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A Framework for Informing County-scale Sustainable Organic Waste Management in Rural Farming Regions of the United States

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Background

Motivation: **Community-level** assessment of **organic waste** management via **resource recovery** in **rural farming** regions can be challenging due to **data unavailability** and contextual **policy**.

Knowledge gaps in literature:

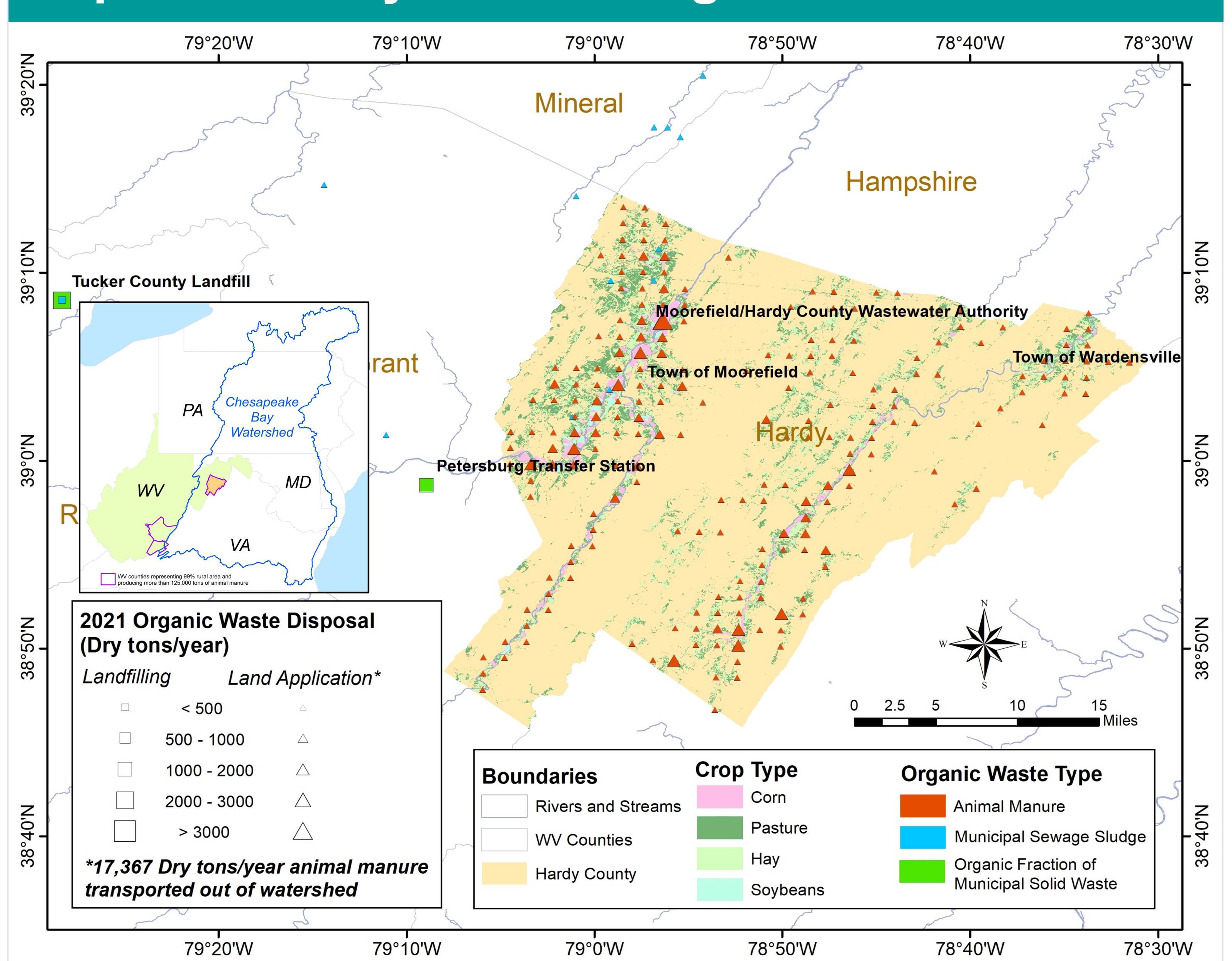
- Assessments were conducted at the **regional- to national-scale**.
- Sustainability analysis included **life cycle assessment** (LCA) and **techno-economic analysis** (TEA), although **not social impact assessment** (SIA).

