# THE COST OF NUTRIENTS

ASSESSING THE ECONOMIC IMPACT OF NUTRIENT LOADING IN THE MISSISSIPPI RIVER

EARTH ECONOMICS

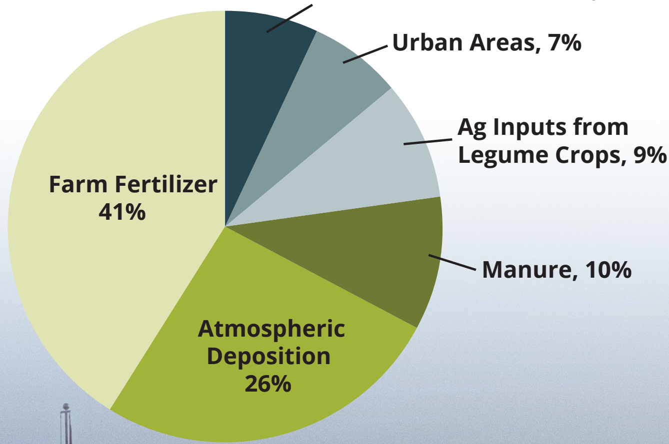
## THE MISSISSIPPI RIVER'S **NUTRIENT PROBLEM**

The Mississippi River, one of largest rivers in the world, is a crucial freshwater resource to millions of people that live on its banks. Water quality in the Mississippi River and Gulf of Mexico has been compromised by human activities that contribute nitrogen and phosphorus ("nutrients") to the watershed. Nitrogen (N) and phosphorus (P) are essential nutrients for plant and animal growth, but agricultural and urban runoff can create an overabundance of nutrients in waterways (Figure 1). Once these nutrients reach rivers, lakes, and the Gulf, they can trigger harmful algal blooms that damage ecosystems.

Nutrient loading in the Mississippi River is costly to both the public and private sectors of cities, towns, and states through which the river flows. For example, nitrogen in the form of nitrate can pose a public health risk in drinking water – even at low concentrations – leading to greater treatment costs for drinking water loaded with nitrates. The total economic burden associated with nutrient loading in the Mississippi River has not been comprehensively studied. In other words, researchers have yet to measure how costly the problem truly is.

Earth Economics, in partnership with the Mississippi River Cities and Towns Initiative (MRCTI), identified what information is already publicly available to begin determining the baseline comprehensive cost of nutrient loading in the Mississippi River.

