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Socio-economic indicators and integrated coastal management

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One of the more significant challenges faced by those interested in and responsible for Integrated Coastal Management is to better refine our understanding of the linkages between coastal system dynamics and the social benefits associated with them. While both the coastal management and marine science communities have developed indicator systems to better assess change, the degree to which such efforts have been linked has been surprisingly limited. For the most part, the management community has focused on institutional measures of program performance while the marine science community has worked to build indicators of the scope and scale of change in natural systems. The degree of interaction between social systems and environmental variability has held relatively less focus. That humans and the environment are linked has been long asserted. Measuring the degree and importance of those interactions has been less of a core activity.

However, the past decade has witnessed a more refined effort to expand an understanding those interdependencies. This has been the result of several related endeavors. First, pressure has been building by national governments and the international donor community to better evaluate the success of coastal management programs. Part of that evaluation pressure has been to link management with the mitigation coastal environmental degradation. Second, the design of international monitoring and assessment protocols, such as the Global Ocean Observing System (GOOS), the Global International Waters Assessment (GIWA), and, more recently, the Global Terrestrial Observing System (GTOS) and the Millennium Ecosystem Assessment (MA) has provided an opportunity for more systematic reflection. And, third, emerging models for indicator development have begun to provide appropriate frameworks for the articulation effective data strategies. Taken as a whole these efforts provide an opportunity to engage in more strategic planning for the design of coastal-based socio-economic indicators. Several nations (or more appropriately regional programs under national sponsorship) have provided for or

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1 begun efforts to better quantify these relationships. However, these have been
2 limited in scale, scope and temporal dimensionality. The recent meeting “The Role
3 of Indicators in Integrated Coastal Management” co-organized by the Department
4 of Fisheries and Oceans of Canada and the Intergovernmental Oceanographic
5 Commission established an opportunity for strategic consideration at the interna-
6 tional level.

7 For these efforts to achieve their hoped for success they should embrace a
8 consistent and internationally compatible approach. It should be fully recognized
9 that local and regional ICM programs must respond to and provide benefit to their
10 own stakeholders. Integrated Coastal Management is an approach driven by local
11 conditions. However, a larger context should not be ignored. Our understanding of
12 social/environmental linkages can only be effectively understood through an
13 assessment across biomes, social conditions and management approaches. Critical
14 lessons are established through multiple and cross-cutting case analyses. The choice
15 of effective and efficient coastal management should draw upon the successes
16 articulated from both similar and dissimilar regulatory environments. The purpose
17 of this paper is to describe a set of indicator models that most directly contribute to
18 this process of strategic planning. It will also report limited and preliminary results
19 of a set of dialogs (primarily conducted through the recent DFO/IOC meeting and
20 through various panel meetings of GOOS) establishing a general framework for the
21 identification of coastal socio-economic indicators.

23

24 **1. The articulation of indicators**

25

26 Environmental concerns that have surfaced in the United States and around the
27 world in the past 30 years have added a new variable into the scientific search for
28 knowledge of the natural world; human influence. The inclusion of humans into the
29 natural web of interactions calls for new protocols for studying natural systems and
30 for solving economic and health problems. Acknowledgment that people are a part
31 of biogeochemical cycles and physical processes has necessitated a more integrated
32 approach to natural resource management and research [1–3]. Economic, political,
33 and social structures are intertwined with resource use patterns. Changes in the
34 condition of natural systems have a direct impact on the ecosystemic functions that
35 humans depend on for health, services, and economic growth. Here, we face a dual
36 challenge. First, understanding the complexity of those linkages is difficult. Natural
37 variability, the impact of episodic events (such as major storms) and anthropogenic
38 forcing all play a substantial role in the flux of natural systems. Isolating the relative
39 contribution of each is, at best, difficult. Second, the complexities of public health
40 risk or economic sustainability are difficult to understand and predict. Determining
41 the role of environmental conditions is even more challenging. These difficulties have
42 contributed the relative paucity of indicator-based approaches to management. The
43 recognized conundrum is that without an integrated and sustained indicator-based
44 system it is unlikely that critical linkages can be established, generally accepted and
45 acted upon.

