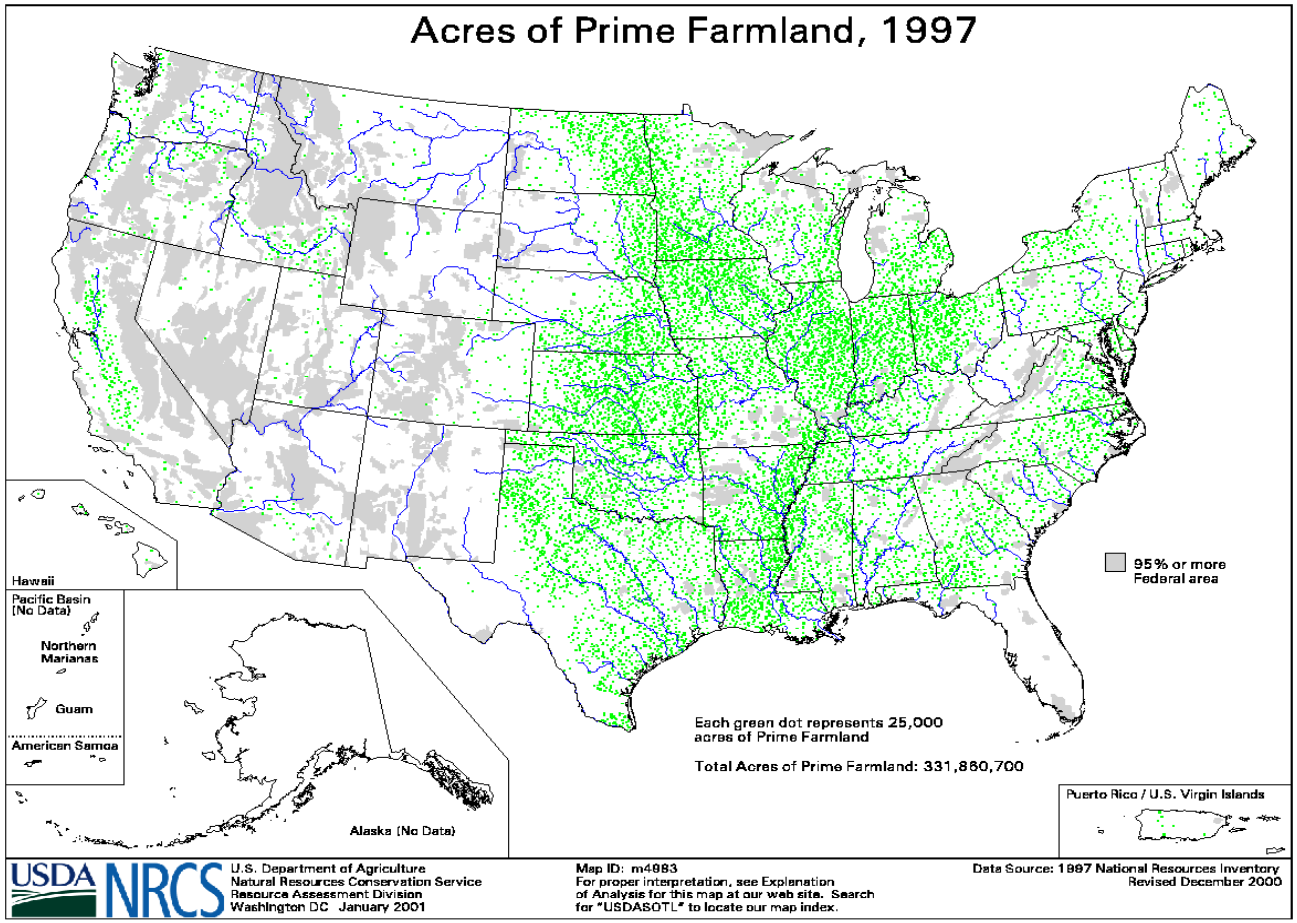
Urbanization-Suburbanization, Growth and No More Land

- 324-million people (2017).
- 50% of population along coastlines.
- 1.7 acres developed per person added to the U.S. population*.

*USA Today: Oct 27, 2006

People, Resources, Trends, and Challenges to Agricultural Sustainability

"Prime Farmland" is often what is lost



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A Sobering Consideration

Three-quarters of the 70% increase in global food products needed in 2050 to feed the growing population will have to come from existing agricultural lands (FAO 2011)

http://www.fao.org/agriculture/crops/thematic-sitemap/theme/spi/en/

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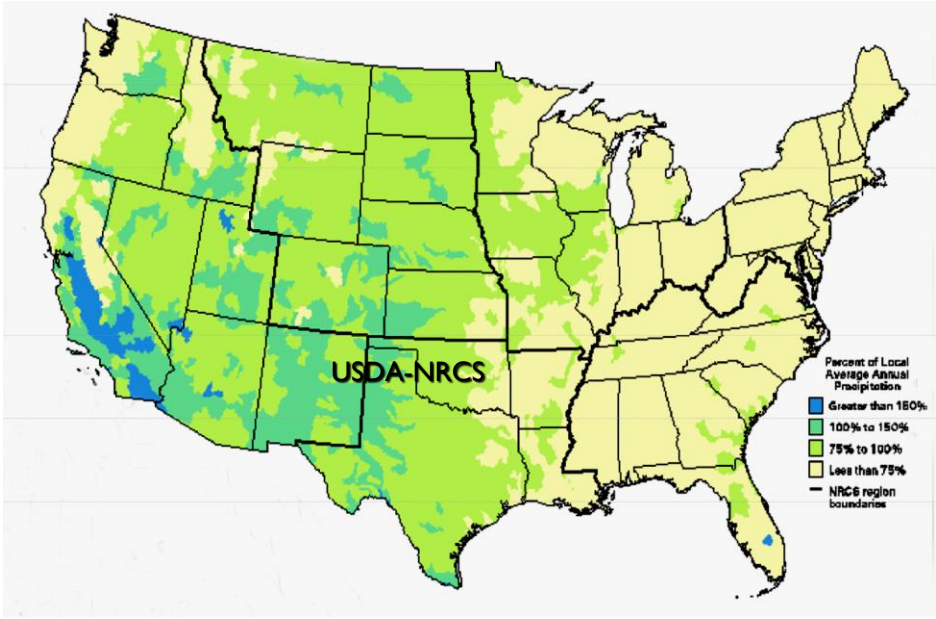
Average Annual Rainfall

People, Resources, Trends, and Challenges to Agr. Sustainability

Freshwater Consumption as a Percentage of Local Average Annual Precipitation



- Greater limitations on water **availability** and quality.
- Increasing demand by growing cities and industries for water.
- Less water available in the western U.S. for agriculture.
- World requirements for water development may increase 57% by 2025.

