Leveraging Ecosystem Services in Stormwater Management

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Managing Stormwater

Challenges

- Aging infrastructure
- Increasing impervious surface
- Increasing population density
- Decreasing tax base in ‘shrinking’ cities
- Funding and disruptions

Sustainable Solutions

- Policy and governance
- Consumption
- Gray + green infrastructure (GI)

Ecosystem Services in Stormwater Management

Ecosystem services (ES) are benefits humans receive from nature

1. **Regulating**-services sustain habitats (e.g., clean air and water)
2. **Supporting**-services critical to ecosystem health (e.g., nutrient cycling)
3. **Cultural**-non-material services (e.g., social capital or exercise)
4. **Provisioning**-products obtained from the environment (e.g., food or medicine)

Note: As defined by the Millennium Ecosystem Assessment (MEA)[1]

We noticed

- MEA definitions are not immediately intuitive or accessible for stakeholders
- Empirical based ES studies related to GI were limited; most focused on regulating and provisional services[2]

Ecosystem Services in Stormwater Management

Should we consider any type of urban greenspace a form of GI?

If so…

→

What ESs are known from urban greenspace and how could they be leveraged with stormwater management?

→

How can communities use the information to maximize benefits they receive?

Building a Framework for Siting GI

How can communities better locate GI to leverage multiple ESs while managing stormwater?

<u>Objectives</u>

1. Increase ecosystem services received
2. Determine where to place greenspace based on community identified needs and concerns

Building a Framework for Siting GI

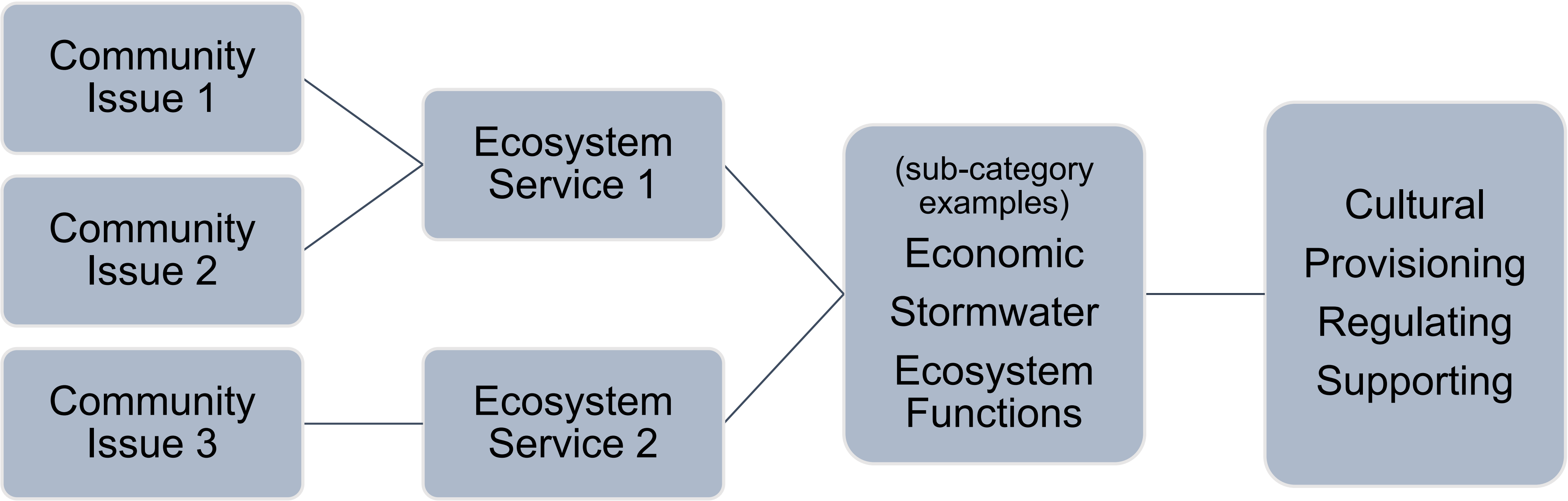
1. Literature review on empirical ES-GI studies ≥2009

