Agricultural strategies to reduce hypoxia in the Gulf of Mexico: Impacts on climate change and water quality

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Hypoxia: What is it?

- Is a seasonally oxygen depleted zone (<2mg/l) in the Gulf of Mexico
- Mobile aquatic species leave the area
- Those that can't leave die or are weakened
- Fish, shrimp, crabs, zooplankton and other important prey fish are less abundant in the hypoxic areas.

Hypoxia: Where is it found?

Source: USGS Fact Sheet, 2000

Hypoxia:

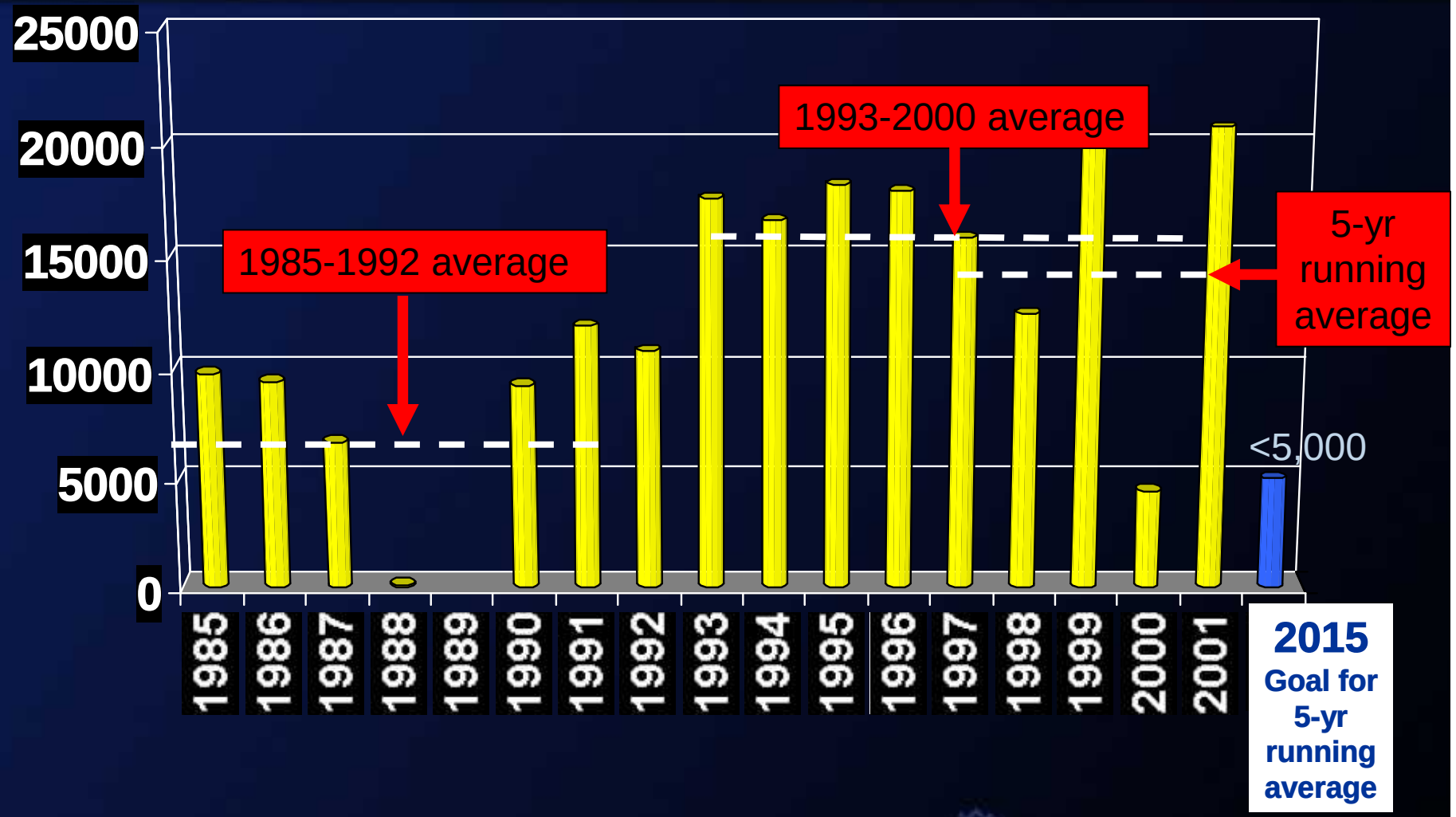
When does it occur?

- During the summer months
- Related to flow rate and nutrient load in the Mississippi River
- Is elevated by tropical storms

