Assessing the management performance of biodiversity conservation initiatives and investments: an institutional approach

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Abstract

An institutional analysis framework for assessing the management performance of biodiversity conservation investments and initiatives is developed in this chapter. While the focus is on biodiversity, the framework is also more widely applicable to problems involving the provision of public goods. This institutional approach is useful for a number of reasons. First, it uses capital assets to describe the state-of-the-world and specify the full spectrum of resource flows available to resource users. This allows analysts to frame the goals and objectives of various actors in terms of the attributes and characteristics of natural, manufactured, human, social and economic capital, and facilitate transparent discussions regarding sustainability. Second, this approach explicitly integrates the Institutional Analysis and Development (IAD) framework with the results-based management approach increasingly being used in the private and public sectors. The IAD framework provides a system for classifying rules and norms according to their function and to incorporate them into the action-activity-output-outcome-impact hierarchies used for results-based management. Third, the integrated institutional framework can be applied at different levels of analysis – political, policy implementation, and operational – in such a way that stimulates thoughtful policy design, analyses, and monitoring of biodiversity conservation investments and initiatives. Taking a multi-level perspective to policy design and implementation is necessary if we are to understand the dynamics of adaptive management, develop effective and efficient conservation investments and initiatives, and account for the full range of direct and indirect benefits of ecological research activities.

Keywords: Institutional Analysis and Development; Results-Based Management; Biodiversity; Environmental Policy; Management Performance; Sustainability; Critical Natural Capital; Species at Risk

1 Introduction

Ecologists study terrestrial and marine ecosystems that are often under severe stress. The stress, often resulting from increasing human activity and resource use (e.g., Turner et al., 1990), can be manifested in a number of ways including the loss of biodiversity (e.g., Cracraft, 1999, Wood et al., 2000). Biodiversity loss imposes costs on human societies by impairing the flow of ecological goods and services that people can put to diverse uses (Perrings et al., 1995; Bengtsson et al., 1997). Besides compromising the sustainable flow of resources that people use for food and as inputs for the production of market commodities, the loss of biodiversity may lead to more serious consequences such as reductions in ecological resilience, impairment of life support functions, and the permanent loss of species that may have inherent value independent of human values and preferences.

Ecologists routinely provide scientific advice to resource managers and policy makers but, all too often, find that their advice is made subservient to short-run economic and employment concerns, even when that advice is recognized as valid (e.g., Patterson, 2004). There is increasing recognition within the scientific community that biodiversity loss is fundamentally a human problem (Mangel et al., 1996; Wood et al., 2000). Human behavior is the driving force behind biodiversity loss and solutions to the problem of biodiversity loss must address the behaviors that cause the problem. Further, it is apparent that the problem is caused in large part by the aggregate impacts of behaviors that seem rationale to individuals and organizations at the micro-level, given the social, economic and institutional context within which they make decisions (Ostrom et al., 1994; Shogren et al., 1999). This implies that the solutions to biodiversity loss, and other serious environmental problems, must account for human incentives and the institutions, or 'rules of the game' (North, 1990), that shape them. This holds true not only at the operational level, the day-to-day level at which people make decisions about resource use, but also at higher levels in which the incentives of people in the political sphere and public administration may also need to be aligned with broader societal interests.

An important theme arising in modern conservation biology is that of the need for adaptive, or experimental, management (Hollings, 1978; Walters, 1986, 1997). Essentially, adaptive management entails the ongoing crafting, implementation, and assessment of directed policy experiments that test various hypotheses about the causal links between policy interventions and the state of the world, supply information about the effectiveness and efficiency of various intervention options, and reduce uncertainty about the world and the behavior of actors within the policy system. While adaptive management is now recognized as a key factor in achieving long-term sustainability (Mangel et al., 1996; NRC, 1999; Gislason et al., 2000; Hall and Mainprize, 2004), pragmatic assessments of biodiversity conservation investments and initiatives have been weak to date. As Saterson et al. (2004: 597-58) note, "few project evaluations are comprehensive enough to assess effects on biological resources, on ecosystem function, and on social welfare and equity. Yet without evaluation, the possibility of adaptive management is limited."

It is this emphasis on adaptive management in the ecology field that leads into the realm of institutional analysis, a research tradition existing at the intersection of the political science and economics disciplines. Institutions are comprised of both formal rules and informal social norms about what behaviors are required, permitted or prohibited in a society (Crawford and Ostrom, 1995; Ostrom, in press). Institutions can specify financial or social rewards for compliance and sanctions for infractions of rules or norms. As a result, they have a strong influence on human incentives, cooperation, and on the critical management transaction costs (gathering information, negotiating agreements, monitoring, and enforcement) of biodiversity conservation. Institutional analysis has a strong empirical orientation with a wealth of studies and insights on the governance of renewable resources systems over the past twenty years (e.g., Ostrom, 1990; Schlager, 1990; Blomquist, 1992; Ostrom et al., 1994; Gibson et al., 2000; Blomquist et al., 2004).

The Institutional Analysis and Development (IAD) framework (Oakerson, 1992; Ostrom, 1986, 1990, 1999) formalizes the institutional approach to policy analysis and specifies a set of universal elements that need to be considered by policy analysts. It is a framework for linking human incentives and decisions at multiple levels of analysis, from the day-to-day operational situations to high level political situations. One can use a variety of theories within the framework (Ostrom, 1999); much of the theoretical and empirical institutional research on renewable resource systems takes the view that humans are goal-oriented, but fallible learners who have imperfect information about the world and the incentives and likely behavior of others (Ostrom, 1997).

Taking an institutional approach to policy analyses of biodiversity conservation initiatives and investments has a number of advantages. First, there is a specific focus on human incentives and behavior. Rules, monitoring and enforcement, all of which critically affect incentives at the individual level, directly impact the effectiveness and efficiency of environmental conservation. Systematically studying various institutional alternatives allows policy analysts to develop logic models and hypothesize about the causal relationships between rules, human behavior, and ecological and socio-economic outcomes.

A second advantage is the incorporation of explicit linkages between different levels of analysis. Day-to-day human behavior is shaped by governance processes at the political level, where political actors make choices about how to achieve broad societal goals and objectives, and at the implementation level, where bureaucrats make decisions about how to implement political decisions. A dynamic framework is necessary for linking scientific research, management performance, conservation outcomes, and political decisions.

A third advantage is that an institutional approach permits analysts to view all management interventions, whether habitat rehabilitation, on-the-ground monitoring, rule-making, or long-term changes to the process by which political choices are made, as investments in various types of capital assets (Rudd, 2004). By expanding the IAD framework to explicitly incorporate capital assets and their resource flows, including ecosystem goods and services, policy analysts have a means of linking ecological monitoring on the state-of-the-world and results-based management performance monitoring systems.

The focus of this chapter is on expanding a capital asset-based IAD framework (Rudd, 2004) to integrate sustainability indicators and results-based management performance monitoring systems in a dynamic framework for adaptive management. After a brief background section on capital assets and sustainability, the balance of the chapter develops the policy analysis framework in steps. It begins with an overview of the operational-level logic model and proceeds to sections on sustainability indicators, management performance, institutional analysis, and the links between levels within the management system.

2 Background

2.1 Characteristics of Capital Assets

The term ‘capital’ has a variety of meanings in business, economics, and the social sciences. Capital assets are comprised of any stock or system that has the capacity to provide a flow of goods and services to human society, now and in the future, and that can be combined with other goods or services and transformed into valuable outputs (Castle, 1998). Capital assets are not entirely used up in the production process, but provide resource flows that people can use over time. A second general characteristic of capital is that it requires investment, reflecting savings or consumption foregone in one time period, to increase well being in the future. Without ongoing investment, capital assets are used up and their capacity to produce sustainable resource flows diminishes. Using a capital asset approach in policy analyses allows for explicit issues of substitutability between types of capital assets and can help frame and operationalize the concept of environmental and socio-economic sustainability (NRTREE, 2003a).

2.2 Types of Capital Assets

Five kinds of capital assets are now widely recognized by academic researchers, policy analysts and government decision-makers: natural capital; manufactured capital; human capital; social capital; and economic capital.

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Natural capital (also denoted as K_n in this chapter) refers to the part of the environment (air, water, soil, and ecosystem) that provides people (1) with products that can be consumed (source services), (2) with waste assimilation (sink services), (3) with nonmarket amenities and (4) with ecological functions that support living systems (Ekins et al., 2003).

