

ANALYSIS

Trade-off analysis for marine protected area management

Katrina Brown ^{a,*}, W. Neil Adger ^b, Emma Tompkins ^a, Peter Bacon ^c,
David Shim ^d, Kathy Young ^c

^a School of Development Studies and CSERGE, University of East Anglia, Norwich NR4 7TJ, UK

^b School of Environmental Sciences and Centre for Social and Economic Research on the Global Environment,
University of East Anglia, Norwich NR4 7TJ, UK

^c Division of Life Sciences, University of the West Indies, St. Augustine, Trinidad and Tobago

^d Department of Marine Resources and Fisheries, Tobago House of Assembly, Scarborough, Trinidad and Tobago

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Abstract

This paper outlines an approach to natural resource management that incorporates multiple objectives for protected area management within a decision-making framework. Both regulators and other major stakeholders are directly incorporated into the approach to enhance decision-making processes. We call this approach trade-off analysis. The approach uses a framework based on multi-criteria analysis (MCA) but involves stakeholders at all stages. This holistic approach is appropriate for multiple use, complex systems such as marine protected areas (MPAs), where many different users are apparently in conflict and where linkages and feedbacks between different aspects of the ecosystem and economy exist. The paper applies trade-off analysis to the case of Buccoo Reef Marine Park (BRMP) in Tobago. Stakeholder analysis is undertaken, and social, economic and ecological criteria identified. The impacts of four different development scenarios are evaluated for these criteria. Stakeholders are asked to weight different criteria and then the outcomes of different stakeholder weightings in the MCA are used to explore different management options. For BRMP, the MCA suggests consensus around development options characterised as limited tourism development for the area surrounding the park in association with the implementation of complementary environmental management. The approach has been used to enhance stakeholder involvement in decision-making and develop consensus-based approaches to management of the MPA. © 2001 Elsevier Science B.V. All rights reserved.

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1. Decision making for multiple use resources

Marine protected areas (MPAs) exist in most of the island states of the Caribbean. They have typically been established by a central regulatory

* Corresponding author. Tel.: +44-1603-593529; fax: +44-1603-451999.

E-mail address: k.brown@uea.ac.uk (K. Brown).

body following recognition of declining resource quality by users and beneficiaries, with the expectation that enhanced management improves resource quality and enhances sustainability. However, deterioration of the marine and coastal environments in many of the designated MPAs in the Caribbean, and more widely, has not been arrested simply by protected area designation and management (e.g. Dixon et al., 1993; Hodgson, 1997). The causes of resource depletion can sometimes be traced to the marginalisation of important stakeholders who feel excluded and withhold support for the protected area (e.g. Mak and Moncur, 1998). In these circumstances exclusion of key agents can undermine the management of these multiple use resources, as suggested by Steins and Edwards (1998), and as observed for terrestrial protected areas (Western et al., 1994).

This paper describes a method to enhance decision-making for marine and coastal resources. The approach combines stakeholder analysis and economic, social and ecological assessment within a framework of multiple criteria analysis. It uses stakeholder participation throughout the research process to derive weights for economic, social and ecological criteria and develops a decision-making tool that enables different stakeholders' perspectives and values to be explicitly included in the analysis. This approach is developed within the context of a multiple use MPA, the Buccoo Reef Marine Park (BRMP) in Tobago, West Indies.

The process of stakeholder involvement makes explicit the diverse perceptions and values of the different actors that create opportunities for decision making and management based on consensus rather than conflict. The trade-offs are quantified, where relevant, with reference to the techniques of environmental economics, to social analysis, and to ecological modelling. Involvement by stakeholders in the process of developing the model, and in discussing the recommendations derived from different weightings, provides an opportunity to explore and construct different development outcomes or scenarios.

The nature of coastal and marine resources demands holistic management solutions; they are characterised by complexity in terms of ecology, patterns of utilisation and users. For small island

nations, in particular, there is a close interaction between water resources, land use and the coastal environment, and degradation is likely to impact on the sustainability of livelihoods of local populations and the long-term viability of any development strategy, which includes tourism. Boersma and Parrish (1999) argue that MPAs often lack functional boundaries and this makes development controls difficult to implement. Land use change, for example, leads directly to changes in nutrient loading, which affect the quality and productivity of the marine environment (Rawlins et al. 1998), while the dependency of coastal communities on fisheries and other marine resources directly affects their landbased livelihood strategies (e.g. Andersson and Ngazi, 1998). Thus, the ecological and economic systems have linkages often with direct and immediate feedbacks (Berkes and Folke, 1998). Although some uses of MPAs are non-consumptive, such as some recreational uses, most uses, whether consumptive or not, are subtractible. For example, uses of the resources by fishers or tourists subtract from the availability of the resource to other users. This limitation may be through congestion, pollution or direct consumption (see Berkes, 1996).

The social and economic impacts of tourism-based development can, therefore, be negative, particularly where there is major dependence on this sector of the economy (Brown et al., 1997). The quality of coral reef resources, for example, in tropical MPAs is a major determinant of the long-term viability of the tourism sector in such areas. The degradation of reef areas can lead both to a decline in overall tourist revenue with knock on consequences for local economies and the consumer surplus associated with the recreational experience (Dixon et al., 1993; Ruitenbeek and Cartier, 1999). These linkages and feedbacks require interrogation and assessment to inform decision-making and the trade-offs between ecological, social and economic impacts need to be evaluated.

The ecological complexity and multiple uses of many MPAs are compounded by diverse and complex systems of property rights, which require state, private and collective decision-making, and by diverse and often-conflicting users. The unique feature of these multiple use resources, as argued

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