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Linking Livelihoods and Conservation: A Conceptual Framework and Scale for Assessing the Integration of Human Needs and Biodiversity

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Summary. — Although there has been increasing interest in trying to link the livelihoods of people living near natural resources to the conservation of those resources, there has been little attempt to systematically assess or measure this linkage. We develop a conceptual framework for defining the linkage between livelihood activities and conservation. We then develop a scale to assess the strength of linkage across five dimensions: species, habitat, spatial, temporal and conservation association. We test the framework and scale by evaluating 39 project sites in the Biodiversity Conservation Network. Finally, we discuss the relevance of linkage to designing appropriate conservation strategies. © 2000 Elsevier Science Ltd. All rights reserved.

Key words — Asia, Pacific, environment, conservation, livelihood, sustainable development

1. INTRODUCTION

Local people often rely on products, services, or land from nearby natural areas to meet their livelihood needs. Their use constitutes one demand on the biological resources of these areas, while their conservation objectives coupled with those of the state, and outside groups constitute another. The resulting conflict, compatibility, or complementarity between the demands created by livelihood activities and conservation objectives have been

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the focal point of much discussion and effort over the last two decades. There has been considerable debate as to the effectiveness of Integrated Conservation and Development Projects (ICDPs or ICADs) that, as the name implies, seek to link conservation and livelihood objectives (e.g., Wells & Brandon, 1992; Brandon & Wells, 1992; Robinson, 1993; Western & Wright, 1994; Larson, Freudenberger & Wyckoff-Baird, 1996; Kramer, van Schaik & Johnson, 1997; Brandon, Redford & Sanderson, 1998). In particular, there has been a strong focus on identifying and quantifying the economic benefits that local people derive from biodiversity (McNeeley, 1988; Peters, Gentry & Mendelsohn, 1989; Dixon & Sherman, 1990; Grimes *et al.*, 1994).

Despite the prolific discussion of the linkage between livelihoods and conservation, there has been little attempt to define systematically the nature of this linkage or to measure it. In Section 2, we define the concept of linkage in the context of a historical review of conservation strategies. In Section 3, we present a conceptual framework for analyzing the linkage between livelihoods and conservation and in Section 4, we develop a scale for ranking linkage. In Section 5, we evaluate a range of linked livelihood activities using our framework and scale. Finally, in Section 6, we discuss implications of this work for the design of integrated conservation and development projects.

The framework and examples presented in this paper are drawn from collaborative work done over the last six years by project partners of the Biodiversity Conservation Network (BCN). BCN was established in 1992 to (a) support site-specific efforts to conserve biodiversity at sites across Asia and the Pacific, and (b) evaluate the effectiveness of an enterprise strategy for community-based biodiversity conservation (BCN, 1997a,b). BCN tested the hypothesis that if communities can benefit economically from the biological resources that they manage or control, then they will take action to counter internal and external threats to these resources. BCN funded 39 sites across 20 projects that each contains one or more enterprises that directly depend on the biodiversity of the site. Approximately 30% of each grant was dedicated to collecting the social, biological, and enterprise data needed to monitor the project's impact and test the direct linkage hypothesis. Final results of the projects are summarized in BCN (1999) and Salafsky, Cordes, Parks and Hochman (1999).

2. A TREND TOWARD LINKING LIVELIHOOD AND CONSERVATION

The concept of linkage between conservation and livelihoods can perhaps best be understood by considering the different approaches to reconciling the demands of conservation and livelihood that have evolved over the past century. We describe three approaches along this spectrum that can be characterized as no linkage, indirect linkage and direct linkage between livelihood activities and conservation (BCN, 1997a,b; Salafsky, 1998). Each approach has strengths and weaknesses and is therefore best suited to certain conditions. Our purpose in reviewing these strategies in this paper is to develop a better understanding of linkage to enable practitioners to decide when linked approaches are appropriate—and when they are not.

(a) *No linkage between livelihoods and conservation: protected areas*

A common approach to protecting biodiversity has been the creation of parks and protected areas that exclude livelihood activities (McNeeley & Miller, 1984; Western & Wright, 1994). Historically, biological resources such as forests were set aside by rulers as hunting grounds, watershed, or forest product reserves. Local people's use of these forests to meet their livelihoods was limited, if allowed at all (Castro, 1991; Manning, 1994; Freeman, 1994). During the last one and one-half centuries, states similarly established parks and other protected areas to meet their own needs of ensuring a public heritage, claiming sovereignty, or acquiring economic benefits (Kramer *et al.*, 1997). These aims sometimes, but not always, were supposed to be in the "public" interest. They rarely, however, aimed to provide local economic development.

The key feature of the protected area strategy is that local livelihood is assumed to conflict with conservation (Figure 1a). Protected areas have strictly defined borders that unauthorized people are not supposed to cross. People are meant to use resources outside of the park and plants and animals are meant to stay in the park. Of the six protected area classifications provided by the World Conservation Union (IUCN, 1994), four fall into this "no consumptive use by people" category. [1]

While protected areas remain an important approach for conservation, they have proven

