



Reducing the Health Impacts of the Nitrogen Problem

A Virtual Workshop from the
Environmental Health Matters Initiative

New sessions every Thursday
from 2:30–5:30 PM (ET)
from January 28 – February 25, 2021



The Geographical Scale of the Nitrogen Challenge in the United States

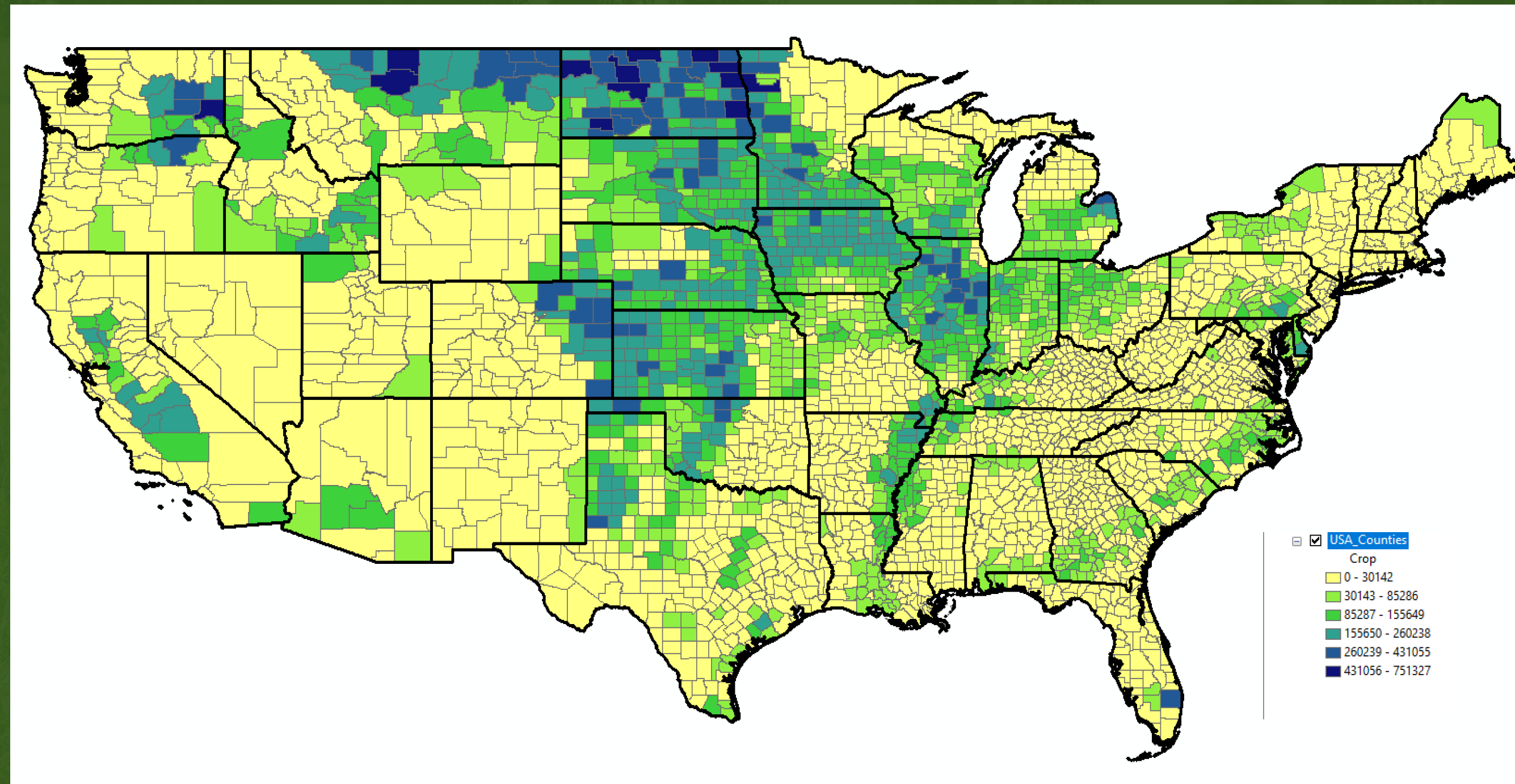
Dr. Matt Helmers

Director of the Iowa Nutrient Research Center

