

Effectiveness of local regulations on non-point source pollution

Evidence from Wisconsin dairy farms

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Motivation

- Non-point source pollution is responsible for 82% of impairment to Wisconsin's rivers and streams and 57% of impairment to lakes, ponds, and reservoirs (EPA, 2016)
- Natural resource-based tourism, often tied to access to clean lakes, rivers, and streams, is an increasingly important part of rural Wisconsin's economy (WI DNR, 2019)
- State and local agencies are engaged in combatting non-point pollution, yet the effect of non-point source policy is not well known in WI or nationwide (Xepapadeas, 2011)

MILWAUKEE COUNTY

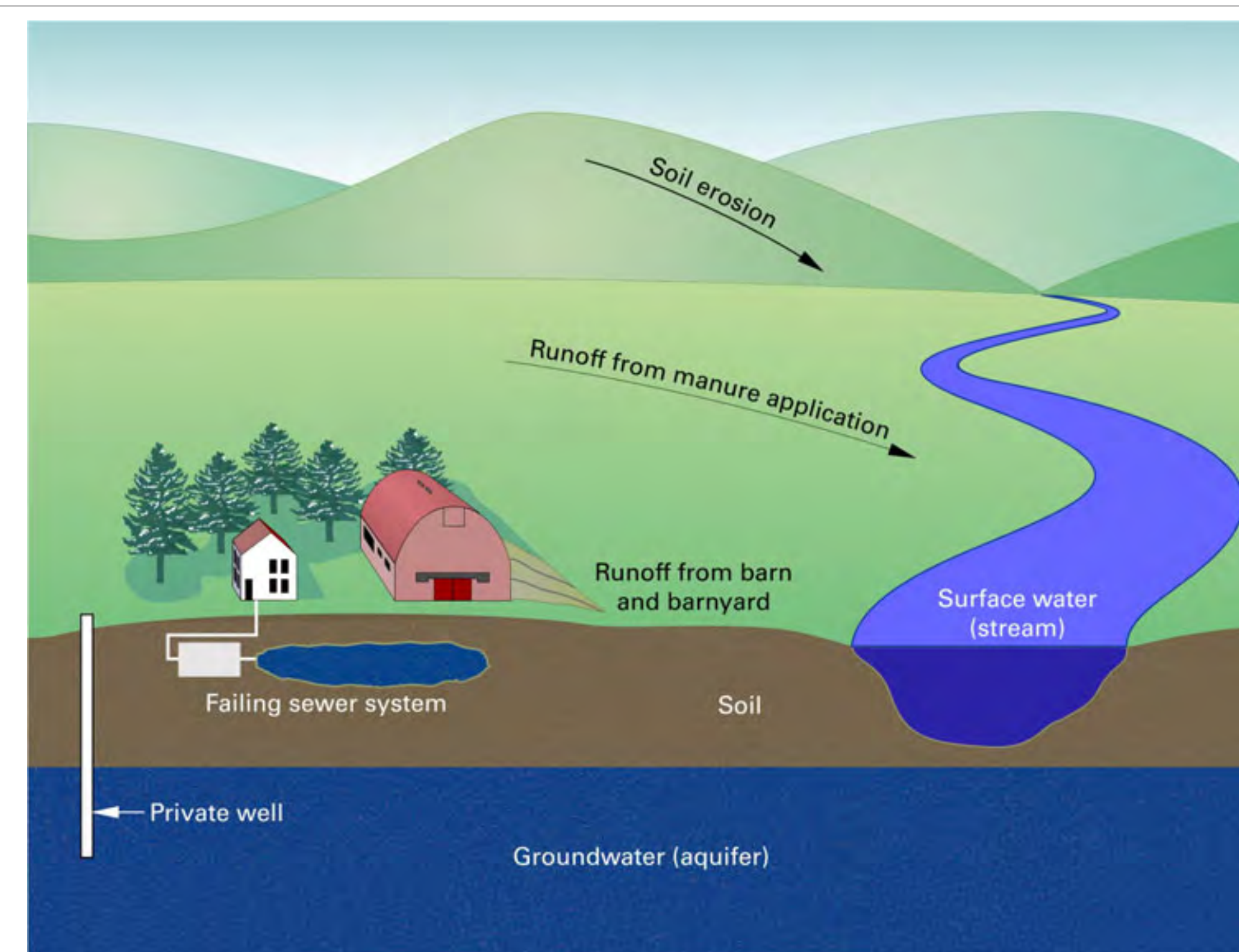
Wisconsin moves to protect groundwater with rules limiting manure spreading