Manufactured capital (K_m) refers to human-produced goods that can be used to produce further benefits for their owners over time (e.g., facilities, infrastructure, equipment, technology). Manufactured capital is also sometimes referred to as produced or infrastructural capital.

Human capital (K_h) refers to the health, knowledge, skills, training, competencies, and other attributes embodied in individuals, that facilitate the effective production of personal, social and economic well-being (Helliwell, 2001).

Social capital (K_s) refers to rules, procedures, protocols, social networks and norms that facilitate mutually advantageous collective action by reducing uncertainty about the world and the behavior of others, hence increasing trust and the propensity to cooperate (see Rudd, 2000; Woolcock and Narayan, 2000; Helliwell, 2001).

Economic capital (K_e) refers to the wealth of households, firms, governments and civil society that can be further invested to build other capital assets and generate resource flows for production processes. **Financial capital** (K_f) is one type of economic capital, consisting of money, property and other financial assets. Clearly most people would also agree that ‘wealth’ can be defined in broader terms that includes nonmarket outcomes that help people satisfy their aspirations and increase their quality of life. These outcomes provide a type of economic value to people yet are not priced in existing markets. They can, however, be thought of as **non-financial economic capital** (K_{nf}).

2.3 Substitution and Sustainability

If we consider the sum of societal capital assets to comprise the total wealth of a society, this leads naturally to the issue of substitutability and sustainability. Can the resource flows from various capital assets replace each other in the production of commodities or, more broadly, in the 'production' of quality of life?

Figure 1 provides a simple hypothetical illustration of how various resource flows could be combined to produce a similar output, fish landings. In the first instance, inexperienced fishers working with simple technology, limited financial resources, and in social isolation (i.e., no information sharing about current fishing conditions) could land 5,000 kg of fish with modest fishing effort given stock abundance was at 100% of environmental carrying capacity. When resource abundance falls, however, to 25% of carrying capacity, more experienced fishers with more sophisticated technology, more funds (i.e., for fuel to travel farther from home port), and good information from other fishers may need to expend twice the fishing effort to land the same volume of fish. In this example, more sophisticated technology, skills, information and better financing, all resource flows from the various capital assets, could act as a substitute for natural capital. Note, however, that although the output was the same (5,000 kg fish landed), the ultimate outcomes may be quite different for the two situations. A 5,000 kg catch may be sustainable given an undisturbed stock but may not be when the stock is already reduced to 25% of the undisturbed level. Operating expenses in the second situation would be higher and could well mean that the more 'sophisticated' fishery is marginally profitable or even erodes the overall stock of financial capital. The two scenarios may also have substantially different implications for bycatch: while turtle entanglements may not enter the cost-benefit calculus of individual fishers, higher turtle bycatch could lead to subsequent decreases in well being and the overall quality of life for other sectors of society.

<<< insert Figure 1 about here >>>

In traditional economic analyses, it is most common to assume that there is a high degree of substitutability between different kinds of capital. From this perspective, known as 'weak sustainability', depletion of natural capital may deemed sustainable if the growth in other assets is sufficiently large to compensate for the loss of natural capital (see Jansson et al., 1994; Pezzey and Toman, 2002). An alternative view is that the substitutability of manufactured for natural capital is limited by the characteristics of natural capital (e.g., threshold effects, uncertainty, irreversibility). A 'strong sustainability' perspective maintains that the stock of natural capital must be non-declining in sustainable systems. Whether other capital assets can substitute for natural capital in various transformation processes is likely most often between the two extremes.

A recent project has defined critical natural capital as "natural capital which is responsible for important environmental functions and which cannot be substituted in the provision of functions by manufactured capital" (Ekins et al, 2003: 169). Critical natural capital can be defined by either its importance (ecological, economic and socio-cultural) or the degree of threat that it faces (a function of the size of the remaining stock and its inherent vulnerability) (de Groot et al, 2003). Taking this perspective, biodiversity may be considered as a type of critical natural capital for either ecological (e.g., species that play an important role ecosystem function, genetically important species) or socio-economic reasons (e.g., species that have special significance for individuals or cultures). If populations, species, or communities were deemed critical natural capital, this would imply that a strong sustainability approach be taken for the management of that aspect of biodiversity and that policies supporting biodiversity conservation must be implemented.

3 Development of the Policy Analysis Framework

3.1 Overview

The basic logic model for an operational level policy analysis (i.e., where the focus is on the day-to-day, 'real world' activities that impact biodiversity) is outlined in Figure 2. Capital assets provide flows of resources that people may use to undertake various activities and produce outputs. This is the traditional realm of ecological and socio-economic research on the 'state-of-the-world' sustainability indicators.

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People's goals and objectives are based on their underlying values and preferences; they respond to threats or opportunities by using resources to undertake activities and produce outputs that they believe will help them achieve their objectives. For renewable resources like fish, the focus of fisheries managers is often on individual target species; threats are defined in terms of population viability or abundance. From the perspective of industry, however, threats may instead be viewed primarily in terms of jobs and income. From a broader societal perspective, threats to all types of capital assets may be important. In Canada, for example, the new *Species at Risk Act* (Douglas, 2002) explicitly acknowledges that the conservation of natural capital – individual species – is an important societal goal and that activities that kill, harm or harass these species must be controlled. The important thing to understand from a policy perspective is that what poses a threat (or an opportunity) depends on the mental filter through which people view the world. In reality, most people will have opinions on the relative importance of various capital assets and be willing to make quantifiable trade-offs between them based on their underlying preferences.

The traditional focus of management performance systems is on how effectively and efficiently resources are transformed to outputs and outcomes. One important trend in modern business management has been the move to objectives- or result-based management (Drucker et al., 1998), where the focus is on how firms use resources, undertake activities, and produce outputs (i.e., goods or services) that generate shareholder wealth. Many management performance concepts from the private sector have now made their way into public sector management as well (e.g., TBS, 2001).

Institutional analysis has only recently been proposed for management performance monitoring purposes (Rudd, 2004). The IAD framework is perhaps best viewed as a tool that can be used to organize the management performance assessment process in a way that explicitly considers both the rules and norms that influence incentives. It is also a tool that can be used to explicitly frame the role of the devolution or decentralization of governance (i.e., community-based management and co-management), an important consideration for environmental conservation (Agrawal, 2001; Rudd et al., 2003) but outside the traditional realm of management performance assessment.

Linkages to other systems must always be considered in policy analyses. First, some outputs and outcomes from within the management system have an influence on other systems. Outputs sold as commodities can be used by others as inputs in linked production processes (e.g., fishers sell fish to processors that sell prepared products to restaurants). Other impacts are indirect (e.g., bycatch of endangered species by fishing vessels targeting commercial species). Operational level situations are also subject to influences from higher levels within the management system (e.g., fisheries managers decide on what rules regarding who may fish and when, where, and how they are permitted to fish or allocate resources to certain projects and not others).

The activities that people undertake and the mix of resources they actually use thus depends on a variety of factors, including their values and preferences, their mental model of the world, the status of capital assets and their resource flow, and institutions. The production of outputs has direct and indirect outcomes. For example, fish landings (an output of fishing activity) can have direct outcomes (reduction of the overall fish stock, revenue generation from fish sales) and indirect outcomes (bycatch, wear and tear on vessels). The ultimate impact on each capital asset is a function of the sum of direct and indirect outcomes of human activities within the management system, exogenous influences from outside the system, and high-level internal influences.

The first challenge in the scoping phase of an analysis is to identify the spatial and temporal boundaries for the analysis and the relevant actors within the management system. For analyses focusing on natural capital, the boundaries of the system can be based on geographic features (e.g., watersheds, ecological zones), biological characteristics (e.g., species distribution range), or political boundaries. The choice of system boundaries will depend on a number of factors, including the types of threats to natural capital and pragmatic management considerations, Generally, it is desirable to focus the analysis on the geographic region within which relevant management authorities have some degree of management control. Stemming biodiversity loss or undertaking effective recovery programs could take decades so the temporal scale of many policy analyses must necessarily be long-term. Once the scale of the analysis is chosen, relevant actors need to be identified at the operational level. That is, those individuals, firms and organizations that have a direct or indirect impact on natural capital within the system need to be specified. The choice of operational level actors may then dictate that certain high level political and bureaucratic actors also need to be considered in the analysis.