**Figure 1.** Sources of Nitrogen Delivered to the Gulf of Mexico (Source: USGS).

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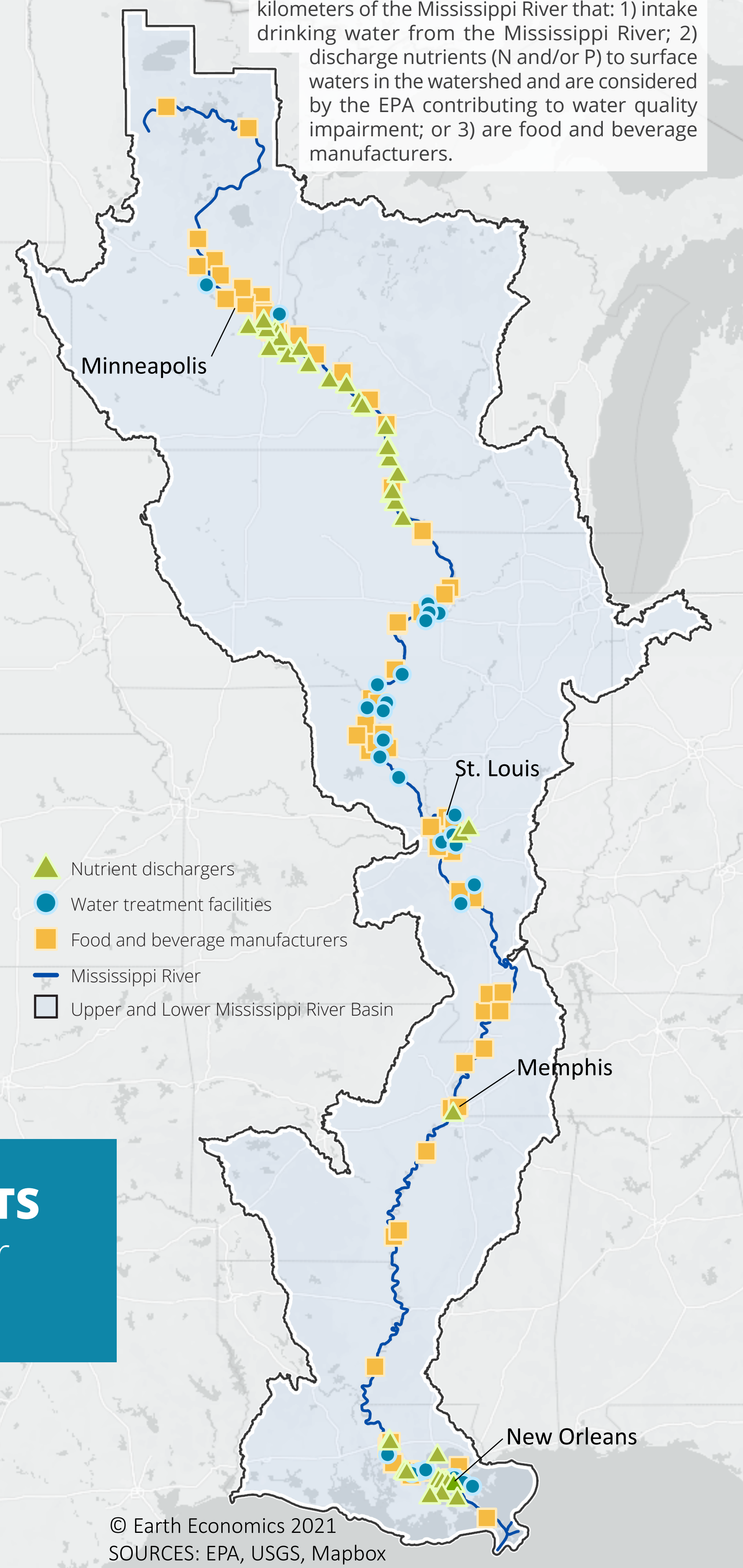
## ASSESSING NUTRIENT **COST DRIVERS**

Earth Economics identified key variables within the communities of the Mississippi River region (i.e., the cities, towns, and counties directly on the river) that will influence how communities incur costs from nutrient-laden water. Highlights include:

- There are at least 35 drinking water treatment facilities across 27 cities and towns that treat water from the Mississippi River for community drinking water (Figure 2),[1] serving no less than 67 percent of the total population in the region.
- There are 54 facilities across 48 cities or towns in Illinois, Iowa, Louisiana, Minnesota, Wisconsin, and Tennessee that: 1) discharged nitrogen and/or phosphorus directly to the Mississippi River watershed in 2020; 2) are located within 2 km of the River; and 3) are classified as "likely contributing to impairments" by the EPA (Figure 2).[2]
- There are 371 food and beverage manufacturers located within 1 mile of the main stem Mississippi River (Figure 2).[3] Food and beverage manufacturers would be most likely to require nutrient removal treatment if using river water in the facility, but also for their nutrient-rich wastewater. Focusing on facilities within a mile of the river is intended to increase the likelihood of finding private facilities bearing these treatment costs.

**TWO-THIRDS OF RESIDENTS** rely on the Mississippi River for drinking water

**Figure 2.** Map of facilities located within 2 kilometers of the Mississippi River that: 1) intake drinking water from the Mississippi River; 2) discharge nutrients (N and/or P) to surface waters in the watershed and are considered by the EPA contributing to water quality impairment; or 3) are food and beverage manufacturers.