1 The first step to using indicators to advance our knowledge of coastal systems and
2 the effectiveness of management programs is to establish an appropriate definition
3 for the term indicator. Measure, variable, parameter, analyte, metric, and index are
4 all terms that can be found in the literature and in the glossaries of current programs
5 designed to develop and use indicator frameworks ([4–6], GOOS, 2002). Each has
6 been used to describe (sometimes inappropriately and occasionally to the point of
7 confusion) efforts to build an empirical approach to understanding coastal system
8 dynamics. In an effort to mitigate that confusion we suggest that a focus on the
9 function of an indicator as an appropriate starting point. The OECD [4] has argued
10 that a successful indicator should:

- 11 • Reduce the number of measures which normally would be required for an exact
12 presentation of a situation; and
- 13 • Simplify the process of communication to managers, stakeholders and commu-
14 nities.

15
16
17 In short, indicators should represent dynamic parts of an overall portrait that is
18 understandable and compelling to its intended user community. They should be part
19 of a process to minimize the number of individual variables and data points while
20 maintaining a sufficient level of critical understanding to those responsible for or
21 interested in coastal systems.

22 For this process to succeed purpose and context must initially be established.
23 What questions serve as motivation for the effort? Some indicator frameworks are
24 designed to determine program performance, some are created to establish links
25 between anthropogenic activity and ecosystemic health, and some attempt to track
26 trends and conditions in ecosystem dynamics or resource use. While this initiating
27 step appears obvious it is often challenged—particularly, in situations in which
28 available information takes precedent over appropriate information. The design of
29 new data-driven programs are often broadly influenced by the availability of existing
30 data files. While it is essential to fully utilize existing data it is equally essential to
31 understand the value and voracity of data when the present context is substantively
32 and substantially different. That data exists does not de facto mean it should be used.

33 When the purpose of data collection is established, a blueprint for the design and
34 use of indicators should be put into place from the inception of the project, to ensure
35 that the time, effort and money invested are not wasted. Five general steps seem to
36 summarize the considerations that should be incorporated into the indicator system:

- 37 • *Articulate an indicator framework driving the selection of specific measures.* With
38 an agreement on a context and question alternative frameworks should be
39 assessed to determine their applicability in selecting an indicator set of greatest
40 value. The needs of and value to the user community should sit at the core of these
41 deliberations.
- 42 • *Determine an efficient and effective data acquisition strategy.* Cost, compatibility
43 and sustainability of effort should be considered as should the value of existing
44 data sources.

- 1 ● *Create and maintain a sustained data management system.* Making data broadly
2 and openly available through an established quality assurance/quality control
3 system is essential.
- 4 ● *Agree to protocols for data analysis.* One of the historic difficulties in system
5 monitoring has been too strong a focus on data acquisition and too little a focus on
6 data analysis.
- 7 ● *Develop reporting products to ensure information reaches and is understood by the*
8 *broader user community.* The number and nature of coastal area stakeholders
9 reaches well beyond the scientific or regulatory communities. Traditional forms of
10 reporting (i.e., limited runs of printed reports with data tables) are increasingly
11 limited in terms of their ability to inform those whose interests are at stake. New
12 graphic display and information management technologies need to be more fully
13 embraced.

14
15 A substantial focus of this paper resides in the first of these steps: that is, the
16 description of frameworks driving the selection of specific measures. However, it is
17 important to recognize that the selection of measures and acquisition of data should
18 be viewed as part of system in which data acquisition, management, analysis and
19 product production are viewed as part of a synthetic whole which should be
20 addressed concurrently in the early stages of program initiation.
21

23 2. Models for the selection of socio-economic indicators

24
25 The indicator models are herein described within a specific context; that is, the
26 linkages between socio-economic conditions (including management and regulatory
27 approaches) and changes in coastal environmental dynamics. As such, they serve as
28 performance measures of success in those aspects of an overall ICM effort for which
29 those linkages are a part. We acknowledge that these linkages are viewed as an
30 important part of an ICM framework—but, only a part. The process of developing a
31 broadly integrated management effort will need to incorporate a richer set of
32 performance measures. Institutional evaluation, an understanding community
33 dynamics, and policy assessment all play a central role. However, the synergies of
34 social/environmental interaction are also important. Most ICM efforts articulate
35 goals relating to coastal environmental improvement yet often lack specific
36 performance measures dedicated to understanding how well those goals are being
37 met.

