

# Multi-Criteria Decision Analysis Tool Review

## Valuation Tools

TABLES Project 2012: Mini reviews	
<b>Guidance</b>	<i>Using your experience and expertise, consider the following tasks in relation to the tool. It may not be possible to complete all tasks for each tool due to a lack of available information, the task not applying to the tool, etc. <b>Please note where this is the case by writing in the reason in the space provided.</b> Please use a maximum of 6 pages of A4 (excluding diagrams and appendices). <b>Your responses are required in the white spaces.</b></i>
<b>Task 1: Basic information</b>	
<b>Name of the tool</b>	Multi-Criteria Decision Analysis
<b>Type of tool (list all that apply)</b> <i>Learning and skills (pedagogic); participatory; regulatory; collaborative; mapping; valuation; modelling; decision; futures; financial; ecosystem services</i>	Participatory; valuation; decision
<b>Group members</b> <i>(minimum size 3 members, must include a BCU rep)</i>	<ol style="list-style-type: none"> <li>1. Althea Davies</li> <li>2. Rosalind Bryce</li> <li>3. Mark Reed</li> <li>4. Jasper Kenter</li> <li>5. Charles Cowap</li> </ol>
<b>Please provide a brief synopsis of the tool</b>  <i>This may include: background context, development (and ownership if appropriate), current use and applications etc.</i>  <i>Please also note any desired outcomes of the tool so that you can make reference back to these in Task 7: SWOT analysis</i>	<p>MCDA (also called Multi-Criteria Evaluation/Analysis or Multi-Criteria Decision Modeling) is a decision-support tool for exploring issues and making decisions that involve multiple dimensions or criteria. It allows economic, social and environmental criteria, including competing priorities, to be systematically evaluated by groups of people. Both quantitative and qualitative data can be incorporated to understand the relative value placed on different dimensions of decision options (in an environmental context, often management options). The method was developed in the fields of operations research and decision theory, and this is reflected in the focus on algorithms and software support systems in much of the literature. However, the tool can also be used without software, to generate qualitative data about decision-making criteria, to rank decision options and discuss reasons for rank positions.</p> <p>Broadly, the process involves context or problem definition, representation of evaluation criteria and management options, and evaluation. When applied in a participatory and deliberative manner, this may involve any of a number of discreet stages, for example:</p> <ul style="list-style-type: none"> <li>• Establish context and identify participants: This ensures the early identification of key issues, socio-environmental dynamics and selection of relevant/representative stakeholders for involvement in the multi-criteria decision-making process. Stakeholder mapping/analysis techniques may be used to systematically consider which stakeholders should be involved (Reed et al., 2009), and a combination of interviews, focus groups, workshops and document analysis can indicate perceived differences and views on the conflict, and help structure stakeholder involvement;</li> </ul>

- Define criteria: Criteria are defined that capture stakeholders' interests via facilitated discussion and literature (e.g. research, policy documentation). Broad criteria, such as environmental, economic, institutional and social variables, can be broken down into more specific indicators;
- Rank or weight criteria: To reflect differing values and priorities, criteria are ranked to indicate their importance relative to the objective of process – this may be done individually and aggregated or facilitated as a group process;
- Define management options: Alternative management options are defined (e.g. using stakeholder mapping/analysis, literature such as policy documents, and/or 'expert' consultation). Options may for example represent current management types or possible future scenarios;
- Score management options against criteria: The performance of each management option is scored against each criterion. This may be completed by all stakeholders (individually), a subset of participants or by researchers. It may include evidence-gathering and/or deliberation to evaluate relationships between criteria and management options, including empirical data, expert opinion, scenarios and modeling;
- Multi-criteria evaluation: Algorithms are used to combine scores and ranks into a weighted value that describes the overall preference towards each option. Results can be presented per individual or aggregated for different groups. Statistical analyses can be applied to assess the robustness of the results and seek patterns amongst participant choices;
- Discuss options based on MCDA results: MCDA is a decision-support tool so outcomes may be deliberated with participants or amongst decision-makers to assess the degree of consensus, negotiate compromise and manage trade-offs.

MCDA has been applied in a range of natural resource management situations, including management of forest and water resources for multiple benefits, conservation planning, and to evaluate management sustainability. It has often been used to choose a management strategy that is optimal from a single user or single priority perspective. Participatory and deliberative approaches to MCDA, with greater emphasis on practical application and usability, have emerged more recently to deal with multiple stakeholders, ill-defined problems and competing objectives. Applications can include assessing the strengths/weaknesses of existing strategies or proposed strategies according to multiple goals and/or interests.

In development studies, MCDA has been adapted to be conducted with participants who may or may not be literate. Matrix Ranking, as it is called, typically represents options and criteria symbolically (e.g. with objects or images) and participants vote for each option against each criterion by placing counters (e.g. beans or stones) in the cells of a matrix in which each option is represented by a row of cells and each criterion is represented by a column of cells. The relative popularity of options can be assessed by gathering counters from each row (option) and comparing the size of each pile. Criteria may be weighted, though this is harder to visualize for participants.