- At the county-level, majority of land in the region is cropland (35%) or forest (24%). This includes over 5.5 million acres of corn and 6.8 million acres of soybeans—the two dominant crops in the region (Figure 3).[4]
- At the state-level, there were 93.7 million acres of field and vegetable crops planted in 2020 across the region (LA, MS, AK, KY, TN, MO, IL, IA, MN, WI).[5] Majority of crop acreage was found in just four midwestern states: Iowa (25%), Illinois (23%), Minnesota (17%), and Missouri (10%).[6]
- There were nearly 19,000 livestock operations in the region's counties as of 2017.[7]

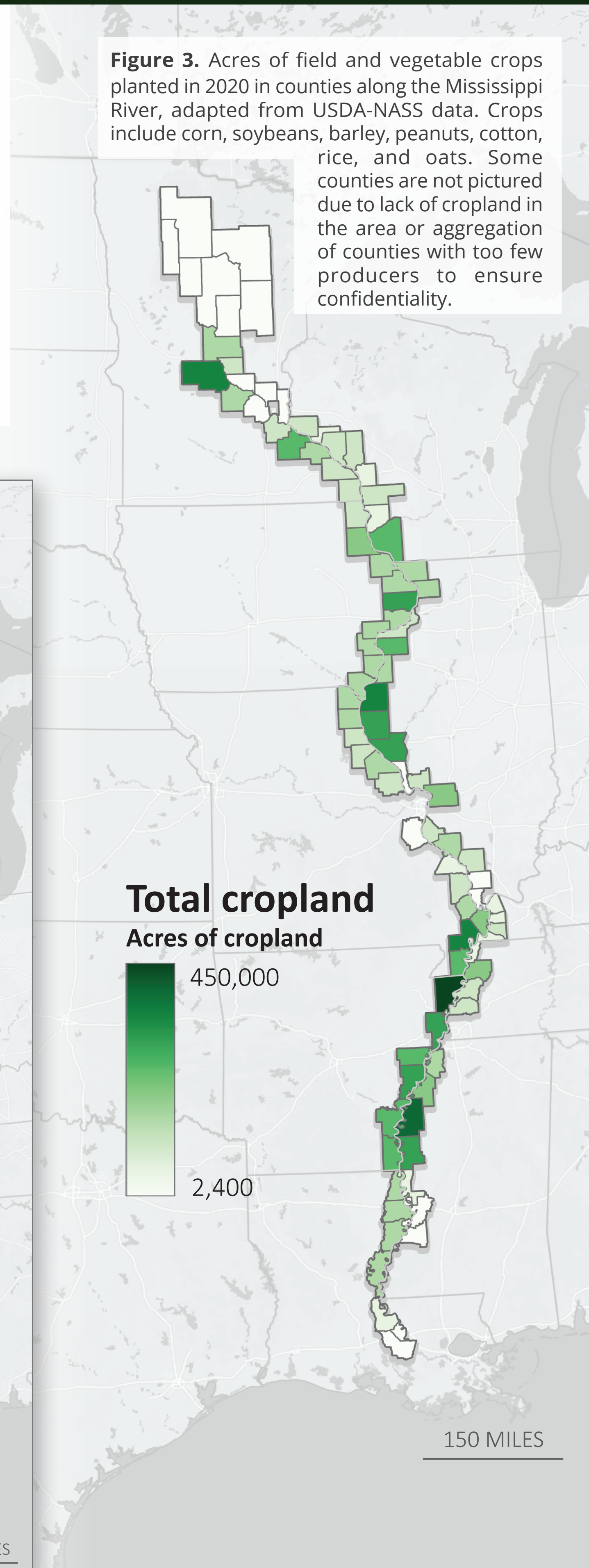
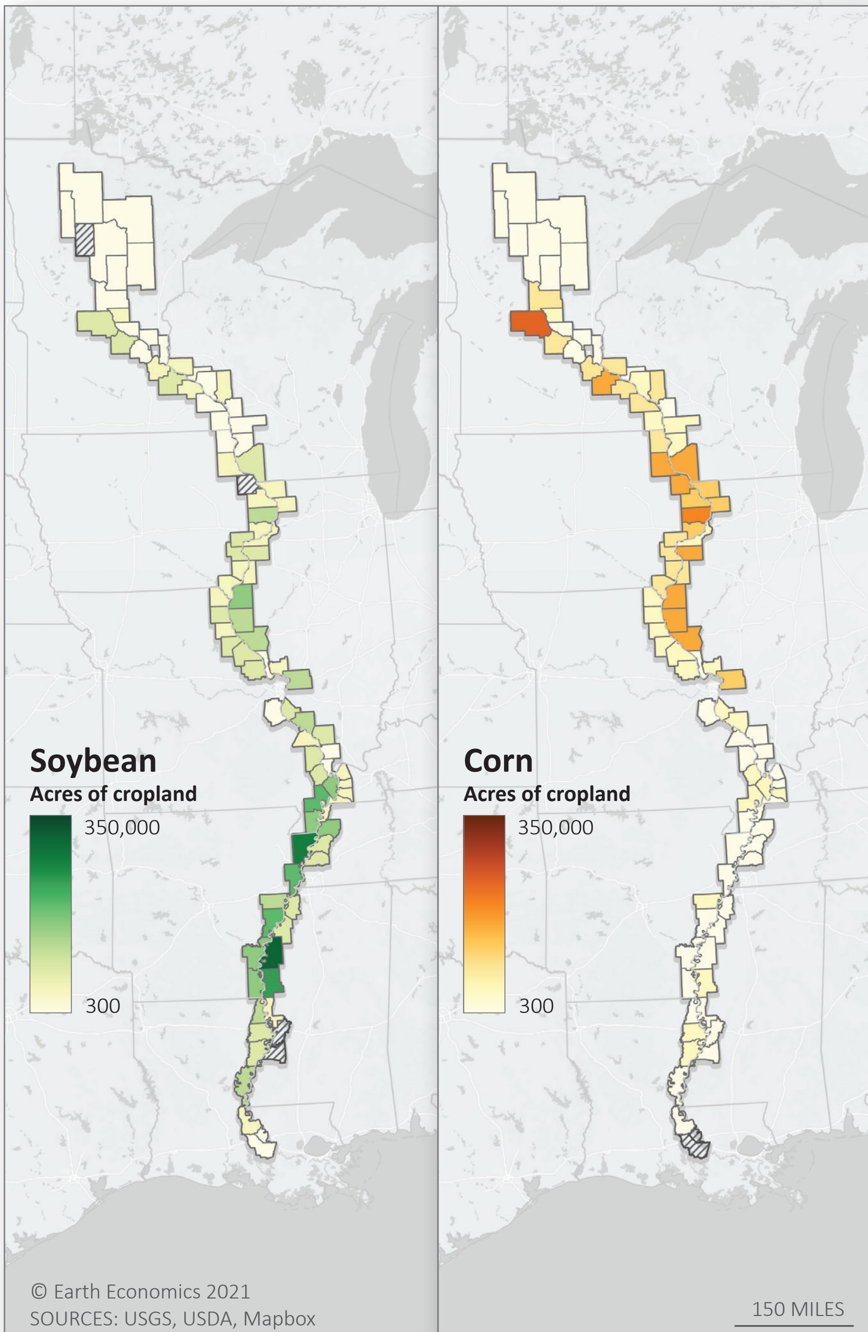



