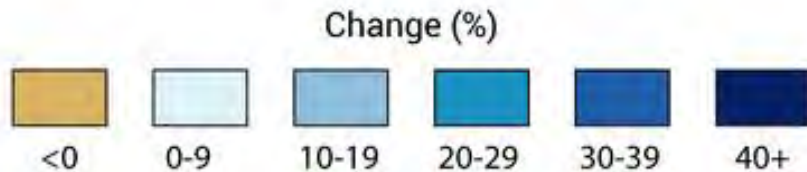
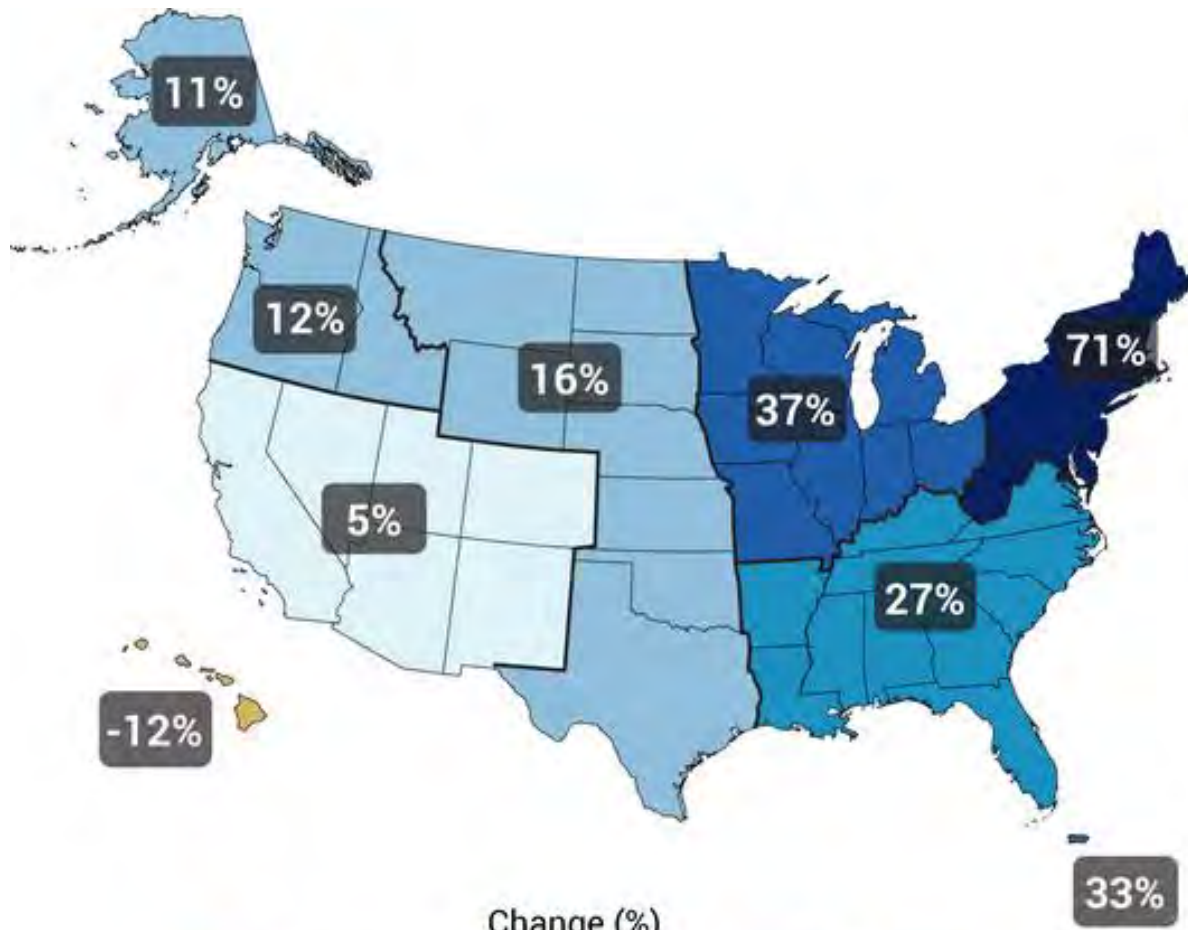




