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technical BRIEF
BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

EPA PURSUES INTEREST IN DEVELOPING COMMUNITY ENVIRONMENTAL RESILIENCE INDICATORS AND INDICES

Introduction

Environmental resilience includes minimizing environmental hazards and public health risks from disasters, facilitating restoration of critical environmental services following a disaster, and building back in a way that mitigates future adverse impacts. Because local social networks, civic organizations, and municipal services play key roles, we approach environmental resilience at the community scale. Community resiliency supports long-term sustainability. Community environmental resilience indicators and indices can help communities conduct self-assessments, develop corrective actions, and measure progress towards attaining their environmental resilience goals.

Community Environmental Resiliency Index (CERI) Workshop I

Vision: EPA, federal, tribal, state & local partners develop indicators & indices as analytical & planning tools to help communities protect public health & the environment by identifying ways to strengthen their resilience to natural & human-made disasters.

Goal: Share expertise and work underway to identify EPA's assets, research needs, & opportunities to develop relevant, actionable, & useful indicators & indices.

EPA's Homeland Security Research Program (HSRP) is working with national experts to develop community environmental resilience indicators and indices to identify public health and environmental vulnerabilities and assess ways to mitigate future disaster risks. EPA held an internal workshop May 6-7, 2014, to pursue interest in developing such indicators and indices. Its aim was to identify assets, interests, and needs. The workshop was held concurrently in Cincinnati, Research Triangle Park, Washington, D.C., and via webinar. It was attended by EPA staff from the Office of Research and Development, Programs, and Regions. The results of that workshop are presented in this brief.

Why Community Environmental Resilience Indicators?

Community environmental resilience involves protecting public health and the environment by reducing vulnerabilities to disasters and developing the capacity to minimize health and environmental risks. By doing so, communities increase their potential to recover quickly from disasters, including homeland security incidents, and sustain resources they depend on for well-being. As climate change amplifies the risks of extreme weather events, community environmental resilience becomes a key component of climate change adaptation. The National Research Council (NRC) report *Disaster Resilience: A National Imperative* recognizes the need for improved ways to measure community resilience to disasters (NRC 2012). Researchers have proposed socioeconomic, demographic, and health indicators of community resilience, but there is no established, scientifically vetted and validated set of indicators. Also, none of these efforts has focused on community environmental resilience indicators. EPA's HSRP is addressing this gap.

EPA's HSRP primarily addresses two key areas: water and wastewater infrastructure protection, and community cleanup and recovery. EPA researchers and program managers have produced tools and technologies that communities can use to enhance their environmental resilience. EPA has also developed science-based, environmental and sustainability indicators in its *Report on the Environment* (EPA 2014).

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HSRP researchers are seeking ways to leverage this science to develop resiliency indicators. This work builds on efforts already underway across the federal government. It can feed into EPA resilience initiatives and support interagency efforts under Presidential Policy Directive (PPD)-8, PPD-21, the national climate action plan, and national response and disaster recovery frameworks. Community environmental resilience indicators can be incorporated into a self-assessment checklist or full-scale index. Decision-makers from the public, private, and civic sectors could use these to identify areas of concern and allocate resources to strengthen resilience to natural disasters, technological accidents, and homeland security incidents.

What is Community Environmental Resilience?

Workshop participants defined community environmental resilience as minimizing environmental risks associated with disasters, quickly restoring critical environmental and ecological services after a disaster, and applying this learning process to reduce vulnerabilities and risks to future incidents. It includes reducing vulnerability to disasters, that is, minimizing exposure and sensitivity to disasters. It also includes increasing the capacity of environmental systems to return after an incident and building back in ways that mitigate future impacts. Community environmental resilience indicators and indices can help communities gauge their capacity to withstand disruption and reduce disaster impacts. Indicators of resilience might include the capacity of a wastewater treatment plant to process storm flow, the capacity of wetlands to provide natural flood protection, and knowledge of the environmental contaminants communities might be exposed to as the result of a disaster. Restoring estuaries and wetlands, proactively managing debris and waste, and addressing interdependencies between water and energy systems are all steps that communities can take to strengthen their environmental resilience.

Workshop Outcome: Environmental Resilience Science & Tools

Workshop participants proposed establishing a scientific basis for investigating environmental resilience by adapting a *coupled human-natural systems model*. They discussed how characteristics of resilient infrastructure such as redundancy, robustness, and connectivity apply to environmental systems. Participants examined how the index development process laid out by Yale's *Environmental Performance Index* might be adapted to create a resilience index. They advocated building on existing EPA resilience tools developed for homeland security, climate change adaptation and disaster recovery (Table 1). They recommended adapting EPA environmental and climate change resilience indicators for a CERI.

