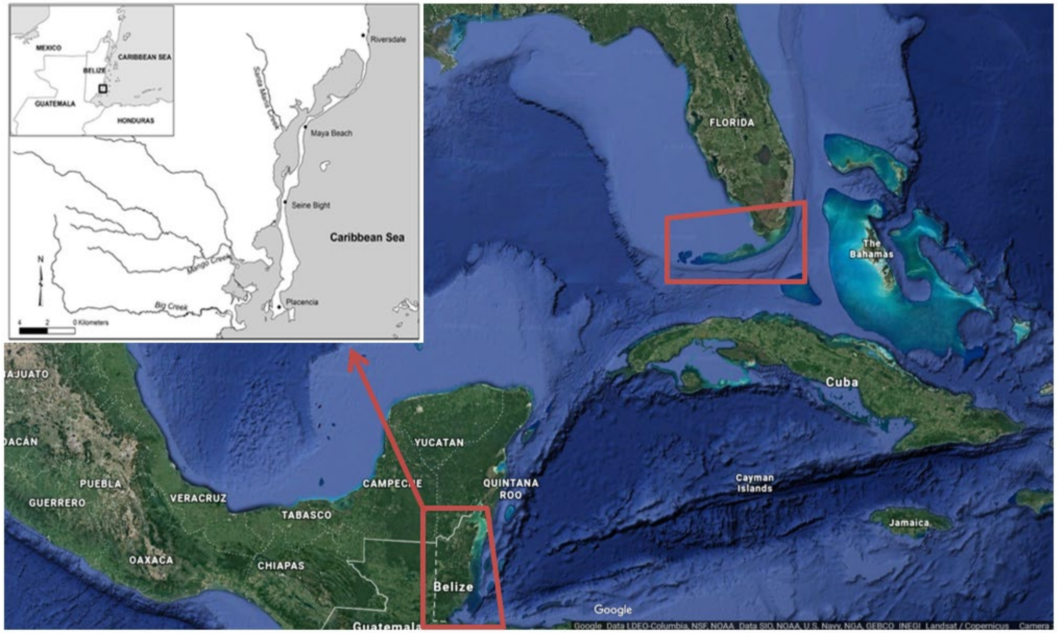
WASTEWATER AND STORMWATER INFRASTRUCTURES IN CONTEXT: SYSTEMS-BASED APPROACHES

Shima Mohebbi, Ph.D.
Assistant Professor
School of Industrial and Systems Engineering
Department of Data Science and Analytics
Affiliate Faculty
Cyber Governance and Policy Center

NOV. 16, 2018

PROJECT I: WASTEWATER INFRASTRUCTURE TRANSITIONS IN COASTAL COMMUNITIES

- Complex interaction between human, engineered, and environmental systems
- Two Case Studies
  - Belize: Bottom-up and consumer-driven
  - Florida Keys: Top-down and policy-driven



PROJECT I: WASTEWATER INFRASTRUCTURE TRANSITIONS IN COASTAL COMMUNITIES

- Belize: Bottom-up and consumer-driven
  - Surveys, interviews, focus group
  - Water quality testing
  - Participatory observation
  - Literature review

