ELSEVIER

Journal of Environmental Management 80 (2006) 167–176

Journal of
Environmental
Management

www.elsevier.com/locate/jenvman

A formal model for consensus and negotiation in environmental management

Helen M. Regan [a,*], Mark Colyvan [b], Lisa Markovchick-Nicholls [a]

[a] *Biology Department, San Diego State University, 5500 Campanile Drive, San Diego, CA 92182-4614, USA*
[b] *Philosophy Program and The Ecology Centre, University of Queensland, Brisbane, Queensland 4072, Australia*

Received 31 January 2005; received in revised form 27 September 2005; accepted 29 September 2005
Available online 13 December 2005

Abstract

Environmental management decisions typically lie at the interface of science and public policy. Consequently, these decisions involve a number of stakeholders with competing agendas and vested interests in the ultimate decision. In such cases, it is appropriate to adopt formal methods for consensus building to ensure transparent and repeatable decisions. In this paper, we use an environmental management case study to demonstrate the utility of a mathematical consensus convergence model in aggregating values (or weights) across groups. Consensus models are applicable when all parties agree to negotiate in order to resolve conflict. The advantage of this method is that it does not require that all members of the group reach agreement, often an impossible task in group decision making. Instead, it uses philosophical foundations in consensus building to aggregate group members' values in a way that guarantees convergence towards a single consensual value that summarizes the group position. We highlight current problems with ad hoc consensus and negotiation methods, provide justification for the adoption of formal consensus convergence models and compare the consensus convergence model with currently used methods for aggregating values across a group in a decision making context. The model provides a simple and transparent decision support tool for group decision making that is straightforward to implement.

Keywords: Group decisions; Consensus; Negotiation; Multi-criteria decision making; Urban open space

1. Introduction

Environmental management decisions are the cause of much debate and disagreement. In the absence of means to resolve the disagreement, the outcome can be crippling standoffs that result in inaction or unacceptable delays in making important environmental decisions. The underlying source of disagreement may be traced to the interdisciplinary nature of most environmental problems. Environmental management decisions typically lie at the interface of science and public policy, and consequently take place at many levels (neighborhood, city, state, etc.) and involve a number of stakeholders (such as land owners, industry partners, urban planners, farmers) with disparate expertise and vested interests in the ultimate decision. Decisions involving diverse groups are the most difficult to make. This is particularly the case when group members have competing agendas and opinions and different knowledge bases. Such is the situation for most committees charged with making environmental decisions.

At present, there is no widely accepted systematic approach to making group decisions for the management of natural resources and the environment. Many decisions are achieved via an ad hoc process that subsumes the differences of opinions within stakeholder groups. Ad hoc approaches to consensus can include anything from small groups agreeing to a course of action through verbal discourse, to facilitation, moderation or mediation of large stakeholder groups to 'work out' solutions to problems. While these can be effective, they do not guarantee consensus or satisfaction among participants that their views have been fully considered in the decision. This is, in part, due to the complex nature of environmental issues and the difficulties in resolving disagreements within a group. Group decision making is often the result of a laborious course of unstructured negotiation that rarely yields repeatable results or outcomes acceptable to the entire group. Moreover, many strategies employed to arrive at a group decision cannot be transferred to alternative scenarios. This leads to decisions that are difficult to analyze retrospectively and cannot readily be used to inform other similar decision contexts.

Concern over human impact on the environment necessitates timely and effective management strategies. In the United

* Corresponding author. Tel.: +1 619 594 2738; fax: +1 619 594 5676.
E-mail address: hregan@sciences.sdsu.edu (H.M. Regan).

