# Policy Approaches to Enable Multiple Pathways to Change

## Food Forum Virtual Workshop

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Editor, *Review of Environmental Economics and Policy and Proceedings of the National Academy of Sciences*

Website: https://dyson.cornell.edu/faculty-research/faculty/clk228/

# THEMES

- Incentives drive the Food System.
- Efficiency is the Friend of Sustainable and Resilient Systems
- Pollution, Lack of Information, and Market Power Reduce Efficiency and Require Policy to Correct

# Goal: Achieve a resilient food system in 2050 that provides access to safe and nutritious food with environmental and economic sustainability.

1. Nutritious diets
   - o Affordable
   - o Balanced (healthy) diet
2. Good farm profitability and working conditions
   - o Farm workers safety
   - o Growers, farmers, ranchers, workers, economic viability
3. Environmental Sustainability
   - o Greenhouse Gas emissions
   - o Water quality: nutrients, chemicals, soil erosion, etc.
   - o Air pollution and odors
   - o Wildlife habitat, biodiversity, etc.
4. Animal welfare
5. Food Safety and more…

# Incentives: Common Reasons Why Market Are Inefficient

Externality and Public Goods: unintended side effects costs on others, people receive the benefit whether they pay for it or not

Market Power: few sellers or buyers control the market

Information: knowing risks and benefits is necessary for good decisions

Private markets generally cannot solve the problem without policy intervention

# Policy Response to Fit the Incentive Problem

Externalities: GHG emissions, nutrients, air pollution, odor, wildlife habitat/biodiversity

Appropriate policy tools: taxes, regulation, cap-and-trade, public provision

Market Power: farm worker safety, economic security

Appropriate policy tools: regulation (anti-trust)

Information: safe and nutritious diets, animal welfare, worker safety

Appropriate policy tools: Education, public service info, regulation

Policies level the playing field for all producers and consumers – the costs and benefits are represented in the systemwide incentives

# Cause: Inadequate income

Markets and market incentives are agnostic about fairness and equity, solutions need to come elsewhere

1. Social safety nets
2. Poverty reduction programs
3. Education, training, etc.

| | Causes | Policy Options | Consumer/Producer Private Behavior |
|---|---|---|---|
| Non-nutritious diet | Lack of information | Labeling, certification, regulations | Self education, labeling, voluntary certification |
| | Unaffordable | Social Safety Net | Consumers respond to price incentives, producers and retailers provide choice for consumers |
| Worker safety | Lack of information<br>Market Power | Education and Regulations | Employers provide better working conditions |
| Farm sector profitability | Market power<br>Weather and risk | Anti trust<br>Social Safety Net | Insurance |
| Environmental Health: GHGs, Air pollution, Water quality, wildlife | Externalities and public goods | Taxes, Cap and Trade, Regulation, Gov't provision | Certification, labelling in some cases |
| Animal Welfare | Information<br>Public good | Regulation, certification | self education, labeling |


# Agriculture in the Mississippi River Watershed

# Mississippi River Watershed

The world's fourth largest river basin, covers

40% of the continental U.S in 32 states.

The region is home to 57% of U.S. farmland,

including 80% of its corn and soybean acreage.

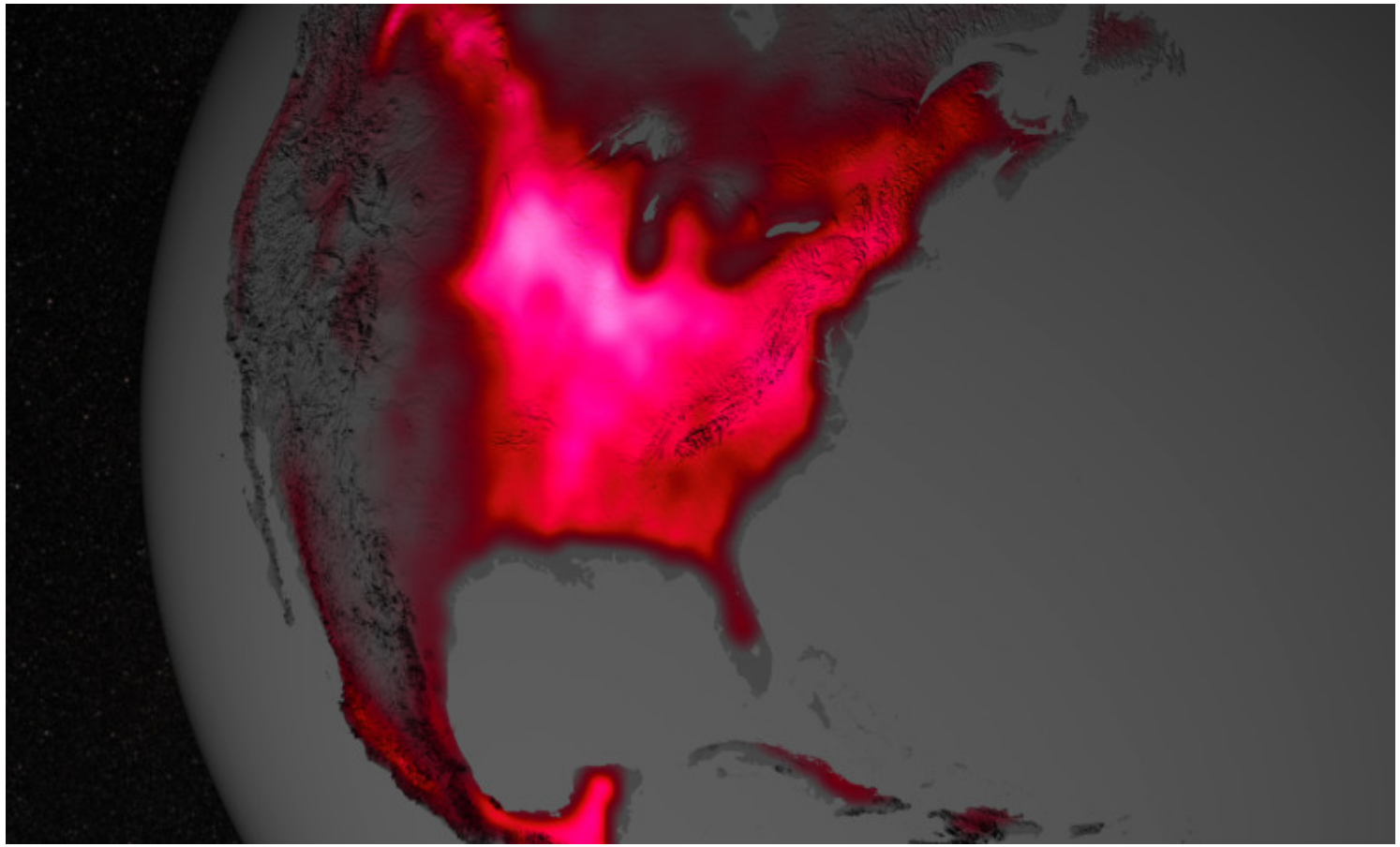
Home to over 350 animal species, and is traversed by over 60% of migratory birds

Has some of the worst nutrient (nitrogen and phosphorus) pollution in the country.

