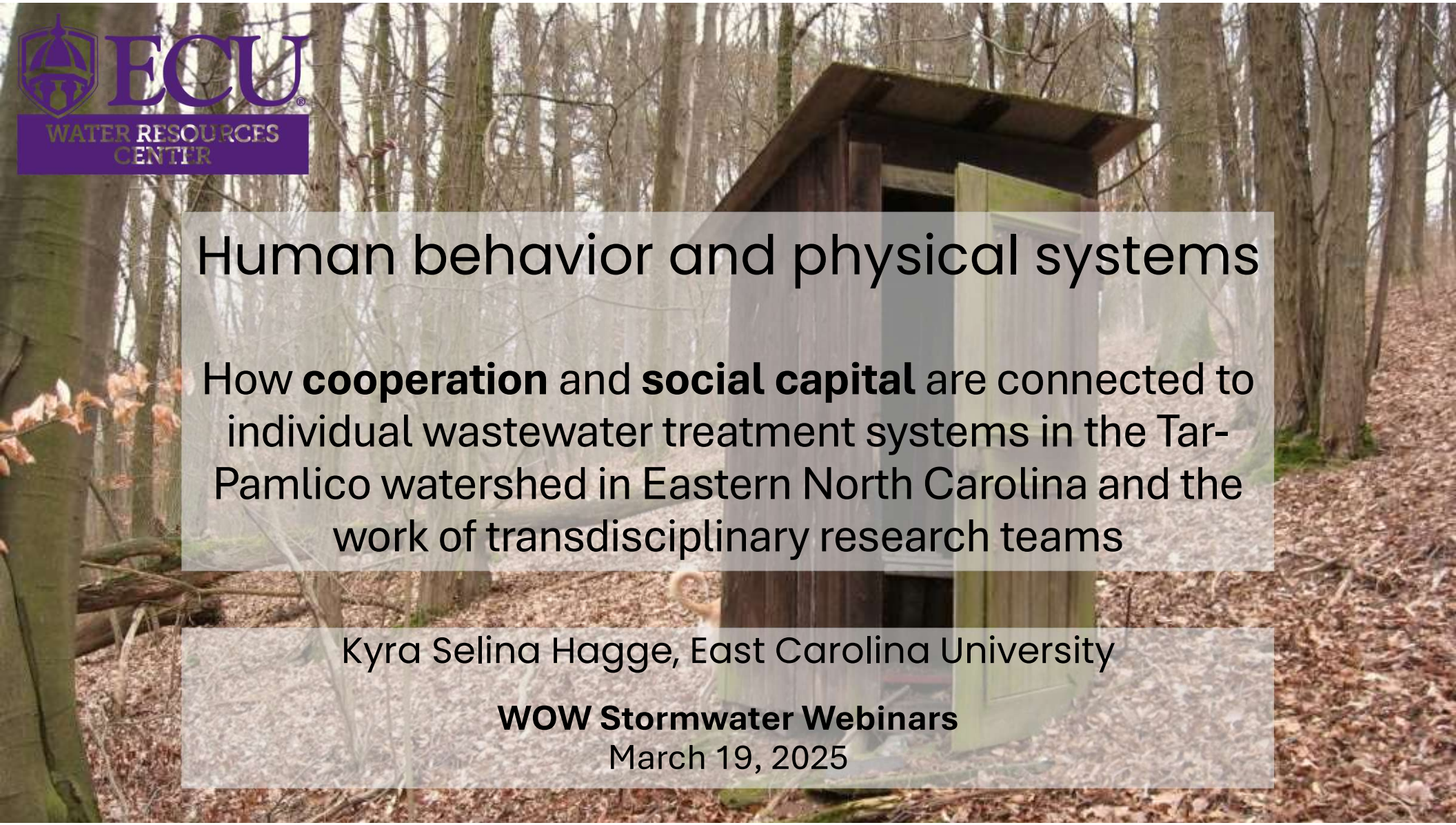


Human behavior and physical systems

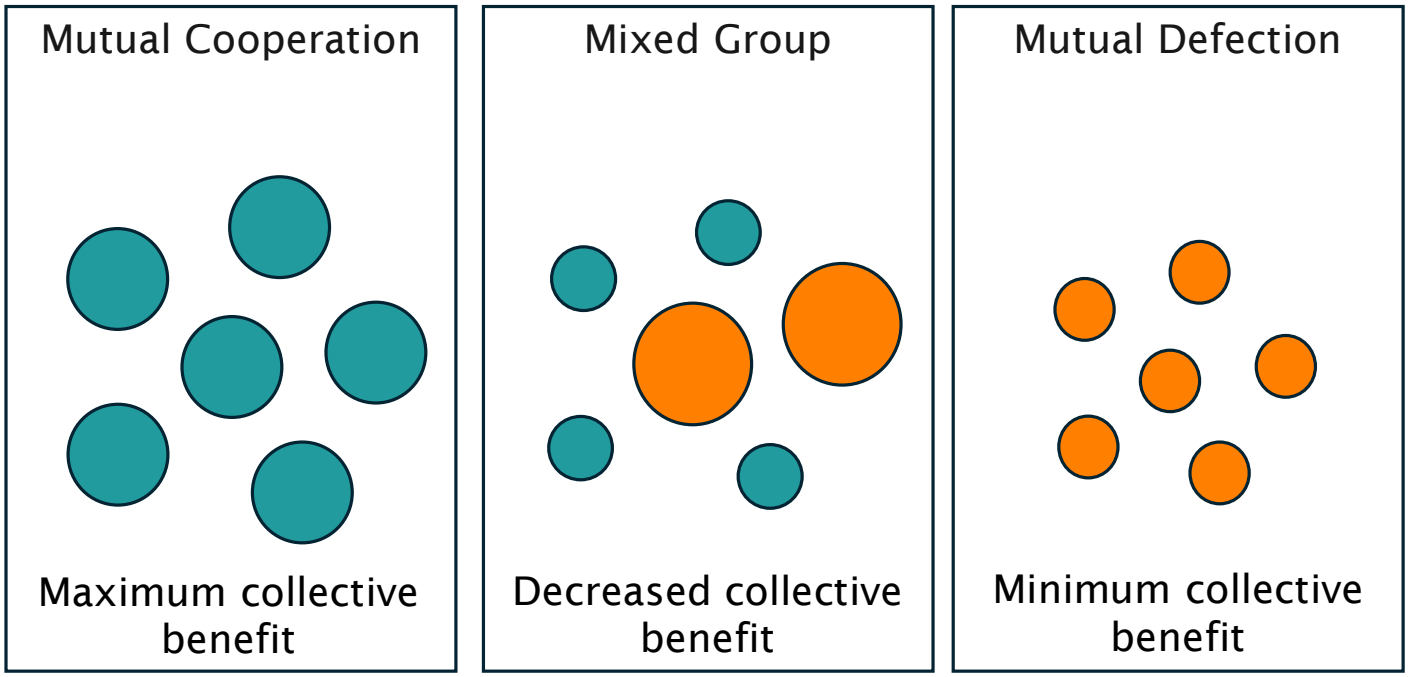
How **cooperation** and **social capital** are connected to individual wastewater treatment systems in the Tar-Pamlico watershed in Eastern North Carolina and the work of transdisciplinary research teams

Kyra Selina Hagge, East Carolina University

WOW Stormwater Webinars

March 19, 2025

Social Dilemmas and Cooperation



Cooperation and transdisciplinary research

Transdisciplinary research: integrates multiple disciplinary lenses and includes community expertise.

→ Social dilemma situation, where personal interest ≠ group interest

To conduct transdisciplinary research:

- Researchers have to decide whether they want to invest their time and resources in their own disciplinary research or transdisciplinary efforts? A lot is at stake: funding, recognition, career progression..

How does cooperation impact collaboration?

