Multi-Criteria Decision Analysis and Cost-Benefit Analysis: Comparing alternative frameworks for integrated valuation of ecosystem services

Abstract

Multi-Criteria Decision Analysis (MCDA) methods has been promoted as an alternative approach to monetary economic valuation of ecosystem services in Cost-Benefit Analysis framework (CBA). We discuss the potential of MCDA in providing a framework for integrated valuation of ecosystem services. We conclude that MCDA does in general perform better than CBA and associated monetary valuation techniques in several aspects that are essential in ecosystem service valuation. These include the ability of a valuation method to account for multiple dimensions of well-being, including ecological and economic as well as cultural and moral aspects of a policy or management problem and to facilitate open and transparent public debate on the pros and cons of alternative courses of action, including the distribution of gains and losses across beneficiaries of ecosystem services. The capacity of MCDA to articulate values related to ecosystem services depends on individual methods used in the MCDA process. More importantly, it depends of the ways in which the process is organized and facilitated. However, MCDA cannot provide representative information of the values of wider population. Further empirical and theoretical research is needed on the potential of hybrid methodologies to combine monetary valuation and MCDA in fruitful ways.

1. Introduction

Ecosystem services such as pollination, flood control and carbon sequestration are vital for human well-being. The importance of these services is widely recognized, but operational mechanisms and approaches for integrating them into policy-making and management practices are still poorly developed (Kareiva et al. 2011; Guerry et al. 2015; Kabisch 2015). In a wave of 'new environmental pragmatism' (Spash 2011), monetary valuation has been promoted as the key strategy for including the value of ecosystems in decision-making. For example, the influential initiative The Economics of Ecosystems and Biodiversity (TEEB) maintains that the best way to mainstream the ecosystem service approach is to make the previously invisible changes in nature's flows into the economy visible through economic valuation, and communicate the value of ecosystems "in the language of the world's dominant economic and political model" (ten Brink 2011, xxix). Monetary valuation of ecosystem services is also endorsed by the Natural Capital project (Kareiva et al. 2011), and assigning monetary value to ecosystem components and functions has become one of the most researched topics in ecosystem service literature (de Groot et al. 2012).

Yet monetary valuation of the environment is also criticized on the grounds that it can actually undermine environmental protection and pave the way for commodification of nature (Gómez-Baggethun and Ruiz-Pérez 2011). According to the critics, economic valuation fails to capture social and ethical concerns such as cultural and moral values because they are not amenable to tradeoffs and monetary

transactions (Chan et al. 2012; Kenter et al. 2015). The critics also warn that monetary valuation can reduce citizen values, including normative beliefs, principles and collective meanings into consumer preferences (Sagoff 1998; Spash 2007; Vatn 2009), and ignore ecological thresholds and distributional impacts (Wegner and Pascual 2011; Farley 2012; Kallis et al. 2013).

Given the limitations of monetary valuation of ecosystem services, there is a growing interest in mixed or multiple criteria assessment methods such as participatory Multi-Criteria Decision Analysis (MCDA), which has variably be seen as an alternative or complementary approach to monetary valuation of ecosystem services in Cost Benefit Analysis (CBA) framework (Vatn 2009; de Groot et al. 2010; Spangenberg and Settle 2010; Wegner and Pascual 2011; Newton et al. 2012; Chan et al. 2012). MCDA is also expected to provide a compatible methodological framework for deliberative valuation, which is considered helpful in addressing plural value dimensions related to common goods such as ecosystem services (Vatn 2009; Wegner and Pascual 2011). According to Vatn (2009), MCDA is particularly suited for integrated valuation of ecosystem services because it can combine information about the performance of the alternatives with respect to evaluation criteria with subjective judgments about the relative importance of the criteria in a particular decision-making context.

MCDA is widely applied in the academic literature on environmental decision-making (Kiker et al. 2005; Huang et al. 2011; Keisler and Linkov 2014), including biodiversity planning and management (Geneletti 2007, 2008) and there is an emerging literature on the use of MCDA in ecosystem service assessment (for a review, see Langemeyer et al. 2016). However, MCDA is also criticized for lack of representativeness and for not providing informing policy-makers about effectiveness in terms of resource use (Hanley 2001).

The problems of monetary valuation of the environment in general (Gregory et al. 1993; Keat 1997; Joubert et al. 1997; O'Neill 1997; Sagoff 1998; Gregory 2000; Spash et al. 2005; Getzner 2005) and ecosystem services in particular (Vatn 2009; Spangenberg and Settle 2010; Wegner and Pascual 2011; Keune and Dendoncker 2014; Kenter et al. 2015) are widely discussed. However, the recent calls for MCDA particularly for ecosystem service valuation demand a detailed evaluation of the potential as well as limitations of MCDA methods as opposed to monetary valuation of ecosystem services. For example, several authors advocate multi-metric approaches such as MCDA and warn about reducing all value into single metrics like monetary units (Wegner and Pascual 2011; Chan et al. 2012; Gómez-Baggethun and Barton 2013). However, as we point out later, some monetary valuation methods and some MCDA methods are not fundamentally different in this respect. It should also be noted that MCDA is a family of methods, and individual methods have a different capacity to facilitate deliberative processes and address intangible and incommensurable ecosystem services.

The aim of this paper is to provide a critical yet constructive evaluation of the ways in which participatory MCDA can, or cannot, address the shortcomings of monetary valuation methods within a CBA framework. With *valuation* we refer to processes where people assign importance to ecosystem services, either via stated preference survey methods like Choice Experiment (CE) or Contingent

Valuation (CV) in terms of willingness to pay (WTP), or via weighting stage in MCDA. MCDA and CBA are *assessment* frameworks that are used to structure the valuation process and/or present the value information to decision-makers.

In the discussion of the relative merits of MCDA and CBA, and related value elicitation and articulation methods, we start with the more technical differences, aggregated vs. non-aggregated policy options (3.1) and universal vs. context specific utilities (3.2), and proceed to the more complex distinctions, which reflect fundamentally different conceptions of democratic decision-making and human rationality. These include the questions of unitary vs. conditional conclusions (3.3), distributional impacts and income asymmetries (3.4), individual vs. social rationality (3.5), interests vs. ethical judgments (3.6), representativeness (3.7) and biases (3.8). These categories are drawn from relevant literatures (Sagoff 1998, Vatn 2009, Spangenberg and Settle 2010, Wegner and Pascual 2011) and adopted for the purposes of this paper, which focuses not on the shortcomings of monetary valuation in general, but the key differences between CBA and MCDA frameworks and related methods in ecosystem service valuation.

2. The basic principles of Cost Benefit Analysis and Multi Criteria Decision Analysis

2.1 Cost Benefit Analysis

Cost-Benefit Analysis (CBA) is an economic evaluation method for comparing the costs and benefits of different project or policy options (Pearce and Nash 1981; Dixon et al. 1986). CBA aims to value all impacts over the lifetime of project alternatives in monetary units, discounted to a specified year, making it possible to screen or rank alternatives by a single monetary measure, often net present value (NPV).

The basic steps of CBA process are (Boardman et al. 2011):

1. Definition of the project options to be evaluated
2. Decision on whose costs and benefits are counted for
3. Selection of the measurement(s) and measuring all the costs and benefits
4. Estimation of the outcome of cost and benefits over relevant time period
5. Conversion of all the costs and benefits into a common currency
6. Discounting the costs and benefits into present value
7. Calculation of the NPV for the project options
8. Performing the sensitivity analyses
9. Recommendations based on the NPV and the sensitivity analysis

The aim is to find the most efficient solution by maximizing social welfare, understood as aggregate individual well-being, for a given allocation of resources, land uses etc. In using CBA for decision-making and choosing the alternative with highest NPV, the so-called Kaldor-Hicks criterion states that if those that are made better off can potentially compensate those that are made worse off by the alternative it is

Pareto efficient. Even if compensation does not actually take place it is assumed that in aggregate, across all projects, costs and benefits will average out over time and over the entire population. Complete substitutability is assumed, meaning that utilities from different types of project impacts, measured in terms of monetary units, can compensate one another.