Dean's Professor in the College of Agriculture and Life Sciences

Professor Dept of Ag. And Bios. Eng., Iowa State University

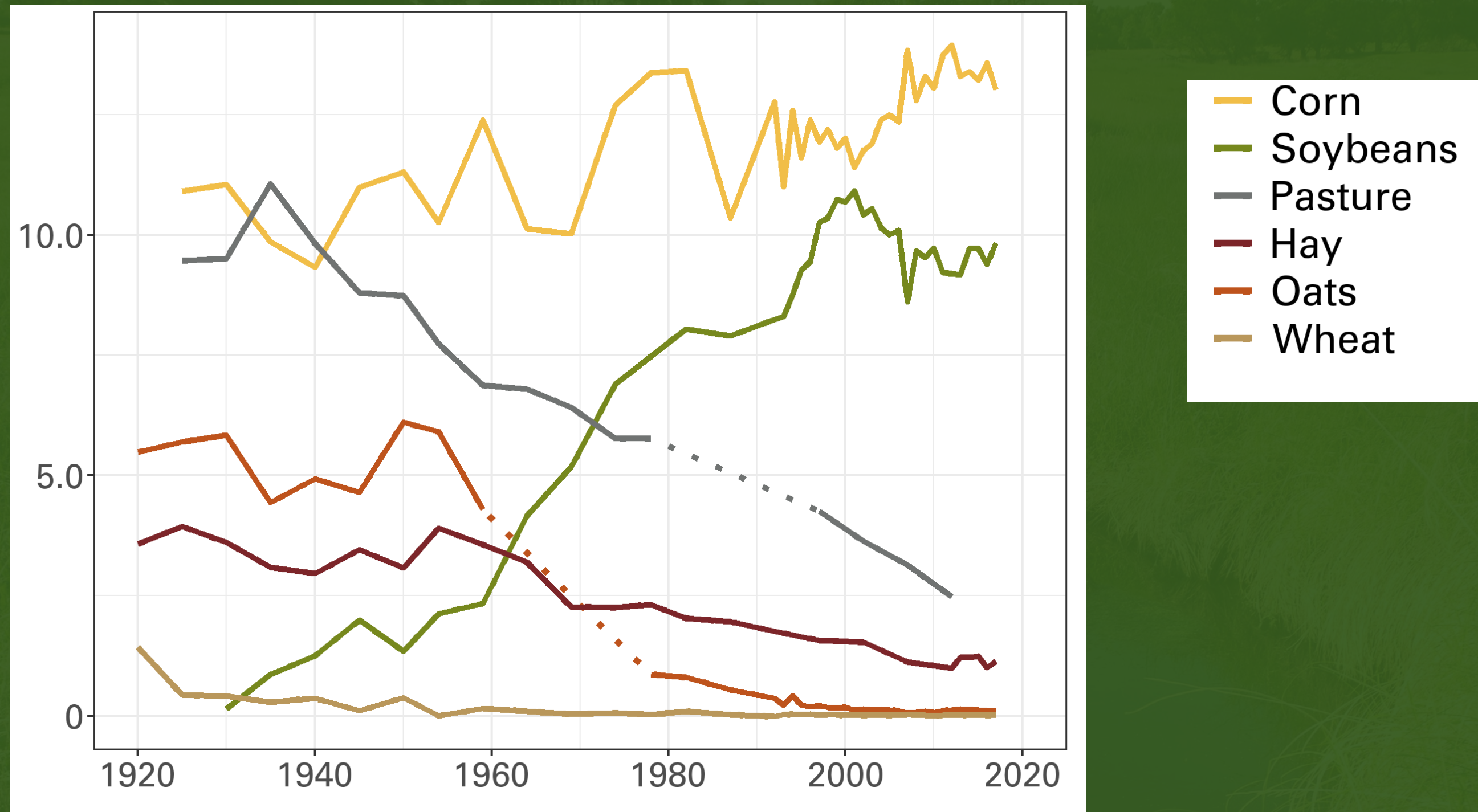
Cropland Acres by County



Source: USDANASS, Census of Ag. 2012

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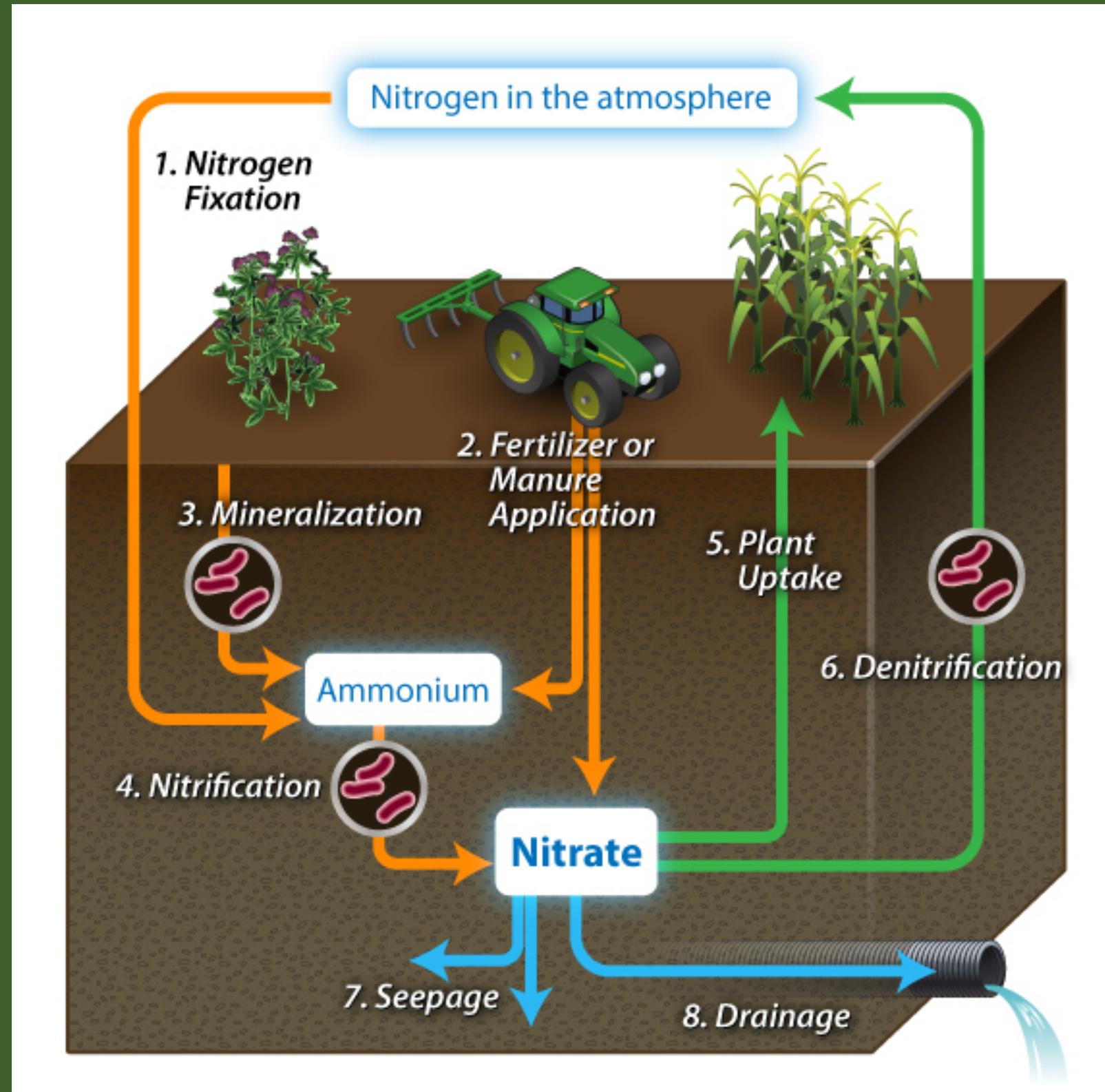
Landuse Changes over Time – Iowa (Millions of Acres)