Interactive question

"What do you think is the biggest challenge in transdisciplinary teams?“

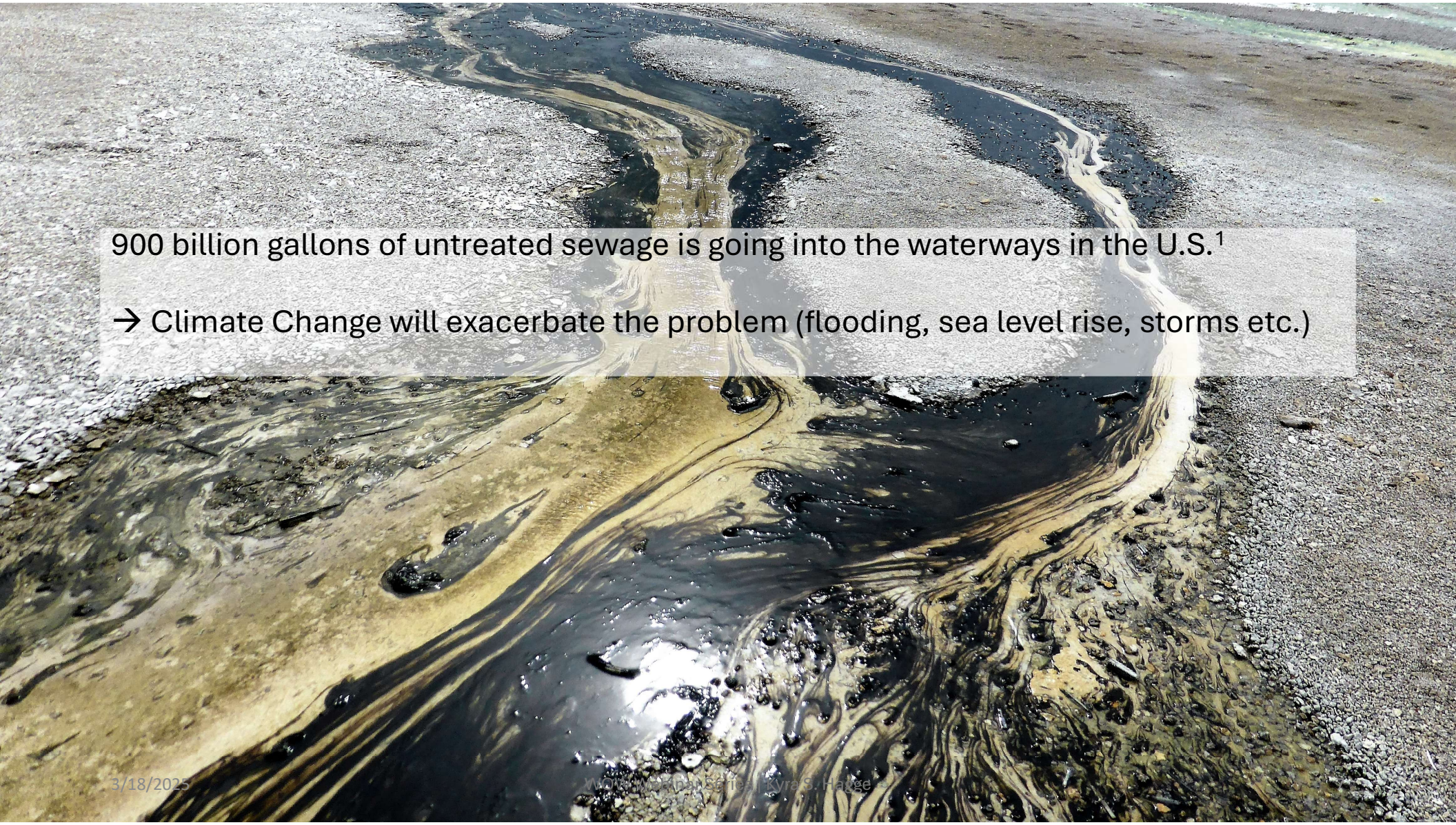
Transdisciplinary research results

Not every researcher in a transdisciplinary research group thinks about cooperation the same way

- Prosocial – think about benefitting others or the society as a whole, even if it means sacrificing personal gains
- Individualistic – maximizing personal gain before considering others' outcomes

- 39% of researchers who are pro-socially oriented would collaborate in a transdisciplinary research venture unconditionally, and 31% collaborate in transdisciplinary research if other researchers in the team are.
- 67% of the individualistic researchers only conduct interdisciplinary research when others do
- Prosocial oriented researchers contribute more money to the pool that benefits the whole research team (56%) vs. 33% by individualistic researchers
- 48% of the individualistic oriented scientists keep their funds to themselves

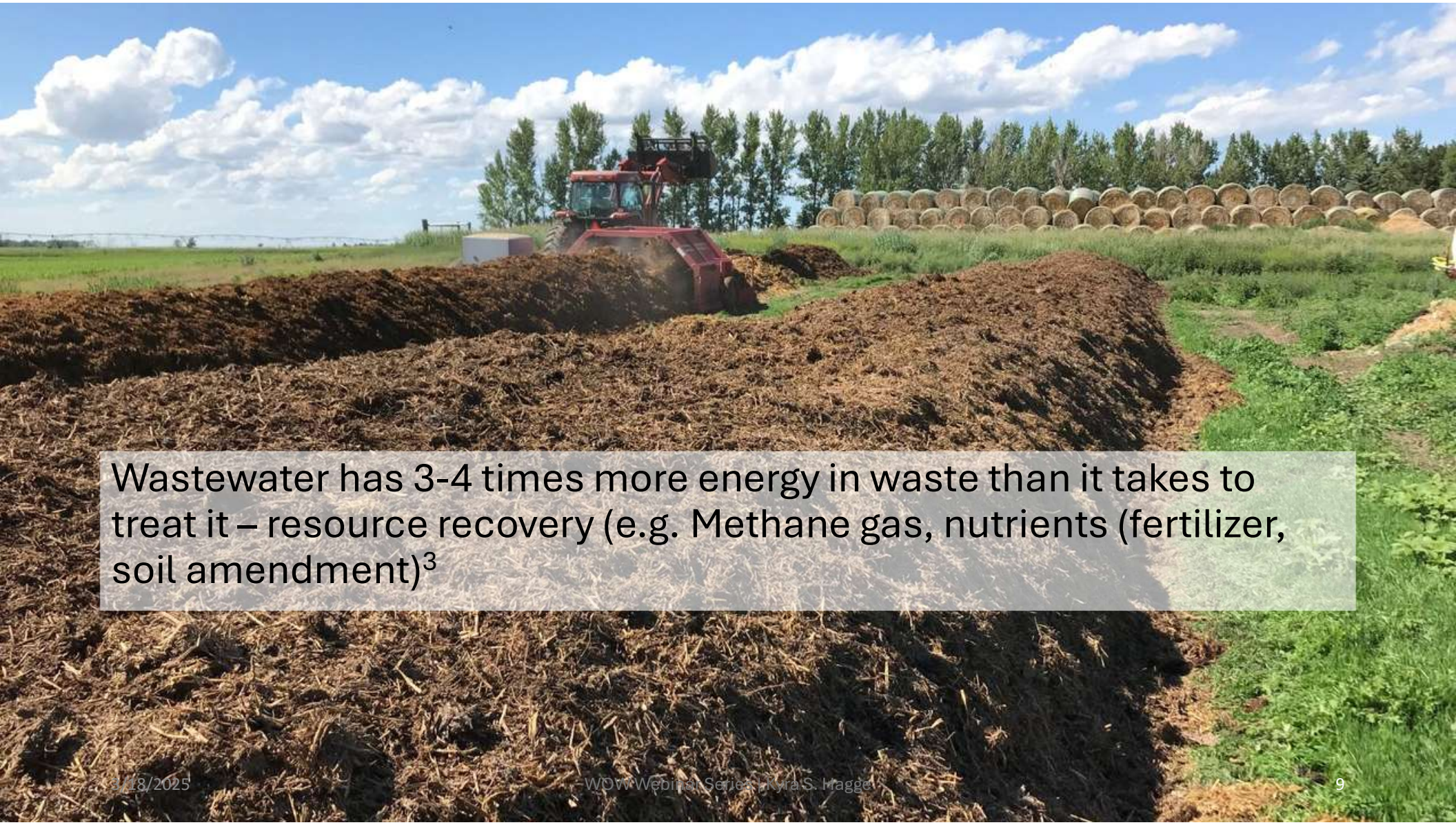
Now let’s go to the field..



900 billion gallons of untreated sewage is going into the waterways in the U.S.[1]

→ Climate Change will exacerbate the problem (flooding, sea level rise, storms etc.)


3% of total energy consumed in the U.S. is used for wastewater treatment[2]



Wastewater has 3-4 times more energy in waste than it takes to treat it – resource recovery (e.g. Methane gas, nutrients (fertilizer, soil amendment)[3]