3.2 Realm of Sustainability Indicators

Within the realm of sustainability indicators (refer to Figure 2), the state-of-the-world is of fundamental interest. Specifying broad goals in general terms is not particularly useful for implementing adaptive management. To be of value, analysts must work at a level of specificity suitable for developing and assessing alternative policy interventions. This means that capital assets need to be described in some detail.

One way to describe capital assets in more detail and develop functional indicators of sustainability is to engage in an ‘unpacking’ exercise, the activity of breaking down high level concepts into terms of increasing specificity until terms represent properties of capital assets that can be measured and monitored (e.g., Jamieson et al., 2001; O’Boyle and Keizer, 2003). A useful unpacking hierarchy for policy purposes (Figure 3) views capital assets (natural, manufactured, human, social, financial and non-financial economic capital) as elements of the overall system, having attributes that can, in turn, be described by characteristics. Characteristics themselves can be described by indicators that provide a single meaningful message (information) used to infer the status of a characteristic of the system. There can be several different indicators for any single characteristic of a capital asset. Verifiers (see Prabhu et al., 1999) are sub-indicators that provide additional data or information that enhances the specificity or ease of assessment of an indicator; they provide details that would reflect a desired condition of an indicator.

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One reason this particular unpacking hierarchy is useful, is that a direct correspondence can be drawn between human goals and objectives, and different levels in the hierarchy describing the capital assets (Figure 4). Goals relate to the desired state-of-the-world, specified in quite general terms. Strategic or conceptual objectives are still relatively abstract, relating to the general condition of different attributes of capital assets. Operational objectives, on the other hand, specify quantifiable states of capital asset characteristics that management is trying to achieve. Indicators and sub-indicators can have specific reference points or targets assigned to them.

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Describing the attributes and characteristics of natural capital can be a complex task due to scientific uncertainty and because the structural components of natural capital can contribute to multiple resource flows. Jamieson et al. (2001) outline early progress in an unpacking exercise by Canadian scientists and resource managers on marine ecosystem-based management. In the Canadian context, three strategic or conceptual objectives regarding natural capital were emphasized: (1) conserve enough ecosystem components so as to maintain the natural resilience of the ecosystem; (2) conserve each component of the ecosystem so that it can play its historic role in the foodweb; and (3) conserve the physical and chemical components of the ecosystem.

Using the terminology outlined above, the first strategic objective, conservation of enough ecosystem components (the stock) to maintain resilience (the flow), was further broken down into operational objectives of maintaining communities, species and populations within bounds of natural variability. The second strategic objective, conservation of components to maintain foodweb integrity, was broken down into operational objectives of maintaining primary productivity, trophic structure and mean generation time. Operational objectives for the third strategic objective included conserving critical landscape and bottomscape features, water column properties, water quality and biota quality.

While these strategic and operational objectives would vary in other locations and situations, it seems sensible to broadly group natural capital strategic objectives into three categories relating to three key attributes of natural capital: (1) the physical-chemical environment, (2) biodiversity and (3) ecosystem structure (Figure 5). Environmental attributes largely determine sink services (i.e., waste assimilation capacity) derived from natural capital. Biodiversity contributes to source services (resources used for extractive and non-extractive purposes), human amenities (e.g., 'icon' species) and life support (i.e., resilience). Ecosystem structure (e.g., trophic structure) largely provides life support services.

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Similar exercises can be conducted for the other types of capital assets although, in practice, it has been exceedingly rare to date that systematic unpacking exercises have been undertaken. In Canada, for example, where most of the effort to date has been directed towards unpacking the ecological components of natural capital, the first socio-economic unpacking workshop for the Eastern Scotian Shelf Integrated Management (ESSIM) initiative (Rutherford et al., 2003) is scheduled for Fall 2004. Still, it is possible to use theoretical insights from different disciplines to develop an outline of the attributes of other capital assets most likely relevant for designing and monitoring policy experiments.

Manufactured capital consists of equipment, facilities, infrastructure and technology. The flow of resources from manufactured capital can best be thought of as 'technical capacity', essentially the maximum amount of output that the existing stock of capital is capable of producing given full utilization of other inputs and standard operating practices (Kirkley and Squires, 1999a). For fishing vessels, for example, their technical capacity depends on vessel size, fuel capacity, gear type, holding capacity, and electronics, assuming there are no resource, staffing or financing constraints that preclude them from being at sea and fishing according to industry standards. A vessel may be able to exceed technical capacity over the short term (e.g., spending more days at sea than standard practice) but there could be a long-term cost due to inadequate vessel maintenance. Unpacking exercises for manufactured capital should generally be straightforward, although it may be difficult and expensive to estimate technical capacity in some sectors due to data constraints. In some cases, unpacking exercises will need to focus strictly on physical assets (e.g., government patrol vessels, public infrastructure such as public wharves, exploratory oil drilling platforms, etc…).

Human time and labor are used in production processes. Apart from the quantity of labor used, the effectiveness and efficiency of transformation processes are affected by the stock of human capital that individuals possess (Helliwell, 2001). Individual-level attributes of human capital include physical health, education and skills. Akin to manufactured capital, it is possible to think of the flow of resources arising from human capital as the human capacity for productivity. In the fishing industry, for instance, this is often manifested through the 'skipper effect' (Kirkley and Squires, 1999b). Controlling for technological sophistication, resource abundance, and other factors, some skippers are more skilled and are able to consistently land more fish because of their knowledge of fish (i.e., local or traditional ecological knowledge) and fishing methods. Research on the role of human productivity is common in the private sector but less so in the public sector and civil society. People with higher levels of educational attainment or local knowledge may view the world different mental filters that differ from people with lower levels of educational attainment or local knowledge and, as a result, may also hold different preferences regarding biodiversity conservation.

There have been rapid advances in social capital theory (see Rudd, 2000; Woolcock and Narayan, 2000) and empirical assessment (e.g., Uphoff and Wijayaratna, 2000; Grootaert and van Bastelaer, 2002; Krishna, 2002) over the past decade. Structural social capital consists of the rules, protocols and procedures that make it easier for people to work together to achieve mutually beneficial collective action. Cognitive social capital consists of the norms and values that people hold that predispose them to cooperate with each other and work for mutually beneficial collective action. The stock of social capital (the rules, procedures, social networks, and norms) provides a flow of resources (information, trust) that can be used in biodiversity conservation initiatives. Social capital can also be formalized through the institutional infrastructure (e.g., constitutions, legislation, regulations, codes) that facilitate the trust, and cooperation between individuals who would otherwise be socially isolated (e.g., North, 1990, 1998).

Financial capital is relatively straightforward conceptually, consisting of the money, property and other monetary assets that households, firm, governments, and civil society organizations possess. The stock of financial assets provides a flow of interest or other returns on investment that can be used to purchase inputs for production processes or undertake investments that will enhance the capacity of the owner to better achieve their objectives in the future.

Non-financial economic capital is conceptually and empirically more challenging but economists have made significant advances over the last twenty years in the field of valuation of natural capital (e.g., Folmer and Gabel, 2000; van Kooten and Bulte, 2000; Bateman et al., 2002). From an economic perspective, people derive economic benefits if they satisfy their preferences. For example, if a person is satisfied knowing that leatherback sea turtles are being protected, even if they know that they will never see a leatherback turtle themselves, that person enjoys a type of non-financial or nonmarket economic benefit. The causes of nonmarket value can be diverse (see Dixon and Pagiola, 1998). A person may enjoy viewing the turtles on a spawning beach ('non-extractive use value') or be altruistic, deriving satisfaction knowing that future generations will benefit from the turtle's ongoing existence ('bequest value'). Alternatively, people may be willing to pay money to support leatherback turtle conservation efforts because it helps them define who they are as a person ('existence value'). As a type of capital asset, non-financial economic capital can provide the motivation to improve one's quality of life; motivated and engaged citizens are more likely to undertake investments of time and effort to conserve biodiversity than apathetic citizens.

In summary, the different types of capital assets can be categorized into attributes, characteristics, and indicators, using unpacking exercises. The focus of sustainability indicators will depend on the situation but general categories of attributes to consider and examples of characteristics and indicators are included in Table 1.

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3.3 Realm of Management Performance Indicators

Within the realm of management performance indicators (refer to Figure 2), the usual focus of business analysts is on the effectiveness and efficiency of production processes that turn resources into outputs. In the private sector, there is a large literature on business management performance (e.g., Drucker et al., 1998; Kaplan and Norton, 2000); while the predominant goal of the private sector is wealth generation, there is growing recognition of the importance of environmental and social sustainability (e.g., Francesco et al., 2003; Foran et al., in press).

