Zia A. *et al*. (2015), *Eliciting Inter-Temporal Value Trade-Offs [...]*, IAFOR Journal of Sustainability, Energy and the Environment **2(1)**:41-62.

ELICITING INTER-TEMPORAL VALUE TRADE-OFFS: A DELIBERATIVE MULTI-CRITERIA ANALYSIS OF VIETNAM'S BAI TU LONG NATIONAL PARK MANAGEMENT SCENARIOS

Asim Zia[1], Paul Hirsch[2], Hoang Van Thang[3], Tran Chi Trung[3], Sheila O'Connor[4], Thomas McShane[4], Peter Brosius[5], Bryan Norton[6]

Abstract. *Background*: While different notions of sustainability and sustainable development have been adopted in the key policy goals of agencies at multiple governance levels, initial enchantment with sustainable development as a "win-win" panacea has given way to the emerging notion of "hard choices" and "difficult trade-offs" that entail inter-generational allocation of environmental resources. Two hypotheses are explored: (i) ***Negative Discounting Hypothesis***: Hyperbolic discounting and positive discount rates do not accurately describe the decision behavior of policy actors in all natural resource management contexts; rather, negative discount rates for ecological and natural resource conservation values could also be observed in some management contexts. (ii) ***Value Pluralism Hypothesis***: Ecological, social, political and other values could be accorded higher weights than economic values in some natural resource management contexts.
Materials and Methods: A deliberative multi-criteria analysis (DMCA) model for eliciting trade-offs among values across multiple space-time scales is presented in the management context of Vietnam's Bai Tu Long National Park (BTLNP). Five management scenarios for BTLNP – business-as-usual, total conservation, total development, multi-use, and community-owned – are evaluated on six criteria: economic welfare, social welfare, good governance, ecosystem services and biodiversity protection, price of land and accessibility.
Results: After group discussions, Vietnamese participants revealed negative discounting for economic welfare, social welfare, and ecosystem services, while positive discounting for the other three criteria. Economic welfare is accorded relatively lesser weight than ecosystem services and good governance.
Conclusions: Deliberative process reveals that multiple use area and community ownership management scenarios could better serve pluralistic stakeholder values.

Keywords: Economic development, Sustainable development, Participatory decision-making, Multi-criteria decision analysis, Environmental planning, Inter-temporal trade-offs

[1] Corresponding author. Department of Community Development and Applied Economics, University of Vermont, 146 University Place, Burlington VT 05405 USA. Tel: +1-802- 656-4695; Fax: +1-802- 656-4447. Email address: asim.zia@uvm.edu
[2] Department of Environmental Studies, SUNY Environmental Science and Forestry, Syracuse NY, USA
[3] Center for Natural Resources and Environmental Studies (CRES), Vietnam National University, Hanoi, Vietnam
[4] Global Institute of Sustainability, Arizona State University, Tempe AZ, USA
[5] Center for Integrative Conservation Research, University of Georgia, Athens GA, USA
[6] School of Public Policy, Georgia Institute of Technology, Atlanta GA, USA

1. Introduction

Since WCED (1987) conceptualized sustainable development as development that meets the needs of the **present** without compromising the ability of the **future** generations to meet their own needs, almost all definitions of sustainability implicitly or explicitly address issues of inter-generational allocation of environmental resources (Norton 2005, Zia 2013). Allocation of different kinds of natural capital over time, for example, signifies **inter-temporal** resource allocation decisions that will directly affect inter-generational environmental sustainability. While different notions of sustainability and sustainable development have been adopted in the key policy goals of different international agencies (e.g. UN, IUCN), national governments, and NGOs since WCED (1987), initial enchantment with sustainable development as a "win-win" panacea has given way to the emerging notion of "hard choices" and "difficult trade-offs" that entail inter-generational allocation of environmental resources (McShane et al. 2010; Ostrom 2007).

In this paper, we focus on assessing inter-temporal value trade-offs that are inherent in sustainable management of natural resources. In particular, we focus on a specific inter-disciplinary theoretical tension that exists between two camps of sustainability theorists in operationalizing inter-temporal value trade-offs. The first camp, predominantly represented by neoclassical economic theorists and their offshoots, argue for positive discount rates in comparing the costs and benefits of inter-temporal resource allocation decisions, for example see (Becker 1976; Becker 1993; Beckerman 1994; Nordhaus 1994; Solow 1993). The second camp, predominantly represented by systems analysts, decision scientists and behavioral scientists, argue for an open-ended elicitation of inter-temporal value trade-offs, which implies that decision makers could display negative, zero, positive or even non-linear discount rates on different sets of values in different decision contexts, for example see (Keeney 2002; Norton and Toman 1997; Loewenstein et al. 2003; Norton 2005; Ariely 2009).

Neo-classical economic theory frames the assessment of inter-temporal value trade-offs from the normative perspective of a discounted utility (DU) model, which was initially postulated by Samuelson (1937). The DU model posits that people have a single unitary rate of time preference that they use to discount the value of delayed/future events. Toman (1994: 400) succinctly presents the dilemma for inter-generational equity and sustainability posed by positive discounting inherent in the DU model: "The typical criterion of discounted inter-temporal welfare maximization in applied welfare economics occupies one point in the continuum of alternative justice conceptions. This criterion not only emphasizes preference satisfaction over rights; it also is highly presentist, since with any positive intergenerational discount rate the welfare of individuals living one generation in the future is scarcely relevant to current decision making. Many writers have suggested that the presentist focus of the present-value (PV) criterion implies an influence of the current generation over the circumstances of its more distant descendants that seems, at least intuitively, to be ethically questionable." Notwithstanding the presentist bias in the DU model, it is widely used in cost benefit analysis, total economic valuation and, recently, valuation of ecosystem services, for example see Freeman (2003). In essence, the DU model posits

that rational human societies should discount future costs and benefits in favor of present costs and benefits.

Behavioral scientists, psychologists, and decision scientists, on the other hand, have empirically discredited the DU model (Ariely 2009; Frederick et al. 2003; Loewenstein et al. 2003). Some have proposed an alternative hyperbolic discounting model, according to which people tend to be more impatient towards trade-offs involving earlier rewards than those involving later rewards. Yet others observe that the DU model cannot be salvaged by merely assuming a different -- hyperbolic, for example, discount function. Rather, they argue, understanding inter-temporal choice behavior requires an account of several distinct motives that can vary greatly across decisions (Frederick et al. 2003).

There are significant ethical and algorithmic limitations when cross-scale value trade-offs are negotiated merely in terms of discounted utility or hyperbolic discounting models (Kelman 1981; Norton 1991, 1994; Norton and Noonan 2007; Page 1997; Sagoff 1998; Spash 2008; Spash and Vatn 2006). Instead of imposing positive discount rates through top-down environmental management and policy-making practices, behavioral, decision and system scientists argue that societal/stakeholder preferences must be elicited through a bottom-up deliberative type of processes. Further, an open-ended methodology must be deployed to elicit inter-temporal value preferences that permit decision makers to display both positive and negative (or even non-linear) discount rates for different values when deciding about "sustainable" inter-temporal consumption rates of natural and environmental resources.

Drawing on this set of theoretical issues and debates, we posit the following hypothesis that will be explored in this study:

(i) ***Negative Discounting Hypothesis:*** Hyperbolic discounting and positive discount rates do not accurately describe the decision behavior of policy actors in *all* natural resource management contexts; rather, negative discount rates for ecological and natural resource conservation values could also be observed in *some* management contexts.

Further, the measurement of trade-offs merely in terms of monetary costs and benefits may ignore other important social, ecological and political values, which are essential for context-sensitive management of natural resources but cannot be easily monetized or classified as costs and benefits (McShane et al. 2010; Norton 2005; Norton and Steinemann 2001; Spash 2008; Spash and Vatn 2006). Pluralistic values can reside both inside individuals and among individuals in societies and across societies. Drawing on this insight, we posit a second hypothesis for this study:

(ii) ***Value Pluralism Hypothesis:*** Ecological, social, political and other values could be accorded higher weights than economic values in *some* natural resource management contexts, both at present and future time scales.