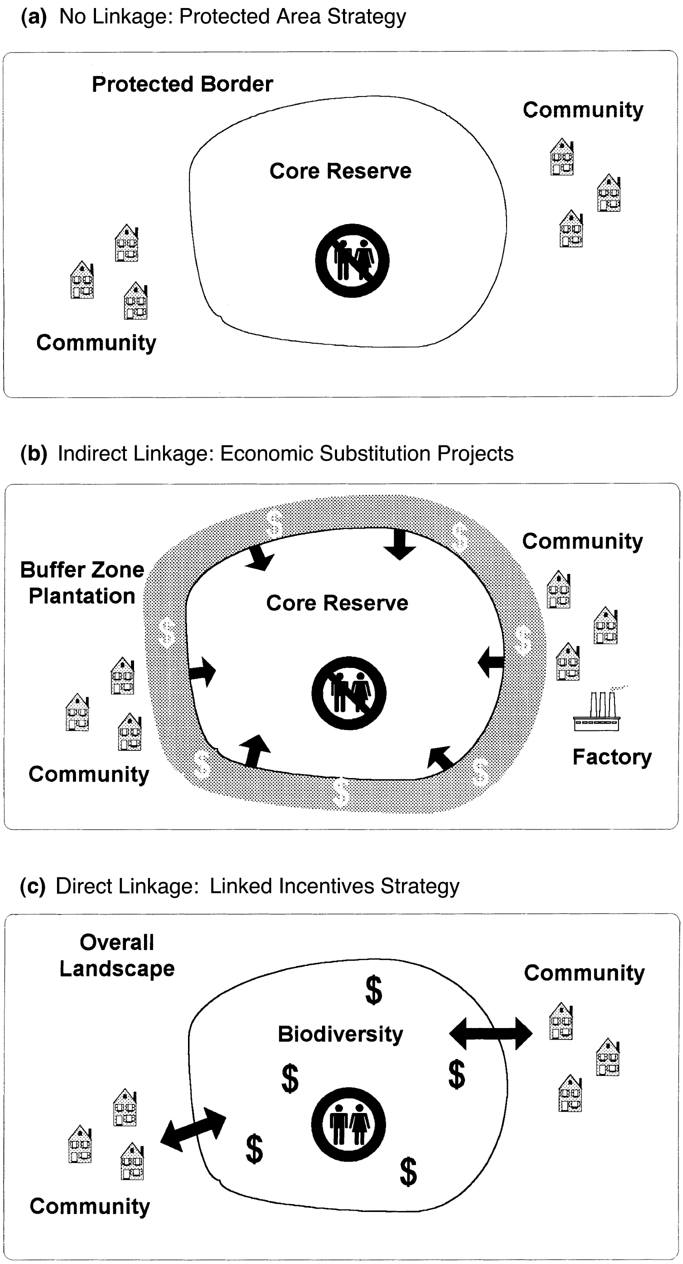

Figure 1. *A trend towards linking conservation and development. (Source: Adapted from BCN, 1997b and Salafsky, 1998).*

difficult to implement in many settings, especially in the developing world (Rao & Geisler, 1990). Protected area boundaries have not been enforceable due to inadequate government resources, weak management capacities, remote sites, and ineffective legal systems. Many protected areas have been proposed on lands or in waters that are legally or customarily owned and managed by local people. It has often been impractical, illegal, or impossible to declare these lands off-limits to human use. The social and political challenges of implementing these projects have often been beyond the capacity of managers, even when backed by substantial donor assistance. Compelling economic conditions also lessen the viability of this approach. In countries where remote populations endure structural social and economic inequities, protected areas have often further restricted the livelihood options of people who are destitute. It has been politically difficult to spend money on protecting biodiversity while poor people's needs increase. Finally, from an ecological perspective, protected areas have seldom been large enough to maintain viable populations of large predators and to maintain critical ecological functions over long periods of time. Even on paper, they at best comprise 10–20% of a country's total area and are seldom located in habitats with valuable alternative uses such as lowland primary forest. While protected areas are and should remain an important part of any conservation plan, conservationists began to realize that they needed to both find ways of overcoming their limitations and finding complementary conservation strategies.

(b) *Indirectly linking livelihoods and conservation: economic substitution*

In response to these limitations, over the past few decades, conservationists (primarily in developing countries) began working with local communities to make economic development feasible around parks and protected areas. The political climate also became more supportive of the resource rights of local people and the need for providing economic development to them (Wells & Brandon, 1992). Conservationists felt it necessary to meet local livelihoods to achieve conservation. They initially relied on strategies, however, where livelihood and conservation were only indirectly linked.

One of the earliest of these indirectly linked approaches used was the *biosphere reserve* (UNESCO, 1972; Sayer, 1991a). In a biosphere reserve, people are entitled to use biological resources according to defined spatial zones (Figure 1b). A core zone is designated as a strict protection area where people's consumptive use of resources is prohibited. The core is surrounded by one or more *buffer zones* that allow use within limits that ensure the protection of the core zone. The original buffer zones were designed as rings of a more or less arbitrary width. Recently, a more sophisticated understanding of conservation biology has led to designs with more complex spatial arrangements that include enclaves for local communities and corridors for wildlife (MacKinnon, MacKinnon, Child & Thorsell, 1986; Kremen, *et al*. 1999).

The key feature of the buffer zone strategy is that zonation is used to create a spatial compromise that enables local people to continue to meet their livelihood needs while still protecting key species and habitats. In particular, the theory is to decrease reliance on the natural biodiversity by substituting other livelihood activities. Conservationists might, for example, assist local residents to grow coffee in the buffer zone, intensify agricultural production, or set up a leather tannery. The idea here is that providing substitute economic activities will keep local people from livelihood activities that damage the local biodiversity. The focus is thus on economic incentives, with little consideration of the biophysical environment.

These indirectly linked approaches have also been difficult to implement (Sayer, 1991b; Oates, 1995; Larson *et al*., 1996). Perhaps the biggest problem has been that these approaches have not been directly tied to conservation behavior. As in the case of protected areas, local people often have continued to use resources in the core reserve even if prohibitions were posted or otherwise made public. Second, economically attractive activities in the buffer zone have often created incentives for expanding the buffer zones into the core area. Finally, these approaches have not provided local people with the incentives to stop external threats to the biodiversity, such as a logging company clear-cutting the forest from the other side of the reserve or a foreign fishing boat coming in and unsustainably harvesting marine resources (Wells & Brandon, 1992; Brandon *et al*., 1998). There often seems to have been no local constituency to monitor the development of these threats and take action on behalf of the biodiversity.

(c) *Directly linking livelihoods and conservation: linked incentives for conservation*

In response to these shortcomings, in the early 1990s, conservationists began to develop new approaches to meet economic well-being and conservation needs. These new approaches were based on making livelihood activities dependent on and hence *directly linked* to biodiversity (Wells & Brandon, 1992; Western & Wright, 1994; BCN, 1997a,b).

The key feature of the linked incentive strategy involves developing dependent relationships between the biodiversity and the surrounding people (Figure 1c). Local stakeholders are given opportunities to benefit directly from the biodiversity, and thus presumably have an incentive to stop external threats to the biodiversity. Livelihoods drive conservation, rather than simply being compatible with it. Furthermore, the strategy recognizes local people's role in maintaining biodiversity. Under this strategy, conservationists might, for example, help local communities set up a nontimber forest product harvesting enterprise or a dive-tourism enterprise. The direct linkage strategy has only recently been tested in practice (BCN, 1997a, Salafsky *et al*., 1999). Before this test could be completed, however, we first needed to be able to define and measure linkage.

3. A CONCEPTUAL FRAMEWORK FOR ASSESSING LINKAGE

(a) *A general model of conservation projects*

Conservation projects can be thought of as one or more interventions designed to counter threats to the biodiversity at a given site (Figure 2; Salafsky *et al*., 1999). In this case, a project can be broadly defined to be "any actions undertaken by any group of people interested in achieving certain defined goals and objectives" (Salafsky & Margoluis, 1998). The scale of a site can range from a small community area to an entire ecoregion or country.

The target condition at the far right side of the model is the state of biodiversity at the site. Biodiversity can be thought of having three main attributes: the species present, the area of habitat present and degree to which is it is intact, and the degree to which the habitat is able to maintain its ecological functions (Noss, 1990).