**Figure 3.** Acres of field and vegetable crops planted in 2020 in counties along the Mississippi River, adapted from USDA-NASS data. Crops include corn, soybeans, barley, peanuts, cotton, rice, and oats. Some counties are not pictured due to lack of cropland in the area or aggregation of counties with too few producers to ensure confidentiality.

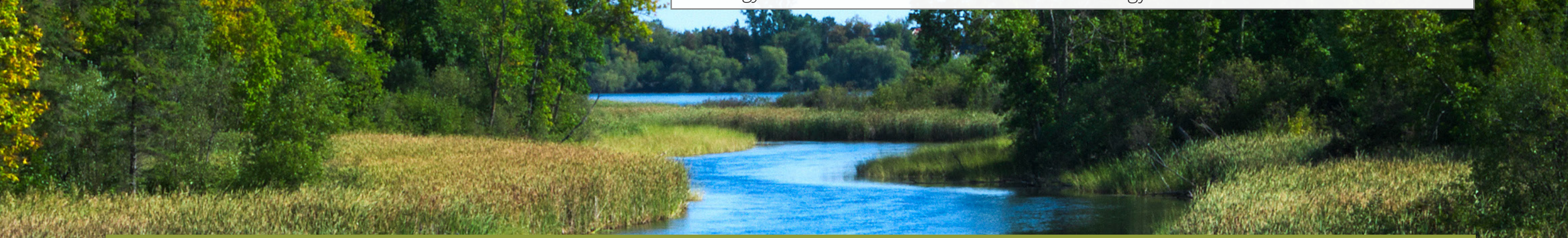


# AVAILABLE **COST DATA**

Earth Economics reviewed publicly available data on the costs of nutrients. The project revealed evidence from in and around the Mississippi River Basin of economic and ecological impacts across several sectors of the economy (Table 1).