In section 2, we discuss the potential of deliberative multi-criteria analysis (DMCA) as an alternative approach to conventional DU or behavioral economic models for eliciting trade-offs among values across multiple space-time scales. While there are a range of open-ended to semi-structured and structured mechanisms for eliciting multi-scaled value trade-offs, for example see (Bazzani 2005; Chung and Lee 2009; Herath 2004; Laukkanen et al. 2002; Marttunen and Hamalainen 2008; Ramanathan 2001), this study provides results from a pilot implementation of DMCA in the management context of Vietnam's Bai Tu Long National Park (BTLNP) with a limited focus on eliciting value trade-offs across multiple temporal scales. In addition to the DMCA model, section 2 also presents the specific empirical methods, including data collection procedures that were deployed in Vietnam, and the limitations of DMCA models in eliciting value trade-offs.

We chose the case-study site of Bai Tu Long National Park (BTLNP) in Vietnam to elicit inter-temporal value trade-offs and pilot-test these two hypotheses in the context of ongoing environmental management conflicts that are symptomatic of similar conflicts worldwide between prioritizing conservation versus economic development goals in management plans. While the Vietnamese government accorded it a national park status in 2001, there are increasing sets of development pressures (especially overexploitation of natural resources such as sandy worm, jelly fish, aquaculture development, tourism development, and transportation) that threaten the ecosystem integrity in BTLNP. To discuss a range of development and conservation management options that face BTLNP (among other national parks and ecosystems in Vietnam), and the consequent inter-temporal value trade-offs inherent in each of these management options, a three-day workshop was organized near the case study site in July 2009, a part of which was devoted to a test implementation of the DMCA approach. Multiple stakeholder groups representing federal and local governments, people's committees, NGOs and academia participated in the workshop, a subset of which also participated in the DMCA exercise. The empirical results from the DMCA application in Vietnam and their decision analytical implications for inter-temporal value trade-offs and ultimately sustainable environmental management are discussed in section 3, and conclusions are drawn in section 4.

2. Materials and Methods

2.1: DMCA Model

A number of studies have been published in the broader environmental management and governance arena that demonstrate the applicability of deliberative multi-criteria analysis models (Howarth and Wilson 2006; Messner et al. 2006; Renn 2006; Stagl 2006; van den Hove 2006). This body of literature has emerged in parallel to the deliberative value focused decision analytic models (Gregory and Keeney 1994; Keeney 1992; Keeney 1988, 1996; Kiker et al. 2005). Kiker et al. 2005 present a broad review of studies that involve the application of multiple criteria decision making models for environmental decision making. Major limitations of deliberative multi-criteria evaluation methods, which concerns issues such as power dynamics in groups, categorization of value hierarchies, and weight determination processes that are explained in section 2.2 in greater detail, are discussed by Hisschenemoller and Hoppe

1995; Keeney and McDaniels 1999; Pellizzoni 2001; Shim et al. 2002; and Stirling 2006.

Our DMCA model, formally presented below, has emerged in response to earlier work of Norton (2005), Norton and Noonan (2007) and Zia et al. (2011). Outlining the elements of a value pluralistic, multi-scalar theory of sustainable environmental management, Norton and Noonan (2007:672) suggested a shift in the unit of analysis to development paths or scenarios:

"Development paths are ways our community/place can develop over time and into the future. Development paths can be thought of, alternatively, as scenarios, but here scenarios are used creatively and reflectively, to explore and evaluate possible development paths according to multiple criteria and not, as in economic models, as a methodological tool to measure welfare change. Proposed policies can be understood as interventions to modify or stabilize systemic effects on community or place, and simulations can be used to explore how policy options might lead to varied scenarios. Goals can be set, not as abstract principles that demand maximization of a single index value (e.g., economic welfare) but as descriptions of favored development paths. Proposed policies, and the development paths they are modeled to shape and encourage, can then be evaluated on multiple criteria, including economic criteria (such as job creation and comparative efficiency of different institutional means to achieve improvements on key criteria), but also including longer-term impacts on ecological systems. So, we are proposing an alternative approach to evaluation of environmental change, which shifts the unit of evaluative analysis from WTP for atomized, discrete commodities, or clearly describable changes in scenarios, to development paths that can be evaluated according to impacts on multiple scales of time and space. In this way we can choose development paths to protect a range of human values, recognizing the multiple ways humans value nature."

DMCA enables elicitation of value trade-offs as a structured participatory mechanism for groups of multiple stakeholders to iteratively discuss incommensurate values and evaluate the weights on those values for choosing valuable actions. Building upon Norton and Noonan's (2007) idea of alternate development paths/scenarios, as also operationalized in Zia et al. (2011), we formally define a multi-criteria expected value function V_{ik} for i^{th} development path in a set of m development paths by k^{th} stakeholder as in equation 1:

$$V_{ik} = \sum_{j=1}^{n} w_{jk} x_{ijk}$$
$$s.t. \sum_{j=1}^{n} w_{jk} = 1 \qquad (1)$$

Where w_{jk} is a weighting or Trade-Off *function* for j^{th} criterion in a set of n criteria by k^{th} stakeholder; and x_{ijk} is an "outcome" or "impact" function for i^{th} alternative on j^{th} criteria as perceived by a k^{th} stakeholder in a group of K stakeholders. For an individual decision maker, the most valued development path is the one with the highest V_{ik}. The real challenge is how to integrate/aggregate V_{ik} across groups of multiple stakeholders for choosing a development path that reflects the pluralistic values of all affected stakeholders. Formally, this aggregation challenge is represented through the

assignment of Ψ_k for aggregating V_{ik} to estimate the societal value V_i of i^{th} development path, as shown in equation 2:

$$V_i = \sum_{k=1}^{K} \Psi_k V_{ik}$$
$$s.t. \sum_{k=1}^{K} \Psi_k = 1 \qquad (2)$$

Substituting V_{ik} from (1) in (2) yields:

$$V_i = \sum_{k=1}^{K} \sum_{j=1}^{n} \Psi_k w_{jk} x_{ijk}$$
$$s.t. \sum_{j=1}^{n} w_{jk} = 1 \text{ and } \sum_{k=1}^{K} \Psi_k = 1 \qquad (3)$$

Table 1. Procedural heuristic of Deliberative Multi Criteria Analysis (DMCA)

Steps	Procedures
1.	Develop a group consensus on alternate scenarios/development paths
2.	Develop a group consensus on criteria (mutually exclusive and typically incommensurate)
3.	Individuals assign weights on criteria
4.	Individuals assign their perceived outcomes/impacts on a constructed scale for each alternate scenario by each criterion
5.	Individuals participate in small group discussion to develop consensus on weights and perceived outcomes/impacts
6.	Workshop level weights and perceived outcomes/impacts are developed
7.	Workshop level weights and perceived outcomes/impacts are used as inputs to compute expected value for each scenario (as per equation 3) for evaluating alternate scenarios
8.	The valuation process is repeated iteratively with different set of stakeholder representatives

Equation 3 provides one of the many possible MCA methods to assign multi-criteria values on alternate development paths conditional upon the weights assigned to different stakeholders, the weights assigned by each stakeholder on different values in the system as well as the impacts perceived by different stakeholders for each alternate development path vis-à-vis each value in the system. Here, we formally stipulate that a *process* issue in aggregation refers to how a stakeholder is included or excluded from the set of K stakeholders. Furthermore, we define that a *power* issue in aggregation refers to the problem of assigning Ψ_k weights to a k^{th} stakeholder. In a perfectly egalitarian society, Ψ_k will be equal for all stakeholders, which is rarely the case in real societies. Power asymmetries can be explicitly represented through the asymmetric assignment of Ψ_k. Since formal MCA cannot endogenously determine K and Ψ_k, we propose the deployment of deliberative and softer version of MCA applications. In particular, we propose a continuous and iterative application of an open ended 8-step deliberative procedure, which is shown in Table 1, to estimate multi-criteria value functions for alternate development paths, as estimated in equation (3). The proposed procedure is sensitive to stakeholder selection, which is a critical feature of understanding the process and power aspects of eliciting trade-offs. Who is brought into the process at the start is important, as well as their ability to express their views during the process, e.g. are participants selected representative of the full range of interests being considered. Iterative implementation of DMCA with different stakeholder groups in specific policy settings could potentially overcome some of the sensitivities associated with stakeholder selection processes. In this paper, we demonstrate the application of this deliberative

methodology in the specific context of eliciting inter-temporal value trade-offs for the management of BTLNP, Vietnam.