38
39 Ideal performance measures provide a clear indication of how well a program is
40 achieving its objectives. Thoughtful design, use, and adaptation are critical to their
41 usefulness as a management tool. Industry, international aid organizations, and
42 government agencies all have unique processes to implement performance measures
43 that are compatible with the specific aims of the organization. Most models use
44 indicators to determine if the performance measures are being met. Considerable
45 theoretical work has been done discussing the framework and design of evaluation

1 techniques [4,7–9]. Several themes repeat themselves in the academic and applied
discussions of indicators that may be helpful to keep in mind as we explore the
3 potential use of performance measures in ICM efforts.

5 An ideal combination of indicators could be fed into a conceptual or technical
model that efficiently identifies what, where, how, and why change is occurring
7 within the system. Performance-based management frameworks should organize
indicators into sets that are responsive to and driven by the needs of the user
community. The Organization for Economic Cooperation and Development
9 (OECD) created the “Pressure–State–Response” model in 1993 to help model the
cause and effect relationship between humans and the environment [10,11]. This
11 model has been expanded since 1993 by the United Nations and the European
Commission (among others) to include the root causes of environmental change and
13 the impacts this change has on ecosystems and on humans. Input, output, outcome
and impact measures are classified according to the programmatic goals of the
15 management action.

17 Developing a performance-based evaluation begins with clearly defined strategic
goals and a detailed set of intermediate targets [12]. The intended results of the
program and the specific type of change that is desired need to be understood and
19 articulated within the context of measurable increments. Differences in the situation,
condition, level of knowledge, or attitudes and behavior of a population need to be
21 assessed with appropriate units [12]. The more precise the vision of the program, the
easier it will be for the organization to develop measures that yield useful
23 information.

25

27 3. Pressure–state–response model

29 The Pressure–State–Response (PSR) model, popularized by the OECD [11], is an
example of a common framework for environmental evaluation. Environmental
31 problems and solutions are simplified into variables that stress the cause and effect
relationships between human activities that exert pressures on the environment, the
33 condition of the environment, and society’s response to the condition (see Fig. 1).

35 Water quality is a typical environmental concern that can be used as an example to
display the three types of indicators. Tons of fertilizers used by waterfront property
owners is an indicator that measures the “pressure” that the environment is
37 experiencing. “state” variables monitor the condition of the environment. In this
example, the actual nutrient dynamics of the water body would serve as the state
39 indicator. The “response” indicator measures the actions taken to reduce pressures
or improve the state of the resource in question. The number of workshops held or
41 amount of protective legislation passed in a certain timeframe to protect water
quality are quantitative examples of response indicators.

43 The P–S–R approach was a useful addition to the literature in that it made explicit
the need to focus on those factors influencing environmental systems and associated
45 consequences (both in terms of environmental conditions and regulatory change).

