Ecological Economics 84 (2012) 110–120

Contents lists available at SciVerse ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

Weighting social preferences in participatory multi-criteria evaluations: A case study on sustainable natural resource management

Eneko Garmendia [a,b,*], Gonzalo Gamboa [c]

[a] Basque Centre for Climate Change (BC3), Bilbao, Spain
[b] Institute for Public Economics, University of the Basque Country, Bilbao, Spain
[c] International Center of Numerical methods in Engineering, Polytechnic University of Catalonia, Spain

ARTICLE INFO

Article history:
Received 21 March 2011
Received in revised form 11 September 2012
Accepted 17 September 2012
Available online 31 October 2012

Keywords:
Complex systems
Social preferences
Participatory multi-criteria evaluation
Incommensurability of values
Weights

ABSTRACT

The use of multi-criteria evaluation tools in combination with participatory approaches provides a promising framework for integrating multiple interests and perspectives in the effort to provide sustainability. However, the inclusion of diverse viewpoints requires the "compression" of complex issues, a process that is controversial. Ensuring the quality of the compression process is a major challenge, especially with regards to retaining the essential elements of the various perspectives. Based on the lessons learned during a case study that assessed sustainable management options for the Urdaibai Estuary (Basque Country-Southern Europe), we propose a process in which the explicit elicitation of weights (the prioritisation of criteria) within a participatory multi-criteria evaluation serves as a quality assurance mechanism to check the robustness of the evaluation process. The results demonstrate that diverse individual priorities can be grouped in a reduced set of social preferences by means of cluster analysis reinforced with a deliberative appraisal among a wide variety of social actors. The approach presented retains relevant information regarding extreme and sometimes irreconcilable positions, allows an explicit social sensitivity analysis of the MCE process, and enables participants to learn from and reflect upon diverse social preferences without forcing their consensus.

1. Introduction

The demand for deliberative approaches to decision-making with respect to sustainability related issues has grown in recent years. Complex, evolving socio-ecological systems affect decision-making because of the associated high degrees of uncertainty, incommensurability of values, and non-equivalent descriptions of the same system (Funtowicz and Ravetz, 1990; Gimarães-Pereira et al., 2006; Kasemir et al., 2003). Traditional scientific approaches and the hegemony of science, which search for unique and objective truths, have been questioned (Harremoës et al., 2001; Wynne, 1992). These are not sufficient for the social resolution of sustainability issues (Giampietro et al., 2006). Consequently, new decision support methods have emerged to engage the public in decision-making processes (Antunes et al., 2009; Santos et al., 2006; Stagl, 2007; Videira et al., 2009). These include the increased use of participatory and deliberative approaches in multi-criteria evaluation processes related to sustainability and natural resource management (Gamboa, 2006; Gamboa and Munda, 2007; Hajkowicz, 2008; Hermans et al., 2007; Kowalski et al., 2009; Liu et al., 2010; Monterroso et al., 2011; Munda, 2004; Proctor, 2004; Roca et al., 2008; Stagl, 2006). Increased participation and/or deliberation allow complex issues to be structured systematically to consider the multidimensional, incommensurable, and uncertain effects of decisions (Banville et al., 1998; Munda, 2004; Munda, 2008; Proctor and Drechsler, 2006; Stirling, 2006). However, the inclusion of social preferences in these processes is still controversial.

Numerous transformations (and in some cases simplifications) are required to convert social preferences into (technical) problem structuring (i.e., the construction of alternatives and definition/evaluation of criteria) and the quality of the transformation process is critical to assure high quality outcomes and sound policy advice (Giampietro et al., 2006). Quality assurance, understood in this context to be a reflexive mechanism for ensuring that the relevant properties of a given system have been incorporated adequately in the assessment, should be based, at a minimum, on scientific, political, and practical criteria (Giampietro, 2010; Millennium Ecosystems Assessment, MEA, 2005). This requires validating the robustness of the analysis from a technical perspective, including non-equivalent descriptions of the same system and the application of sensitivity analyses (Saltelli et al., 2000). At the same time, and more interestingly in the context of this paper, quality check mechanisms should allow for the validation of results from a social perspective, taking into account the diversity of social preferences.

The aim of this study was to explore the issue of criteria weighting from a new perspective, drawing on the extensive body of literature focused on sophisticated toolkits and mathematical algorithms for the elicitation of weights. In this paper, we briefly address the critical "compression" phases of participatory multi-criteria evaluation (MCE)

* Corresponding author. Tel.: +34 944014690x23; fax: +34 944054787.
E-mail address: ene.garmendia@gmail.com (E. Garmendia).

0921-8009/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.ecolecon.2012.09.004

processes and, using a case study as illustration, provide an approach to criteria weighting that enhances the social sensitivity aspects of group decision making, while facilitating critical reflection upon social preferences without forcing consensus.

2. Reducing Complexity and Determining Weights in MCE

Public decision-making for sustainability must deal with multiple legitimate but often contrasting priorities. Such decision-making processes are usually characterised by high degrees of uncertainty, values in dispute, and urgency (Funtowicz and Ravetz, 1990) and require some form of deliberative institutions within which the weight of different reasons can be considered (Holland et al., 1996). In other words, taking into account that the environment is characterised as a site of conflict between competing values and interests and the different communities that represent them (Martinez-Alier et al., 1998), decision-making processes that search for pathways towards a more sustainable future require holistic approaches that are capable of integrating multiple fields of knowledge (e.g., political science, environmental science and ecology, economics or sociology) with the diversity of perspectives that coexist in the society (Munda, 2008). Among others, the latter requires the inclusion of multiple social actors including representatives from civil society and policy-making authorities at various levels, NGOs, interest groups from industry and those that represent marginalised groups and the voiceless (e.g., future generations) (O'Neill, 2001).