2.2. Limitations of DMCA Models in Eliciting Value Trade-Offs

The deliberative MCDA approach is designed to work best when processes achieve or approach "ideal speech situations" (Habermas 1984, 1998). In real world situations, however, we are far from ideal speech situations. For example, ideal speech situations require that all participants be given a fair opportunity to participate and deliberate about their concerns in any given problematic situation. In real world situations, powerful participants may use explicit or implicit forms of power to influence the participation or the position of weaker participants.

Deliberative MCDA methodologies also require extensive computational and cognitive skills to be implemented by the participants for "authentic" deliberations. In reality, as has been extensively demonstrated in decision theoretical research, many participants could be averse to forcing themselves out of their "comfort zones" or "routines" in terms of thinking about assigning constant-sum weights to values or comparing the impacts of different design options vis-à-vis different values. Another problem, known widely since the work of Howard Raifa (1968), concerns the assumption that values be mutually exclusive for assigning constant-sum weights. While decision theorists have designed very sophisticated value mapping methods to implement the requirements of this value exclusivity assumption, it is very challenging and linguistically daunting to map exclusive values. When it comes to working across linguistic and cultural boundaries, such as the case of working in Asia, this kind of exclusive value enunciation challenge becomes even more intractable due to the politics of language and other power and process dynamic issues discussed above. Messner (2006: 164) summed up methodological problems with deliberative MCA approaches: "what MCA method and which participatory approach should be selected for a certain evaluation problem? Who should determine the criteria? How is double counting prevented? Who decides on the weightings? Who is to be included in the participation process? How can objective results be attained?"

Finally, aggregation issues, i.e. who should be assigned how much weight when aggregating value functions in a given problem solving situation, have posed difficult challenges for participatory and deliberative MCA tools, as also discussed by Wilson and Howarth (2002), Howarth and Wilson (2006) and Stirling (2006). All of these are very tangible limitations of deliberative MCA methodologies and utmost attention and caution must be observed while implementing such methods in the field settings and interpreting the data from these deliberations for policy analytical purposes. For additional thorough discussion of deliberative MCDA limitations, readers are referred to Hisschenemoller and Hoppe 1995; Pellizzoni 2001; Shim et al. 2002; Stirling 2006; and Wittmer et al. 2006.

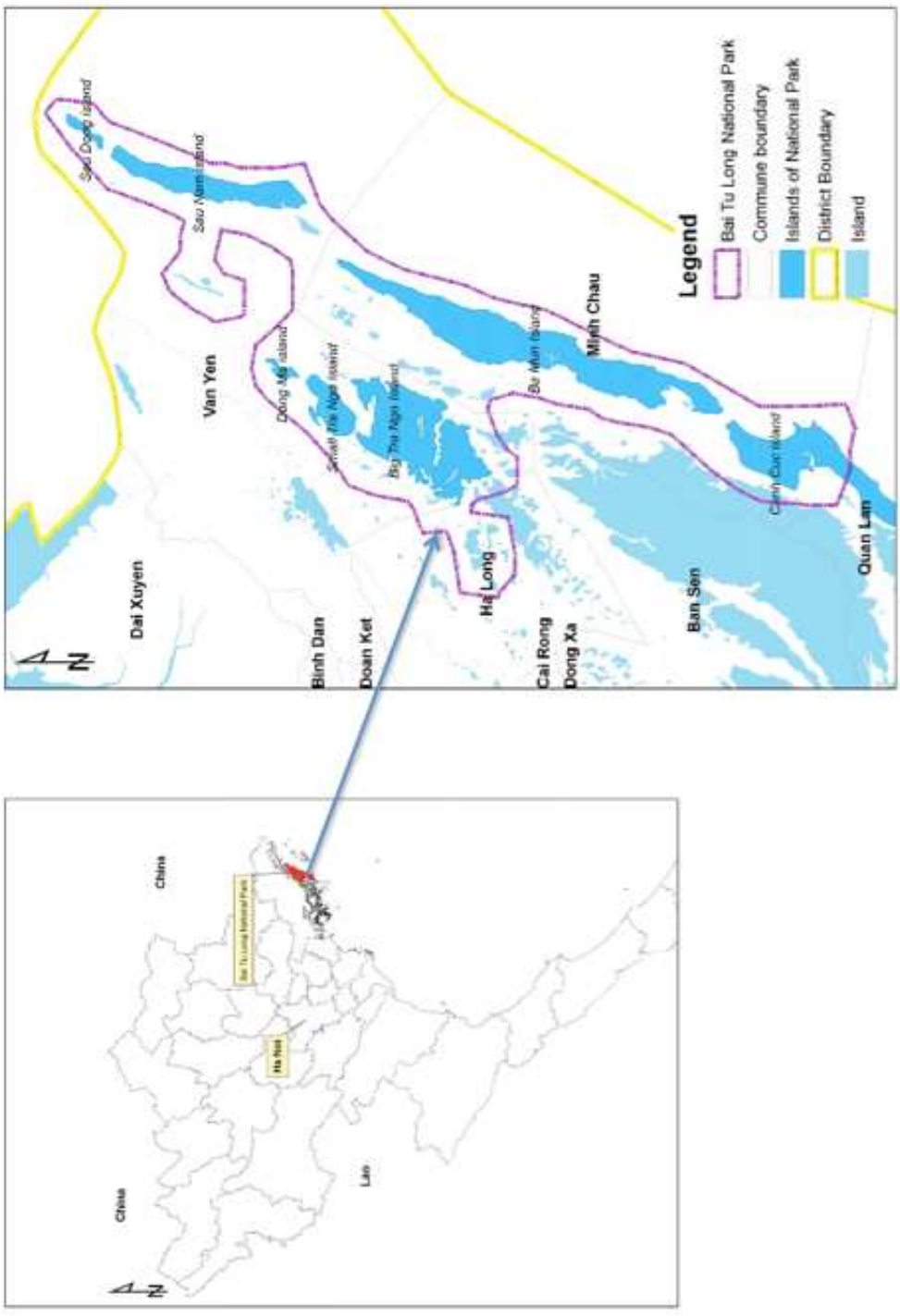

Figure 1. Location of Bai Tu Long National Park in Vietnam

2.3. Data Collection Procedures in Vietnam

A 3-day research workshop was organized in Ha Long Bay, Vietnam in July, 2009 to discuss various methodological and substantive issues pertaining to trade-offs

between conservation and development issues prevailing in Vietnam. The DMCA model was implemented with 26 workshop participants during a four-hour session in the workshop. The participants included national and commune level policy makers, international stakeholders from IUCN and WWF, as well as social and ecological scientists and community scale activists. The 19 of these 26 participants completed individual level steps (as shown in table 1), while the other 7 participants did not furnish completed surveys.

To contextualize the DMCA discussion for BTLNP, the moderators (two of the authors) began the discussion by focusing upon different management and design alternatives for managing various socio-economic and ecological problems of the case study site (step 1 in Table 1). All the workshop participants have direct experience working on various conservation and development issues pertaining to the management of BTLNP. A background working paper providing detailed history and the evolution of "business as usual" (BAU) scenario in BTLNP was circulated among the workshop participants prior to the workshop. Here is a brief synopsis of this business as usual management scenario.

Bai Tu Long national park consists of over 40 islands and the bay in which they are contained [Figure 1]. It is linked to the well known Ha Long Bay, a UNESCO World Heritage Site. Bai Tu Long National Park was established in 2001 by Vietnam's Prime Minister, succeeding the former Ba Mun National Conservation Zone. The park is located within the boundaries of 3 communes: Minh Chau, Van Yen and Ha Long of Van Don. The park has a total area of 15,783 hectares, of which the marine area spreads over 9,658 hectares. The buffer zone of the park, which contains almost 25,000 people, consists of 16,534 hectares spread over 5 communes: Van Yen, Minh Chau, Ha Long, Ban Sen and Quan Lan.

Bai Tu Long national park has a variety of ecosystems and landscape types, including rocky and earthy mountains, mangrove forests, small islands, caves, natural pools, and beaches. Under the business as usual scenario, a number of species, including the rhesus monkey, the Asian Serow, the Tokay Gecko, the civet and various orchids are threatened by overexploitation of forest products on rocky and earth mountains, and are becoming rare. In addition, a number of valuable sea products including sandy worm, marine crab, *Babylonia areolata,* and sea worms are being overexploited. Intensive operation of cargo ships and fishing boats in the bay area and near the shoreline, as well as fishing by mines, threaten the habitat and egg-laying areas of sea turtles, a species that needs strict protection.