## Task 2: Use of the tool

Position / Use	Stage	Currently used	Could be used
<p><i>If you can, please indicate which stage(s) of the decision / policy making process your tool is / could be used in (these stages were identified in the specification document)</i></p>	Ideas	Local stakeholders may identify key factors relevant to the local level effectiveness and/or acceptability of management options.	
	Survey	<p>Problem definition: gathering criteria via stakeholder engagement helps establish the range of interests relevant to a particular issue.</p> <p>Early stage discussions to define the problem context can help identify the 'right' stakeholders, i.e. those with interest and influence</p>	
	Assess	<p>Systematic method for assessing the potential or actual impacts of different management options on a range of interests; these may be multiple interests held by a single stakeholder or organisation, or the range of interests held by different stakeholders or user groups.</p> <p>Key strength is the ability to include qualitative and quantitative data in support of varied stakeholder interests, thereby potentially increasing legitimacy and fairness</p>	
	Policy / decision	<p>This is a decision-support tool; the weighted scoring process indicates the preferences of individuals or groups towards the range of options on the table.</p> <p>These form a systematic and transparent basis for negotiation over decisions/policy</p>	
	Implement	N/A	
	Evaluate	<p>The method can be used to evaluate the performance of existing management or policy strategies according to multiple indicators or stakeholders' interests; this can be used to identify strengths and weaknesses of existing strategies, and bringing in additional stakeholders (e.g. with local knowledge) can indicate locally-relevant gaps or failing that need to be addressed to improve the effectiveness of current strategies.</p>	<p>Adaptive management: The process provides an 'audit trail' so the basis for decisions can be re-examined using the same protocol when new information becomes available</p>

Please add any further comments here:

Task 3: Existing literature about the tool	
<p><b>Are you aware of any KEY policy and / or academic literature evaluating your tool?</b> (e.g. reports, journal articles, books)</p>	<p>DCLG (2009) Multi Criteria Analysis: a Manual. <a href="https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7612/132618.pdf">https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7612/132618.pdf</a></p> <p>Proctor W, Drechsler M, 2006, "Deliberative multicriteria evaluation" <i>Environment and Planning C: Government and Policy</i> 24: 169-190</p> <p>Linkov I, Satterstrom F.K., Kiker G., Batchelor C., Bridges T., Ferguson E. (2006) From comparative risk assessment to multi-criteria decision analysis and adaptive management: Recent developments and applications. <i>Environment International</i> 32: 1072–1093 <a href="http://www.lisdmp.org/MeetingMaterials/Resources/EnvIntl_1485.pdf">http://www.lisdmp.org/MeetingMaterials/Resources/EnvIntl_1485.pdf</a></p>
Task 4: Your experience of working on the tool	
<p><b>Have you done any research/consultancy work on this tool in terms of its development, testing and/or evaluation?</b> If so, please provide an outline.</p>	<p>Based on our experience and responses from participants during workshops assessing the impacts on upland managers of a policy shift towards managing the land for multiple benefits (Scottish Land Use Strategy), we highlight numerous key considerations for future multi-criteria work in environmental conflict situations:</p> <ul style="list-style-type: none"> <li>▪ For MCDA outcomes to be useful there should be an appetite for change, a willingness to act on the results and opportunity for constructive dialogue, and stakeholders must be receptive to structured dialogue as part of a decision-making process.</li> <li>▪ MCDA is best applied as part of a larger conflict resolution or management planning process. This can make policy makers or managers more aware of shortcomings in existing management effectiveness, trade-offs and how conflicts may be avoided.</li> <li>▪ Sets of criteria that reflect the diversity of views and values amongst stakeholders should be drawn from stakeholders directly as well as from research and policy. Each criterion should be clearly defined to avoid ambiguity in understanding the differing views, including recognition that criteria can be either positive (e.g. maximising game numbers for harvest) or negative (e.g. minimal predator numbers). There should be similar numbers of economic, environmental and social criteria to avoid bias towards one particular dimension.</li> <li>▪ The alternative management options that are evaluated during the process can represent current management types, possible future scenarios or a gradient of management activity and may be co-developed with stakeholders.</li> <li>▪ Scoring the performance of management options against criteria requires stakeholders to make trade-offs between multiple values. It is critical that the questions put to stakeholders to derive these scores are clear and unambiguous in terms of context and scale. An iterative process with discussion and opportunities to re-score may improve the search for compromise.</li> <li>▪ There are several methods of deriving a final 'value' for each management option. Aggregating individual responses may be a useful way of summarising views from groups or regions but no consensus should be inferred without allowing time for further deliberation. Transparency should be maintained and all conclusions and</li> </ul>

