
V. LESSONS LEARNED

In completing the evaluation of existing sustainability/indicators projects and drawing from the expertise of the NFRPA/NA C&I project work group, there are several lessons learned about the use of C&I, the process of C&I development and implementation, and the use of benchmarks in the C&I framework. Highlights of these lessons learned are presented here. The interested reader should also refer to section IV (Evaluation of Existing Sustainability/Indicators Projects) and section VI (Recommended Criteria and Indicators Resources) of this sourcebook. Our understanding of the theory and practical uses of C&I will continue to evolve as progress is made in the many efforts that are still ongoing.

A. THE USE OF CRITERIA AND INDICATORS

Why use criteria and indicators?

Useful for defining sustainability. Forest sustainability is an abstract concept that defies simple definition and explanation. However, criteria and indicators can help us measure important aspects of forest sustainability and articulate measurable goals, as well as describe the possible outcomes of various actions and decisions at many levels. Criteria and indicators of forest sustainability provide a logical framework by which people can monitor and assess trends in forest activities and values. Evaluating the full suite of a given set of C&I allows society to measure progress towards forest sustainability (Oregon Department of Forestry 2000a).

Convey critical and complex information simply. Assessments based on a well-constructed C&I framework can indicate the effectiveness of efforts to ensure high quality forest management and community development. To the degree C&I information contributes to sound policy and management decisions, it can build public confidence in forest management, decision making, and support for investments in forest sustainability.

Meet the demand for a holistic approach. A hierarchical structure of C&I is used to encompass a full range of sustainability-based values and/or goals. Indicators associated with each criterion describe components of ecological, social, and economic systems that can change. Because of the interconnections among ecological, social, and economic systems, there may be some overlap in the measurements used to address various indicators. The same data may have several interpretations depending upon the criteria and indicators they are used to address. For example, the amount of forest land of a given forest type has different implications for biological diversity, production of wood and nonwood products, water quality protection, recreation, and potential value-added in processing. Such overlap is natural and necessary to achieve a holistic assessment approach.

Can and should be used at a variety of scales. Values embedded in criteria transcend scale, thus they provide a vehicle for linking local, State, national, and global conditions, actions, and policy. Most countries (including the United States), several States, and numerous regional and local efforts support the use of criteria and indicators as a tool to promote discussions about sustainability. The National Research Council's *Ecological Indicators for the Nation* states, "Indicators can be useful at many levels—community, state, ecoregional,

watershed, national, and international—and better indicators are needed at all such scales” (National Research Council 2000, p. 2). It is important to match the scale of indicators to the scale of the ecological, social, and economic processes at which they are most useful.

What advantages are linked to the use of common indicators?

Promote linkages across multiple scales. This can be accomplished through the use of common indicators with different levels of resolution or generality. For example, indicators related to information on the amount and type of forest land are useful for all levels of planning and assessment, from local to international. At the international level, it may be sufficient to distinguish forest types in general categories such as coniferous and deciduous forests. At the regional level, forest type groups such as maple-beech-birch and oak-hickory are relevant. At the site level, the natural community with all floristic and structural components may be most relevant. It is also beneficial if indicators at different scales can be nested. As stated in a report from the Sustainability Institute (Meadows 1998, p. 22):

At each of these levels, actions are taken and information is needed. We picture a nested set of indicators, each informing the “system in focus” at its own level (say, actual water quality in this lake) and aggregating to inform the system at the next higher level (average water quality in the region’s lakes). Aggregation is necessary to keep from overwhelming the system at the higher levels of the hierarchy.

Facilitate communication and cooperation. Use of a common C&I framework could improve our ability to compare, develop, and share resource data and information across administrative and jurisdictional boundaries. A commitment to common criteria and indicators can help maximize the return on investments in resource inventory. It would provide a common vocabulary for Federal and State agencies and other stakeholders. In addition, a common framework could help identify opportunities for organizations with similar goals to work together. Many States are engaged in developing and implementing C&I, spearheaded by either State agencies or nonprofit groups. It is important for State forestry agencies to be aware of and participate in these existing C&I networks.