HABs occur in all Basin states with increasing frequency

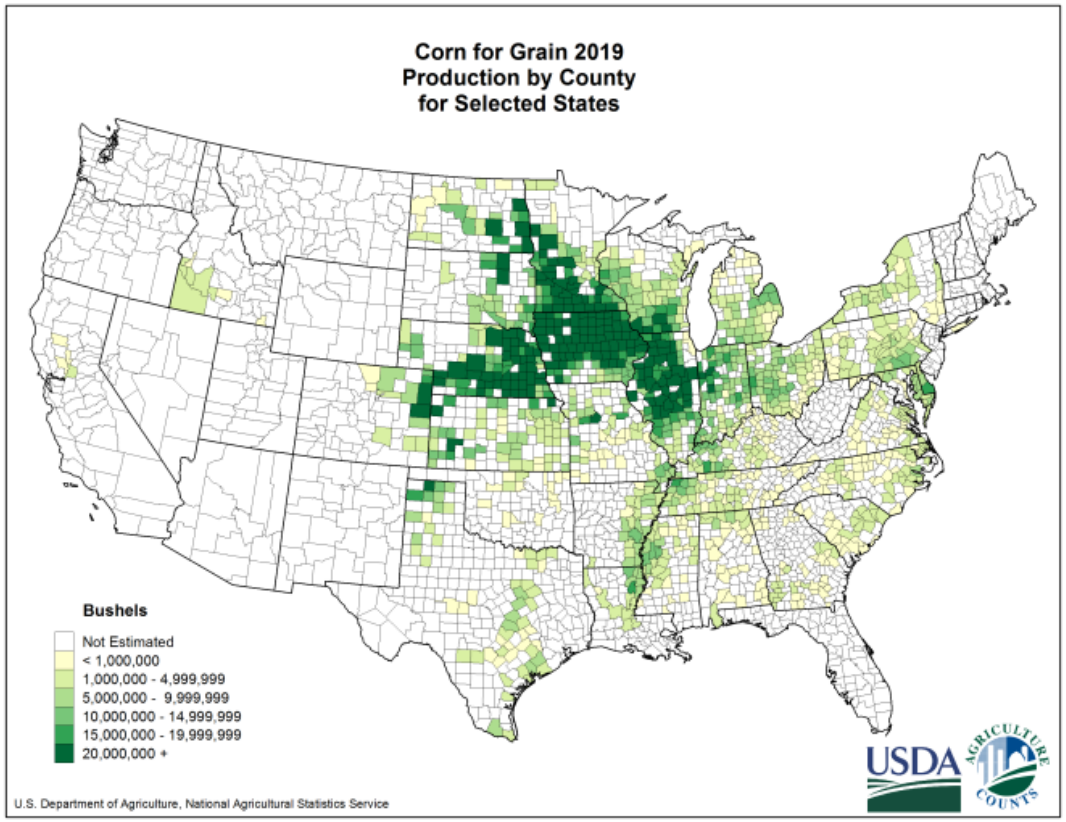
Large and growing annual dead zone at the outlet of the Basin in the Gulf of Mexico

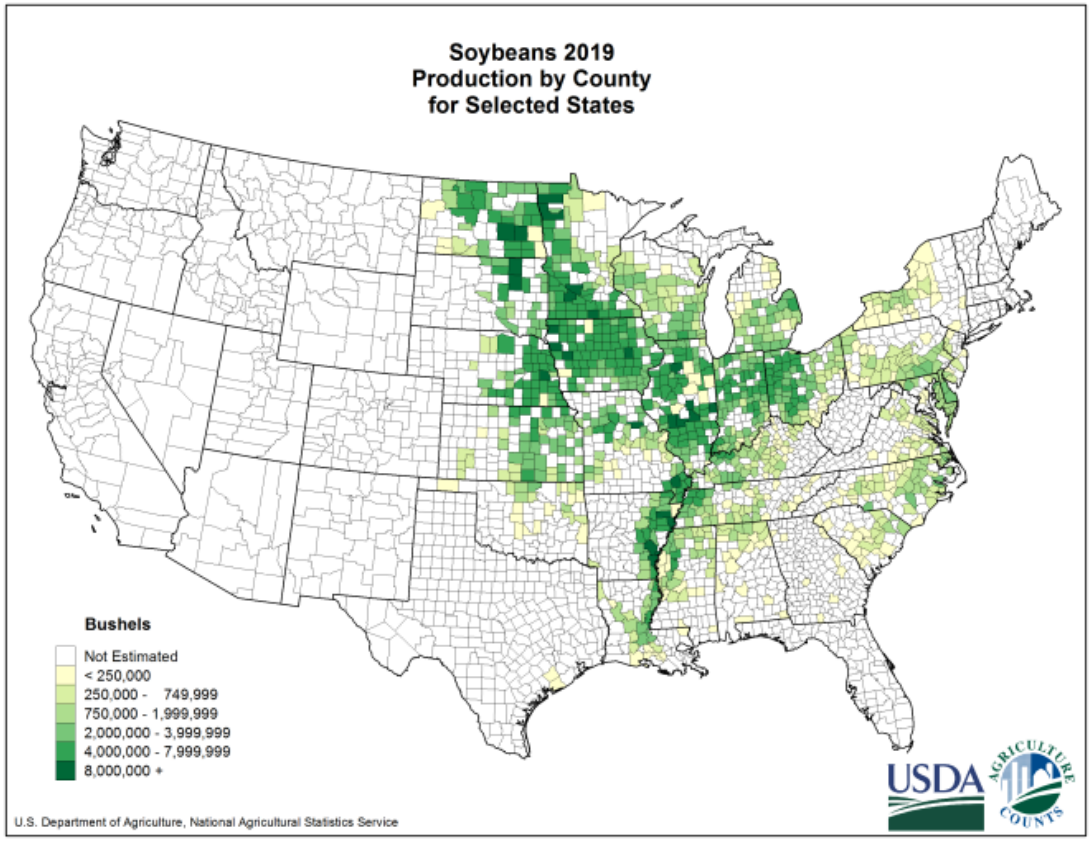
# During peak growth, this is one of the two most productive systems in the world



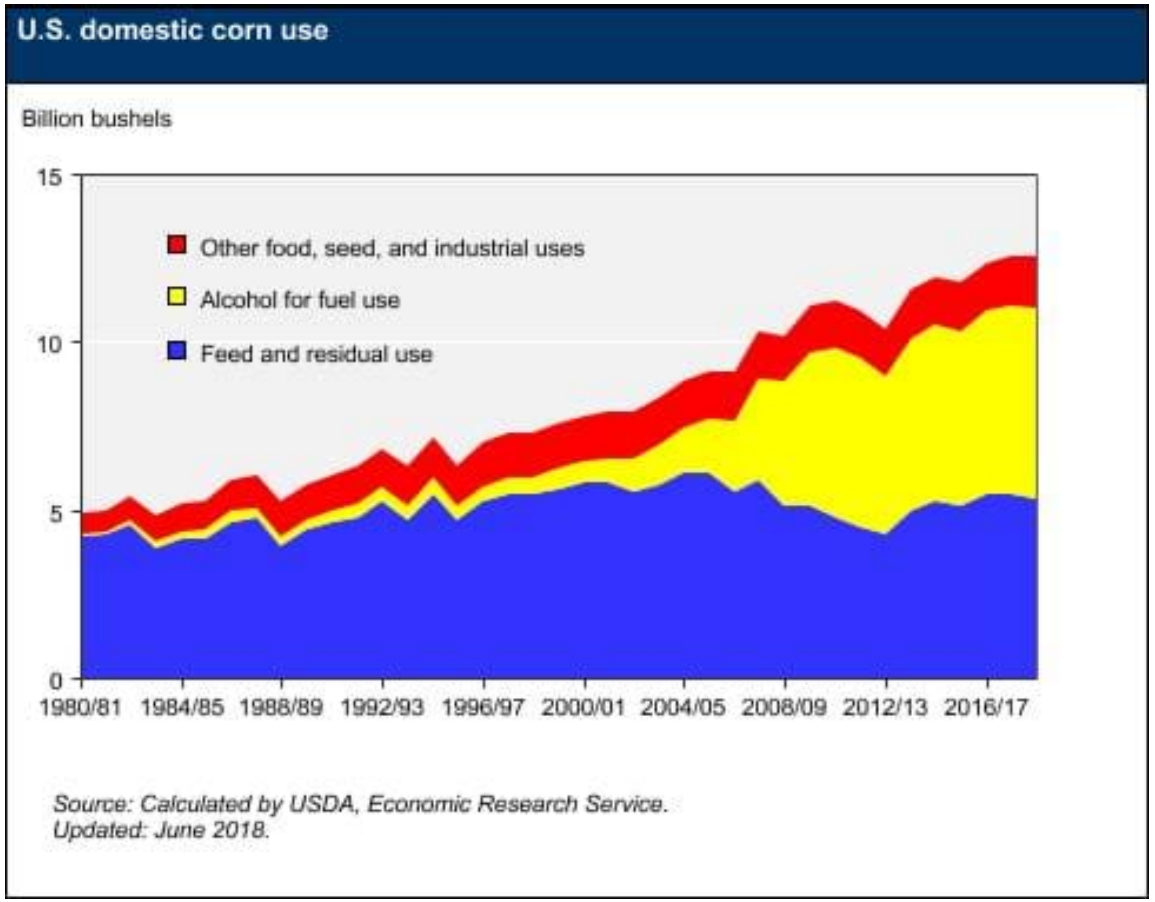
*The glow represents fluorescence measured from land plants in early July, over a period from 2007 to 2011. These data have been used to indicate the amount of photosynthesis, a proxy for agricultural productivity.* *Credit: NASA's Goddard Space Flight Center* http://www.jpl.nasa.gov/news/news.php?release=2014-097