This target condition is affected by one or more human-caused *direct threats*. Direct threats are human actions that have the most proximate influence on the biodiversity (Salafsky & Margoluis, 1999). Direct threats can be subdivided into *internal threats* that are caused by the stakeholders living at the project site and *external threats* that are caused by outsiders. Examples of direct threats include overharvesting of nontimber forest products by local people or water pollution produced by a large factory that destroys a reef. Behind these direct threats are causal factors that are often less visible, but significant drivers of the threats. Examples of these causal factors include local people's needs for cash, government trade policies, or local road and transportation development. The model assumes that all threats are caused by human activities so that natural fire from a lightning strike is not a threat, but fire started by a farmer is. Threats also include natural events that are exacerbated because of human activities such as fire started by a lightning strike that spreads more rapidly than expected because of the impact of selective logging.

Well-designed conservation projects use a mixture of different strategies or interventions to combat threats at a given site. The three conservation paradigms discussed in the introduction correspond to three such strategies: direct protection, economic substitution, and linked incentives.[2] Each strategy is designed to mitigate direct or indirect threats to the biodiversity. To be effective, a strategy must be employed on a scale appropriate to the scale of the threat, economically and socially viable, and responsive to changing conditions.

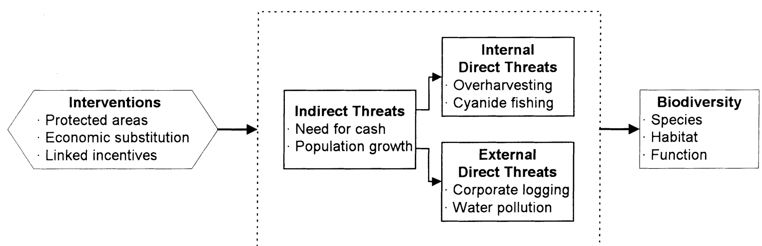

Figure 2. *A general model of conservation projects. (Source: Adapted from Salafsky & Margoluis, 1999. Note: Rectangles indicate conditions of the project site. Hexagons indicate interventions undertaken by the project team.)*

(b) *Models of different conservation strategies*

The general model of conservation projects can be expanded to differentiate among conservation strategies and show how they lead to conservation (Figure 3).

In the protected area model (Figure 3a), livelihood activities merely appear as one of the internal threats to biodiversity. The project implements a protected area to counter these internal threats as well as external threats.

In the economic substitution model (Figure 3b), the project implements livelihood activities such as the development of coffee plantations or a leather tannery as substitutes for other livelihood activities that adversely affect the biodiversity. The goal here is to increase the benefits that the local people receive from alternative conservation-oriented activities so that they no longer have the incentive to practice the damaging livelihood activities. As shown in the diagram, however, the substitution approach is not able to affect the external threats to the biodiversity.

Finally, in the linked incentives model (Figure 3c), there is a link between biodiversity and the livelihood intervention. This link is the driving force behind the sequence of activities leading to conservation. It "closes the loop" to make the system self-perpetuating. The linked

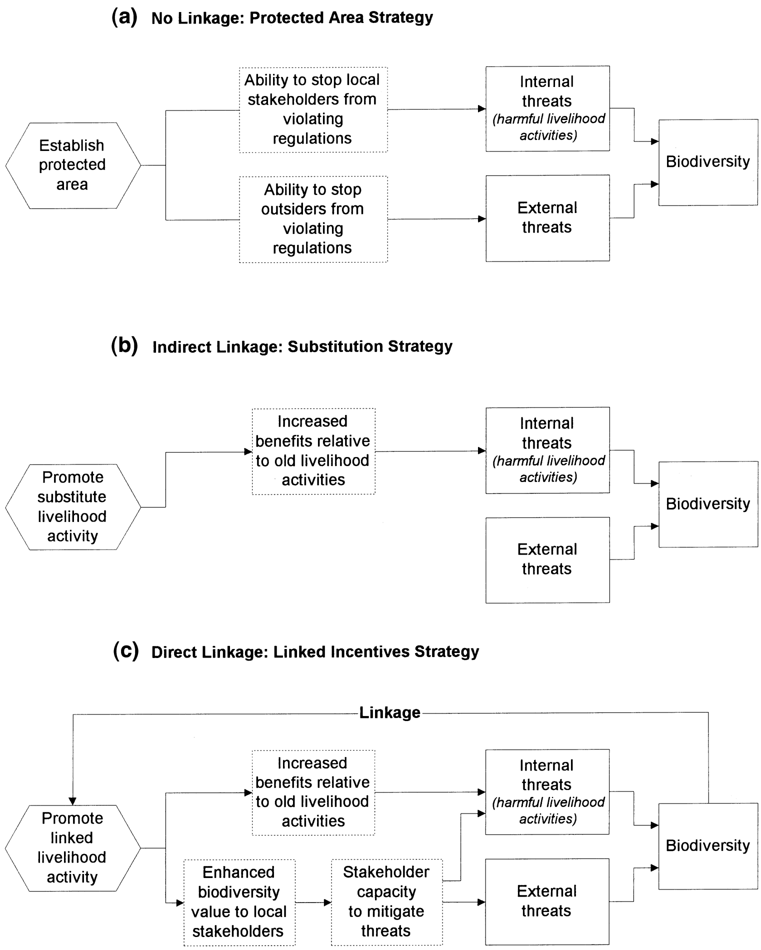

Figure 3. *Models of three conservation strategies. (Note: Rectangles indicate conditions of the project site. Hexagons indicate interventions undertaken by the project team. In this paper, we consider the model shown in 3c, focusing in particular on the linkage between biodiversity and the livelihood activity. We explicitly exclude from our ranking system the benefits that stakeholders receive from the livelihood activity and their capacity to mitigate threats.)*

activities counter internal threats by providing more attractive livelihood options so that the stakeholders no longer practice their damaging livelihood activities. In addition, the linked activities should enhance the value of the biodiversity to the local people, thus prompting them to take actions to mitigate both the internal and external threats to the biodiversity. [3]

Each of the relationships in the linked incentives model is necessary to ensure the success of the intervention. If any one link in the chain fails, the activity does not lead to conservation. There are a number of assumptions underlying each relationship. The livelihood activity must produce sufficient value to the stakeholders to create incentives for them to engage in threat mitigation activities. Stakeholders must have not only the incentive to take conservation actions, but also the capacity and resources to do so effectively. The key assumption in this model, however, is that it is possible to establish one or more livelihood activities that are linked to the biodiversity. Linkage is the fundamental relationship that shapes the presence and strength of the other steps in the chain. In the remainder of this paper, we focus on defining and measuring this linkage relationship.

4. DEFINING AND ASSESSING LINKAGE

To analyze linkage at any given site, we must assess whether it exists and how strong it is. Qualitative observations can be made about the kinds of impacts linkage might have on biodiversity. One simple test that can be used to see whether a given livelihood enterprise is linked to the biodiversity is to ask the question "If the biodiversity of the site were to be damaged, what would happen to livelihood activity?" If the activity will continue, then the activity is not linked to the biodiversity. If the activity is disrupted, however, then it is linked to the biodiversity. This test was used by BCN staff members to assess the linkage between enterprise activities and biodiversity in their initial evaluations of projects.