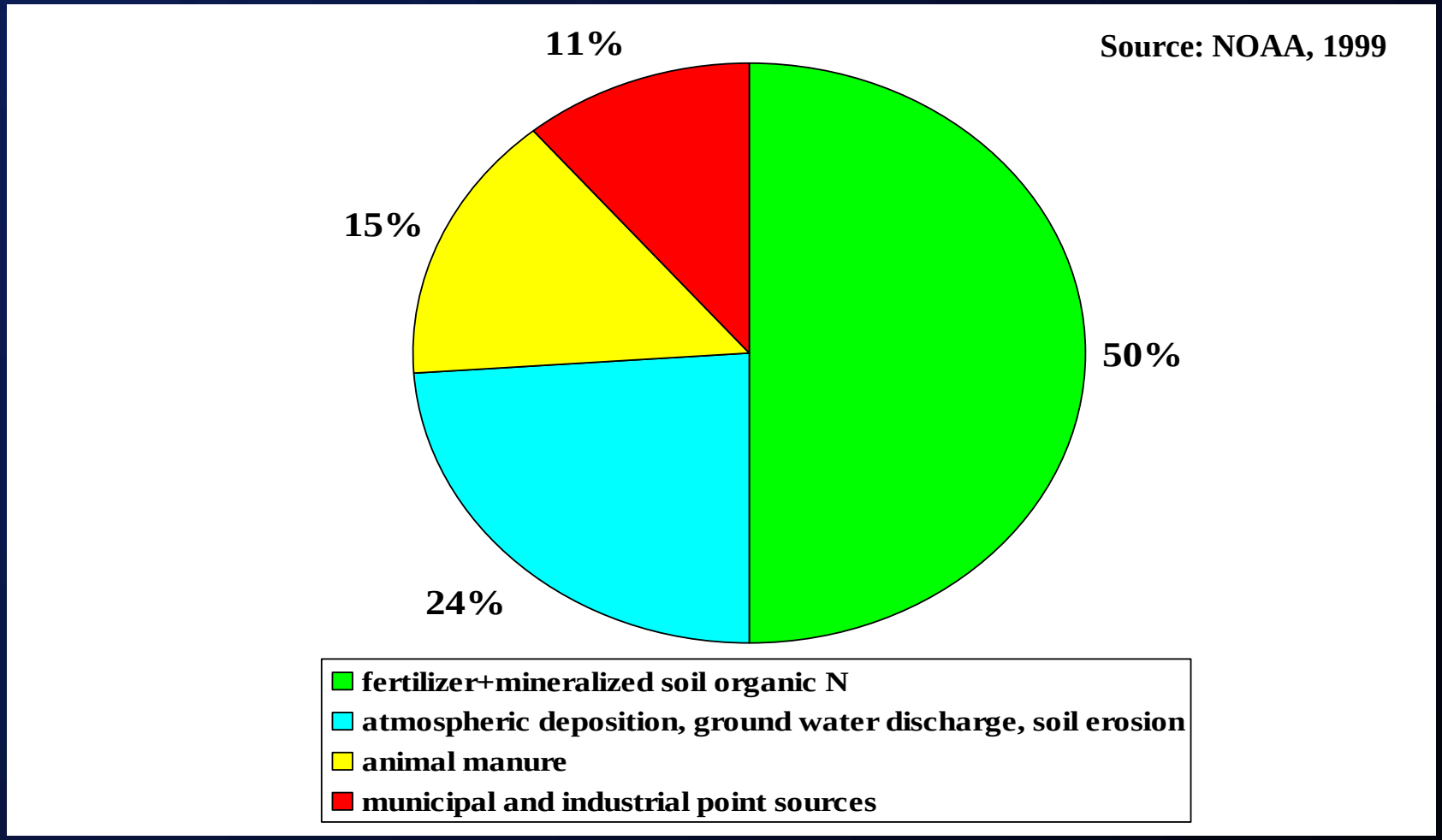
What is it's cause?

- Nutrient over-enrichment- Nitrogen

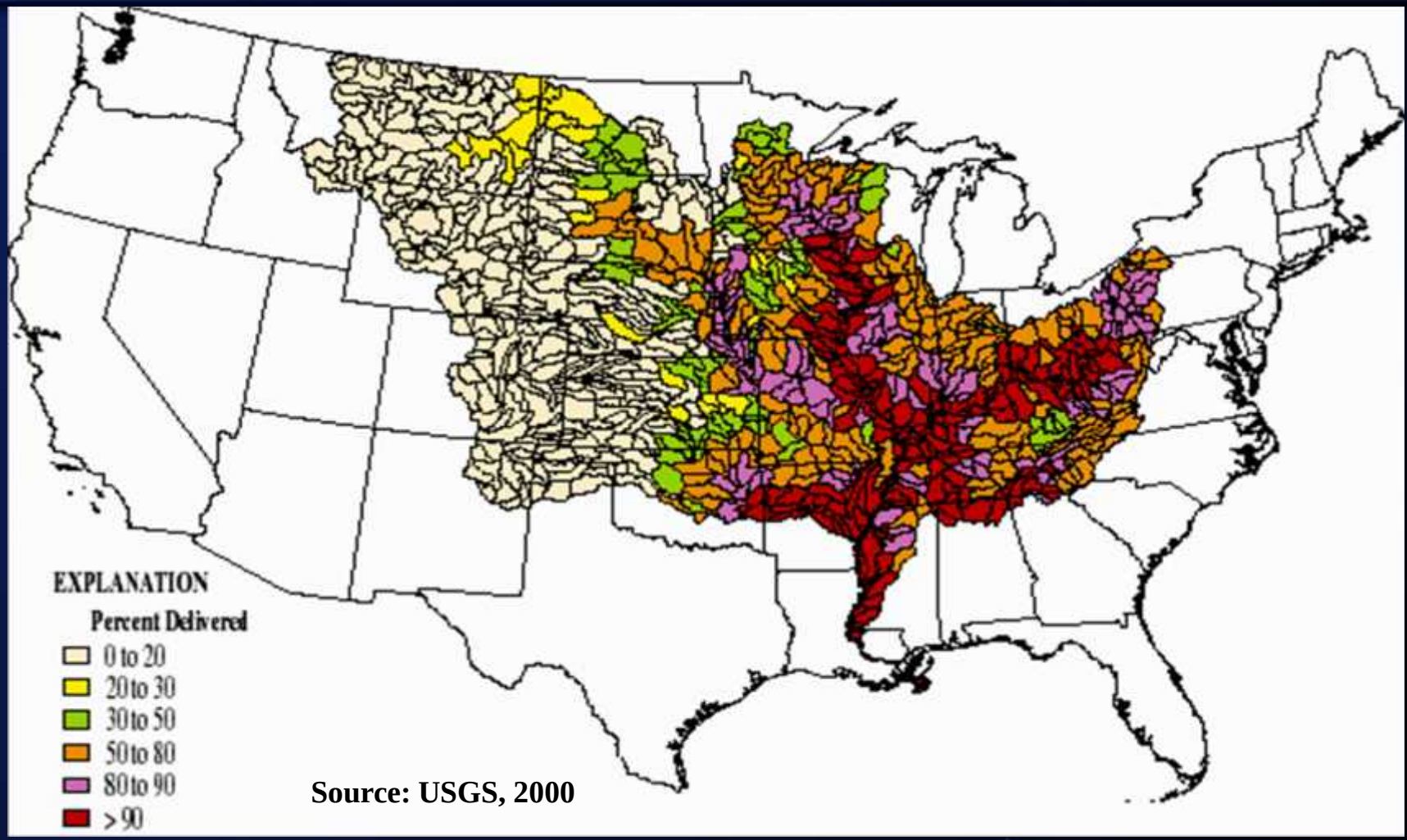
Hypoxia: Areal Extent of Hypoxic Zone 1985 - 2001



