

## **Social Indicators for Nonpoint Source Water Quality Planning and Evaluation**

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### **Abstract**

In partnership with USEPA Region 5, the USDA-CSREES Great Lakes Regional Water Quality Program, and land grant universities in the region, six states in the Upper Midwest (USA) are pursuing a new approach to integrate social indicators into planning and evaluation of nonpoint source (NPS) water quality efforts. An inter-organizational team has developed a system for measuring change associated with individual action (behavior) and related local capacity associated with federally funded NPS projects. The system involves a set of core indicators, additional supplemental indicators, methodologies and instruments for data collection, analysis, and reporting, coordinated and supported through an on-line system. The project has the potential to improve the ability of environmental planners and project managers to understand connections between social and environmental factors. Its regional scope and application offer a unique opportunity to target, measure, and report interim resource management accomplishments consistently at multiple levels. This paper will provide a rationale for the approach, an overview of the indicators, their associated support system, and their application to environmental planning.

### **Introduction**

Planners interested in water quality face a significant challenge: we have limited options for addressing the most significant sources of water quality impairments, and we lack a clear focus that will guide planning and facilitate program evaluation and adaptation. Nonpoint source (NPS) pollution is the primary source of water quality impairment in the United States (USEPA 2000), and addressing NPS pollution requires influencing management decisions that affect rural and agricultural lands as well as runoff and erosion in urban and developing areas.

Advances in environmental modeling and planning visualization techniques help illustrate that NPS pollution is not uniformly distributed across the landscape. In order to effectively reduce environmental impacts of NPS, our planning, implementation and evaluation efforts should focus on those areas most critical to improving water quality, the individuals making management decisions for those lands, and the factors that influence their decisions.

With the exception of large confined animal feeding operations (CAFOs), regulatory solutions for addressing agricultural sources of NPS are rare and generally unpalatable for state and federal legislatures. In order to influence management practices in agricultural settings, we rely on persuasive approaches that involve promotional and educational efforts, financial incentives, and offers of technical support. Yet we invest very little effort into planning or evaluating persuasive efforts, and even less assessing whether the efforts are effective with the audience most influencing environmental impacts: those making decisions regarding land management of critical areas (Nowak et al. 2006, Nowak and Cabot 2004). We face similar challenges for the built environment.

Water quality problems have built up throughout many decades and will take decades to amend. Even when appropriate practices are put into place, there will be a lag before water quality actually improves. This delayed response makes it difficult to demonstrate accomplishments. Confirming the adoption of corrective practices and other beneficial behavior changes provides more immediate indications of expected water quality change.

NPS programs in six Upper Midwest states are addressing this situation. In partnership with USEPA Region 5, the USDA-CSREES Great Lakes Regional Water Quality Program, and land grant universities in the region, the six states in USEPA

Region 5 (Wisconsin, Minnesota, Michigan, Illinois, Indiana, and Ohio) are pursuing a new approach to integrate social indicators into planning and evaluation of NPS water quality efforts. An inter-organizational team has developed a system for measuring change associated with individual action (behavior) and related local capacity associated with federally funded NPS projects. The system involves a set of core indicators, additional supplemental indicators, methodologies and instruments for data collection, analysis, and reporting, coordinated and supported through an on-line system.

Social indicators provide consistent measures of social change within a watershed. These indicators will assist in planning and measuring the effectiveness of NPS programs by providing a system to measure: changes in awareness, attitudes, constraints, capacity to address NPS management issues, and behavior. This paper explains the rationale for social indicators in NPS management and describes the indicators and associated support system developed for this initiative. We close with a discussion of opportunities and challenges related to using social indicators in planning, implementation, and evaluation of environmental and natural resource management.