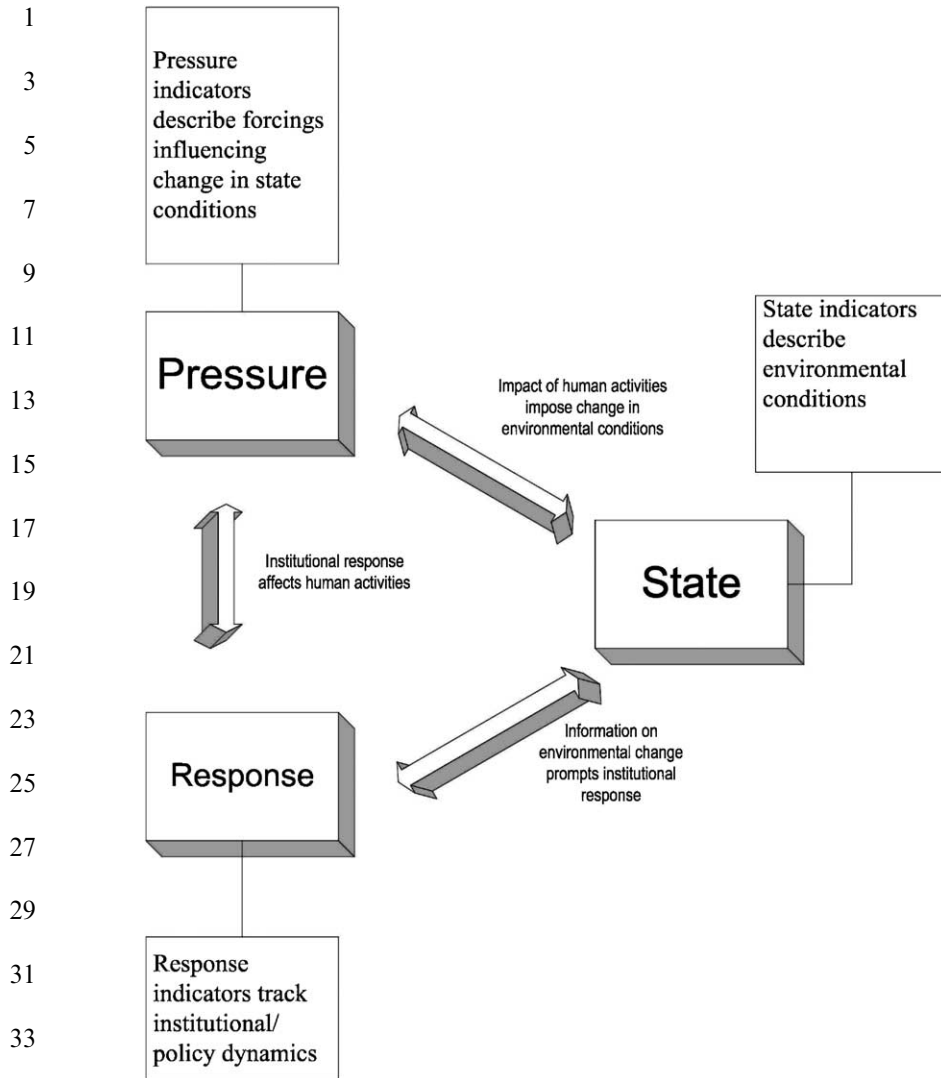


Fig. 1. Pressure–State–Response model for indicator development. Adapted from: OECD [11] and LEAD [20].

However, its conceptual limitations are significant. It describes a system overly simple in its view and overly narrow in its scope.

4. Driving force, pressure, state, impact, response model

The original P–S–R descriptions focused on anthropogenic pressures and responses. One of several problems was that the original definitions did not

1 effectively factor natural causes into the pressure category. Therefore, natural
2 variability and episodic events had no real place in the model. While anthropogenic
3 forcing is often an important, if not dominant, factor in environmental change,
4 efforts that ignore other influences may lead to the imposition of unwarranted
5 regulatory constraints that hold little, if any, promise to improve environmental
6 quality.

7 In part, this challenge led some, most notably the United Nations Commission on
8 Sustainable Development to describe a Driving Force–State–Response model. A
9 primary modification here was to expand the concept of “pressure” to incorporate,
10 social, economic, institutional and natural system pressures (UNEP, 2002).
11 However, even when “driving force” replaces “pressure”, the model does not
12 explicate a category to account for the underlying reasons for the pressures. To
13 analyze policy options and resource allocation in environmental management, it is
14 essential to have a grasp of the root causes of the problems being addressed [13]. A
15 model that measures pollutants but gives no information about the social conditions
16 surrounding driving pollutant introduction (e.g., changes in the organization of
17 watershed agriculture or coastal industrial production) is not providing the data
18 needed to inspire meaningful change.