An important conflict under the BAU scenario concerns the compensation to local communities whose livelihoods have been affected since BTLNP has been set up, which may underlie some of the problems in implementing the protections afforded by the National Park status. To implement its conservation requirements, Bai Tu Long National Park authorities do not allow households/local communities to continue to harvest productive plantation forests or make use of the tourism potential of coastal protected plantation forests. While the National Park is drafting a plan to compensate the house-

holds/local communities for withholding these livelihood activities, the compensation thus far has not been paid.

A related conflict surrounding the conservation of the habitat that is the breeding place of the globally-protected turtles also reflects the tension between conservation and development under the BAU management scenario. For the local communities, the value of the ecosystem is higher if it provides them sources of livelihood. On the other hand, many domestic and foreign conservation projects, which aimed at raising awareness and promoting sustainable harvest of marine resources, have been ineffective. Our field research indicates that most of these projects have either given up mid-way or ended earlier than the initial plan. Both the governmental and non-governmental organizations, among others, have implemented several integrated conservation and development projects. However, these integrated projects have not been successful due to the low investment and inappropriate support to the local people in terms of providing them with alternative livelihoods, some of which involved pig raising, canarium plantation, and raising sweet snails (*Babylonia areolata)* to reduce pressure on harvesting sandy worm.

During the opening discussion on implementing DMCA, the following five management scenarios for BTNLP system boundaries were almost consensually chosen for further consideration by the workshop participants. All of these five management scenarios are practically a mix of conservation-development options, but slightly different from the IUCN categorization of land-uses in biodiversity hotspots (http://www.unep-wcmc.org/protected_areas/categories/index.html):

(i) **Business As Usual (BAU)**: As described above, BTLNP is maintained as a national park with buffers around it.

(ii) **Total Conservation**: Similar to IUCN land-use category of "strict nature reserve", this scenario excludes all human activity in and around the national park boundaries.

(iii**)** **Total Development**: This scenario will eliminate any land-use policies that require ecosystem or biodiversity conservation and permit the market forces to drive the future land-use. None of the IUCN categories will apply under this scenario.

(iv) **Multi-use Area**s: Similar to IUCN category of "managed resource protected area", stakeholders will decide a mix of conservation and development zones within the broader boundaries of the study area.

(v) **Community-owned**: This alternative arose in the specific governance context of Vietnam. Under this scenario, national and provincial scale government entities will cede land-use decision making power to the communes residing in the study area. One participant strongly objected to the inclusion of "community-ownership" scenario as a management option because Vietnamese society does not have widespread experience with this management option. After interactive discussion, this scenario was retained as an option for further exploration.

Next (step 2 in Table 2), a group consensus was developed on the multiple criteria for evaluation of these management options. The following six criteria were consensually agreed upon:

(i) ***Economic welfare:*** Maximize Per Capita Gross Domestic Product, measured at the national scale;

(ii) ***Social Welfare:*** Maintain social equity and protect cultural heritage;
(iii) ***Good governance***: Ensure transparency and accountability in the governance system;
(iv) ***Ecosystem services and biodiversity protection***: Maximize the protection of biodiversity and ecosystem services from the landscape in the study area;
(v) ***Price of land:*** Enable market forces to determine the price of land based on its location and economic exploitation opportunities; and
(*vi)* ***Accessibility***: Maintain the accessibility of the ecosystem services generated by forests and ecosystems to the local and indigenous communities.

Since we are especially interested in scale issues pertaining to different valuation criteria, for step 3 in table 2, participants were asked to individually mull over and fill in their constant sum weights for each of these five criteria along two temporal scalar dimensions: now and future. It was explained to participants that this binary/discrete temporal bifurcation was a simplification of otherwise a continuous temporal scale and that "now" represented "short term" (days to years) while "future" represented long term (decades to centuries) temporal scale. Spatial scales were not included in this particular application due to shortage of available time, but they can be added in future applications (e.g. see Zia et al. 2011).

3. Results and Discussion

3.1. Pre- and Post-Deliberative Weights on Stakeholder Values

Two interactive survey forms, as shown in Tables 2 and 3, were distributed to the individuals for weighting and assessing their perceived impacts, respectively. In Table 2, the participants were instructed to assign higher weight (in %) to the valuation criteria that were more important to them or they cared more about and lesser weight (in %) to the criteria that they cared less about for the relevant temporal scale, with the constraint that all the weights must add up to 100%. In multi-criteria decision analytical literature, such constant sum weighting schemes are also known as fixed-point techniques. Of the 19 participants, 2 participants' individually assigned weights did not add up to 100 (a range of 95 and 130), which were rescaled to 100% for statistical analysis.

Figure 2 shows the constant sum weights that were elicited from 19 participants at the individual (panel a) and group (panel b) levels. Participants were split in five heterogeneous groups of 4 to 5 individuals, with each group assigned at least one international, one national, one local and one scientist as a stakeholder. Ecosystem services and biodiversity conservation for the future generations were most highly valued by the participants, as shown by relatively higher weights assigned to this criterion in both panels of Figure 1. Noticeably, post-deliberative weighting for the protection of ecosystem services is statistically significantly higher than the weights assigned to all other criteria, both for present and future temporal scales ($p < 0.001$). On the other hand, criteria such as economic welfare and price of land were relatively assigned lower weights. In other words, participants at both the individual and group levels are willing to trade-off economic welfare for the protection of biodiversity and

ecosystem services. Noticeably, participants assigned higher weight to good governance in present times, while social welfare in future time-frame was assigned relatively higher weight.

Table 2. Weighting Matrix: respondents were asked to assign weight from 0% to 100% for each value dimension, so that the total adds up to 100%. Next, respondents were asked to split the weights for each criterion along the temporal scale. Higher weight implies more importance for that value dimension. The numbers show the means and standard deviations in () from the individual level workshop respondents (N=19).

Value Dimension	***Assign Weight (0 to 100%)***	**Temporal Scale**	***Split Weights***
Economic welfare (GDP/Capita)	19.15 (6.68)	Now	8.82 (5.23)
		Future	10.33 (7.95)
Social welfare (social equity and protection of cultural heritage)	18.87 (5.05)	Now	8.02 (4.13)
		Future	10.85 (5.58)
Good governance (transparency and accountability)	20.47 (6.75)	Now	11.25 (8.15)
		Future	9.22 (5.00)
Ecosystem services and biodiversity protection	29.95 (7.60)	Now	11.83 (6.51)
		Future	18.12 (7.45)
Price of Land	5.12 (2.86)	Now	3.07 (3.30)
		Future	2.05 (2.31)
Accessibility	6.43 (4.37)	Now	3.86 (5.55)
		Future	2.57 (2.77)
Total	**100%**		**100%**

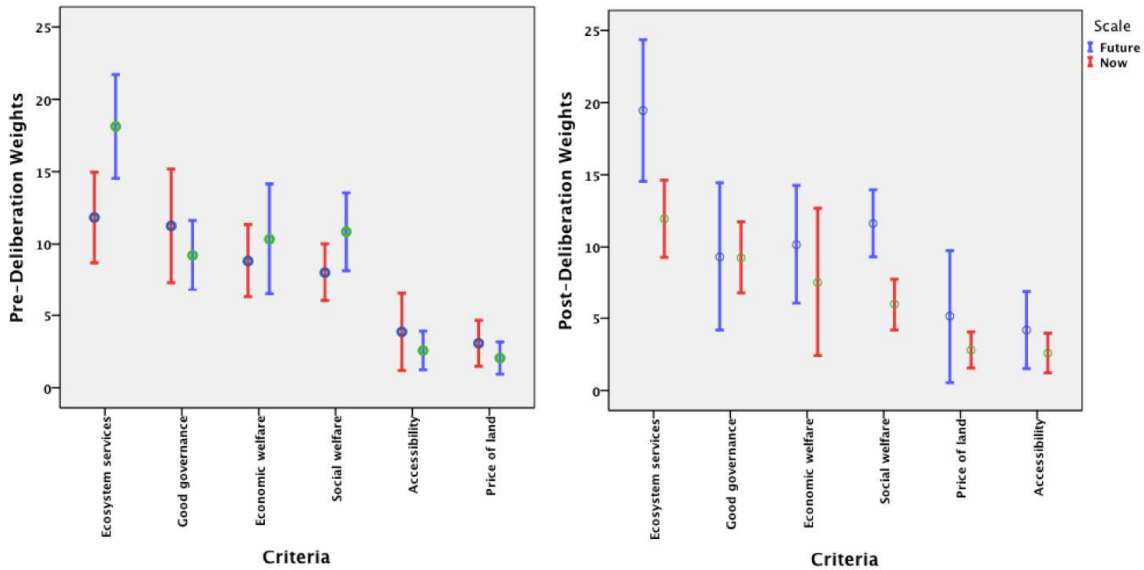

Figure 2. Pre-deliberative and post-deliberative constant-sum weights elicited for value dimensions, distributed by temporal scale: Error bars show 95% confidence interval around mean.