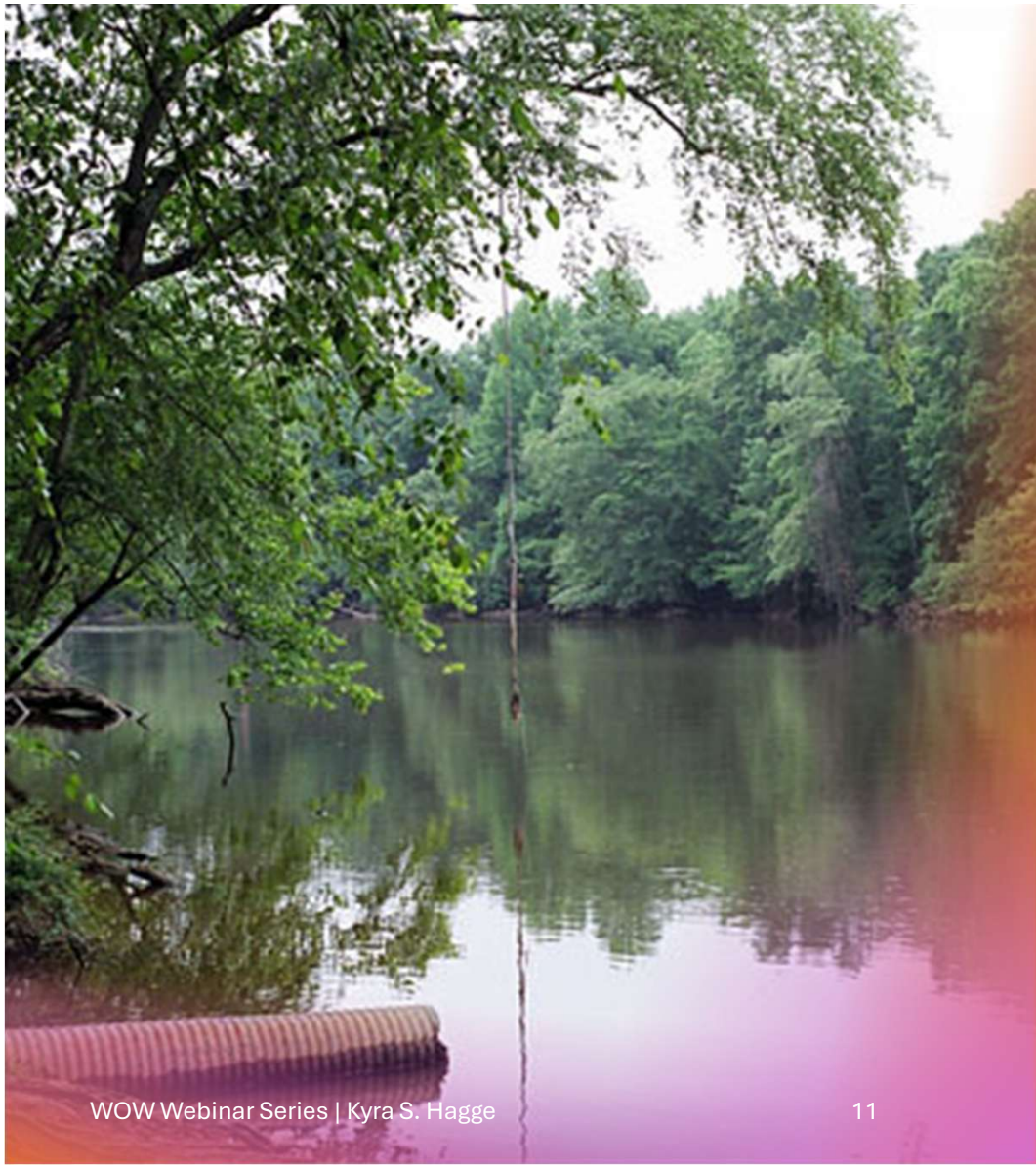
Additionally..

- Geology (changing environment, e.g. barrier island system) or economics (less affluent rural areas, low population density) are prohibiting the connection to centralized sewer systems.

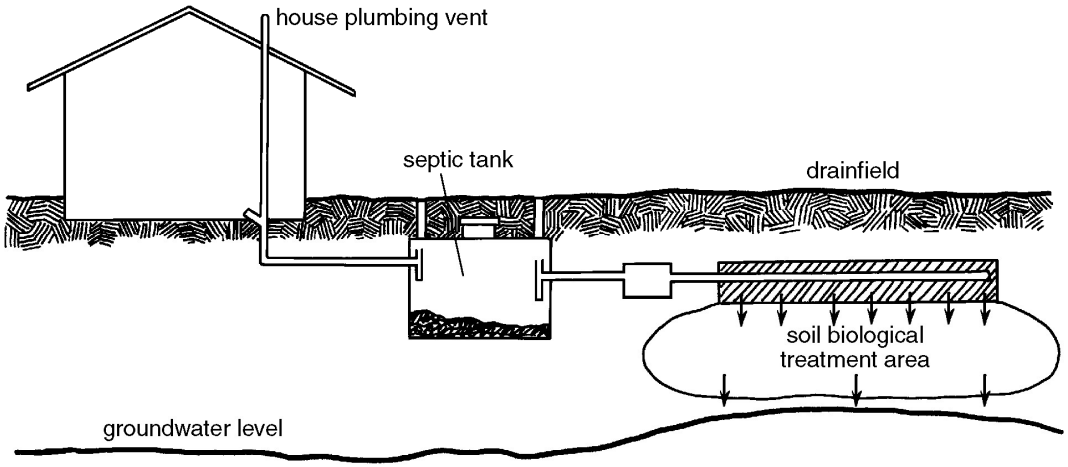
- Therefore: Individual wastewater treatment solutions are necessary.

Technologies

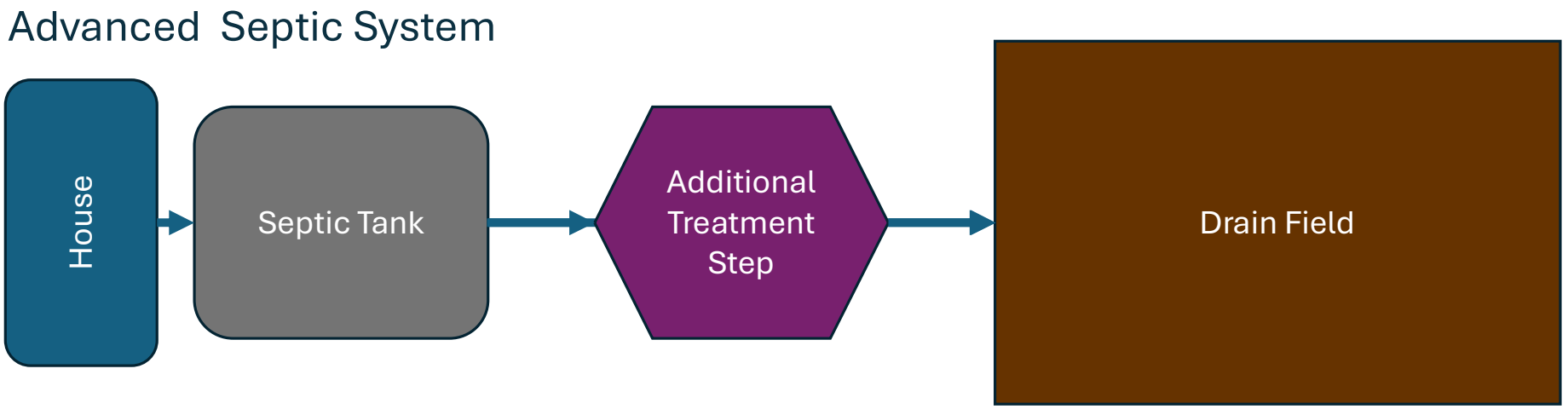
- Traditional septic system
- Advanced septic system
- Cluster septic system