USDA Economic Research Service

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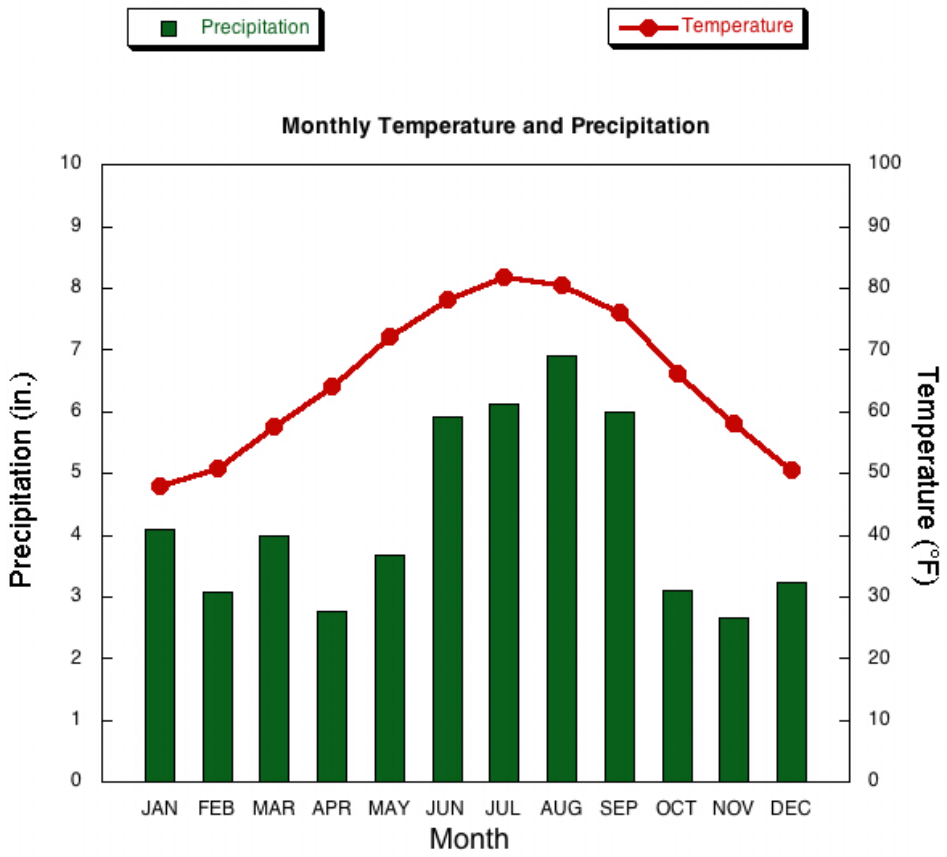
Annual Distribution of Rainfall – Charleston, SC

Even though SC has plentiful rainfall...

It doesn't necessarily occur at critical times during plant growth and development

Climate uncertainty may be making the distribution even more sporadic



http://drought.unl.edu/archive/climographs/CharlestonSCANC

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Why Irrigate Ag Crops?

- Increase yield/profit in low rainfall years
- Yield stability across years
- Safeguard investment (seed, fertilizer, chemicals, fuel, equipment, etc.
- Risk management
- Pest control (pre-emerge and systemics)
- Optimize use of applied nutrients

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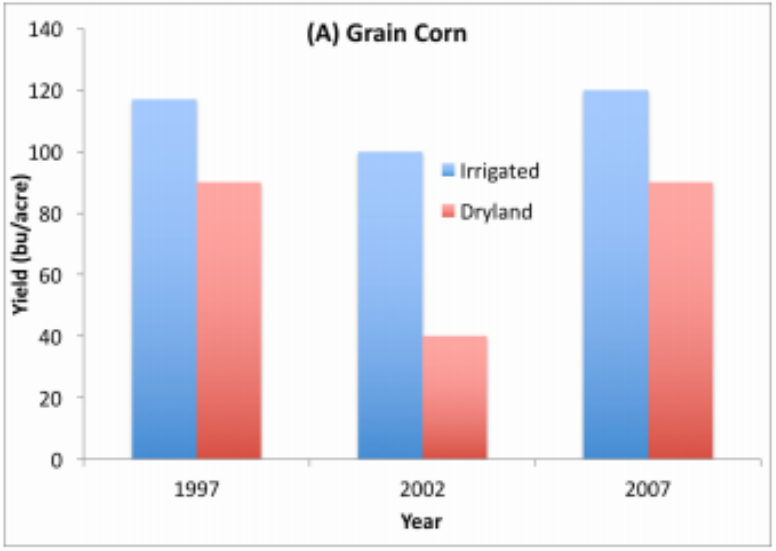
AC 07 - October 2017
Agronomic Crops

Comparison of Irrigated and Dryland Crop Production in SC

José Payero, Ahmad Khalilian, Edisto Research & Education Center

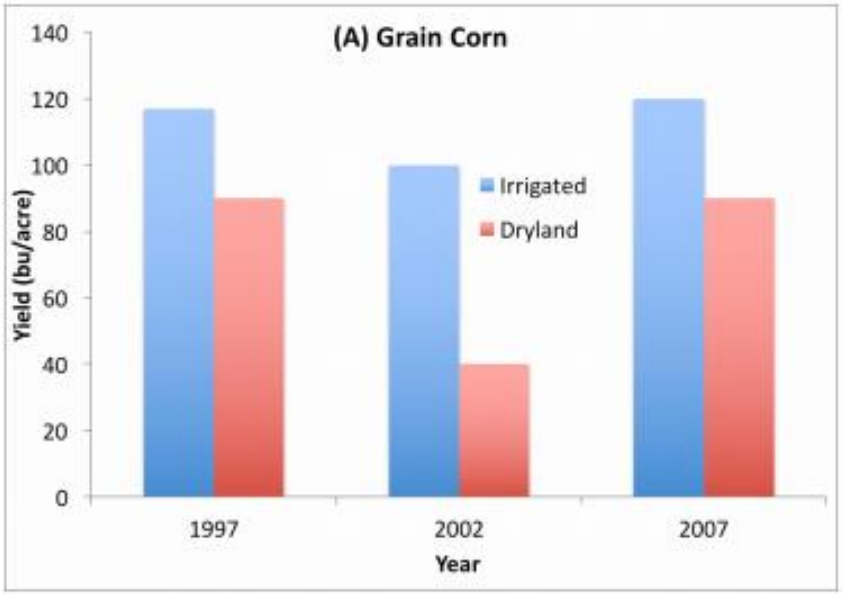
What is the problem?

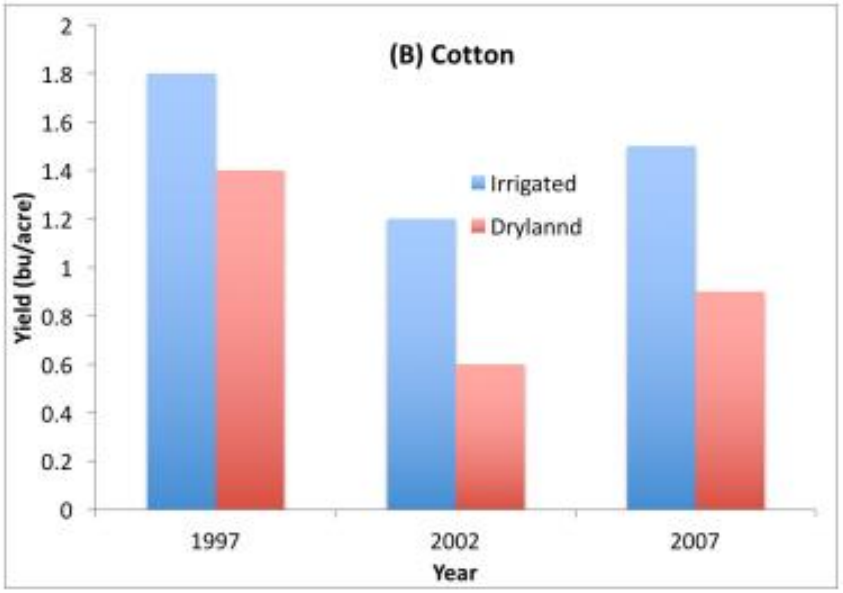
Climate change and climate variability threaten to increase the uncertainty of water supplies, potentially posing major risks to agriculture due to longer and more frequent droughts, more severe floods, temperature extremes, and unusual shifts in pressure from insects and crop diseases. A recent report from the International Panel on Climate Change (IPCC) indicated that "there is medium confidence that drought will intensify in the 21th century in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration" and suggested that extreme events will have greater impacts on sectors with close links to climate, including water, agriculture