Hypoxia: What are the sources of N?



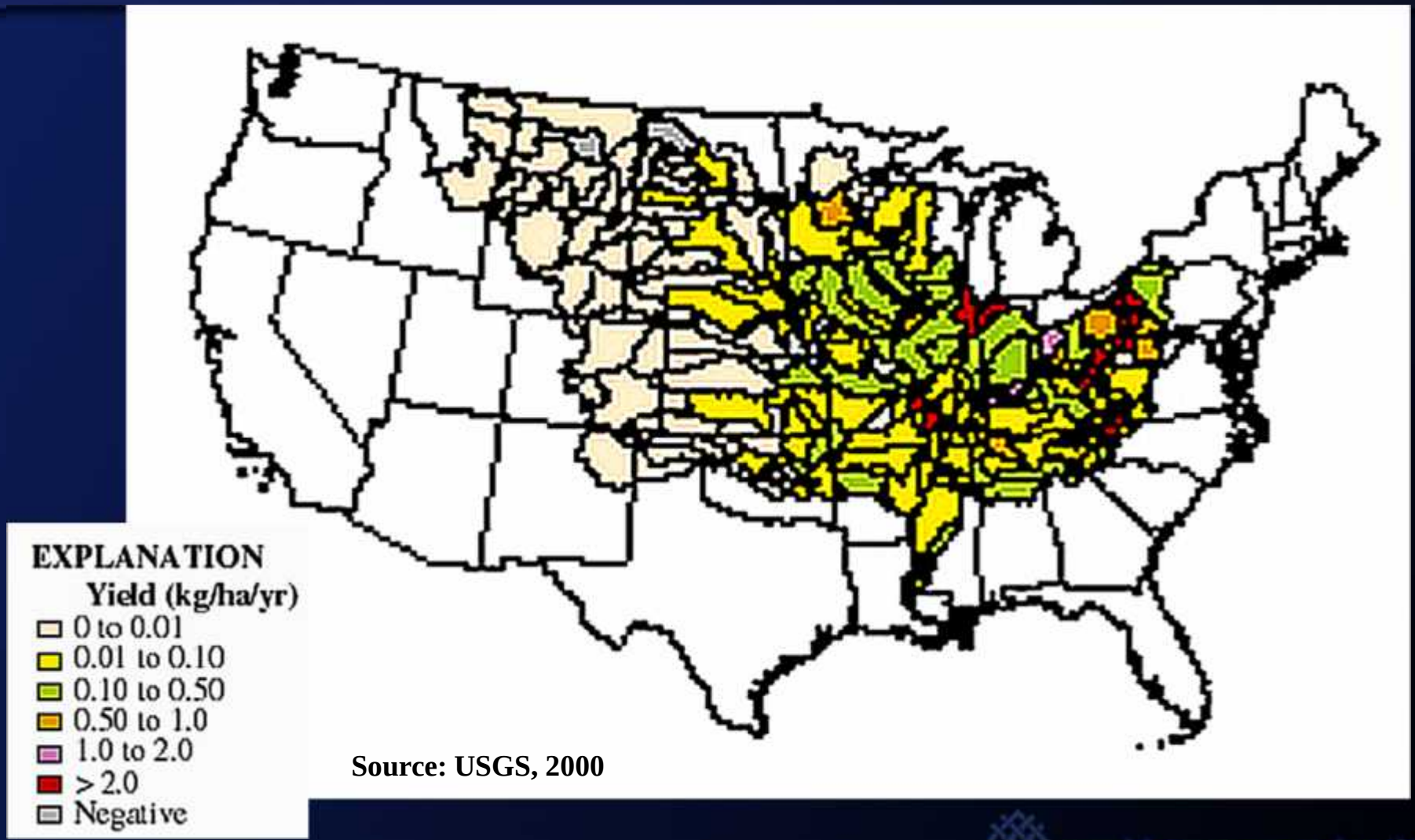
Hypoxia: Where does it come from ?



Source: USGS, 2000

Where does it come from ?