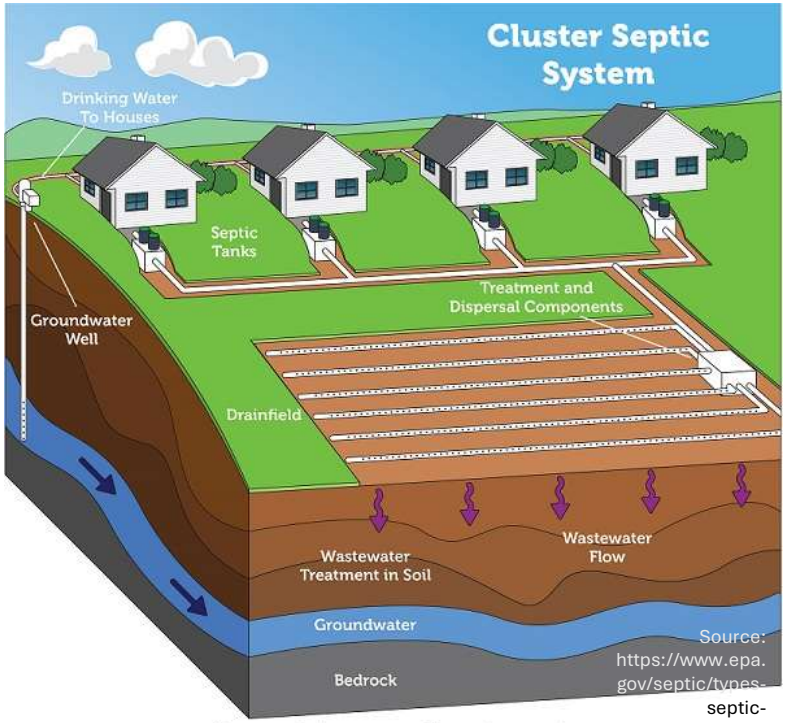
Traditional septic system



Advanced septic system



Cluster septic system



Source: https://www.epa.gov/septic/types-septic-systems#cluster

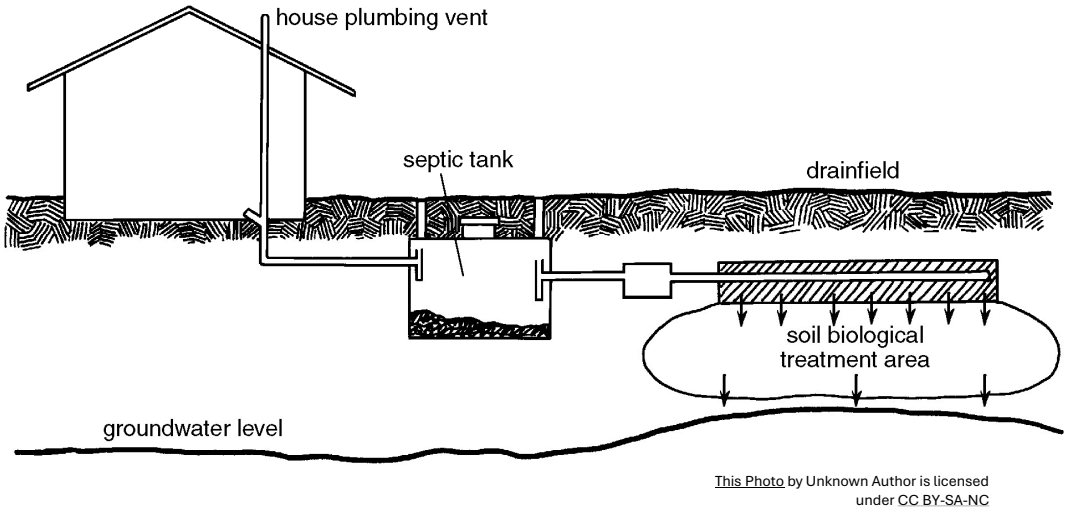
Source: anchoragetank.com/septic-systems/advantex/commercial-advantex/call-of-the-wild-subd/

Community drain field

Opportunities and challenges with individual wastewater treatment

Opportunities:

+ in situ treatment replenishes aquifers
+ Low-cost option in rapidly developing or less developed areas



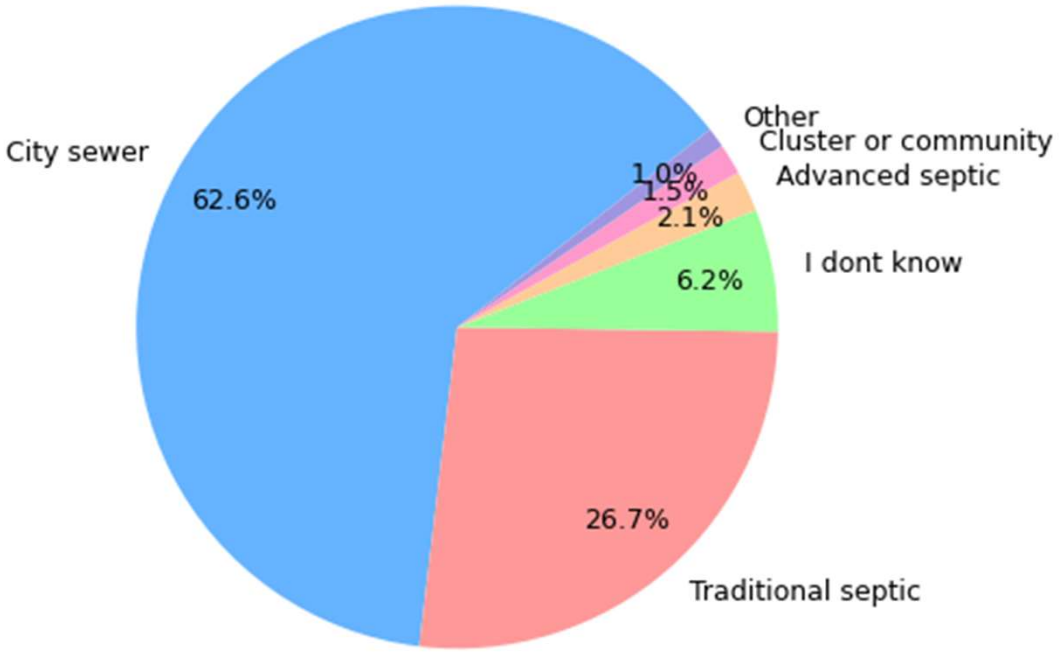
Challenges:

- Changing environment (sea-level rise, flooding..)
- Individual responsibility for the system (knowledge, maintenance)

Pilot Data

- 215 respondents from:
  - Eastern NC (25 respondents) collected at the Tar River Community Science Festival in November 2024
  - All of the U.S. in three rounds of pilot surveys on Academic Prolific (190 respondents) between November 2024 and January 2025

Distribution of technologies

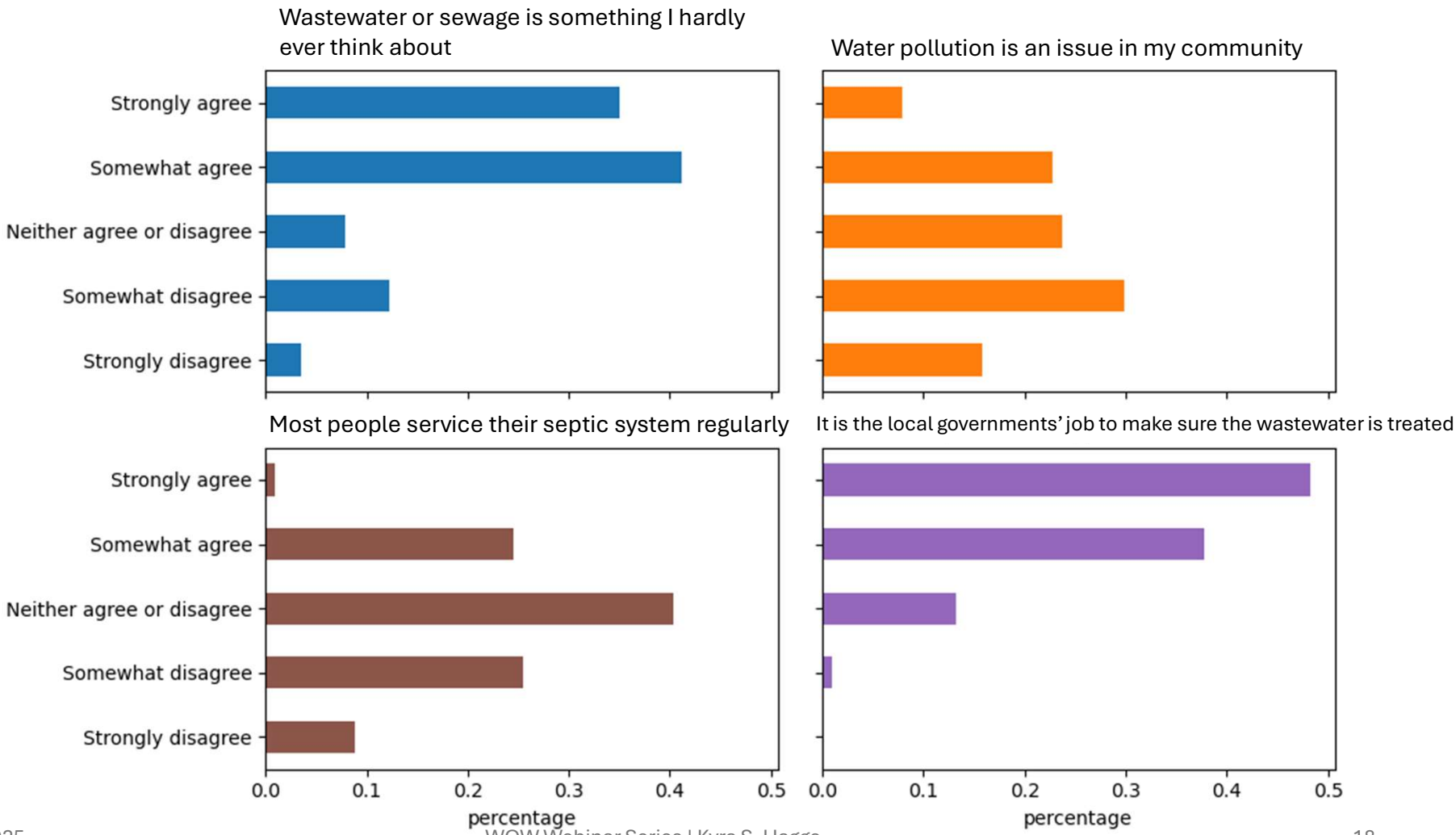


Regarding septic system maintenance:

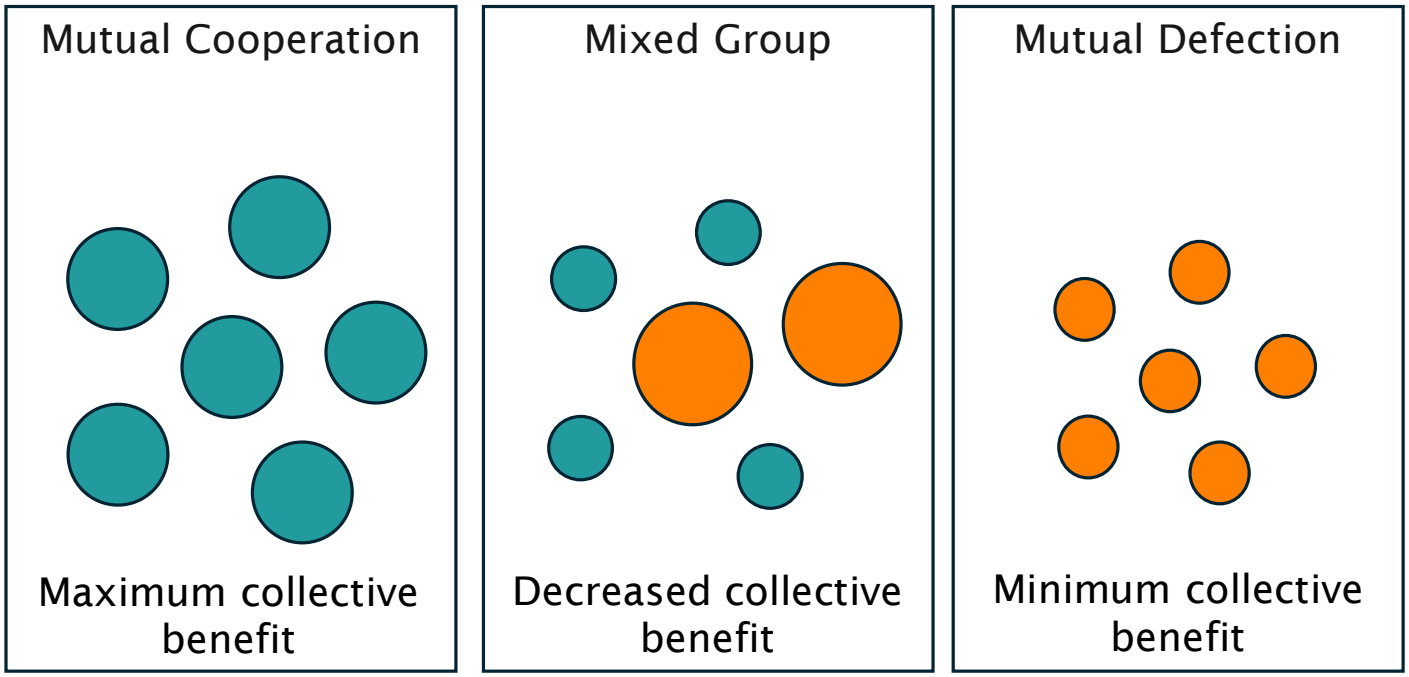
- 20% are maintaining their septic system regularly
- 40% are only reacting when there is an obvious issue
- 35% maintain it, but not on a regular schedule
- 5% never maintain their system

- About 55% don't feel equipped to maintain their septic system

Wastewater perceptions



Social Dilemmas/Cooperation/Social Capital



Social capital

- Connections between people and services these connections bring to the individual

- Research found connections between reliable human relationships (or social capital) and more resilient infrastructure

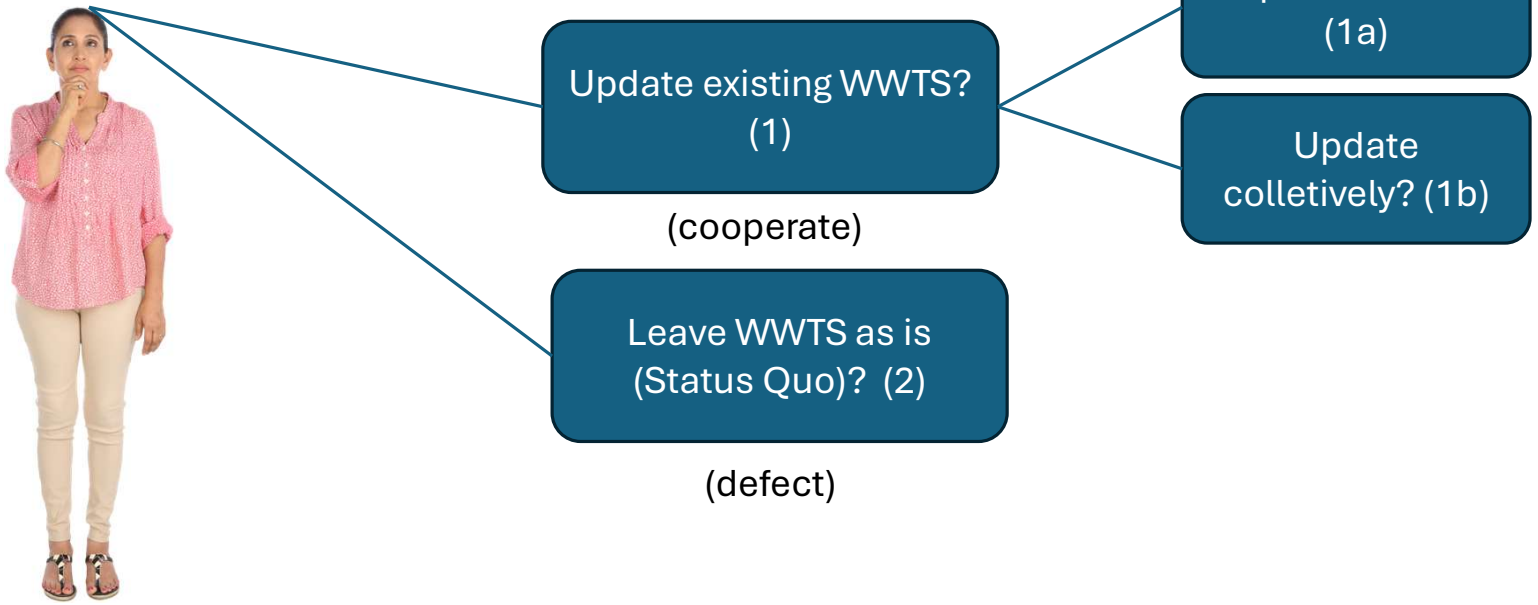
Research questions

- So in my research I am focusing on questions like: How do individual decisions in a social, environmental, and economic context lead to environmental pollution and environmental injustice?
- Where can policy and education be implemented to improve the outcomes?


Lake Gaston
15
Haliwa-Saponi SDTSA
Tar-Pamlico Basin
Durham
216 ft
Rocky Mount
Princeville
Raleigh
Tar River
Greenville
Pocosin Lakes National Wildlife Refuge
84 ft
Nags Head
Goldsboro
Coastal Plain
Kinston
Coharie SDTSA
Cape Hatteras National Seashore
New Bern
Fayetteville
Cape Lookout National Seashore
Havelock

Basic decision of a Homeowner

- On-site wastewater treatment system (WWTS): different actions possible (1&2)