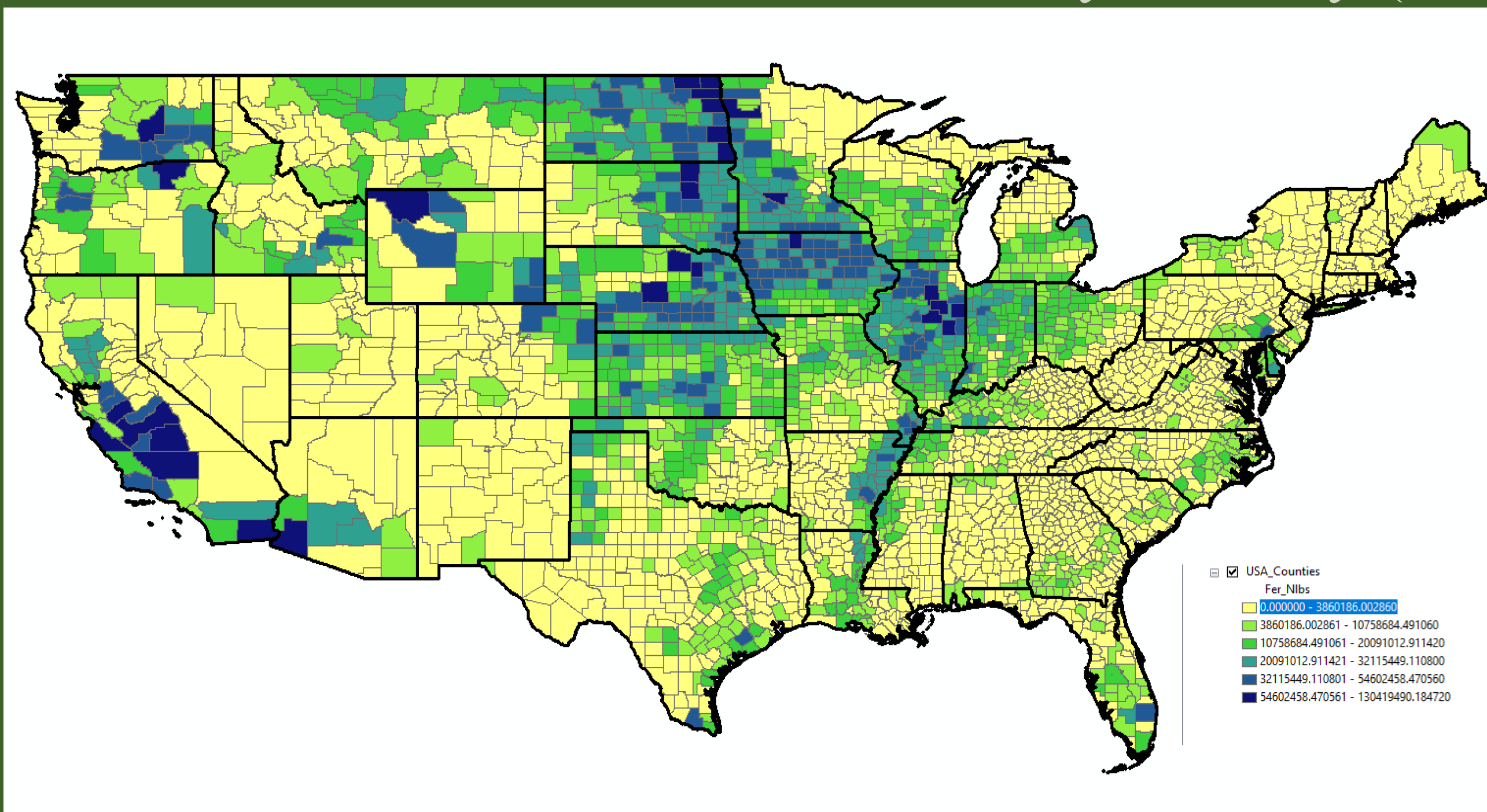
Source: USDA Census of Agriculture, NASS

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Nitrogen Cycle



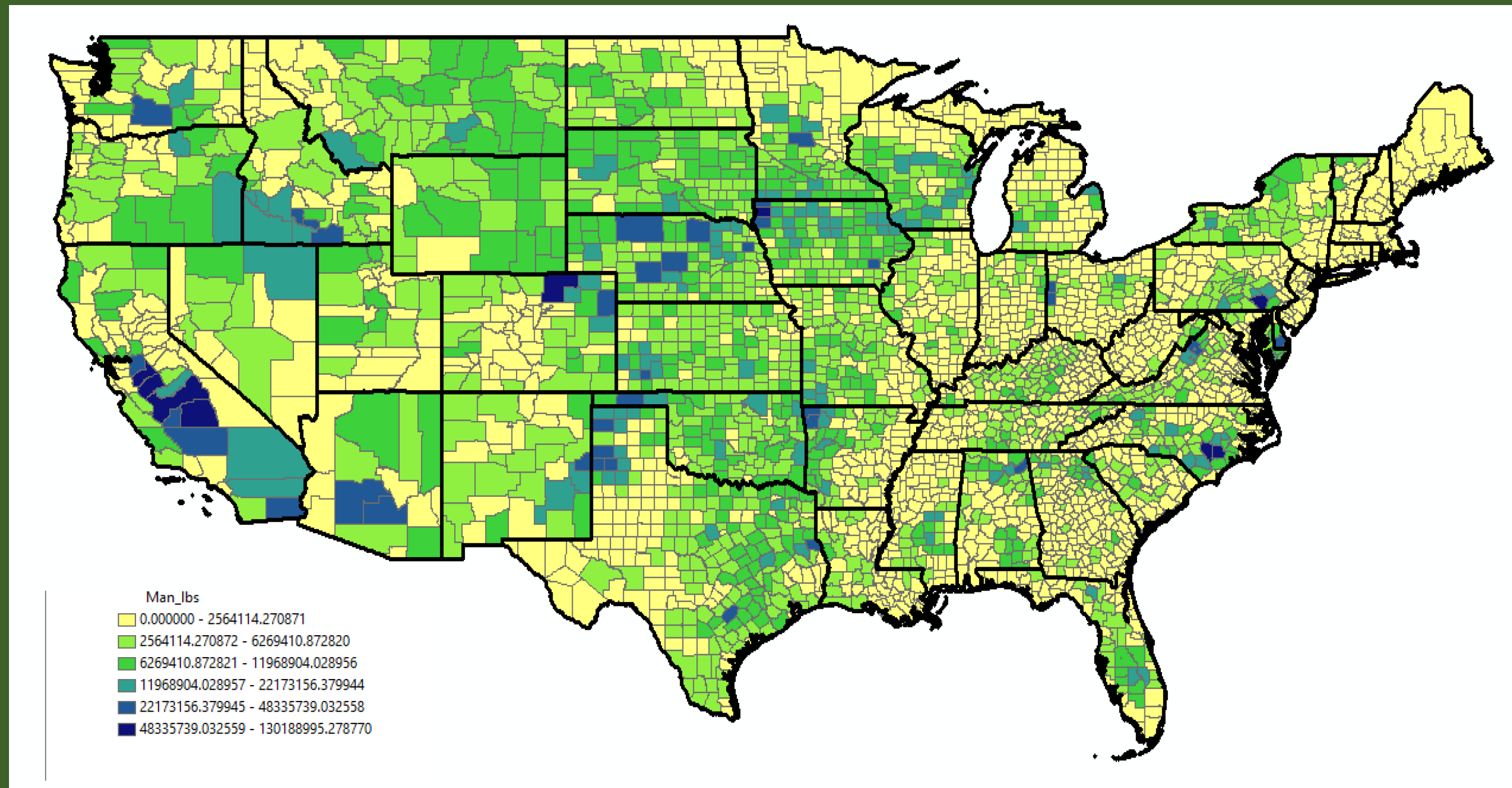
Estimated Commercial Fertilizer N by County (lbs of N)



Source: Brakebill, J.W. and Gronberg, J.M., 2017, County-Level Estimates of Nitrogen and Phosphorus from Commercial Fertilizer for the Conterminous United States, 1987-2012: U.S. Geological Survey data release, <https://doi.org/10.5066/F7H41PKX>.