### **Background and Development Process**

Recognizing the importance of incorporating measures of social change into their management efforts, program leaders overseeing NPS initiatives in USEPA Region 5 approached the USDA-CSREES Great Lakes Regional Water Leadership Team for assistance developing social indicators to measure the effectiveness of NPS projects funded through their programs in this multi-state region. Prior to the initiative, each state NPS program in the region had outlined an evaluation framework describing an outcome-based evaluation approach that included provisions for tracking program performance

through the ongoing use of administrative indicators (e.g., funds utilized, activities completed) environmental indicators (e.g., water quality, habitat, and related physical environmental conditions), and social indicators. The use of social indicators was a new concept which was not initially well accepted, understood, or defined. A multi-state social indicators team was created to clarify options for using social indicators and develop a set of social indicators that could be collected for all funded projects, could be aggregated to evaluate state and regional-level impacts, and could support program-level evaluation.

The regional social indicators team outlined a process for indicator development and application that involved five phases: 1) design and scoping for the indicator development project; 2) workshops in each state for stakeholder input; 3) web-based rating and feedback on potential indicators; 4) expert reduction and operationalizing; and 5) further stakeholder involvement in testing and refining.<sup>1</sup> Following initial testing and refinement, the final phase has evolved into extended pilot-testing, to be completed in 2011.

Clarifying terminology and concepts related to social indicators and their integration with NPS planning, implementation, and evaluation was a significant challenge. Although social measures have influenced public policies for much longer, the term “social indicators” became commonly used in the 1960s, typically for measures such as unemployment rates, crime rates, life expectancy, and related social conditions (Cobb and Rixford 1998; Bauer 1966), as well as for “perceptual” measures such as subjective well-being and quality of life (Land 2001). As generally conceived, social indicators are statistics and other measures that enable assessment of the social trends and

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<sup>1</sup> A more detailed explanation of the development process is available in Genskow and Prokopy, In Review.

the human dimensions of programs and program impacts (Bauer 1966; Bright et al. 2003; Cole et al. 1998). Social indicators are generally “available to be collected over time and are primarily derived from available data sources...” (Force and Machlis 1997, p. 369), and as with all indicators, they serve as a “proxy or metaphor for phenomena that are not directly measurable” (Cobb and Rixford 1998, p. 1).

Efforts at incorporating social indicators into natural resource management include applications for ecosystem management (Force and Machlis 1997), watershed management (Morton and Padgitt 2005; Hibbard and Dority 2005), aspects of sustainability (e.g., CCFM 2004; Carruthers and Tinning 2003), and social impact assessment (e.g., Burdge 2004). Indicators identified through those processes encompass a variety of issues, including community capacity and activism, community interaction and information flow, demographic information, economic conditions and employment, education, property and land use, and public safety and health (Nolan 2004). However, while providing important trend data for community and regional settings, many social indicators relate only indirectly to the primary goals of conservation and resource management programs and secondary sources of data may not respond to activities during the time-frame of specific conservation projects.

One of the many challenges of indicator projects lies in distilling the universe of potential indicators into a usable set with relevance for program implementation and management decisions. For NPS, the most relevant indicators would provide information about behaviors and factors influencing their adoption. Much of the literature related to this and other environmental behaviors draws from social psychological models, adoption-diffusion, and stages of change. In particular, the Theory of Planned Behavior (Ajzen 1988, 1991), linking attitudes, subjective norms, behavioral

intentions, and behavior this theory, has received considerable attention in recent years and has been used to better understand a wide array of behaviors in the natural resources arena (e.g., Corbett 2002). Complementary theories build upon diffusion of innovations models (Rogers 1995), linking adoption of new technologies to knowledge about the technology, perceived risks associated with use of the technology, attitudes toward the technology, and perceptions of peer group attitudes toward the technology. Additionally, literature related to environmental education and outreach programs suggest similar influences and the importance of understanding underlying interests, constraints, and situational factors when seeking to influence specific audiences (Stern 2000, Stevens and Andrews 2006).