For assigning group-level weights, participants were allowed to keep their individually assigned survey forms (Table 2) in front of them while deliberating about developing a group consensus to assign weights. The variance in group level weights (Figure 1b) is much higher than the individual level (Figure 1a), which either shows the level of dissention among the participants within and across the groups or it is simply an artifact of small sample size (N=5 for groups). Our focus in this paper is not on providing statistically generalizable results, as this study merely demonstrates the test application of a deliberative MCA methodology to elicit stakeholder values at multiple temporal scales. More valid results will require iterative implementation of this methodology with all relevant BTLN P stakeholders, a task that could be accomplished in the follow up research. The statistical analysis reported here is for methodological demonstration purposes only. Overall, the averages of the assigned weights appear to be very similar after the deliberation.

3.2. Impacts on Values Under Alternate Management Scenarios

Table 3. Impact Evaluation Matrix: respondents were asked to assign an impact value of 0 (worst impact) to 100 (best impact) for each cell, row by row. The numbers show the means and standard deviations in () from the individual level workshop respondents (N=19).

Criteria	*Temporal Scale*	*Business as Usual*	*Total Conservation*	*Total Development*	*Multi-Use*	*Community Ownership*
Economic welfare (GDP/Capita)	Now	35.26 (23.89)	17.89 (18.95)	48.95 (30.39)	51.05 (28.99)	40.79 (23.23)
	Future	21.58 (18.11)	28.16 (25.77)	20.79 (21.93)	60.00 (24.21)	48.42 (25.98)
Social Welfare	Now	20.00 (16.24)	24.21 (22.37)	38.95 (24.86)	52.37 (25.78)	52.63 (27.45)
	Future	27.63 (25.07)	32.11 (27.35)	22.89 (19.67)	64.74 (20.98)	55.26 (33.31)
Good Governance	Now	28.05 (23.46)	25.47 (26.49)	24.58 (27.93)	52.63 (32.07)	44.74 (29.36)
	Future	29.32 (30.88)	31.74 (30.00)	23.68 (27.78)	67.37 (26.99)	49.47 (30.50)
Ecosystem Services and Biodiversity Protection	Now	29.21 (16.09)	47.11 (34.01)	30.79 (29.45)	48.16 (23.52)	38.95 (23.01)
	Future	31.05 (26.17)	60.26 (36.68)	18.16 (27.34)	65.53 (22.72)	48.16 (24.45)
Price of Land Based On its Location	Now	35.53 (30.13)	18.42 (22.36)	39.21 (37.05)	38.68 (30.99)	31.05 (27.71)
	Future	33.68 (32.01)	19.74 (25.30)	35.00 (36.17)	45.26 (34.82)	35.26 (28.74)
Accessibility	Now	20.89 (25.22)	19.47 (27.02)	15.53 (26.18)	29.47 (32.39)	23.95 (31.12)
	Future	21.32 (24.48)	20.53 (27.53)	11.58 (20.88)	33.68 (33.20)	27.89 (31.02)

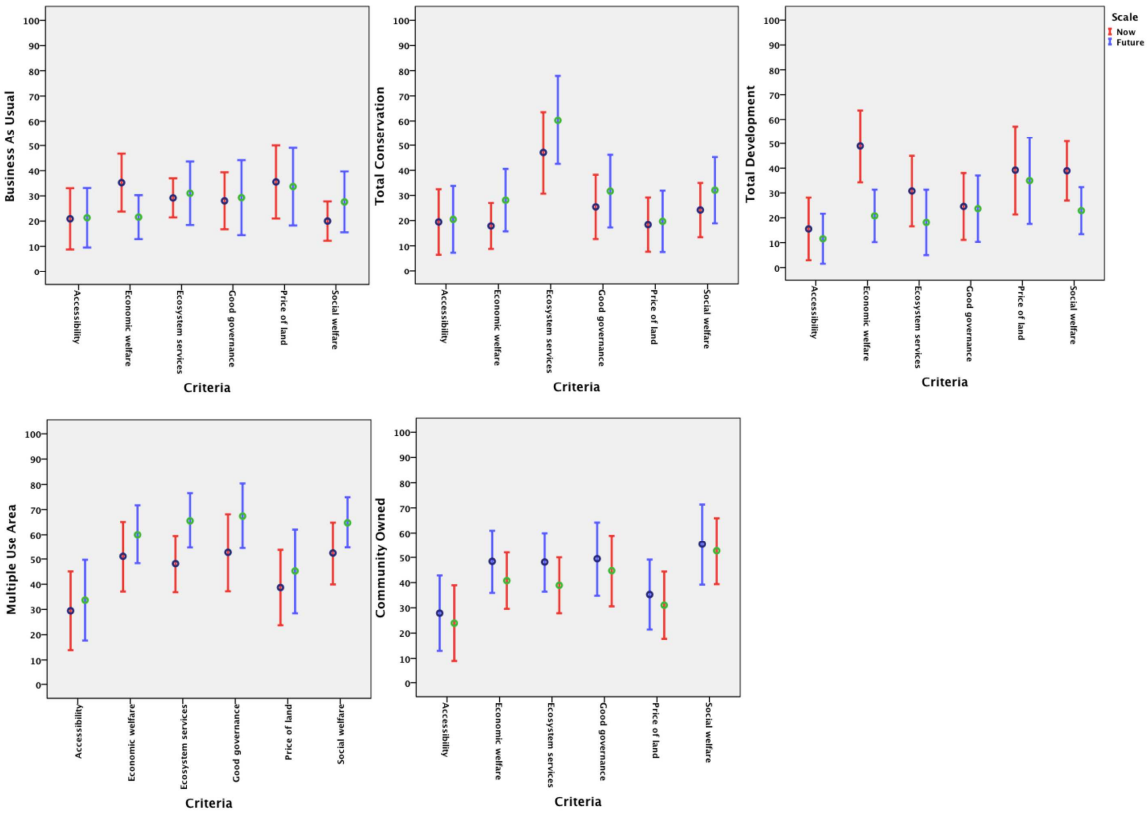

Figure 3. Pre-deliberative impacts by valuation criteria and temporal scale for business as usual (panel a), total conservation (panel b), total development (panel c), multiple use area (panel d), and community owned (panel e) management scenarios: Perceived impacts are measured on a continuous scale from 0% (worst impact) to 100% (best impact). Error bars show 95% confidence interval around mean perceived impacts.

Prior to congregating participants in groups, an impact evaluation matrix (Table 3) was also provided to the workshop participants for assigning perceived impacts on each criteria for each development path, first at individual levels; and then in deliberative groups (step 4 and 5 in Table 1). For this impact evaluation matrix, the participants were asked to assign a value of 0 (adverse impact) to 100 (best impact) for each cell (x_{ijk}), row by row of Table 3. For example, in the first top left empty cell, as explained to participants, they judged the economic welfare impact at present time scale if the business-as-usual management scenario was continued, and so on for 59 other cells in the impact evaluation matrix shown in Table 3. Figure 3 shows the impact evaluation matrices for each of the five management scenarios in five panels, as perceived by participants at the individual level prior to group deliberation. There are some interesting discernable patterns that emerge from the comparison of the five panels of Figure 3. For the management option of business as usual scenario, participants perceive relatively mediocre to worst impacts for all the criteria at both temporal scales. Consistent with the theoretical expectation, the total conservation scenario is perceived to have a better impact for the protection of biodiversity and ecosystem services at both present and especially future time scales. In contrast, the protection of biodiversity and ecosystem services, especially at future time scales, is perceived to receive much worst impact under total development scenario. The economic welfare especially at present time scale is perceived to be relatively better off under the total development scenario. While un-surprising, this finding demonstrates internal validity of the measurement

constructs employed in this study. More interestingly, the management option of multiple use area is perceived to have much better impact for almost all criteria than either total development or business as usual scenarios. Similar patterns are discernable for community ownership scenario. Overall, the workshop participants appear to have a consistent perception of the impacts on the valuation criteria when different management scenarios are pursued. Larger sample size in the follow up studies will probably further narrow the confidence intervals of these perceived impacts. Group level perceived impacts (not shown here) are very similar to the individual level perceived impacts (Figure 3).