Some livelihood activities however are more linked to biodiversity than others. There is therefore a need to define linkage more precisely and assess relative degrees of linkage. Like "utility" in economics, linkage is ordinal rather than cardinal. We cannot say how much a given livelihood activity is linked to conservation in an absolute sense, but can only say that one activity is more linked than another. We can, however, consider different types of livelihood activities and use them to develop a scale that measures the level of linkage (DeVellis, 1991). To develop our linkage scale, we considered a range of different livelihood options in the context of case studies from the BCN portfolio of projects. The first three columns of Table 1 list the type of livelihood activity, the location of the specific project we considered, and references for the project. These case studies are described in greater detail in BCN (1997a,b).

In the remaining columns of Table 1, we ranked the different activities based upon dividing the broad question of "How linked is this activity?" into five dimensions of linkage:

—*Species dependence*: Dependence of the livelihood activity on maintaining species at the site.

—*Habitat dependence*: Dependence of the livelihood activity on maintaining habitats at the site.

—*Spatial dependence*: Percentage of the site on which the livelihood activity depends.

—*Temporal dependence*: Period and frequency of biodiversity use on which the livelihood depends.

—*Conservation association*: Dependence of the livelihood activity on associated conservation values.

Our rankings were on a scale of one to five where one is completely unlinked and five is completely linked. Rankings were based on subjective evaluations made by BCN program officers and project staff. [4] Rankings are more relative than absolute. In addition, our rankings reflected "actual" conditions at the site rather than "theoretical" possibilities (e.g., the actual percentage of area used, not the total amount possible at the site). To this end, it was necessary to first develop a specific definition of the biodiversity at the project site. This was often not a trivial task—it involved defining the site along four dimensions including spatial area, stakeholders, time, and the core enterprise (BCN, 1998; Salafsky *et al.*, 1999).

(a) *Species dependence*

The first dimension of linkage involves determining the degree to which the livelihood activity depends on the use of different plant and animal species at the project site. Livelihoods depend directly on a species when (i)

Table 1. *Case study sites and rankings*[a]

Type of enterprise	Site and country	Habitat type	Linkage dimension (1–5 scale)					Avg	Std dev
			A. Spec	B. Hab	C. Spat	D. Temp	E. Cons		
Plant products									
Handicrafts—Produced from various forest products	MINDANAO (#12) Philippines	Tropical forest	3	4	5	4	2	*3.6*	*1.1*
	CRATER MOUNTAIN (#15) PNG	Tropical forest	2	3	2	5	3	*3.0*	*1.2*
Fiber—Abaca tree (*Musa textilis*) fiber used in paper production	MINDANAO (#12) Philippines	Tropical forest	1	2	2	2	1	*1.6*	*0.5*
Essential oil—Pressed from herbs for use in traditional medicine	HUMLA (#1) Nepal	Alpine meadow	1	5	4	5	2	*3.4*	*1.8*
Herbal medicine—Produced from various forest plants	BILGIRI RANGAN HILLS (#5) India	Tropical forest	2	2	4	2	1	*2.2*	*1.1*
Jams and jellies—Produced from wild and planted fruits	KALAHAN (#14) Philippines	Tropical forest	2	1	2	2	3	*2.0*	*0.7*
Oil nuts—Ngali nuts (*Caniarium indicum*) used to produce oil	MAKIRA (#19) Solomon Islands	Tropical forest	1	2	4	3	3	*2.6*	*1.1*
Silk—Using oak leaves to produce tasar silk	GARHWAL (#3) India	Temperate forest	2	3	4	4	2	*3.0*	*1.0*
Rattan & bamboo—Materials for handbag production	SANGGAU (#8) Indonesia	Tropical forest	3	1	5	5	3	*3.4*	*1.7*
Rattan & resin—Harvesting raw materials	PALAWAN (#13) Philippines	Tropical forest	2	4	4	4	1	*3.0*	*1.4*
Timber (*plantation*)—Growing wood in buffer zone plantations	ROYAL CHITWAN (#2) Nepal	Savanna	1	1	1	1	1	*1.0*	*0.0*
Timber (*forest*)—Small scale community based timber production	GUNUNG PALUNG (#7) Indonesia	Tropical forest	3	4	3	5	4	*3.8*	*0.8*
	EAST NEW BRITAIN (#17) PNG	Tropical forest	2	4	3	5	2	*3.2*	*1.3*
Animal products									
Butterfly farming—Rearing butterflies in captive enclosures	LORE LINDU (#9) Indonesia	Tropical forest	4	5	4	3	4	*4.0*	*0.7*
Butterfly ranching—Rearing butterflies in open areas	ARFAK MOUNTAINS (#10) Indonesia	Tropical forest	4	5	4	4	4	*4.2*	*0.4*
Reef fishing—Harvesting reef fish to protect reef areas	PADAIDO ISLANDS (#11) Indonesia	Marine	5	5	5	5	1	*4.2*	*1.8*
Deep water fishing—Harvesting deep-water fish to protect reefs	ARNAVON ISLANDS (#18) Solomon Islands	marine	1	2	1	1	1	*1.2*	*0.4*

Honey hives—Producing honey in hives	GARHWAL (#3) India	Temperate forest	3	1	4	3	1	*2.4*	*1.3*
	LORE LINDU (#9) Indonesia	Tropical forest	3	2	2	1	1	*1.8*	*0.8*
Honey hunting—Collecting honey from wild bee nests	LORE LINDU (#9) Indonesia	Tropical forest	3	3	5	5	2	*3.6*	*1.3*
	BILGIRI RANGAN HILLS (#5) India	Tropical forest	4	3	4	5	3	*3.8*	*0.8*
Ecological services									
Biodiversity prospecting—Seeking pharmacological active species	VERATA VILLAGES (#20) Fiji	Marine	5	5	2	1	2	*3.0*	*1.9*
Adventure tourism—Scuba diving and homestays	PADAIDO ISLANDS (#11) Indonesia	Marine	5	5	4	5	3	*4.4*	*0.9*
Adventure tourism—River rafting	LORE LINDU (#9) Indonesia	Tropical forest	2	5	3	3	3	*3.2*	*1.1*
Ecotourism—Hosting tourists who come to see biodiversity and culture	ROYAL CHITWAN (#2) Nepal	Savanna	3	5	5	5	3	*4.2*	*1.1*
	SIKKIM (#4) India	Temperate forest	4	5	4	4	4	*4.2*	*0.4*
	GUNUNG HALIMUN (#6) Indonesia	Tropical forest	5	5	4	5	3	*4.4*	*0.9*
	CRATER MOUNTAIN (#15) PNG	Tropical forest	3	4	2	4	5	*3.6*	*1.1*
	MAKIRA (#19) Solomon Islands	Tropical forest	5	5	4	4	5	*4.6*	*0.5*
Religious tourism—Visiting a holy lake	SIKKIM (#4) India	Temperate forest	1	5	5	5	5	*4.2*	*1.8*
Scientific research and training—Hosting scientists & researchers	CRATER MOUNTAIN (#15) PNG	Tropical forest	5	5	2	5	5	*4.4*	*1.3*
	LAKEKAMU BASIN (#16) PNG	Tropical forest	4	5	3	5	4	*4.2*	*0.8*
Averages									
All sites			2.9	3.6	3.4	3.8	2.7	*3.3*	
All products			2.5	3.0	3.4	3.5	2.1	*2.9*	
All services			3.8	4.9	3.5	4.2	3.8	*4.0*	
Plant products			1.9	2.8	3.3	3.6	2.2	*2.8*	
Animal products			3.4	3.3	3.6	3.4	2.1	*3.2*	