**Table 1.** Data availability for each sector and cost driver of nutrient loading in the Mississippi River. ● = data is currently available for this cost driver; ◉ = available data from another sector or cost driver may be applicable; ○ = data is not publicly available but could be collected.

| SECTOR | COST DRIVER DESCRIPTION | DATA |
|---|---|---|
| Water Treatment | Capital Costs | ● |
| | Operations & Maintenance | ◉ |
| Manufacturing | Capital Costs | ◉ |
| | Operations & Maintenance | ◉ |
| Agriculture | Comprehensive Nutrient Management Plan | ● |
| | Fertilizer Replacement Cost | ● |
| Recreation | Beach Closures | ○ |
| | Consumer Surplus | ● |
| | Visitation | ○ |
| Natural Resources Harvest | | |
| *Fisheries* | Fish losses | ○ |
| *Forestry* | Best Management Practices | ● |
| *Navigation* | n/a | |
| *Energy* | Emissions technology | ● |



# CO-BENEFITS OF NUTRIENT MANAGEMENT **WITH NATURE-BASED SOLUTIONS**

Many nutrient mitigation strategies—like wetland restoration, floodplain reconnection, and improved edge-of-field practices—offer additional ecological and economic benefits beyond nutrient reduction. These are called co-benefits, and they take many forms: green spaces can slow and store stormwater and runoff, helping to ease flooding; they sequester carbon, helping keep it out of the atmosphere; they can offer recreational spaces, improve habitat, and improve soil stability.

Because ecosystems are living systems, natural assets like floodplains are often more resilient and less costly to maintain than built infrastructure. Consider a healthy floodplain and a water treatment plant – both are effective at reducing nutrient loads. However, two differences are notable.

1. The water treatment plant requires continual operations and maintenance costs and eventual replacement, whereas the floodplain does not.
2. The floodplain does more than purify water; it offers a number of economically valuable ecosystem services as co-benefits – like habitat and climate stability.

Acknowledging the economic value of nature often shows nature-based solutions to be more cost effective than built infrastructure, while raising awareness of the long-term connections between people and these natural assets. Understanding these values is critical to making informed land-use decisions, and there is robust literature on ecosystem services valuation to support this effort.

## **MEASURING THE PROBLEM** IS CRITICAL

The most significant conclusion from this study is the need for a more detailed, comprehensive analysis of the impacts of nutrient loading to different sectors of the economy—locally, regionally, and across a diversity of communities. Understanding how these costs vary across the basin is an important step to developing a coordinated response that can match the distributed nature of the nutrient loading problem.

Earth Economics used these findings to develop a set of criteria to choose two sites for a future deep dive study that would detail the costs associated with nutrient loading to individuals, as well as the public and private sectors. The chosen sites are New Orleans, LA and "Quad Cities" in IA and IL (includes Davenport and Bettendorf, IA and Rock Island, Moline, and East Moline, IL).