Increased Yields/Profits

Average yields for 3 years in South Carolina – irrigated vs dryland



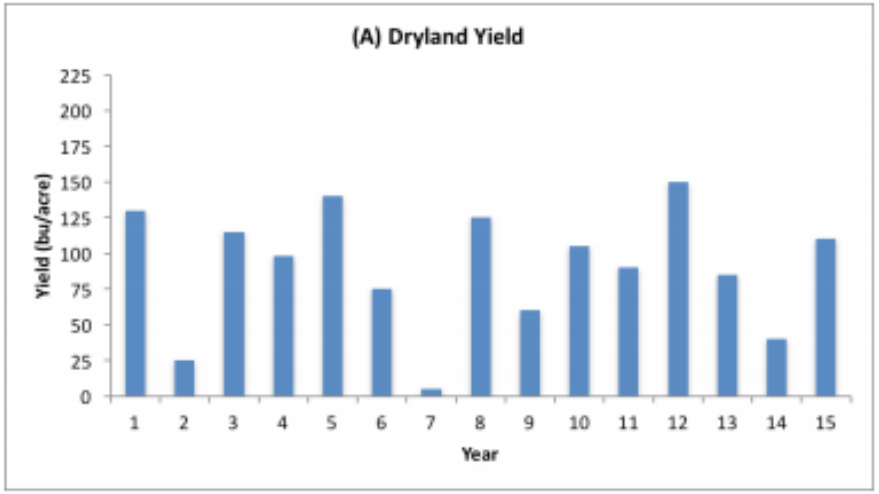


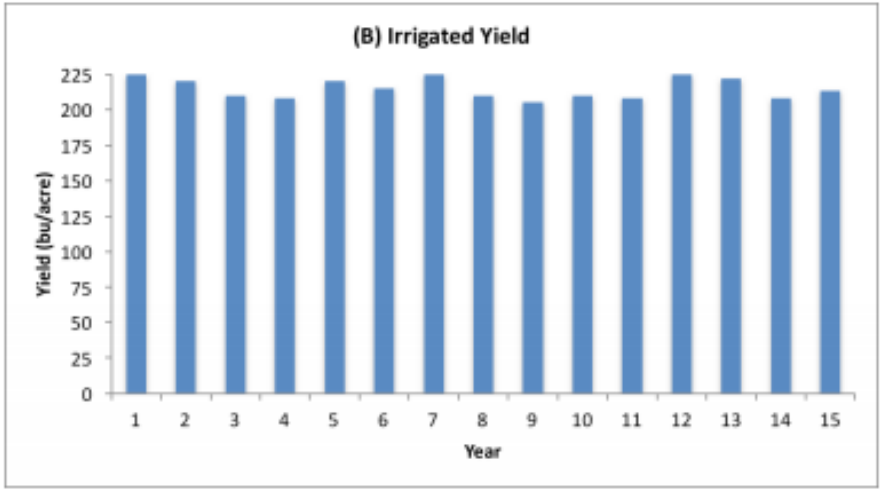
Cost of Pumping for Irrigation

- Average Irrigation cost ~ $9.00/ac-in applied:
  - ~$7/ac-in for electric
  - ~$11/ac-in for diesel
- So for 500 acres of irrigated land @ 10 inches of irrigation:
  - $45,000

Yield Stability

15 years of simulated corn yields in South Carolina





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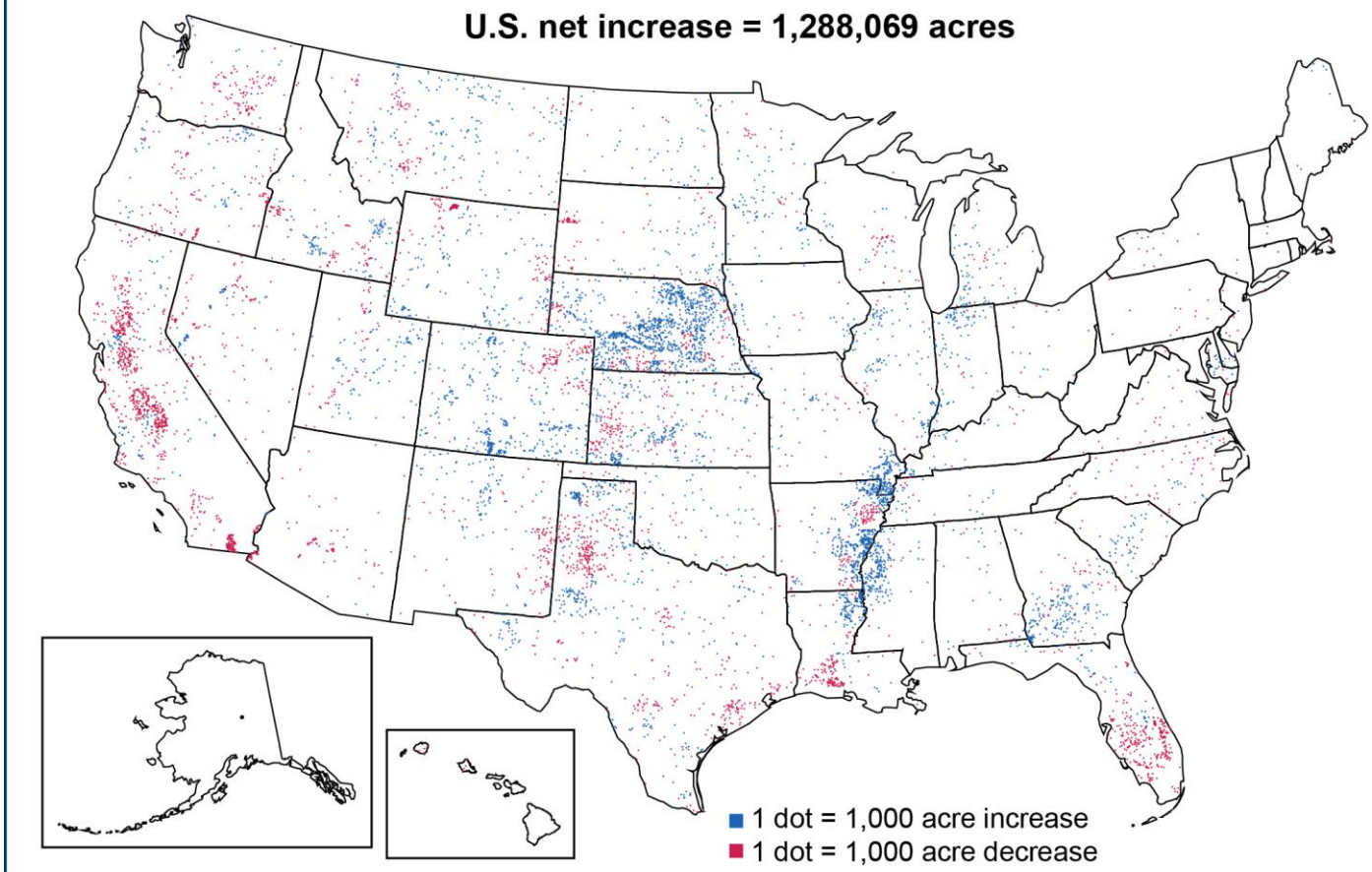
Change in irrigated acreage, 2002-07



Source: USDA, National Agricultural Statistics Service, Map Atlases for the 2012 Census of Agriculture.