2. Aggregated and assigned services into
   A. An MEA category and subcategory

3. Framework emphasizes stakeholder involvement

Setting Up the Framework

- 105 original research papers + 18 review papers
- 35 ecosystem services were identified and classified



GREENSPACE/GREEN INFRASTRUCTURE	MEA CATEGORY*	SUB-CATEGORIES	ECOSYSTEM SERVICE	EXAMPLE OF PROBLEMS ALLEVIATED	REFERENCES
Parks/trees/forest, median strips	Cultural	Community Building	Resilience	lack of protected natural areas	32, 105
Green Roofs	Provisioning	Consumer Products	Energy Consumption	high building energy costs or fossil fuel consumption	13, 46, 58, 94, 95
Parks/trees/forests, Green roofs	Regulating	Mediated Processes	Microclimate Regulation	high urban temperatures	13, 25, 37, 42, 88, 90
Forests	Regulating	Stormwater	Improved Infiltration	surface ponding or excessive runoff	17, 34, 35, 80, 96, 90
Parks/trees/forests, Community Gardens, urban agriculture	Supporting	Ecosystem Functions	Soil Management	poor nitrogen cycling, soil porosity	14, 42, 87

Designing the Framework

Key Elements:

- Process for prioritizing where to site GI
- Encourages stakeholder involvement
- Identify stormwater needs
- Identify social, economic, and environmental issues of concern
- Locate to maximize benefits

Applying the Framework

1. Identify **suitable** location(s) for installing GI for stormwater.
2. Identify social, economic, and/or environmental **concerns or issues** the community wants to address and identify their spatial distribution.

Applying the Framework

3. Select **measurable** ecosystem services shown to address the identified needs and issues.
4. Determine areas of **overlap** between identified issues and stormwater management needs, while considering available space, existing land use, etc.

Applying the Framework

5. Identify type(s) of GI **suitable** for selected locations and capable of providing desired benefits.

6. **Install** GI at the location(s) identified

7. **Measure and monitor** the system using indicators to quantify the progress.

Testing the Framework

Shrinking cities are viable options

- Older industrial cities across the US
  - e.g., St. Louis, Cleveland, Pittsburgh, Detroit, Baltimore, etc.
- Characterized by declining populations and increasing vacant lands[3]
  - Top 20 cities have 28-53% population decline from 1960-2000
  - Vacancy ranges from 8-16% of total parcels
  - Associated social, economic, environmental issues
- Opportunities for GI planning and promoting ecosystem services
  - Vacant properties could be converted to GI
  - High concentration of vacancies typically reside in lower-income communities of color

Testing the Framework

St. Louis, MO – an example

- Largest population decline ('60-'00) of 20 oldest industrial cities (53.6%)[3]
- Total vacant parcels ~ 25,000[4]
  - Public land bank holdings: 11,500 parcels
  - Vacant lots: 8,000 lots
  - Financial cost to the city almost $66 million
- Investigating alternative methods for maintenance
- City Sustainability Plan targets stormwater and public interests

Green-vacant lots | Blue-vacant buildings

Linkages to Research at SYSENC

Foster synthetic, actionable scholarship on the structure, functioning and sustainability of ES systems

Environmental problems are social problems

Synthesis=info, data, knowledge

Co-creation, trying to capture diversity of perspectives (flexibility/open mind), safe space for generating insights