3.3. Negative Discounting Hypothesis

Regarding the negative discounting hypothesis, as shown in Table 2, we find that workshop participants displayed slight preference for negative discount rates on economic welfare: future economic welfare is weighted 10.33%, higher than present 8.82%. Similar negative discounting is preferred for social welfare (future 10.85% versus 8.02% for present), and ecosystem services and biodiversity protection (future 18.12% versus 11.83% for the present). In contrast, positive discount rates were revealed for good governance (11.25% for present versus 9.22% for future), price of land (3.07% for present versus 2.05% for the future) and accessibility (3.86% for the present versus 2.57% for the future). Post-deliberative group level weights display similar discounting functions. We thus reject the hypothesis that positive or hyberbolic discount rates are displayed by all stakeholder groups involved in natural resource management. Rather, negative discount rates, i.e. valuing future more than the present for some values, could also take place in some management contexts. Since we only used generic "present" and "future" time periods, more sophisticated time-scale is warranted in future studies to estimate discount functions.

3.4. Value Pluralism Hypothesis

For the value pluralism hypothesis, we find, as shown in Table 2, that economic welfare is only accorded 19.15% weight, while ecosystem services, good governance and social welfare values are, respectively, assigned 29.95%, 20.47% and 18.87%, weights. If workshop participants were merely concerned about economic welfare, they must have accorded it 100% weight, or at least a weight that is higher than ecosystem services and good governance. From this finding, we infer that Vietnamese stakeholders in the BTLNP management context cherish pluralistic values, which implies that those management models that require all values to be represented in terms of economic values might not be adequate in such management contexts. Conversely, multi-criteria analysis is more appropriate when we are confronted with value pluralism in management contexts.

3.5. Evaluation of Management Scenarios

Figure 4 shows the individual level (pre-deliberative) and group level (post-deliberative) expected value (as formalized in equation 3) means around their 95% confidence intervals under the assumption that each participant (or group) has equal

weight (Ψ_k). We find that individual participants placed highest expected value for Multiple Use Area scenario in both pre- and post-deliberative exercises, which is closely followed by the community ownership scenario. On the other hand, the remaining three scenarios of business as usual, total development and total conservation are *dominated* by multi-use and community ownership scenarios.

Breaking down the aggregate expected values shown in Figure 4, the five panels of Figure 5 show the expected value across multiple temporal scales for each decision criterion. From the demonstrative workshop results, we find that the management scenarios of multiple use areas and community ownership provide relatively higher expected value for almost all valuation criteria in future time scales. On the other hand, the management scenarios of total development and business as usual dampen the expected values across the board. Finally, the management scenario of total conservation provides relatively higher expected value for the protection of biodiversity and ecosystem services but this scenario also dampens the expected values for good governance and social and economic welfare criteria.

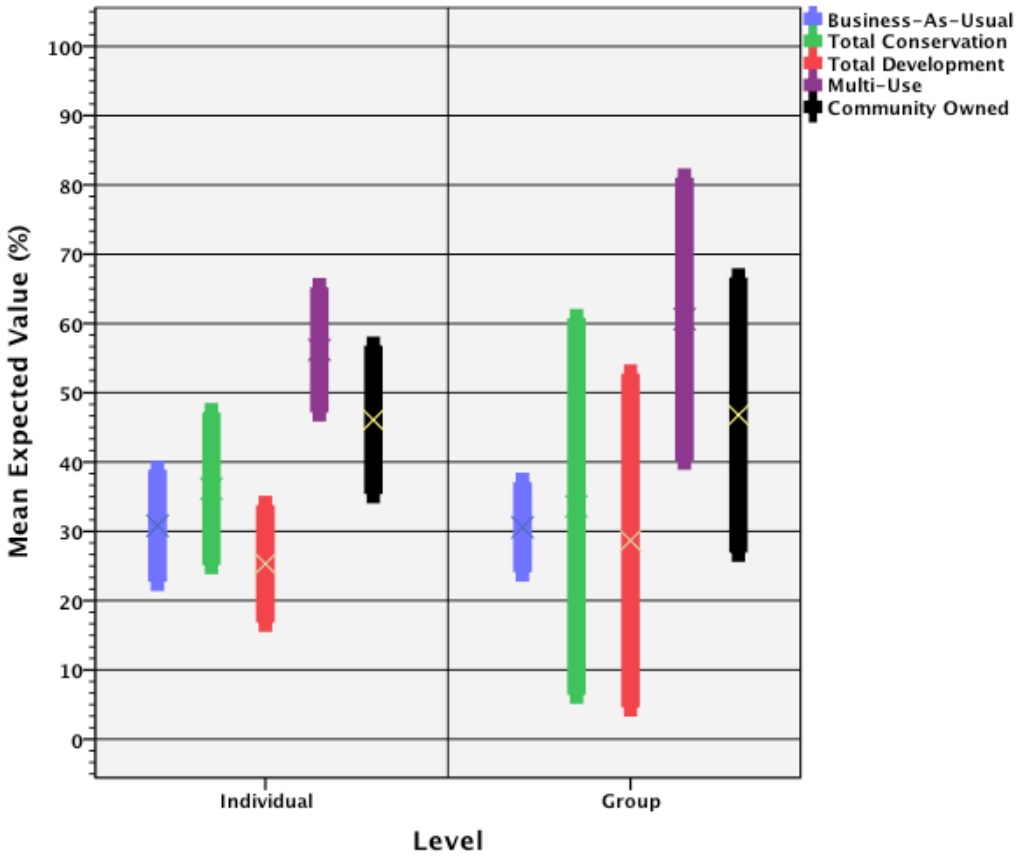

Figure 4. Expected value of alternate management scenarios, aggregated at individual (equal weights) and group (equal weights) levels.

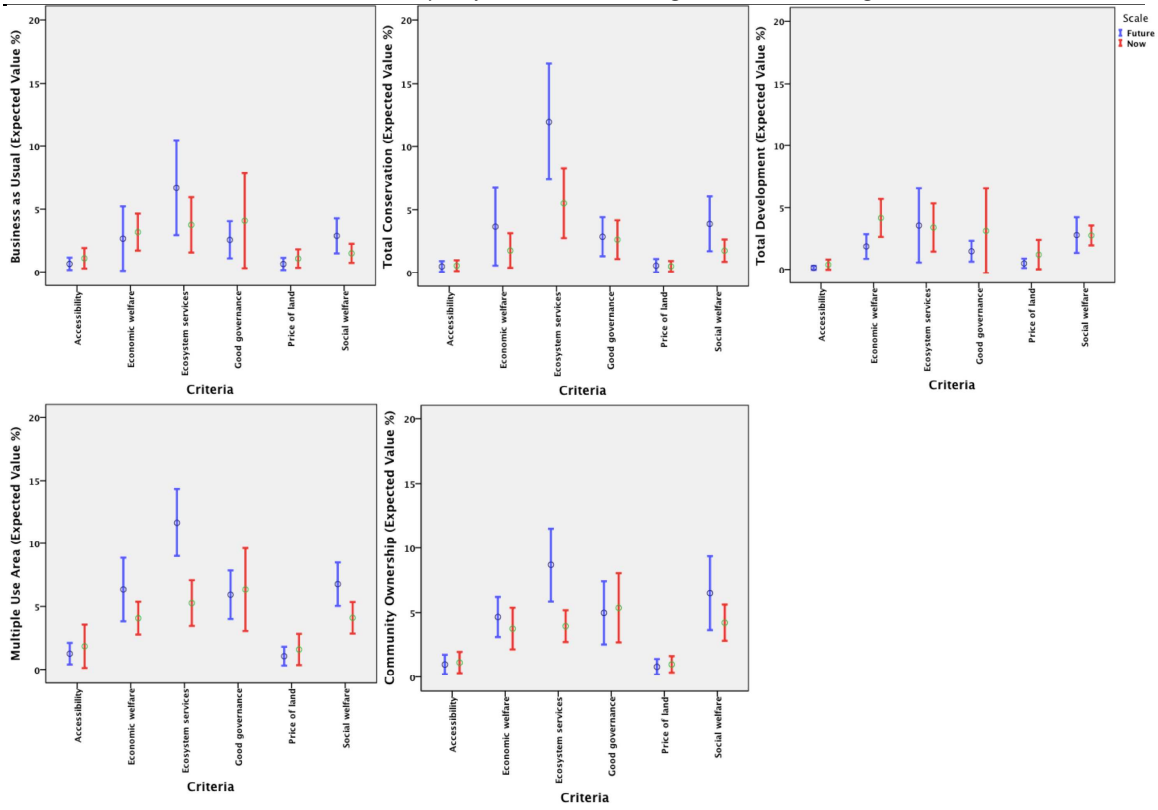

Figure 5. Pre-deliberative expected values by value dimension and temporal scale for business as usual, total conservation, total development, multiple use area, and community owned management scenarios: Expected values are measured on a continuous scale from 0% to 100%. Error bars show 95% confidence interval around mean expected values.