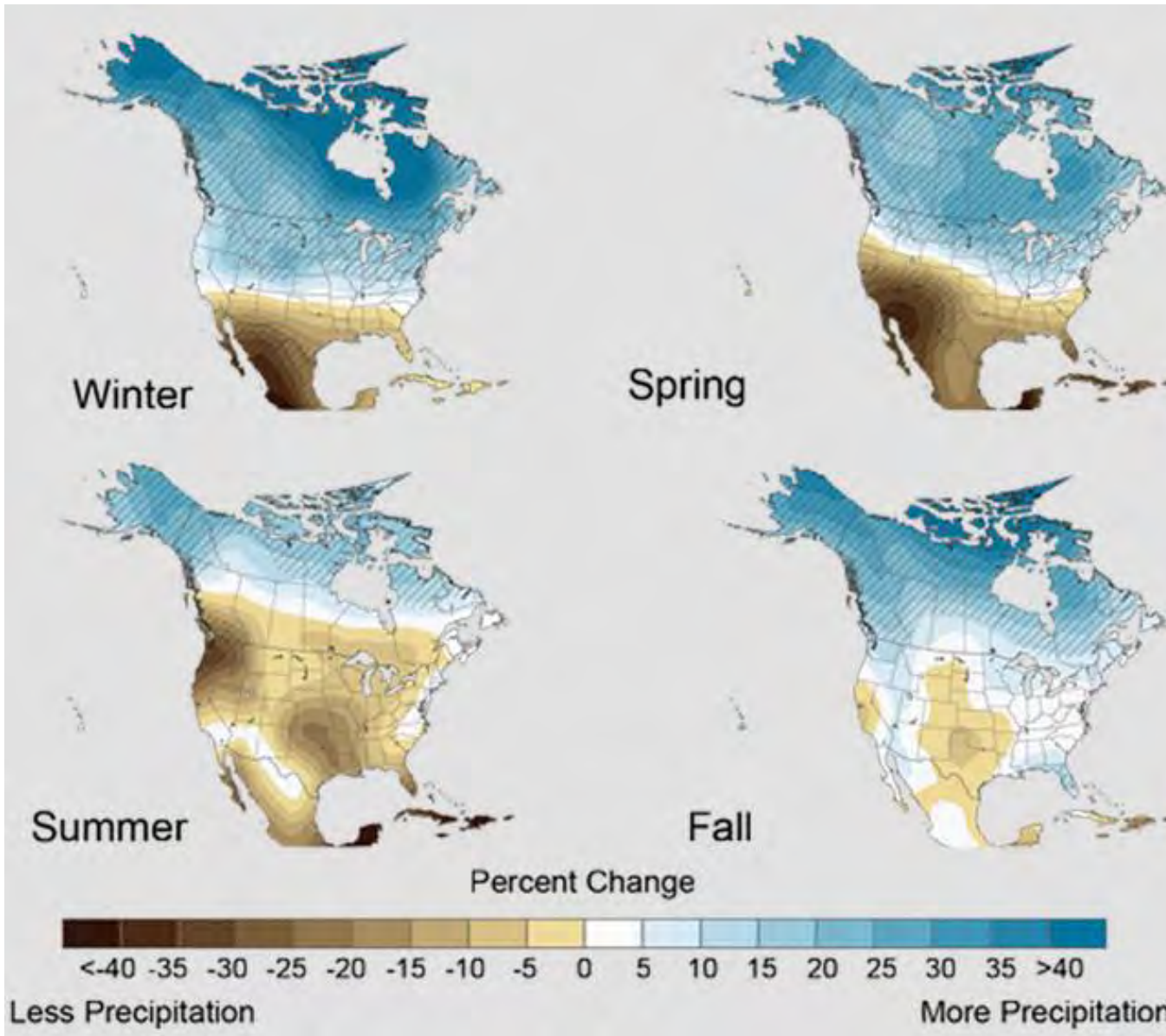
## 2015 SOIL HEALTH WORKSHOP

# Soil Health in the Larger Context

# Regional Increases in Very Heavy Precipitation Events (1958-2007)



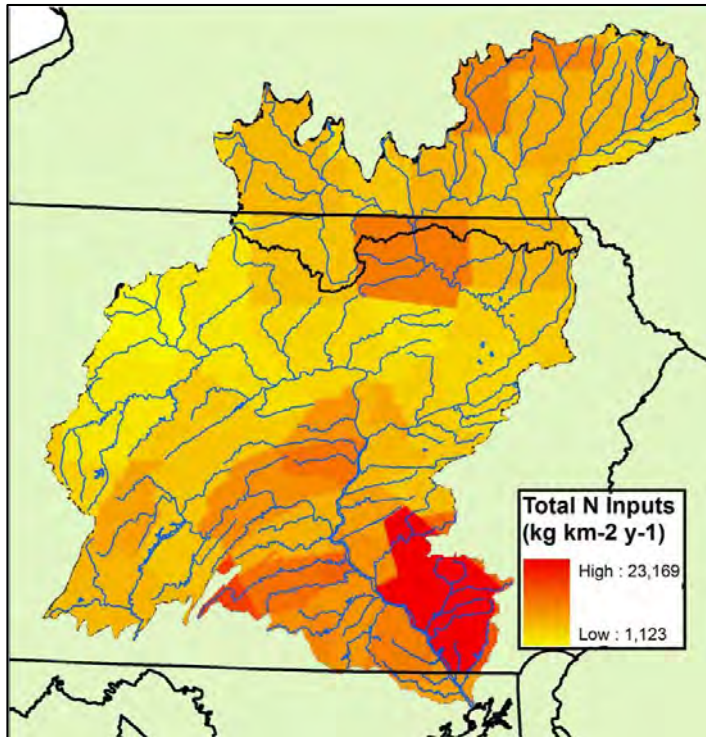