0301-4797/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jenvman.2005.09.004

States the effects of human activities on the biotic environment is more prominent in California than in any other of the 48 contiguous states. California is the most populous state in the US with a human population of almost 34 million. This population is expected to grow to about 45 million by 2020 and could reach 60 million by 2020 (The Resources Agency, 2001). To address the imperative of conserving California's remaining natural and agricultural resources and serve the needs of residents in the face of increasing urbanization and land use, a framework has been established to identify landscapes that are important for investment for conservation management, known as the California Legacy Project (CLP; California, 2000,http://legacy.ca.gov/). The main aim of the CLP was to develop a strategy for setting conservation priorities at a statewide level and to develop 'a long-term set of priorities and targets for future investment in resource protection and habitat acquisition and preservation' (The Resources Agency, 2001). The CLP considered priorities for the following areas: the protection of biodiversity, agriculture, rangelands, forestlands, recreational lands and urban open space. A preliminary step in the process involved multi-criteria decision making (MCDM) by stakeholder groups to specify criteria to identify lands for each priority area (such as urban open space) important for acquisition, management and stewardship. MCDM is a process where multiple criteria are incorporated into management planning. Each person weighted each criterion according to their view of its relative importance to the overall goal. However, this framework fails to achieve a satisfactory summary of weights aggregated across all group members. A simple central tendency of weights based on a geometric mean was used, but this failed to explicitly incorporate the variability across the group. As a result, stakeholders involved in the group decision-making process did not feel entirely satisfied with the final weights placed on criteria.

In this paper, we use the California Legacy Project MCDM framework as a case study to demonstrate the utility of a mathematical consensus convergence model in aggregating values (or weights) across groups. This method has been used in political contexts (Collignon, 2003) and in a greenhouse gas policy context (Ridgley, 1993). We will focus specifically on the issue of reaching group consensual criterion weights for the urban open space priority area. However, the method is general and can be extended to other contexts and subjectively assigned values and degrees of belief.

We argue for the development of formal methods for negotiation and consensus in environmental management, and we present the consensus convergence model and its implementation to the California Legacy Project criteria for identification of important areas for urban open space. We provide a much-needed framework for making group decisions that are transparent, repeatable and straightforward to implement.

In Section 2, we present a background to the environmental decision–making context used as a case study for the formal consensus convergence model. In Section 3, we present limitations to the types of ad hoc consensus-building processes that are usually used for decision making in environmental problems and explain the merits of formal methods for reaching consensus. In Section 4, we present the formal consensus convergence model and apply it to the case study at hand. In Section 5, we present the results of this application and compare results with two techniques commonly used to aggregate weights across a group. In Section 6, we discuss the philosophical implications and benefits of applying such a model compared to the methods currently used. We conclude with a discussion of the model's limitations and potential extensions.

2. Environmental management context: urban open space management

Urban open space provides a range of benefits to metropolitan populations. These include mitigating air and water pollution, ameliorating suburban sprawl, providing opportunities for recreation, promoting sound mental and physical health, reducing crime and fostering cohesive neighborhoods, attracting businesses, and stabilizing property values (The Trust for Public Land, 2004,http://www.tpl.org). Investment, management and stewardship of urban open space can assist in revitalizing neighborhoods and building healthy communities as well as protecting lands, which may have high natural and cultural resource values. However, not all lands accomplish these goals equally well, and resources to acquire such lands are often limited, so suitable lands must be well chosen and prioritized. Thus, the provision for open space in urban areas is a vital component of city planning (Erickson, 2004).

Many urbanized areas in the US, indeed in many countries across the globe, are under-served by local and regional recreational facilities. A projected minimum of an additional 2,376,000 acres of recreational and park space must be obtained to meet the need of an increasing population in California (The Resources Agency, 2001). The Resource Agency recognized this need to address urban open space in its mission of identifying important lands for acquisition, stewardship or management.

In 2002, a 2-day workshop involving academics, government agency administrators, consultants and practitioners was held to nominate criteria for the identification of high priority urban open space lands. The group members constructed a multi-criteria decision tree to define the list of criteria pertinent for identifying land important for acquisition, management or stewardship of open space in heavily urbanized areas in California. Fig. 1 contains the decision tree constructed by the group. Six over-riding criteria emerged as the most relevant for urban open space. These were: (i) Improves quality of urban system; (ii) Provides for multiple park and recreational opportunities; (iii) Physical and visual accessibility; (iv) Regional strategic significance; (v) Threats; and (vi) Restores and maintains natural resource and/or working landscape values. Each of the six major criteria was divided into a number of sub-criteria. For the purposes of illustration, we will focus solely on the six overriding criteria. A full description of