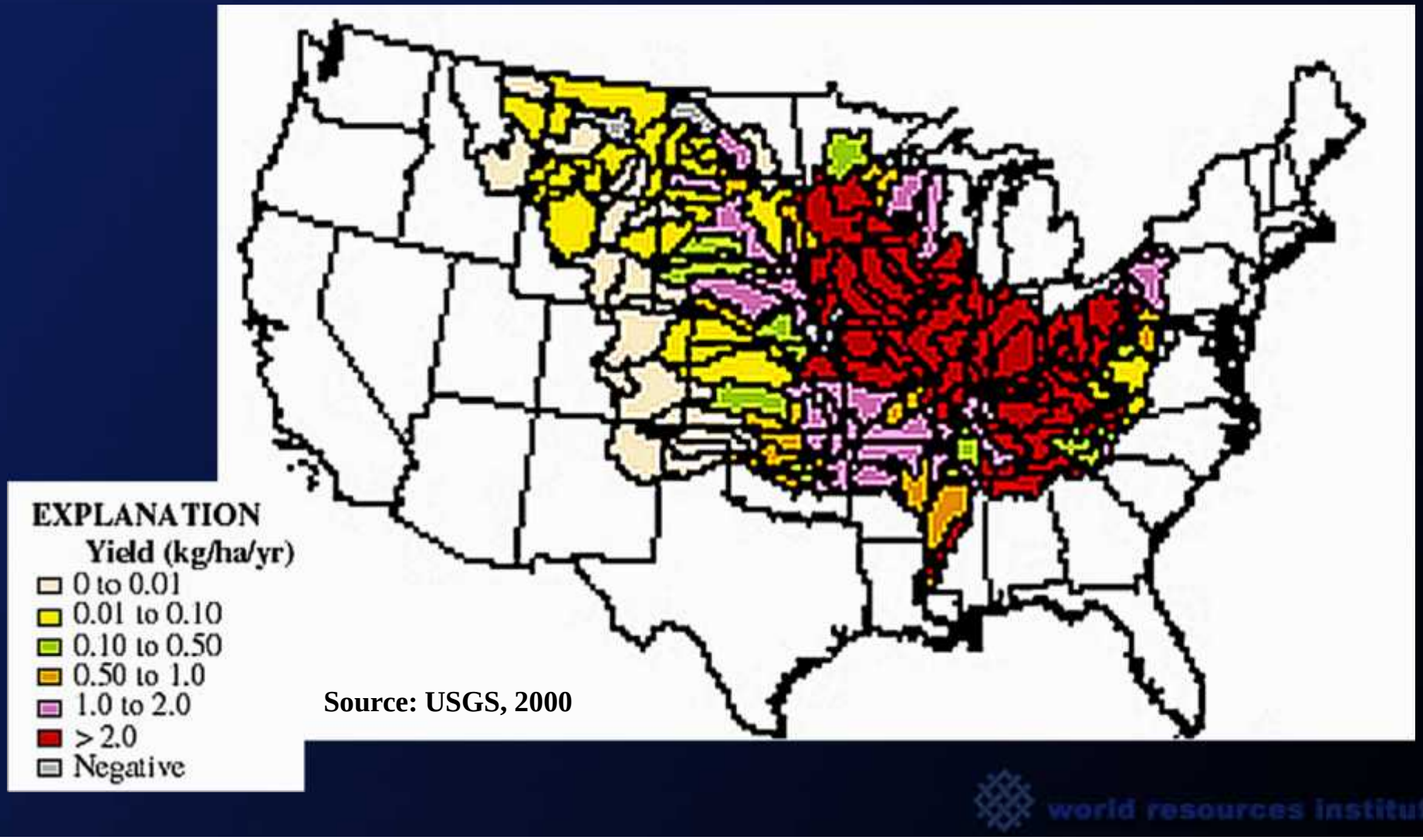
Point Source N



Source: USGS, 2000

Where does it come from ?

