

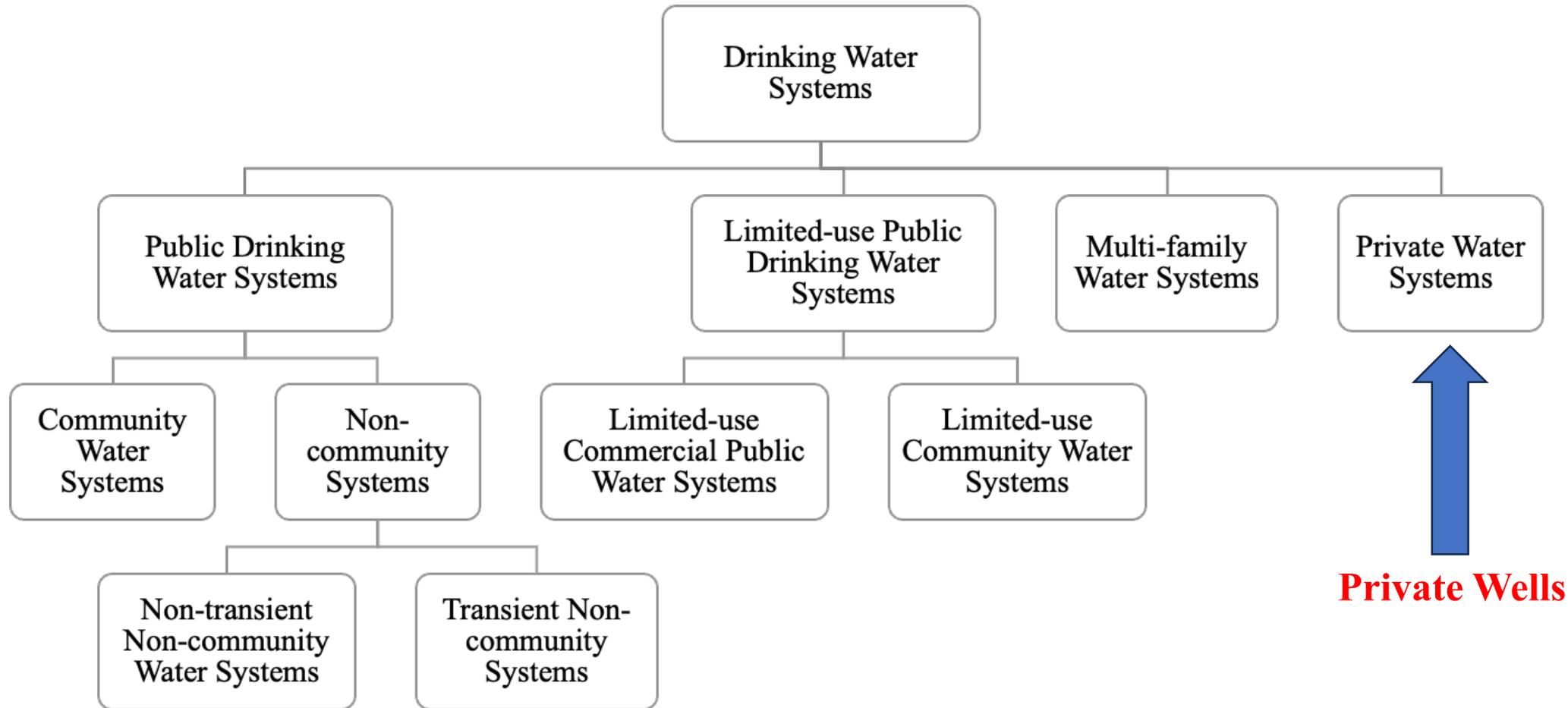
# Assessing Health and Economic Impacts of Nitrate Contamination in Florida's Private Wells

*Weizhe Weng, Brendan Tuliao, Jinyang Li, Di Fang, Yilin Zhuang,  
Andrea Albertin, Chang Zhao*