# Projected Change in Precipitation by 2080



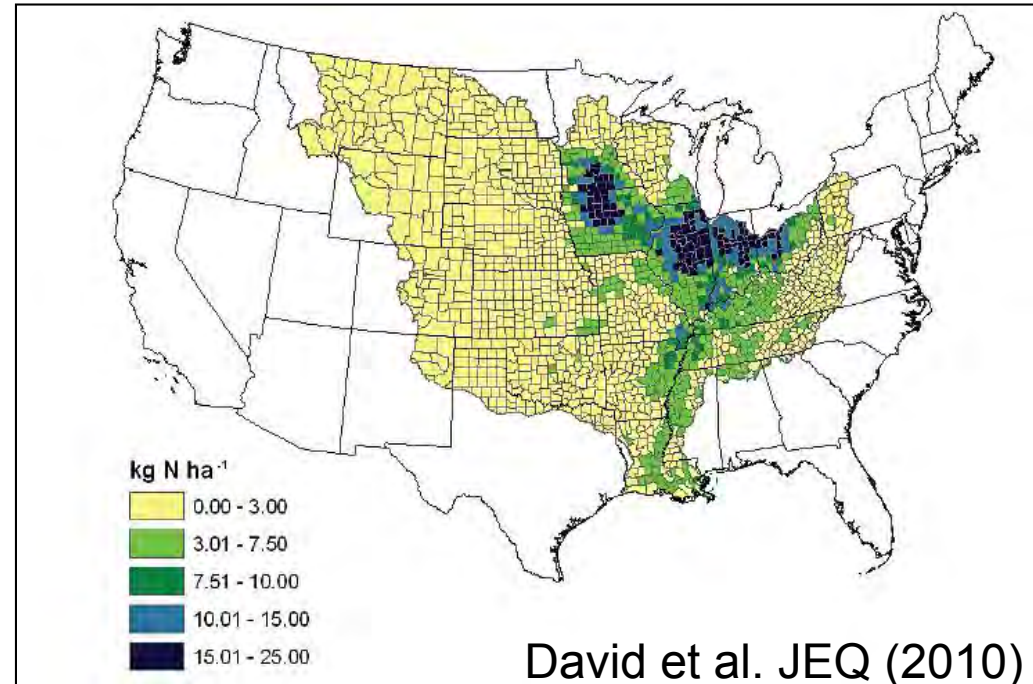


# The Hypoxia Concern

## Riverine N Inputs in the Chesapeake and Mississippi River Basins



Courtesy of Peter Woodbury, Dennis Swaney, and Robert Howarth, Cornell University.