BELIZE COASTAL ZONE MANAGEMENT AUTHORITY & INSTITUTE

BELIZE FISHERIES DEPARTMENT

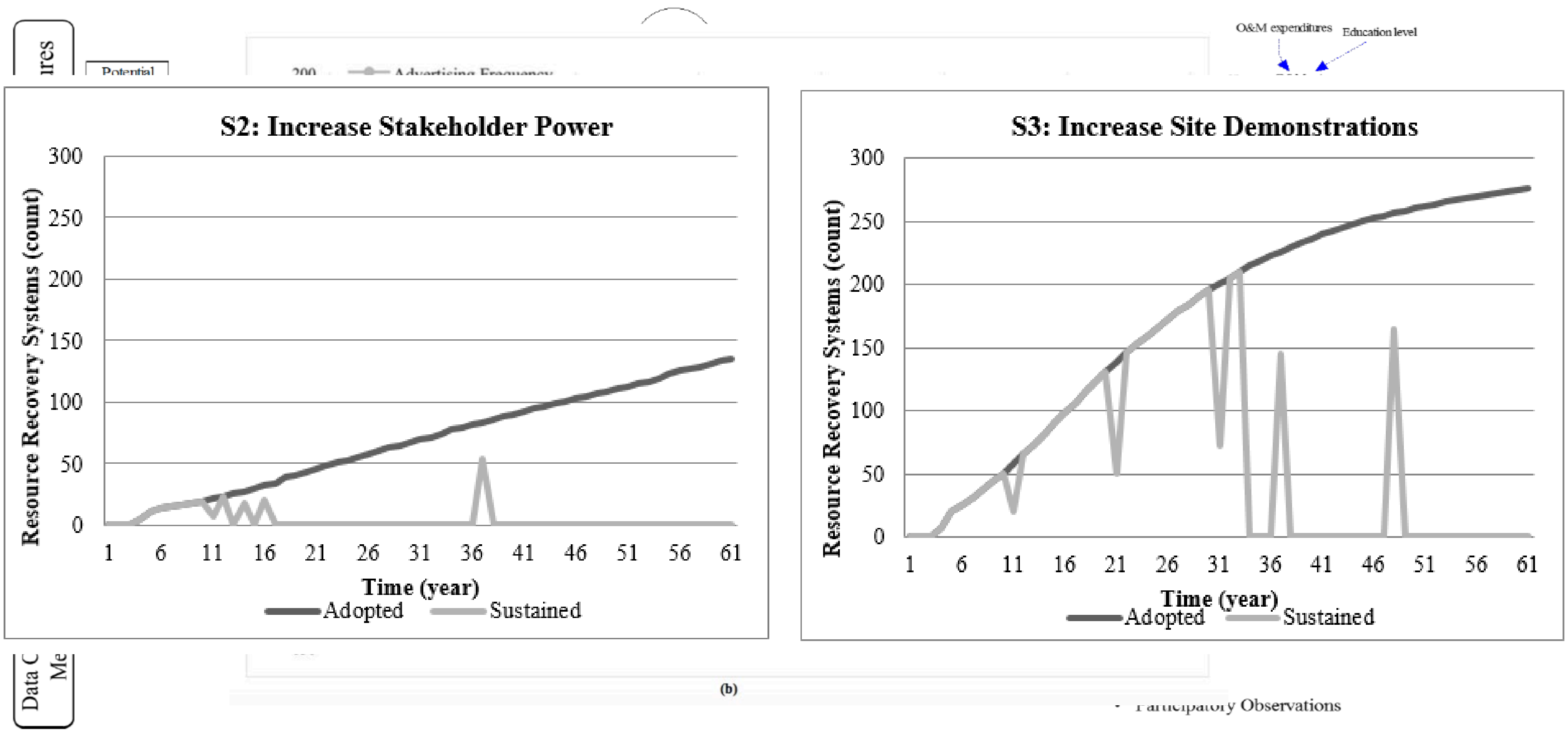
DEPARTMENT OF THE ENVIRONMENT

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

CBA

PROJECT I: WASTEWATER INFRASTRUCTURE TRANSITIONS IN COASTAL COMMUNITIES

- Belize: Bottom-up (Socio-technical strategies)



PROJECT I: WASTEWATER INFRASTRUCTURE TRANSITIONS IN COASTAL COMMUNITIES

- Florida Keys: top-down (Socio-technical Strategies)

PROJECT II: INTEGRATED WATER/WASTEWATER SYSTEMS THROUGH THE LENS OF REVERSE LOGISTICS

Decision Variables

- Q_{plt}: Quantity processed by the process p in location l at period t
- Y^{w}_{ldt}: Quantity of water w delivered from location l to d at period t
- $U_{lt} = \begin{cases} 1 & \text{if location } l \text{ increases capacity at time period } t \\ 0 & \text{otherwise} \end{cases}$
- X_{lt}: Capacity increase in location l at period t

Objective Functions

- $Min\ Z = [C, CF, EE]$

$$C = \sum_{p,l,t} SNPV_{p,l} \cdot Q_{plt} + \sum_{l,t} \left(\beta \cdot U_{lt} + \alpha_l \cdot X_{lt}\right),$$

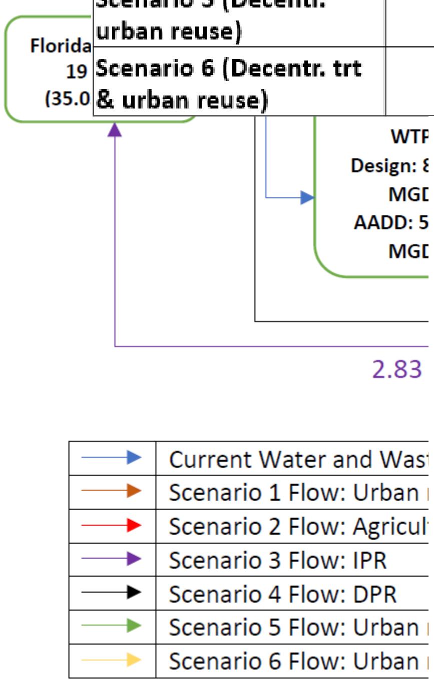
$$CF = \sum_{p,l,t} cf_{pl} \cdot Q_{plt} + \sum_{l,d,w,t} cf_{pl} \cdot Y^{w}_{ldt},$$