Management performance in the public sector and non-governmental organizations (NGOs) is very important for biodiversity conservation as societal conservation objectives tend to fall outside the scope of private sector goals and objectives. Despite the importance of good management, government and NGO management performance tends to lag the private sector and both have sometimes lost sight of their conservation goals. Saterson et al. (2004: 597-598) note, for example, that "in most projects, either the conservation goal is never specified or it is confused with conservation strategies being applied. For example, a project goal may be described as 'obtaining a conservation easement' rather than using an easement as a tool to protect the species or habitat…". Governments, in particular, have tended in the past to evaluate their performance based on the activities they undertook rather than the strategic outcomes they achieved.

The trend to results-based management in the private sector is, however, becoming more influential in public sector and NGO management. Governments and environmental organizations are increasingly engaging in results-based management assessments that consider the ultimate impacts of their activities and outputs (e.g., Hocking et al., 2000; TBS, 2001; NRTREE, 2003b; Pomeroy et al., 2004). In Canada, the Treasury Board has adopted a Results-Based Management and Accountability Framework (RMAF) (TBS, 2001) that requires all government Departments to be increasingly accountable for their outcomes rather than just their activities. The RMAF is "intended to serve as a blueprint for managers to help them focus on measuring and reporting on outcomes throughout the lifecycle of a policy, program or initiative" (TBS, 2001: 1). It ties resource use to expected outcomes by using a results-based logic model that shows the logical sequence of activities, outputs and outcomes for a policy, project or initiative. The components of an RMAF assessment include (1) a profile with a concise description of the policy, project or initiative, (2) an outline of the logic model, (3) the ongoing performance measurement strategy, (4) an evaluation strategy, and (5) a reporting strategy. The Canadian government has also adopted a lifecycle approach to results-based management, in which monitoring, evaluation and reporting on policies, programs and initiatives is ongoing and feeds back to strategic analyses (i.e., essentially adaptive management applied to diverse initiatives).

The simple logic model of the RMAF is shown in Figure 6. An actor has direct management control over the inputs they use, the activities they undertake, and the products (goods or services) that they produce. As such, an actor has control over how efficiently it produces a given output and can influence the cost of production by carefully choosing its inputs and/or improving productivity. The production process and its outputs have direct and indirect outcomes. Effectiveness, in the RMAF, is a measure of how outputs under management control actually achieve strategic objectives that may be substantially beyond management influence.

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As the causal chain between the output and final impact becomes lengthier, external factors come more and more into play. For instance, effectively managed marine protected areas (MPAs) are sometimes hypothesized to have an impact on human health (e.g., Pomeroy et al., 2004), an important human capital attribute. One possible hypothesis is that MPAs provide financial benefits for local citizens and governments (e.g., fishing, tourism and tax revenue), that some of that money is reinvested in public health provision (e.g., diagnostic equipment, facilities, clinic staffing), and that those investments actually improve the health of local residents. A second hypothesis is that local people will have a better diet if they eat local fish spilling out over MPA boundaries instead of imported, processed food products. Clearly the logic model of the first hypothesis is more tenuous than the second. The likelihood of MPAs being an effective (never mind efficient) investment for improving human health may be quite low given all the external factors that come into play (i.e., MPAs must provide local economic benefits that can be captured; government agencies must decide to invest their new wealth to build health care infrastructure; and health care services must effectively provide quantifiable outcomes – improvements in health status – for local people).

Results-based management systems use a hierarchy to map the production process from resource use to final impacts (e.g., TBS, 2001). Using an institutional framework, analysts systematically consider the full range of resource flows, from all capital assets, that are consumed in production activities (Figure 7). Activities are the primary link in the chain through which outcomes are achieved; a number of actions, each consisting of further sub-actions, may be needed for any particular activity. Activities are operations or work processes internal to an organization, intended to produce specific outputs. Outputs are the direct products or services stemming from the activities and delivered to a target group or market. Activities and outputs have direct outcomes and indirect outcomes (that can be external beyond the scope of the management system) that impact, along with the outcomes of other actors and external influences, the state of the various capital assets. Changes in capital assets, in turn, influence resource availability in the next time period.

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When people perceive threats to important capital assets they can respond in a number of ways, including:

- Curtailing consumption of constraining resource flows;
- Obtaining better information about the state-of-the-world and how resource flows can be transformed into outputs more efficiently and effectively;
- Obtaining better information about the preferences and behavior of others (i.e., the market for the good or service and the competition) to increase the benefits derived from a given quantity of output; and
- Undertaking investments that build capital assets, increase resource flows, and alleviate resource flow bottlenecks.

Curtailing human 'consumption' is extremely important in the case of biodiversity conservation. It is possible for resource users to exhibit self-restraint and curtail consumption voluntarily if there are incentives to do so (Ostrom, 1990; Ostrom et al., 1994). Unfortunately, the proper incentives that support biodiversity conservation (e.g., secure property rights, 'user pay' schemes, congruence between ecological and political system boundaries) are often absent and voluntary curtailment of the activities that cause biodiversity loss is unlikely for purely altruistic reasons. Biodiversity has public good characteristics: it provides benefits to society as a whole and society would be better off with increased levels of biodiversity but there are no incentives for individual actors to invest in supplying biodiversity because others can capture the benefits without contributing their 'fair share'. As a result, there will usually be an important regulatory role for governments to play. Rules and regulations are needed to shape human activities impacting biodiversity, as are systems of monitoring and enforcement to make those rules credible (i.e., sufficient monitoring, enforcement, and sanctions or inducements to actually alter human incentives).

3.4 Realm of Institutional Analysis

So far in this chapter, the policy analysis framework has been expanded to incorporate an expanded range of resource flows in a results-based management system. This link is not made explicitly in management performance assessments although it is clear most businesses implicitly consider a wide range of resource availability issues in their strategic planning process. While simply linking a capital asset- and results-based management framework may prove useful for environmentally responsible business planning, it is unlikely to be sufficient for policy analyses of complex biodiversity conservation initiatives and investments. Policy analysts need to delve deeper, into the realm of institutional analysis.

It is first important to differentiate between organizations and institutions. Organizations are groups of individuals bound by some common purpose to achieve objectives; their role is primarily as agents of institutional change whereas institutions are the rules and norms that are the focus of change. "Conceptually, what must be clearly differentiated are the rules from the players. The purpose of the rules is to define the way the game is played. But the objective of the team within that set of rules is to win the game..." (North, 1990: 4-5).

'Winning the game', when it comes to biodiversity conservation and recovery, requires human constraint. We must necessarily be concerned with complicated questions if we are to achieve conservation objectives. What are people's underlying values and preferences – are they willing to sacrifice financial wealth, or other capital assets, to conserve natural capital? Are social norms sufficient for effective biodiversity conservation? If so, what kinds of investments can help build those norms? If not, what types of rules or regulations are needed to ensure biodiversity is protected? What is the role of monitoring effort, vigorous prosecution and sanction size on compliance – are the expected costs of being caught and prosecuted enough to alter prohibited behavior? Should we use incentives or sanctions to alter the costs and benefit equation for people engaging in activities adversely impacting biodiversity? Are formal rules and social norms aligned – does it make sense to invest aggressively in enforcement if social norms dictate turning a blind eye on non-compliance? How can rules be effectively applied in local systems if the driving sources of biodiversity loss arise outside of management boundaries?

These questions – that are absolutely central to the issue of biodiversity conservation – are about the institutions that shape human incentives and behavior. Rules and social norms provide important resource flows (i.e., information about the world, information about the behavior of others, trust, and predictability) that are needed to solve public good provision problems and are not adequately accounted for in standard results-based management performance monitoring systems. Moreover, the cost of biodiversity conservation is largely comprised of the transaction costs of management, the costs of gathering information, negotiating agreements, monitoring, and enforcement. Transaction costs depend on the capacity of people to cooperate for mutual benefit.