19 Another element missing from the P–S–R model is an examination of human
20 motivation responding to the state of environmental conditions. While social
21 stewardship of the environment should be an essential component of environmental
22 policy, it is not the sole motivation. Social resources are not infinite. Expenditures of
23 time, energy and effort are prioritized according to a rich and often conflicting suite
24 of factors. Certainly, one of those factors should be the social costs imposed or
25 benefits gained through changes in the quality of supporting environments. The
26 social impact of environmental change is an essential factor in influencing policy. An
27 indicator system that records the state but not the impact essentially assumes that
28 every change in the pressure, state, or response should be given the same amount of
29 attention or resources. Realistically, all ICM efforts are a careful balancing of
30 priorities. Including indicators that measure impacts to humans and the ecosystem
31 makes the model a more useful management tool.

32 Thus, challenges to the initial P–S–R model have contributed to the refined and
33 expanded approach described as the Driver–Pressure–State–Impact–Response
34 Model by, among others, the European Commission [9]. Within this model:

- 35 • *Drivers* describe large scale socio-economic conditions and sectoral trends such as
36 patterns in coastal land use and land cover, and growth and development in
37 coastal industry sectors,
- 38 • *Pressures* such as patterns of coastal wetland alteration, the introduction of
39 industrial POPs/metals and fertilizer use in the coastal watershed hold the ability
40 to directly affect the quality of coastal environments;
- 41 • *State* indicators describe observable changes in coastal environmental dynamics
42 and in functions describing sustainable development;
- 43 • *Impacts* are the discrete measured changes in social benefit values linked to
44 environmental condition such as the cost of marine-vectored disease, loss of
45

recreational bathing beach value, or losses to commercial fishing value due to contaminant burdens; and,

- *Response* indicators are described as the institutional response to changes in the system (primarily driven by changes in state and impact indicators).

Fig. 2 represents the D–P–S–I–R approach and is designed to emphasize the fact that any indicator framework should focus not only on the articulation of appropriate indicators and on the development of data acquisition systems (indicators), but should also embrace the need for analysis and capacity building through the construction of reporting products responsive to user needs.

As already noted, the present effort is a focus on using conceptual models in the building of socio-economic indicators viewed to be of greatest value in understanding the dynamics of social/environmental integration. Table 1 provides an illustration of that effort. Here, indicators are classed according to whether they best