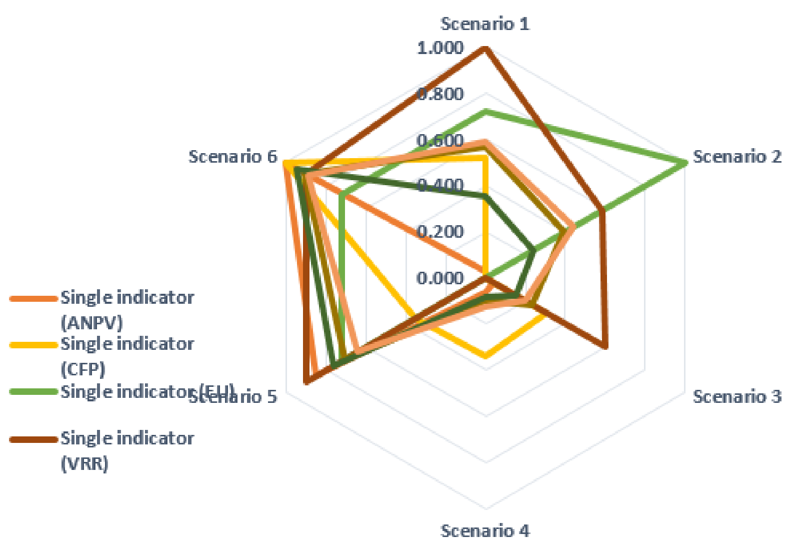
$$EE = \sum_{p,l,t} e_{pl} \cdot Q_{plt} + \sum_{l,d,w,t} e_{pl} \cdot Y^{w}_{ldt}.$$

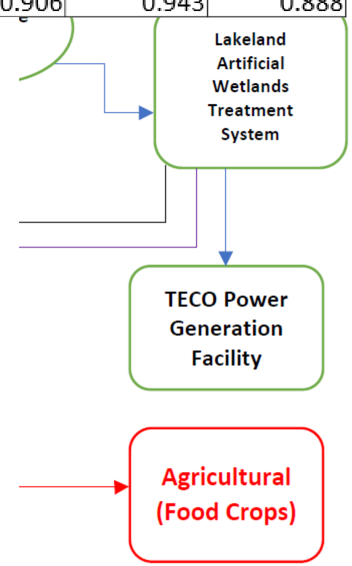
Courtesy of Tchobanoglous and Leverenz (2013)

PROJECT II: INTEGRATED WATER/WASTEWATER SYSTEMS THROUGH THE LENS OF REVERSE LOGISTICS

	Economic indicator (SNPV)	Environmental indicator (CFP)	Environmental indicator (EU)	Social indicator (Value of resource recovery)	R̅ (Base)	R̅ (Cost Int.)	R̅ (Env. Int.)
Scenario 1 (Urban reuse)	0.025	0.522	0.721	1.000	0.567	0.350	0.589
Scenario 2 (Agricultural reuse)	0.000	0.000	1.000	0.581	0.395	0.237	0.437
Scenario 3 (IPR)	0.036	0.303	0.000	0.601	0.235	0.156	0.202
Scenario 4 (DPR)	0.064	0.340	0.000	0.000	0.101	0.086	0.129
Scenario 5 (Decentr. urban reuse)	0.846	0.353	0.721	0.902	0.705	0.762	0.638
Scenario 6 (Decentr. trt & urban reuse)	1.000	1.000	0.721	0.902	0.906	0.943	0.888

