# Predicting Wastewater Workforce Retention Impacted by Sectoral Challenges in Rural Communities

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## Introduction

- U.S. wastewater systems face persistent workforce shortages that threaten long-term service delivery.
- Workforce retention research traditionally emphasizes worker-centered factors such as pay, burnout, work-life balance, and career growth.
- Broader sectoral conditions may also shape whether workers remain in the wastewater workforce, but these conditions remain unexamined.



**Fig 1.** Decentralized Wastewater Conducting Maintenance on a Septic Tank

## Research Question

How do sectoral challenges and worker-centered determinants interact to influence wastewater workforce retention?

- Identify pathways linking contextual challenges to worker-centered determinants.
- Evaluate direct and indirect effects on workforce retention.
- Identify intervention points beyond individual workers.

## Methodology

**Literature Review** — Identification of contextual challenges and workforce retention drivers. →

**Data Collection** — Nationwide survey deployment. →

**Modeling & Validation** — Using Partial Least Squares Structural Equation Modeling (PLS-SEM). →

**Results Interpretation** — Identify relevant advice for target stakeholders.

**Fig 2.** Adopted Methodology

## Data Preparation and Analysis

**Data collection and cleaning:**

- National wastewater workforce survey
- Convenience, purposive, and snowball sampling
- Data points: 152 responses, 107 after cleaning

**Considered worker-centered determinants:**

Burnout · Career growth · Pay and benefits satisfaction · Work-life balance

**Considered contextual challenges:**

Reactive work culture · Rurality and job scarcity · Infrastructure funding diversion

## Results and Discussion

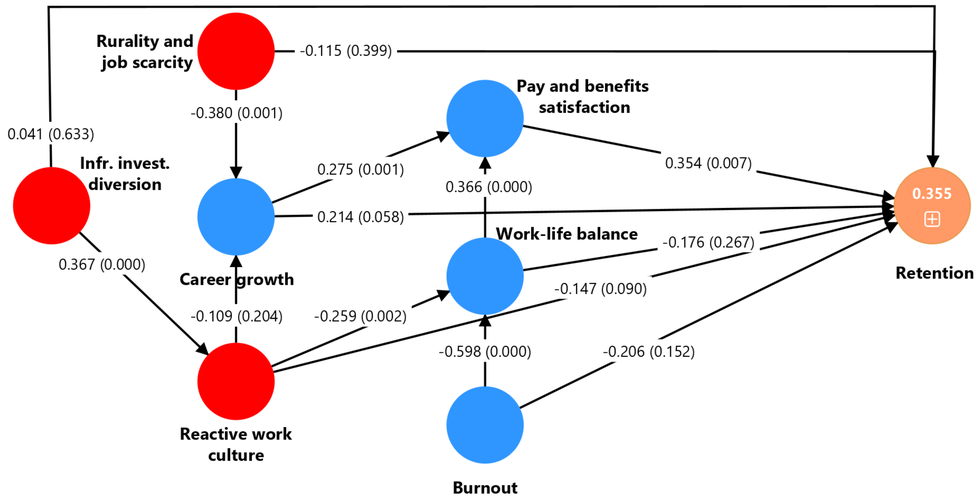



**Fig 3.** Contextualized PLS-SEM Model for Decentralized Wastewater Workforce Retention

**1. Contextual Challenges Matters Indirectly**

- Contextual challenges showed no significant direct effects on retention.
- Their influence occurs primarily through established worker-centered determinants.

**2. Contextual Challenges Undermine What Makes Workers Stay**

- Rural job scarcity and reactive work culture weaken career growth and work-life balance, reducing pay satisfaction being the strongest driver of retention.
- The sector is weakening its own ability to retain workers.

## Stakeholder Recommendations and Policy Implications

**Improve Compensation Strategically**
Compensation increases alone will not sustain retention unless contextual barriers are addressed, especially in limited-resource rural communities with limited financial flexibility

**Protect Preventive O&M Funding**
Tie infrastructure funding to explicit preventive O&M requirements to prevent resources from being diverted to different system mechanisms

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