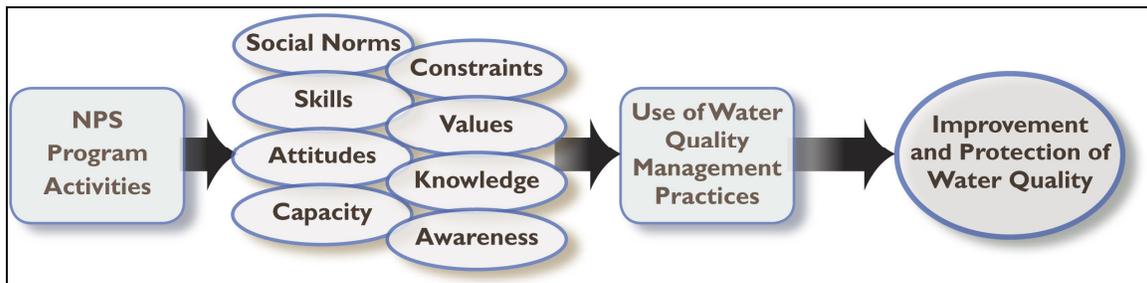
Specifically related to NPS, many researchers have attempted to isolate the primary factors that influence adoption of agricultural management practices (e.g., Ervin and Ervin 1982; Napier and Bridges 2002; Nowak 1983, Nowak 1992; Traoré et al. 1998; Shepard 2005). This body of research suggests numerous potential influences, including education level (Gould et al. 2000; Kim et al. 2005; Wu and Babcock 1998); farmer age (Featherstone and Goodwin 1993); risk aversion (Feder 1980; Kim et al. 2005; Napier et al. 1986); farm size (Featherstone and Goodwin 1993; Feder 1980); and farm income (Napier et al. 2000; Valentin et al. 2004).

In short, the research suggests that there are many potential factors that can influence a decision to adopt a given environmental and conservation practice and which of those factors are most salient will depend on the nature of the practices being promoted, individual characteristics, and local context. In order to concentrate NPS efforts on areas with the greatest potential impact, Nowak et al. (2006) reiterate the importance of targeting outreach and incentive efforts toward specific behaviors for

audiences delineated by specific environmentally sensitive lands. Effective planning and management must take these factors into account and develop programs based on knowledge of environmental conditions as well as knowledge of target audiences and other contextual factors that influence their behavior.

Applied to NPS projects, social indicators are measures that describe the capacity, skills, knowledge, values, beliefs, and behaviors of individuals, households, organizations, and communities. By measuring these indicators for audiences affecting critical environmental areas, water quality managers can help determine whether policies, programs, and initiatives are likely to lead to intended social and behavioral changes and, ultimately, to improvements in water quality (see Figure 1).

Figure 1: A simple conceptual model of NPS programs and water quality



### **The Social Indicator Framework**

Through the indicator development process, and consistent with others exploring similar approaches (e.g., Morton and Padgit 2005, Hibbard and Dority 2005), we developed an initial set of “core” indicators that would apply to all projects using this approach. We also identified an additional set of supplemental indicators that individual projects could use selectively to augment core indicators with a broader set of measures; the supplemental indicators will be further developed and tested over time.

The indicators are intended to be measured at two points in time – pre- and post-

project with the potential for long-term monitoring and assessment, depending on available local and state resources. The fact that core indicators will largely be collected as primary data is a departure from other indicator projects that have used “readily accessible” secondary data to provide measures for their indicators (Cobb and Rixford 2005, Rossi and Gilmartin 1980). All indicators had to meet criteria for selection. The criteria were drawn from previous efforts (e.g., CCFM 2004; Cole et al. 1998; Bright et al. 2003) and required indicators to be clear and understandable, measurable, practical in terms of accessibility and cost, valid, aggregatable, and reflective of stakeholder ownership.

Our final conceptualization for indicators included those that could provide information about awareness, attitudes, constraints, capacity, and behavior change that would be expected to lead to water quality improvement and protections. These indicators measure the adoption of actions known to be beneficial to water quality or the abandonment of actions known to be detrimental. The awareness, attitude, and constraints indicators measure aspects of an individual’s reasoning process that are precursors to behavior change. These are important because they represent different dimensions of the reasoning process, all of which are critical to motivating behavior change. Awareness indicators are based on the premise that there is a continuum of knowledge. For example, before becoming truly knowledgeable about a specific NPS water impairment, a person must first display an awareness of the existence of the problem, awareness of consequences associated with the problem, and awareness of appropriate actions to address the problem. The Attitudes indicators measure the relative value individuals and communities place on the relevant water-resource issues. Indicators related to constraints reflect influences such as limited access to equipment and technology, existing social

norms, and other factors constraining action. Capacity indicators address the availability, to the individual or to the community, of resources needed to respond to water quality problems. Specific project goals and intended outcomes for each category of indicators are included in Table 1.