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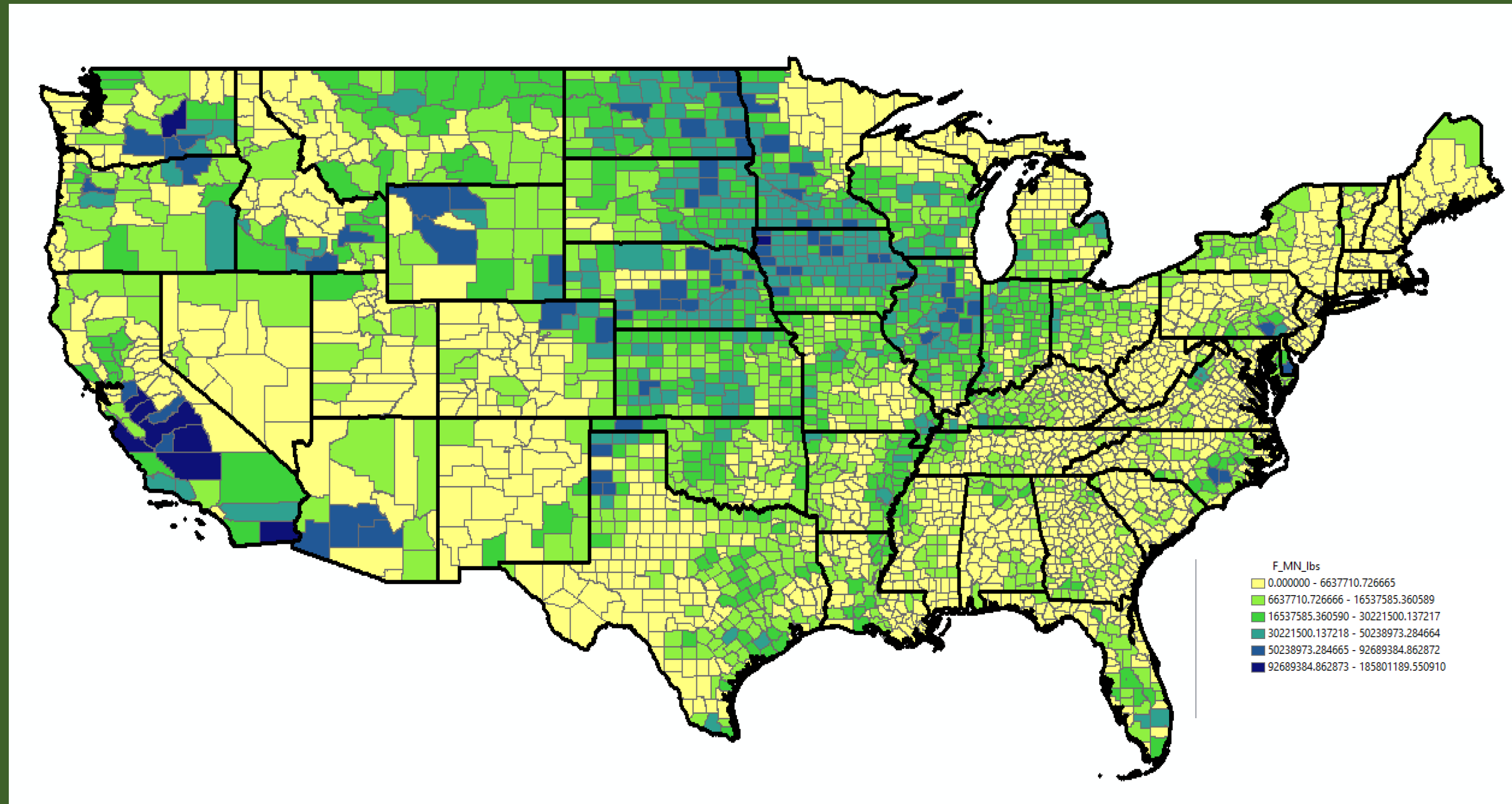
Estimated Manure N by County (lbs of N)



Source: Gronberg, J.M., and Arnold, T.L., 2017, County-level estimates of nitrogen and phosphorus from animal manure for the conterminous United States, 2007 and 2012: U.S. Geological Survey Open-File Report 2017-1021, 6 p., <https://doi.org/10.3133/ofr20171021>.

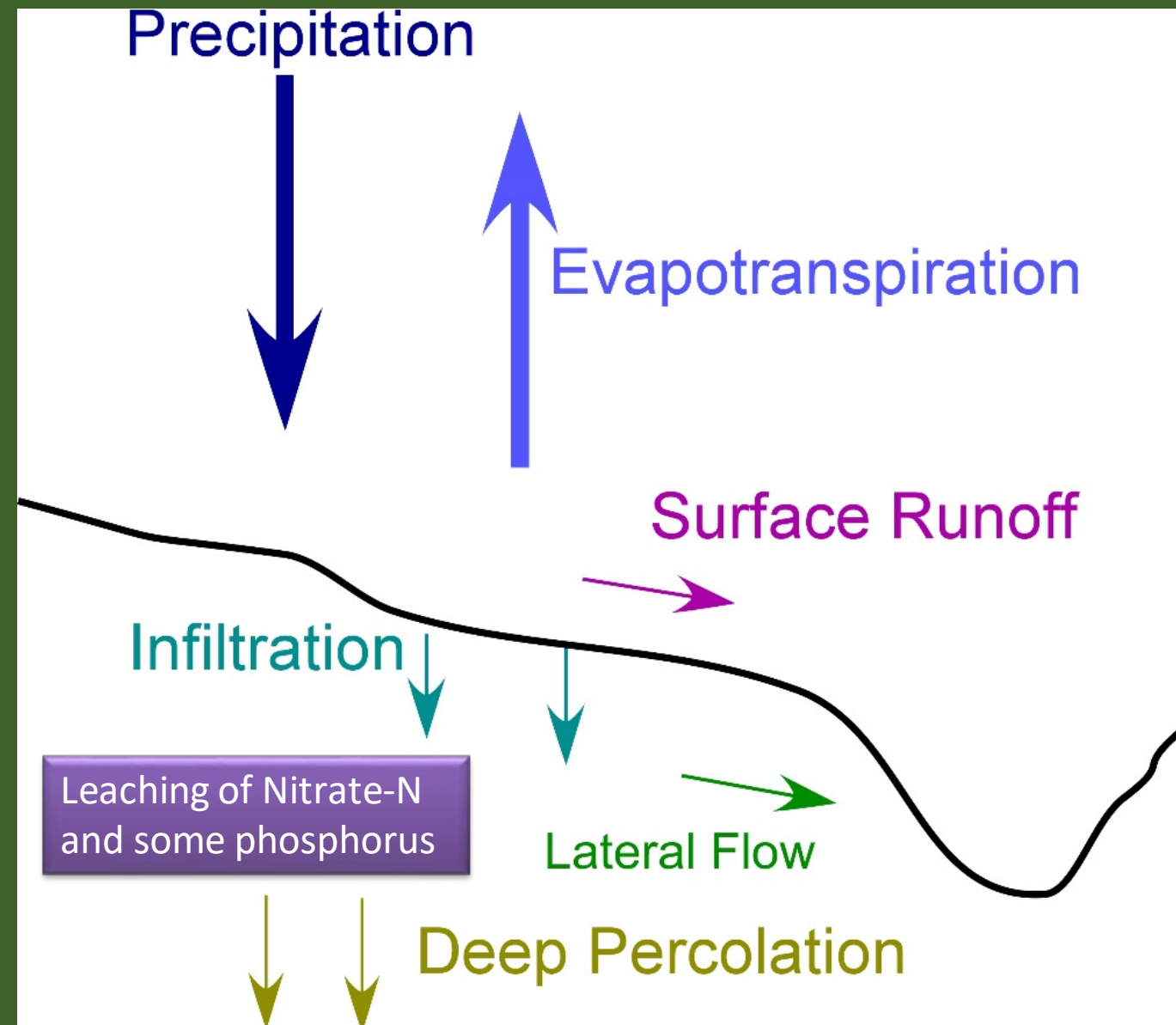
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Estimated Combined Commercial and Manure N by County (lbs of N)