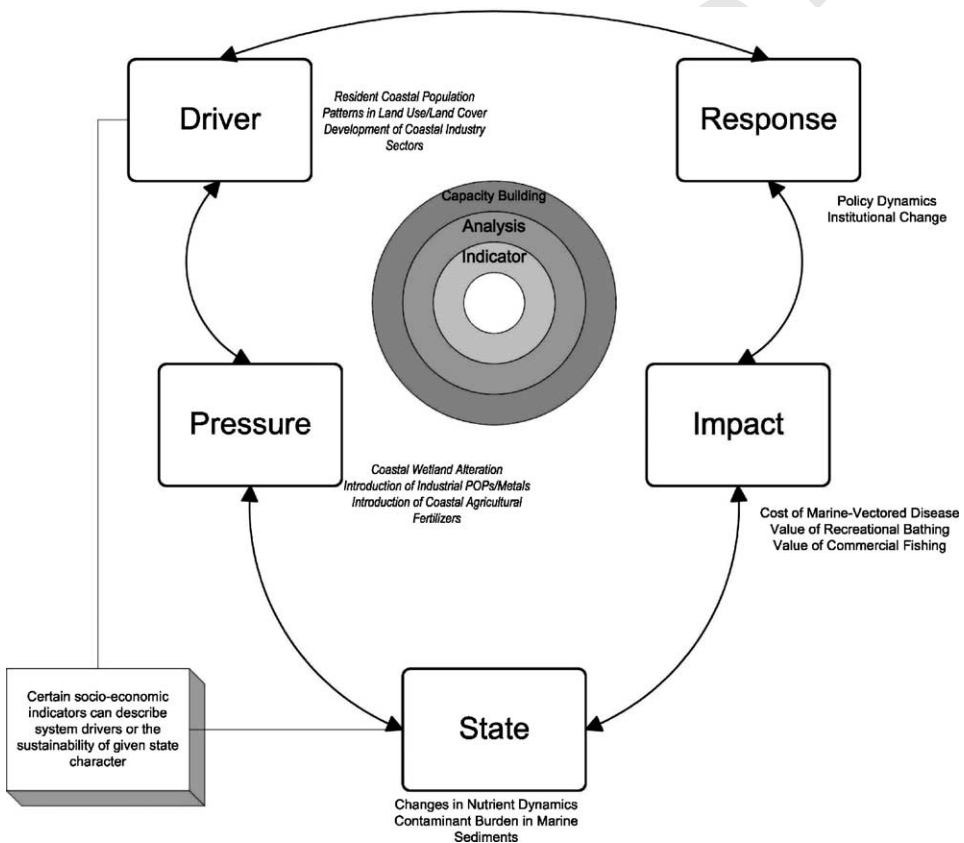


Fig. 2. Driver-Pressure-State-Impact-Response model for indicator development. Adapted from: IUCN [21] and European Commission [9].

1 Table 1
 Illustration of socio-economic indicators within a driver–pressure–state–impact–response framework

3	Driver/state	Pressure	Impact
5	Population dynamics	Resident coastal population Coastal land-use/land cover Coastal zoning patterns	
9	Economic conditions	Annual GDP growth Environmentally adjusted net domestic product Economic value/ employment in coastal industry	
15	Social conditions and cultural traditions	% population with potable water Cultural stability/ integrity	Change in user conflict
19	Development pressure/ capital construction		% of altered coastal land Cost of coastal flooding/ hazards and savings provided by coastal habitat
21		% of impermeable surface in CZ	Dredging costs driven by sediment contamination
23		Coastal fill acres/year	
25	Habitat change/ ecological value	Service value of coastal habitat Value of habitat driven manufactured products	Social costs of invasive species Service value changes from habitat alteration Changes to non-use values of coastal habitat
29			
31	Contaminant introduction	% of population with wastewater treatment	% of coastal harvesting areas under environmental restrictions
33		Fertilizer use in coastal watershed Industrial inputs of POPs/metals	
35			
37	Resource extraction activities	Oil spills from extraction/ transportation Commercial fishery landings Seafood consumption patterns	Seafood value changes from seafood risk/ habitat alteration
39			
41			
43	Human uses/activities	Coastal aquaculture Beach attendance	Marine-vectored disease Beach closing costs
45			

1 meet the description of Driver, State, Pressure or Impact indicators. They are also
2 classed into the substantive themes of:

- 3
- 4 ● Population dynamics
 - 5 ● Economics conditions
 - 6 ● Social conditions and cultural traditions
 - 7 ● Development pressure/capital construction
 - 8 ● Habitat change/ecological value
 - 9 ● Contaminant introduction
 - 10 ● Resource extraction activities
 - 11 ● Human uses/activities

13 These substantive themes are used to stress the complexity of the coastal social
14 system. When developing an indicator system data should be drawn from a broadest
15 range of human activities influencing, and influenced by, coastal environments. In
16 any given situation it may be that the range of influence is more narrow than those
17 characterized in these thematic categories. However, a systemic review of the
18 possible relationships should be an early part of the design of any indicator-based
19 effort. [Table 1](#) is provided as an illustration of specific indicators representing these
20 classes. It draws from a more complete list of indicators developed for the recent
21 meeting in Ottawa(1). This set can be viewed as a fuller palette against which the
22 discrete informational needs of individual programs could be judged. [Table 1](#) also
23 attempts a reflection of more recent discussions on the application of the model to
24 various questions facing coastal and environmental managers. In linking the model
25 categories of driver and state the table attempts to emphasize the value of context in
26 indicator development. In certain instances indicators may best assess the relationship
27 between drivers and pressures. In other instances the same indicators are best viewed
28 as contributing toward an understanding of the influence of Pressures on the State of
29 social sustainability functions (OECD, 2002). This illustration is meant to further
30 stress the need for flexibility in the development and use of indicators. Models hold
31 their greatest value when they provide insight and inspiration into a broad range of
32 complex questions and hold less value when viewed as a constraint on creative
33 application. The D–P–S–I–R approach more effectively represents the complexities
34 of social/environmental interaction and highlights the need to understand and
35 measure the nature and scale of that dynamic.