# Mississippi River Watershed and Agricultural Production



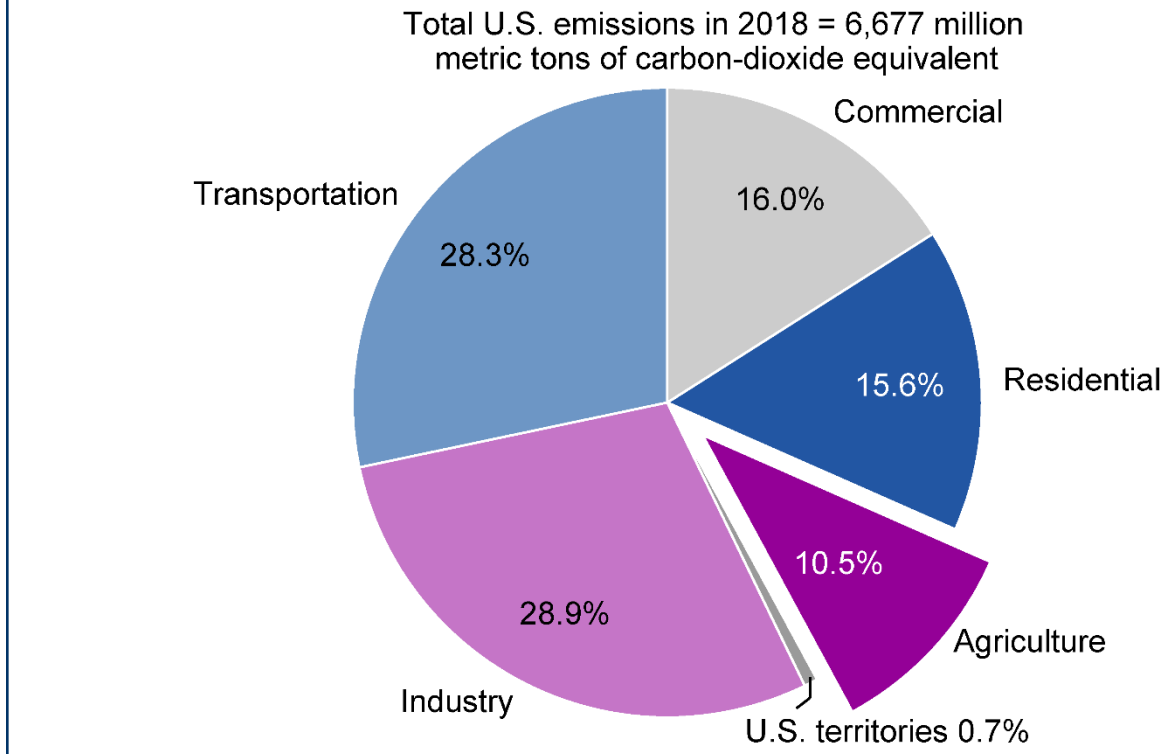

USDA 2020 prospective plantings:
97 million acres corn, 84 million acres soybeans, 45 million acres wheat


U.S. domestic corn use
Billion bushels
15
10
5
0
Other food, seed, and industrial uses
Alcohol for fuel use
Feed and residual use
1980/81
1984/85
1988/89
1992/93
1996/97
2000/01
2004/05
2008/09
2012/13
2016/17
Source: Calculated by USDA, Economic Research Service.
Updated: June 2018.

# Environmental Problems

# Agricultural Production: Carbon Footprint

**Estimated U.S. greenhouse gas emissions by economic sector, 2018**




Note: Carbon dioxide emissions associated with electricity consumption are allocated to each end-use sector.
Source: USDA, Economic Research Service using data from U.S. Environmental Protection Agency, April 2020: *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018*, Table ES-7.

Policy Response:

Carbon tax or cap-and-trade

# Water Quality: EPA National Aquatic Resource Surveys

**Rivers and Streams(2008-2009):**

46% of the region's streams in "poor" condition, 25% fair

Nutrient pollution is the largest single problem

Fish suffocated in the Lake Erie algae bloom of August 2011. — Photo By Tom Archer

**Lakes (2012):**

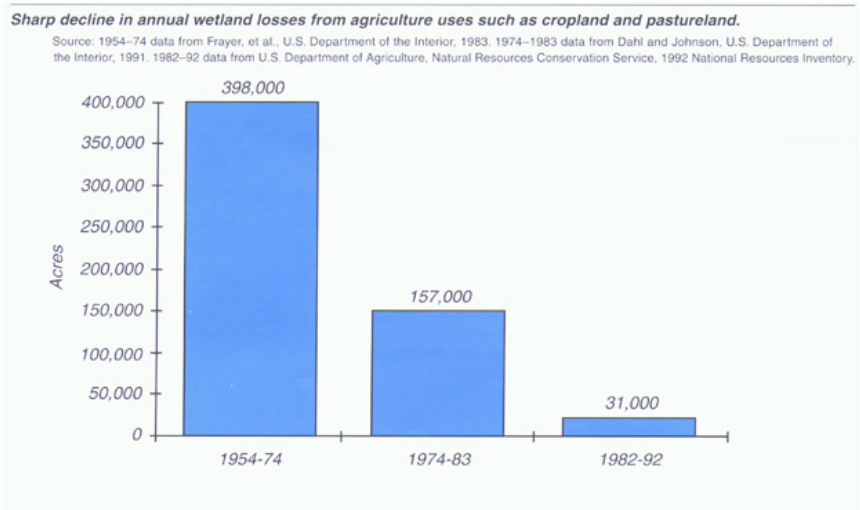
35% of lakes have excess nitrogen

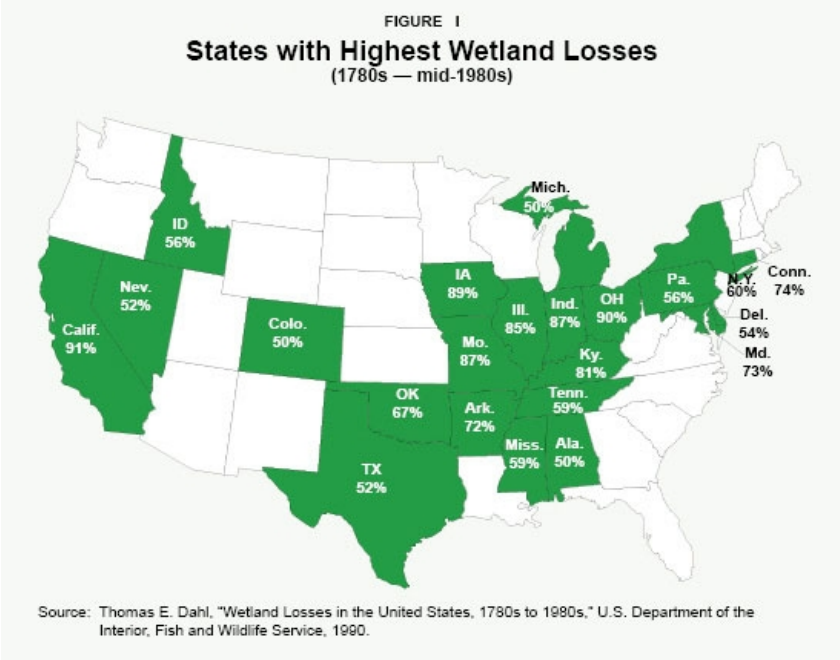
40% have excess phosphorus

https://phys.org/news/2018-01-phosphorus-pollution-dangerous-worldwide.html

# Wildlife Habitat, biodiversity


Historical North American tallgrass prairie range in dark green; estimated remaining range in red.
https://www3.beacon-center.org/blog/2016/04/09/can-evolution-help-us-rebuild-native-habitats/