Study goal: Develop a data-driven **framework** to inform **community-level sustainable** management of organic waste in rural farming regions utilizing **open-source data** and methods.

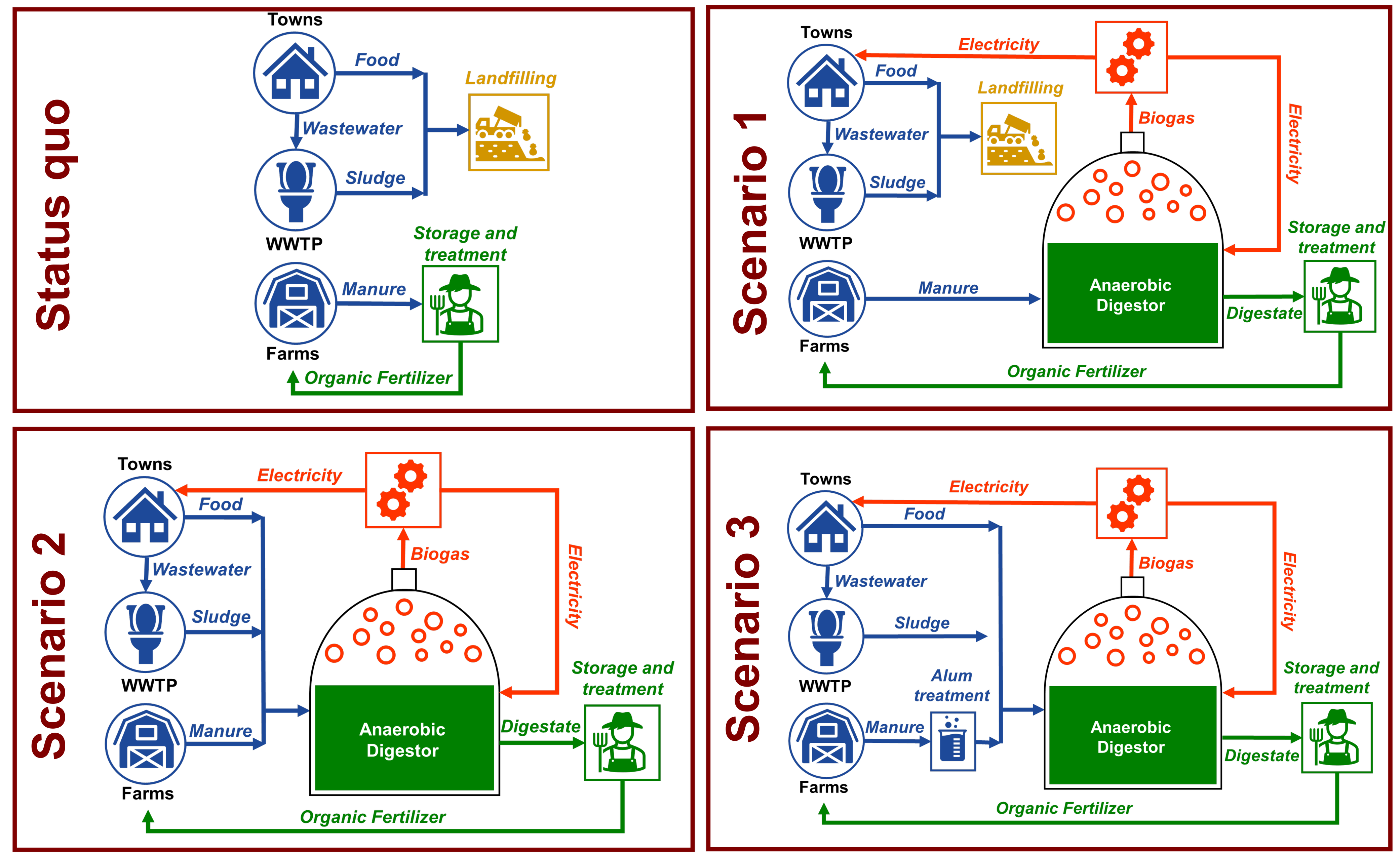
Proposed Framework

- Step 1: Quantify mass of organic waste available for resource recovery
- Step 2: Develop alternative resource recovery scenarios
- Step 3: Analyze environmental, economic, and social impacts of scenarios
- Step 4: Inform relevant policies to promote resource recovery