There are various methods to estimate benefits of non-marketed goods and services in CBA (Pearce et al. 2006). In discussing monetary valuation we focus on stated preference methods that elicit WTP (CE and CV). In these methods, stated preferences are obtained through representative surveys of the population affected. In Contingent Valuation (CV) technique, the monetary values of the impacts are estimated on the basis of a person's willingness to pay (WTP) in a given currency for achieving a certain environmental improvement, or avoiding a certain deterioration (e.g. in water quality). In Choice Experiments (CE) survey respondents are asked to choose between different project/policy alternatives, described in terms of a number of attributes describing i.e. the level of ecosystem service(s) provided and a price of that alternative to the respondent (Hanley et al. 2001). Representing the confidence bounds of willingness to pay in CBA is encouraged, exploring the robustness of project ranking. Recent examples of CE studies on ecosystem services include a study of stream-related ecosystem services by Allen and Moore (2016), protected areas by Jeanloz et al. (2016) and marine ecosystem services (Hattam et al. 2015).

The underlying assumption of stated preference methods is that people are the best judges of their own well-being and the factors that contribute to it, and that people state their willingness to pay for a certain good or service on individual basis ("What is the expected benefit to me?") instead of considering the societal benefits at large; otherwise it is not possible to sum up individual preferences to estimate aggregate individual well-being (Keat 1997). The aggregate well-being estimate is important because it shows the Pareto efficient allocation of resources. The focus is in individual preferences and therefore also other-regarding existence and bequest values are ultimately conceived in CBA framework as the personal satisfaction, 'warm glow', that people gain by being altruistic (Davidson 2013). According to Raymond et al. (2014), stated preference methods are grounded on instrumental paradigm, which focuses on contextual, quantifiable and objectively measurable values that are aggregated arithmetically into social values. Key considerations in the instrumental paradigm are sample sizes and representativeness, and decision-makers are mainly seen as end users of the value information, not involved in generating it.

The other group of methods to estimate benefits of non-marketed goods and services is revealed preference methods, in which the values are estimated on the basis of consumer behavior, e.g. on household prices. These methods have been subject to less critique than stated preference methods because they are based on people's actual behavior, not on constructed hypothetical markets for non-market goods and services. Revealed preference methods are used widely to estimate the monetary value of cultural ecosystem services like recreation and ecotourism (Milcu et al. 2013).

2.2 Multi Criteria Decision Analysis

MCDA is a general framework for supporting complex decision-making situations with multiple and often conflicting objectives that stakeholder groups and/or decision-makers value differently (Belton and Stewart 2002). It is rooted in operational research and support for single decision-makers (Mendoza and Martins 2006), often in terms of finding an optimal solution to a decision-making problem. The emphasis in MCDA applications in environmental management and policy-making has nevertheless shifted towards multi-stakeholder processes to structure problems and to facilitate dialogue on the relative merits of alternative courses of action (Marttunen and Hämäläinen, 1995, 2008; Munda 2004; Keune and Dendoncker 2014; Geneletti and Ferretti 2015; Langemeyer et al. 2016).

The general steps in a MCDA process are presented in Figure 1 and illustrated in case study examples in Appendices 1 and 2. The following phases are typically carried out in participatory MCDA processes:

(i) Identifying the problem (What is the decision context, who are the key stakeholders and what are their objectives and concerns?),

(ii) structuring the problem (developing alternatives and determining criteria which are used to evaluate the alternatives),

(iii) estimating performance (or ranks) of alternatives with respect to each criterion, usually in a form of an impact matrix, using (i) natural measures like monetary units or hectares; (ii) proxy measures, which indirectly assess the performance of the alternatives (e.g. the number of indicator species as a yardstick of biodiversity); and (iii) constructed measures, which report the achievement of the objective using a scale tailored to the decision context,

(iv) eliciting stakeholders' and/or decision-makers' values (e.g. ranking the criteria in preference order or assigning numerical weightings to reflect the relative importance of each criterion)

(v) synthetizing the results using a mathematical model to do evaluate trade-offs and the overall performance of the alternatives, either to suggest a solution to the decision-making problem, to illustrate different perspectives and/or to discover new solutions, and finally

(vi) analyzing the sensitivity of the results to changes in model parameters to assess the robustness of the analysis.

In participatory MCDA processes these steps are carried out in close collaboration with stakeholders, who contribute to problem formulation, structuring and weighing, and often also to impact assessment (see Appendices 1 and 2). Early involvement of stakeholders is instrumental to successful problem structuring (Gamper and Turcanu 2007). The arrows in Figure 1 indicate that the process is iterative, not linear.

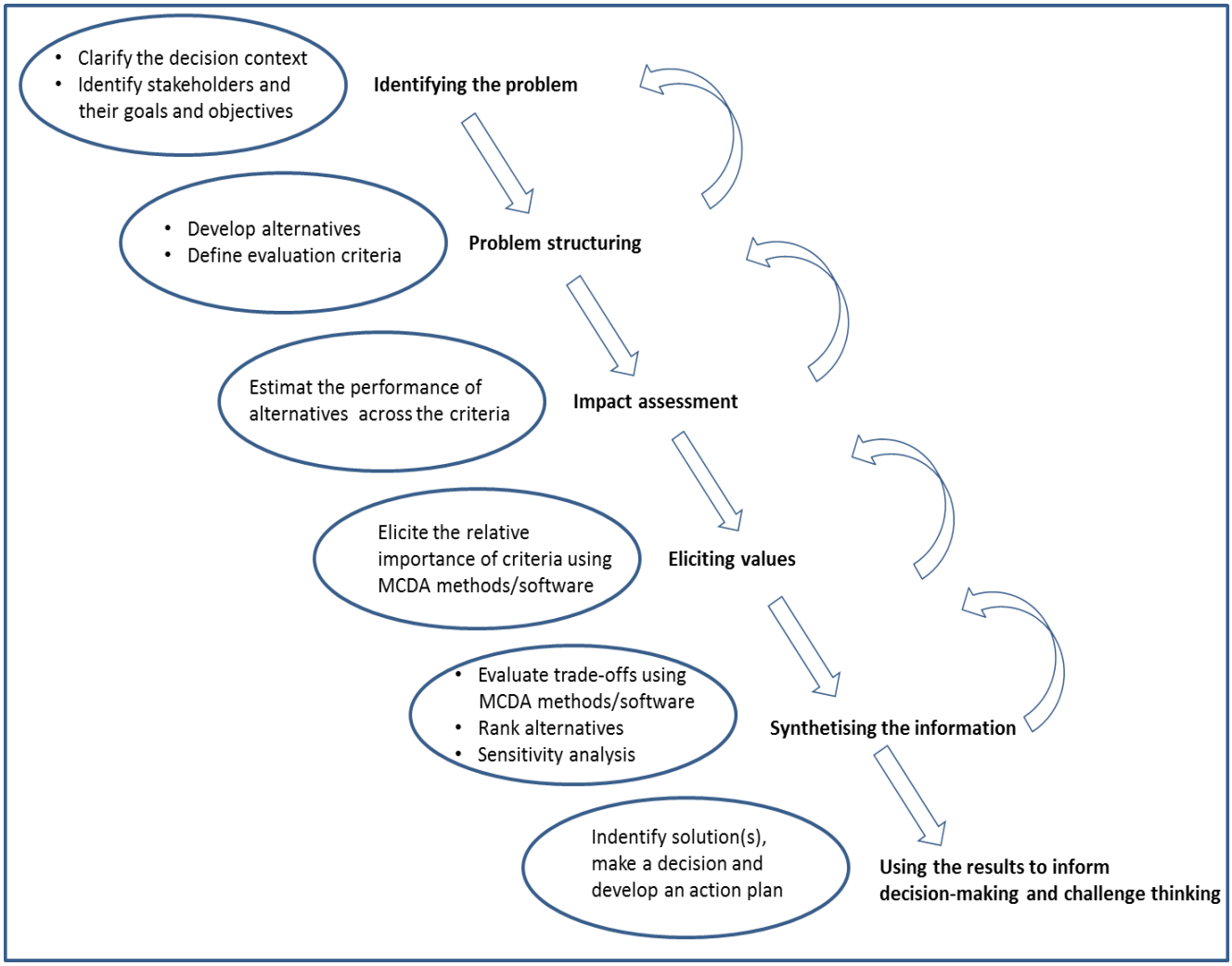

Figure 1. General steps in MCDA process, modified from Catrinu-Renström et al. (2013) and Belton and Stewart (2002).