The IAD framework provides a platform for organizing and classifying institutions. Rules specify behaviors that are required, permitted or forbidden and specify the sanction or incentive (payoff) associated with rule compliance or contravention. All rules can be structured in terms of the three states of behavior. Norms follow a similar structure but do not explicitly spell out sanctions or incentives even though there are implicit payoffs associated with norm compliance or contravention (Crawford and Ostrom, 1995; Ostrom, in press). Ostrom (1990, in press) outlines seven different types of rules that can be applied to people and organizations:

- Boundary rules specifying whom is allowed to participate in activities of interest (e.g., only licensed fishers are allowed to fish with licensing based on geographic proximity to the fishing grounds and a minimum level of historical use);
- Position rules that specify the role each participant plays (e.g., 'placeholder' rules that define the roles and responsibilities of recovery team members);
- Authority rules that specify what actions and activities are permitted, required or forbidden (e.g., when [seasons], where [zones], and how [gear restrictions] licensed fishers are permitted to fish in areas where endangered species are known to occur);
- Information rules that specify reporting requirements (e.g., specified levels of observer coverage and data submission requirements for licensed fishers);
- Aggregation rules that specify decision rules and how individuals or organizations make aggregate decisions (e.g., recommendations for listing a species under Canada's *Species at Risk Act* are made by regional authorities but the ultimate decision to list is made exclusively by the 'competent Minister', the elected official in charge of the relevant government agency);
- Scope rules specifying regarding what states of the world (i.e., outputs and outcomes) are permitted, required or forbidden (e.g., rules specifying total allowable catch, daily bag limits, size restrictions or bycatch quotas); and
- Payoff rules that specify incentives or sanctions for abiding by or violating rules, respectively.

Figure 8 shows the different types of rules and how they fit into the results-based management performance framework. In day-to-day operational situations, actors within the system consider rules and norms to be fixed over relevant time scales. For instance, a fisher works within the rule set outlined by fishery managers for the season; once officially authorized to fish (e.g., by paying an annual license fee), a fisher knows when, where and how he is allowed to fish, and what reporting requirements and seasonal landing limits are in place. If any one of those rules were to change, it could conceivably lead to substantially different behavior on the part of the fisher. Rules and norms influence the incentives of fisheries enforcement officers as well. A fishery officer may have certain monitoring and enforcement activities that she is required to undertake, is prohibited from participating in, or is required to report on. Payoff rules may specify a salary for the officer that is independent of the number of patrols she participates in or on the number of successful prosecutions she initiates.

<<< insert Figure 8 about here >>>

The behavior of actors within an operational situation may be strategic: the fisher's compliance with rules may depend on the vigilance of the fishery officer. The amount of government resources devoted to enforcement may, on the other hand, depend on the compliance history of the fishing industry. An institutional approach is useful for considering the causes and consequences of incongruent rules and norms. Certainly, social norms in some fisheries are at least as important as formal rules (e.g., the Maine lobster fishery – Acheson, 1988). Enforcement costs can rapidly become prohibitive if formal rules prescribe sanctions for one type of behavior while norms prescribe social rewards for the same behavior.

At the operational level, institutions may be taken as fixed but the 'rules of the game' can obviously evolve in response to changing physical conditions, technology, and societal values. Institutions are human artifacts, crafted and revised over generations (Ostrom, 1997). In the case of social norms, there is an evolutionary process within a culture that shapes norms over time. From a management performance perspective, it is important to understand what norms are at work in a system and under what conditions to consider engaging in norm-seeding investments (Sunstein, 1996). However, it is formal rules that are under direct management control. As such, the process of creating and crafting rules supporting biodiversity conservation in multi-level, linked systems needs to be the primary focus of policy analysts.

3.5 Linkages in the Institutional Framework

Commodities from one system can be traded and used as inputs (intermediate goods) in production processes in other systems. It is quite possible to engage in activities that are sustainable at the local scale but that simply 'export' the sustainability problem to other areas (or to future generations). The definition of sustainability depends on the geographic and temporal scale of analysis and needs to be appropriate for the policy problem at hand (Folke et al., 1998). Controlling biodiversity loss may especially depend on the market demand and signals being passed back into the system from distant markets (e.g., Wood et al., 2000).

Activities within one system can also cause direct or indirect outcomes in other systems. Using a capital asset approach to policy analysis can help to organize the external effects. The driving forces affecting biodiversity loss can be classified according to their impact on various characteristics and attributes of capital assets: environmental change affects natural capital and its resource flows; technological innovation and development impacts manufactured capital; demographic change (e.g., migration and mortality patterns) influences the stock of human capital in a system; cultural change (e.g., through globalization) and international treaty obligations affect social capital; and macroeconomic factors (e.g., currency exchange rates, interest rates) affect financial capital.

Vertical links within a system are of particular importance when designing and analyzing policies for adaptive management. The rules governing operational situations are crafted in higher-level collective action (Ostrom, 1990) or implementation situations. Actors in implementation situations, most often civil servants in the government bureaucracy, use resources, undertake activities, and produce outputs just as operational level actors do. One output is the creation of social capital (i.e., formal rule sets) that shape human incentives in operational situations. Actors in implementation situations can also invest directly in other types of operational level capital assets (e.g., hiring and training staff, building technological infrastructure, direct investments in natural capital recovery, norm seeding).

Implementation level actors often have substantial discretionary power to craft rules and make investments but they, like operational level actors, are still influenced by rules and social norms that shape their behavior. It is possible to use the schematic of Figure 8 for policy analyses of implementation situations; boundary, scope, authority, reporting, aggregation, scope and payoff rules exist for bureaucrats and can be analyzed just as they would for resource users (although norms may be more difficult to document and analyze). One important distinction between operational and implementation situations is that implementation level actors do not use natural capital directly. Another distinction is that position and aggregation rules are likely to figure much more prominently in an implementation level analysis. Positions within bureaucracies tend to be well defined and aggregation rules often specify decision-making procedures in great detail.

The rules that shape incentives for implementation level actors are created at an even higher constitutional or political level. Political level situations involve actors (e.g., elected politicians, industry groups, consumer advocates, lobbyists, NGOs) whose outputs are (1) the rules that govern the behavior of implementation level actors, (2) policy directions for implementation level actors to follow, and (3) direct investments in implementation level capital assets. Again, one could use the schematic in Figure 8 for analysis of political situations. Natural and manufactured capital are virtually inconsequential assets at this level; human, social and financial capital provide the most important resource flows for political actors. Aggregation rules specifying how political decisions are taken become extremely important at this level of analysis (e.g., parliamentary protocol, committee voting rules). Behavior at the political level is subject to rules from a meta-constitutional level (Ostrom, 1997) and, as importantly, a wide variety of tit-for-tat social norms.

Figure 9 illustrates the multi-level IAD framework. Important links exist between operational, implementation, and political situations (Ostrom, 1990; Hill and Lynn Jr., 2004). From a top-down perspective, actors in political situations set general policy directions, create rules governing the behavior of implementation level actors, and make decisions about how to generate revenue and best invest their resources to achieve political objectives. Actors in implementation situations work within these constraints to create detailed rules and regulations that shape the incentives of operational level actors and invest their allotted resources at a finer scale in order to implement strategic policy directives. Operational level actors work within environmental, financial, socio-economic and institutional constraints to produce outputs that they think will help them achieve their aspirations regarding the conservation and accumulation of different types of capital assets.

<<< insert Figure 9 about here >>>

All three levels are subject to external influences ranging from environmental change to market pressures to international obligations. In addition, there are feedback mechanisms from lower to higher levels. Political actors in modern democracies are keenly aware that their ability to participate in decision-making at the political level is dependent on societal preferences expressed through voting behavior and polling. Some operational level actors will be interested in gaining access to the political process to influence decisions about rules or resource allocations. If the potential financial returns of favorable political decisions are sufficiently large, it may make economic sense to lobby (or bribe) politicians to alter their personal incentives. While not explicitly included in Figure 9, there can also be strong bottom-up links between the implementation and political levels (e.g., between senior bureaucrats and elected officials) and between operational and implementation levels (e.g., direct lobbying of resource managers by resource users).

Understanding the variables that help create rules and shape incentives at multiple levels is necessary if we are to be able to answer the types of important questions about biodiversity conservation outlined earlier in this chapter. Adaptive management requires feedback mechanisms that allow for the flow of information and evolution of rules by providing links between politicians, bureaucrats, and resource users.

4 Conclusions

An institutional analysis framework for assessing the management performance of biodiversity conservation investments and initiatives has been developed in this chapter. While the focus has been on biodiversity, it is also more widely applicable to problems involving the provision of public goods.

This framework is useful for a number of reasons. First, it uses a capital asset approach to describe the state-of-the-world and specify the full range of resource flows available to resource users. Second, it explicitly integrates the Institutional Analysis and Development (IAD) framework with a results-based management framework used widely in the private and public sectors. Third, the integrated IAD – results-based framework can be applied at different levels of analysis, in operational, implementation, and political situations, in such a way that allows for sophisticated analyses of adaptive management investments and initiatives.