Help elucidate cumulative effects. The use of common indicators across jurisdictions provides an opportunity to capture cumulative effects. The influences of ecological, social, and economic systems and policies operating at different geographic and temporal scales can be illuminated by transcending political boundaries.

How are criteria and indicators used?

The development of C&I is not an end in and of itself; the real value is their utility in communicating important information about forests and forest management. While the development of C&I is an important and daunting task, C&I are a valuable tool when used in assessment, planning, issue management, inventory, monitoring, and communicating with others. They provide a format that supports scientifically based forest management and effective policy formulation.

Assessment. C&I serve as a logical framework for organizing successive assessment and reporting activities. A C&I assessment is an instrument to detect trends in ecological, social,

and economic systems. C&I assessments are proactive vehicles for routine early detection of critical trends. Assessments provide a synthesis of information in support of planning and decision making; however, they are not decision making documents.

Comprehensive strategic forest resource planning. The C&I framework is a planning tool to ensure that planning considers the full range of values and conditions important in setting goals and objectives for management and describing desired future conditions. C&I also serve as a monitoring tool to ensure that comprehensive and strategic forest resource plans are implemented. C&I should be used to identify where there are problems and identify potential management course corrections.

Issue management. Assessing or analyzing issues with C&I helps identify areas of common ground and opposing views among diverse stakeholders. In addition, it provokes thought about what needs to be done and who can do it. The C&I framework helps sort out what needs to be explicitly addressed. For example, as part of their strategic planning process, the Oregon Department of Forestry is using the criteria from the Montreal Process as a way to develop an organized list of issues that is exhaustive and mutually exclusive (Birch 2001). Developing a list of issues that fully articulates public concerns about a particular criterion, such as biological diversity or productive capacity, is much more manageable than trying to address sustainability as a whole.

Prioritize inventory and monitoring. C&I can be used to identify and prioritize information needs that will be addressed through inventory and monitoring programs. It is important to consider monitoring and reporting cycles since they may vary for individual indicators. C&I-based planning projects and assessments require inventory and monitoring data. Therefore, by extension, the framework will be useful in structuring a whole information system—a comprehensive inventory and monitoring program.

Communication. Concise, consistent, and easy to follow reports enable agencies, organizations, and the public to link sustainability goals and objectives to concrete measurements. Utilizing a Web-based reporting system allows the flexibility to update the data on an indicator-by-indicator basis as the data become available. However, periodic comprehensive reports are recommended. A handful of reports among the sustainability efforts evaluated were particularly good examples. In the reports from *Maryland's Environmental Indicators* and *New Jersey Future*, each indicator was presented in a consistent format with one indicator per page (figure 11).

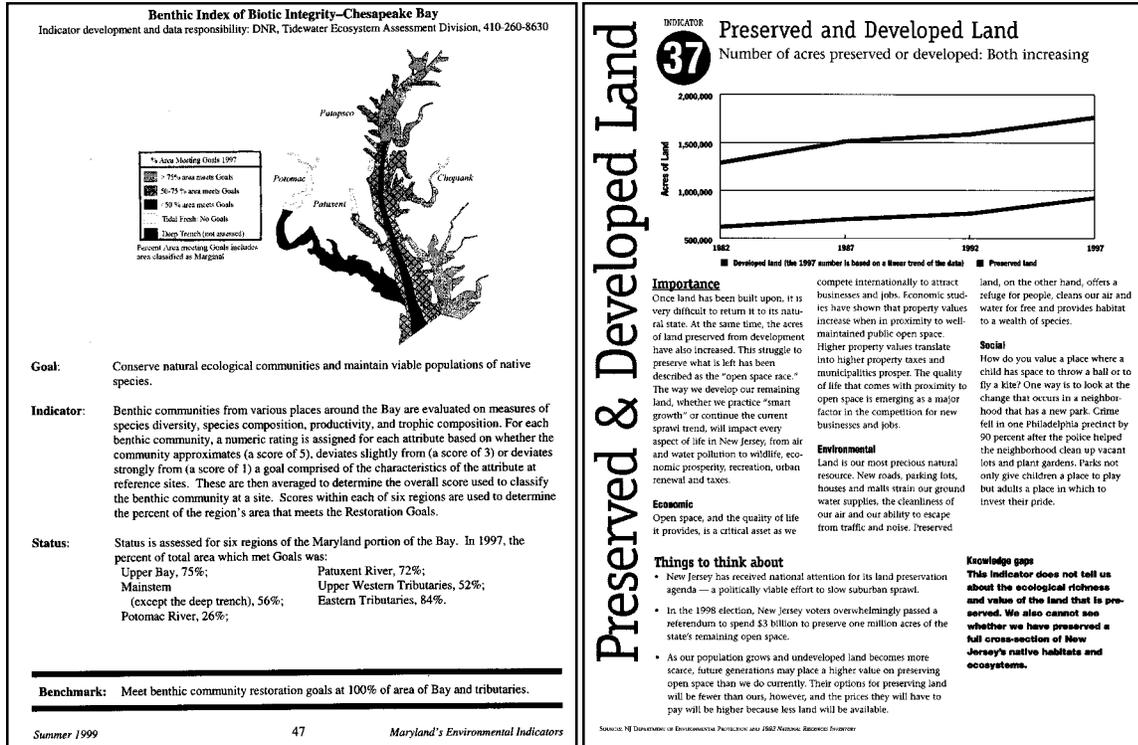
The Maryland and New Jersey reports included some of the following components for each indicator:

- Indicator—indicator wording with definitions or clarification where necessary
- Importance—brief explanation of why the indicator is important
- Development and data responsibility—list of *who* is responsible for the indicator
- Goal—overarching goal or criterion the indicator is measuring
- Data—indicator data presented as a table, graph, or map
- Status—short trend statement (e.g., increasing) with brief explanation of data results

Figure 11. Example formats for reporting on indicators to decision makers and the public

Maryland's Environmental Indicators: A Status Report (Maryland Department of the Environment 1999)

Living with the Future in Mind: Goals and Indicators for New Jersey's Quality of Life (New Jersey Future 1999)



- Benchmark—statement of the reference condition or the desired condition
- Knowledge gaps—description of important knowledge gaps and relevant steps to address these gaps
- Things to think about—short statements intended to make connections between the indicator results and other aspects of sustainability and present further facts that support the illustrated indicator trend

These indicator reports are exemplary in that complex scientific information was clearly and consistently presented in a space-limited format. In addition to the indicator report pages shown here, both of these reports included preceding pages that presented and described each criterion or goal. Both reports had effective formats for reporting on C&I to decision makers and the public. Reporting on the indicators is a critical component of the often iterative process of indicator development and implementation. As stated in a report published by the Sustainability Institute, publishing and promoting the indicators “requires translating them into striking graphics, clear language, and an effective outreach campaign. It helps to link the indicators to the policies and driving forces that affect them, to illustrate their linkages, and to point to the actions that can be taken to improve them” (Meadows 1998, p. 27).

How can a criteria and indicators assessment be conducted?

There are a number of activities common to C&I-based assessment processes.

- Determine the degree of public involvement you desire.
- Identify your data needs and availability, deciding how to handle gaps in desired information.
- Develop clear data definitions and methods of measurement.
- Agree on the target audience(s) and degree of interpretation to be provided in the assessment report.
- Establish clear linkages between the objectives of your assessment and those of other efforts (certification, planning, department projects).
- Look for opportunities to leverage resources for mutual benefit.

Work with public and professional stakeholders. Identify and work with stakeholders to ensure credibility and usefulness. At a minimum, identify others whose help will be needed to carry out the endeavor. Include decision makers likely to benefit from the information provided and stakeholders active in the assessment area. At the local scale, residents should be included. Opportunities for professional involvement include the development of criteria and indicators, providing quality assurance, data management, and indicator interpretation. Assessments can be a powerful vehicle for promoting public involvement in resource planning and decision making. Involvement early in the assessment process creates understanding about criteria and indicators and supporting data that will carry into planning and decision making processes.