FOOD AND  
RESOURCE ECONOMICS

# Drinking Water Systems in Florida





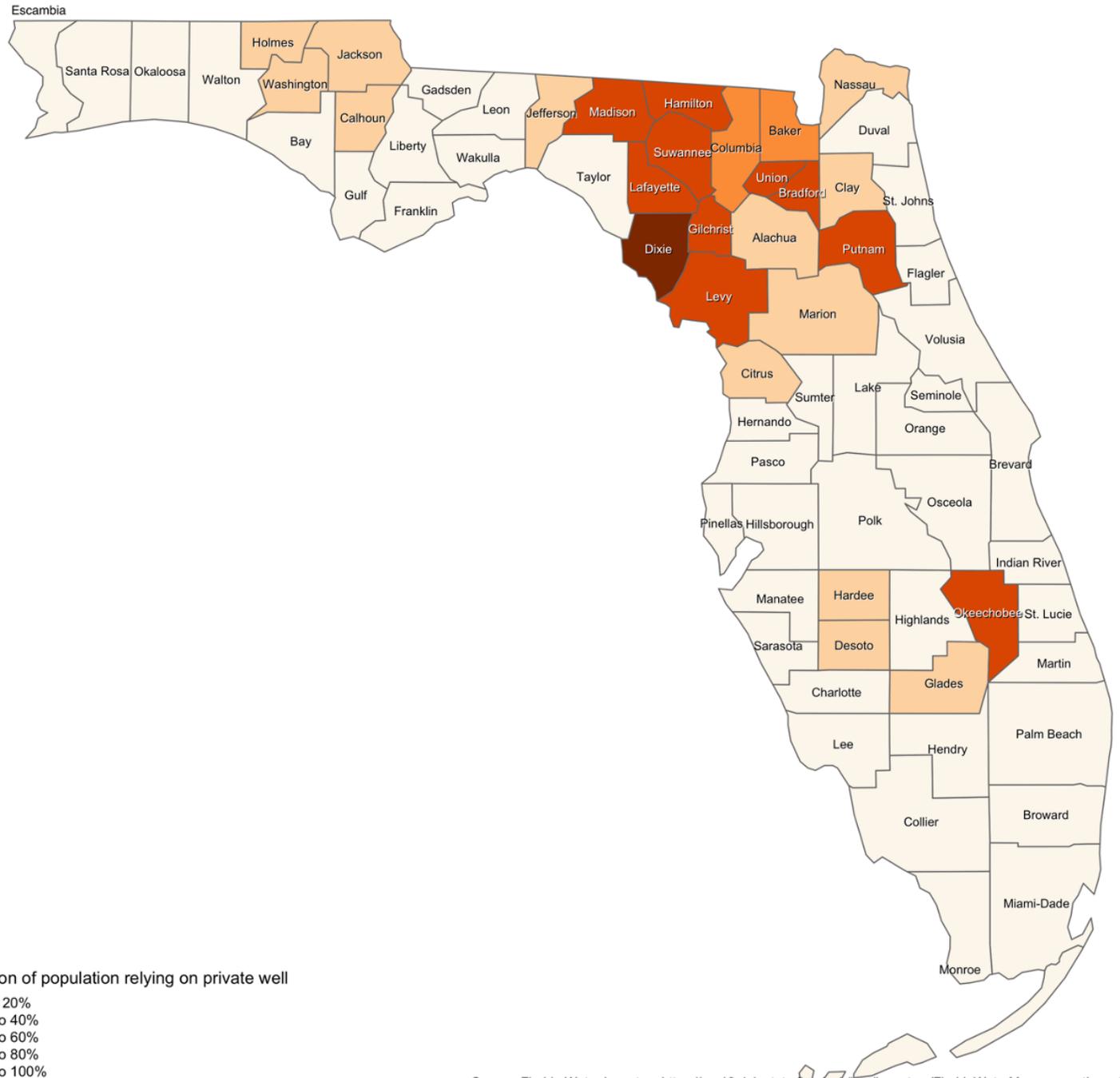
An estimated 2.5 million Floridians, or 12%, rely on private wells for home drinking water consumption.

Source: Florida Department of Health. 2020.