A large number of MCDA methods have been developed to sort, rank or evaluate decision alternatives. They all follow at least roughly the general steps presented in Figure 1 but have different principles and procedures for eliciting and structuring information and different algorithms for combining it (Keisler and Linkov 2014). It is also important distinguish between MCDA methods and MCDA process in which the individual methods are used to assist problem structuring, stakeholder engagement and evaluation of the relative merits of alternatives.

A brief description of different MCDA methods with their pros and cons is presented below (see also Guitouni and Martel 1998; Salminen et al. 1998; de Montis et al. 2005; Ananda and Herath 2009). We have selected MCDA methods that are most commonly used in ecosystem service assessments (Langemeyer et al. 2016) and support stakeholder interaction and learning (see de Montis et al. 2005). These methods are multi-attribute value tree analysis (MAVT), analytic hierarchy process (AHP), rank based methods (e.g. AURORA), and outranking methods (e.g. NAIADE).

In MAVT and AHP, a problem is structured in a form of a value tree that presents a hierarchical structure of the criteria and alternatives. In the preference elicitation stage of MAVT, participants are asked to

assign numerical weightings to reflect the relative importance of each appraisal criterion for them. It is important to note that the weights need to be elicited with reference to the range of variations of the criteria that occur in the specific decision problem. MAVT methods further require subjective judgment about constructing value functions for each criterion that normalize individual impacts to a common scale of comparison (scoring). Value functions define the preferences for each criterion 'internally', i.e., how much a person values incremental changes in the measurement values of a single criterion in different parts of the scale (intra-criteria evaluation). After applying the value functions, a normalized evaluation matrix is produced, where all criteria are expressed in the same value range (typically, between zero and one). Under certain assumptions (see e.g. Keeney and Raiffa 1976), one can use an additive model to obtain the overall values for each alternative by multiplying the criteria-wise performance scores with corresponding criteria weights and then summing them up. However, it is important to note that aggregation of weights across participants is not necessary in MAVT applications (see section 3.3).

In MAVT participants consider all criteria simultaneously first, choose the most important one, and then compare each criterion against that one. In AHP information about the importance of the criteria are given as pairwise judgments about the preference between each pair of criteria under each branch of the value hierarchy. Similarly, information about the performance of the alternatives under each criterion is given as pairwise judgments. The weights for the criteria and alternatives are obtained by using an eigenvector technique for the pairwise comparison matrix (Saaty 1980). By aggregating these one gets the relative overall weights for the alternatives describing their overall preference compared to the other alternatives.

Rank-based methods differ from MAVT and AHP in that they use ordinal scale instead of cardinal scale and ask participant to provide a rank order of the criterion (see e.g. de Keyser and Springael 2009). Consequently, the overall rankings of the alternatives are obtained by aggregating the criteria-wise rankings of the alternatives. Thus, rank-based methods do not explicitly consider the criteria-wise value differences between the alternatives, but, for example, a small difference between two alternatives can be considered by assigning the same ranking to both these alternatives.

Outranking methods determine pairwise outranking assessments of each pair of alternatives to sort or rank the alternatives. Novel Approach to Imprecise Assessment and Decision Environments (NAIADE) by Munda (1995) has been introduced as a discrete multi-criterion method using pair-wise comparison that may include crisp, stochastic or fuzzy measurements of evaluation criteria. NAIADE requires the definition of indifference and preference thresholds for quantitative criteria by means of four binary relations: indifference, strict preference, large preference, and incomparability. The NAIADE tool also allows the applicant to decide for the degree of compensation between different criteria. This constitutes an important advantage over MAVT approaches because potential incommensurability relationships between criteria (and related values) can be accounted for explicitly and trade-offs between criteria can be limited. However, the tool lacks the possibility to use weights explicitly (Munda 2008). In addition, the NAIADE tool offers an explicit approach to conflict analysis between social actors (not only organized interest groups but societal actors more broadly) drawing on institutional analysis and sociological

research methods. This is why Munda (2004) uses the term Social Multi-Criteria Evaluation (SMCE) to distinguish his approach from participatory MCDA processes with stakeholders.

MCDA is underpinned both by instrumental and deliberative paradigms (Raymond et al. 2014), depending on the design of the process. It can be used in an instrumental fashion to aggregate preferences, quantify trade-offs for the use of decision-makers (though it seldom seeks representativeness) or it can be used in deliberative fashion to probe and form and social values with relevant interest groups, including decision-makers. We will look at these different used in the next chapter.

3. The relative merits of MCDA and CBA in ecosystem service valuation

3.1 Aggregated vs. non-aggregated policy options

Ecosystem service assessment usually requires integrated valuation which covers multiple and often conflicting services such as provisioning services (e.g. timber, crops), regulating services (e.g. flood protection, carbon sequestration) and cultural services (e.g. recreation and beautiful landscapes), and associated benefits such as poverty alleviation, human health, cultural heritage and biodiversity conservation (Wegner and Pascual 2011; Chan et al. 2012; Geneletti 2013; Gomez-Baggethun et al. 2014; Horwitz and Parkes 2016).

In a CV survey respondents are asked to express their WTP for a single good or a single policy option. This is feasible in cases which focus on single objective like recreation (e.g. Lehtoranta et al. 2013) or conservation programmes with several positive environmental outcomes (e.g. Keynon and Nevin 2001). However, CV surveys, on their own, are not particularly suited for integrated valuation purposes which are concerned with balancing multiple ecosystem services and their provisioning at different levels rather than losing or gaining an environmental good as a whole (Hanley et al. 2001). Instead, weight or rank elicitation in a MCDA process, or choice between different attribute levels in CE, invites participants, or respondents, to select from multiple alternatives, displayed in terms of their disaggregated value dimensions like provisioning or cultural services, or related benefits such as health, identity and sense of place. The key difference between all MCDA methods and CE here is that in the latter, attribute is always price whereas economic impacts are not necessarily (though often) a criterion in MCDA processes.

3.2 Universal vs. context specific utilities

Stated preference methods ask people to express their preferences in terms of monetary units (CV) or in terms of choices with implicit monetary value (CE). Monetary estimates have a universal interpretation while the weights in MAVT process are always context dependent and do not have a meaning outside

the particular decision-making situation (Kangas et al. 2010). This is significant especially when valuing intangible services such as cultural heritage and existence value of biodiversity. If the unit of measurement is money, it seems to imply that the criteria, or attributes, like existence value of biodiversity or cultural heritage, have an 'objective' value that transcends the particular situation. If the unit of measurement is rankings or weights on a cardinal scale, the results only apply to the particular decision-making situation at hand, with certain changes in option performance under each evaluation criterion. While it could be problematic to argue that the value of white woodpeckers is X euros, it is less problematic to say that some development projects can go ahead, or be rejected, one grounds that destroying/saving a white woodpecker habitat is more important than certain amount of jobs, in certain time and place. Context dependency is addressed in the benefits transfer literature, which looks at how largely stated-preference values vary according to study context (Johnston et al. 2015).

