IOWA STATE UNIVERSITY

2023 Iowa Water Conference Navigating Extremes

17th Annual Iowa Water Conference

09/19/2023

Disparities in potential nitrate exposures within Iowa public water systems

Emmanuel Padmore Mantey[1], Lu Liu[1]*, and Chris Rehmann[1]

1. Department of Civil, Construction and Environmental Engineering, Iowa State University

Background and Introduction

- Iowa confronts health risks from high nitrate levels in drinking water due to agricultural practices and persistent water system contamination.
- Approximately 4% of public water systems in Iowa are equipped with nitrate treatment.
- Little is known about the disparities in nitrate exposure across various sociodemographic groups in the state.

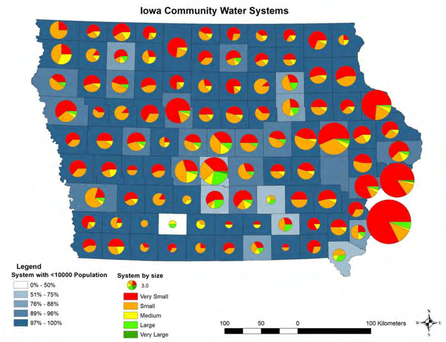
Objectives

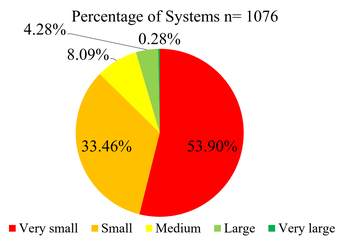
- Investigate long-term nitrate trends in the Iowa Public Water Systems (PWSs).
- Categorize PWSs based on risk levels.
- Evaluate potential sociodemographic variations in nitrate exposure.

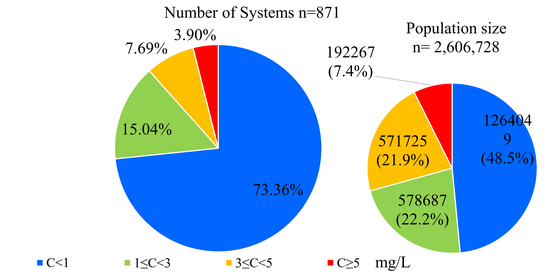
Methods

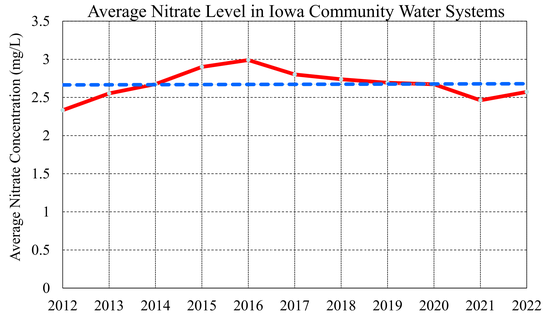
- Analyzed average annual nitrate concentrations in 871 PWSs in Iowa using the Iowa Department of Natural Resources data from 2012 to 2022.
- Compiled and linked sociodemographic information (race, gender, age, level of income, etc.) from Enforcement and Compliance History Online (ECHO) to each PWS for examination.
- Classified PWSs based on risk levels defined by frequency of exceedance above threshold (5 mg/L).
- Applying statistical methods to identify variations in exposure among different groups.

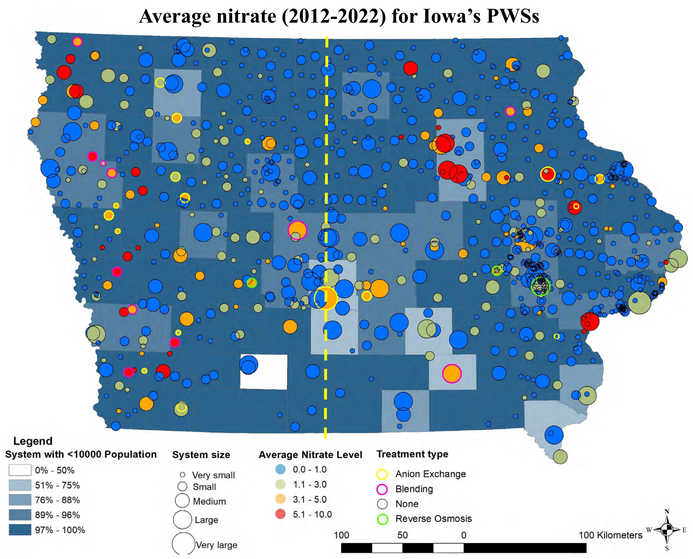
Results

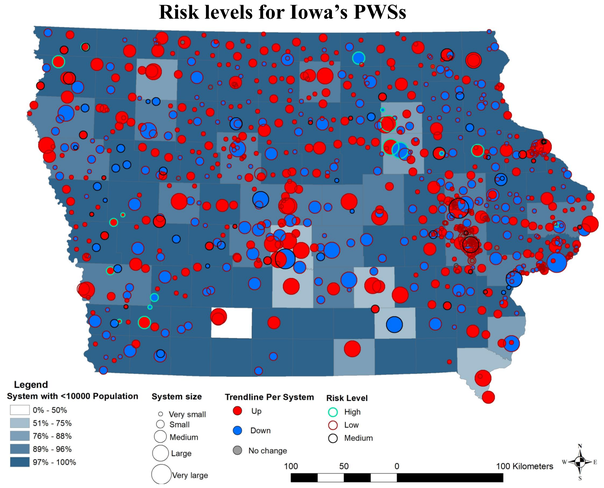












Risk Level	Number of Systems	Percentage
High	19	2.45%
Low	695	89.45%
Medium	63	8.10%

	Treatment	Average over 5 mg/L	Consistently above 5 mg/L
West	None	13	8
	Anion Exchange	4	1
	Blending	1	0
	Reverse Osmosis	0	0
East	None	14	9
	Anion Exchange	2	0
	Blending	0	1
	Reverse Osmosis	0	0

Demographics (Population)							
Groups exposed to C>5 mg/L	Very small	Small	Medium	Large	Very large	Total	Percentage
State	2,505	15,039	30,626	144,097	0	192,267	7.40%
Low-Income	401	2,734	7,601	50,929	0	61665	**10.10%**
People 65 and Older	228	2013	5313	20667	0	28,221	**9.60%**
People of Color	82	688	2,803	31,977	0	35550	**9.20%**
Children 5 years and Younger	86	639	2,138	9,472	0	12,335	**8.70%**

Low Nitrate= 95% High Nitrate=5% for all demographic groups

Results are significant at p < .05 using unequal variances t-test

Conclusions

- A rising trend between 2012 and 2022 was identified, peaking at 3 mg/L in 2016.
- 2.45% of the PWSs are "high-risk" systems. Locations coincide with areas for intensive animal feeding operations.
- Lack of nitrate removal processes at these PWSs contributes to sustained elevated levels.
- On average, 7.4% of the population served by PWSs has been exposed to elevated nitrate levels in the past decade.
- Low-income, elderly, people of color, and young children are statistically more exposed to high nitrate levels compared to the state average.

Future work

- Analyze the economic impacts of nitrate contamination in terms of healthcare costs.
- Further research on certain sociodemographic groups (e.g., people of color) in Iowa who are disproportionately affected by nitrate contamination.

Acknowledgments

We'd like to acknowledge funding agencies for supporting this research and ISU undergraduate students Matthew Decker, Sarah Kothlow, Suryansh Mishra, and Jacob Dunn for helping the research.

padmore@iastate.edu Emmanuel Padmore Mantey