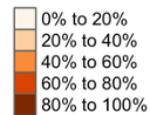
"Private Well Testing." <http://www.floridahealth.gov/environmental-health/private-well-testing/index.html>



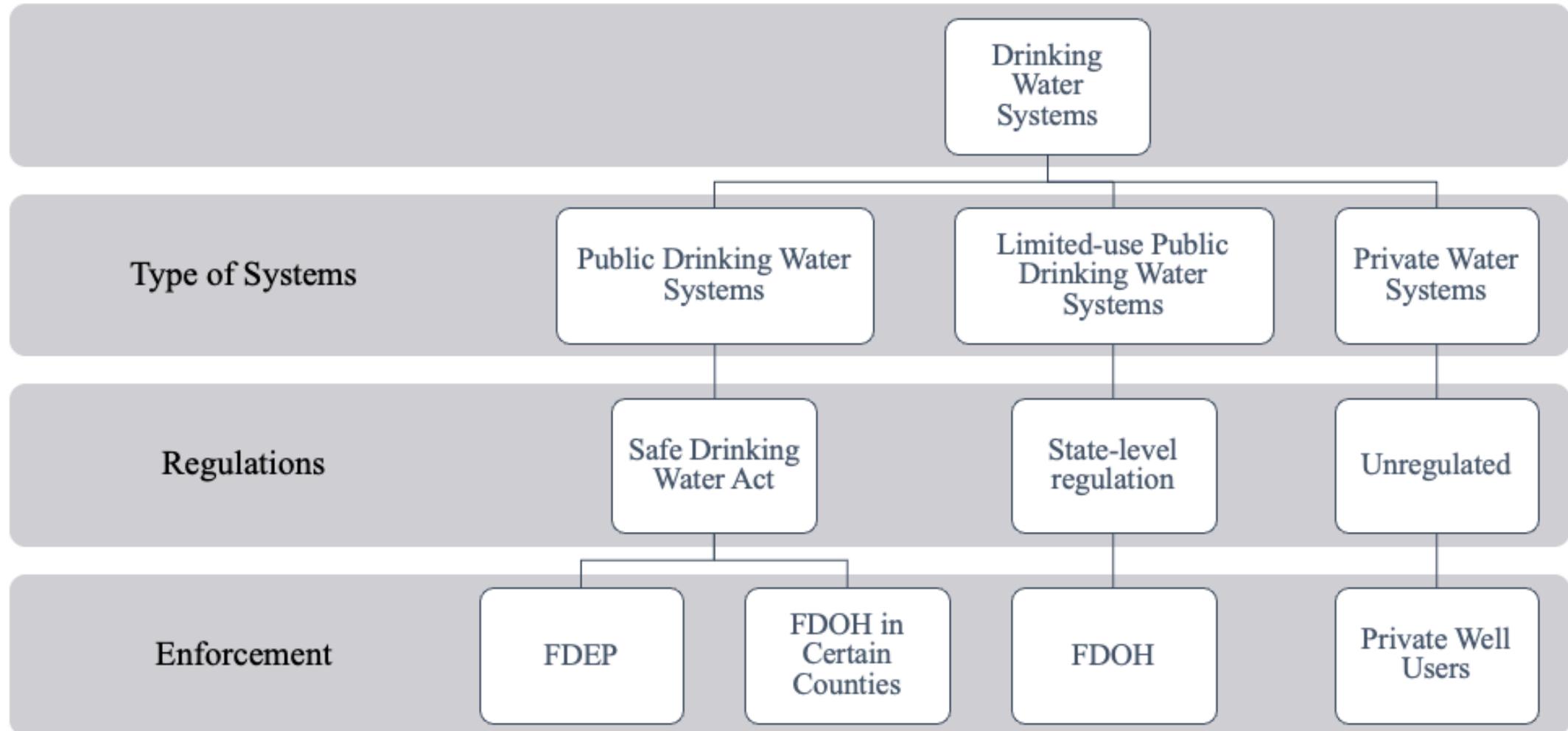
# Proportion of Population Relying on Private Wells for Drinking Water



Proportion of population relying on private well



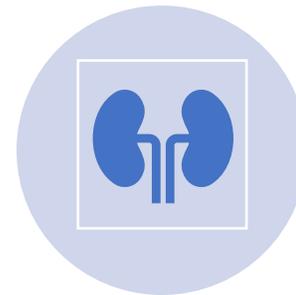
# Regulatory Landscape of Drinking Water System