The advantage of using capital assets to describe the state-of-the-world is that it allows for analysts to consider the full spectrum of resource flows from biodiversity that help people improve their quality of life (or to take an even broader view, the quality of life of other species). Moreover, it allows analysts to examine people's preferences and frame their goals, strategic objectives and operational objectives in terms of the elements, attributes and characteristics of the various capital assets. This facilitates transparent discussions regarding sustainability and the willingness of people to accept trade-offs between different capital assets, a crucial factor in political decision making and the management of biodiversity. Further, using capital assets in a policy analysis or monitoring program helps ensure that balance is maintained in analyses and that all important stocks and flows are considered. This implies the need for ecologists to work as part of inter-disciplinary teams on systematic capital asset unpacking exercises.

Integrating the IAD and results-based management frameworks is important for analyses of biodiversity conservation because biodiversity has public good characteristics. Society as a whole will benefit from biodiversity conservation yet it is often not in the narrow interest of individuals or firms to contribute to conservation efforts. Rules or social norms – institutions – are needed to constrain the behavior of actors and increase behavioral predictability. The IAD framework provides a system by which to organize and classify rules and norms according to their function, and to slot each type of rule or norm into more mainstream results-based action-activity-output-outcome-impact hierarchies.

The institutional framework can be used to examine day-to-day behavior of resource users in operational situations, bureaucrats in implementation situations, or political actors in political situations. Outputs from one level cascade down to the next lower level. That is, investments and initiatives at higher levels have outputs that directly influence capital asset accumulation or depletion at lower levels. The influence may be via direct investment decisions or it can be via the formulation of rule sets – social capital – that alters the incentives of actors at lower levels. Feedback is not unidirectional, however, and there are also feedback mechanisms from the operational level to political level (e.g., voting behavior, polling and lobbying). Adopting a multi-level perspective on policy formation and implementation is necessary if we are to understand the dynamics of adaptive management and develop directed policy experiments that contribute to biodiversity conservation.

Designing policy experiments requires systematic consideration of alternative institutional arrangements and investments (Ostrom and Ostrom, 2004) and information on both the technical effectiveness and economic efficiency of the alternatives (Shogren et al., 1999). As Saterson et al. (2004: 597) highlight, "conservation funding is finite and needs to be allocated optimally. To achieve this… we need more systematic evaluation of the impacts and costs of individual approaches and more synthesis of site-specific information to enable comparisons of the relative effectiveness among conservation approaches." All conservation interventions, whether they are direct investments in natural capital or they shape resource use through institutional change, can be fundamentally viewed as investment decisions (Rudd, 2004). The standard economic advice for facilitating species recovery is to progressively choose recovery investments with the highest marginal benefit to cost ratio until recovery resources are exhausted or there are no more investments for which marginal benefits equal or exceed costs (see van Kooten and Bulte, 2000). This resource allocation process can occur at coarse and/or fine scales (i.e., broad allocations amongst regions or species groups and specific allocations amongst recovery plans for single species) and should account for time by discounting flows of financial costs and benefits that occur in the future. From a temporal perspective, choices can be made that focus on the short-term (i.e., operational level investments aimed at increased monitoring and enforcement of existing rules), medium-term (i.e., implementation level investments aimed at changing the set of rules that govern operational level resource use) or long-term (i.e., political level investments aimed at changing the rules that govern how lower level rules are made – that shift power).

From an ecological research perspective, what work is needed to support biodiversity conservation and how can it be made more relevant to actors in political and implementation situations? First, there is a need to identify critical natural capital. Ecological rationale is needed for cases when critical natural capital is defined for ecological reasons or due to the degree of threat that it faces. Ecological input is also required, however, even when critical natural capital is defined strictly for economic or cultural reasons because of the need to set reference points for results-based management performance.

Second, if the public sector (or NGOs) are to be made more accountable under results-based management, there is obviously a need to understand the technical linkages between activities, outputs, outcomes, and impacts. Given the uncertainty regarding the state of biodiversity and the inherent difficulties in relating management interventions to final impacts on biodiversity conservation and recovery, there is a strong role for applied ecological research to document the links between management outcomes and recovery, and the influence of external factors on the recovery process.

There are also more subtle roles for ecological research. One relates to the influence of ecological knowledge on predictability. For example, Jin et al. (in press) calculated the value of environmental research in clarifying the relative contributions of exogenous natural factors and endogenous human activity in a coastal system subject to nutrient enrichment. The value of research, calculated as the difference in net economic benefits between the optimal levels of economic activity with and without uncertainty, was in the order of 2.5% of the total damages from nutrient enrichment. When there are higher levels of predictability in a system, people tend to make decisions based on longer time horizons: the rate at which they discount the future falls as uncertainty is reduced. This can have a substantial impact the economic viability of policy alternatives that have relatively high up-front costs but significant conservation benefits in the longer term.

Another contribution of ecological research that is often overlooked is the impact of research activities on social capital, particularly the social networks that impact information flow and the social norms that build trust. In fisheries, it is widely recognized that collaborations between researchers and fishers can improve and reduce the cost of data collection and increase trust (see Haggan et al., 2003), but the direct economic value of that information and trust is rarely recognized in policy analyses. Better information can reduce the costs of management because management information is a byproduct of normal private sector business activities. Further, there should be indirect benefits accruing when ecological researchers cooperate with researchers from other disciplines, resource users or bureaucrats. In research on the factors that influence rural community development, for instance, O'Brien et al., (1998) found that important long-term benefits resulted from the process of people working together even if specific projects that people worked on together were 'failures'. Trust can arise when people work together and can both increase the willingness of people to share information and increase the likelihood of compliance with conservation rules when they are viewed as legitimate (i.e., not imposed arbitrarily by outsiders).

Finally, it should also be noted that ecological research may influence the mental models that people use as filters to evaluate what constitutes desirable states of the world. That is, ecological research and advocacy activities by ecologists can shape the values and preferences that people hold. It is fairly common to consider influencing the values of the general public and operational level resource users through awareness-building and stewardship campaigns. Taking an institutional perspective, activities that aim to shape the mental models of decision-makers at higher levels may be even more important for biodiversity conservation. An important component of an applied ecological program may involve activities that effectively interpret the results of biodiversity research for politicians and bureaucrats. An ecological research program should be viewed as more than just the narrow production of research outputs; it is an investment that has direct and indirect outcomes just like most other production activities.

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List of Tables and Figures

Element	Attribute	Characteristic (Example)	Indicator (Example)
K_n	Environment	Water Quality	Water Temperature
	Ecosystem	Trophic Balance	Trophic Level of Landings
	Biodiversity	Icon Species	Marine Mammal Abundance
K_m	Equipment	Commercial Fishing Fleet	Fleet Technical Capacity
	Infrastructure	Communications	Cellular Coverage
	Technology	Monitoring Technology	Patrol Vessels with Radar
K_h	Education	Educational Attainment	% Finished High School
	Health	Life Expectancy	Incidence of Heart Disease
	Skills	Local Ecological Knowledge	Years Fishing in Area
K_s	Social Networks	Connectivity of Fishers	No. Industry Organizations
	Rules	Resource Harvest Rule Set	Consistent Rules re. Harvest
	Social Norms	Trust Levels in Community	Willingness to Partner
K_f	Investments	Government Assets	Government Budget Surplus
	Property	Financial Wealth of Fishers	Debt to Asset Ratio
K_{nf}	Non-Extractive Use	Wildlife Viewing	Willingness to Pay for Viewing Experiences
	Non-Use	Bequest Value	Willingness to Pay to Protect Biodiversity for the Future