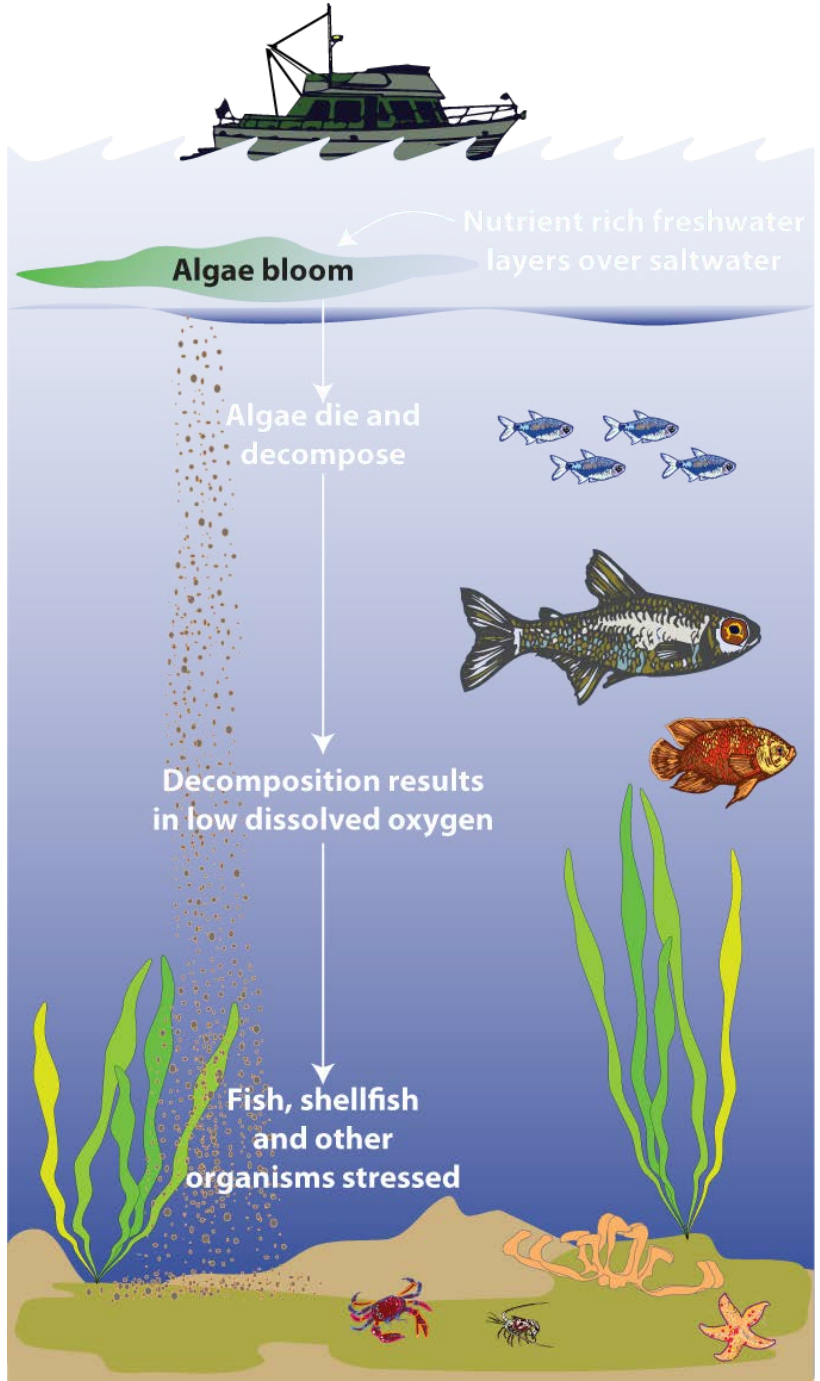
# Gulf of Mexico Hypoxic Zone

Annually recurring “dead” zone

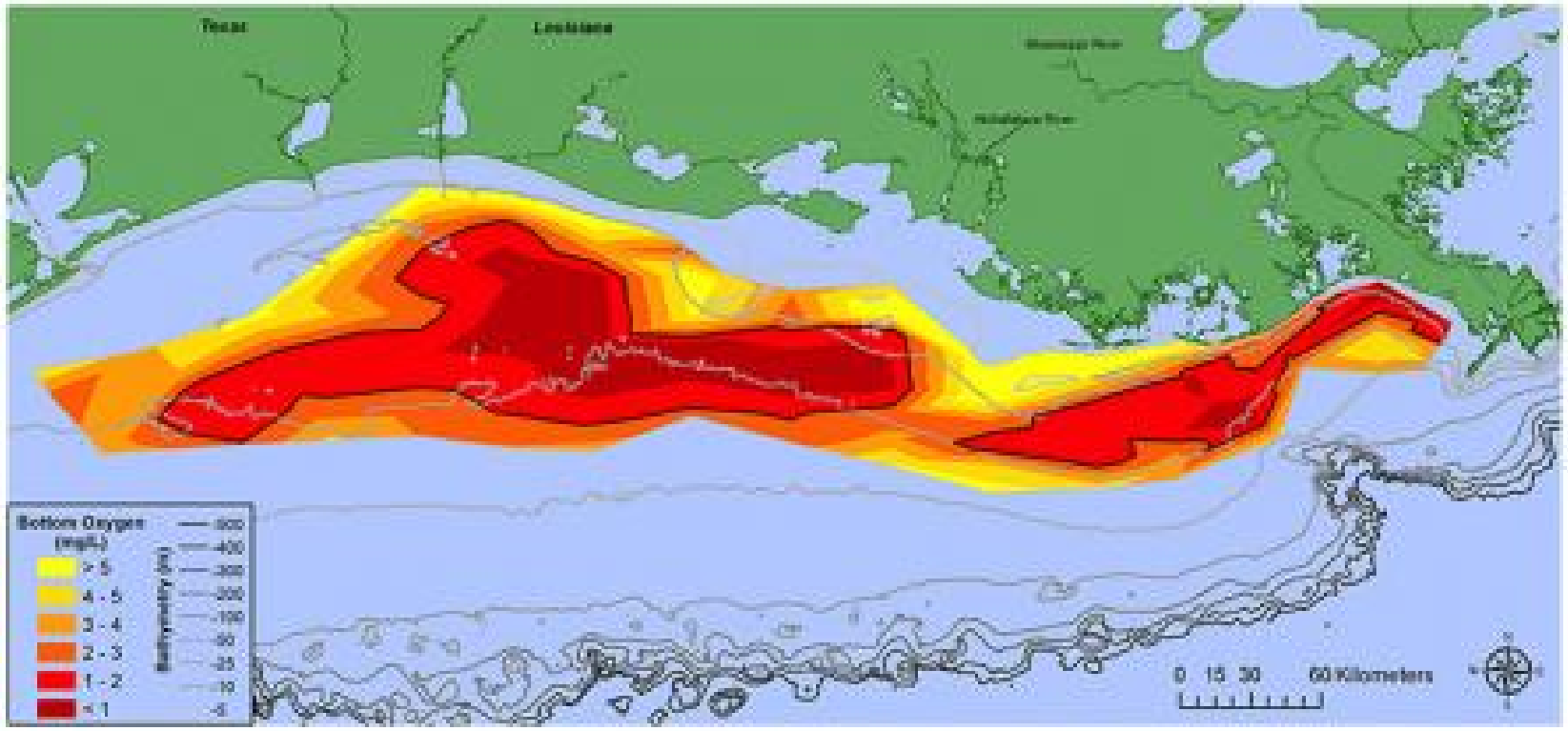
Recent average size = 5800 sq mi

Commercial/recreational fishing

*Image courtesy of Nancy Rabalais (Louisiana Universities Marine Consortium)*

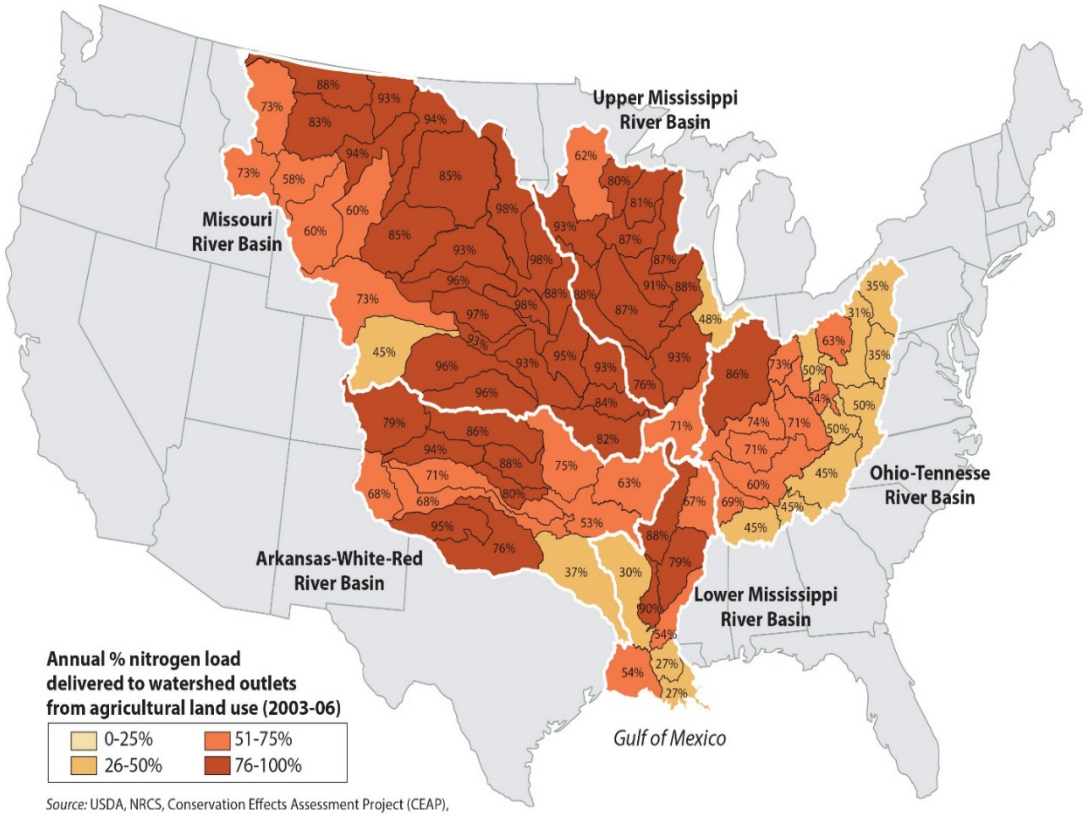


# Gulf of Mexico Hypoxic Zone 2019

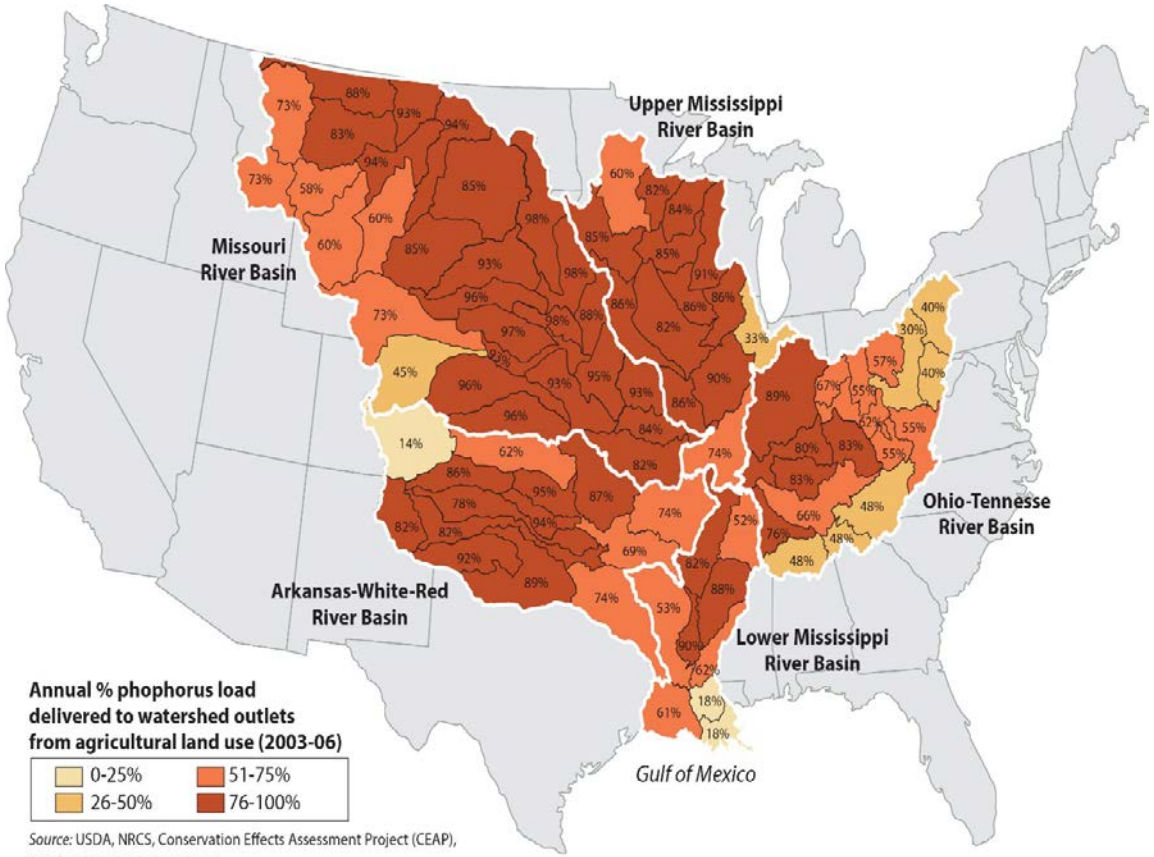



Distribution of bottom-water dissolved oxygen, July 22-July 31, 2019. Black line denotes 2 mg/L. Data source: N.N. Rabalais, Louisiana State University & Louisiana Universities Marine Consortium; R.E. Turner, Louisiana State University. Funding source: NOAA

# Agricultures Contribution to the Dead Zone




*Source:* USDA, NRCS, Conservation Effects Assessment Project (CEAP), Cropland National Assessment




*Source:* USDA, NRCS, Conservation Effects Assessment Project (CEAP), Cropland National Assessment

# What magnitude of change is needed to address Gulf Hypoxia?

1. Iowa Nutrient Reduction Strategy estimates need to
   - reduce and optimize fertilizer use AND
   - change how farming is done : cover crops, perennials, wetlands, drain management, bioreactors, flood zone restoration, etc

2. Must be done on 90% +of agricultural land,
   cost of about $800 million/year in Iowa

3. Other estimates in the same ball park, total for entire Basin
   $3-5 billion/year

# What policies could be undertaken to achieve this?

## Iowa Nutrient Reduction Strategy Needs

- To reduce and optimize fertilizer use
  - Tax commercial fertilizer
- To change how farming is done
  - Regulations require changes in how farming is done
  - Cover crop, erosion control, wetlands, bioreactors, etc