# Florida Well Owner Network (FWON)



To educate residents about well water quality and quantity, and best practices to ensure well maintenance and groundwater protection



To facilitate access to well water testing and provide information about treatment options if problems are found



To complement efforts by agency partners to increase awareness among Floridians about best practices regarding wells, septic systems, and drinking water quality



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# Facts about Nitrates

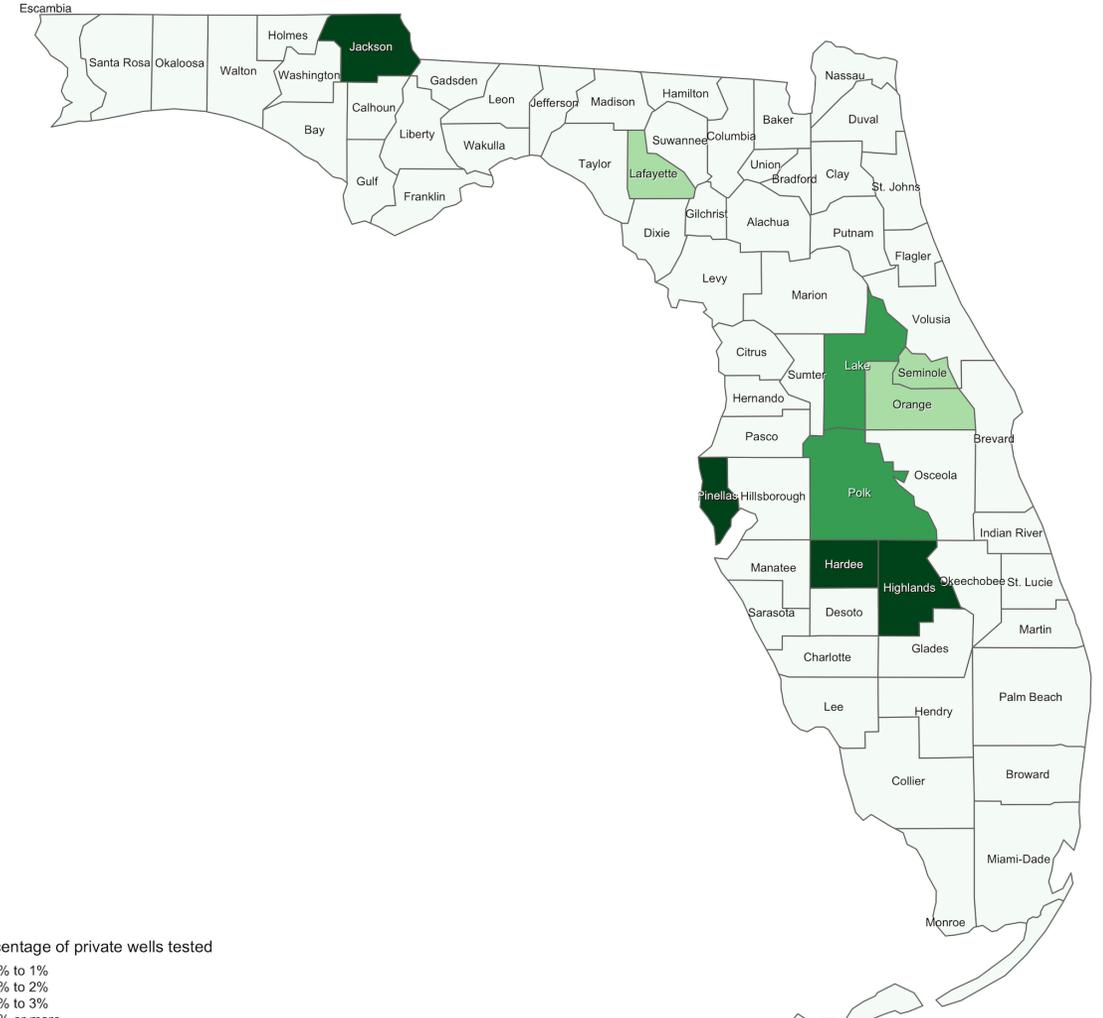
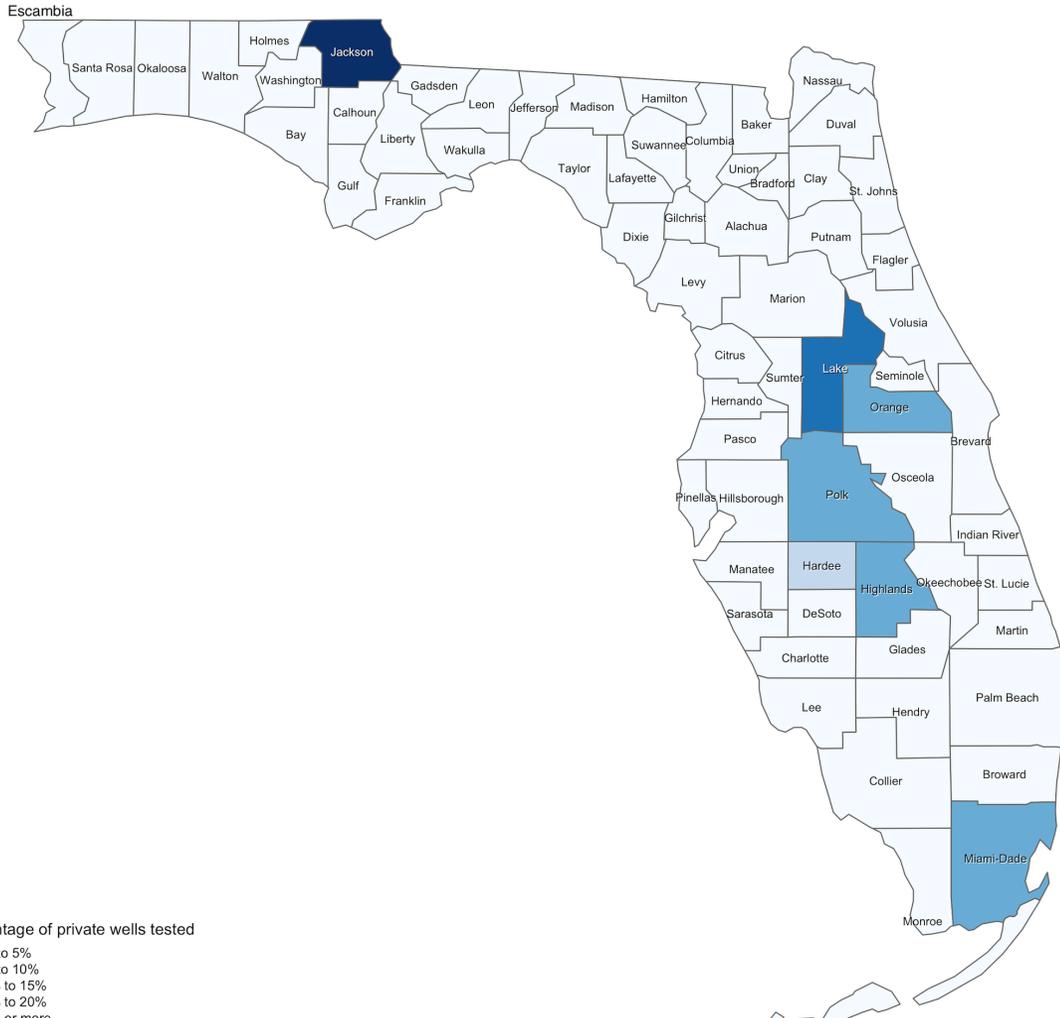
- Nitrates are chemicals found in nature.
- Drinking nitrate contaminated well water is the most likely type of exposure
- You cannot see or taste nitrates. Therefore, water that tastes good might contain nitrates.
- There is no required sampling of private drinking water wells.
- EPA's maximum contaminant level (MCL) for nitrates, set to protect against blue-baby syndrome, is 10 mg/l.