[a] Numbers in the site column refer to the BCN project sites. Background information about these projects can be found in BCN (1997a,b). This table contains data for 32 sites out of the total of 39 BCN sites. The seven sites that are omitted are the ones in which the same type of enterprise is employed at multiple sites and thus do not represent independent data points for the purpose of these analyses. The five columns under linkage dimension correspond to the five dimensions discussed in the text.

material from the species is physically used as an input to produce a product (e.g., an oilnut) or maintain a livelihood pattern (e.g., swidden farmers dependence on forest slash as a source of soil nutrients), (ii) the species is used *in situ* to generate benefits for its "standing value" (e.g., ecotourism), or (iii) the species is used to attach cultural meaning to a livelihood practice (the burning of fragrant wood to ensure a good hunt).

Our rankings are based on the number and proportion of species to be conserved that the livelihood activity depends on. The more species that an activity depends on, the greater the degree of linkage. Specific rankings are that the livelihood activities depend on:

—No species or just one species.
—Two or three species.
—A medium range of species present.
—A wide range of species present.
—The whole range of species present at the site.

Most of the case study sites were reasonably straightforward to rank. In a few cases, it was necessary to distinguish between indigenous species and introduced or cultivated species. For example, the fruit production enterprise at the KALAHAN (#14) site in the Philippines used both indigenous fruits such as dagway (*Saurauia subglabra*) and dikay (*Embella philippinenses*) and introduced fruits such as guava (*Psidium guajava*). We thus counted only the indigenous fruits in our ranking. Honey was also problematic to rank. Some of the case study enterprises that we considered harvested honey from wild native bees in the forest (e.g., *Apis dorsata* at the LORE LINDU (#9) site) while others harvested honey from domesticated introduced bees kept in hives (e.g., *Apis mellifera* at the GARHWAL (#3) site). Furthermore, at various times during the year, the bees fed on indigenous wildflowers while at others they fed on agricultural crops. We thus estimated the proportion of time the bees used native versus introduced food plant species in calculating the ranking.

Our rankings assume that all species count equally toward conservation. In reality, it is probably the case that not all species are of equal importance. In particular, there are certain species that are of vital importance to the maintenance of ecosystems. But, since even ecologists have trouble resolving whether it is the "little things" or the "big things" that run the world (Wilson, 1987; Terborgh, 1988), in the interest of simplicity, we have chosen to avoid attempting to weight species in terms of their importance.

(b) *Habitat dependence*

The second dimension of linkage involves determining to what degree the species used by the livelihood activities themselves depend on maintaining the surrounding habitat in order to survive. Linkage is higher where the creation of growing conditions in another location or domestication of these species are not desirable or possible. The species might depend on pollination by a bat found only in forest habitats, the rising and falling water levels associated with a tidal zone, or on the sunlight regime of a closed canopy forest. The classic example of a dependent species is the Brazil nut, which until recently was believed to grow only in wild forest. It is now well established, however, that it is possible to grow Brazil nuts in plantations (E. Ortiz, personal communication). In thinking about the degree of habitat dependence, it is necessary to think about *technical dependence* versus *economic dependence*. For example, it may be technically possible to grow Brazil nuts outside of the forest, but not economically feasible to do so if the plantations require huge investments of labor and materials to function and thus equal or better quality nuts can be harvested from the forest at a cheaper price.

Our rankings are based on the strength of the dependence relationship between the species used by the livelihood activity and the surrounding habitat. The stronger the relationship, the greater the degree of linkage. Specific rankings are that the species is:

—Always obtainable outside the natural habitat.
—Usually obtainable outside the natural habitat.
—Obtainable outside the natural habitat, but not at an economically competitive cost.
—Technically obtainable outside of the natural habitat, but only with great difficulty and expense.
—Not obtainable outside of the natural habitat.

Here again, in a few cases the rankings required some interpretation. For example, butterfly production can be done in two ways. *Farming* as practiced at the LORE LINDU (#9) site involves rearing butterflies in captivity and hand feeding them the plants that the butterflies obligately depend on. *Ranching* as practiced at the ARFAK MOUNTAINS (#10) site involves planting their food plants and attracting wild butterflies to come and lay their eggs on the plants. Ranching is thus more dependent than farming on the wild populations, although the fact that butterfly farmers need to renew their populations with wild stock every few generations means that they are still linked to the forest. In a number of cases where the livelihood activity involves harvesting a nontimber forest product, it was difficult to determine where the product was coming from on the spectrum from natural forest to managed forest to forest gardens (Salafsky, 1994). For example, at the MAKIRA (#19) site, many of the oil nut trees in supposedly primary forest may in fact be from old abandoned agroforestry plots, thus lowering the true habitat dependence.

Our rankings assume that habitat dependence is relatively static. In reality, however, habitat dependence can change quickly due to technological developments. For example, it might seem impossible to plant a certain tree species until someone discovers that seedling establishment depends on mycorrhizal relationships and develops the means for inoculating soil outside the forest. Furthermore, developments in technology or in economic conditions can rapidly change the system by lowering cost barriers or raising incentives to domesticate species or otherwise sever the link between the species and its native habitat.

(c) *Spatial dependence*

The third dimension of linkage involves determining what proportion of the overall site the livelihood activity depends on. The greater the percentage of area used, the greater the degree of linkage (with the numbers that we give being approximate guidelines). Specific rankings include that the livelihood activities depend on:

—Only one small section of the site (< 5%).

—Several sections of the site (6–25%).

—About one-quarter to three-quarters of the site (26–74%).

—Most of the area of the site (75–95 %).

—All of the area of the site (100%).

In ranking our case studies along this dimension, we found it helpful to consider the range of habitats at the site—what ecologists refer to as beta-diversity. Many nontimber forest products might grow only in one type of habitat (e.g., rattan harvested in lowland forest). A livelihood activity that depends on this species will thus only at best use the area of the site where that habitat is found. This activity is less linked than an activity that uses multiple habitats (e.g., birdwatching that uses swamp, riverine, lowland, and upland forest).