Component parts and their interactions

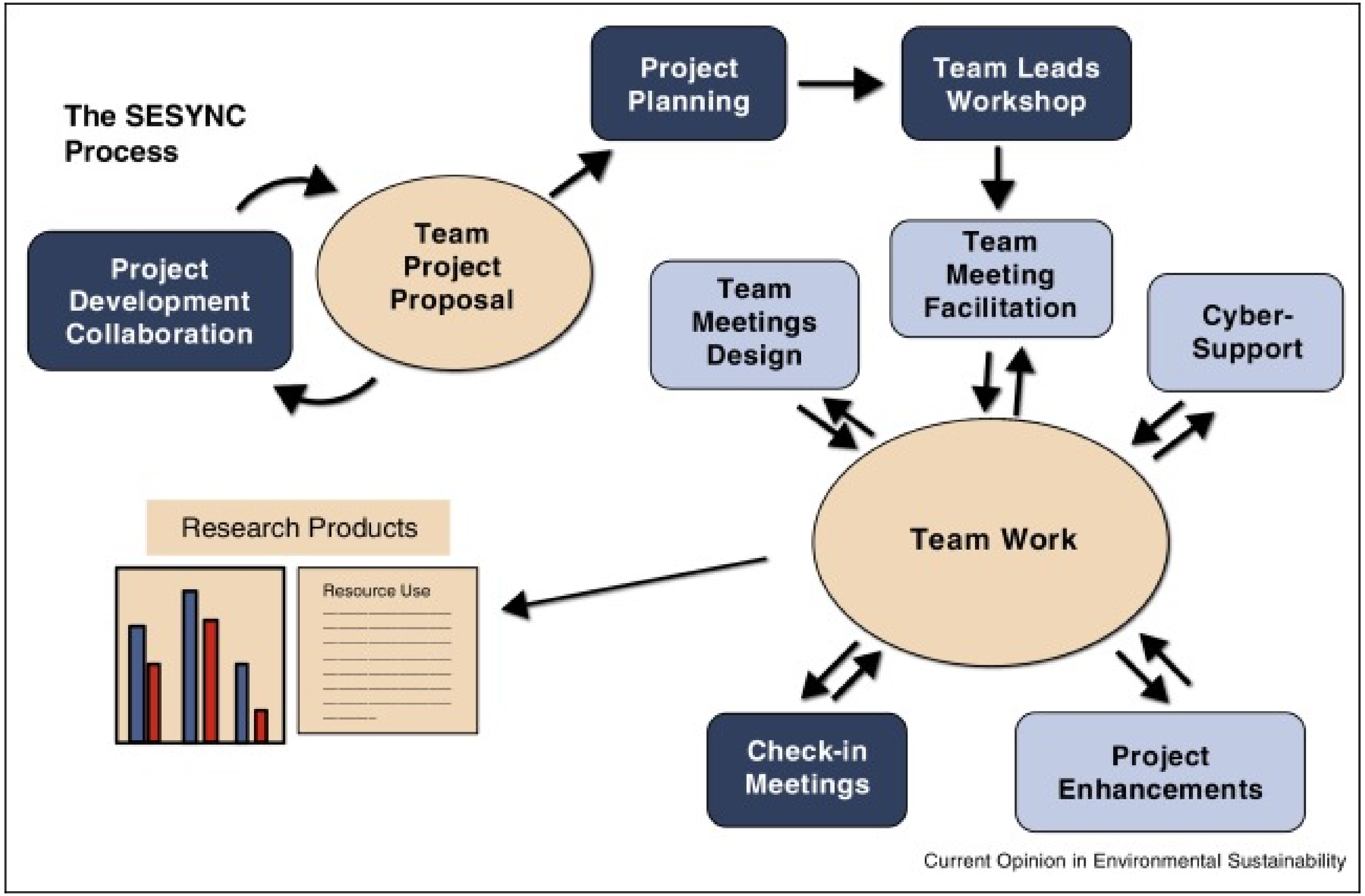
Non-linear feedbacks

Cross-scale interactions

Addressing Wicked Problems at SESYNC

- Building environmental equity into science engineering and systems work
- How do social biases like anti-blackness, classism impact the way resources are not just distributed but our methodologies in evaluating resource allocation and climate change mitigation planning

Potential Collaborations



Thank you

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Note

All photos courtesy of USDA, USACE, or USEPA Flickr accounts

Disclaimer

This research was performed while F. Hoover held a National Research Council Research Associateship Award at the United States Environmental Protection Agency (US EPA). The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of US EPA. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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