Agricultural N

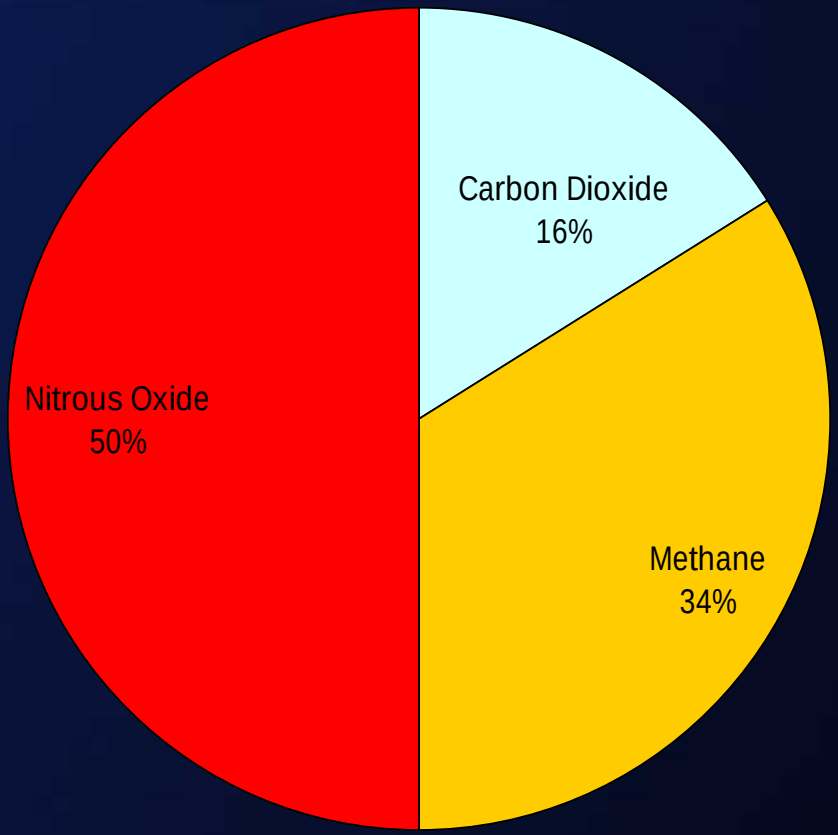


Source: USGS, 2000

U.S. Greenhouse Gas Emissions

	Total U.S. Emissions (MMTCE)	Ag Production Emissions (MMTCE)	Ag's Share of U.S. Total Emissions (%)
Carbon Dioxide	1,494	28	2
Methane	181	60	33
Nitrous Oxide	119	88	74
HFCs, PFCs, SF_6	40	~0	0
LULUCF	(211)	?	?
Total (Net)	1623	176	11

GHG emissions from U.S. Ag



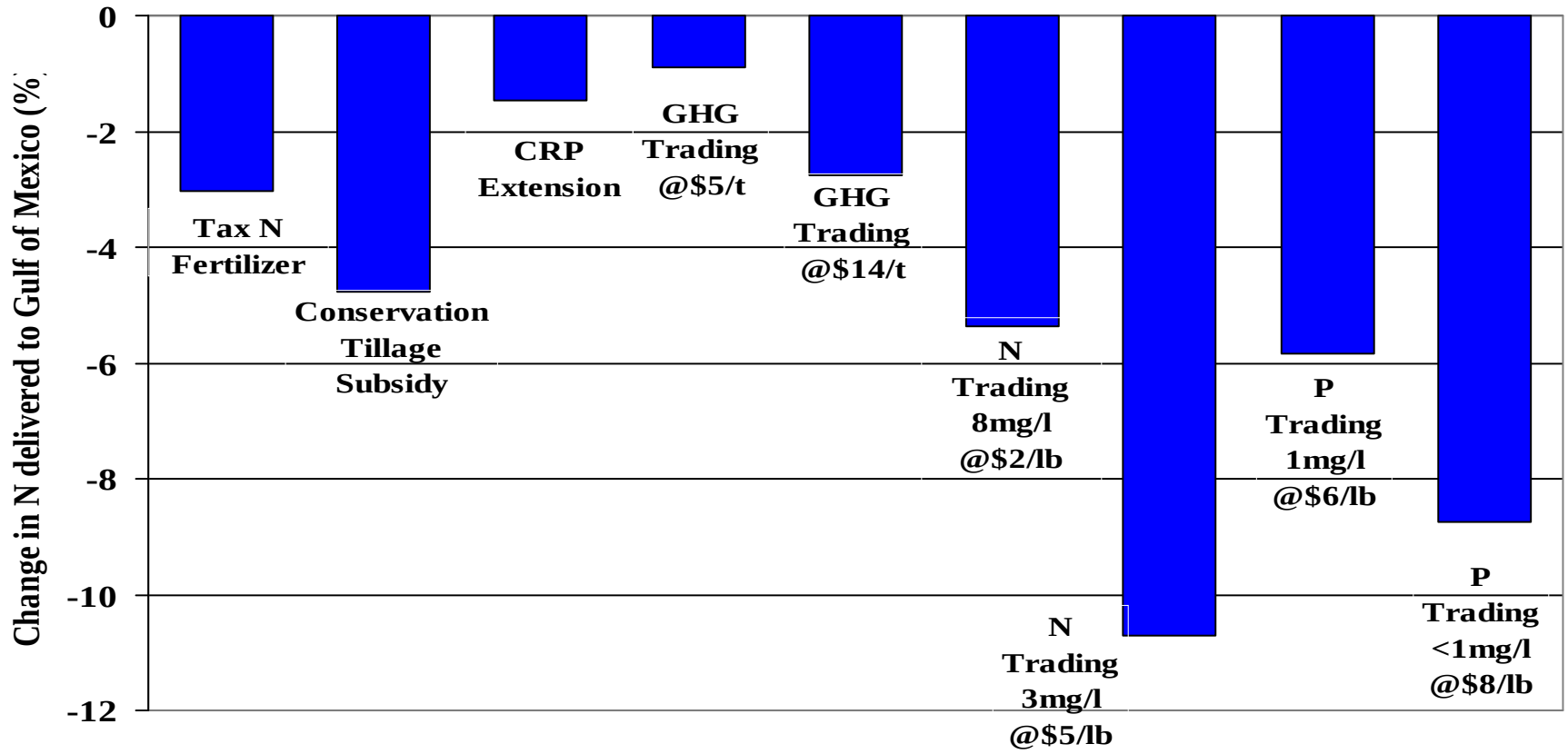
WRI Analysis -- Methodology

- USMP
  - Static model of US Agriculture
  - Comparison to Baseline- with/without policy
  - Predicts how changes in farm, trade, resource, environmental or input policy or how changes in commodity demand or technology will affect the ag sector.