Difficulties in applying this scale to our case study sites arose most from the different tourism enterprises. The tourists at the ROYAL CHITWAN (#2) site in Nepal only visit a small portion of the overall park. If we were considering the whole park as our site, we would face a dilemma since on one hand the tourists are using only a small fraction of the site. On the other hand, the tourists are coming primarily to see rhinos, tigers, and other large fauna populations that require the entire park area for their long-term survival. We solved this problem by defining only a portion of the overall park used by the BCN supported project as our site. Often the linkage may depend on the particular characteristics of the livelihood activity as it is practiced at the site. For example, the LORE LINDU (#9) adventure tourism site in Sulawesi involves rafting down a river so that the tourists only see a narrow strip of forest bordering the river. Presumably, much of the inland forest on either side of the river could be clearcut without affecting the tourism experience. The MAKIRA (#19) adventure tourism site in the Solomon Islands, however, involves hiking along a loop route and includes climbing up numerous ridges to get views of the vast expanse of surrounding primary forest. Presumably, if this forest were to be cut, it would dramatically influence the overall tourism experience.

Finally, we also had some difficult in separating out *actual* area used from *potential* area used. In the rattan harvesting example at the PALAWAN (#13) site, local people use the entire lowland forest area for harvesting rattan. In the timber example at the EAST NEW BRITAIN (#17) site, however, the local people are only harvesting the timber directly near the village because they have huge tracts of land and do not yet need the timber located farther away. Nonetheless, this site received a lower ranking because presumably the very abundance of forest land means that the community members might have less incentive to reject logging proposals that would use the forest located away from the village. As a rule, we only considered the actual area used over the evaluation period.

(d) *Temporal dependence*

The fourth dimension of linkage involves determining the total amount of time the livelihood activity requires interactions with the forest. Temporal dependence is a function of the frequency of this action and the length of time of each interaction.

Our rankings are based on the total amount of time that the activity requires contact with the biodiversity. The closer to continuous use that the activity requires, the greater the degree of linkage. Specific rankings include that the livelihood activities require:

—Only a one-time use of the site.
—Only occasional uses of the site for short periods of time.
—Regular but not long-term uses of the site.
—Repeated long-term uses of the site.
—Continuous use of the site.

This dimension was perhaps the most difficult one to rank consistently. In particular, it was challenging to determine what time frame we needed to be thinking about and the potential factors that might change usage patterns over time. For example, in many sites, the livelihood activity is seasonal. Sasonality can occur, however, or a number of different reasons. Some nontimber forest products such as the Illipe nuts in Borneo are only available during *masting periods* that occur ever three or four years (Salafsky, 1994). Clearly, this type of nut should be lower ranked than oil nut case study in the Solomon Islands where the product is available every year. Seasonality is also important in relation to other potential uses of the habitat. For example, in the HUMLA (#1) essential oil pressing case study, access to the meadows where the key plants grow is restricted only to a few summer months. During the remainder of the year, the habitat lies buried under meters of snow and is presumably not threatened by other activities. Thus, it seems unfair to "penalize" the linkage ranking of this activity since it functionally covers all critical times.

In addition to the availability of a product or service, temporal dependence is also affected by various economic and social factors. For example, demand for dive tourism at the PADAIDO ISLANDS (#11) site might be higher during vacation periods in developed country markets or reduced during periods of political unrest in Indonesia. Likewise, production of handicrafts at the SANGGAU (#8) site in West Kalimantan might only be possible during times when the community members are not busy with their regular farming work. Given that it is difficult to predict the effect of these social conditions in the future, we have to base our rankings on observed conditions to date. This means, however, that a tourism enterprise in a country where demand has collapsed due to a political crisis in the capital city will be lower ranked than the identical enterprise in a country whose government is stable.

Finally, there is the issue of sustainability with regard to the degree of long-term use. For example, most NTFPs such as rattan could conceivably be harvested at a low intensity on a continuous long-term basis or mined over a quick period. Here again, we thus had to base our rankings on the actual conditions at the site. Thus the PALAWAN (#13) rattan harvesting enterprise had a reduced ranking because rattan stocks were depleted over the life of the project whereas at the SANGGAU (#8) site in West Kalimantan, stocks were at least somewhat maintained through replanting efforts.

(e) *Conservation association*

The fifth and final component of linkage involves determining the degree to which the feasibility of the livelihood activity depends on its association with conservation. This conservation association most commonly occurs when there is a "green market" for the product (Panayoutou, 1993). On the demand side, a green market means consumers either pay a price premium for the product, or preferentially choose the product over its competitors because they know that it comes from a linked production process. On the production side, a green market occurs when producers engage in the livelihood activity as opposed to some other activity because of its conservation benefits. In both cases, from an economist's perspective, green marketing effectively involves bundling two goods together: the product or service itself and the conservation that is perceived to occur as a result of purchasing or producing the product. This conservation value is in effect being sold in a "green market." A high green market potential enhances linkage because, for example, in the case of an eco-enterprise, the enterprise would presumably not be feasible if it could not sell both the product itself and the associated conservation value.

Our rankings are based on the potential green market association of the product or service. The greater the association, the greater the degree of linkage. Specific rankings include that the livelihood activity has:

—Absolutely no green market potential.
—Very limited green market potential.

—Some green market potential.
—Substantial green market potential.
—Extensive green market potential.

Most of the products were relatively easy to rank. The most difficult aspect of the ranking involved separating the commodity itself from its green market aspect. For example, are tourists coming to the National Park at the ROYAL CHITWAN (#2) site to see rhinos and tigers or are they coming because they know they are contributing to conservation itself, or both? Furthermore, since green markets are more formalized for some commodities, (e.g., certified timber) it makes it hard to compare these markets to other products where the green market is not so well established.

5. RESULTS

(a) *Methodological concerns*

Overall, the scales that we have developed seem to be reasonably straightforward to use. There are, however, at least a few methodological issues that may need to be addressed.

The first of these issues is with regard to the relative *weighting* of the various dimensions. Our ranking system implicitly treats each of the five dimensions as having equal weight in the overall average score. In effect, we are assuming that the conservation association dependence dimension is as important to the overall concept of linkage as the species dependence or habitat dependence dimensions. We have chosen to make this decision in the interest of simplicity.

This choice, however, raises some serious issues. In particular, it causes some activities that intuitively seem not very linked (e.g., oil nuts or abaca fiber) to be more highly ranked then they might otherwise be because of the relatively high spatial and temporal rankings that they receive. These higher rankings thus pull up the overall score.

As a result, it might be desirable for some people to either use weights for the various dimensions or to drop some of the dimensions in their use of the ranking system (assign them a weight of zero). In particular, it might be useful to treat the species and habitat dependence dimensions as the primary criteria and the others as secondary criteria. In effect, this would involve scoring an activity only on these two criteria and then adding the other criteria only if the average score based on the first two dimensions is over two or three.