# Proportion of Private Wells Tested For Nitrate Concentrations

**Panel A: All Historical Records (1990 to 2022)**

**Panel B: The Most Recent 10 Years (2012 to 2022)**



Source: Florida Department of Environmental Protection, Florida Department of Health, Aquifer Watch

Source: Florida Department of Environmental Protection, Florida Department of Health, Aquifer Watch

# Economic Impacts of Nutrient Pollution

- Impacts on Housing Market and Public Finance



Ecological Economics  
Volume 169, March 2020, 106556



Analysis

## Coupling Natural and Human Models in the Context of a Lake Ecosystem: Lake Mendota, Wisconsin, USA

Weizhe Weng<sup>a</sup>, Kevin J. Boyle<sup>b</sup>, Kaitlin J. Farrell<sup>c,d</sup>, Cayelan C. Carey<sup>c</sup>, Kelly M. Cobourn<sup>e</sup>, Hilary A. Dugan<sup>f</sup>, Paul C. Hanson<sup>f</sup>, Nicole K. Ward<sup>c</sup>, Kathleen C. Weathers<sup>g</sup>

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## Quantifying co-benefits of water quality policies: An integrated assessment model of land and nitrogen management

Weizhe Weng, Kelly M. Cobourn, Armen R. Kemanian, Kevin J. Boyle, Yuning Shi, Jemma Stachelek, Charles White

First published: 08 August 2023 | <https://doi.org/10.1111/ajae.12423> | Citations: 1

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# Infant Health Impacts of Nitrate Pollution

Adverse Health Outcome	Reference Literature	Nitrate cut-off (mg/L)	Risk Ratio
Neural Tube Defects	Brender et al. 2013	4.5	1.43
Very Low Birth Weight	Stayner, 2017	1	1.17
Very Preterm Birth	Stayner, 2017	1	1.08

## Reference:

- Brender, J. D., Weyer, P. J., Romitti, P. A., Mohanty, B. P., Shinde, M. U., Vuong, A. M., ... & National Birth Defects Prevention Study. (2013). Prenatal nitrate intake from drinking water and selected birth defects in offspring of participants in the national birth defects prevention study. *Environmental health perspectives*, 121(9), 1083-1089.
- Stayner, L. T., Almborg, K., Jones, R., Graber, J., Pedersen, M., & Turyk, M. (2017). Atrazine and nitrate in drinking water and the risk of preterm delivery and low birth weight in four Midwestern states. *Environmental research*, 152, 294-303.

# Economic Costs for Nitrate-Attributable Adverse Birth Outcomes

## Direct Economic Costs

- **Costs of hospitalization for medical concerns**
  - Grosse et al. 2016: Lifetime direct medical costs for neural tube defects- \$747,636 to \$1,026,088 per case (in 2024 U.S. dollars)
  - Institute of Medicine: Premature births- \$86,842 per case (in 2024 U.S. dollars)

## Indirect Economic Costs

- **Expected lifetime earnings loss due to IQ reduction**
  - Kormos et al. 2014: Low birth weight was considered to incur a 4.98-point loss in IQ
  - Lin et al. 2018: 1 point IQ reduction reduces expected lifetime earnings by 1.39 percent
  - USEPA: each IQ point loss was valued at \$15,218 to \$20,580 in 2024 dollars

# What Does the Scientific Literature Say?

- **Temkin et al. (2019):** National study
  - Annually, 2,939 very low birth weight births, 1,725 very preterm births, and 41 births with neural tube defects could be attributable to nitrate exposure
  - Nitrate-attributable cases of neural tube defects, very low birth weight and very preterm birth account for 1.4%, 5.3%, and 2.7% of total annual cases of these adverse reproductive outcomes in the U.S.
  - Overall, the annual economic costs for infant health impacts ranges from \$254 to \$342 million (lower bound, in 2024 dollars)
- **Mathewson (2020):** Wisconsin study
  - Direct medical costs:
    - \$0.75 to \$2.1 million for neural tube defects (annually, in 2024 dollars)
    - \$10 to \$48 million for very preterm birth and very low birthweight (annually, in 2024 dollars)
  - Indirect economic costs:
    - \$4 to 15 million from very low birthweight births (annually, in 2024 dollars)

# How about Florida?

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- What's next?
  - Integrating Geo-AI, economic models and public health research
    - Conducting risk and exposure assessment at a fine geospatial scale
    - Quantifying health and economic impacts of nitrate contamination
    - Exploring optimal information channels to increase private well testing and monitoring



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