- Public funding to augment, wetlands, flood plain, prairie restoration

## Prices will rise, incentives will be properly aligned

# Price increases to Food System

## Cost for address 200 - 300 million acres cropland

- $3 billion/year to achieve 40% reduction
- $10-15 /acre

## Context

- Corn and soybean crops sell for about $100 billion/year
- Federal crop insurance subsidies $20 billion/year
- Trump taxpayer funded payouts of $57 billion for trade war

# Regulation Example: Everglades Agricultural Regulatory Progam

- Goal 25% Phosphorus reduction
- Mandatory changes in practices on all farms began in 1995
- Implemented via points
  - o flexibility in options to change practices
  - o Points system used based on expert judgment
  - o Implementation and water quality monitoring required and enforced
- Huge success, within the first 3 years the program achieved a 55% P load reduction

Wikipedia

# What role can/should policy play? Some overarching themes

1. Multiple goals means multiple policy responses, some may be partially at odds with each other

2. Policies should address the core problem as directly as possible, if C is the problem, tax Carbon not meat or food miles

3. Policies level the playing field for all – the costs and benefits are represented in the systemwide incentives

4. Pollution, Lack of Information, and Market Power Reduce Efficiency and Require Policy to Correct

# Thank you

# Questions and Comments Welcome

Support from the Cornell Atkinson Center for Sustainability, Iowa State Center for Agricultural and Rural Development, US Environmental Protection Agency, USDA NIFA program,  the National Science Foundation, and