Sustainability is the capacity for:
- Human health and well-being
- Economic vitality and prosperity
- Resource abundance and quality

Resilience is the capacity to:
- Overcome unexpected problems
- Adapt to change
- Prepare for and survive catastrophe

EPA scientists posit that resilience to disasters is necessary for long term sustainability, and are investigating the relationship between resilience and sustainability. EPA's Database of Sustainability Indicators and Indices (DOSII) provides a tool for considering how sustainability and resilience indicators are interrelated.

Workshop participants also identified an emerging need for research that addresses environmental justice and resilience. Communities with economically disadvantaged or marginalized populations located in proximity to environmental hazards could be disproportionately affected by disasters. For example, disasters generate large volumes of waste and debris. Regional coordination is required to support communities' capacity to manage this waste, and that debris disposal does not affect already overburdened populations. Fully considering a disaster's environmental life cycle, that is, the environmental consequences of preparedness, mitigation, response, and recovery, is necessary when assessing resilience.

Table 1. EPA Resilience Tools Discussed at CERI Workshop

Resilience Tool	Purpose
Climate Resilience Evaluation and Awareness Tool (CREAT)[1]	Water utilities explore climate change impacts & adaptation strategies
CANARY & TEVA-SPOT[2]	Detection & early warning for contaminants & service disruption in drinking water distribution systems
Community-Based Water Resiliency Tool (CBWR)[1]	Water utilities gauge current preparedness efforts. Community awareness of including water sector in emergency planning.
Emergency Water Supply planning guidance[1]	Guidance on how to plan for disruptions in drinking water services
Flood Resilience: A Basic Guide for Water & Wastewater Utilities[1]	Understand flooding threats, identify vulnerable assets, evaluate mitigation options
Water Security Toolkit[2]	Evaluate & design rapid responses to water contamination incidents
Water Resiliency Action Planner Kit[1]	Convene meetings with key players in water utility planning to discuss roles & responsibilities during water service interruptions
Water/Wastewater Agency Response Networks (WARN)[1]	Intra-state network of utilities that share local water sector resources during disasters or service disruptions
My Environment[1]	Integrate community environmental & health data into maps; "Shout out" reports on local environmental efforts
I-WASTE[4]	Estimate types of debris, select appropriate waste management after a disaster
Waste Estimation Support tool (WEST)[1]	Estimate waste from a wide-area radiological incident as a function of selected decontamination approaches
Municipal Solid Waste Decision Support Tool (MSW-DST)[3]	Solid waste planners evaluate environmental aspects & cost of integrated waste management strategies
Integrated Climate & Land Use Scenarios[1]	Estimate housing density, population, impervious surfaces for climate scenarios
Environmental Justice (EJ) View[1]	Create online maps to view factors affecting community environmental health
[1]available via search on www.epa.gov [2]https://software.sandia.gov//trac [3]https://mswdst.rti.org/ [4]http://www2.ergweb.com/bdrtool/login.asp. Tools may require permission to access and training to use.	

Workshop Outcome: Developing INDICATORS for an INDEX

After reviewing currently available resilience tools, workshop participants compiled a preliminary list of qualitative and quantitative environmental resilience indicators (Table 2). Participants also agreed that indicators should be compelling to community stakeholders, easily measured, and lead to action. Since resilience involves interactions across complex social, economic, and environmental systems, these indicators cover social and environmental trends and conditions. For example, environmental, economic, and demographic data together may highlight the challenges of handling wastes produced by a disaster.

Table 2. Community Environmental Resilience Indicators Proposed at the Workshop

Water resilience	Waste resilience
Practiced emergency response plans	Household recycling rates
Active watershed association	Percent population below poverty line
Access to emergency water supplies	Available landfill capacity
Ratio of municipal debt to revenue	Number of Superfund sites per square mile
Presence of mutual aid agreements with neighboring communities	Scenarios conducted with stakeholders to pre-plan waste & debris management
Contamination warning systems in place	Familiarity with debris disposal options

Workshop participants identified several potential purposes and audiences for developing community environmental resilience indicators and indices:

- Communities conduct self-assessments to benchmark current conditions, capabilities and needs.
- Communities take corrective action based on indicators and track improvements.
- Researchers identify thresholds where environmental and ecological systems gain or lose resilience.
- Federal program managers identify funding opportunities and measure policy outcomes.
- Audiences include federal, state, and local agencies, and stakeholders such as urban planners, businesses, and others involved in disaster planning, mitigation, response, and recovery.

Achieving community environmental resilience will require long-term planning and implementation. EPA's CERI project team aims to develop environmental indicators and contribute the best available science and research that can support community environmental resiliency. Its next step is to host a second workshop in July, 2014 to refine indicators and the purpose and scope of an index.

References

EPA. 2014. *Report on the Environment*. Public Review Draft. http://cfpub.epa.gov/roe/ (Last accessed 3/25/15).

NRC. 2012. *Disaster Resilience: A National Imperative*. Washington, DC: The National Academies Press.

For More Information

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