37

38 5. Process and outcome indicators

39

40 The indicator approaches described above can, and should, be incorporated into
41 more traditional program evaluation efforts. They can make important contribu-
42 tions to emerging and evolving efforts to assess the success of Integrated Coastal
43 Management. However, again, certain caveats need to be recognized. Integrated
44 Coastal Management represents a complex set of activities that include, but is by no
45 means limited to, efforts to improve environmental quality. Assessments of the

1 success of ICM (particularly at the local level) need to incorporate a broad range of
2 cultural and institutional measures. However, the degree to which evaluation
3 measure can expand to more effectively incorporate social/environmental dynamics
4 the stronger the argument will be that these programs hold broad and general value.

5 Evaluation efforts can usually be divided into those that measure process, those
6 that measure outcomes, and those that measure both [14,15]. In the context of
7 coastal program evaluation, process evaluation measures the policies, the laws
8 passed, money spent, permits issued/denied, and the management programs
9 implemented. Outcome indicators document the changes in social or physical
10 conditions brought about by the activities of the public program [16]. Acres of land
11 protected, number of public access sites established, an improvement in water
12 quality, or measures of organizational learning or progress are all considered
13 outcome indicators. Historically, much of the coastal management evaluations
14 conducted in the United States, for example, have concentrated on measuring
15 process indicators [16]. Managing for results has recently become a trend in US
16 governmental agencies, sparked by the Government Performance and Results Act of
17 1993. Focusing on outcomes rather than solely on process indicators intends to shift
18 the government away from overemphasizing inputs and hopes to introduce
19 accountability for desired agency results [7]. Performance measurement also
20 promotes communication within an organization about what the exact goals are,
21 how they are to be achieved, and who is responsible for each aspect of project
22 implementation [7]. Strengths and weaknesses of the project and of the organization
23 are more easily identified and addressed early in the process if outcomes are being
24 measured for each objective [7]. Within coastal management, it is more difficult to
25 find and collect outcome data than process data. Contributing outcomes directly to a
26 specific program is also a challenge compounded by the fact that criteria for success
27 are not often clear from coastal legislation or program plans [17]. Creating an
28 indicator framework that has a place for both process and outcome indicators can
29 help trace management efforts more directly to environmental and social conditions.

31 32 33 **6. Input, output, outcome, impact indicators**

34
35 Program assessment indicators can also be theoretically categorized into input,
36 output, outcome, and impact variables [5]. The World Bank categorizes indicators to
37 correspond with project components following an implementation scheme that flows
38 from project design to implementation of sub-projects interacting toward desired
39 impacts. Tracking the performance of a project begins with input measures to keep
40 track of procurement of material of equipment, funds, material and labor. Output
41 and outcome indicators relate back to the stated goals of sub-projects and impact
42 indicators measure progress towards the goals stated at the highest level of the
43 project/organization. The World Bank uses this model to evaluate development
44 projects of all kinds, but the framework is applicable to coastal program evaluation
45 as well [18].

1 To demonstrate some examples of these types of measures, indicators from the D–
2 P–S–I–R model can be viewed as contributory to each of these categories. Input
3 variables measure the amount of time, personnel, or resources invested in a project
4 or task (response indicator). Output indicators measure specific actions taken by the
5 program, such as a decrease in point pollution (pressure). The outcome indicator
6 measures larger goals of the program such as improved water quality as measured
7 through nutrient dynamics (state). Impact indicators take this thinking one step
8 further, measuring the improved quality of resources or human health (impact). Any
9 organization attempting to design a performance-measuring system must recognize
10 that each action could be measured using input, output, outcome, and impact
11 indicators and design goals with this spectrum of results in mind. Accepting such an
12 assessment approach provides an effective mechanism to link specific program
13 performance measures with a broader environmental and social sustainability
14 perspective. It also more effectively structures the opportunity to link coastal
15 environmental monitoring programs with local ICM program actions and goals.

