EnviroInfo 2011: Innovations in Sharing Environmental Observations and Information

NextGen Environmental Health Analysis: Community-Centric Approaches and Tools

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Abstract

After spurring the creation of environmental programs years ago, public involvement has been measured until recently. Advances in environmental informatics have dramatically changed the field, and the community is once again at the center, with increased participation and direct involvement in solutions for environmental sustainability ahead.

1. Introduction

From the outset, the community has been at the heart of environmental protection programs. With its grassroots origins, public involvement has enhanced and sustained environmental initiatives for decades. With the relatively recent emergence and fast-paced expansion of environmental informatics, community awareness of and participation in environmental health and sustainability programs has markedly increased. Examples of the process and progress for community-centric approaches are highlighted below.

2. The Past: Origins and Evolution of Environmental Health Analysis

2.1 The Early Years

The U.S. environmental movement is often traced to the alarm sounded 50 years ago by marine biologist and conservationist Rachel Carson in her book *Silent Spring* (Carson 1962). An eloquent essayist, Carson painted a bleak picture of the future if the practice of agricultural spraying of pesticides continued unchecked. She contended that diminishing bird populations attributed to the overuse of these synthetic chemicals portended a similar fate not just for other wildlife but also for human health, as evidence was beginning to surface linking environmental pollutant exposures to cancer.

Carson advocated for the responsible use of pesticides, based on understanding potential health and environmental impacts at the ecosystem scale. She cautioned that overuse could lead to the emergence of pesticide-resistant organisms, as malaria-carrying mosquitoes were indeed developing resistance to DDT. Carson also warned of inadvertently opening the door to invasive species that could alter the balance of a region – not just ecologically but economically. Her environmental message reached the public ear, in part because the recent thalidomide tragedies of the late 1950s and early 1960s had stirred a general unease regarding health and safety in light of the expanding use of novel chemicals for which potential adverse effects had not yet been adequately assessed. Moreover, decades of relatively uncontrolled releases of pollutants from pipes and stacks and dumps to rivers and air and soil had finally collectively choked urban skies and dirtied the waters to the extent that a trash-laden oil slick on the Cuyahoga River caught fire.

Both Carson and the Cuyahoga have been credited with being the catalyst for a sweeping set of environmental regulations in the United States, beginning with promulgation of the National Environmental Policy Act (NEPA) in 1970 and the formation of the U.S. Environmental Protection

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Agency that same year. Regulations for clean air, safe drinking water and ambient water quality, solid and hazardous waste management, protection of endangered species, pesticides, control of toxic substances, and more were established throughout the 1970s and into the 1980s. As the national charter for environmental protection, the two main thrusts are first to consider the potential impacts on the human environment of all major actions proposed by federal agencies, and second to involve the public in that process. Specifically, the implementing regulations by the Council on Environmental Quality (CEQ 1970) emphasize that "NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken." Also importantly, the NEPA analysis requires consideration of cumulative impacts. That is, past, present, and reasonably foreseeable future actions that could collectively contribute to adverse effects, e.g., due to geography or timing, must be considered. Here the human environment is broadly defined, to encompass not just the physical and biological components but also the social and economic components. Thus, within a decade, striking progress had been made based on the groundswell of public support for environmental protection that many believe began with a single book, whose popularity was established primarily by word of mouth, as supported by television images of smog-covered skies and a burning river.

2.2 Formal Public Involvement and Stakeholder Programs

Early public involvement can be illustrated by the NEPA process and the related process established for the cleanup program. Public involvement under NEPA was implemented in a fairly formal manner, with an upfront scoping meeting and a follow-on meeting for the draft environmental evaluation. The public generally submitted comments orally or in writing, by letter or at the meeting, and the agency typically responded in the form of a written responsiveness summary that accompanied the final report. Although this structure was intended to ensure a public voice, in many cases it constrained constructive interactions.

The Superfund legislation in 1980 and amendments in 1986 to address the cleanup of contaminated sites also emphasized public involvement. By that time (and continuing today), this involvement had evolved to consist of more interactive meetings with the opportunity for one-on-one exchanges at public information or public availability sessions. Nevertheless, information was still commonly shared via traditional means, such as hard copy reports, mailings, and the standard media.

As the availability and capabilities of information and communication technology (ICT) methods and tools increased, communities began to play a more active role in requesting and reviewing environmental data to gain a better understanding of risk implications. Involvement was strengthened via scientific partnerships with local schools, such as the Partnership in Education program established by the U.S. Department of Energy at a midwestern cleanup site (DOE 1992). Extending somewhat beyond the traditional methods and tools, site personnel visited nearby schools and gave "mad scientist" lectures, and students visited the site and took part in science projects relevant to the ongoing evaluations, e.g., to personally observe contaminants being precipitated by a bench-scale water treatment system. Involving the local community – particularly the youth – was a key factor in the overall success of this cleanup project.

As ICT tools developed further, so too did the approaches for stakeholder participation. For example, ten years later an independent team of scientists was tapped to support another DOE cleanup project. For that effort, an interactive web-based system was developed that tapped extensive site databases and included measurements as well as environmental standards for comparison, in addition to risk calculation and decision support tools (RACER 2007). These efforts enabled local citizens to track pollutant levels by area and medium (e.g., soil, surface water, and groundwater) and contribute to the development of cleanup alternatives for areas of interest. A further unique aspect of that project was the intent from the start to provide these integrated tools to the community upon completion – thus establishing a truly community-centric approach for this environmental project.