We can at least say, however, that no one dimension has an undue effect on the final score. The average livelihood activity in our study sample had a ranking of 3.3 on our five-point scale. If we look at the average ranking for each of the dimensions in relation to this mean, we see that the species and conservation value dimensions are lower than the mean whereas the habitat and temporal rankings are above the mean. But, since none of the means for the individual dimensions are more than 0.6 of a ranking point away from the overall mean, this indicates that there is no one dimension that has an overwhelmingly strong influence on the overall score.

A second issue is with regard to the *site-specific nature* of the spatial and temporal dependence dimensions. While the degree of linkage as assessed along the species and habitat dependence dimensions is fairly independent of where the activity is taking place, the spatial and temporal dimensions are closely tied to the nature of the project site. Furthermore, there is in some ways a bias against large sites. For example, the handicraft enterprise at the MINDANAO (#12) site uses the entire area of forest at the site, which is less than 3,000 hectares in size. The handicraft enterprise at the CRATER MOUNTAIN (#15) site, by contrast, uses only a small fraction of the 60,000 hectares of forest that the community stakeholders control. Clearly, the handicraft enterprise at the second site is less linked spatially—and this is reflected in the lower ranking. It is important to realize, however, that this result is a function of the relative scale of the two sites. It also suggests the common sense conclusion that communities' capacity to protect biodiversity will be directly related to the relative size of the site and distribution of valuable species.

A third issue returns to the concept that not all species or habitats at a site are necessarily equal in either their conservation importance or the degree to which they are *threatened.* For instance, if the primary threat in a given site is poaching of a large animal, then a livelihood activity that makes use of that specific animal is in some ways relevantly better linked than an activity that does not involve that animal even though it uses more species overall. The ranking system may thus have to be adapted to account for this type of situation.

(b) *Patterns emerging from the linkage ranking data*

In this paper, the rankings of the livelihood activities in our sample were mostly done by other BCN Program Officers (the exception being the projects from Papua New Guinea, which were ranked by NS). Still, the subjective nature of our rankings means that there is a danger of circular argument in looking for patterns in our data set. Observed patterns may be a result of biases in the rankings. Furthermore, the data set is not a random collection of conservation and development projects and thus care must be taken in extrapolating our results. Nonetheless, a closer examination of the linkage ranking data for the 32 sites presented in Table 1 shows several interesting observations.

Examining the differences between those livelihood activities that involve harvesting products and those that involve ecosystem services, we find that the ecosystem service activities have a higher mean ranking (4.0 ± 0.5) than the product harvesting activities (2.9 ± 1.0). A Mann-Whitney U-test shows that this difference is significant ($n = 32$, $p = 0.001$). The differences in the mean ranking between the two groups are also significant for the species, habitat, and conservation value dimensions considered separately, but not for the spatial and temporal dimensions. These findings are consistent with our expectations in that product harvesting activities tend to focus on fewer species and have less linkage to the habitats, but require a relatively higher percentage of the overall area of the site and continued access to the resource.

In general, the animal products have a higher overall ranking than the plant products, especially if the two forest-based timber harvesting enterprises are excluded from the plant group. Three of the animal product harvesting activities score a mean ranking that is higher than 4.0 but none of the plant product harvesting activities exceed a score of 3.8. The difference between the means of the two groups is not significant, perhaps in large part due to low scores for honey collected from hives and deep water fishing. The high scoring animal products largely seem to be the butterfly collecting and fishing enterprises that use a wide range of species and have a high degree of dependence on the surrounding habitats.

We found no apparent patterns in comparing the rankings of livelihood activities in different geographic locations or in different habitat types, although this is not surprising given the way in which our sample of projects was selected.

(c) *Relationship between degree of linkage and project success*

Ultimately, from a conservation practitioner's point of view, what matters most is whether a project leads to conservation success. BCN primarily used a *Threat Reduction Assessment (TRA) Index* to assess the conservation outcome at each of the 39 BCN project sites (see Salafsky & Margoluis, 1999 for a detailed discussion of the TRA Index and Salafsky *et al.* (1999) for a discussion of BCN's overall results). BCN's working sub-hypothesis, as shown by the heavy dashed line in Figure 4, was that an increase in the degree of linkage should lead to an increase in conservation success. When we plotted the average ranking across all sites, however, we found that if anything, the relationship was in the opposite direction as indicated by the solid regression line. A 2×2 chi-square analysis (dividing both variables at their median ranking) showed no significant association between linkage and conservation ($n = 39$, $\chi^2 = 2.09$, $p = 0.148$) and, if anything, suggested a negative association.

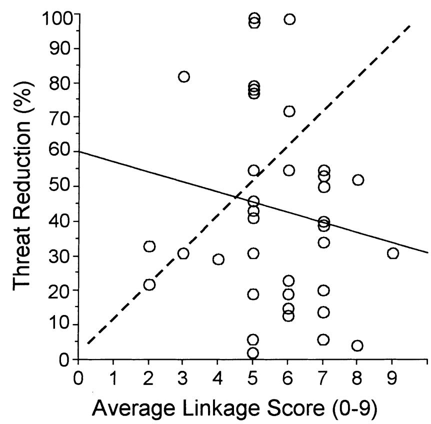

Figure 4. *Threat reduction plotted against average linkage ranking. (Source: From Salafsky et al., 1999. Note: The heavy dashed line represents BCNs working sub-hypothesis. The solid OLS regression line in this graph is presented only to provide visual guidance as to the direction of the association between the two variables. Since the linkage data are rankings, no inference can be made about the slope of the line.)*

6. CONCLUSIONS

(a) *Using the framework to design and evaluate livelihood and conservation projects*

Overall, we found the framework to be helpful in orienting our thinking about how best to implement a project using a linked incentive strategy. In particular, we found that the process of defining and evaluating linkages for a given project forces the people involved with the project to think carefully about whether a linked incentives strategy is feasible. Although our data set was restricted to enterprise-based approaches to conservation, there are a few basic principles that seem to emerge from our work regarding the conditions under which a linked incentive strategy might lead to conservation:

—*Nontimber forest product harvesting enterprises have relatively low linkage rankings and are thus difficult to use in a linked incentive strategy*: We found that in general, nontimber forest product harvesting activities have lower linkage rankings than ecosystem-services based activities. Because most nontimber forest product harvesting businesses depend on only one or two species, there is likely to be strong pressure to increase the management of the system to promote these species, ranging from forest enrichment to domestication in agroforestry or agricultural systems. These management approaches may maintain the population of the focal species, but may have no impact or even a negative impact on overall habitat conservation.