David et al. JEQ (2010)

### Gulf Hypoxia Action Plan Goal

- 45% reduction in riverine total N

# Agricultural GHG Emissions

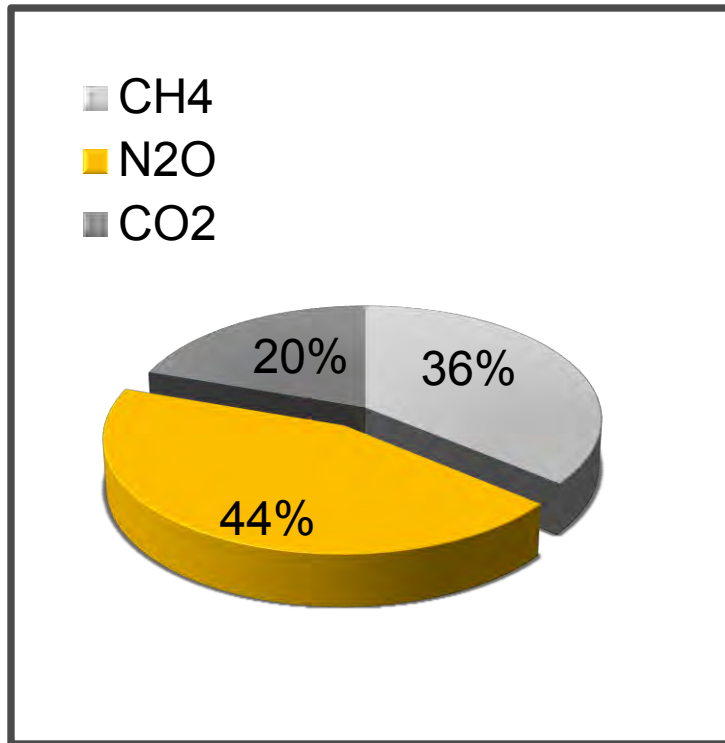
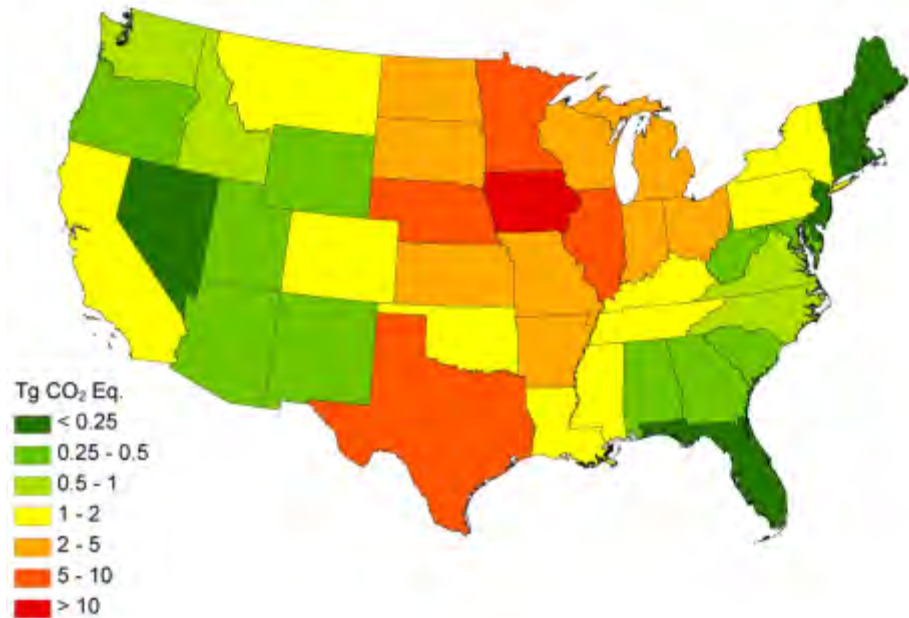


Figure 2: Major Crops, Average Annual Direct N<sub>2</sub>O Emissions Estimated Using the DAYCENT Model, 1990–2007 (Tg CO<sub>2</sub> Eq./state/year)