### **The Support Structure**

Along with the indicators, the social indicators team has developed a data collection and management process that is supported by survey instruments, a support network, and a handbook as well as an on-line support tool for instruction, instrument production, data entry, analysis, and reporting. Data collection instruments include pre-project and post-project survey questionnaires for various audiences that use consistent question formats to capture social indicator data while enabling project-specific customization of pollution sources, management practices, constraints, and communication channels. The questionnaires reflect principles of sound instrument design (e.g., Dillman 2007) and are structured to collect information about attitudes, knowledge regarding local sources of water quality impairments and their consequences, awareness of potential measures to address problems, current behaviors, motivations, and factors that influence decisions. Projects can also add locally relevant questions. Currently questionnaires have been developed for the two most common types of audiences in NPS projects – farmers and non-farm households. Over the next three years additional questionnaires will be developed and tested for other target audiences identified through an initial piloting effort and by state NPS program managers.

Table 1. Goals, Intended Outcomes, and Core Social Indicators for NPS Management

<p><b>Goal:</b> Increased awareness among a target audience</p> <p><b>Intended Outcome:</b> Awareness gained regarding the relevant technical issues and/or recommended practices of the target audience in the critical area</p> <p><b>Indicator 1:</b> Awareness of pollutants impairing waterways  <b>Indicator 2:</b> Awareness of consequences of pollutants to water quality  <b>Indicator 3:</b> Awareness of appropriate practices to improve water quality</p>
<p><b>Goal:</b> Attitudes among target audience supportive of NPS management actions</p> <p><b>Intended Outcome:</b> Attitudes changed in a way that is expected to facilitate desired behavior change of target audiences in critical areas</p> <p><b>Indicator 1:</b> General water-quality-related attitudes  <b>Indicator 2:</b> Willingness to take action to improve water quality</p>
<p><b>Goal:</b> Reduced constraints for using appropriate practices</p> <p><b>Intended Outcome:</b> Constraints to behavior change will be reduced.</p> <p><b>Indicator 1:</b> Constraints to behavior change</p>
<p><b>Goal:</b> Increased capacity to address NPS management issues in the project area</p> <p><b>Intended Outcome 1:</b> The project improved the recipient's capacity to leverage resources in the watershed.</p> <p><b>Indicator 1:</b> Resources leveraged by grant recipient in the watershed as a result of project funding (including cash and in-kind resources)</p> <p><b>Intended Outcome 2:</b> Increased capacity to support appropriate practices by target audiences in critical areas</p> <p><b>Indicator 1:</b> Funding available to support NPS practices in critical areas  <b>Indicator 2:</b> Technical support available for NPS practices in critical areas  <b>Indicator 3:</b> Ability to monitor practices in critical areas</p>
<p><b>Goal:</b> Increased adoption of NPS management practices by a target audience</p> <p><b>Intended Outcome:</b> The project resulted in changes in behavior and/or adoption of practices to prevent new problems and improve or maintain water quality in the critical area by the target audience.</p> <p><b>Indicator 1:</b> Percentage of critical area receiving treatment  <b>Indicator 2:</b> Percentage of target audience implementing practices in critical areas  <b>Indicator 3:</b> Ordinances in place that will reduce nonpoint source stressors</p>

Other instruments within the SI system provide tools for evaluating specific implementation activities (e.g., landowner workshops and newsletters) and for collecting contextual information that influences project development and implementation. For

example, there is a set of structured questions project staff and other key stakeholders can use to identify external factors influencing their project.