3.3 Unitary vs. conditional conclusions

A more fundamental difference between CBA and MCDA frameworks with respect to multiple value dimensions relates to the degree of aggregation of the results. In CBA, the results are usually presented in a highly aggregative manner, condensing all information into monetary units and reporting only the net benefits of each alternative—often a single figure—which renders different criteria invisible (Stirling 2006). The ecological, economic and socio-cultural aspects can be included in the analysis but decision-makers, or citizens, cannot see the trade-offs for themselves. This 'black box' characteristic of CBA can 'close down' policy discourses by providing a unitary prescriptive advice (Stirling 2006), and in effect replaces representative democracy: If the analysis can reveal a single best option, the only reasonable thing for policy makers to do is to choose that one. The problems with fixed and final answers in contested ecosystem management situations have led CBA theorists to propose more 'open source' and iterative CBA that complement democratic processes (Turner 2007; Hockley 2014).

Aggregation can be used also in MCDA processes to create a single rank order of the alternatives. Indeed, it is a quite common practice in MCDA studies to present average weightings of criteria and rankings of alternatives (see e.g. Forsyth et al. 2012; Sanon et al. 2012). Therefore, it could be argued that CBA and MCDA methods such as MAVT and AHP are not fundamentally different, after all, because both can include aggregation, in terms of monetary units as in CBA or utilities as in MAVT/AHP. Furthermore, both monetary and MCDA methods can describe the management/policy alternatives using multiple metrics (cf. Chan et al. 2012). In CE studies several attributes related to policy or management options are depicted in multiple metrics like in terms of number of species or percentages of protected areas, and survey respondents are asked to estimate their willingness to pay for the attribute (or a combination of them in CV studies), in monetary units. In MAVT, the changes in each attribute are described in a similar way and participants are asked to express their preferences in terms of comparable units such as points on a cardinal scale. Therefore, both methods basically reduce all information into a single metrics.

However, the main aim of MCDA is to demonstrate the relative merits of alternative courses of action from different perspectives (Belton and Stewart 2002) and therefore it is possible, and even advisable, not to aggregate across diverse stakeholders but illustrate the pros and cons of alternative courses of action from the perspective of stakeholders with similar values and preference structures (Stirling 1997; Spangenberg 2001; Munda 2004; Stirling 2006; Munda 2008). This 'horizontal' approach to MCDA (Spangenberg 2001) is consistent with value pluralism, which recognizes the indeterminacy of reason endemic in ethical judgments (Smith 2003). It acknowledges the fact that in complex decision-making situations involving intangible objects like aesthetic value, biodiversity, and economic gains, it is difficult, if not impossible, to produce single right answer. Instead, conflicting judgments prioritize different values and are supported by different kinds of justifications. As Smith (2003, 25) formulates it: "The weightings that different agents give to the differing values associated with environmental entities will depend upon the particular perspective and form of life from which they judge. […] Such judgments can be well reasoned and publicly accessible, but at the same time conflict with one another".

The Upper Lapland case (Appendix 1) is an example of a non-aggregative MCDA process. It grouped individuals who had the same preference ordering of the alternatives and used representative—not average—preference rankings to draw plural and conditional conclusions: If one considers biodiversity, Sami culture and wilderness experiences as the most important criterion in the debate over the use of arctic old-growth forest, then the alternatives are the better the less logging they involve. However, if one assigns substantial value to local income as well as social cohesion and some value also to the other criteria, then the middle range alternatives appear more preferable. The most important outcome of the analysis was to show that the trade-off situations and distributional impacts are real and cannot be wished, or 'optimized', away (see van der Hove 2006). This then paved way to a negotiation process, which resulted in logging restrictions in the most important pasture lands (Sarkki and Heikkinen 2010).

One approach to aggregation in MCDA is to determine a joint set of weights through group deliberation (see e.g. Stagl 2006; Proctor and Drechsler 2006). Deliberated group values can be better informed than individual values, and group deliberation about values can activate transcendental values that have previously been implicit (Kenter et al. 2015). However, using consensual, or negotiated, set of weights can be at odds with the notion of value pluralism, especially if it means forcing a consensus among people with very different values and interests (Garmendia and Gamboa 2012).

CBA is based on aggregating monetary values for different impacts on provisioning, regulating and cultural services across affected individuals. The theoretical grounds to aggregate utility across individuals is nevertheless contested by scholars (Harsanyi 1955, cited by Wegner and Pascual 2011; Feldman 1987, cited by Kenter et al. 2015) who point out that it is not possible to draw out any single conclusions unless all parties completely agree about how different dimensions should be traded off against each other, a situation which is highly unlikely for geographically, generationally and socially distant heterogeneous groups of people (see also Munda 2004).

3.3 Distributional impacts and income asymmetries

Distribution of gains and losses across beneficiaries is a key consideration in ecosystem service valuation (Wegner and Pascual 2011; Pascual et al. 2014; Gomez-Baggethun and Muradian 2015). Traditional CBA is primarily concerned with an efficient allocation of finite resources and therefore it tends to make limited account of the distribution of gains and losses across beneficiaries of ecosystem services (Kallis et al. 2015). Monetary valuation estimates are also, by definition, constrained by individuals' disposable income, and therefore WTP studies might actually capture ability rather than willingness to pay. This is particularly problematic in the presence of large income asymmetries, which can lead to an underestimation of ecosystem services that are essential to the wellbeing of less affluent groups such as indigenous people (Wegner and Pascual 2011; Sandel 2012; Pascual et al. 2014 ; Gómez-Baggethun and Muradian 2015). It could be argued that the inequalities reflected by disposable income are real constraints in everyday decisions and less objectionable for non-essential decisions 'on the margin'. However, a number of environmental management decisions affect people's livelihoods (i.e., affect the constraints themselves) and - in the sense that they are not marginal - also fall outside monetary valuation theoretical foundation.

To increase the policy relevance of CBA, distributional analysis is nowadays recommended as part of CBA for policy-support (Boardman et al. 2011; Turner 2016). For example, Lele and Srinivasan (2013) illustrate economic impacts from creating a wildlife sanctuary in southern India by stakeholder groups. Furthermore, WTP studies across different socioeconomic areas or social classes can be adjusted by income parity so that a higher weight is given on all costs and benefits accruing to socially disadvantaged or below-average income groups (Turner 2016). Turner (2016) has proposed a balance sheet approach, which includes conventional economic and economic analysis in CBA framework, with added emphasis on equity and fairness considerations, and combines this with information on local policy impacts such as unemployment and loss of social capital. Multi-criteria analysis methods are then used to address trade-offs, including contested moral claims, in deliberative settings.

Distributional issues also include intergenerational equity. Since monetary valuation draws on preferences expressed by people in markets, it forecloses the preferences and interests of future generations (Martinez-Alier 1987). In addition, distribution across generations is heavily influenced by the choice of the discount rate (i.e. the discount of future benefit when comparing it to a current benefit) Discount rates in monetary valuation of the environment have typically ranged between 3% and 5%, which have been criticized for heavily underestimating the interests of future generations. As noted in the interim report of The Economics of Ecosystems and Biodiversity (EC, 2008 : 5), "a 4% discount rate means that we value a natural service to our own grandchildren (50 years hence) at one-seventh the utility we derive from it, a difficult ethical standpoint to defend". A possible tool for addressing this issue is using social discount rate, which takes into account ethical dilemmas such as consumption now versus later or for society rather than for an individual (TEEB 2010).