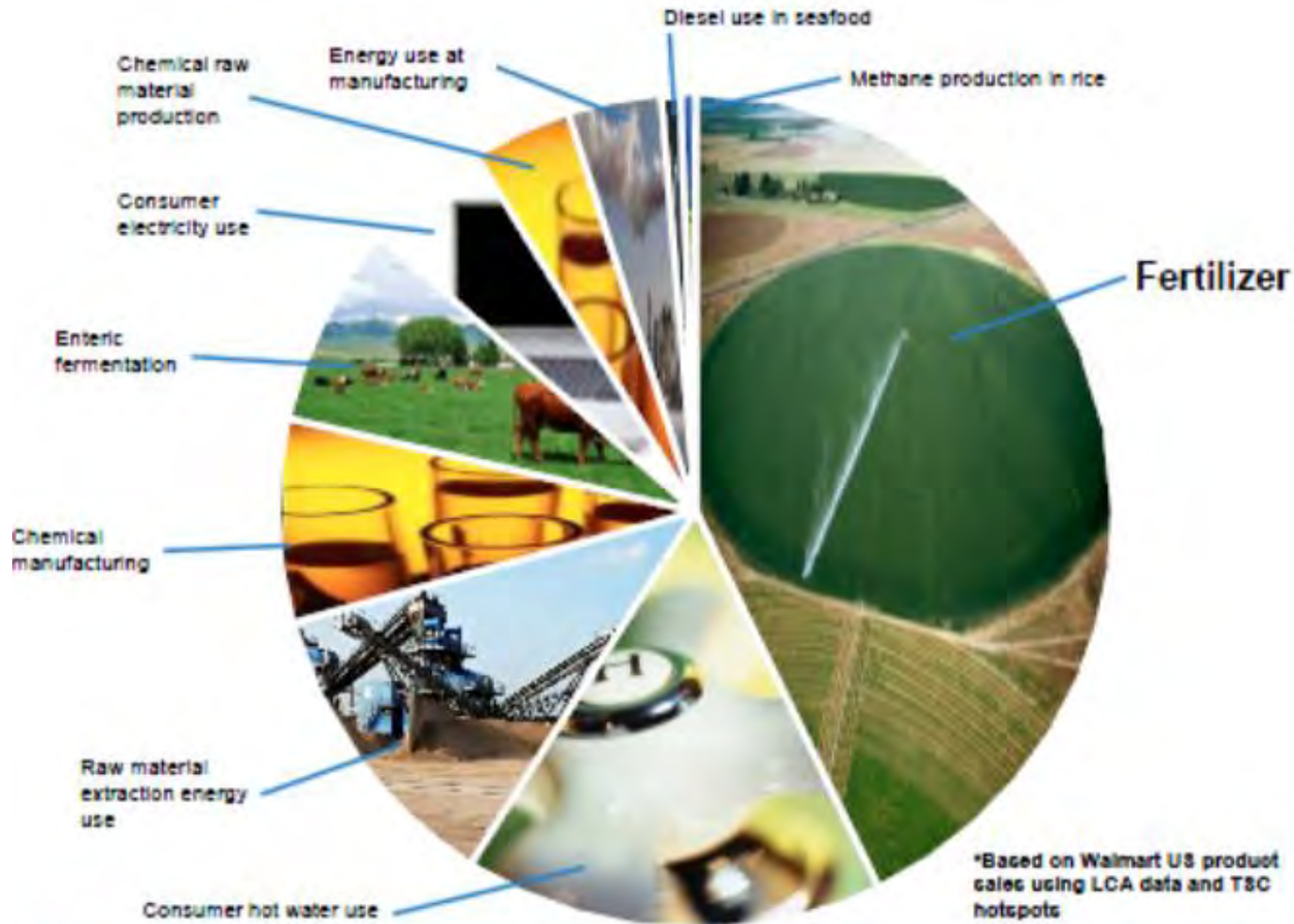


*Del Grosso et al., GBC 2010*

***Nitrogen application to US agricultural lands in 2008 had a greater global warming impact than the entire US aviation industry (EPA, 2010)***

# Walmart Carbon Footprint:

“fertilizer is by far the “hottest” input in our supply chain”



\*Based on Walmart US product sales using LCA data and TSC hotspots

# Many sources of variation in N availability

→ generalized recommendations are too simplistic

- Organic amendments (manure, compost, etc.)
- Crop rotations
- Soil type differences
- Soil organic matter contents
- Soil and crop management (tillage, planting date, etc.)
- **Weather:**
  - **Temperature**
  - **Precipitation!**