Cornell Atkinson Center for Sustainability

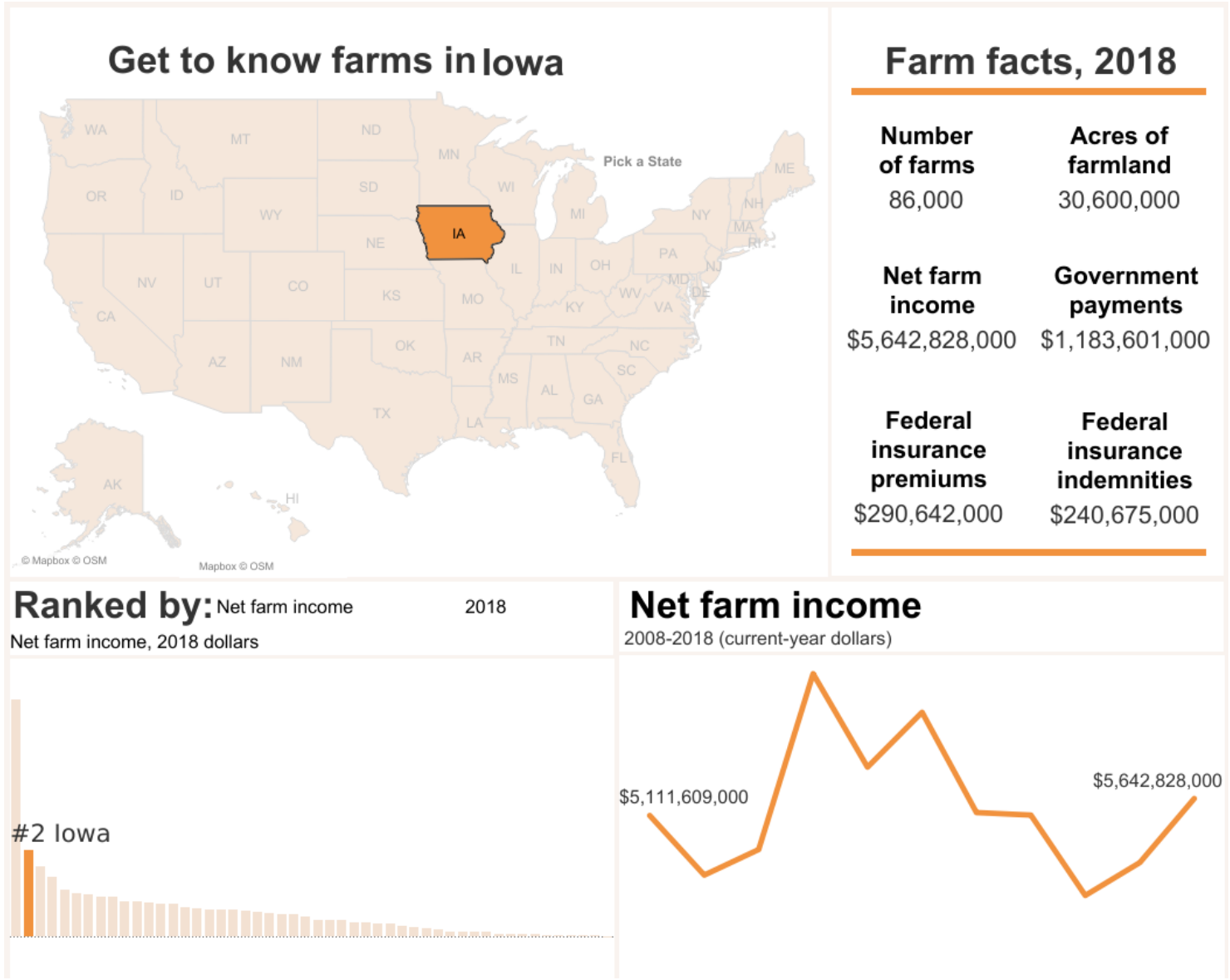
atkinson.cornell.edu

# Some Literature

Kurt Waldman and John Kerr. “Limitations of Certification and Supply Chain Standards for Environmental protection in Commodity Crop Production” *Annual Review of Resource Economics*, 2014

Samira H. Daroub, Stuart Van Horn, Timothy A. Lang & Orlando A. Diaz (2011): Best Management Practices and Long-Term Water Quality Trends in the Everglades Agricultural Area, Critical Reviews in Environmental Science and Technology, 41:S1, 608-632

Gordon Rausser, Steven Sexton, and David Zilberman. “The Economics of the Naturalist Food Paradigm,” *Annual Review of Resource Economics*, 2019




https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics/charts-and-maps-about-your-state/

# Groundwater nitrate levels, USGS data

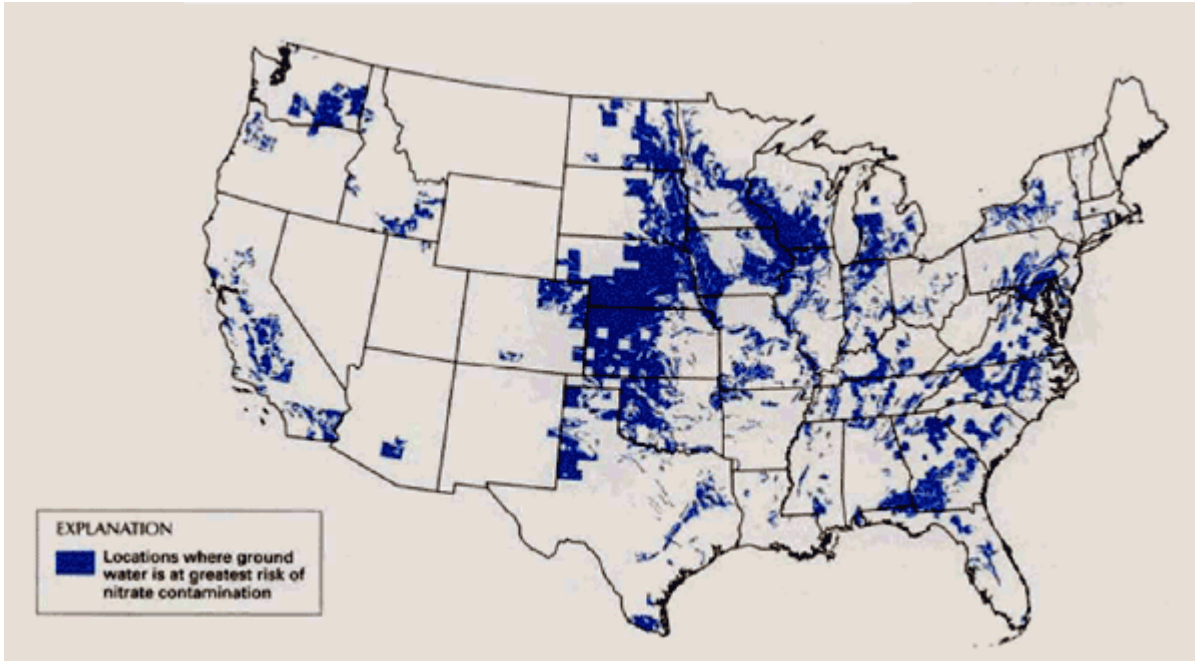
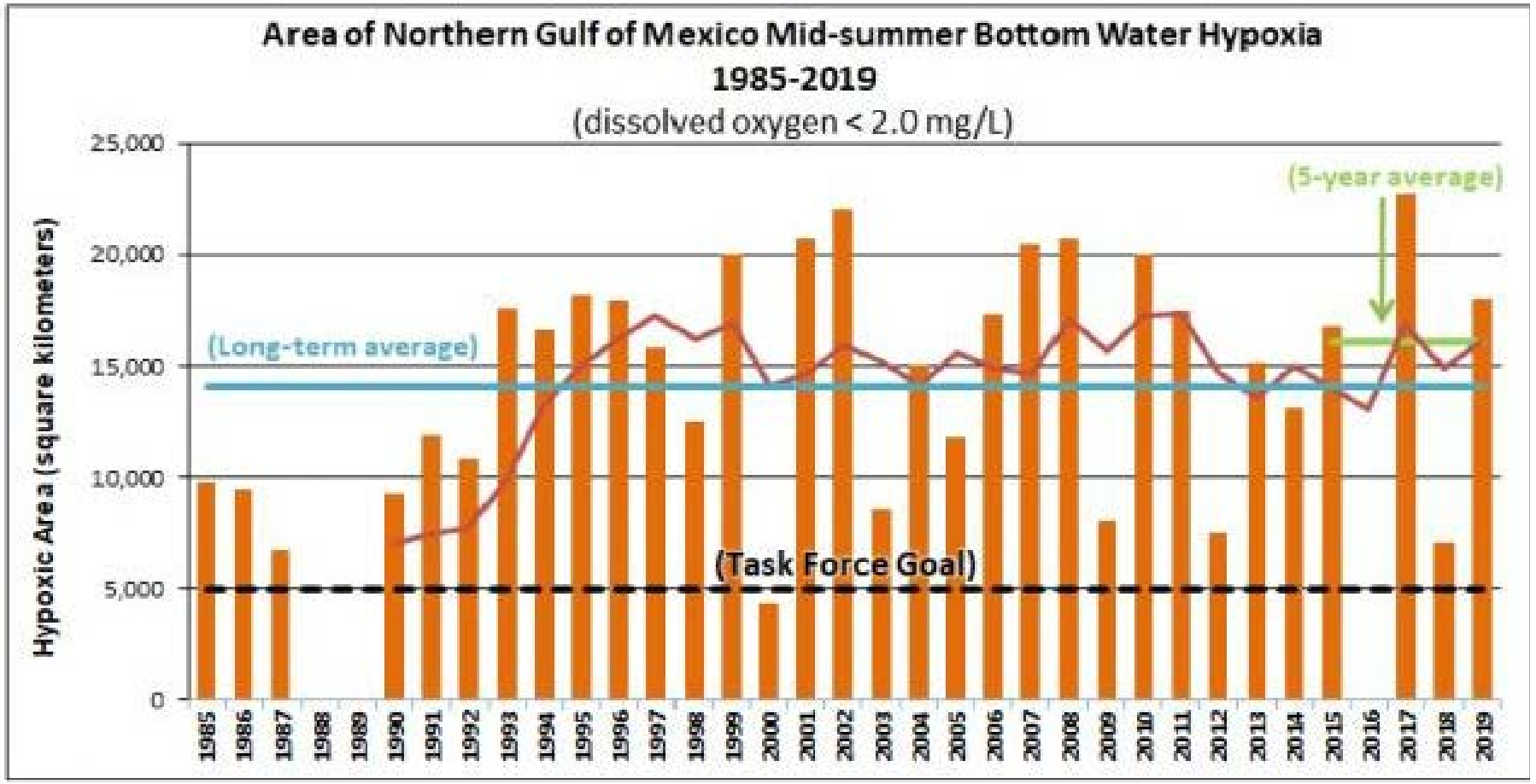