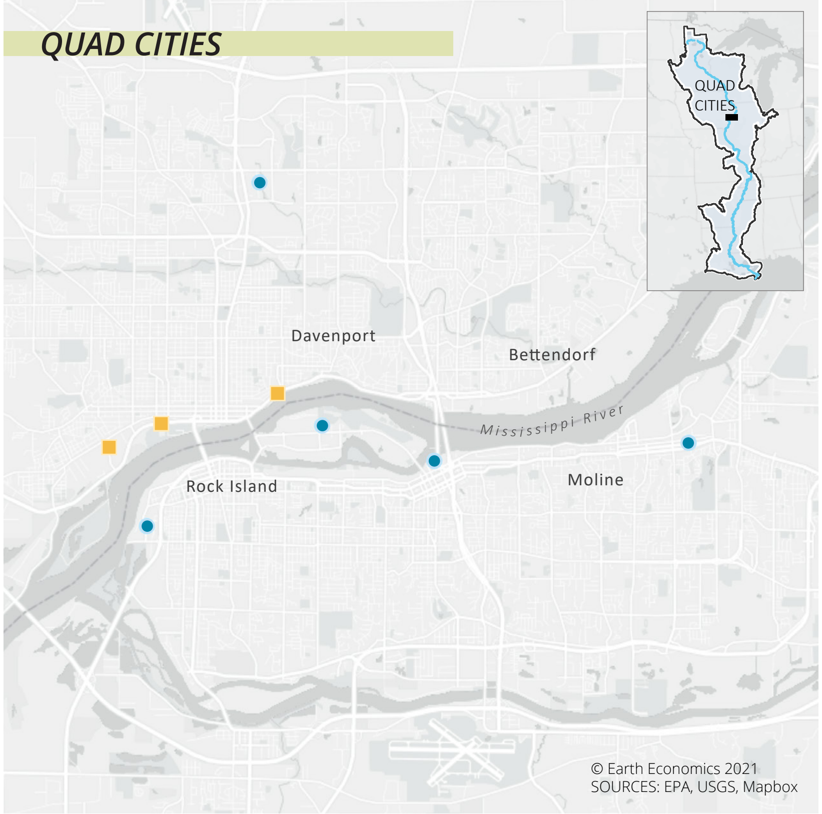
## **SELECTED COMMUNITIES**
## New Orleans
## Quad Cities

These communities were chosen because they collectively represent:

1. Cities that get their drinking water from the Mississippi River – likely among the most significant cost driver;
2. Evidence of impaired waters and nearby industry likely to bear costs of nutrient loading (for example, agriculture, recreation, and manufacturing);
3. Different populations and densities, as well as diverse geographies and watersheds;
4. Areas with greater social vulnerability and climate risk.

Measuring the problem is a critical step in finding efficient solutions. Detailed research in the these communities will be a unique and important effort. It would bring together multiple sources of data to demonstrate how nutrient-loaded water imposes additional costs to communities large and small across the Mississippi River Basin.

**Figure 4.** Map of facilities in New Orleans and Quad Cities located within 2 km of the Mississippi River that: 1) intake drinking water from the Mississippi River; 2) discharge nutrients (N and/or P) to surface waters in the watershed and are considered by the EPA contributing to water quality impairment; or 3) are food and beverage manufacturers.

*Aerial view of Moline, IL on the Mississippi River*


1 EPA. U.S. Environmental Protection Agency Safe Drinking Water Information System (SDWIS). Available online at: https://ofmpub.epa.gov/apex/sfdw/f?p=108:1:::NO:1.

2 EPA. U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Data. Available online at: https://echo.epa.gov/trends/loading-tool/get-data/monitoring-data-download.

3 EPA. U.S. Environmental Protection Agency, Factility Registry Service (FRS) Geospatial Data. Available online at: https://www.epa.gov/frs/geospatial-data-download-service.

4 USGS SPARROW. 2002. Mississippi-Atchafalaya River Basin 2002 Nutrient Loading. U.S. Geological Survey, Washington, DC. Available online at: https://sparrow.wim.usgs.gov/marb/.

5 USDA NASS. 2020. Quick Stats, published crop-specific planting data. USDA National Agricultural Statistics Service, Washington, DC. Available online at: https://data.nal.usda.gov/dataset/nass-quick-stats. USDA-NASS, Washington, DC.

6 USDA-NASS. 2020. CropScape, Cropland Data Layer: Published crop-specific data layer. USDA National Agricultural Statistics Service, Washington, DC. Available online at: https://nassgeodata.gmu.edu/CropScape/.

7 USDA NASS. 2017. 2017 Census of Agriculture. Available online at https://www.nass.usda.gov/AgCensus.



This project was completed in partnership with the Mississippi River Cities and Towns Initiative.


Earth Economics is a leader in ecological economics and has provided innovative analysis and recommendations to governments, tribes, organizations, private firms, and communities around the world. **eartheconomics.org | info@eartheconomics.org**



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