**Interactions are complex and nonlinear**



# Soil Health and Nitrogen



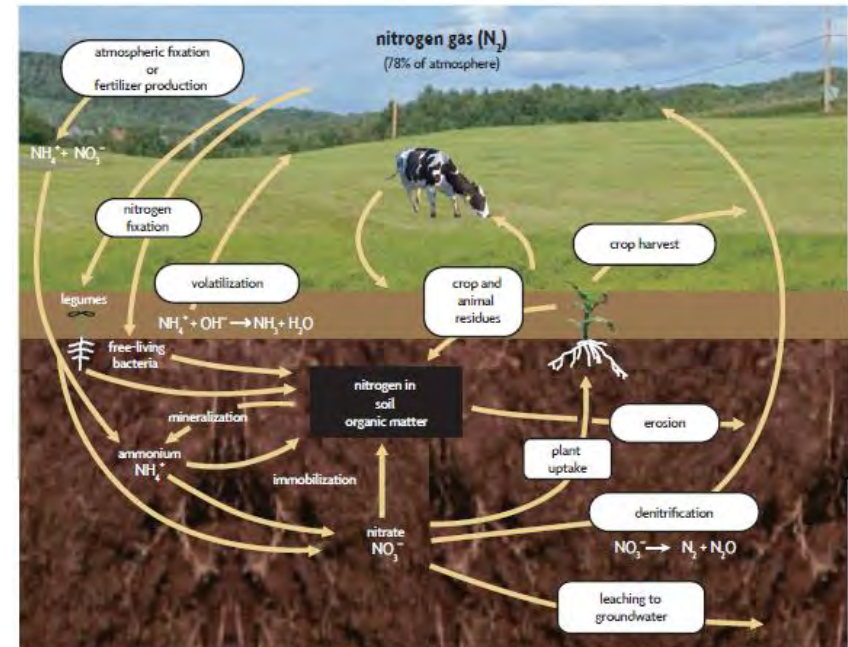


# Major N Processes in Adapt-N Model

- Net additions:
  - Mineralization - immobilization
  - Urea hydrolysis
- Transformations
  - Nitrification
- Losses
  - Denitrification (nitrification)
  - Ammonia volatilization
  - Leaching
  - Plant N uptake

## ➤ Modifications for Enhanced Efficiency Compounds

$$\Delta q_{(\text{NO}_3\text{-N, NH}_4\text{-N, etc})} = q_0^* [1 - \exp(-kt)]$$



# Cloud-Based



## Nitrogen Recommendation

Grower: Smith Farming  
 Farm: Corey's Farm  
 Field: Skunk River East  
 Zone: Main Zone

Nitrogen recommendation for July 30, 2014:

<b>160</b> lbs N/Acre <small>N recommendation</small>	<b>143-179</b> <small>N recommendation range</small>
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Recommendation based on supporting estimates and assumptions:

<b>205</b> lbs N/Acre <small>Expected N in crop at harvest</small>	<b>74</b> lbs N/Acre <small>N mineralization so far</small>	<b>117</b> lbs N/Acre <small>N loss so far</small>
<b>0</b> lbs N/Acre <small>Partial credit from prior crop</small>	<b>52</b> lbs N/Acre <small>N in crop now</small>	<b>23</b> lbs N/Acre <small>Expected future loss</small>
<b>2</b> lbs N/Acre <small>Expected future mineralization</small>	<b>6</b> lbs N/Acre <small>N in soil now</small>	<b>13.6" / 28.0"</b> <small>Rainfall since planting / Rainfall since 01/01/14</small>

### Field information

Soil: Webster  
 Maturity Class: Grains: 107 day corn  
 Planted: 06/01/14  
 Expected Yield: 200.0 bu/acre  
 Harvest Population: 30,000  
 Organic Matter %: 3.5  
 Previous Crop: Grain Corn  
 N fertilizer already applied: 100 lbs N/Acre  
 Irrigation Applied: None  
 Manure Applied: No  
 Adapt-N Zone ID: 8758