A central component of support for state programs and NPS projects in the Great Lakes Region (Region 5) is the web-based Social Indicators Data Management and Analysis (SIDMA) tool (see Table 2). SIDMA will be used to help project coordinators organize, analyze, report, and visualize social indicators related to water quality improvements through spatial relationships. SIDMA can be accessed by project coordinators and staff through an interactive web site and will integrate with existing systems already in use for tracking and reporting NPS data. SIDMA includes a survey-builder feature that allows project staff to construct pre-project and post-project questionnaires using question structure and phrasing consistent with other projects across the region; the survey will be generated in a format project staff can mail or use as the basis for a telephone, in-person, or email survey. SIDMA also allows projects to enter survey responses directly on-line and provides data analysis and data export functions. Projects can also record interim data and “success stories” during implementation. Eventually, SIDMA will support web-based responses to mailed surveys, and in those cases where e-mail is an effective option for reaching an audience, it will support an e-mail survey.

*Table 2. Features of the Social Indicators Data Management and Analysis (SIDMA) tool.*

Survey builder	Provides survey questions to be selected and adapted for use by a watershed project
Geographic information and mapping tools	Provides watershed boundaries and population data
Data input screens and database	Use to input and store responses from questionnaires and other social indicator data
Data analysis tools	Use to generate descriptive and inferential statistics from survey data
Mechanism for reporting social indicator data	Use to report required social indicator data to USEPA Region 5
Report writing tools	Provides assistance for communicating social indicator data

As noted, we are currently entering into an initial three-year pilot test phase which will involve multiple NPS projects in each of the region's six states. Pilot projects will use detailed protocols for documenting issues related to staff capacity, level of assistance provided during implementation, costs, and other questions of interest. NPS projects involved in the testing and refinement phase will also have access to support and technical assistance from the SI Team. Long-term support needs will be identified and documented through this pilot phase.

### **Opportunities and challenges for environmental and natural resources planning**

This project provides an exceptional opportunity to explore the use of social data for planning and evaluating environmental conservation initiatives at a multi-state scale. Although our team was initially assembled to identify indicators supporting a regional *evaluation* framework for NPS, the effort broadened in scope to emphasize important linkages to planning. NPS and related conservation projects using these indicators must target their efforts toward critical areas (identified through environmental planning approaches), understand factors that influence land management decisions affecting those areas, and craft initiatives to address those factors. This approach will lead to plans that include explicit social outcomes and interventions based upon existing attitudes, knowledge and behavior of specific audiences in specific areas. Both planning and evaluation involve a systematic and consistent approach for employing social indicators at regional, state, and local scales.

Environmental planning has long-emphasized the importance of incorporating social data into plans and mitigating negative environmental and social consequences of

management efforts (Grumbine 1994, Burdge 2004). Environmental communication and extension programs have also emphasized audience specific strategies (McKenzie-Mohr and Smith 1999, Stern 2000). Yet, practically, it has been rare for environmental management projects to use social data effectively for planning, evaluation, and adaptive management. This is particularly evident in NPS efforts, which have either failed to focus outreach efforts on areas identified through planning processes or have omitted social factors from implementation strategies and adaptive planning frameworks. Social data are equally relevant for applications in groundwater protection and wetland, estuarine, forestry, and wildlife management.

Although we are excited about potential applications for this system, we recognize several limitations. We are providing a core set of indicators that focus on individual change and measures of capacity for supporting change among target audiences. Many additional measures that might be useful are not included in this system. Social indicator data will be expensive to collect and will challenge already thin budgets for natural resource management. Staff generally involved in resource management initiatives have limited experience collecting and using social data, yet will need to do so for both developing and adapting plans over time. It will be important to both build capacity for these approaches and to provide sufficient ongoing support. Additionally, regional consistency is critical for collecting data useful for state and federal agency accountability, yet there are inherent tensions between regional consistency and local flexibility. Effective indicators must accommodate the management needs of stakeholders at multiple levels.

We are addressing some of these questions through pilot tests involving multiple projects in each of the region's six states over a three-year period. While this project

addresses the needs of a specific federal program and its state counterparts, we hope the project sparks similar efforts for related conservation issues. We feel this effort will continue to provide helpful insights for integrating social data into environmental planning and management.

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