**Figure 2. Ground water nitrate levels are likely to be highest where (1) the water table is less tan 100 feet (2) soils are well–drained (3) nitrogen inputs (like fertilizer or manure) are high, (4) the population density is high, and (5) the ratio of woodland to cropland is low (d).** https://pubs.usgs.gov/fs/fs218-96/

# Trends: Gulf Hypoxia




https://www.epa.gov/ms-htf/northern-gulf-mexico-hypoxic-zone

# Results of Program: Phosphorus Loads

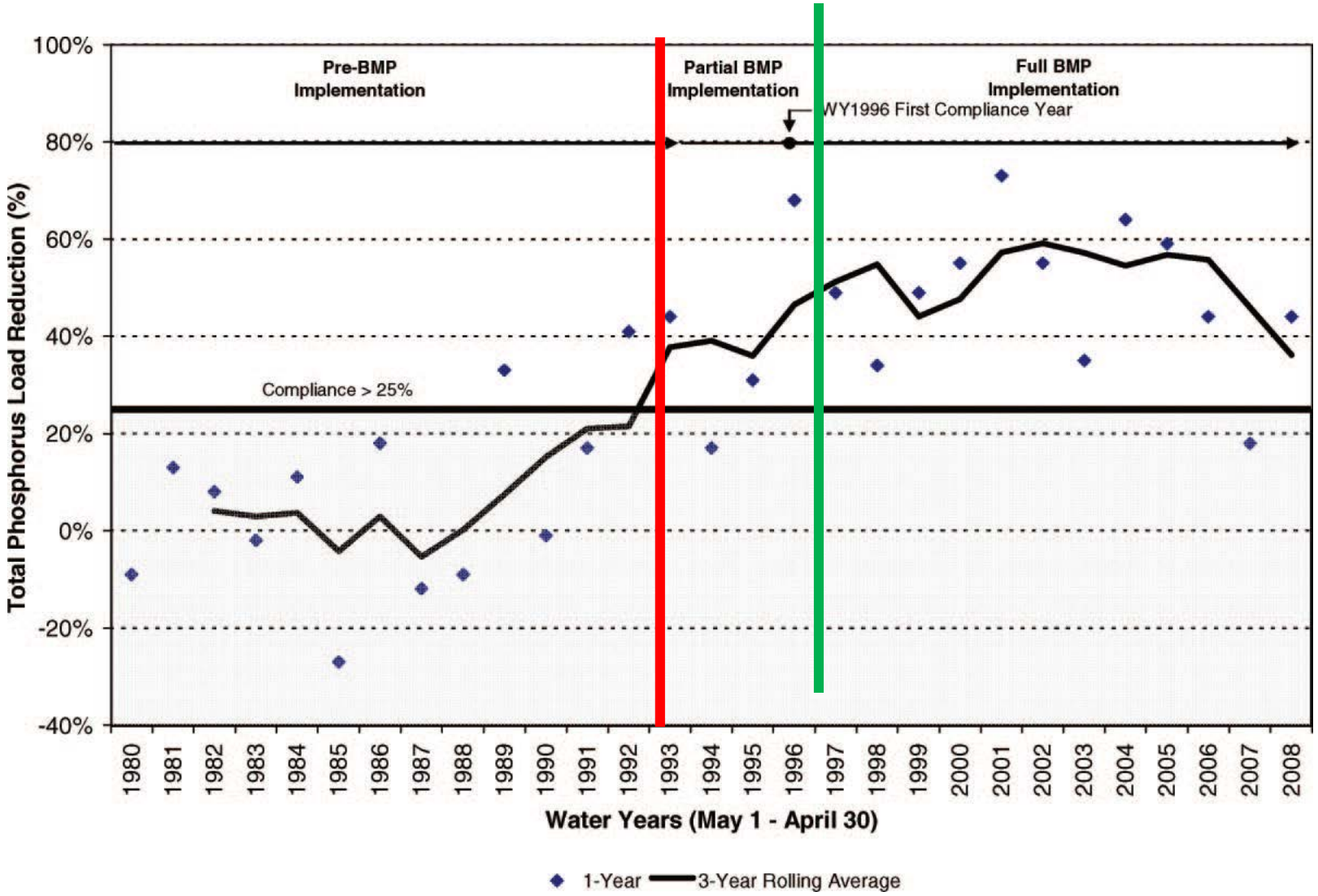



**FIGURE 3.** Annual basin-level total phosphorus load percentage reduction from the Everglades Agricultural Area (WY1980–2008).
Samira H. Daroub, Stuart Van Horn, Timothy A. Lang & Orlando A. Diaz (2011): Best Management Practices and Long-Term Water Quality Trends in the Everglades Agricultural Area, Critical Reviews in Environmental Science and Technology, 41:S1, 608-632