In MCDA all stakeholder weights count equally regardless of their income level, and distributional impacts are usually addressed explicitly. For example, in a participatory MCA of irrigation management alternatives in Caia district, Portugal, the differences in participant perceptions of the alternatives, including the pros and cons for different actors, were explicitly documented (Antunes et al. 2011, see Appendix 2). The social impact matrix (see Appendix 2) highlighted, for instance, that farmers who had already invested in irrigation system rehabilitation were concerned about new costs from additional measures. However, in order to avoid the distributional pitfalls of CBA, MCDA must be designed so that stakeholders participating in the process represent the diversity of interest, including future generations.

The importance of income disparity is highlighted in the conflict over old growth forest in Finnish Upper Lapland (see Appendix 1) between relatively well-off forestry sector employees and reindeer herders, most of who live in a subsistence economy. A hypothetical WTP survey among the local population, with roughly equal number of people engaged with both livelihoods, is likely to show that the optimal solution is to increase logging at the expense of reindeer herding. However, if a stated preferences survey was administered to a sample of Finnish respondents, the value of reindeer herding culture is likely be higher; it does not cost anything for non-local people to express a WTP for an ‘exotic’ culture up in the North. Indeed, a study by Bosted and Lundgren (2010) showed that WTP by average Swedish people to maintain cultural heritage of Sami reindeer herding at least at the current level was several times the forest industry's turnover per year. This thought experiment illustrates the importance of budget constraints for the analysis results. It also shows that there is no single ‘right’ way to conduct the analysis and hence no single ‘right’ answers either. It also brings up the problem of treating indigenous culture as a commodity, a point to which we return in section 3.5.

3.4. Individual vs. social rationality

A fourth, and perhaps the most important, difference between MCDA methods and monetary valuation relies in the notion of interests. Stated preference surveys, using either CE or CV methods, are based on methodological individualism, which assumes that people have a fixed set of preexisting preferences that can be elicited via a survey instrument. However, the assumption that preferences exist prior to a choice so that people know what they want is problematic in ecosystem service valuation because people rarely have ordered set of preferences for unfamiliar objects such as biodiversity (Gregory 2000) or regulating services like pollination or carbon sequestration (Vatn 2005; Spash 2008). People can fill in a CE or CV questionnaire on the basis of their first hand reactions or gut feelings, and these ‘whims’ (Kenter et al. 2015), which are subject to several framing effects (Kahneman and Knetsch 1992), then become ‘data’, which is treated as an accurate representation of people’s interests and values and used to calculate an ‘optimal’ solution.

MCDA methods, too, can be used to elicit individual preferences, but unlike survey methods, they can also be used to support deliberative multi-stakeholder processes in which participants can learn about the consequences of alternative courses of action and reflect and revise their preferences through

interaction with other people (Bana e Costa and Oliveira 2002; French et al. 2009; Keune and Dendoncker 2014; Garmendia and Stagl 2010; Kenter et al. 2015). This view of preference formation is consistent with deliberative theory, which emphasizes the social construction of individual preferences (Bohman 1996). According to Benhabib (1996), deliberation is a procedure for being informed, and hence methodological individualism is inadequate in formulating reasoned judgments about complex social and political issues: “It is incoherent to assume that individuals can start a process of public deliberation with a level of conceptual clarity about their choices and preferences that can actually result only from a successful process of deliberation (Benhabib 1996, 71)”.

In participatory MCDA applications, stakeholders are often closely involved throughout the process, including criteria selection and impact assessment, which gives them time to assimilate new information, clarify ideas and formulate an informed judgment at the weighting stage. The structured, step-wise nature of MCDA process can also reduce the cognitive burden of participants, gradually building to conclusions, as opposed to instant opinions required by a CV or CE instrument (Kenyon 2007).Given the importance of learning, MCDA theorists have suggested that the main outcome of the process is actually not the results, i.e. the ranking of the alternatives, but a joint problem solving process in which people have become to understand the various aspects of the problem situation and possibly to discover new solutions to meet their needs and concerns (Belton and Stewart 2002, Marttunen et al. 2015). For example, in the MCA of irrigation management alternatives in Portugal (Appendix 2), a major outcome of the analysis was a better ‘social insight’ of the participants about the management problem from different viewpoints. This insight was instrumental in devising solutions that can satisfy divergent interests (Antunes et al. 2011).

Deliberative valuation is possible also in monetary valuation context (see Spash 2001, 2007, 2008, Wilson and Howarth 2002). Deliberative monetary valuation (DMV) provides respondents a richer understanding of what is being asked and help people to probe their own interests. Deliberation can also make respondents more civilly minded, deriving more personal satisfaction from attributes such as biodiversity that contribute to the common good. However, using monetary units as a measure of value in deliberative processes tends to limit the types of values that can be expressed in a valuation exercise (see also section 3.5). WTP questions, even deliberative ones, focus on individual preference satisfaction (“I want”) and preclude expressions of normative beliefs such as principles and convictions, or citizen preferences (“We ought to”) (Sagoff 1998). The overall societal wellbeing estimate is achieved by summing up individual gains; there will be ’double-counting’ if other regarding considerations are included alongside people’s own expected well-being (Keat 1997). To counter this ‘consumer bias’, some studies have elicited social rather than individual WTP, posing the question in the form of “What are we as a society willing to pay, or which choices do we make” (Kenter et al. 2011). However, these analyses are not consistent with utility maximization theory underlying CBA. Instead, the results can be interpreted as the preferences of a set of actors in a certain decision-making context, in a similar way as the results of a MCDA process.

3.5. Interests vs. ethical judgments

Theorists in the field of environmental valuation have distinguished between two types of value judgments: judgments concerning expected contributions to people's own well-being and ethical judgments concerning what people regard as morally right and justifiable (Keat 1997; Sagoff 1998; Wegner and Pascual 2011). The latter type of judgment is particularly important in environmental policy and management contexts where decisions have impacts on life-supporting ecosystem services such as carbon sequestration and maintenance of soil fertility, which influence the well-being of other people, in other parts of the world, across generations (Vatn 2009). Another example of ethical judgments relate to cultural heritage, identity and related spiritual values that are enabled by active or passive use of environmental spaces (Kenter et al. 2015). As Chan et al. (2012) point out, "to lose or ignore these [cultural ecosystem services] is to risk all basis for meaning and value".

As discussed in section 3.4, monetary valuation methods can only capture judgments about personal satisfaction; otherwise there is a risk of double counting (Keat 1997). It could, of course, be argued that ethical values and culturally shared normative beliefs are reflected in the judgments of people's preferences, and hence they are implicitly included in WTP estimates. However, formulating questions in terms of personal welfare and willingness to pay tends to evoke consumer values (What is my economic gain?) at the expense of citizen values and normative judgments (What is the right thing to do in this situation?). More importantly, ethical judgments about right and wrong cannot be incorporated into net benefit calculations; some practices like slavery are categorically wrong regardless of their utility to other parties. As Keat (1997, 40) formulates it: "To claim that people—or animals etc.—have certain rights is to claim that they should never be treated in certain ways, even if the calculation of aggregative individual well-being shows that the action which has these effects [unacceptable damage to the interests or well-being of particular individuals or groups] would be the most beneficial one".

The problems with putting a price on intangible ecosystem services that involve ethical judgments are illustrated in a study about the economic benefits from Sami reindeer herding culture in Sweden (Bosted and Lundgren 2010). While the WTP study started from the recognition of the neglected role of Sami culture in policy-making, and showed that the total societal welfare from preserving the forests exceed the economic losses in the forest sector, it is still morally problematic to consider the cultural identity and way of life of an indigenous nation as a cultural stock or commodity that is enjoyed by individuals in an economy. The Sami people have rights as a nation irrespective of the welfare that their culture and existence generate to average Swedish citizens. In this kind of cases right-based approaches can provide more appropriate valuation languages (Gómez-Baggethun and Muradian 2015).