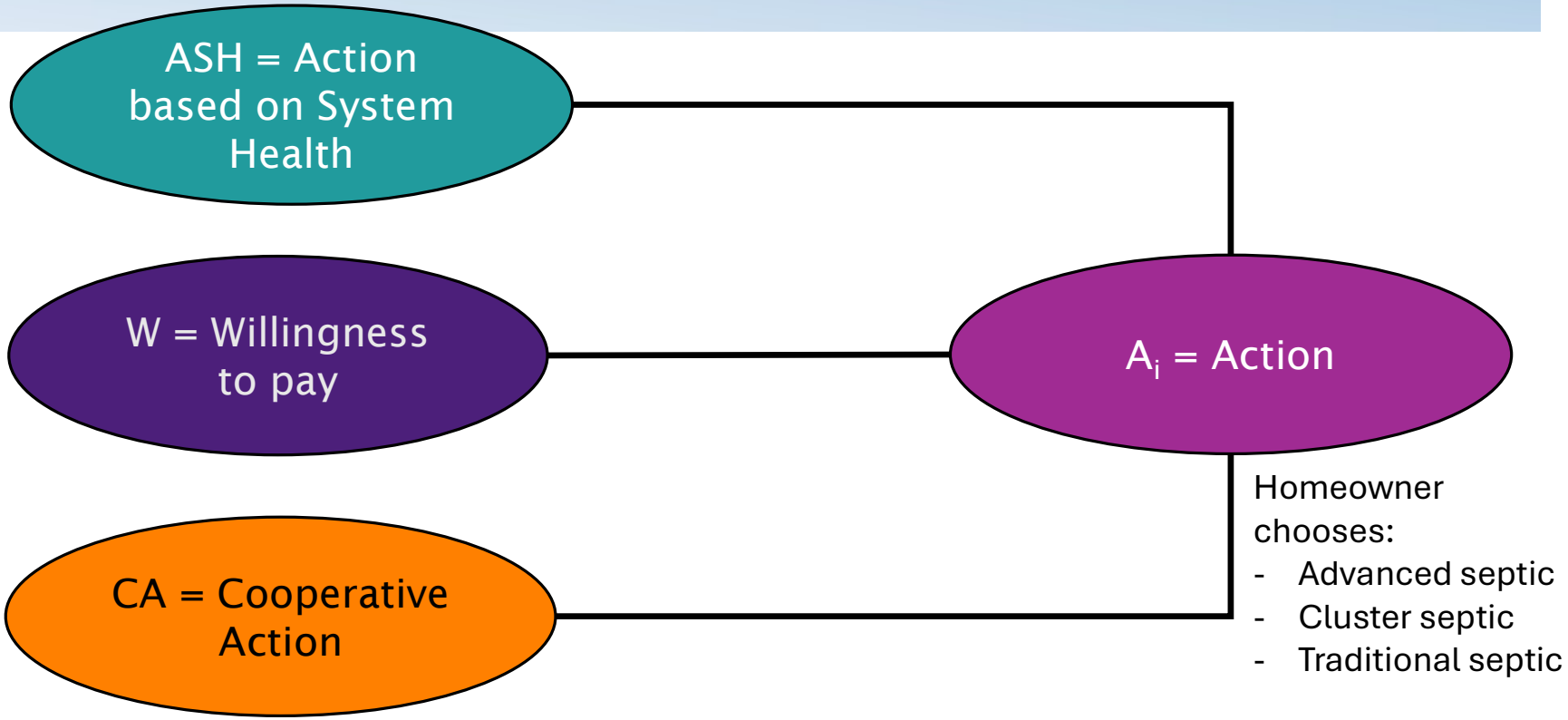


Interactive question

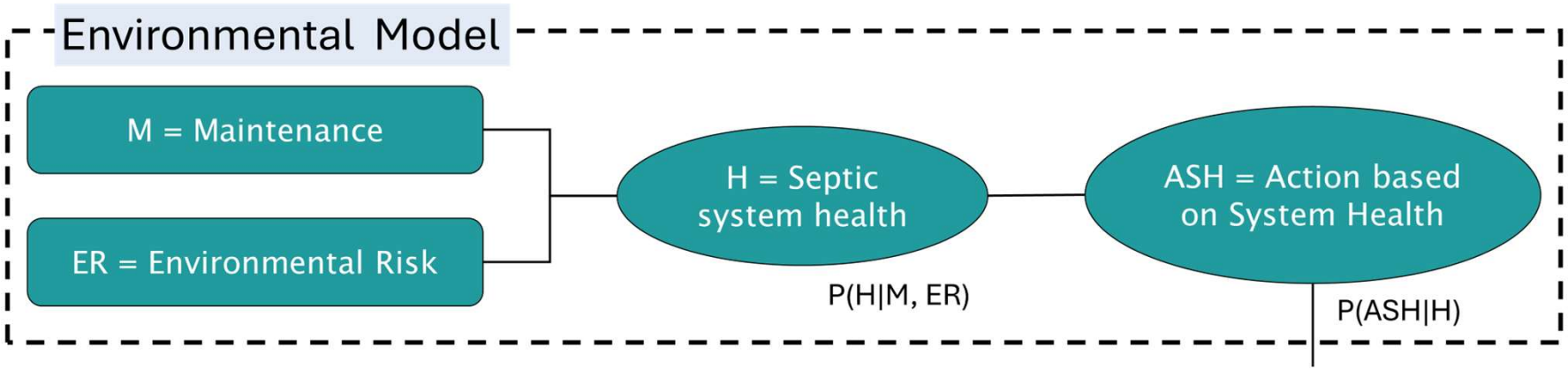
"What factors most influence homeowners' decisions about individual wastewater treatment?“

(please provide one word at the time)

