Modeling the Institutional Determinants Drivers of Reactive Operations and Maintenance in Decentralized Wastewater Systems

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Introduction

- Alabama Black Belt: rural, limited-resource communities
- Inadequate wastewater infrastructure due to reactive operations and maintenance (O&M)
- Reactive practices: delaying repairs until visible problems occur



Fig 1. Straight Piping in Alabama's Black Belt

Research Question

What are the factors and how do they contribute to **reactive** O&M for decentralized wastewater systems?

- Identify potential **drivers** of reactive O&M.
- Understand how drivers **impact** reactive O&M.
- Provide **recommendations** to Black Belt stakeholders.

Methodology

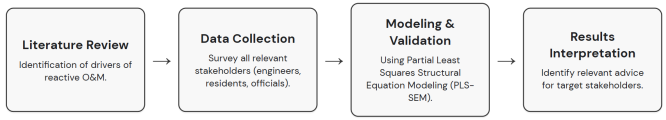


Fig 2. Adopted Methodology

Data Preparation and Analysis

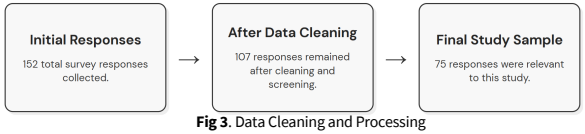


Fig 3. Data Cleaning and Processing

16 states, with data collection still ongoing

16 survey indicators

Partial Least Square Structural Equation Modeling (PLS-SEM)

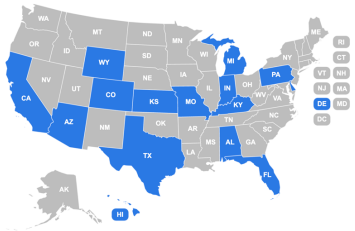


Fig 4. Data Collection Coverage

Results and Discussion

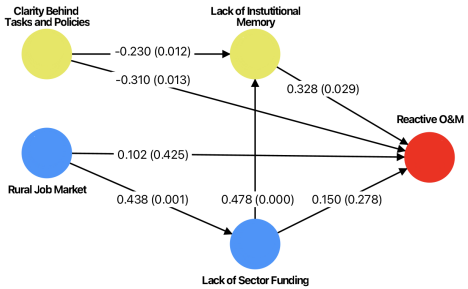


Fig 5. Complete PLS-SEM Model

- Lack of clarity behind tasks can demotivate workers to :
  - Do preventative repairs.
  - Document system functionality.
- Lack of documentation of system functionality forces constant problem-solving efforts from newer workers.

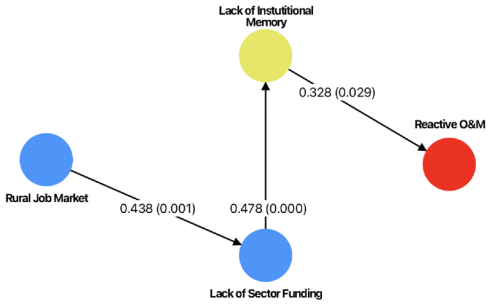


Fig 6. Indirect Path on our PLS-SEM

- Loss of institutional memory is a recurring challenge across the wastewater sector.
- Rural wastewater organizations face this challenge more acutely because limited resources restrict knowledge preservation.
- Limited staffing and expertise also reduce communities' capacity to pursue federal funding.

Stakeholder Recommendations and Policy Implications

Clarify Tasks and Policies
Convert policies into role-specific procedures defining who acts, when, and why

Simplify Funding Access
Streamline a rural community waiver for standard funding requirements

Shared Grant Administration
Fund shared grant administrators, fiscal agents, and technical intermediaries across communities

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Acknowledgments

We would like to thank all of the organizers in the 2026 Summer Research Experiences for Undergraduates (REU) Program Smart and Sustainable Construction in the Digital Era, as well as the U.S National Science Foundation (NSF) for funding this project.