Clearly state the assumptions used to interpret data. Indicators normally are constructed to describe conditions or, more specifically, the pace of change in some given condition. Indicators may provide insight into cause and effect relationships when they are interpreted with reference to a specific spatial, temporal, or conceptual context that is relevant to the criterion under discussion. Examples of a spatial context include ecosystem, watershed, State, and community. The historical range of variability is a temporal context. A conceptual context is intergenerational equity—the degree to which benefits are distributed among present and future generations.

Recognize that C&I can't do all things. There are many information needs that must be met through venues other than C&I monitoring and assessment. Criteria and indicators are a useful tool for the purposes described above; however, there is a continuing need for other types of information to solve natural resource management problems and to manage resources effectively.

B. THE PROCESS OF CRITERIA AND INDICATORS DEVELOPMENT AND IMPLEMENTATION

Implementation of C&I is an iterative process. This process includes development of indicators, identification and standardization of data to support each indicator, reporting on indicators, and indicator revision. The measures used, and even the indicators themselves, are subject to revision in accordance with underlying science, data availability, and

experience. Development of an initial set of indicators may take 1 to 3 years alone, depending upon stakeholder involvement and the nature of the planning process with which it is affiliated. Therefore, to be done well, C&I implementation requires a long-range commitment as well as flexibility to adapt C&I content and processes as more experience is gained.

What makes a good indicator?

It is critical to carefully evaluate potential indicators. Several groups and reports have examined the question of what constitutes a “good” indicator (Williams and others 1998). Those reports have consistently identified the following characteristics:

- **Relevance to criterion**—Indicators should be clearly related and relevant to the criterion.
- **Understandable**—Indicators should be clear in content: easily understandable, with units that make sense, expressed in imaginable, not eye-glazing, numbers. The indicator should pass the common sense test applied by the general public.
- **Measurable**—Indicators should be measurable on a consistent, reliable basis, using well-defined data that can be compiled without long delays.
- **Policy relevant**—Indicators should be relevant for all stakeholders in the system, including the least powerful.
- **Feasible**—The value of the information provided by an indicator should not exceed the cost to gather it.
- **Sufficient to the purpose**—Indicators should not contain too much information to comprehend, nor too little information to give an adequate picture of the situation.
- **Sensitive to change**—Changes in the forest, whether from human actions or natural changes, should elicit a response in an indicator in time to act on it.
- **Scale appropriate**—Indicators should be measurable at a scale appropriate to that of the forest sustainability monitoring effort and not over- or under-aggregated.
- **Compatible**—With the exception of locally important indicators, indicators should “roll up” into State, regional, and national efforts to define criteria and indicators of forest sustainability.

Quantitative or qualitative. Indicators may be measured in a quantitative or qualitative way. If quantitative data are not available, qualitative information can be used to demonstrate changed conditions. It is just as important to provide clear definitions for qualitative information as it is for quantitative information.

One or more metrics may be needed. Data types and measurement protocols used in inventory and monitoring are called metrics or verifiers. An individual indicator may be measured with one metric (acres), several metrics (size and growth rate), or a calculation based on several metrics (carbon flux).

Scale is an important consideration. Scale affects the cost of implementation, statistical design, data availability, and data compatibility across jurisdictions. The precision and

accuracy of inventories is tied to scale. Common measures are crucial for comparing conditions among jurisdictions at a given scale. Standardization simplifies the aggregation of data from local to global scales.

How are indicators developed?

Common steps in indicator development include the following (adapted from Meadows 1998):