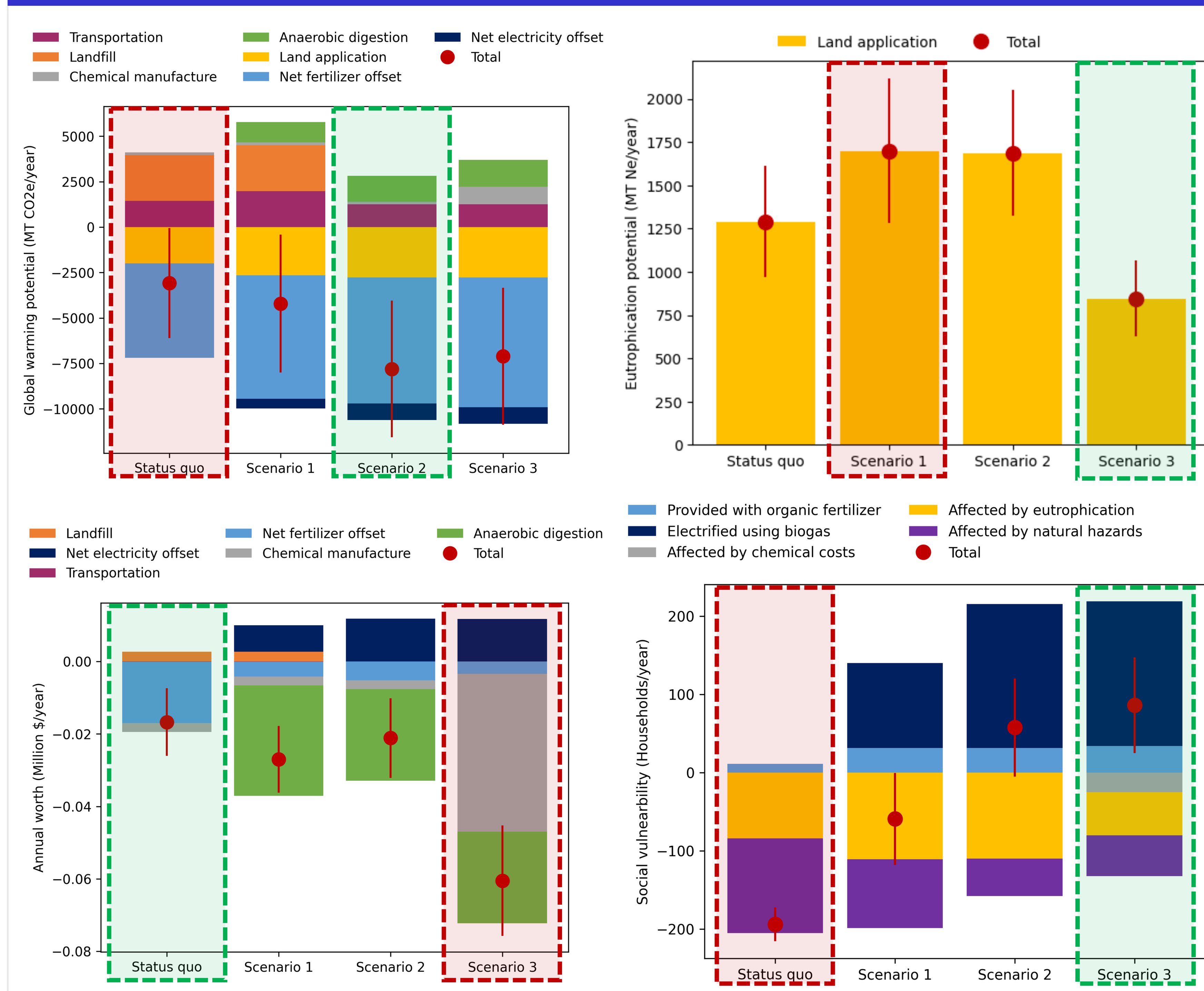
Step 1: Quantify mass of organic waste



Step 2: Develop alternative resource recovery scenarios



Step 3: Analyze environmental, economic, and social Impacts



Legend

Best Scenario

Worst Scenario

Methods

LCA:

1. USEPA Waste Reduction Model (WARM)