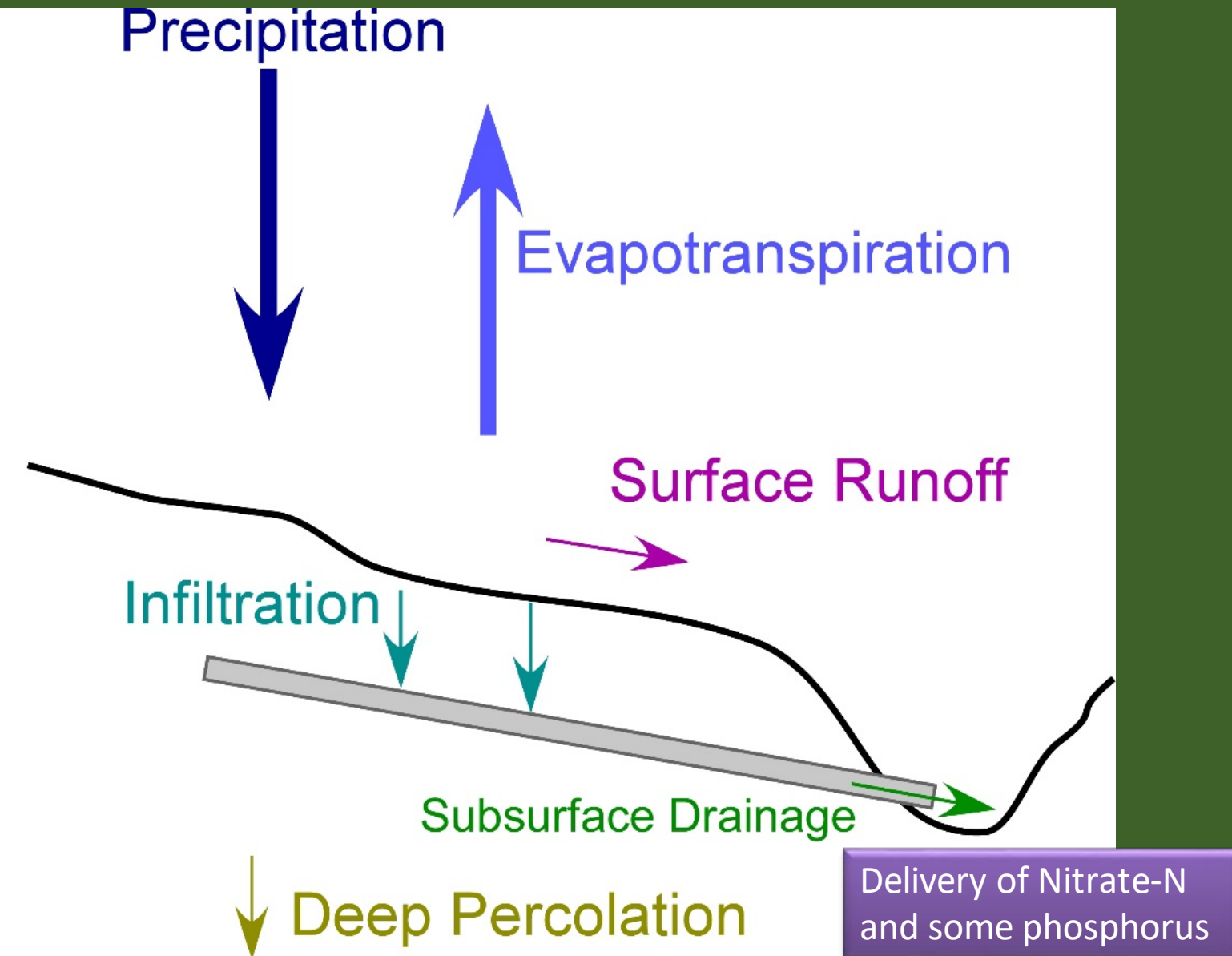


Water Flow Pathways

Naturally Well-Drained Soils

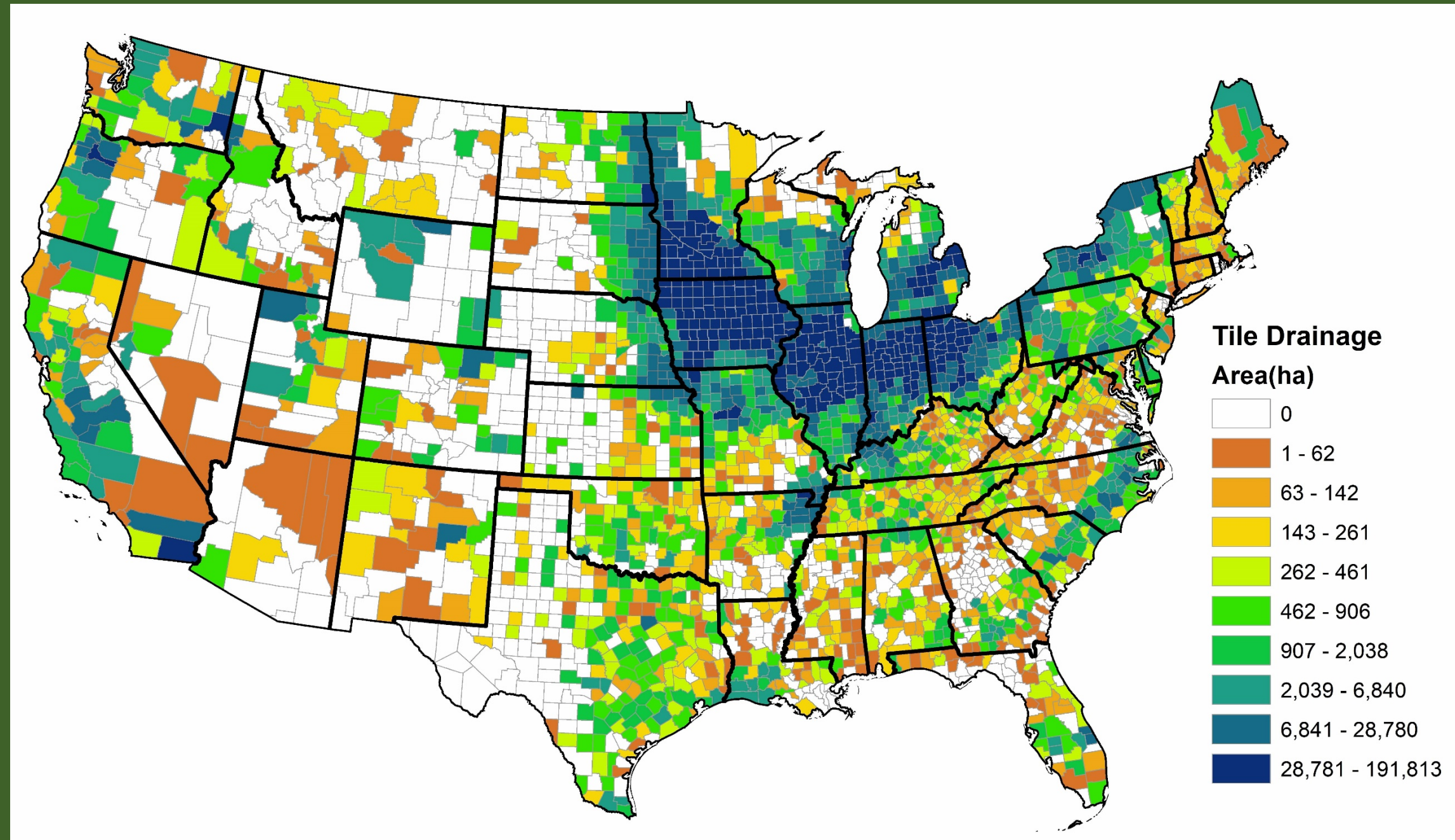


Soils with Poor Natural Drainage