Lee Bergquist Milwaukee Journal Sentinel
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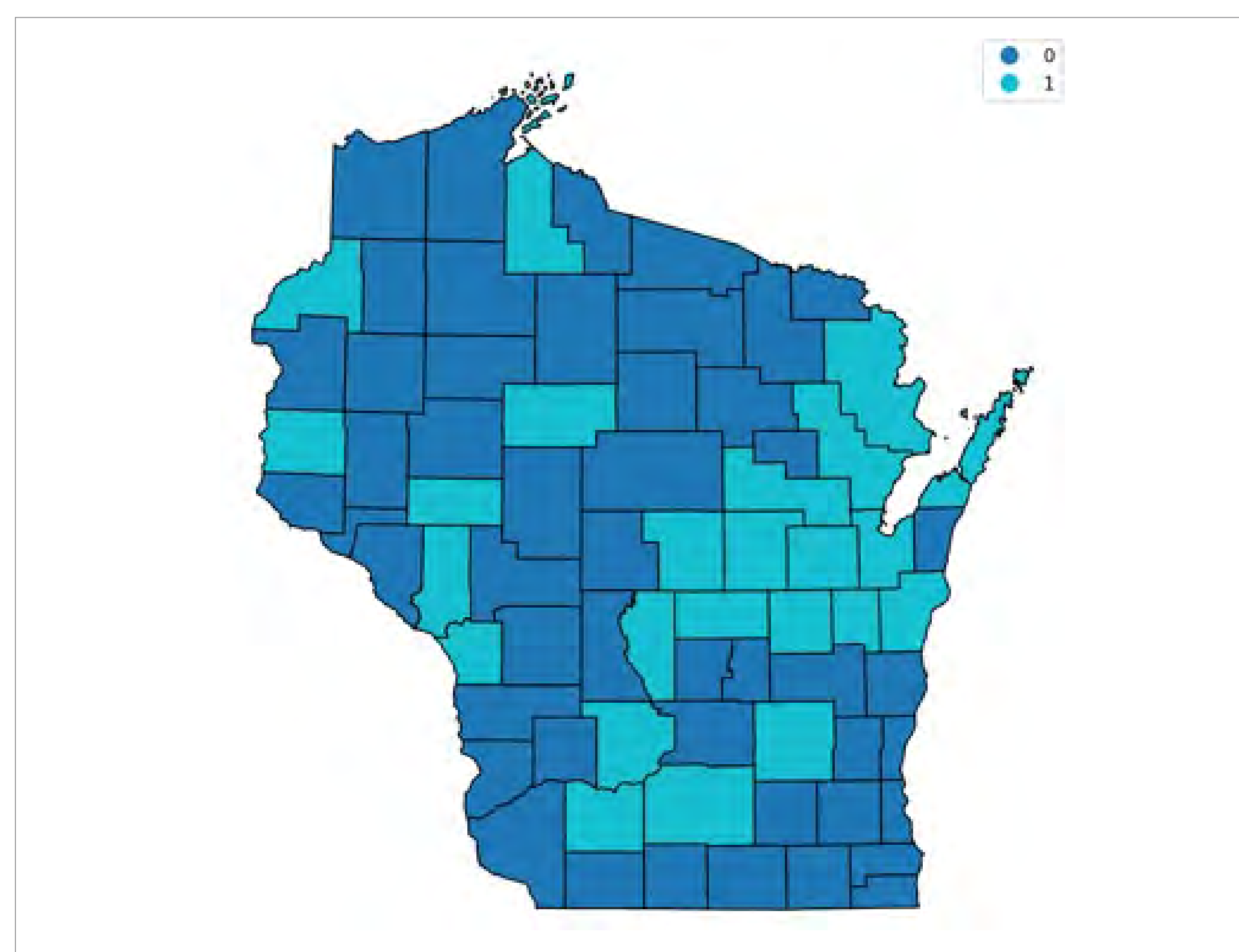
Source: WI DNR