Also the starting point of most MCDA methods is that all criteria can be traded off against each other, and a gain in one dimension compensates for a loss in another. Furthermore, as the term preference elicitation indicates, the weighting stage in MCDA invites participants to express their view of the relative importance of the assessment criteria in specific context ('contextual values', Kenter et al 2015). Therefore it could be argued that MCDA methods, too, cannot incorporate ethical judgments or address

'transcendental values' (Kenter et al. 2015). However, there are two major differences between monetary valuation methods and MCDA methods with respect to ethical judgments. First, MCDA methods do not seek societally effective solutions for resource allocation but aim at illustrating the trade-offs related to a specific decision-making situation from different perspectives. Therefore, double counting of values is not a problem but participants to a MCDA process can also express other regarding values. In fact, articulation of the ethical considerations pertaining to the problem situation can be a major outcome of the analysis (see Saarikoski et al. 2013). Second, some MCDA methods such as NAIADE (Munda 2004, 2006) consider incommensurable values explicitly by allowing adjustment of the degree of compensability in the aggregation of evaluation criteria (see also Oikonomou et al. 2011). For example, a threshold for a minimum amount of drinking water supply could be set which is excluded from trade-offs with other ecosystem services. Thresholds can also be used in MAVT through the shape of the value function, which can block compensation for certain ranges of the criteria.

3.6 Representativeness

MCDA methods are suited for eliciting the preferences of a relatively small group of decision makers and stakeholders, not capturing individual preferences across the whole population like stated preference surveys providing information for CBA. Due to this shortcoming, Hanley (2001, p. 113) has argued that "decisions made with the aid of MCDA may well fail on the ground of representativeness and democracy". Deliberative monetary valuation is susceptible to the same problem as deliberative processes can only engage a limited number of participants.

It is indeed important to know the preferences of the whole population on issues where efficient allocation of public resources is a key consideration. For example, in lake restoration projects funded by public money, which can only cover a certain number of projects, it is important to know which restoration options will generate the largest overall gains, and whether the benefits from restoration to people enjoying the good water quality exceed the costs of restoration in the first place (Lehtoranta et al. 2013). However, in "wicked" policy problems it seems to be more important to engage people who have high stakes in the matter than elicit the preferences of uninformed and disinterested general public (see section 3.3). Representativeness in small group processes can also be improved by ensuring that all relevant perspectives on the question are included, and the participants are able to represent their constituencies. As Aldred and Jacobs (2000) point out, interests are argumentative perspectives rather than groups or individuals. Furthermore, the SMCE approach by Munda (2004) allows broadening the scope of actors by sociological research methods (see Antunes et al 2011; Appendix 2). A further possibility to increase representativeness is the approach proposed by Raymond et al. (2014) by which values deliberated in a group process will be validated thought an instrumental (quantitative) assessment like a survey.

3.7 Biases

Preference elicitation methods in both MCDA and stated preference studies are prone to several cognitive and motivational biases such as framing bias, anchoring bias, splitting bias, proxy attribute bias and strategic bias (Weber et al. 1988; Venkatachalam 2004; Retief et al. 2013; Montibeller and von Winterfeldt 2015). In addition, deliberative group processes, such as MCDA or DMV, are criticized for being open to undue influence from a dominant member of the group, or powerful and charismatic expert witnesses (Kenyon and Nevin 2001; Pohl 2004). In group processes, participants can also feel a pressure to accommodate with the majority views or socially desirable views at the expense of their own interests and preferences (Kenter et al. 2014)

Deliberative valuation studies have attempted to counter the distorting effects by including a professional mediator or facilitator whose task is to ensure that all voices are heard and respected (Smith 2003). Nevertheless, it is important to critically evaluate that to what degree learning in deliberative processes is endogenous to participants, and to what degree it is instigated by those that develop, frame, and facilitate the process (Kenter et al. 2015).

4. Concluding remarks

The starting point of this paper is the calls for MCDA as an alternative approach to monetary valuation of ecosystem services in CBA framework. The comparative analysis illustrates that MCDA does in general perform better than CBA and associated monetary valuation techniques in several aspects that are essential in ecosystem service valuation. These include the ability of a valuation method to account for multiple dimensions of well-being, including ecological and economic as well as cultural and moral aspects of a policy or management problem (Chan et al. 2012; Gomez-Baggethun and Martín-López 2015; Kenter et al. 2015) and to facilitate open and transparent public debate on the pros and cons of alternative courses of action, including the distribution of gains and losses across beneficiaries of ecosystem services (Pascual et al. 2014; Gomez-Baggethun and Muradian 2015).

The capacity of MCDA to articulate values related to ecosystem services depends, to some extent, on individual methods used in the MCDA process. MCDA methods like NAIADE can accommodate weak comparability of values and hence respect the incommensurability of certain values such as subsistence or questions of right and wrong better than MAVT and AHP methods, which basically assume full compensability. On the other hand, NAIADE does not include a weight elicitation stage, which is important for transparent valuation. Rank-based methods and AHP place less cognitive demands on participants and might therefore be better suited for working with a large group of lay people than MAVT. Furthermore, the SMCE approach by Munda (2004) is particularly suited for illustrating distributional impacts and conflicting interests and values. As the example by Antunes et al. (2011) demonstrates, SMCE can be combined with MCDA methods such as AHP (Appendix 2).

However, the most decisive factor in MCDA is the ways in which the process is organized, including stakeholder involvement and facilitation, and the ways in which the results are presented, not the technicalities of the algorithms. MCDA processes using MAVT can be carried out in a very similar way as

CE to indicate how much people are willing to trade one good or service for another, and to provide an aggregate estimate of the overall utility provided by each alternative. Used in this way, MCDA does not actually provide an alternative to monistic approaches which utilize singular units of measure (cf. Wenger and Pascual 2011). However, as illustrated in the discussion, it is possible to use MCDA in a disaggregating fashion not to calculate a single index but to make plural and conditional conclusions (Stirling 2006; cf. de Montis et al. 2005). This usage of MCDA is compatible with value pluralism which acknowledges the fact that people can make conflicting and yet justified ethical judgments. However, as O'Neill (1997) has pointed out, that does not entail radical incomparability of values in a sense that choices are arbitrary. Instead, such judgments call for reasoned debate, which explicates the underlying normative and ethical beliefs. MCDA methods, if well used, can support such reasoned argumentation about reasons for and against proposals. Furthermore, MCDA method can open up discussion not only about values but also factual claims via transparent scoring process. Environmental knowledge is often contestable (see Antunes et al. 2011; Saarikoski et al. 2013; Hockley 2014) and value conflicts can sometimes be disguised as factual controversies (see Appendix 1).

It is also important to note that MCDA and stated preference survey methods feeding into CBA serve different purposes. MCDA methods are best suited for assisting discussion and debate between a limited set of stakeholders, usually in a conflict situation. Unlike SP methods, they cannot provide statistically reliable information of public preferences in general. If the ecosystem service in question has the characteristics of private goods such as recreation opportunities, which are provided by using public funding, it is well justified to use stated preference methods and use the information in a CBA framework to determine whether, or where, the investment in recreation opportunities is worthwhile. Monetary valuation can also be helpful in awareness raising context by drawing policy makers attention to the economic importance of ecosystem services and associated benefits (Gómez-Baggethun and Barton 2013; Barton et al. 2015).

It is also possible to use both monetary and non-monetary valuation methods to cover a broad range of values and combine CBA and MCDA methods in social economic analyses of projects (Newton et al., 2012; Catrinu-Renström et al. 2013). Promising hybrid valuation approaches are the balance sheet approach by Turner (2016), which combines CBA, social impact assessment and multi-criteria analysis methods, and pragmatic approach by Raymond et al. (2014) in which arithmetic, utilitarian approaches can provide evidence for deliberative processes, which cover also other types of value information. The potential of these hybrid approaches to articulate multiple dimensions of values in complementary and theoretically consistent ways need further examination in real-life case studies.