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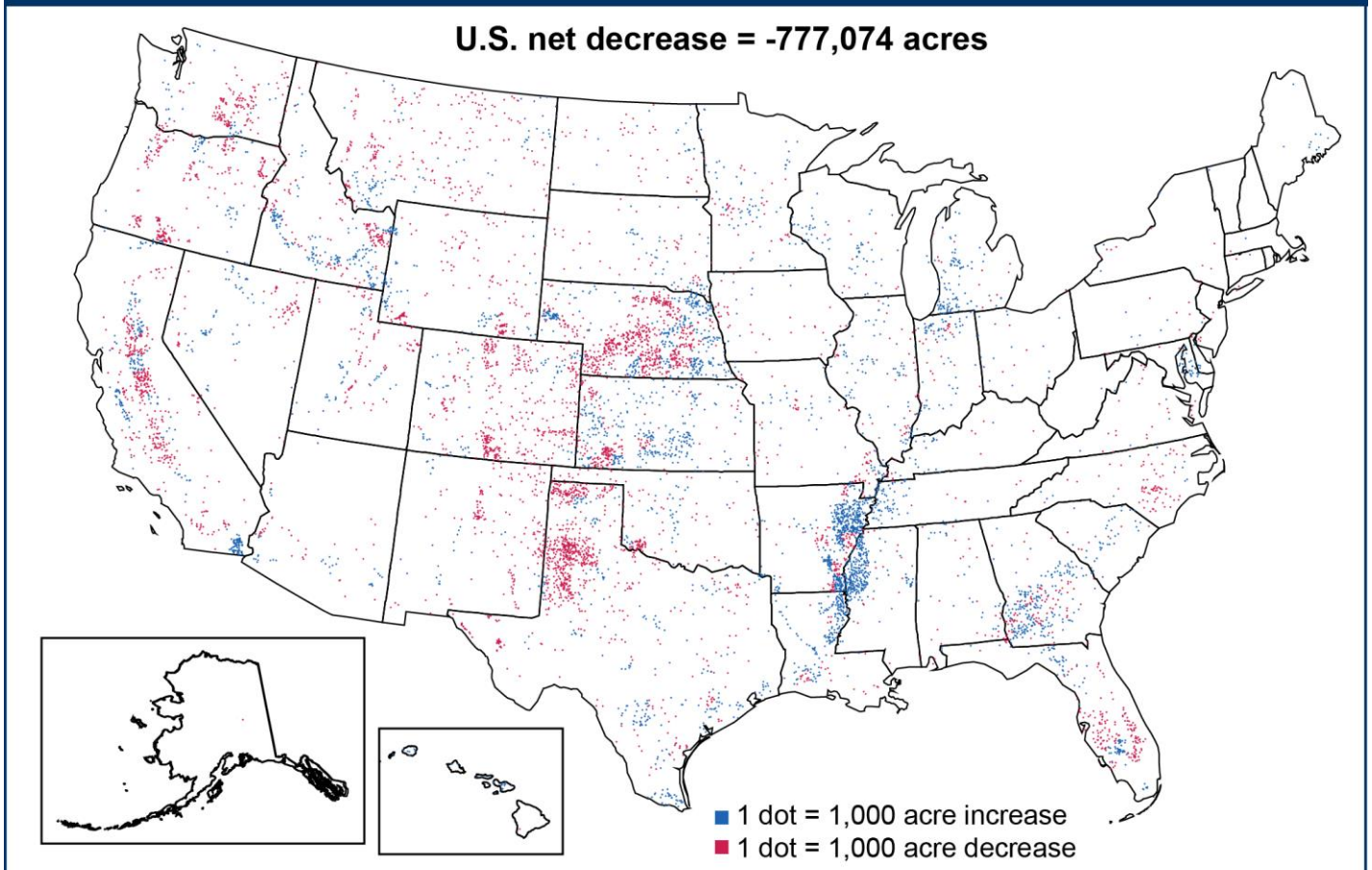
Change in irrigated acreage, 2007-12



Source: USDA, National Agricultural Statistics Service, Map Atlases for the 2012 Census of Agriculture.

What to Consider for Irrigation

- Irrigation type-efficiency of system (60-95%)
- Soil water holding capacity (0.6-1.8 inches/foot)
- Crop Growth Stage
- Utilization of Sensors for more precise estimation of soil moisture
- Split apply weekly rates if possible

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Irrigation Water Management

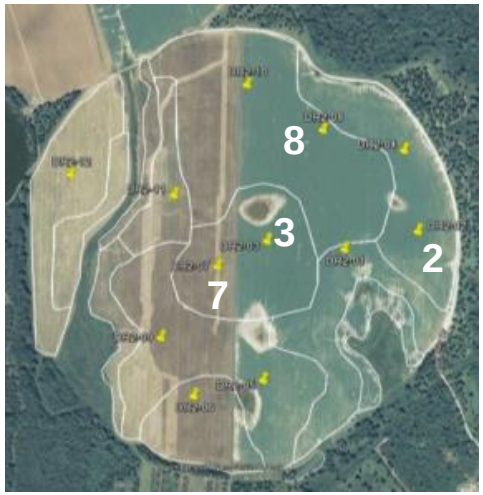
- Apply irrigation water only when needed
  - Advanced irrigation scheduling
- Apply irrigation water more efficiently
  - Efficient irrigation sprinklers
- Apply irrigation water more precisely
  - Variable-Rate Irrigation (VRI)
- Apply irrigation water using decision support tools
  - *e.g.* UGA's Smart Sensor Array linked to VRI