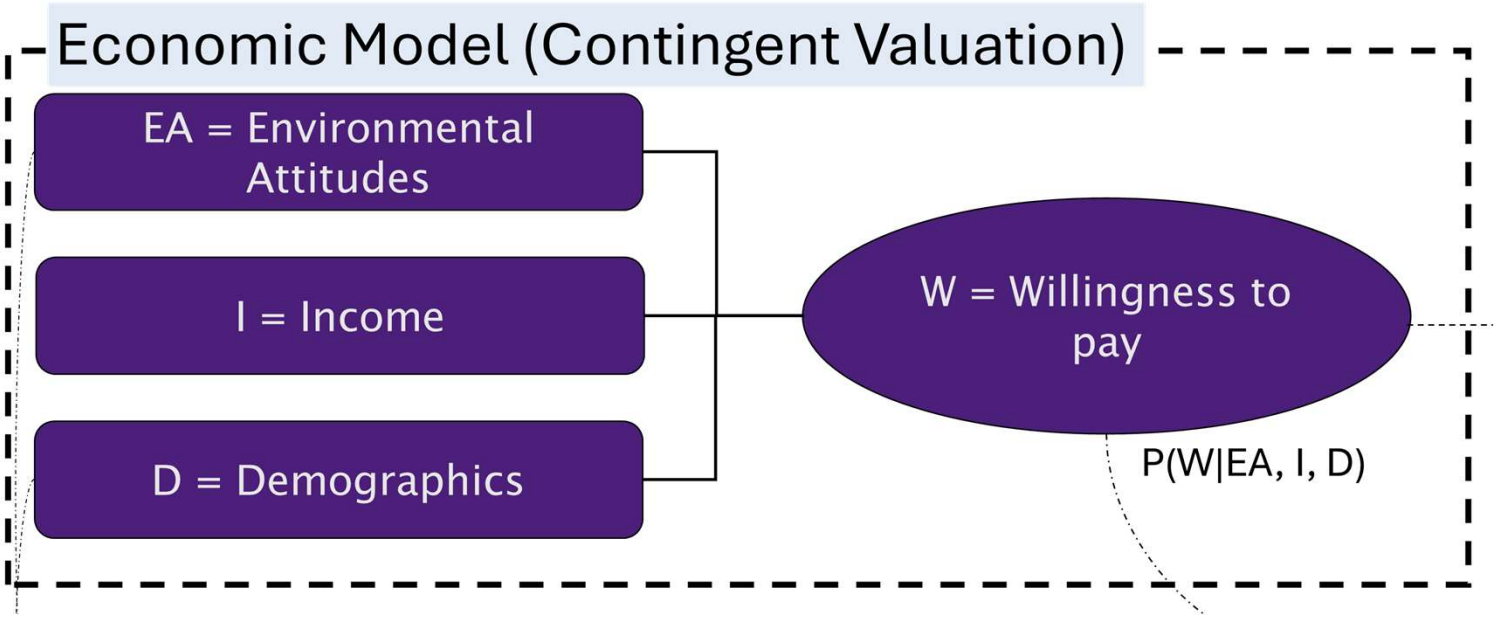
Model overview



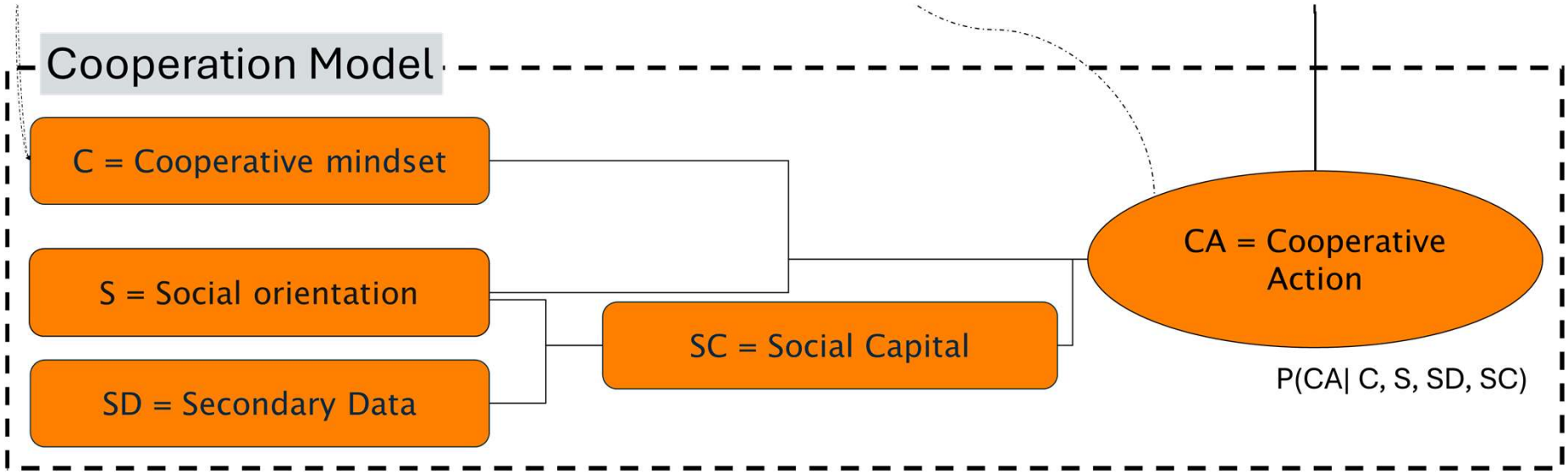
Septic system health – Take action



Willingness to pay

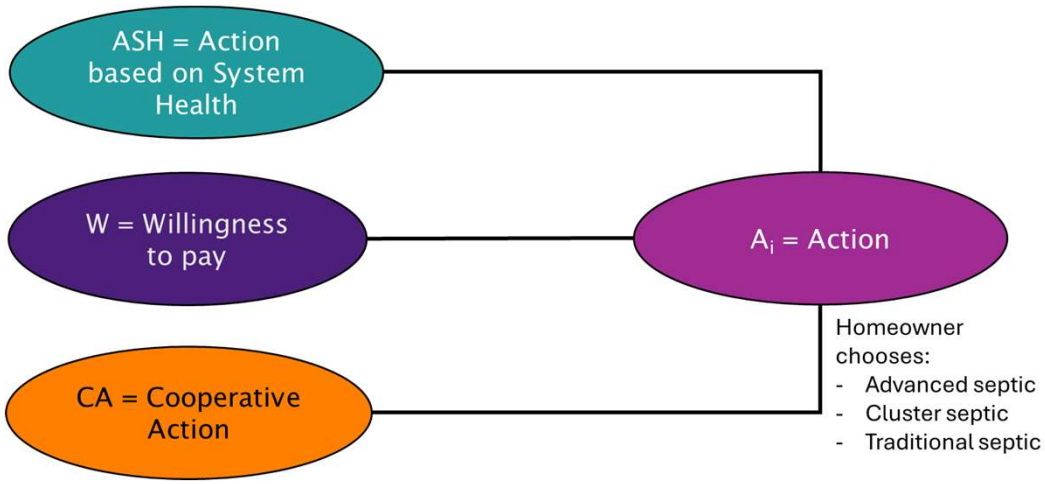


Cooperative action



Data collection instruments

- System Health: GIS model (ArcNLET) + simulation data from Agent-based Model
- 2 surveys
- Survey part 1: Contingent Valuation
  - Willingness to pay (WTP)
  - Connection of demographics and WTP
- Survey part 2: Cooperation and Social Capital
  - Social orientation
  - Cooperative mindset
  - Social capital
- Agent-based model (ABM)



Social capital- Dimensions

- Bonding: close-knit ties, such as to family members, kin, or close friends. Easier formed, higher levels of SC in homogenous communities (also trust, civic participation). Especially valuable after shock events.
- Bridging: horizontal integration between people of different backgrounds, or so-called weak ties (Granovetter, 1973). Access to more resources/information (Woolcock & Narayan, 2000). More resilience through bridging SC because of "linkage to external assets" as well as innovation/adaptation.
- Linking: the vertical ties across different levels of power, where regular citizens connect with those individuals that govern them (Szreter & Woolcock, 2004). Connection to leaders – helps distribute scarce resources.
- Personal: Individuals who have the means themselves don't have to rely on their relationships for help.
- Isolation: not having access to social capital is also impacting people's ability to withstand and recover from adverse events.

Social capital - measurement

5 questions, asking people about every-day situations e.g.

Imagine that your vehicle was damaged in a car accident and you could no longer drive it for a week. How would you try and get to work? (or if your work does not involve a commute, how would you run your errands that require a car?) Consider your current circumstances (where you currently live) and rank each option from the most likely to least likely approach you would pursue.

4 _____ I would rent a car or use a ride sharing service even if the cost to me was high.

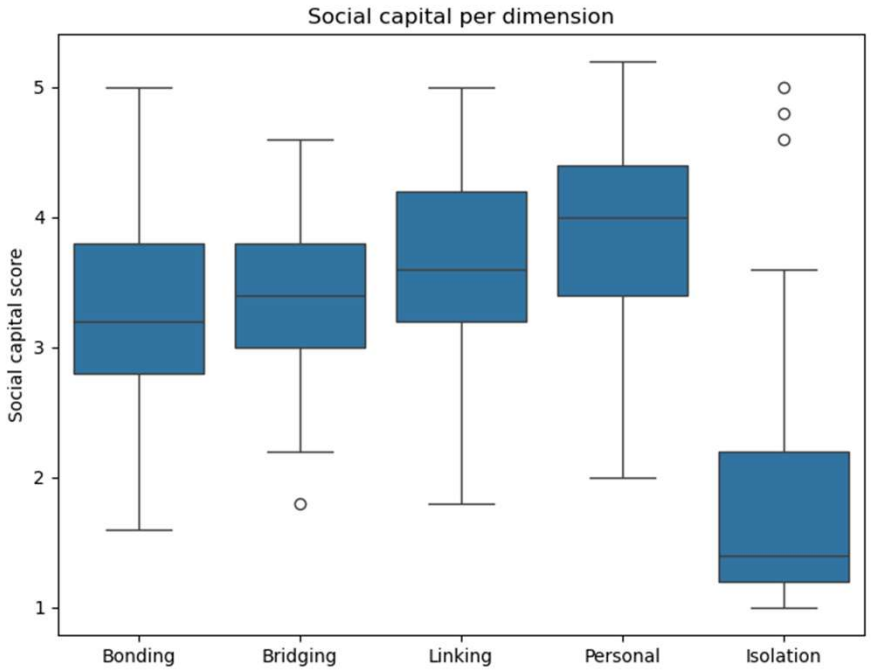
2 _____ I would call the city to find out what community services I could use to help me out.

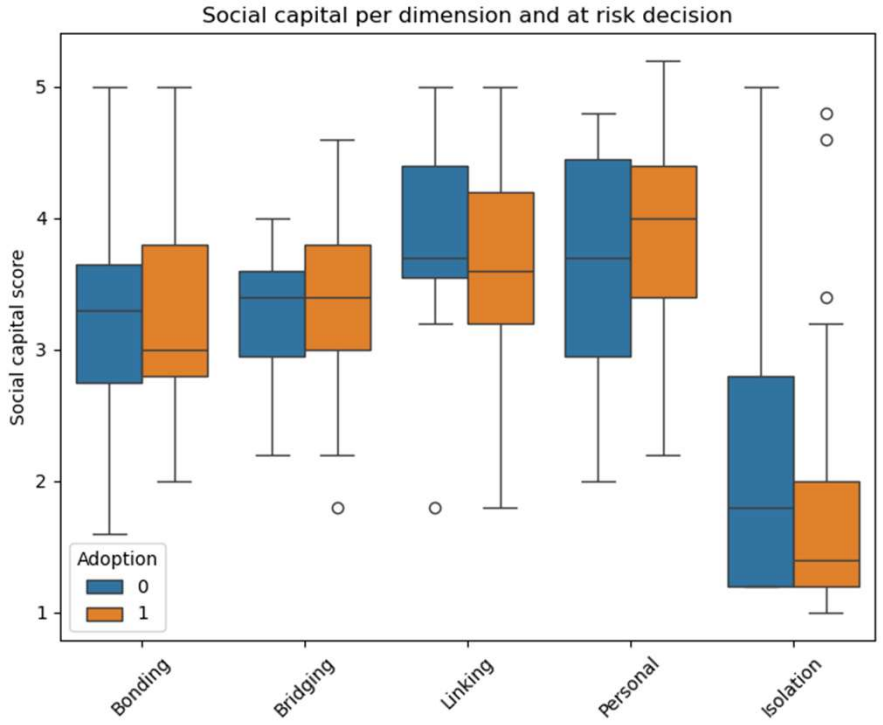
1 _____ I would call on a close friend or family member to help me figure out what to do.

3 _____ I would use my networks to find someone I could get a ride with (e.g., co-worker, or by asking people I know or posting on social media).

5 _____ In my current community I do not have anyone I would ask for help if my car broke down.