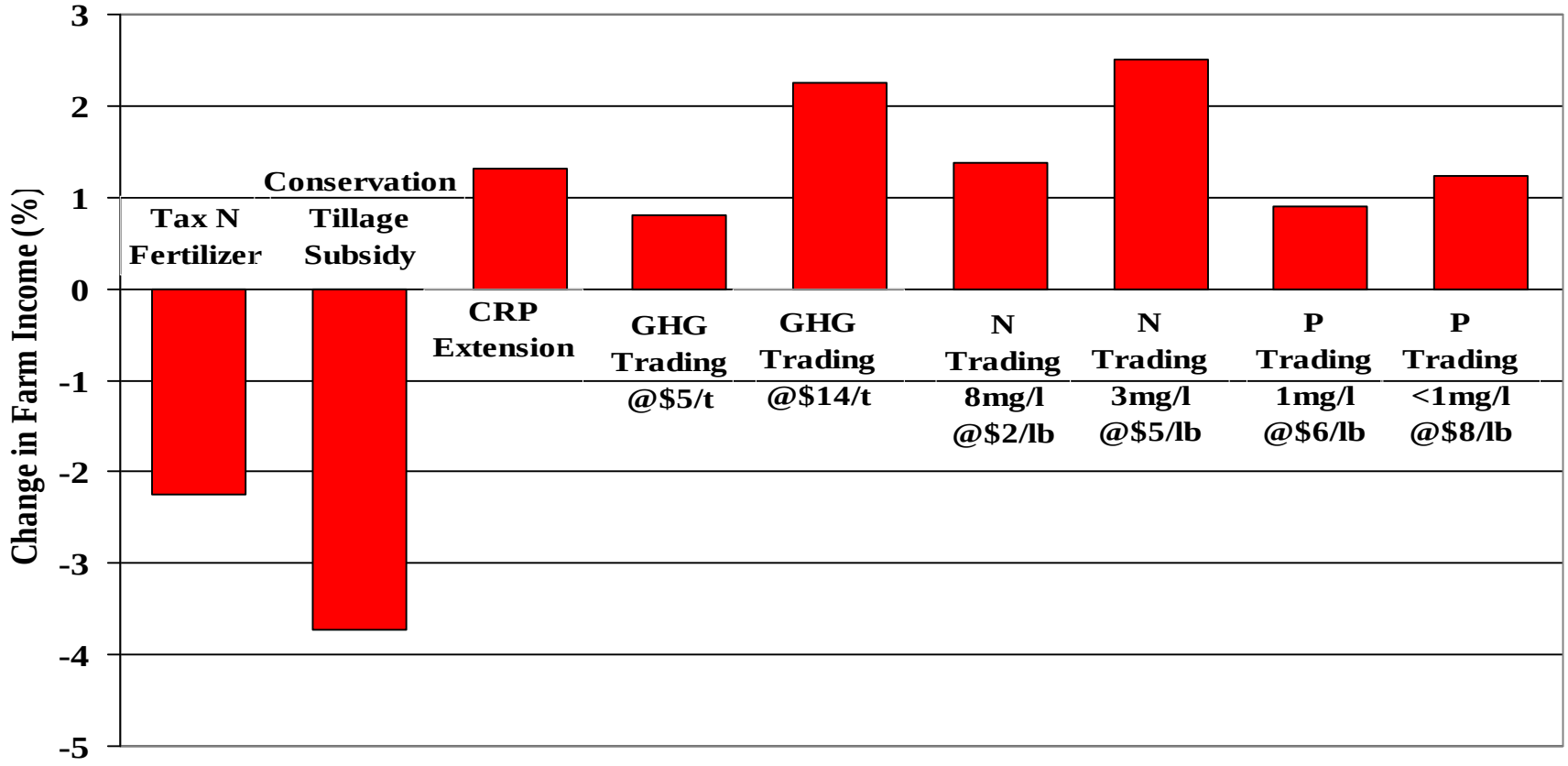
WRI analysis -- Policies Tested

- Conservation Tillage Subsidies
- CRP Extension
- Tax on N fertilizer (70%)
- Greenhouse Gas Trading (N_2O and C)
  - $5/t C and $14/t C
- Nutrient Trading (N)
  - WWTP discharge limit of 8 mg/l/day N
  - WWTP discharge limit of 3 mg/l/day N
- Nutrient Trading (P)
  - WWTP discharge limit of 1 mg/l/day P
  - WWTP discharge limit of less than 1 mg/l/day P