Variable Rate Irrigation – VRI

Irrigation Management Zones – IMZs

High density, low cost sensing systems

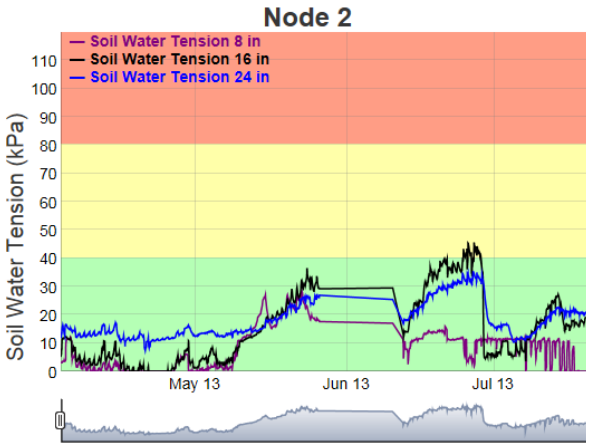
Soil Moisture Variability

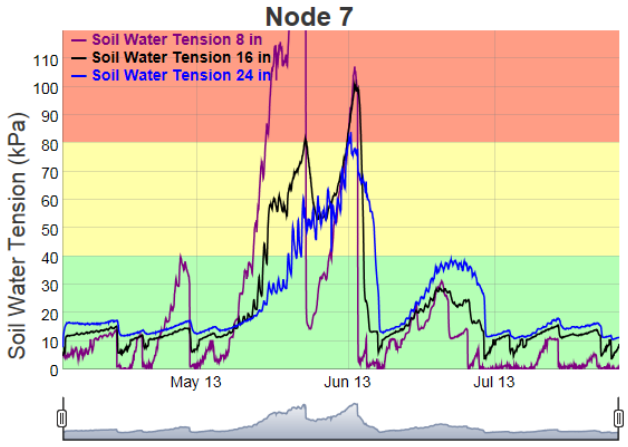


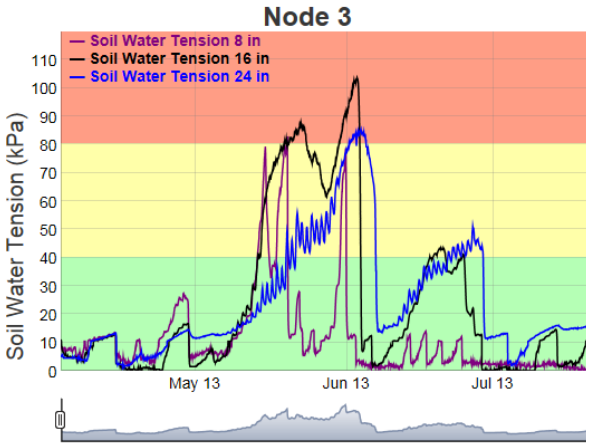
UGA Smart Sensor Array

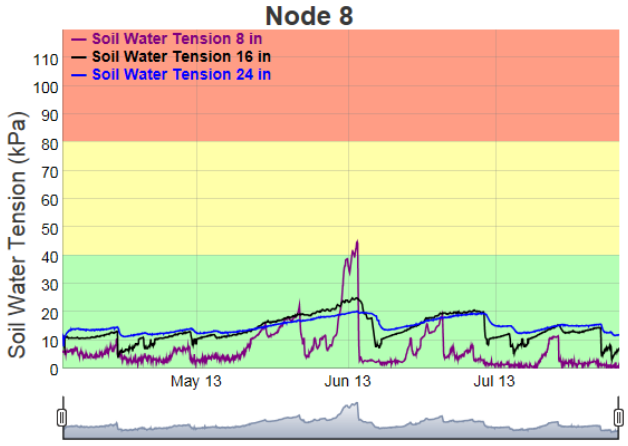
Corn

- Dry
- Drying
- Adequate Soil Moisture







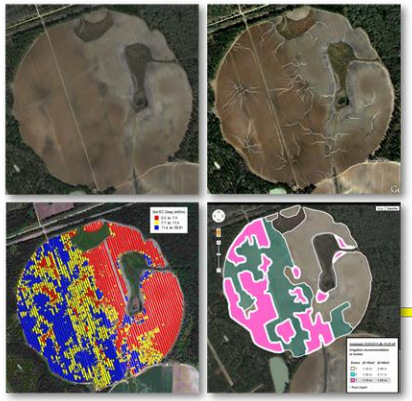


Variable-Rate Irrigation

- Also called VRI or precision irrigation
- VRI refers to the application of different volumes or rates of water to different segments of a field
  - rates are based on perceived or measured water requirements of sub-field zones

Dynamic Variable Rate Irrigation

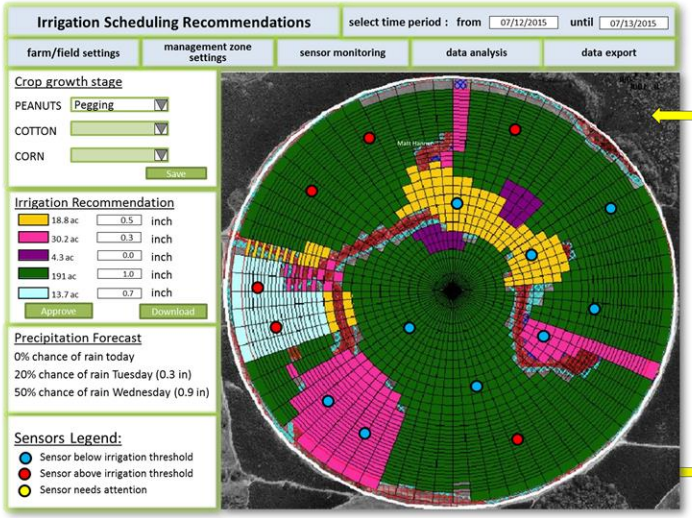
- Variable Rate Irrigation (VRI) for center pivots applies different volumes or rates of water to individual irrigation management zones (IMZs) within a field
- Rates are based on perceived or measured water requirements of IMZs
- The UGA Smart Sensor Array (UGA SSA) is used to develop irrigation recommendations for IMZs
- After farmer approval, VRI prescription is sent via cellular modem to pivot controller



IMZs – Irrigation Mgmt Zones

VRI – Variable Rate Irrigation

UGA SSA

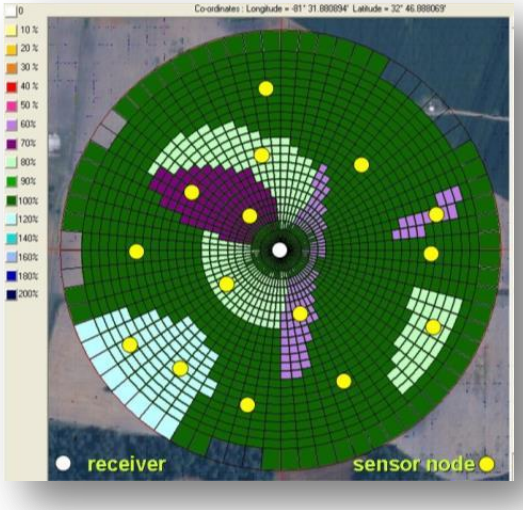


UGA SSA Data Portal

End User

University of Georgia Smart Sensor Array UGA SSA

- Designed to enable dynamic variable rate irrigation
  - Dynamic prescription maps based on soil moisture data
  - High density of sensors to populate IMZs
- Design characteristics
  - Truly wireless
  - Energy efficient
  - Low cost
  - Low profile
  - Easy installation/removal