Table 1

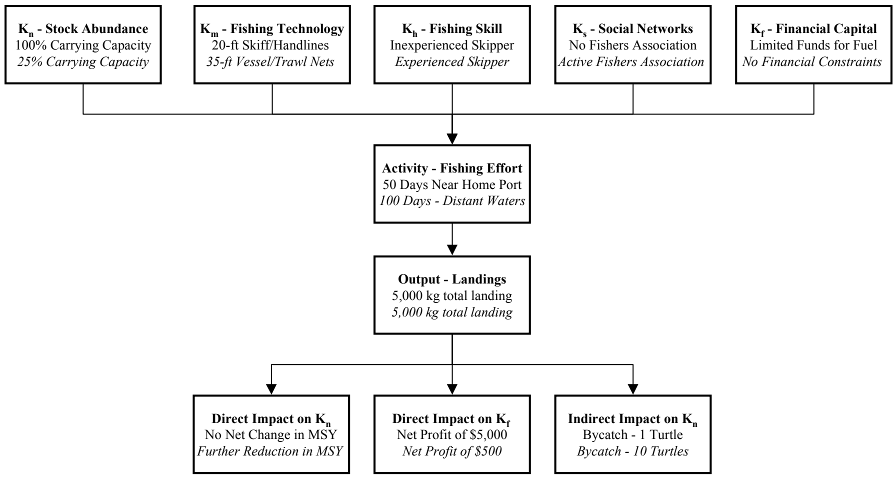

K_n - Stock Abundance
100% Carrying Capacity
25% Carrying Capacity
K_m - Fishing Technology
20-ft Skiff/Handlines
35-ft Vessel/Trawl Nets
K_h - Fishing Skill
Inexperienced Skipper
Experienced Skipper
K_s - Social Networks
No Fishers Association
Active Fishers Association
K_f - Financial Capital
Limited Funds for Fuel
No Financial Constraints
Activity - Fishing Effort
50 Days Near Home Port
100 Days - Distant Waters
Output - Landings
5,000 kg total landing
5,000 kg total landing
Direct Impact on K_n
No Net Change in MSY
Further Reduction in MSY
Direct Impact on K_f
Net Profit of $5,000
Net Profit of $500
Indirect Impact on K_n
Bycatch - 1 Turtle
Bycatch - 10 Turtles

Figure 1

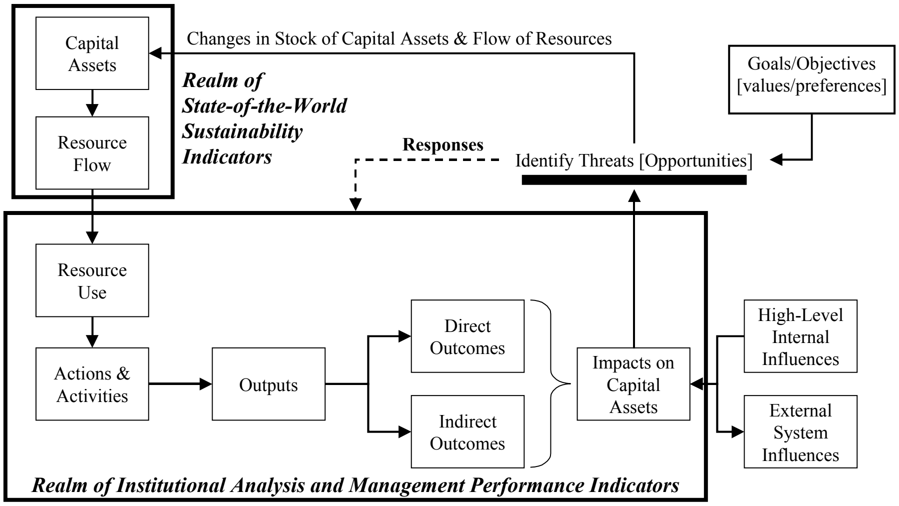

Capital Assets
Resource Flow
Changes in Stock of Capital Assets & Flow of Resources
Realm of State-of-the-World Sustainability Indicators
Goals/Objectives [values/preferences]
Responses
Identify Threats [Opportunities]
Resource Use
Actions & Activities
Outputs
Direct Outcomes
Indirect Outcomes
Impacts on Capital Assets
High-Level Internal Influences
External System Influences
Realm of Institutional Analysis and Management Performance Indicators

Figure 2

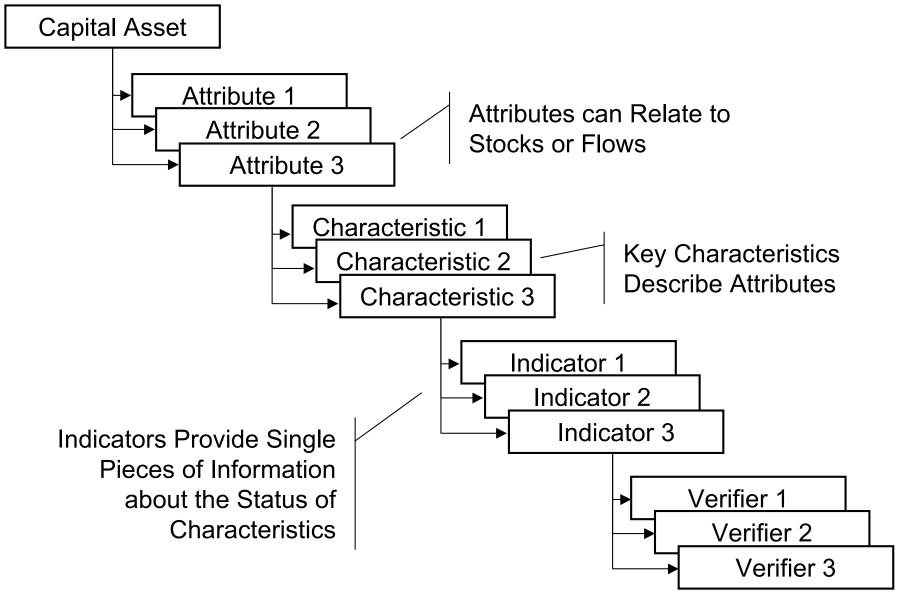

Capital Asset
Attribute 1
Attribute 2
Attribute 3
Attributes can Relate to Stocks or Flows
Characteristic 1
Characteristic 2
Characteristic 3
Key Characteristics Describe Attributes
Indicator 1
Indicator 2
Indicator 3
Indicators Provide Single Pieces of Information about the Status of Characteristics
Verifier 1
Verifier 2
Verifier 3

Figure 3

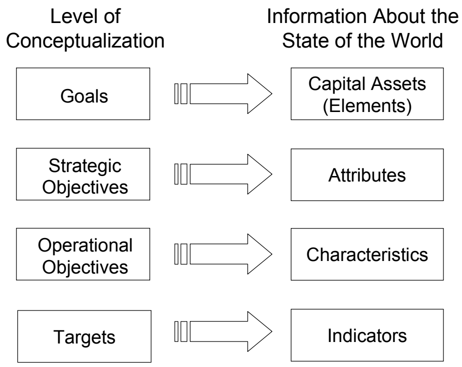

Level of
Conceptualization
Information About the
State of the World
Goals
Capital Assets
(Elements)
Strategic
Objectives
Attributes
Operational
Objectives
Characteristics
Targets
Indicators

Figure 4

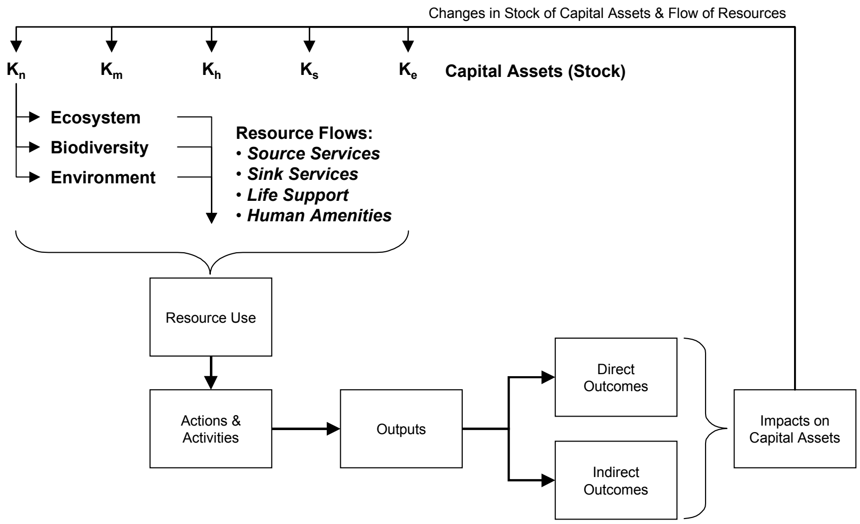

Changes in Stock of Capital Assets & Flow of Resources
Kn
Km
Kh
Ks
Ke
Capital Assets (Stock)
Ecosystem
Biodiversity
Environment
Resource Flows:
• Source Services
• Sink Services
• Life Support
• Human Amenities
Resource Use
Actions & Activities
Outputs
Direct Outcomes
Indirect Outcomes
Impacts on Capital Assets