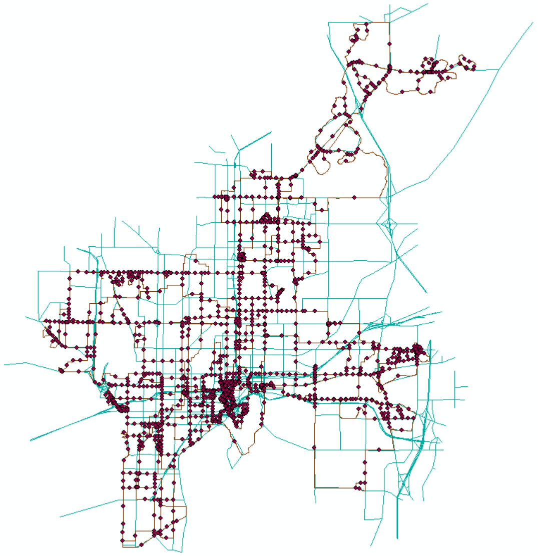


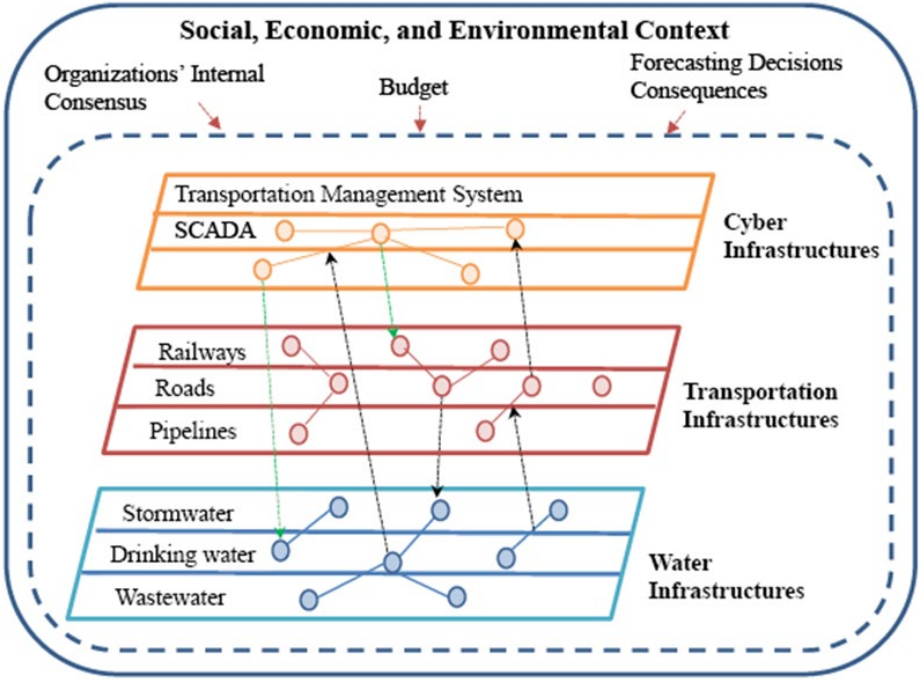




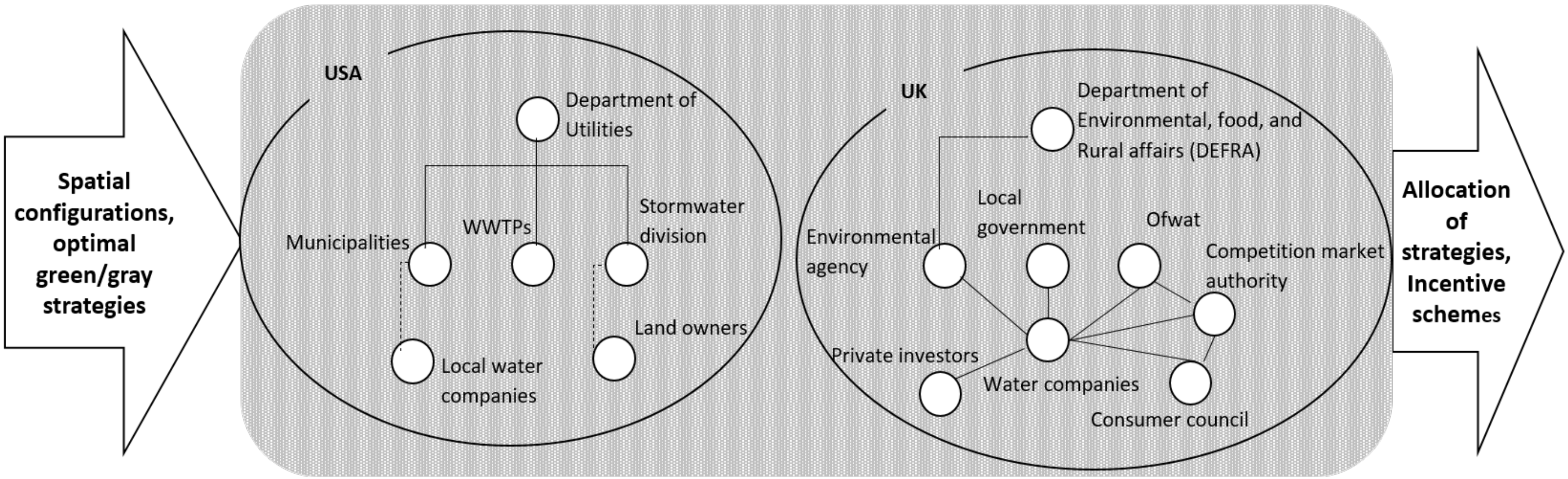
PROJECT III: RESILIENCE OF INTERDEPENDENT INFRASTRUCTURES

- Interdependency at different levels
  - Physical-based
  - Virtual-based
  - Socioeconomic-based





PROJECT IV: STORMWATER INFRASTRUCTURES AND ORGANIZATIONAL GOVERNANCE



Thank you

Email: mohebbi@ou.edu
Twitter: @ShimaMohebbi
Web: http://www.ou.edu/coe/ise/shima-mohebbi