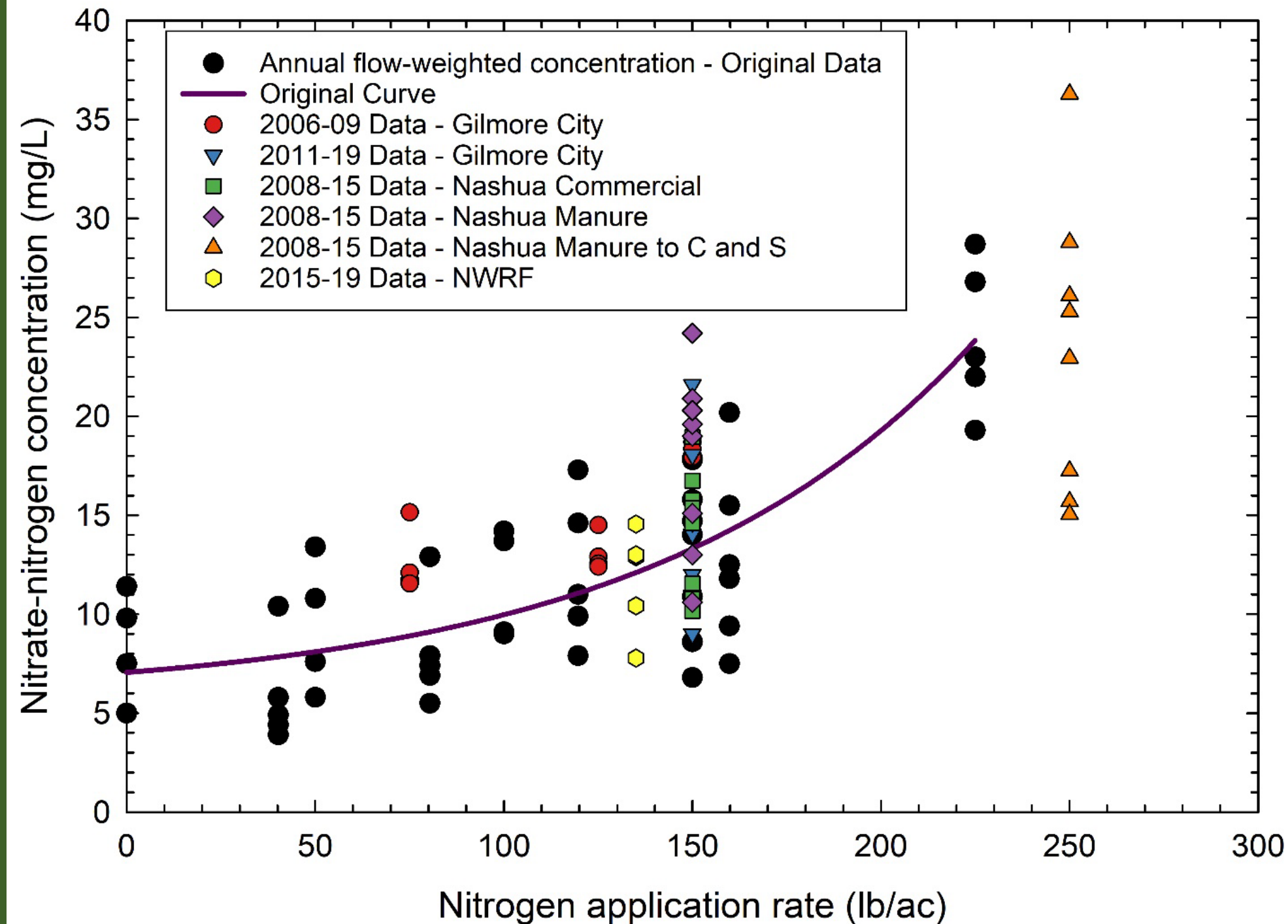
Land management and land use impacts ET and infiltration which in turn impact surface runoff, subsurface drainage, deep percolation