3. The Present: How Far We've Come

Extending from the historical emphasis on environmental pollution, substantial progress has been made in integrating environmental information to address multiple stressors, within frameworks developed to account for fate, transport, and complex interactions as part of cumulative risk analyses. As legacy waste management problems are being resolved, the focus has now shifted from environmental risk to environmental sustainability. This move reflects a growing recognition of issues at a much larger scale, which result from increasing global consumption in the face of finite supplies. Agencies and communities continue to grapple with a host of issues, including those foretold 50 years ago such as invasive species and chemical-/drug-resistant organisms, now also joined by significant challenges such as climate change sustainable development. Further advances in environmental informatics have dramatically changed the face of environmental programs and enhanced the opportunity for community involvement at multiple levels. Information is now shared in real time via a variety of mechanisms and forms. Open government initiatives abound, providing datasets, tools, resources and services that promote public involvement. For example, the U.S. data.gov initiative recently celebrated its second anniversary, with open data sites now extending across more than half the states and 21 countries. Topical elements include data and apps, semantic web, and a developer's corner (to promote the sharing of ideas, mashups, and apps) as well as education and communities. The latter encourages participation in areas such as health, energy, and restoring the Gulf of Mexico (following the 2010 oil spill disaster).

Multiple agencies and organizations continue to expand ready access to data and tools with a key objective being to heighten community awareness and facilitate participation in environmental protection and sustainability programs. For example, the U.S. Environmental Protection (EPA) Envirofacts program provides online information and tools that citizens can use to find information about their neighborhood such as where industrial facilities are releasing lead to air or water, or the status of cleanup at a local site. Real-time air quality data are also available, as are environmental indicators and regional data and trends, including for illnesses that have been linked to environmental conditions. These data can be used to guide prioritization of environmental management activities, especially useful under current budget constraints.

Advances in "green" applications from chemistry and remediation to buildings and energy have placed the emphasis on designing for protection at the outset. With an established record of integration, efficiency, innovation, and inclusion, environmental informatics methods and tools are well suited to serve as the foundation for these initiatives. In emphasizing the importance of civic participation and social innovation, including for environmental health and sustainability, the White House has encouraged prizes and challenges to enhance community participation. A recent DOE initiative illustrates this new approach. Per an Executive Order, federal agencies must develop strategic sustainability performance plans, and DOE has committed to specific reductions in greenhouse gas (GHG) emissions and to improving energy efficiency, water conservation, waste reduction, and sustainable acquisition. Within the energy efficiency arena, DOE announced the L Prize competition in 2010 to encourage the lighting industry to develop a high-performance, energy-saving replacement for conventional light bulbs – with a prize of $10M. The winner was announced in August 2011, having produced a 10-watt LED bulb anticipated to save $3.9 billion dollars a year in energy costs and avoid 20 million metric tons of carbon emissions.

Community participation is also being incentivized at the regional scale to promote partnerships for innovation and smart development. For example, a competition for Regional Innovation Clusters is designed to tap geographic links to promote economic development in geographic concentrations by combining common needs for talent, technology, and infrastructure (EDA 2011).

Broad access to both human and information resources enhanced by the integrating discipline of environmental informatics has increased participation of the general public at the national level as well. The U.S. EPA recently tapped into the exploding interest in apps, issuing an open challenge for "Apps for the Environment" (EPA 2011). This program will not only produce innovative apps for combining and deliv-

ering environmental health data at the personal level, it also brings the community into that process with an aim of sustained involvement. With a similar approach, last year First Lady Michelle Obama launched a competition sponsored by the U.S. Department of Agriculture (USDA 2010) – "Apps for Healthy Kids" – as part of the campaign to end childhood obesity within a generation. That challenge tapped into the growing trend toward gamification, highlighted in recent Web 2.0 expositions, and a number of winners produced creative apps to address this issue; a further win is having engaged that segment of the population on whom rests the burden of creating innovative solutions for much greater challenges that lie ahead.

4. NextGen: Where to from Here

Risk governance approaches have been established to promote stakeholder involvement in environmental health and sustainability programs, dealing with issues that range from natural disasters and nanomaterials to biofuels and climate change (Renn 2010). Environmental informatics provides a key integrating platform for these participatory processes, and insights gained to date will provide valuable context for the increasingly complex challenges in the years to come. The trend toward open community involvement in developing and applying solutions – rather than relying on government agencies alone – is expected to keep pace with ever-increasing advances in ICT and environmental informatics, which have essentially already cut the traditional generation time by half or more. With immediate access to more extensive data and more sophisticated tools for integrating and interpreting that information, the public is expected to be planted firmly at the center of environmental health and sustainability programs for the next generation.

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Bibliography

Carson, R. (1962): Silent Spring, Houghton Mifflin Co., Boston, Massachusetts (US).

DOE (2011): Department of Energy Announces Philips Lighting North America as Winner of L Prize Competition, U.S. Department of Energy, Washington, DC (US).

EDA (2010): Regional Innovation Clusters Initiative, U.S. Economic Development Administration, Washington, DC (US).

EPA (2011): Apps for the Environment, U.S. Environmental Protection Agency, Washington, DC (US).

RAC (2007): RACER: Risk Analysis, Communication, Evaluation, Reduction, Risk Assessment Corporation, Neeses, South Carolina (US).

Renn, O. (2008): Risk Governance: Coping with Uncertainty in a Complex World, EarthScan, Taylor and Francis Group.

CEQ (1970): Protection of Environment, 40 CFR (U.S. Code of Federal Regulations) 1500-1508, NEPA Implementing Regulations, Council on Environmental Quality, Washington, DC (US).

USDA (2010): Apps for Healthy Kids, U.S. Department of Agriculture, Washington, DC (US).

WSSRAP (1992): WSSRAP Update, An Informal Exhibit for DOE's Neighbors, Vol. 3, No. 2; U.S. Department of Energy, Weldon Spring Site Remedial Action Project, St. Charles, MO (US).