Figure 5

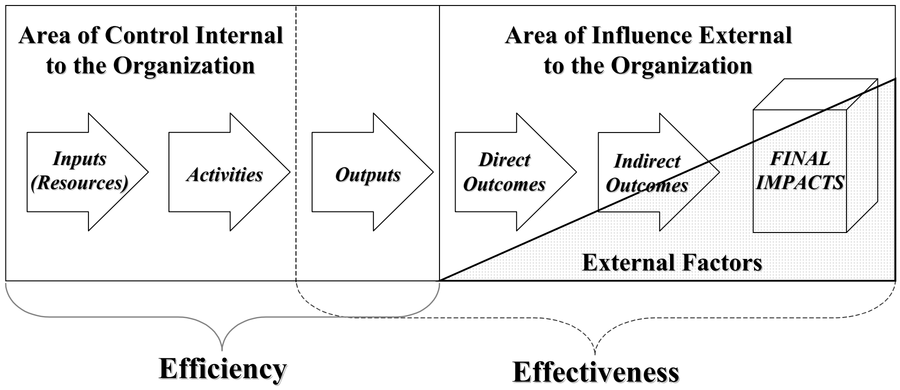
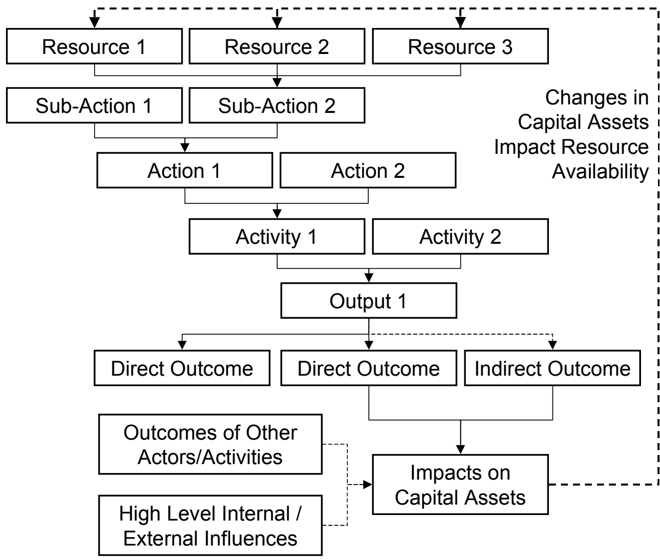

Area of Control Internal
to the Organization
Area of Influence External
to the Organization
Inputs
(Resources)
Activities
Outputs
Direct
Outcomes
Indirect
Outcomes
FINAL
IMPACTS
External Factors
Efficiency
Effectiveness

Figure 6



Resource 1
Resource 2
Resource 3
Sub-Action 1
Sub-Action 2
Changes in Capital Assets Impact Resource Availability
Action 1
Action 2
Activity 1
Activity 2
Output 1
Direct Outcome
Direct Outcome
Indirect Outcome
Outcomes of Other Actors/Activities
Impacts on Capital Assets
High Level Internal / External Influences

Figure 7

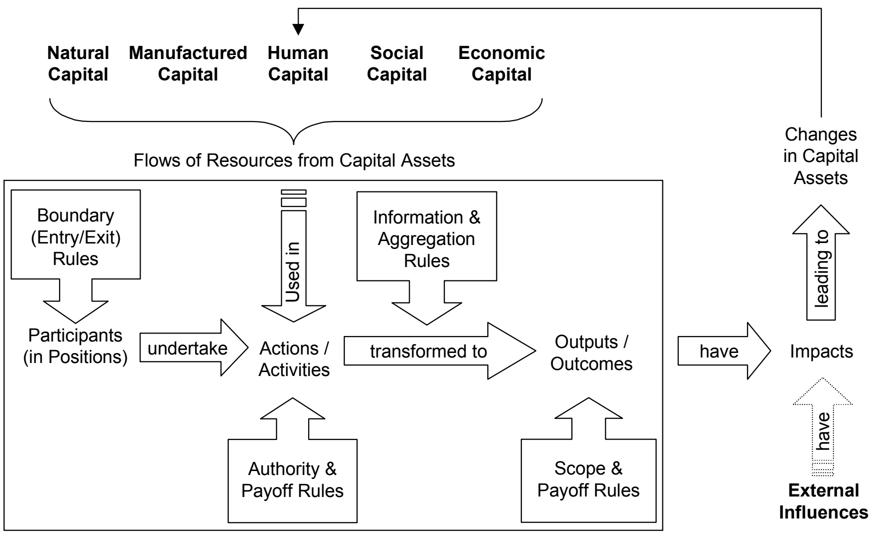

Natural Capital
Manufactured Capital
Human Capital
Social Capital
Economic Capital
Flows of Resources from Capital Assets
Boundary (Entry/Exit) Rules
Used in
Information & Aggregation Rules
Participants (in Positions)
undertake
Actions / Activities
transformed to
Outputs / Outcomes
have
Impacts
Changes in Capital Assets
leading to
have
External Influences
Authority & Payoff Rules
Scope & Payoff Rules

Figure 8

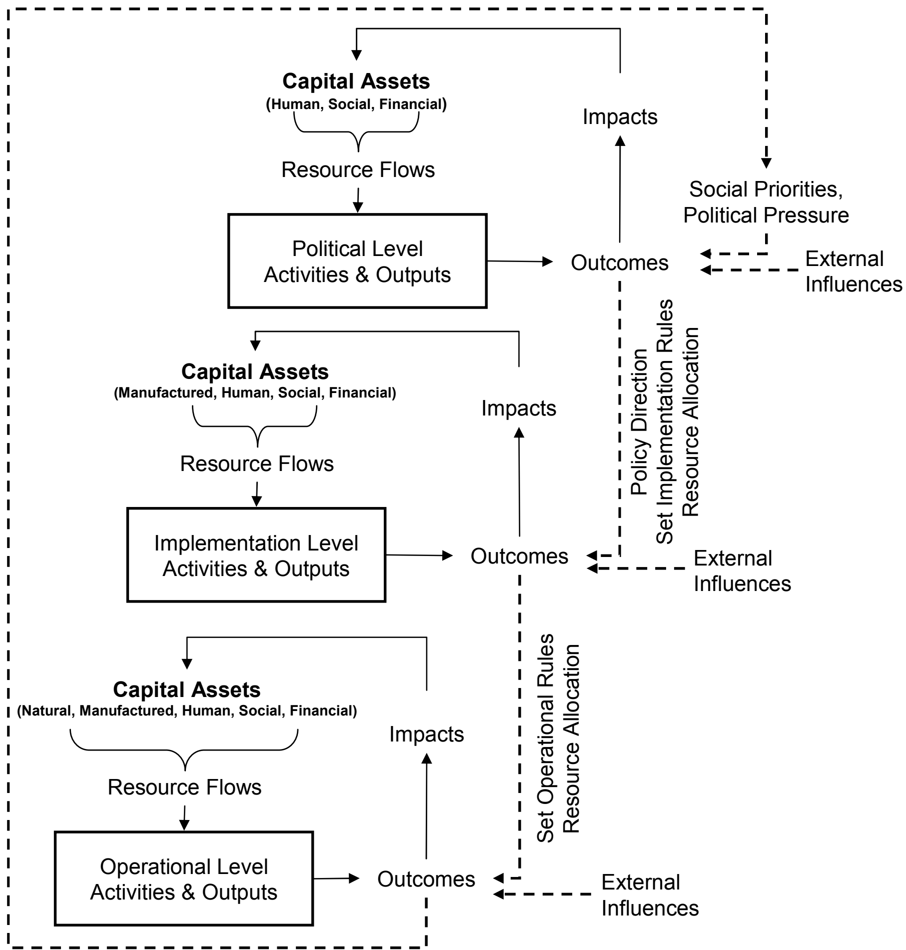

Capital Assets
(Human, Social, Financial)
Resource Flows
Political Level
Activities & Outputs
Impacts
Outcomes
Social Priorities,
Political Pressure
External
Influences
Policy Direction
Set Implementation Rules
Resource Allocation
Capital Assets
(Manufactured, Human, Social, Financial)
Resource Flows
Implementation Level
Activities & Outputs
Impacts
Outcomes
External
Influences
Set Operational Rules
Resource Allocation
Capital Assets
(Natural, Manufactured, Human, Social, Financial)
Resource Flows
Operational Level
Activities & Outputs
Impacts
Outcomes
External
Influences

Figure 9