17

18 **7. Broadening the concept of program performance**

19

20 As already noted most ICM program efforts incorporate the improvement of local
21 environmental conditions in either the rationale for the program or in the statement
22 of program goals. Therefore, indicators of environmental variability and the socio-
23 economic relationships to them should be built into a comprehensive system of
24 program performance. And, while it is readily acknowledged that environmental
25 improvement and social change are not typically reflected within the duration of a
26 specific ICM program effort this should not preclude their inclusion as indicators of
27 longer-term program success or as contributors to development of broader-scale
28 policy development. These broader indicators of change cannot be used alone to
29 judge program implementation at individual sites, however, this information is
30 critical to understand local, state, and national trends. Indicators of coastal
31 environmental change can be used to prioritize projects at the site level and should
32 feed into state, national, and potentially international efforts to relate coastal and
33 human health to management efforts. Ecological indicators should be one category
34 of performance measures crafted from the mission statements of coastal manage-
35 ment programs to reflect pressures to the environment from natural sources (such as
36 weather) and the environmental state of coastal systems.

37 The pressures imposed by human action are also important in forming strategic
38 goals program priority actions. Land use patterns may contribute to an under-
39 standing of water quality data, and demographic trends in the surrounding towns
40 may help managers redesign education programs.

41 Tracking anthropogenic influences will provide a better long-term picture of
42 program effectiveness in changing behaviors and attitudes as well as documenting
43 health and economic consequences (impacts) of environmental services and
44 degradation. Any practical environmental program must incorporate social realities
45 into its plan of action. Selecting indicators for socio-economic factors enriches the

1 body of measures used to improve programming and evaluate progress on a broader
2 scope than using institutional performance measures alone.

3 To adapt to the most pressing local issues and assess the long term impacts of
4 program action monitoring information outside the direct control of the site
5 management should also be assessed, organized, and used to shape local plans.
6 Recently, agencies, nations and even small towns have been publishing “sustain-
7 ability indicator” lists that track economic, ecological, cultural, and social indicators
8 to alert decision makers to trends [18,19]. Through these data, the state of the
9 environment can be assessed along with the pressures that result from human social
10 and economic activity. Models can be drawn, plans made, and actions prioritized
11 based on monitoring indicators. Program implementation should address the
12 findings of a monitoring program or data collection that reflects current conditions
13 and patterns. Achieving the goals of Integrated Coastal Management requires a clear
14 picture of programmatic progress, environmental conditions and influencing
15 anthropogenic factors.

16 This view admits to significant challenges. Attempting to tease out the relative
17 contributions of natural cycles, episodic events, and anthropogenic influence requires
18 sophisticated statistical analysis and the occasional heroic assumption. Programs
19 may contribute to improvements in the state of the natural environment and relieve
20 certain pressures on the estuary, but it is clearly difficult to measure the proportion
21 of change attributable to a specific action. The long-term use of socio-economic and
22 ecological indicators can indicate how well the programmatic approach contributes
23 to broader goals of Integrated Coastal Management over the period of years to
24 decades (which, admittedly, is beyond the budgetary cycle of most local programs).
25 In the short term, these indicators can aid local managers in moving toward more
26 informed decisions on prioritizing projects and revising strategic plans.

27 Socio-economic, ecological, and management indicators all fit into a linked
28 approach to program performance. Understanding coastal processes, and therefore
29 evaluating program success in addressing coastal issues, requires a broad and rich set
30 of integrated indicators. Comprehensive program assessment should incorporate
31 appropriate components revealed through consideration of a D–P–S–I–R modeling
32 effort as well as more traditional institutional performance measures. The more
33 effective integration of social condition, environmental dynamics and institutional
34 response can only enrich the process of informed decision-making on sustainable
35 resource use and development practices.

37

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40 8. Uncited references

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42 [22]; [23]; [24]; [25]; [26]; [27]; [28]; [29]; [30]; [31]; [32]; [33]; [34]; [35]; [36]; [37]; [38];
43 [39]; [40]; [41]; [42]; [43]; [44]; [45]; [46]; [47]

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