Estimated Tile Drainage by County



Source: USDA Census of Ag. 2017. From: Valayamkunnath, P., Barlage, M., Chen, F. et al. Mapping of 30-meter resolution tile-drained croplands using a geospatial modeling approach. *Sci Data* 7, 257 (2020).
<https://doi.org/10.1038/s41597-020-00596-x>

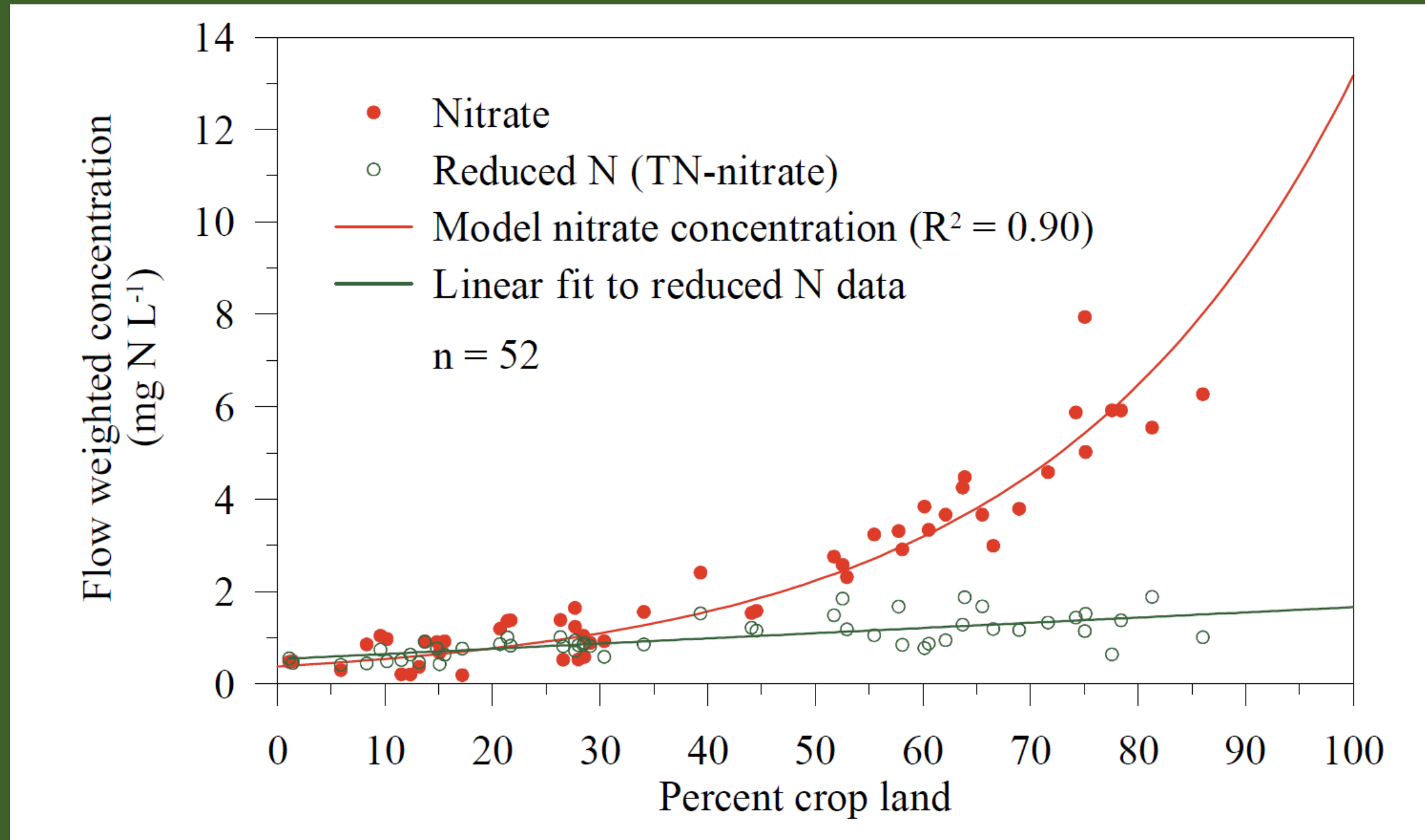
Nitrate-N Leaching – Iowa Information (Corn-Soybean Rotation)



Original Curve with Data from 1990-2004

For comparison: Restored prairie had nitrate-N concentrations <1 mg/L in leachate

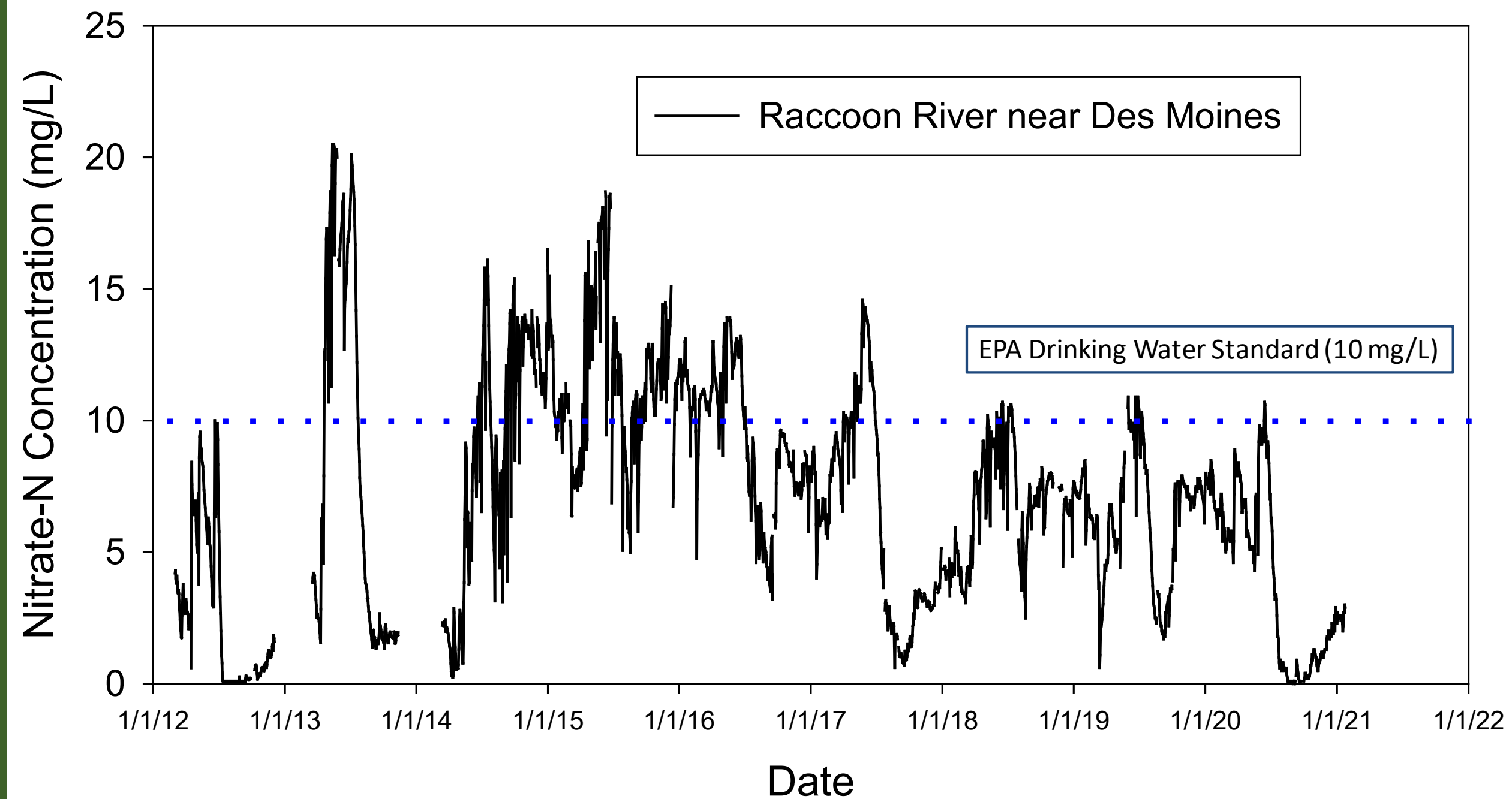
Nitrate-N Concentrations Related to Landuse – Upper Miss and Ohio River Basins (Crumpton et al., 2006)