Participatory and social multi-criteria evaluation frameworks were developed to aid this type of decision-making. MCE has evolved since the early 1970s and is now considered a well-developed scientific field with abundant literature (Figueira et al., 2005; Kangas and Kangas, 2005; Ananda and Heralth, 2009). The origins of MCE lie in the fields of mathematics and operational research. When first developed, MCE was characterised by the methodological principle of multi-criteria decision making (MCDM) with little or no participatory mechanisms included (Zionts, 1979; Zionts and Wallenius, 1976). The primary objective was to elicit clear preferences from a (mythical) decision maker and then to solve a well-structured problem by means of mathematical algorithms (e.g., designing an engine taking into account power, weight, efficiency). Progressively, ideas about procedural rationality (Simon, 1976) and the constructive or creative approach (Roy, 1985) led to the development of multi-criteria decision aid (MCDA), in which the quality of the decision-making process became central. Investigators began to emphasise the need to include public participation in MCE (Banville et al., 1998; de Marchi et al., 2000; Proctor, 2004), thus fostering the emergence of participatory multi-criteria evaluation (PMCE) (Banville et al., 1998; Proctor and Drechsler, 2006) and social multi-criteria evaluation (SMCE) (Munda, 2005, 2008), in which context appropriate deliberation is a prerequisite to assure a quality outcome.

In operational terms, the application of a participatory or social MCE usually entails the following steps (Munda, 2004, 2005):

(i) Identification and classification of relevant social actors by means of institutional analysis, individual interviews with key agents, focus groups, etc.;
(ii) Problem definition, which follows a similar procedure as that outlined above;
(iii) Creation of alternatives and the definition of evaluation criteria. This process must be the result of a dialogue between the scientists and the social actors.
(iv) Valuation of criteria in a multi-criteria impact matrix. The matrix synthesises the scores of all criteria for all alternatives. Each criterion score represents the performance of each alternative according to each criterion;
(v) Selection of the multi-criteria evaluation method. Many multi-criteria models have been formulated in the last decades (Figueira et al., 2005), each one with advantages and disadvantages (Montis et al., 2004) . In each case, the most appropriate model must be chosen by weighing their pros and cons;
(vi) Assessment of social actors' preferences and values: preference and indifference thresholds, and prioritization of criteria (i.e. weights). This step is done mainly through in-depth interviews, surveys and focus groups;
(vii) Application of the model through a mathematical aggregation procedure. The criterion scores must be aggregated by means of a mathematical algorithm that ensures that the ranking of alternatives are consistent with the information and the assumptions used.
(viii) Social analysis and discussion of the results to check the robustness of the analysis. Results are exposed to public debate and validation. This step also entails a sensitivity analysis in which some of the assumptions or parameters included in the model are given a different value, to test whether the final ranking of alternatives changes and the results are robust.

2.1. Reducing Complexity in Multi-criteria Evaluations

The process outlined above entails a compression process that transforms a complex reality into a simplified representation of it. This process encompasses the following steps: first, a virtually infinite information space is reduced to a limited set of narratives, expectations and goals that delimit the “problem” at hand. Next, a further compression is accomplished through the representation of the “problem” through a multi-criteria structure, in which a finite number of alternatives is evaluated according to a set of multi-dimensional criteria. The validity of the (multi-criteria) representation depends on how well the virtually infinite information about the external world is compressed into a finite representation (Giampietro, 2010). Because of its normative nature, this process cannot be addressed from a purely technical perspective; participation and collaboration among all relevant social actors is needed. Complex decisions must be made about who participates in defining and structuring the problem, the choice of the aggregation procedure, and the corresponding parameters for the MCE (i.e., preferences and indifference thresholds, weights, operators, degree of compensation) (Munda, 2008).

2.2. Use of Weights in Public Policy Decisions Related to Sustainability

The definition of weights in PMCE is a means of reflecting on social preferences/priorities in the assessment. Allowing social actors to express their priorities explicitly can also help identify areas of conflict critical to analysing plausible compromise solutions. The elicitation of weights can greatly influence the results of the MCE (Strager and Rosenberg, 2006; Triantaphyllou and Sanchez, 1997) and has been the focus of many studies (Al-Kloub et al., 1997; Ananda and Heralth, 2009; Choo et al., 1999; Hajkowicz et al., 2000; Hämäläneinen and Alaja, 2008; Hämäläneinen and Salo, 1997; Jacobi and Hobbs, 2007; Roy and Mousseau, 1996; Stillwell et al., 1987; Tzeng et al., 1998; Vansnick, 1986). Nevertheless, how to define weights in the context of public policy for sustainability, where numerous social actors with confronted interests interact and negotiate, is not an easy task.

2.2.1. Compensation among Criteria

According to Choo et al. (1999) the true meaning and validity of criteria weights are crucial in order to avoid improper use of the MCE models. Unfortunately, criteria weights are often misunderstood and misused, and there is no consensus on their meaning. Broadly speaking, we can distinguish between two types of weights: importance coefficients and trade-offs. The main difference between weights as importance coefficients and weights as trade-offs is that of compensation between criteria (i.e., the possibility that a good performance related to some criteria can offset bad performance