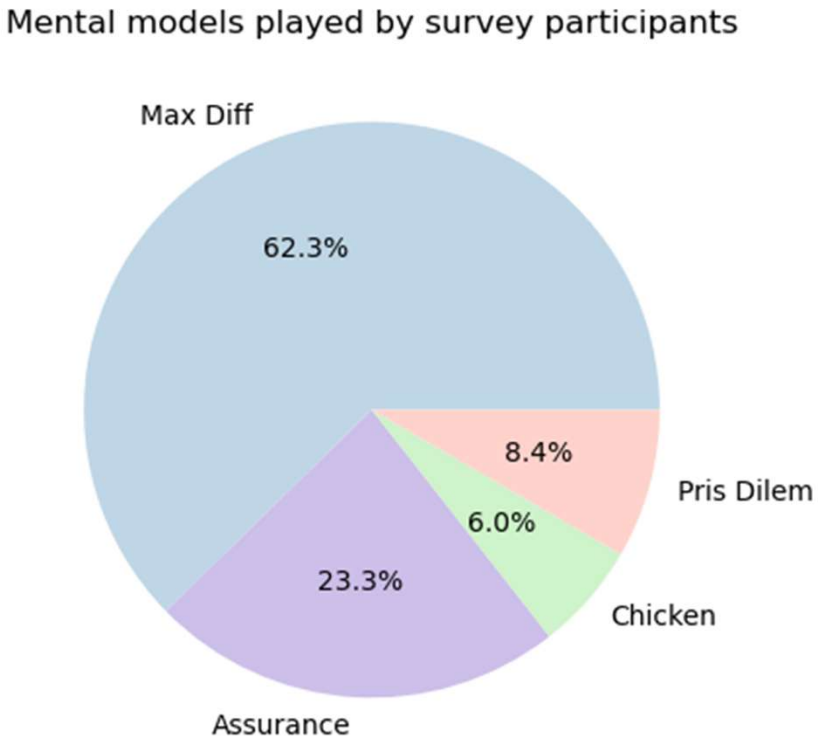
Social capital



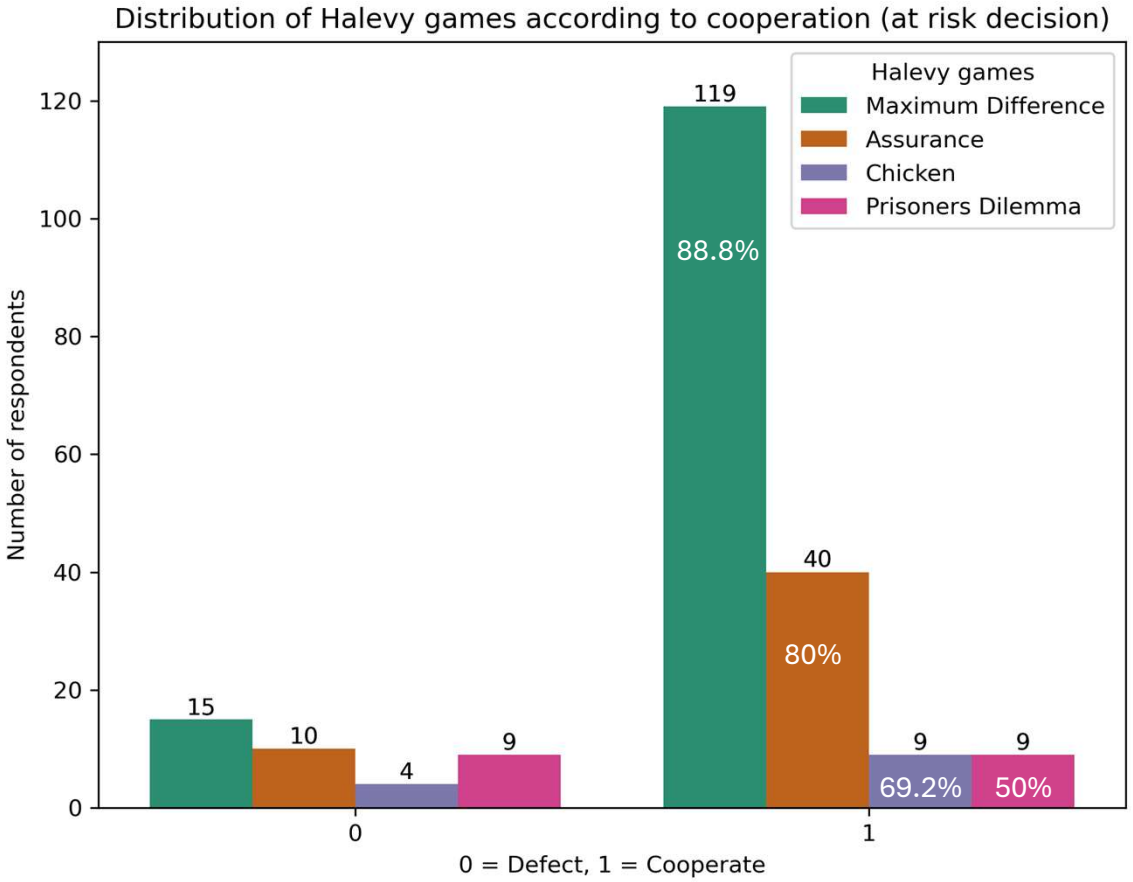


Cooperative Mindset (Halevy et al. 2012)

- Maximum Difference: Cooperation is always the best choice, regardless of what the other party chooses (unconditional cooperation)
- Assurance: The best strategy is to mimic what the other party is doing (conditional cooperation)
- Chicken: Doing the opposite of what the other party is doing is the best strategy (conditional defection)
- Prisoners' Dilemma: Defection is the optimal strategy, regardless of the other party's decision (unconditional defection)



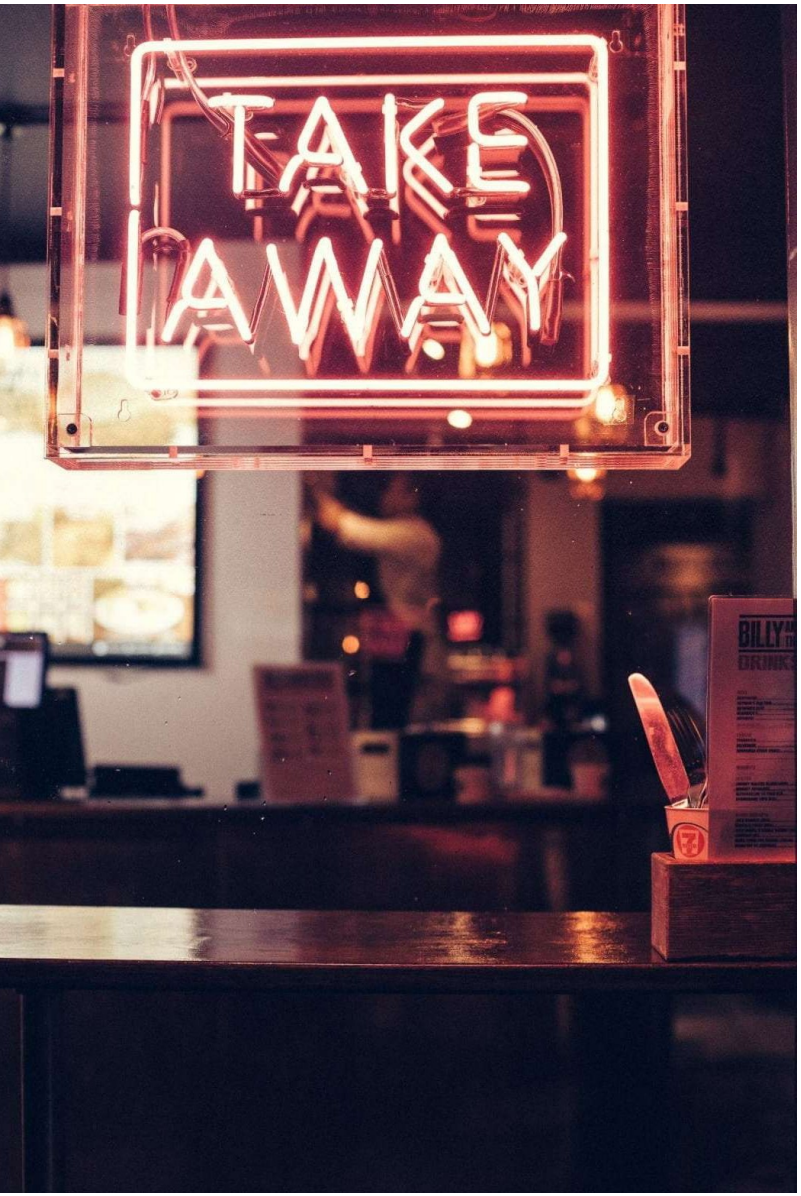
Cooperative mindset related to cooperation



People with prisoners' dilemma mindset (8.4%) are less willing to cooperate (to switch to an alternative system)

Some reasons people do or don't cooperate

- Rationality: The benefits of updating my system outweigh the costs
- Altruism: I switch my system because it benefits others, even at a cost to myself
- Reciprocity: I want a clean environment, so I need to update my system
- Drop in bucket: The pollution reduced will not make a difference
- Sucker: Many people don't update their system, so I don't have to either
- Free riding: Many people already update their system, so I don't have to



Take-aways from this research

1. Thinking about what dilemma might underlie the environmental pollution problem can lead to important insights and show directions for policy implications

2. People differ in their characteristics, how they approach cooperation cognitively, how they perceive cooperation vs. competition, how they relate to other people and to which resources they have access to.

3. Research is not just dependent on the topic being researched, but also the scientists and other stakeholders involved in conducting it.

4. Understanding these differences is the first step towards developing interventions aimed at enhancing cooperation, whether that is to improve environmental pollution or to boost transdisciplinary research.

Thank you for your attention!

Any questions and feedback are greatly appreciated.

Please follow this link or scan the QR code to leave your feedback anonymously and find more contact information : https://linktr.ee/kyrasha

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