- ***Select a small working group.*** The working group, responsible for the success of the venture, should be multidisciplinary, with strong ties to the audience for which the indicators are intended. The working group is most effective when it combines experts and non-experts from the outset, but the critical element is long-term commitment to the process.
- ***Clarify the purpose of the indicator set.*** It is important to determine whether the indicator set is meant to educate the public, provide background for key policy decisions, evaluate the success of an initiative or plan, or address multiple purposes. Different purposes give rise to different indicators and different communication strategies.
- ***Review existing models, indicators, and data.*** Begin the process of indicator development by doing some homework on previous work. The Montreal Process indicators are recommended as a starting point with advantages as stated previously. Research what existing or prior work has been done in your region and State. Understand what a criteria and indicators framework can and cannot do for you. Evaluate your needs with close attention to the level of detail needed to support assessment and decision making.
- ***Draft a set of proposed indicators.*** The working group draws on its own knowledge, the examples it has collected, and the advice of outside experts, if needed, to prepare a first draft. The draft may go through several revisions before it is ready for the next step. Initial indicator sets, in particular, tend to be very long. In later drafts, they need to be pruned down to become more focused and practical.
- ***Provide an opportunity for review of indicators.*** The draft indicators need to be presented to a broad cross-section of the community for their input. This process serves several important goals: it educates the participants, gathers their collective creativity and expertise, and makes them stakeholders in the success of the project. Often, it gives rise to new relationships and alliances among the participants and can even generate new action initiatives to address problems identified by the indicators.
- ***Perform a technical review.*** An interdisciplinary team of knowledgeable people should sort through the proposed final draft indicators, considering such things as measurability, statistical and systemic relevance, and scale, trying to stay true to the intentions and preferences expressed by the wider stakeholder review process. This technical review helps to fill in gaps and weed out technical problems, and produces a final indicator set that is ready to be fleshed out with data.
- ***Research the data.*** Identify data needs and availability, and develop a common understanding of data definitions and the pros and cons of specific metrics. At this stage,

the indicators are usually subject to additional revision, driven by data concerns and new learning. If you are responsible for inventory and monitoring design, develop standard protocols and quality control and assurance mechanisms.

Indicators should tap into our understanding of how ecological, social, and economic systems operate and interact. In order to separate what *should* be measured as indicators from what *could* be measured, it is helpful to clearly articulate the important components of ecological, social, and economic systems pertinent to the suite of criteria you have adopted in your effort. Ecological, social, and economic system frameworks developed through the USDA Forest Service’s LUCID project are available for this purpose (USDA Forest Service 2001b). The frameworks help in selecting indicators by providing a mechanism to evaluate the spatial, temporal, and values-based context of potential indicators.

A coherent information system is needed. To provide information about forest sustainability, a whole information system is needed from which indicators can be derived. Therefore, while developing indicators, it is important to think about the development of an information system of which indicators are just one part. For example, when discussing indicator development, the Balaton Group, an international network of sustainable development scholars and activists, realized that they were also referring to “the design of not only the instrument panel (indicators) that governments and citizens need to see to steer the ship and avoid obstacles, but also the design of the background wiring (information system) that collects and sorts information and delivers it to the panel” (Meadows 1998, p. 28).

Do indicators need to be measurable at this point in time?

Do not eliminate indicators that are not currently measured. It is tempting when narrowing a list of potential indicators to think, “If you cannot measure it, it is not worth considering.” However, do not preclude important indicators that are not currently measured. It is often possible to identify surrogate measures, such as in the fashion of the *Maine Forest Sustainability Standards’* use of proxy indicators (Maine Forest Service 1999). Research and representative case studies can also be used to document significant trends if inventories are based on incomplete or incompatible information.

Who are the audiences for C&I reports?

Consider the target audience(s) and their use of the C&I information. It is helpful to have a clear sense of the target audience(s) and their use of C&I information when developing an indicator set and determining what outreach strategy to use. The most common target audiences are the general public, decision makers, and both public and private forest managers. C&I can be used as a vehicle to raise awareness among the general public, to raise issues and provide information on program and policy effects important to decision makers, and to serve as a critical source of information on forest conditions, trends, and responses for forest managers committed to adaptive management.

Audiences can be targeted in several ways; the following are two approaches.

- ***Tiered Approach.*** Identify overlapping levels of indicators with each level targeted to a specific audience/purpose (tiers of indicators similar to those in Oregon Department of

Forestry 2000b). Among the benefits of this tiered approach is the ability to break a larger, more comprehensive list of indicators into smaller, more easily accomplished pieces, while simultaneously producing tangible products that meet critical information needs for target audiences. A consequence of this approach is that there may be variations in data currency across reports generated, leading to some miscommunication among the various targeted groups.