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Appendix 1

A MCDA process of the conflict between forestry and reindeer herding in Finnish Upper Lapland

A participatory MCDA process, using MAVT approach, was carried out in Finnish Upper Lapland to address a persistent conflict about loggings of old-growth forests: The economically viable logging potential is in over 140-year-old forest that are also important winter pastures for reindeer, which depend on tree-hanging lichens, abundant in old-growth forests, during the critical winter months when ground lichen is covered by thick snow and ice. The fact that most of the reindeer herders are indigenous Sámi people adds an ethno-political aspect to the conflict.

A participatory MCDA process was carried out with 15 key stakeholders including forest sector representatives, reindeer herders, Sámi organisations, local municipalities and ENGOs, which were concerned about the ecological values of the old-growth forests. The process started with identifying the stakeholders' key concerns and preferred options and including them into the value tree (Fig. 1). The options ranged from no logging (Alt 1 in Figures 1 and 2) to maximum logging scenario (Alt 5), and the criteria covered the ecological, economic and socio-cultural aspects of the debate. These included a) employment and income effects to the key opposing sectors, forestry and reindeer herding, b) the vitality of Sámi reindeer herding culture; c) local recreational use of nature: hunting, berry picking and roaming in the nature; d) biodiversity and wilderness experience; and e) mutual understanding, which referred to the prospects of finding a balance between different sources of livelihoods.

The criteria weights were elicited from the stakeholders via interactive decision-analysis interviews (Marttunen and Hämäläinen 2008) using web-HIPRE software (Mustajoki and Hämäläinen 2000). The output of the analysis is presented in Fig. 2. The 15 interviews resulted in an equal number of preference models, which were grouped into three clusters according to the preference order of alternatives. It is important to note that the results are not aggregated but show a representative ranking of each alternative for each group having a similar set of preferences.

It was interesting to observe that unlike in the public debate, none of the stakeholders preferred the maximum logging scenario. Most interviewees placed some value to all criteria with a consequence that they preferred middle-range alternatives. This observation lends some support to the hypothesis that a balanced consideration of all aspects of a debate can promote learning and reflection. An important observation was also that value and interests conflicts took the form of factual debate e.g. on the actual effects of forestry operations to the viability of reindeer herding (see also Saarikoski and Raitio 2013). Therefore, it is important to engage stakeholders not only in the weighting stage but also in the impact assessment stage. Perhaps the most important outcome of the analysis was to show that there is no single best solution; therefore, compromise oriented negotiations are the only feasible alternative in the face of the irreducible plurality of values in "wicked" natural resource management conflicts.

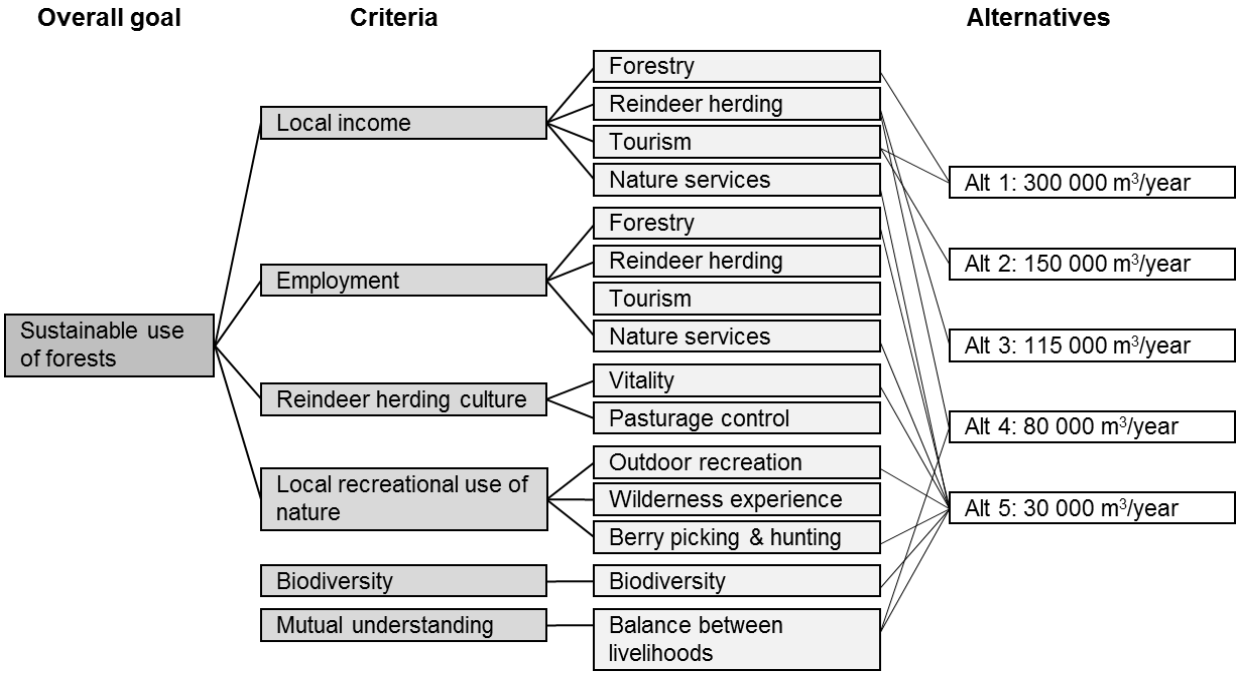

Figure 1. Value tree in the Upper Lapland MCDA process, showing the alternatives (different logging scenarios) and the criteria according to which the alternatives were evaluated.

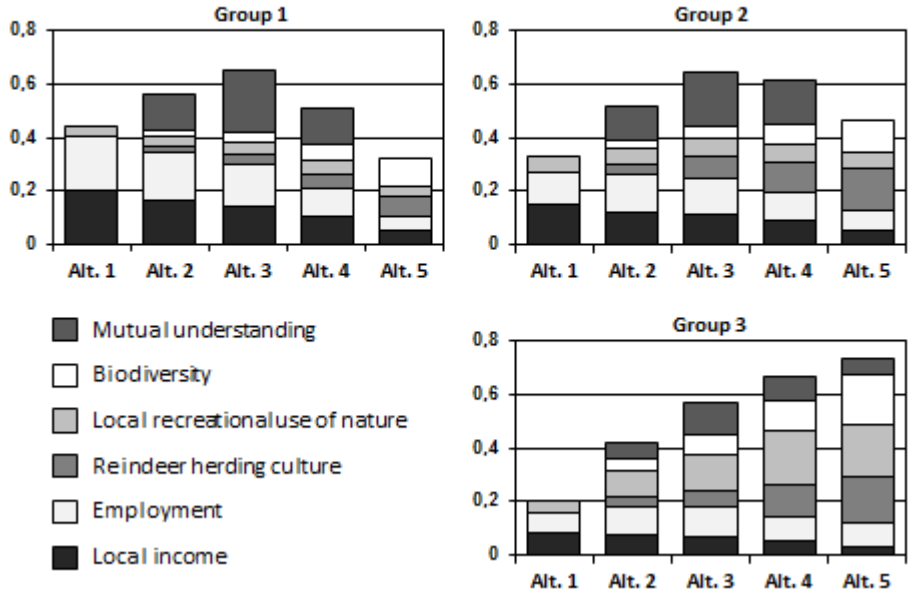

Figure 2. The results of the analysis, illustrating three representative preference rankings of the alternatives by the stakeholders involved in the MCDA process.