2. USEPA Tool for Reduction and Assessment of Chemicals and other Environmental Impacts (TRACI)
3. Nutrient Use Geographic Information System (NuGIS)

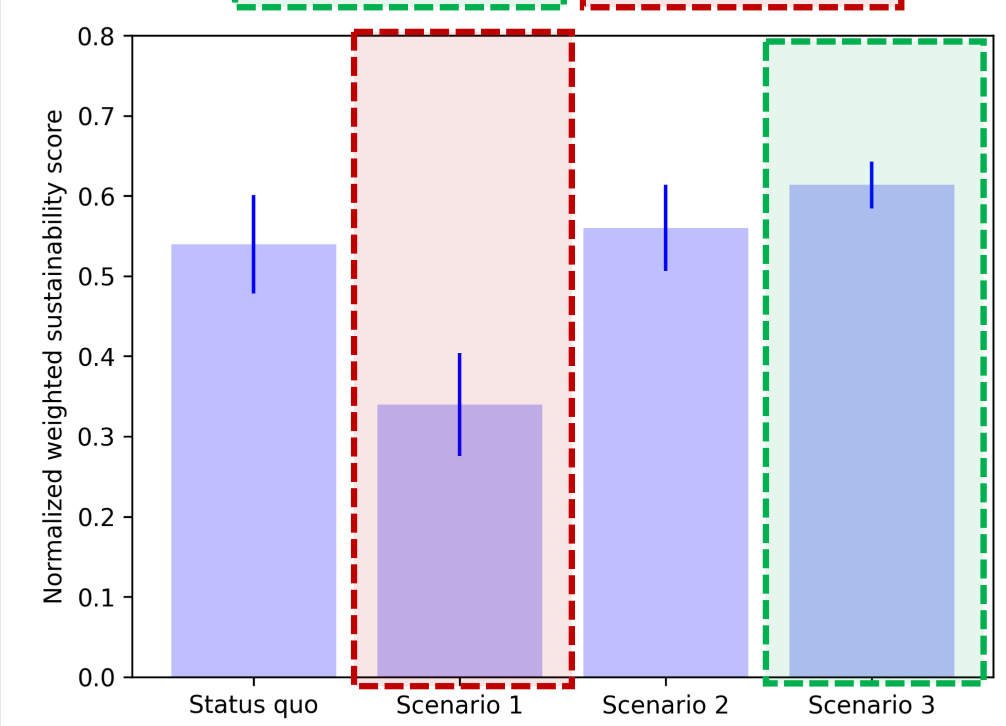
TEA:

1. USEPA Co-Digestion Economic Analysis Tool (CoEAT)
2. USEPA Cost Estimating Tool for Managing Source-separated Organic Waste (OrganEcs)
3. Net Present Value (NPV)