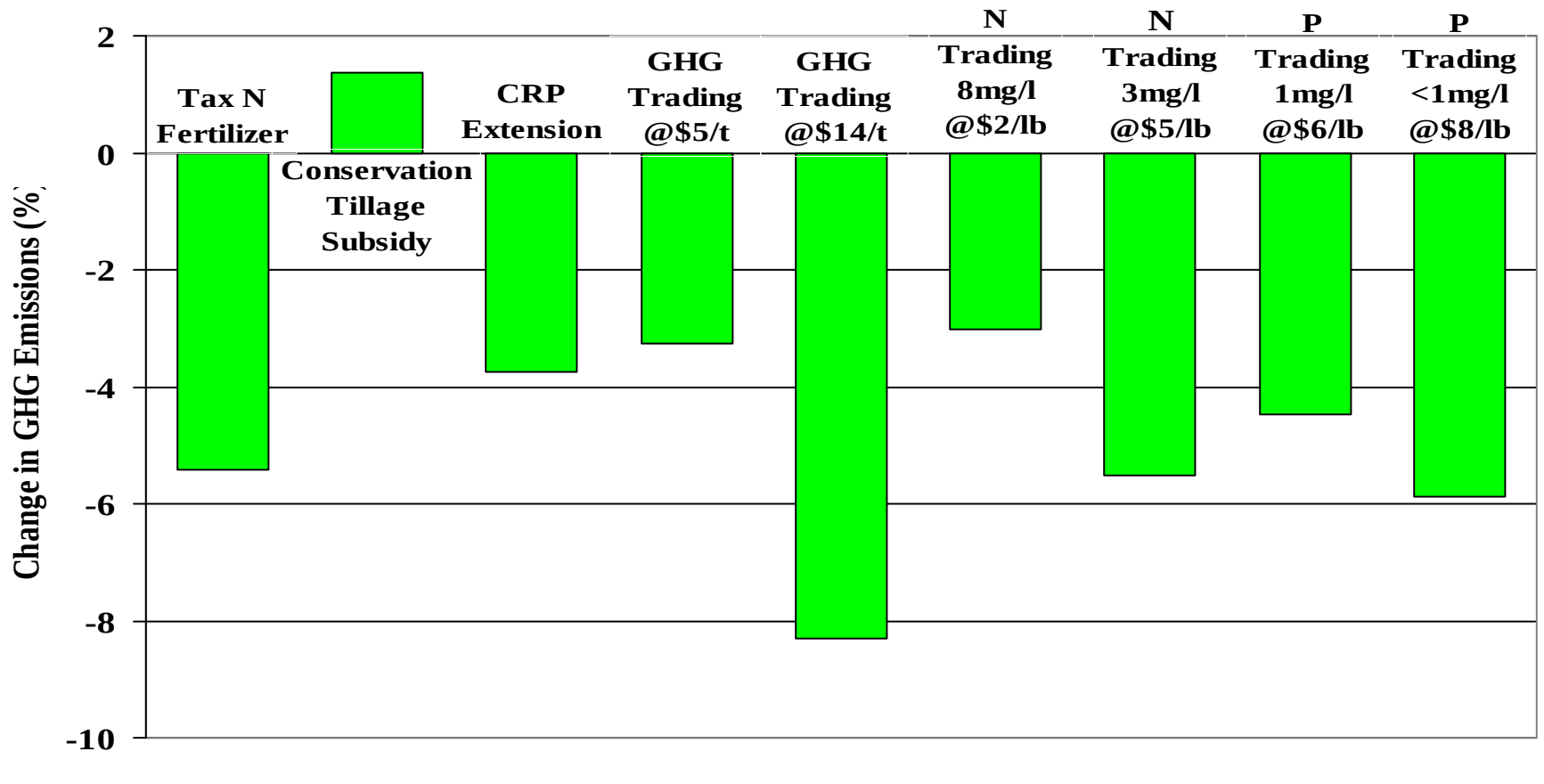
N delivered to Gulf of Mexico



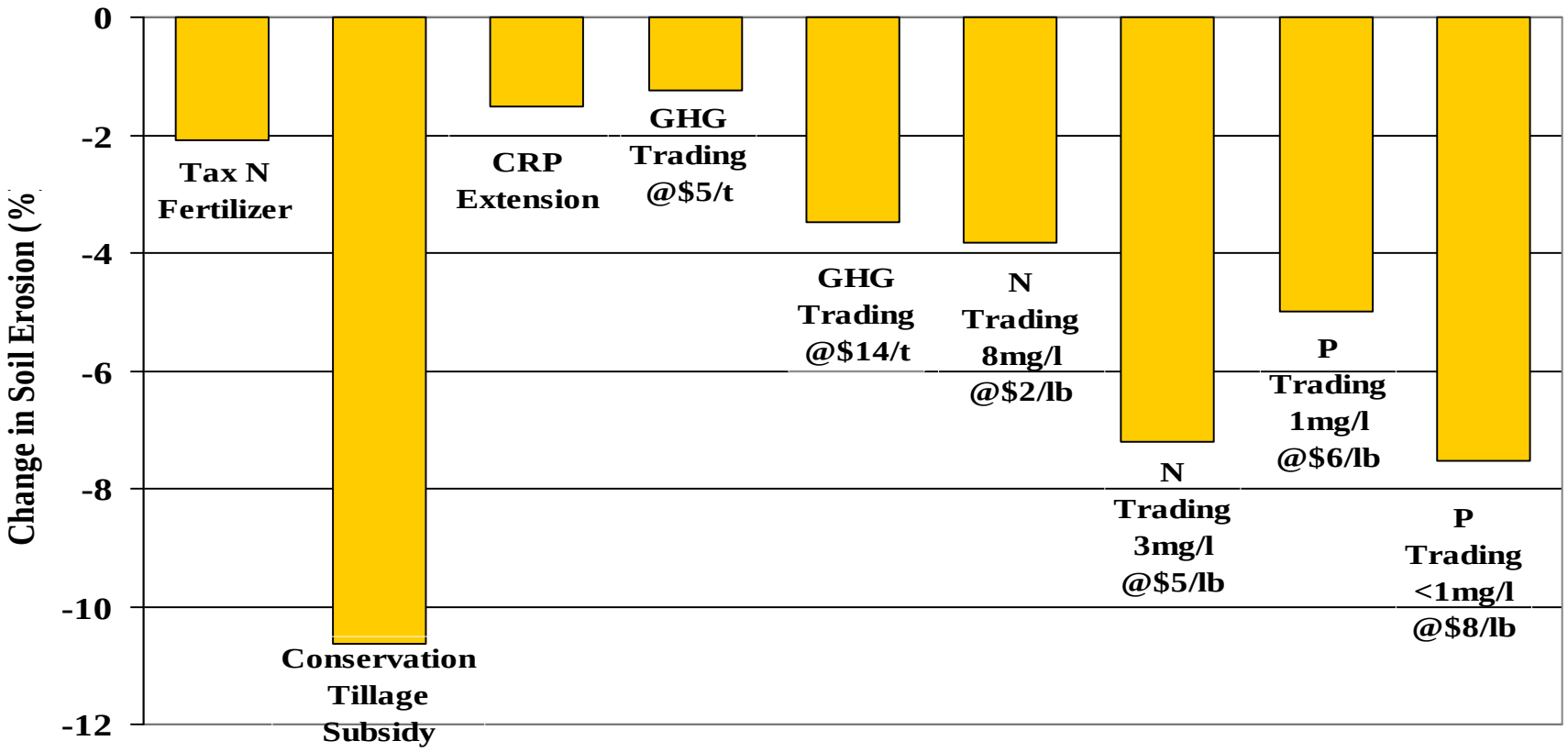
Total Farm Income



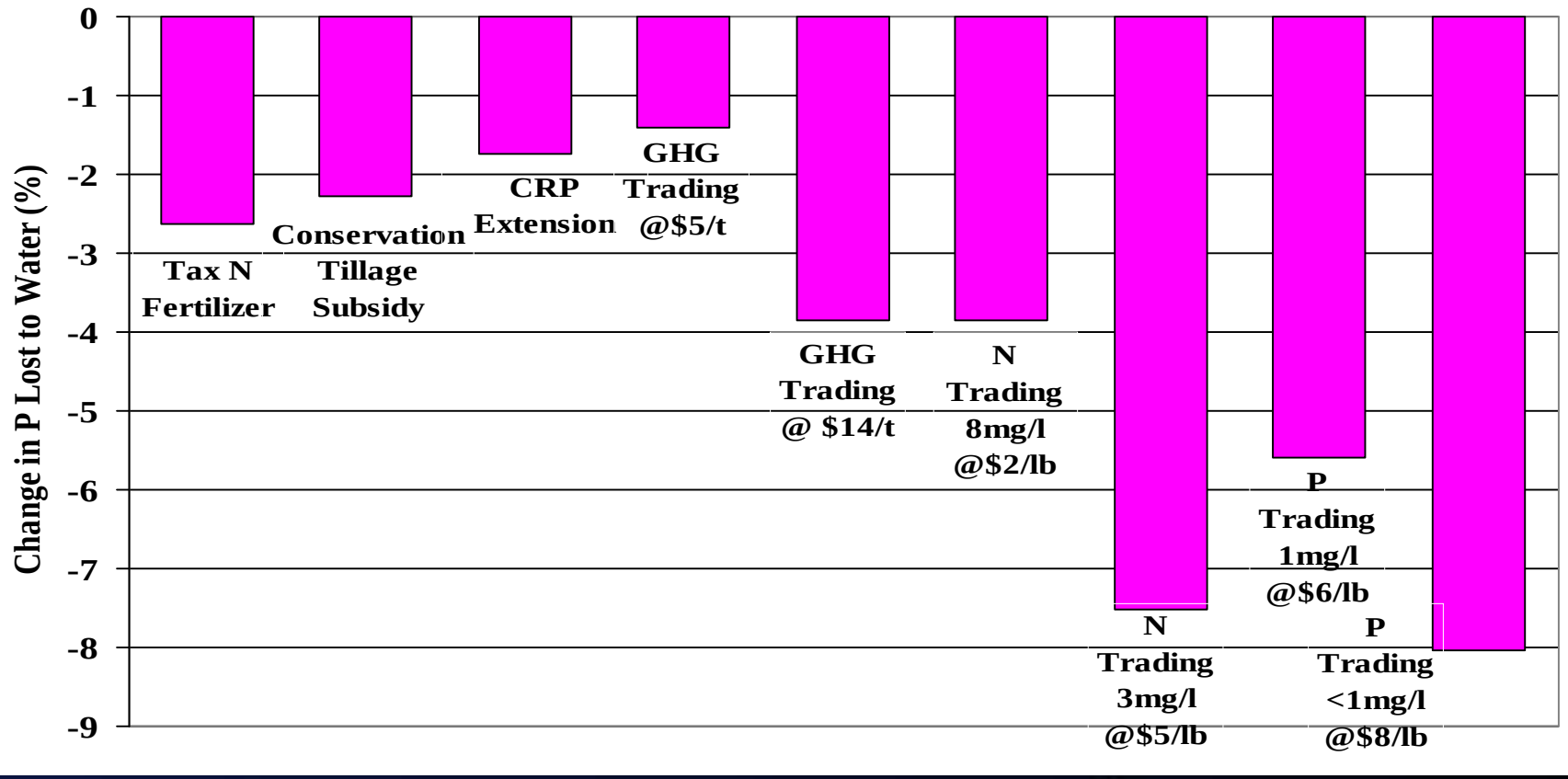
Greenhouse Gas Emissions



Soil Erosion



Phosphorus Lost to Water



Findings

- **Hypoxia**
  - Important to consider N attenuation as moves through the MS basin.
  - Nutrient trading offers the best reduction in N delivery- both N and P.
  - GHG trading has benefits at higher C prices.

Findings

- **GHG Emissions**
  - At high C price, GHG trading offers highest GHG mitigation rates.
  - At low C price, N and P trading offer the best opportunities for GHG reductions.

Findings

General

- Across the board subsidy have limited success.
- Targeting policy will be important.
- Significant synergies between water quality and climate change.
- Farm income does not have to be sacrificed for environmental improvement.
- **Nutrient trading appears to be the best all round performer.**