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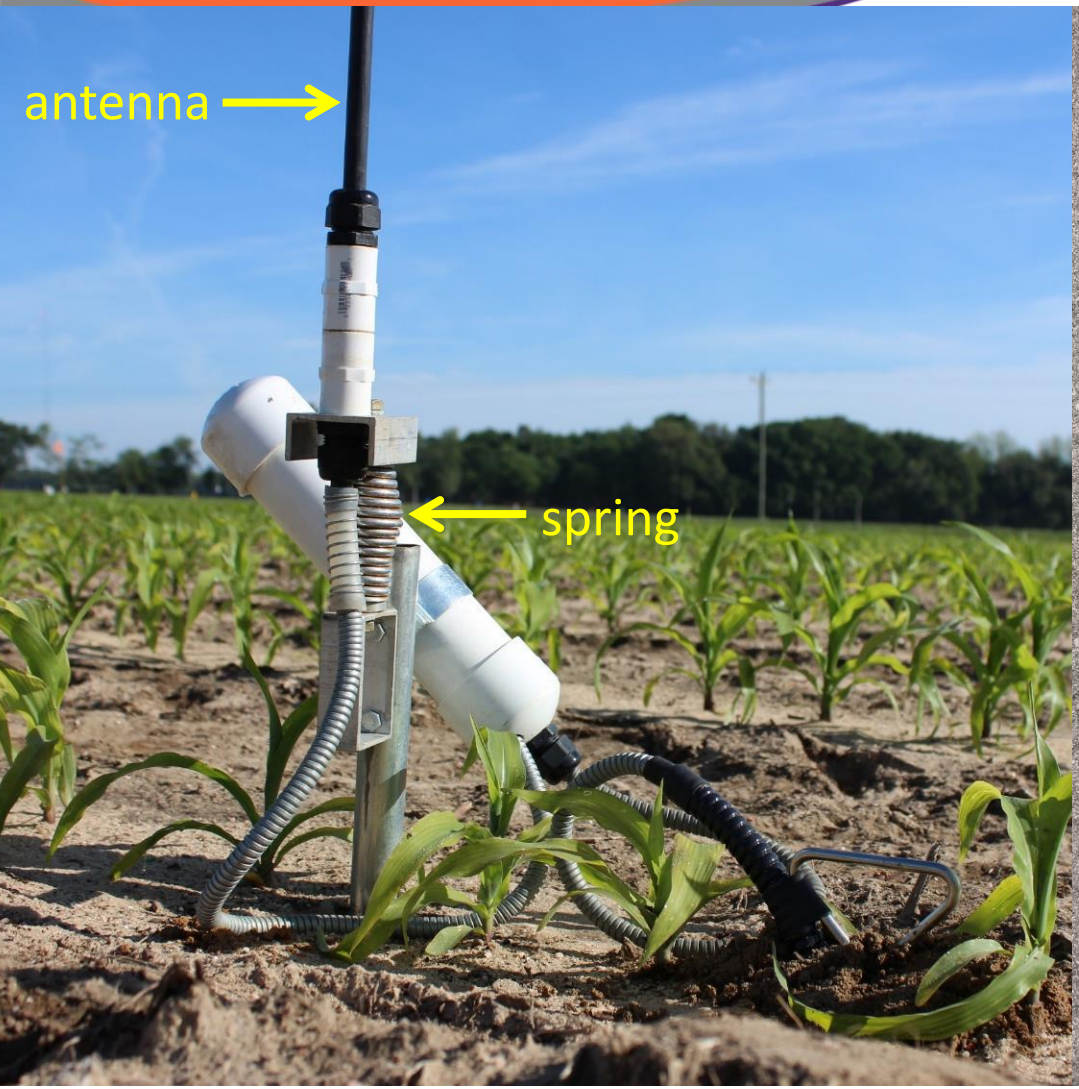

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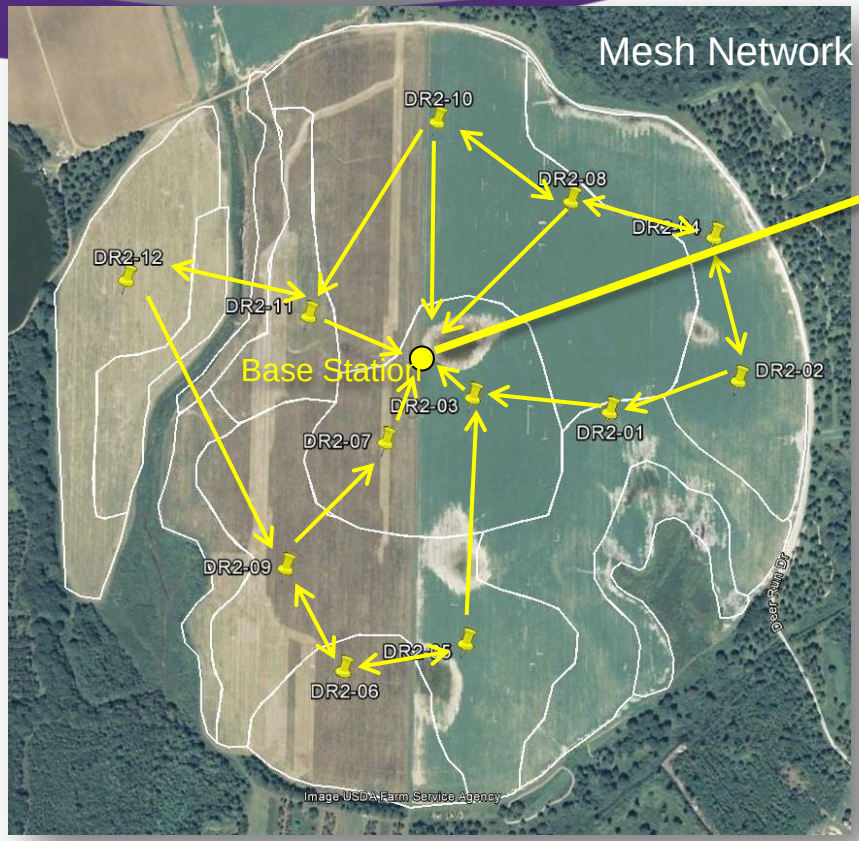

Cell modem

UGA SSA Data Portal

Battery volts, life

Soil water tension at 8, 16, 24 in

Temp on circuit board, ambient, soil

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07/19/2012 18:01:04,1,045AC2,2.92,85%,6.1,22.7,18.7,30.6,30.6,44.7,622
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07/19/2012 18:01:10,5,045837,2.79,78%,34.9,124.7,76.2,29.8,29.8,29.8,510
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07/19/2012 18:01:12,7,04408A,2.87,83%,64.2,111.8,69,29.3,27.4,29.3,493
07/19/2012 18:01:12,8,044239,2.79,78%,51.8,101.3,77,29.5,27.5,30.2,507
07/19/2012 18:01:13,9,0441D1,2.83,81%,60.6,54.5,21.6,28.4,26.9,28.5,574
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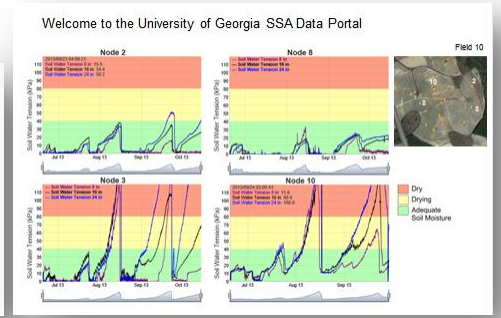
Node number