SIA:

1. US EPA Environmental justice tool
2. White House Climate and economic justice tool

Step 3: *Continued*



$$SS_i = (0.20)(nGWP_i) + (0.40)(nEP_i) + (0.35)(nAW_i) + (0.05)(nVH_i)$$

Where, $nGWP_i$, nEP_i, nAW_i, and nVH_i referred to normalized values of global warming potential, eutrophication potential, annual worth, and social vulnerability for different scenarios, respectively ($i = 0$ denoted status quo and $i = 1 - 3$ denoted scenarios 1 through 3).

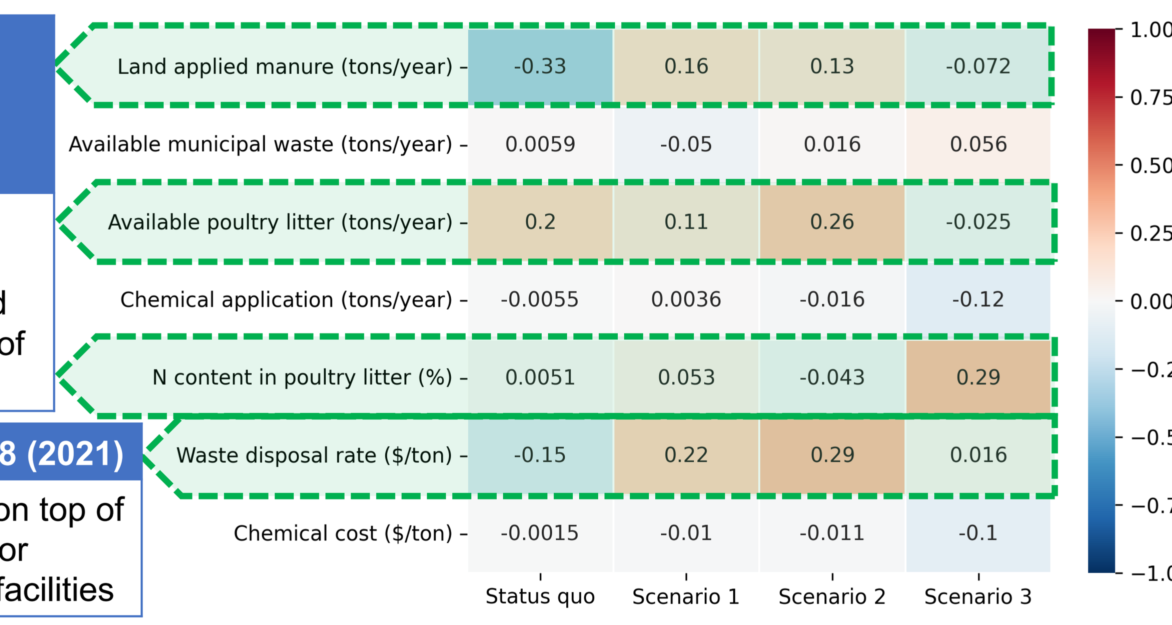
Step 4: Inform relevant policies

WV Chesapeake Bay Watershed Implementation Plan (2019)

County-level co-digestion of 85% poultry litter instead of transporting out of watershed by 2025

WV Senate Bill 368 (2021)

Include incentives on top of penalty deduction for resource recovery facilities



Conclusion

Major findings: Based on the **preference** of Hardy County farming **community** for improving environment, economy, and society

- The overall **sustainability** of scenario 1 (**anaerobic digestion of manure**) was **worse** than **status quo**.
- **Co-digesting** municipal waste with **chemically-treated** manure (scenario 3) resulted in the **most sustainable** organic waste management over other scenarios.

Impacts: The framework can be a **useful tool** for rural farming regions in the USA to aid the **context-specific evaluation** of **commercially-available RRCC** technologies at the **community level** and inform **policies** for sustainable waste management.

Acknowledgements

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