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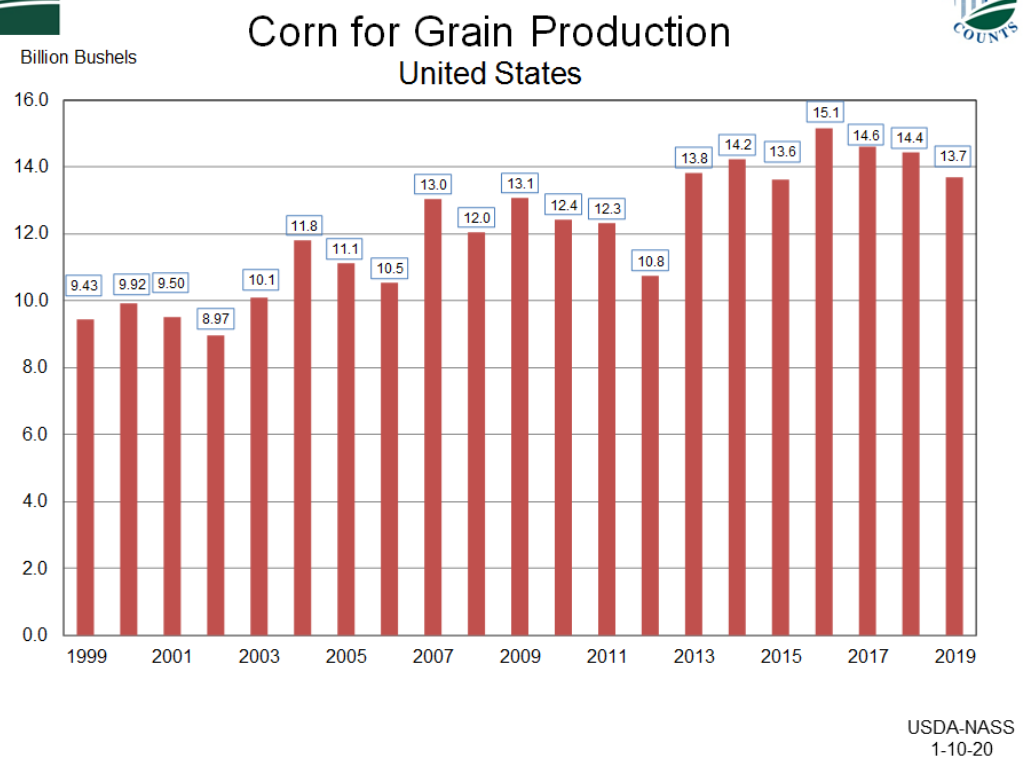
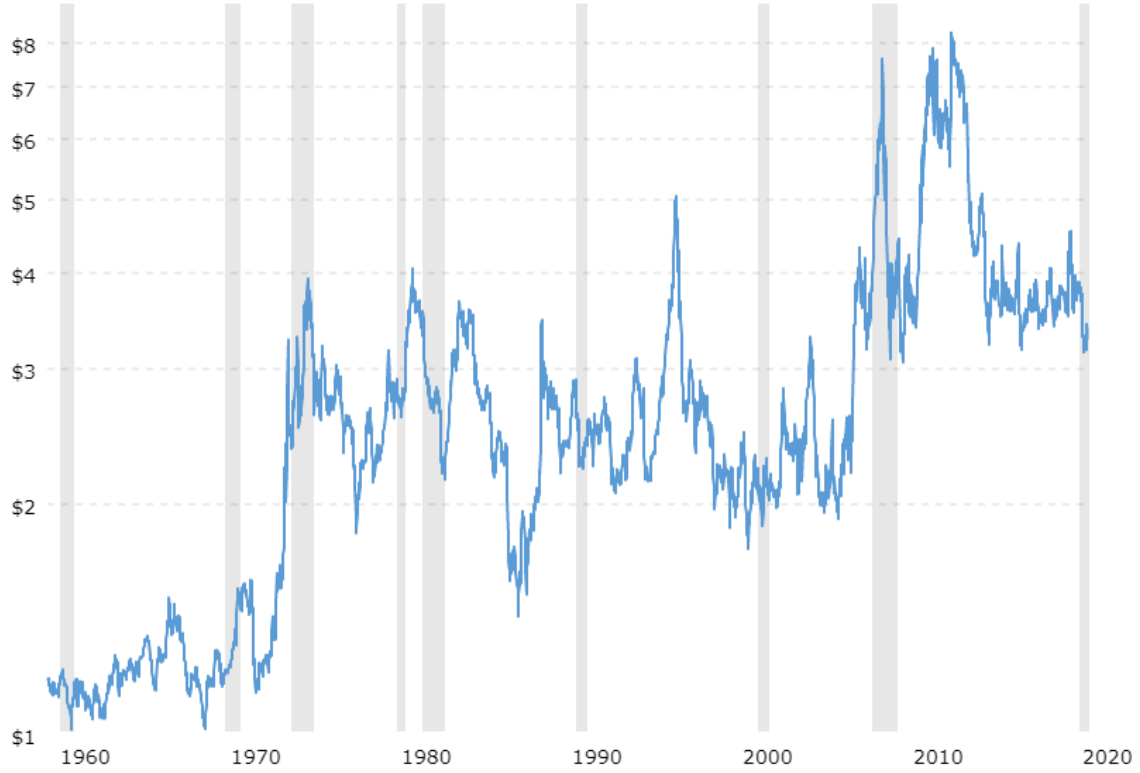


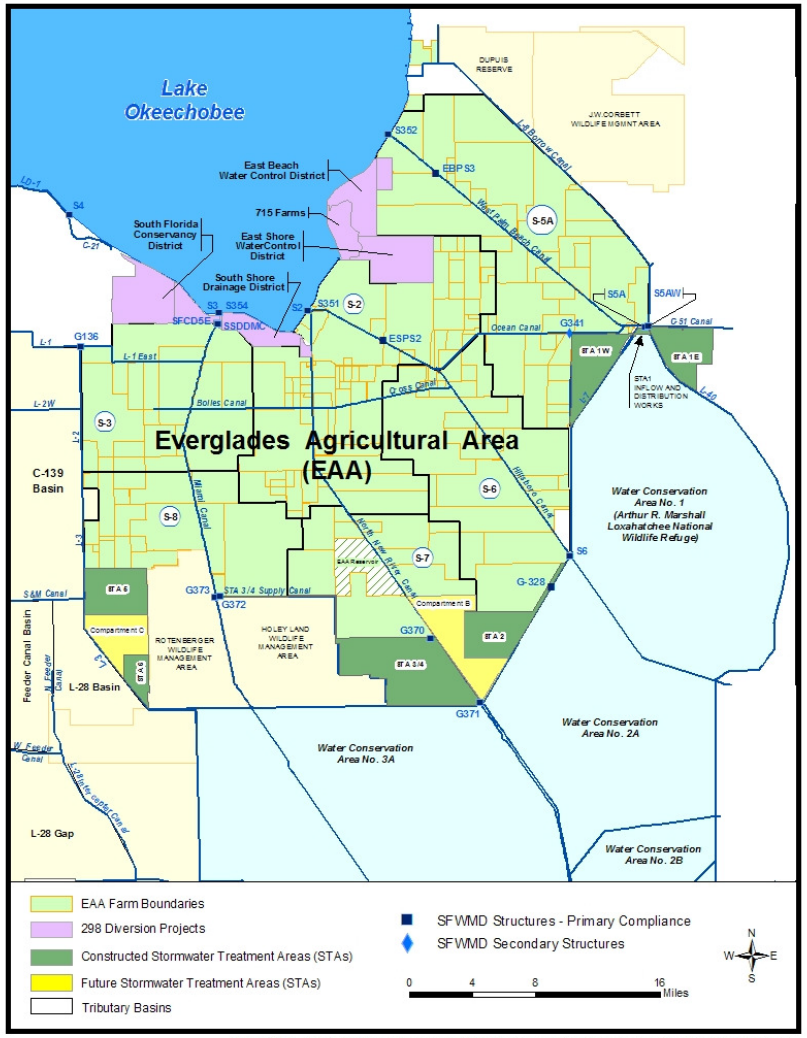

## Corn Prices - 59 Year Historical Chart

Interactive chart of historical daily corn prices back to 1959. The price shown is in U.S. Dollars per bushel. The current price of corn as of July 20, 2020 is **$3.2825** per bushel.




https://www.macrotrends.net/2532/corn-prices-historical-chart-data

# EAA Regulatory Program




- 700,000 acres
- Mainly sugarcane, some sod, vegetables and rice
- First 3 years: 55% P load reduction (SFWMD, 1998)

# Cau

| | Market Failures<br>Policy Solutions Often Needed | | | | Social Justice/ Fairness<br>Markets are indifferent<br>Policy may be needed | Market Successes<br>Consumer and Producer Behaviors<br>Policy may not be needed |
|---|---|---|---|---|---|---|
| | Information/ Education | Externalities | Public Goods | Market Power | | |
| **Nutritious Diets** | | | | | | |
| • Health choices | Government provision | | | Anti-trust | | Consumers self education, purchasing decisions, producers packaging to sell their products, voluntary certification |
| • Affordability | | | | | Social Safety Net/Income support | Consumers respond to price incentives |
| **Farmer wellbeing** | | | | | | |
| • Worker safety | Government provision | | | Regulations | | |
| • Economic profitability | | | | | | Social Safety Net/Income support |
| **Environmental Health** | | | | | | |
| • GHGs<br>• Air pollution<br>• Odors<br>• Water quality | | Taxes, Cap and Trade, Direct Regulation | | | | |
| • Wildlife/biodiversity | | | Government , NGO provision | | | |
| **Animal Welfare** | Certification | | Regulation | | | Consumers self education, purchasing decisions, |

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