- **Targeted Communication.** Identify one comprehensive suite of indicators (e.g., the 67 identified in the Montreal Process) and use a communications strategy to excerpt the information appropriate for each target audience/purpose. In essence, measure once, but report out in multiple ways. This approach is being used in the *Forest Sustainability Assessment Report for the Northern United States* (USDA Forest Service 2001a). A benefit of this approach is that multiple targeted user groups will reference the same data. A consequence is that difficulties in data compilation and interpretation for a small portion of the indicators can delay public dissemination of the larger volume of information.

How many indicators are needed to address sustainability?

There is no magic number of indicators to meet the needs of all potential users of criteria and indicators information. Different indicator sets are used to meet the needs of all potential users of C&I information. The number of indicators necessary will vary with the scale, intended use, and outreach strategy chosen.

A comprehensive set addresses the major aspects of each criterion. At minimum, a sustainability criteria and indicators set should address important conditions and processes of ecological, social, and economic systems and strive to achieve balance among the three. A comprehensive set of indicators should address the major aspects of each and all agreed upon criterion.

A balancing act between concise and sufficient. It is difficult to balance the need for a concise list of indicators with the need for a list that is sufficient to address sustainability. Generally, the higher the number of indicators, the greater the time and expense incurred collecting and assessing information. These pragmatic issues cannot be ignored. Costs can be controlled by reducing the resolution of data used for assessment and increasing reporting cycle length. A C&I framework also helps streamline organizational inventory, monitoring, and data management efforts by reducing redundancy and utilizing state-of-the-art data capture methods. It may be helpful to phase in the use of a comprehensive set of indicators following an agreed upon timetable.

C. THE USE OF BENCHMARKS IN THE CRITERIA AND INDICATORS FRAMEWORK

What are sustainability benchmarks?

A point of reference or reference condition. “With respect to indicators, the most common definition of a benchmark is: a point of reference, or reference condition, from which measurements can be made or a standard against which others may be judged” (Bridge and others 2002, p. 3). Their purpose is to gauge the effectiveness of planned actions by gauging the outcome of those actions against a desirable or undesirable outcome. Benchmarks can be statements of desired condition (e.g., specific acreage in protected areas), a defined reference

point (historical condition, desired future condition, threshold condition), or a policy or program performance target. Benchmarks may be quantitative or qualitative.

Why use sustainability benchmarks?

Set clear public expectations. Benchmarks set clear public expectations for measurable outcomes from management activities, programs, and policies. When linked to indicators of sustainability, benchmarks help promote outcome-based forest policy with the goal of providing a more stable and predictable public policy that supports and encourages long-term investment in forests. For example, the Maine Forest Service (1999, p. 27) believes that “the State should begin to focus more on outcome-based forestry regulation, on the premise that this approach will do more to promote, stimulate, and reward excellent forest management yet still provide a baseline of regulatory protection for critical public resources.”

Can be linked to the C&I framework through reference to specific indicators. A benchmark can be linked to a specific indicator by basing the benchmark on the metric(s) or data used to monitor trends for a given indicator. Benchmarks can provide a context for interpreting an indicator. For example, it may be possible to define statements about the desired future direction of change in the indicator (Bridge and others 2002).

How are sustainability benchmarks developed?

Should be set in an open public process. A transparent process brings credibility to the use of benchmarks. Sound science is a prerequisite to the benchmark setting process. However, benchmarks, especially for indicators that deal with ecological, social, and economic tradeoffs and investments in forests or forest management, are heavily dependent on public values. Achieving agreement in these situations may require lengthy or complex negotiations.

A lack of knowledge or information can make it difficult to set meaningful benchmarks. For example, lack of information on the amount of nonwood forest product harvesting and the effects of this harvesting on ecosystem resilience makes it difficult to set a benchmark based on either harvest volumes, standing inventory, or ecosystem condition. As noted by Bridge and others (2002), “In some instances, the science supporting the indicator is so new that establishing credible benchmarks is difficult or unwarranted until further research is completed” (p. 2). Benchmarks will have varying levels of precision due to lack of data, tools, scientific understanding, or simply the nature of the indicator.