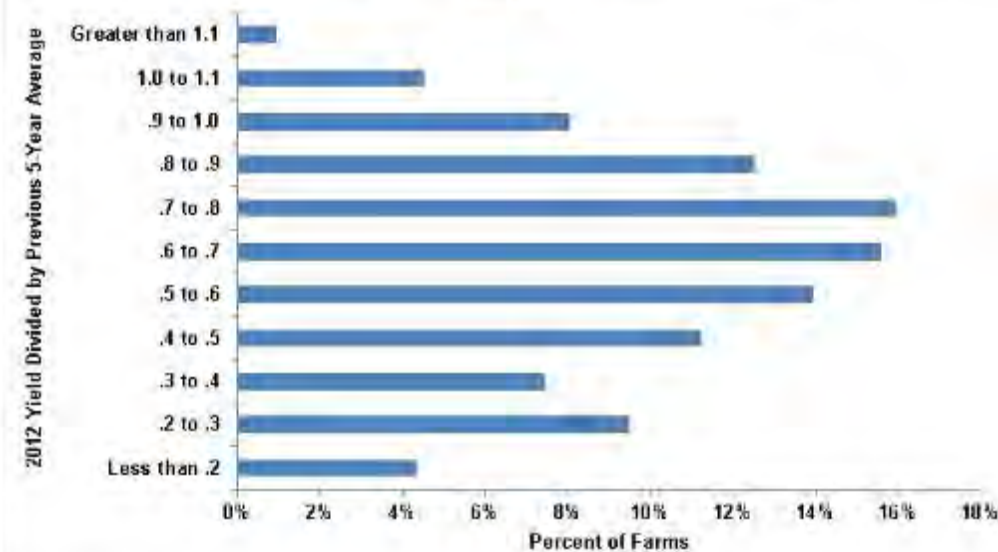


# Reduced Yields from Drought and Crop Insurance

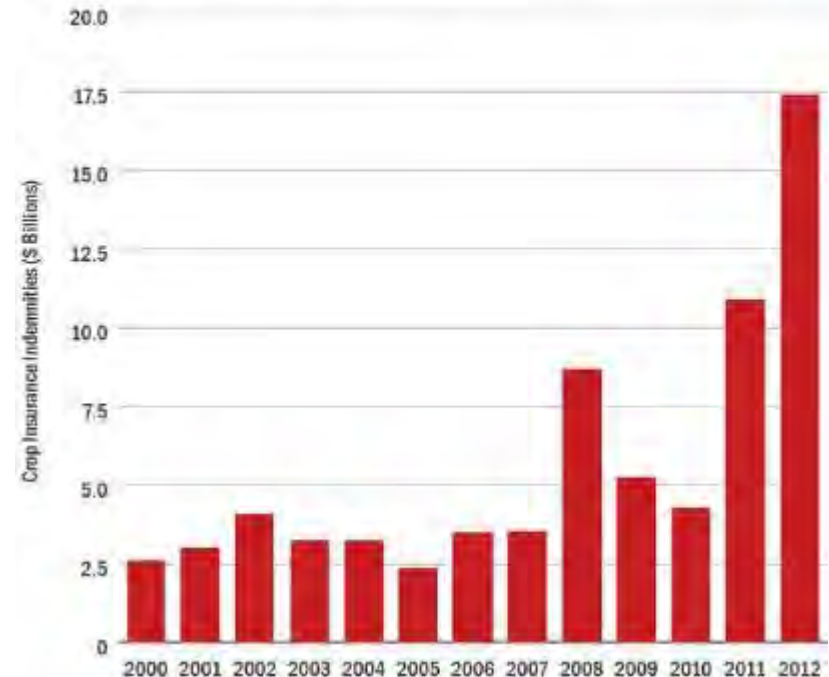


## 2012 drought in Midwestern US

Figure 1. 2012 Yield Divided by Five-Year Average, FBFM Farms in Illinois.