Sources of non-point pollution



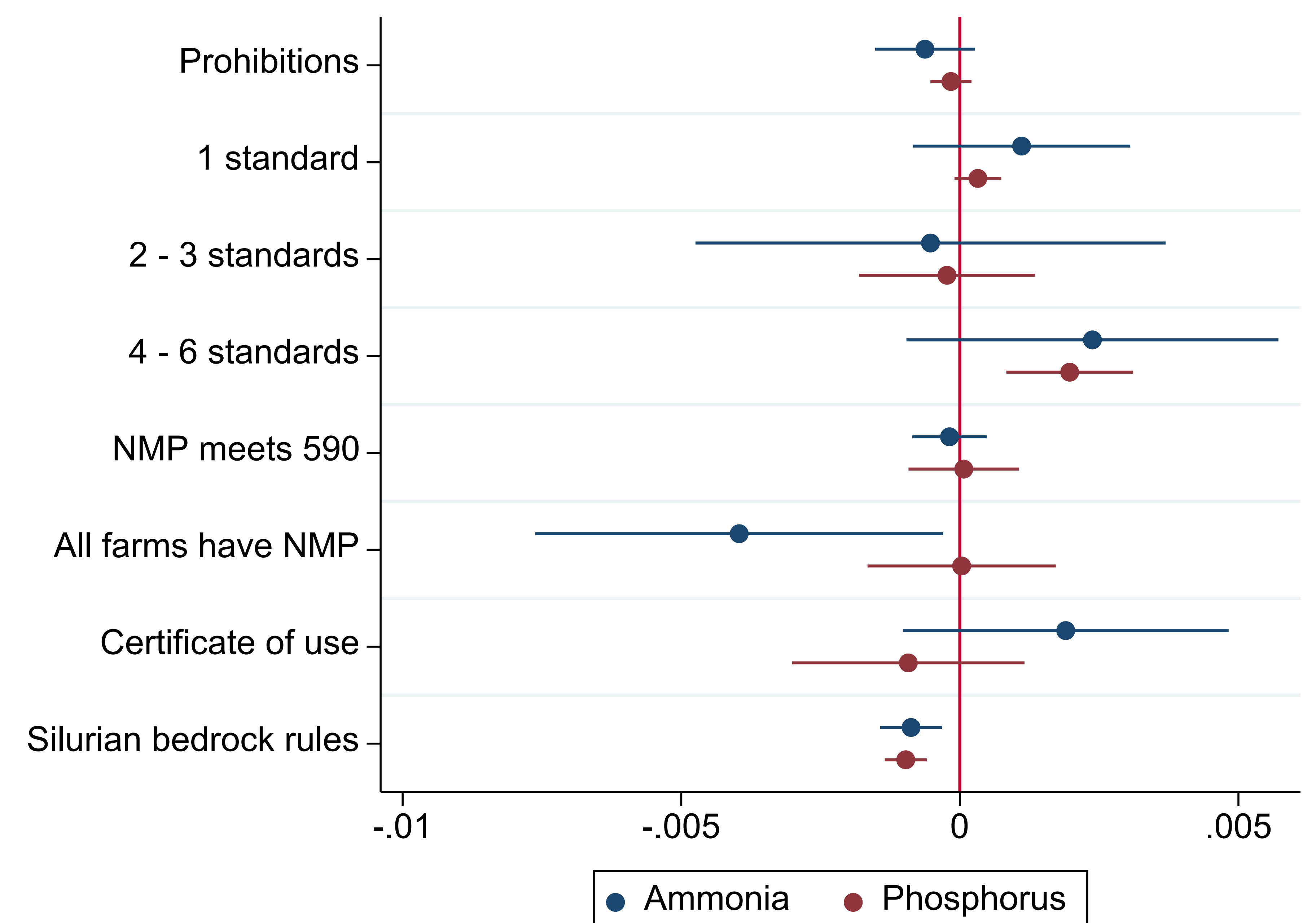
Source: Washington State University

Counties requiring a nutrient management plan in 2020



Results

Water quality in relation to number of farms in the HUC8 currently subject to ordinance characteristic



In the immediate term, we find that:

- Concentration of ammonia falls when counties require a nutrient management plan
- Concentrations of ammonia and phosphorus fall after the Silurian bedrock rules
- Concentration of phosphorus increases when counties implement the full set of NR 151 standards

When we consider the net effect of an ordinance over three years, we find that:

- Concentrations of both ammonia and phosphorus fall due to an NMP requirement
- Concentrations of ammonia and phosphorus fall after the Silurian bedrock rules
- Adverse effect of full set of standards are less evident, indicating longer-run effects will be null or improve water quality

Methods

Data sources

- We construct a novel dataset of all county manure ordinances since 2008 (latest major update to state code NR 151 was 2010)
- Geolocate all dairy farms within a county and HUC8 using dairy farm addresses and operating dates from WI-DATCP
- Pair this with data on filtered ammonia and phosphorus concentrations from the Water Quality Portal

Econometric model

$$Q_{hym} = \alpha O_{hym} + \beta X_{hym} + \delta_h + \gamma_y + \varphi_m + \varepsilon_{hym}$$

- Q_{hym} : pollutant concentration
- O_{hym} : ordinance environment
 - Number and share of farms in HUC8 h that have implemented an ordinance aspect
- X_{hym} : control variables (precipitation, temperature, number of farms, cropped area, non-CAFO point-source pollution permits, CAFOs)
- $\delta_h, \gamma_y, \varphi_m$: HUC8, year, and month FE

Conclusions

These policies are relatively new, and improving water quality is a long-term goal. However, we still find evidence of short- and medium-term benefits of policies

- Evidence that policies requiring nutrient management plans improve water quality
 - Win-win for farmers and environment, as NMP encourage optimal use of nutrients
- Significant improvement in water quality after Silurian bedrock rule change
 - This same result may not occur if the policy were implemented in the rest of the state due to geological differences
- Other ordinance requirements show null effects

This is a complex policy and ecological environment, and the long-term effects of these policies should be studied in future work.