—*Timber production and butterfly harvesting are more linked and are thus better candidates for a linked incentive strategy*: Of the various product harvesting projects, the ones with the highest linkage rankings are timber production and animal product harvesting. Timber is highly ranked because it uses a number of species and has a strong habitat linkage. Animal harvesting is highly ranked because animals are at a higher trophic level and thus depend on the surrounding habitat for their survival. These types of products thus may make more sense for a project using a linked-incentive conservation strategy.

—*Livelihood activities that make use of ecological services have the highest linkage rankings and therefore may be the best candidates for a linked incentive strategy*: Owing to the high numbers of species used and their dependence on the habitat, service activities like tourism tend to get the highest linkage rankings. These types of businesses thus may also make sense for a linked-incentive conservation strategy. Unfortunately, other evidence from the BCN program shows that these types of enterprises tend to be more complex and thus more difficult for local communities to implement successfully without external support (Salafsky *et al.*, 1999).

—*Local perceptions of linkage are essential*: In working with BCN project partners to develop the linkage rankings, we realized that there is often a gap between what an outside investigator perceives as linkage and what the local stakeholders perceive as linkage. As our model of the linked incentives strategy shows, ultimately, unless the local stakeholders recognize the link, it will not matter in terms of influencing their actions. For example, at the ROYAL CHITWAN (#2) site, our rankings reflect the strong linkage between the entire area of the park and the local rhinos that tourists come to see. If local people do not perceive this link, however, then they may not take action to stop direct threats (poaching) or indirect threats (habitat conversion) to the rhinos in other parts of the park.

—*Linkage is only one among many factors influencing conservation success*: As shown in Figure 3c, there is a series of relationships that all must hold true for a linked incentives conservation project to work. In addition to having at least moderate linkage between the biodiversity and the livelihood activity, the strategy also requires that the project generate cash and noncash benefits for the stakeholders and that the stakeholders have the capacity to take action to mitigate internal and external threats. Other factors not shown in the model that also affect the success of a project include the biophysical, social, and institutional context that the project is operating in and the skill of the project team (Salafsky *et al.*, 1999). The observed lack of association between linkage and conservation success may thus in part be attributed to the fact that, following the model in Figure 3c, linkage is a necessary but not sufficient condition for conservation to take place. High linkage by itself is not a guarantee of conservation success.

(b) *Using the framework to compare linked incentives with other conservation strategies*

It is perhaps unsurprising that linked incentive strategies are not a universal panacea for conservation problems. Returning to the three strategies presented at the start of the document, if we have learned anything, it is that there is no one strategy that works everywhere—and indeed, probably no one strategy that can work on its own at any given site. The choice of a conservation strategy is not an either-or question, but rather, as shown in Figure 5, a matter of fitting the right combination of strategies to the conditions at hand (Salafsky *et al.*, 1999). For example, it may be possible to develop a linked tourism enterprise in one only part of a protected area, and use other approaches in parts of the park where the linkage strategy is less appropriate.

To make conservation happen, practitioners thus need to be able to understand the specific local conditions at their project site, both at the start of their project, and as they change over time. They need to develop the appropriate mix of strategies that can include protected areas, unlinked incentives, linked incentives and other strategies such as education and awareness. In addition, they need to monitor the results of their interventions, analyze the data, and use it to make the appropriate responses in a process of adaptive management (Salafsky & Margoluis, 1999). The key to this adaptive management process is information. In particular, it is important to have a conceptual understanding of each strategy and to have tools to measure it. To this end, the framework presented in this paper should provide a better understanding of the linked incentive strategy and its strengths and weaknesses relative to other options.

(c) *Future research needs*

Future work that will be needed to develop the ideas presented in this paper include:

—*Address methodological issues*: We need to solve the methodological problems related to weighting of dimensions, comparability of spatial and temporal dependence dimensions across sites, and differences in conservation value among species.

—*Test the framework on other types of livelihood activities*: We need to see how the linkage applies to other data sets. In particular, it will be interesting to see whether the rankings are applicable to other types of conservation and development projects like carbon sequestration, promotion of farming, game meat hunting, and other activities.

—*Develop similar frameworks for other conservation strategies*: Finally, to improve our collective ability to do conservation, we need to develop a better understanding of linked incentives as well as all other conservation strategies to determine the conditions under which each works, each does not work, and why.

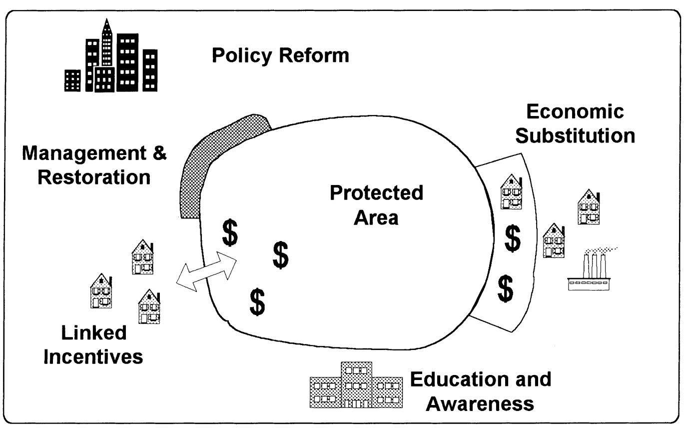

Figure 5. *Conservation at any site requires a mixture of different strategies. (Source: Adapted from BCN, 1997b and Salafsky, 1998.)*

NOTES

1. The four classifications that exclude use by local communities include (I) Strict Nature Reserve, (II) National Park (managed mainly for ecosystem conservation and recreation), (III) National Monument (managed mainly for the conservation of specific features), (IV) Habitat/Species Management Area (managed mainly for conservation through management intervention). The remaining two types are (V) Protected Landscape/Seascape (protecting areas where the interaction of people and land/sea have produced an area of distinct character), (VI) Managed Resource Protected Area (managed mainly for the sustainable use of natural ecosystems to meet community needs).

2. These three approaches are not an exhaustive list of conservation strategies that can be employed. Others include biological management, *ex situ* protection, environmental education, and policy reform (Salafsky & Margoluis, 1999).

3. In this paper, we focus on "inherently linked" livelihood activities that are by definition directly dependent on natural resources. Our framework, however, ignores what might be termed "artificially linked" livelihood activities that are not inherently dependent on natural resources, but that are coupled to them by outside actors. For example, a conservation organization might explicitly link a leathery tannery jobs program in a community to specific conservation actions or outcomes. The organization would thus tell the community that "we will subsidize these jobs if you cease from hunting a rare species of bird or if populations of the bird species do not drop below some agreed upon level." In effect, this artifically linked livelihood represents a fourth conservation strategy that could be added to Figure 3. It is, however, outside the scope of our paper.

4. BCN staff rankings were made using an expanded (0–9) version of the scale presented in this paper. These rankings were then converted into the 1–5 scale used in this paper by taking the ranking, dividing it by 2, adding 1, and rounding down to the nearest integer. In addition, the precise wording of the points along some of the scales were changed after assessments were made.

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