3.6. Implications of Power Dynamics and Governance Processes in the Study Findings

The demonstrative application of the proposed DMCA methodology for eliciting value trade-offs at multiple temporal scales shows that the business as usual management scenario at BTLNP is *dominated* by multiple use area and community ownership management scenarios at both temporal scales. The rejection of the business as usual scenario that emerged through the DMCA speaks to the power of deliberation that can be accomplished in stakeholder negotiation processes. This is despite the fact that more powerful national and international level actors were present in the group level deliberations. While this demonstrative result calls for change in the current management and more proactive research to design alternative management strategies at BTLNP, we propose iterative implementation of the proposed DMCA method in future to examine and adapt BTLNP to a relatively large number of multiple stakeholders' values. A change in the current multi-level governance system will thus be warranted. In this context, the proposed methodology could potentially provide a participatory governance mechanism for a large group of stakeholder groups to engage in structured discussions for elucidating cross-scale trade-offs. So, from the demonstrative application of this participatory methodology, we find that although workshop participants are willing to trade off present economic welfare for the long term protection of biodiversity and ecosystem services, promotion of good governance and

social welfare are also considered important for both short-term and long-term time scales. Since this is a demonstrative application of our proposed DMCA methodology, we do not endorse switching BTLNP status to either multiple use or community ownership management scenarios. However, the elicitation of value trade-offs at multiple temporal scales provides sufficient information to warrant additional research with multiple stakeholders to assess the viability of current management of BTLNP and devise alternate management plans that balance multiple values.

3.7. Implications for Environmental Planning Theory and Practice

The systematic assessments of inter-temporal value trade-offs that ensue from alternate courses of public action reside at the core of sustainable environmental management (Norton 2005). A pluralistic and multi-scalar theory of sustainability must acknowledge pluralistic values across diverse cultures and societies as well as ensure that the local communities are able to participate in public decision-making. This study presented a demonstrative application of the DMCA methodology that enables both transparent participation of multiple stakeholder groups as well as elicits inter-temporal value trade-offs in variegated sustainable environmental management decision-making contexts. Following Norton and Noonan's (2007) recommendation, the focus on the unit of analysis is shifted from the atomistic assessment of expected utilities to an integrative assessment of alternative development paths across a full spectrum of values represented by multiple stakeholder groups. Similar arguments about shifting unit of analysis to development paths have been made by Vatn and Bromley (1994); Bromley (1998) and Vatn (2002). Another major finding of this study, that will require additional empirical testing, concerns the possibility of negative discount rates in environmental management and international development arenas. The discounted utility model, propounded by neo-classical economists for sustainability assessments (e.g., Becker 1976; Becker 1993; Beckerman 1994; Nordhaus 1994; Solow 1993) might not be appropriate for the environmental planning related decision making due to its fundamental assumptions about the inevitability of positive of discount rates in all management contexts. Instead, we argue that sustainability assessments, which often involve challenging decisions about current and future consumption of natural resources, must use multi-criteria and multi-scalar decision analytical models (e.g. DMCA method) to enable the articulation of negative discount rates, as evidenced in the case of BTLNP management.

The proposed DMCA procedure has direct implications for planning practice. In actual field based DMCA applications, more meaningful and detailed consideration on scenario and criteria selection must be given. This will require typically a lot more time than many stakeholders are typically willing to spend in the deliberative processes. Both the level of detail that the scenarios are described in and the decision criteria are framed may engender new conflicts or perpetuate existing tensions, as also shown by Redpath et al. (2004). Further, in practice, specific set of stakeholders engaged in the process might change the scenarios and decision criteria. In future studies, practical applications of deliberative multi-criteria and stakeholder-based approaches require meta-evaluation procedures to compare successful with non-successful interventions in the governance processes and planning practices.

4. Conclusions

We have demonstrated, from a systems analytical perspective, the viability of applying a deliberative and participatory approach to elicit pluralistic values of multiple stakeholder groups. The elicitation of value trade-offs at multiple temporal scales can also be made operational with the proposed methodology, which can be extended in future studies to include spatial scales as well. The computational and cognitive limitations of this methodology, however, pose considerable challenges. We found especially that the estimation of the perceived impact matrix proved to be computationally challenging for many workshop participants. We are optimistic that environmental impact assessment and strategic impact assessment studies can be combined with our proposed DMCA methodology to reduce the computational and cognitive stress and even incorporate uncertainty information about the impacts of alternate management options (for an example, please see Klauer et al. 2006). Nevertheless, making hard choices requires hard thinking and work in clarifying values, the weights on those values and the impacts of different management options with respect to those weighted values. Participatory deliberative mechanisms enable clarification of values, weights and alternatives and ultimately reduce the computational and cognitive stress of making hard choices. Most importantly, iterative deliberation about environmental planning conflicts will help to make value trade-offs explicit and transparent. Recognition of power and governance challenges, multiple values, multiple scales and the empowerment of local communities through deliberative mechanisms is the cornerstone of a decision/system analytical theory of environmental management that could be made operational by DMCA methodology laid out in this study in a unique environmental management context in Vietnam (given that many multi-criteria studies have been conducted in developed world). In practical applications, more thorough and concrete considerations can be given to selecting stakeholders, defining decision criteria and developing management scenarios. Finally, the discounted utility model of neoclassical economics does not appropriately capture the negative discount rates or the value pluralism harbored by many important stakeholder groups in natural resource management contexts. The presentist bias of the discounted utility model makes it inappropriate for assessing sustainable management plans. Instead, participatory and deliberative approaches that accommodate pluralistic values, and non-linear weights on those values, are more appropriate for sustainability related decision-making involving inter-generational allocation of natural resource endowments and inter-temporal value trade-offs. The proposed shift in the sustainability assessment paradigm will enable future generations to be accorded similar importance as present generations in challenging decisions often involving hard trade-offs between present and future.

Acknowledgement

We gratefully acknowledge the financial support provided by the John D. and Catherine T. MacArthur Foundation for the research project "Advancing Conservation in a Social Context: Working in a World of Trade-Offs."

References

Ariely, D., 2009. Predictably Irrational: The hidden forces that shape our decisions, revised and expanded edition. HarperCollins, New York.

Bazzani, G.M., 2005. A decision support for an integrated multi-scale analysis of irrigation: DSIRR. Journal of Environmental Management. 77, 301-314.

Becker, G.S., 1976. The Economic Approach to Human Behavior. Chicago and London.

Becker, G., 1993. Nobel Lecture: The Economic Way of Looking At Behavior. The Journal of Political Economy. 101, 395-409.

Beckerman, W., 1994. Sustainable Development: Is it a Useful Concept? Environmental Values. 3, 191-209.

Bromley, Daniel W., 1998. Searching for Sustainability: the Poverty of Spontaneous Order. Ecological Economics. 24(2-3), 231-240.

Chung, E.S., Lee, K.S., 2009. Prioritization of water management for sustainability using hydrologic simulation model and multicriteria decision making techniques. Journal of Environmental Management. 90, 1502-1511.

Frederick, S., Loewenstein, G., O'Donoghue, T., 2003. Time discounting and time preference: a critical review, in: Loewenstein G., Read, D., Baumeister, R.F., (Eds), In Time and decision: Economic and psychological perspectives on intertemporal choice., Russell Sage Foundation, New York.