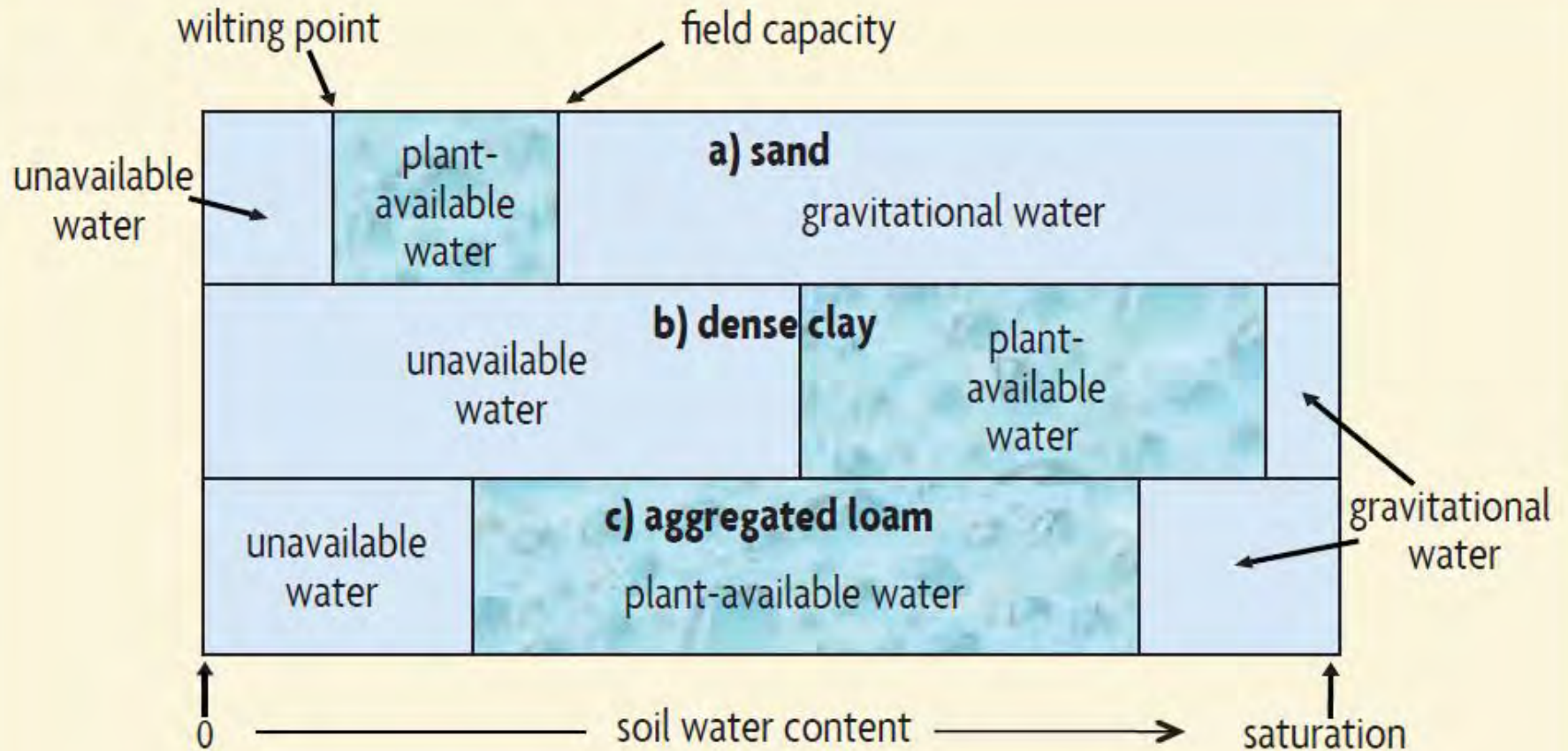
From 2001-2010, federal crop insurance indemnities averaged just \$4.1 billion a year. However in 2011 and 2012, the FCIP paid out record-breaking amounts of \$10.8 billion and \$17.3 billion, respectively, with drought accounting for nearly \$13 billion in 2012.



<http://farmdocdaily.illinois.edu/2013/10/range-farm-yields-2012-drought.html>



# Water storage depends on texture and aggregation



# Available Water and Rooting

**A) High Penetration Resistance, penetrated by single corn root with few lateral fine roots**



**B) Low PR, many fine roots**



An additional dimension to plant-available water capacity of soils: **The water in the soil may be available, but roots also need to be able to access it, as well as the associated nutrients.**



# Resilience – Drought Impact differs with Soil Management: Carroll, Ohio 2012



**Same soil type & location, different management**

(Archuleta, 2012, NRCS National Soil Health Team, personal communication)



# Probability of Dry Period

(important for irrigation considerations)



**Subregion 2**  
Conditional probability that a given precipitation event ( $\geq 0.50$  inches)  
is preceded by a dry sequence of at least length 'n'