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Appendix 2

Participatory multi-criteria analysis of water management alternatives in the Caia Irrigation Perimeter, Portugal

A participatory multi-criteria analysis (MCA) process was organized for the evaluation of irrigation management alternatives in the Caia irrigation district, Portugal (Antunes et al, 2011). This irrigation district covers around 7 500 ha of agricultural land. A farmers' association governs water and irrigation infrastructure management. The current gravity distribution network and water delivery scheme lead to significant water losses in the system. Some farmers have constructed small ponds to temporarily store water for later use as an adaptation to the characteristics of existing infrastructure.

The focus was on the design, evaluation and comparison of irrigation management alternatives in a participatory setting, encouraging direct involvement of concerned actors. The adopted approach combined the elements of Social Multicriteria Evaluation (SMCE) (Munda, 2004; 2008) and the Analytic Hierarchy Process (AHP) (Saaty,1990) involving the following key stages:

1. Institutional analysis: actors identification, characterization of the legal and institutional framework;
2. Framing the decision: reaching a commonly agreed problem statement;
3. Defining key objectives and criteria: identifying what values matter most to the participants in this particular situation;
4. Establishing alternatives and considering the relevant constraints;
5. Identifying consequences: i.e. evaluating the desirability of the alternatives according to the proposed criteria;
6. Ranking of alternatives applying an aggregation procedure;
7. Social impact analysis, discussing the implications of each alternative for the main actor groups.

The main actors identified included farmers and their associations, relevant public authorities and experts in agriculture and water management. The process was developed in a stepwise manner, using participatory workshops (to frame the problem and define the main objective, identify alternatives and select the main criteria) and individual interviews (to determine criteria importance and to compare alternatives regarding each criterion).

The following alternatives were identified (1) Business as Usual (BAU); (2) Rehabilitation of the existing irrigation system (REHAB); (3) Modernization of the irrigation system (MOD); (4) Adoption of improved irrigation technologies (TECH); (5) Integrated water resources management (IWM); (6) Changes in agricultural practices and crop selection (CROP). AHP was used to structure the evaluation process and rank the alternatives. This was done through the development of a hierarchical model of the decision problem and the computation of the criteria weights and alternatives rankings, based on pairwise comparisons of alternatives and criteria provided by the actors in individual interviews (Figure 1). Participants were more comfortable in making pairwise comparisons, rather than providing criteria absolute criteria weights and scores for each alternative.

This analysis was complemented with an analysis of alternatives following SMCE methodology principles. An actor impact matrix was produced based on the analysis of the narratives of the different actor groups regarding each alternative, collected during the interviews. A part of the impact matrix is presented in Table 1. Farmers were sub-divided into two groups, as there was a significant difference in opinions for some alternatives between those farmers that had already invested in on-farm water retention structures and those that had not done it.

The ranking of alternatives and the social impact matrix were used as a basis for discussion in a final workshop. Modernization of the irrigation system is the preferred alternative according to the obtained overall ranking, but it also has very unbalanced performance values for the different criteria. Furthermore, the social impact matrix shows that this alternative is rather controversial. This discussion of the alternatives ranking together with the analysis of the different actor groups positions was perceived as very positive: instead of fostering dispute over one selected alternative, choices are clarified, identifying important conflicts across objectives and among actors from different groups.

An evaluation of the process was performed by email consultations and telephone interviews. Social learning was an important outcome: participants acknowledged that they had gained a 'social insight' of the irrigation management problem and understood better the issue and each other's viewpoints.

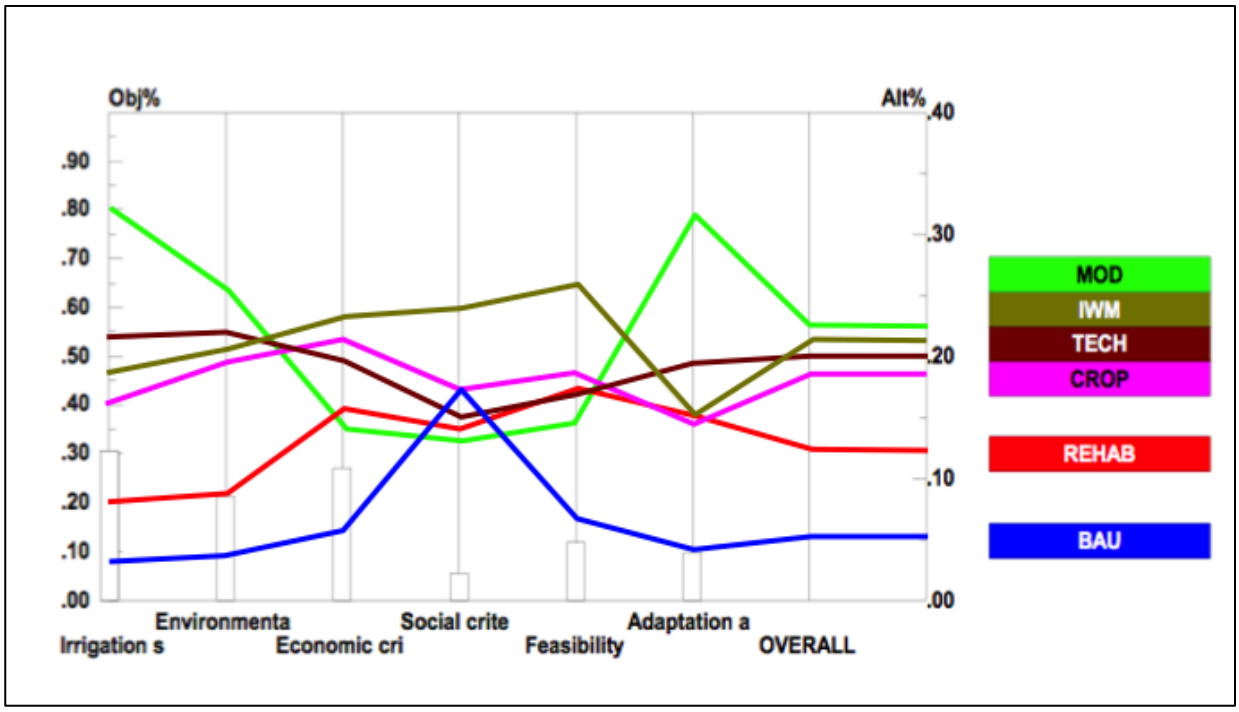

Figure 1 – Ranking of alternatives for the selected criteria

Table 1: Social impact matrix

ALTERNATIVES	ACTOR GROUPS			
	FARMERS No investment in rehab	**FARMERS** Investment in rehab	**PUBLIC AUTHORITIES**	**EXPERTS / SCIENTISTS**
BAU	**VERY BAD** Any change better then actual situation.	**VERY BAD** *If we thought that the problem does not exist and that irrigation in Caia functions well we wouldn't have made any investments in the first place.*	**BAD** *Something needs to be done.*	**VERY BAD** BAU is not efficient. Requires change at several levels.
REHAB	**BAD/MODERATE** Water losses still remain high. It is not sustainable in a long term.	**GOOD** *It is not very expensive and it makes a lot of difference. We have proofs that our upgrades work.*	**VERY GOOD** Currently the most preferable, combined with TECH and CROP.	**MODERATE / GOOD** Improves current situation, but not significantly. No large long term impact.
MOD	**VERY GOOD** *If there is money...this is the ideal solution. We would have high initial costs, but water use efficiency may significantly increase. This is a step prior to integrated water management.*	**BAD** Relevant only in the future, 7-8 years, as this is the payback period of investment made. *Very expensive and we doubt the technical feasibility of this option.* Farmers should decide if the system should be changed or not.	**VERY BAD** Least favourable option. Complicated, economically and politically. Sooner or later it will result in the same problems if farmers' practices do not change.	**MODERATE** Strong positive impacts on water and economic productivity, but very negative on costs and employment. Farmers cannot bear costs.

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