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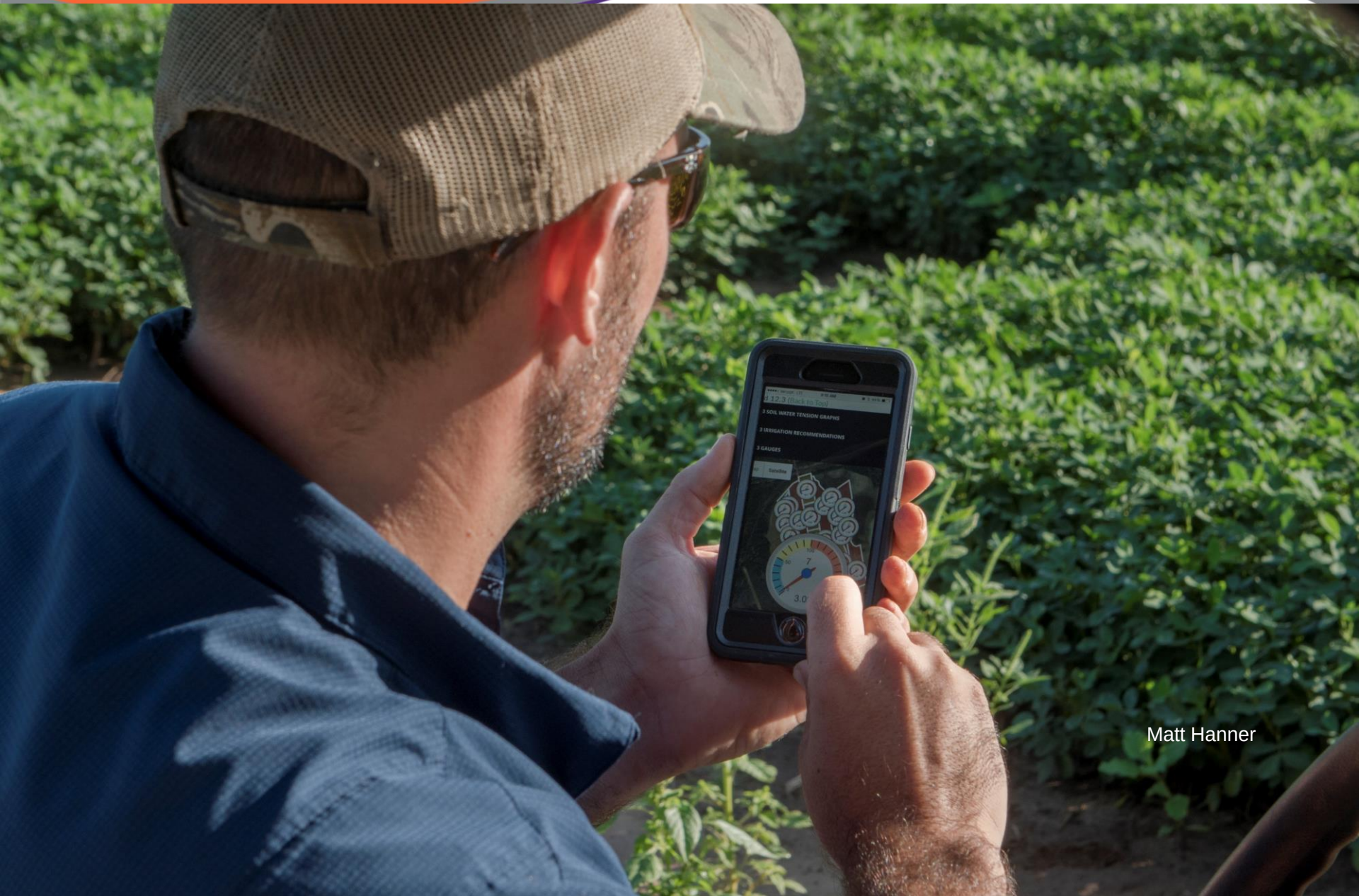

Matt Hanner

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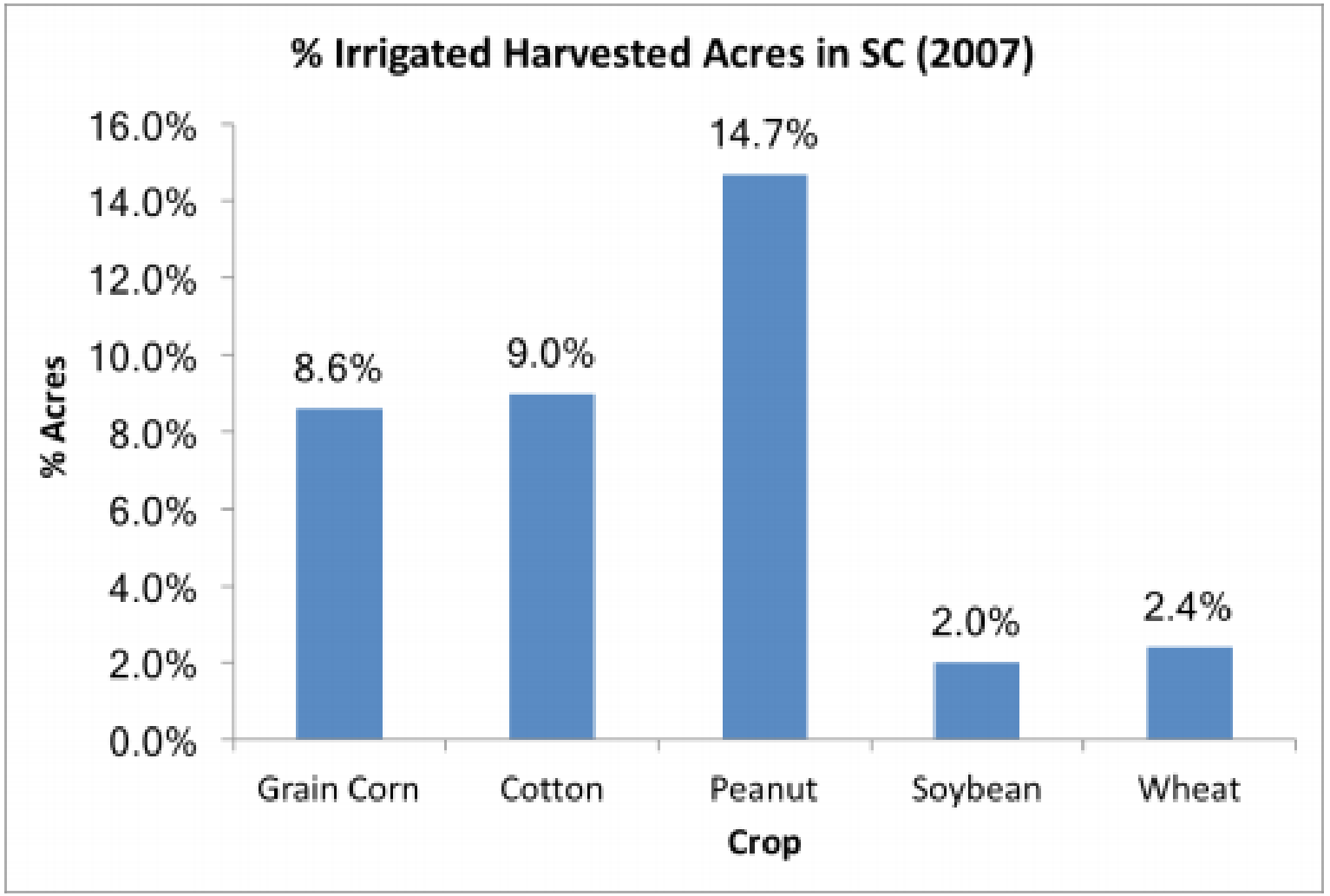
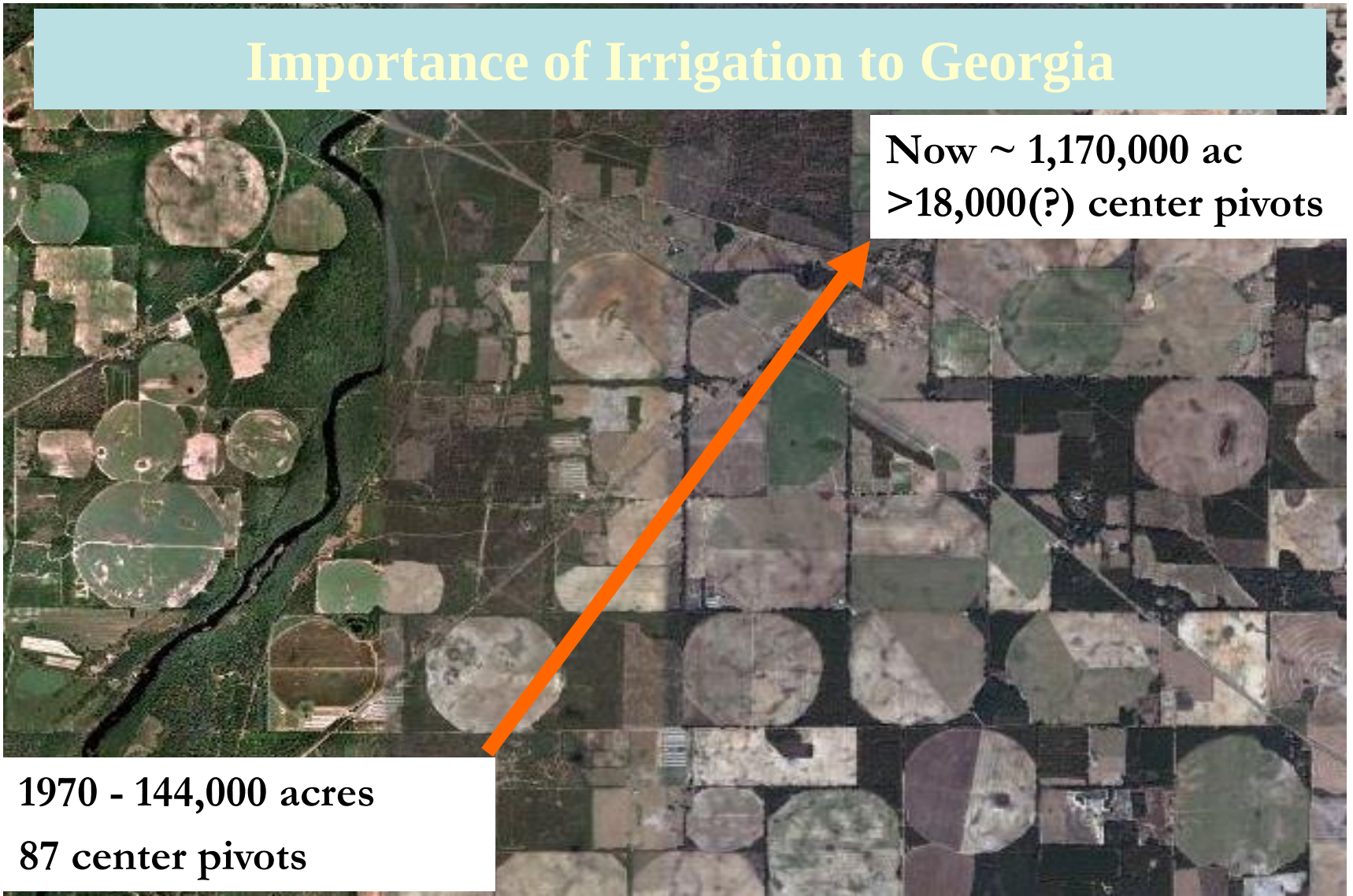
Peanut Harvest