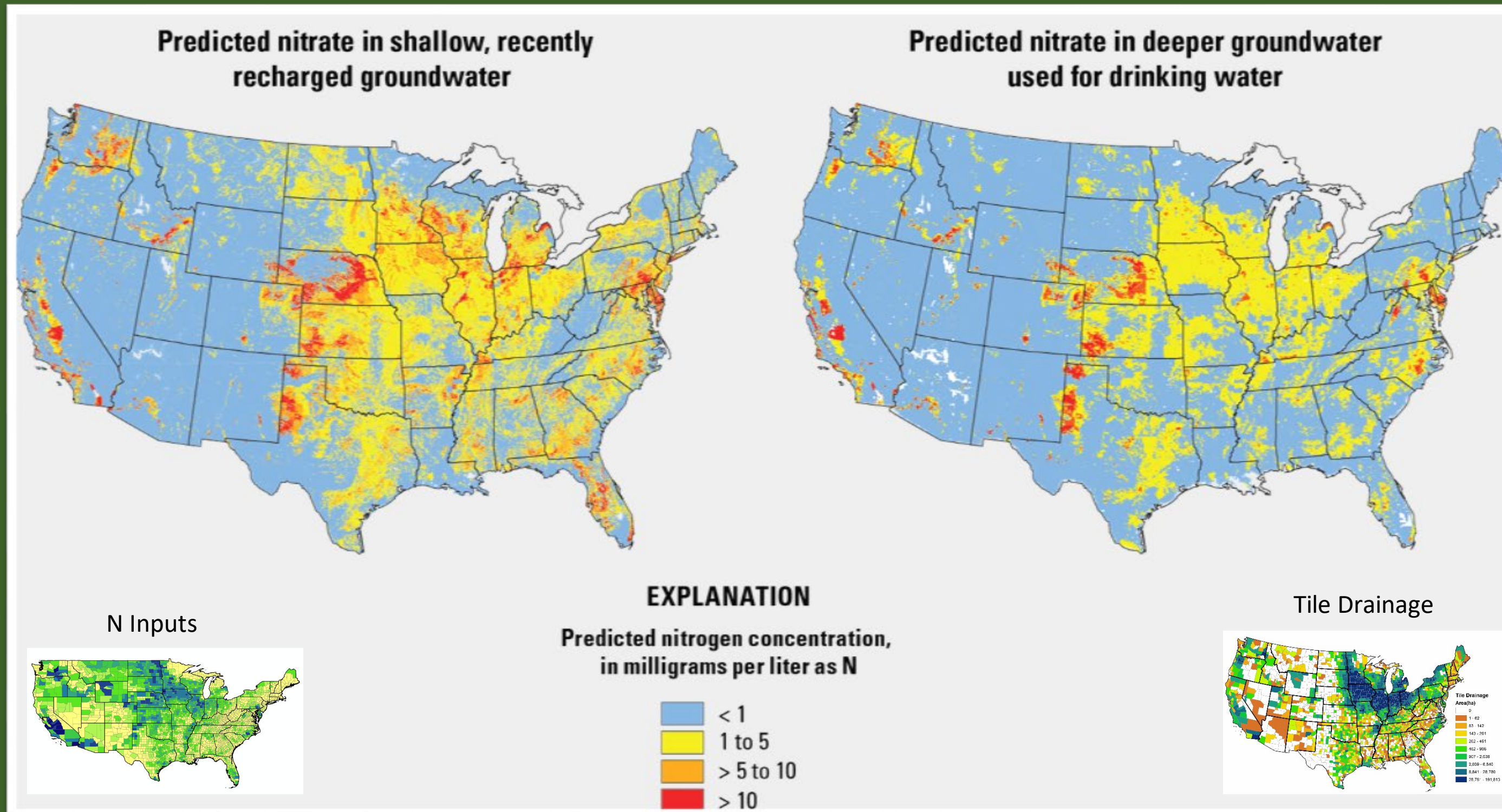
Crumpton, W.G., Stenback, G.A., Miller, B.A., and Helmers, M.J., 2006, Potential benefits of wetland filters for tile drainage systems—Impact on nitrate loads to Mississippi river subbasins: U.S. Department of Agriculture, CSREES Project Completion Report.

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Nitrate-N Concentrations Raccoon River near Des Moines



Predicted concentrations of nitrate in U.S. groundwater



Source: [The quality of our Nation's waters: Water quality in principal aquifers of the United States, 1991-2010](#)
USGS Circular 1360, figure 6-7

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Summary

1

Substantial areas of the U.S. in annual crop production – these areas have grown over time

2

Areas with extensive crop production also have extensive Nitrogen inputs from commercial fertilizer and manure

3

Nitrate-N leached below the plant root zone is susceptible to loss to downstream waters – surface or ground water

4

Tile drainage throughout much of the Upper Midwest delivers nitrate-N lost from crop root zone to streams

5

Areas with extensive cropland and N inputs have elevated Nitrate-N concentrations in surface and groundwater