Freeman, A.M., 2003. The Measurement of Environmental and Resource Values: Theory and Measurement. Washington, D.C. Resources for the Future.

Gregory, R., Keeney, R.L.,1994. Creating policy alternatives using stakeholder values. Management Science. 40, 1035-1048.

Habermas, J., 1984. The Theory of Communicative Action.. Beacon Press, Boston, Massachusetts.

Habermas, J., 1998. Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy. The MIT Press, Cambridge, Massachusetts.

Herath, G., 2004. Incorporating community objectives in improved wetland management: The use of the analytic hierarchy process. Journal of Environmental Management. 70, 263-273.

Hisschenemoller, M., Hoppe, R., 1995. Coping With Intractable Controversies: The Case of Problem Structuring in Policy Design. Knowledge And Policy. 95, 1-18.

Howarth, R.B., Wilson, M.A., 2006. A theoretical approach to deliberative valuation: aggregation by mutual consent. Land Economics. 82(1), 1-16.

Keeney, R.L., 1988. Building Models of Values. European Journal of Operational Research.

Keeney, R.L., 1992. Value Focused Thinking. Harvard University Press, Harvard, Massachusetts.

Keeney, R.L., 1996. Value-Focused Thinking: Identifying Decision Opportunities and Creating Alternatives. European Journal of Operational Research. 92, 537-549.

Keeney, R.L., 2002. Common mistakes in making value trade-offs. Operations Research. 50(6), 935-945.

Keeney, R.L., McDaniels, T.L., 1999. Identifying and structuring values to guide integrated resource planning at BC Gas. Operations Research. 47(5), 651-662.

Kelman, S., 1981. Cost-Benefit Analysis: An Ethical Critique.Regulation. 5, 74-82.

Kiker, G.A., Bridges, T.S., Varghese. A., Seager, T.P., Linkov, I., 2005. Application of Multicriteria Decision Analysis in Environmental Decision Making. Integrated Environmental Assessment and Management. 1(2), 95-108.

Klauer, B., Drechsler, M., Messner, F., 2006. Multicriteria analysis under uncertainty with IANUS – method and empirical results. Environment and Planning C: Government and Policy. 24(2), 235–256.

Laukkanen, S., Kangas, A., Kangas, J., 2002. Applying voting theory in natural resource management: a case of multiple-criteria group decision support. Journal of Environmental Management. 64, 127-137.

Loewenstein, G., Read, D., Baumeister, R.F., eds. 2003. Time and decision: Economic and psychological perspectives on intertemporal choice. Russell Sage Foundation, New York.

Martinez-Alier, J., 2001. Ecological conflicts and valuation: mangroves versus shrimps in the late 1990s. Environment and planning C: Government and Policy. 19, 713-728.

Marttunen, M., Hamalainen, R.P., 2008. The Decision Analysis Interview Approach in the Collaborative Management of a Large Regulated Water Course. Environmental Management. 42, 1026-1042.

McShane, T.O., Hirsch, P.D., Trung, T.C.,. Songorwa, A.N., Kinzig, A., Monteferri, B., Mutekanga, D., Thang, H.V., Dammert, J.L., Pulgar-Vidal, M., Welch-Devine, M., Brosius, P.J., Coppolillo, P., O'Connor, S., 2010. Hard choices: making trade-offs between biodiversity conservation and human well-being. Biological Conservation doi: 10.1016/J.biocon.2010.04.038.

Messner, F., 2006. Applying participatory multicriteria methods to river basin management: Improving the implementation of the Water Framework Directive. Environment and Planning C: Government and Policy. 24, 159-167.

Messner, F., Zwirner, O., Karkuschke, M., 2006. Participation in multi-criteria decision support for the resolution of a water allocation problem in the Spree river basin. Land Use Policy. 23, 63-75.

Nordhaus, W. D., 1994. Managing the global commons: The economics of climate change.. MIT Press, Cambridge, Massachusetts.

Norton, B., 2005. Sustainability: A philosophy of adaptive ecosystem management. University of Chicago Press, Chicago.

Norton, B.G., Steinemann, A., 2001. Environmental Values and Adaptive Management. Environmental Values. 10(4), 473-506.

Norton, B.G., Noonan, D., 2007. Ecology and valuation: big changes needed. Ecological Economics. 63, 664-675.

Norton, B.G., Toman, M., 1997. Sustainability: Ecological and Economic Perspectives. Land Economics. 73(4), 553-568.

Ostrom, E., 2007. A diagnostic approach for going beyond panaceas. Proceedings of the National Academy of Sciences. 104, 15181-15187.

Page, T., 1997. On the problem of achieving efficiency and equity, intergenerationally. Land Economics. 73(4), 580-596.

Pellizzoni, L., 2001. The myth of the best argument: Power, deliberation and reason. British Journal of Sociology. 52(1), 59-86.

Raiffa, H., 1968. Decision Analysis. Reading. Addison-Wesley, Massachusetts.

Ramanathan, R., 2001. A note on the use of the analytic hierarchy process for environmental impact assessment. Journal of Environmental Management. 63, 27-35.

Redpath, S. M., Arroyo, B. E., Leckie, F. M., Bacon, P., Bayfield, N., Gutierrez, R. J., & Thirgood, S. J., 2004. Using decision modeling with stakeholders to reduce human–wildlife conflict: a raptor–grouse case study. Conservation Biology. 18(2), 350-359.

Renn, O., 2006. Participatory processes for designing environmental policies. Land Use Policy. 23, 34-43.

Sagoff, M., 1998. Aggregation and Deliberation in Valuing Environmental Public Goods: A Look Beyond Contingent Pricing. Ecological Economics 24(2-3), 213-230.

Samuelson, P., 1937. A Note on Measurement of Utility. Review of Economic Studies. 4, 155-161.

Shim, J.P., Warkentin, M., Courtney, J.F., Power, D.J., Sharda, R., Carlsson, C., 2002. Past, present, and the future of decision support technology. Decision Support Systems. 33, 111-126.

Solow, R., 1993. Sustainability: An Economist's Perspective. In Economics of the Environment: Selected Readings: Dorfman, R.D., Dorfman, N.S. (Eds.), W.W. Norton & Company. New York, New York.

Spash, C.L., 2008. How much is that ecosystem in the window? The one with the bio-diverse trail. Environmental Values. 17(2), 259-284.

Spash, C.L., Vatn, A., 2006. Transferring environmental value estimates: Issues and alternatives. Ecological Economics. 60, 379-388.

Stagl, S., 2006. Multicriteria evaluation and public participation: the case of UK energy policy. Land Use Policy. 23, 53-62.

Stirling, A., 2006. Analysis, participation and power: Justification and closure in participatory multi-criteria analysis. Land Use Policy . 23, 95-107.

Toman, M., 1994. Economics and "Sustainability": Balancing Trade-Offs and Imperatives. Land Economics. 70(4), 399-413.

Vatn, Arild., 2002. Efficient or Fair: Ethical paradoxes in Environmental Policy. Pages 148-180 in J. Paavola, and D. W. Bromley, editors. Economics, ethics, and environmental policy: contested choices, Blackwell Publishers, Oxford, UK.

Vatn, A. and D.W. Bromley., 1994. Choices Without Prices without Apologies. Journal of Environmental Economics and Management. 26,129-148.

van den Hove, S., 2006. Between consensus and compromise: Acknowledging the negotiation dimension in participatory approaches. Land Use Policy. 23, 10-17.

WCED., 1987. Our Common Future. Report of the World Commission on Environment and Development (WCED), available online.

Available from: http://www.un-documents.net/wced-ocf.htm (accessed December 2009)

Wittmer, H., Rauschmayer F., Klauer, B., 2006. How to select instruments for the resolution of environmental conflicts? Land Use Policy. 23, 1-9.

Zia, A., 2013. Post-Kyoto climate governance: Confronting the politics of scale, ideology and knowledge. Rutledge Press, London.

Zia, A., Hirsch, P., Songorwa, A. N., Mutekanga, D. R., O'Connor, S., McShane, T., Brosius, P., Norton, B. G., 2011. Cross-Scale value trade-offs in managing social-ecological systems: The politics of scale in Ruaha National Park, Tanzania. Ecology and Society 16(4), 7. Available from: http://dx.doi.org/10.5751/ES-04375-160407

Received: 13 March 2013 • **Revised**: 8 September 2014 • **Accepted**: 15 November 2014