Irrigation in South Carolina



Importance of Irrigation to Georgia



Now ~ 1,170,000 ac
>18,000(?) center pivots

1970 - 144,000 acres

87 center pivots

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SC Agricultural Water Use and Irrigation Survey

Clemson PSA Water Use Task Force

CLEMSON COOPERATIVE EXTENSION

WATER RESOURCES CENTER SC

Why Conduct a Comprehensive Survey?

- Legislative and general public interest in the current condition of SC water resources due, in part, to:
  - Increased occurrence of extreme weather events such as droughts and floods
  - Increasing water demands for municipal supply, industry, agriculture, recreation, and environment

- The need for accurate data to inform sound resource management decision-making

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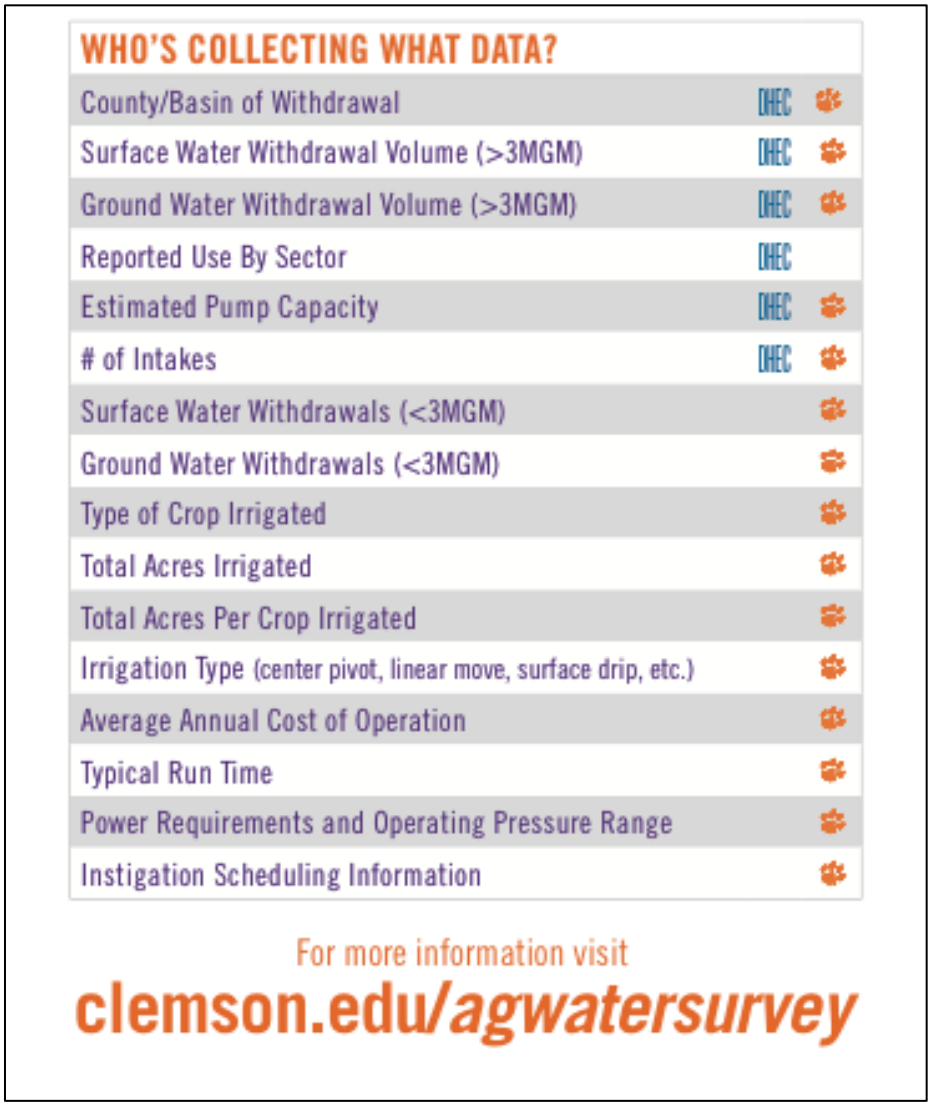
So What's Missing?

- Surface and Groundwater Withdrawals under 3 MGM
- Irrigation System Type (Center Pivot, Surface Drip, etc.)
- Total Acres Irrigated
- Crop(s) Irrigated
- Power Source and Capacity
- Scheduling Method



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Thank You

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Questions?

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