	<p>interpretation should draw on discursive interpretation in addition to appropriate statistical analysis to avoid generating a false or unstable consensus.</p> <ul style="list-style-type: none"> <li>Visual methods are useful for representing uncertainty and communicating differences of opinion and can form the basis for negotiating compromise and managing trade-offs in policy-making and environmental planning</li> </ul>	
<b>Guidance</b>	For Tasks 5-7, please also try to consider the <b>future</b> development and application of this tool in the TABLES project in your answers.	
<b>Task 5: Incorporating the ecosystem approach (EA) and ecosystem services (ES)</b>		
<i>**Please refer to the summary text about ES for concept clarification at the end of this template (appendix)**</i>		
<p><b>Using examples (from practice, research or consultancy), explain how EA and/or ES are currently incorporated in/by the tool</b></p> <p><i>If neither approach is currently incorporated, please move to the next question</i></p>	<p>There is increasing interest in the use of MCA for ecosystem services management and decision-making, although many examples in the literature are theoretical or focus on a restricted set of services (e.g. Lester et al. 2012), often with limited or no participation. Therefore theoretical or conceptual recommendations of MCDA for ecosystem services management (e.g. Fish et al. 2011, Carpenter et al. 2009) generally lack practical testing. Similarly, the application of MCDA to more intangible non-market values (e.g. cultural or social values) is currently limited and refers mainly to practical aspects of cultural uses (e.g. recreation access).</p>	
<p><b>How <u>could</u> the ecosystem approach and/or ecosystem services be (further) incorporated within the existing tool?</b></p>	<p>The main difficulty lies in reducing the many interrelated aspects of ecosystem approach/services to a realistic but workable number of criteria or characteristics of options, since MCDA usually involves scoring the impacts of each option for each criterion. A list should provide a balance between completeness, with a risk of overwhelming detail, and conciseness, where oversimplification could increase uncertainty and mistrust. Highly complex settings, which seek to consider multiple ecosystem services or attributes may not be suited to MCDA. Threshold effects, high variability or multiple feedback loops between biological and management systems at local and wider (e.g. global market) scales may not be adequately managed using MCDA, unless the issue can be broken down into more manageable facets (potentially both to MCDA and to participants) without losing fundamental detail and connectivity.</p>	
<b>Task 6: Situating the tool within priority questions/criteria arising from the scoping interviews</b>		
<p><b>Explain how the tool can be situated within the priority questions/criteria that arose in the scoping</b></p>	<p><b>Priority question/criteria</b></p>	<p><b>Does your tool address/implement this question/criteria? Or does it have the potential if it was better integrated with an EA/ES approach?</b></p> <p><i>Please explain how.</i></p>
	<p><b>Language and communication</b></p>	
	<p>1. Contribution to aiding the development of shared vocabulary within which principles of EA and ES can</p>	<p>By breaking down key themes or complex issues into simpler, often measurable entities (sometimes called criteria and indicators), the process can help reduce</p>

<b>interviews</b>  <i>Complete as many boxes as required</i>	be shared with multiple stakeholders across built and/or natural environment	linguistic uncertainty and therefore help develop shared vocabulary. It can be an effective way of making the assumptions of different decision-makers explicit, thereby identifying common ground as a basis for developing a shared vocabulary to describe similar evaluation criteria
	2. Capacity of the tool to develop shared understandings of the many identities and values of places from the perspectives of multiple visitors, residents and businesses	Useful as structured, systematic and transparent tool for breaking down complex issues into component parts which can be more readily defined. This is useful for making explicit and recognising values held by different stakeholders, as well as the relative importance of these values in a particular context. See Task 5, however, for limitations in complex contexts, which applies when evaluating how stakeholder identities or values are affected by particular management options. Modelling may be useful for estimating interactions but uncertainties and 'black box' effects on transparency must be acknowledged.
	3. Capacity of the tool to improve or enable engagement across different publics so avoiding the usual suspect problem	Visual methods of representing the range of views are useful for communicating responses and soliciting input from different audiences. By enabling diverse publics to take complex decisions together, this tool has the capacity to enable diverse participants to engage effectively together around environmental decisions
	<b>Learning from experience/pedagogy</b>	
	4. Capacity of the tool to help reveal and value 'hidden' assets that are not recognised by communities or publics that use them	Not known
	5. Extent to which tool is building on other tools or EA/ES progress	Assessing impacts of options on criteria can draw on a wide range of existing tools since the method can incorporate qualitative and quantitative data, e.g. cost-benefit analysis, choice experiment, other (e.g. ecological) modelling. Deliberative approaches to MCDA typically build on a range of existing participatory approaches e.g. citizen's jury
	6. Extent to which tool is locally derived or grounded or can be adjusted to closely reflect 'local' context. Is the tool suitable for an open source approach?	Highly suited to incorporating local values – adapting criteria and options to local conditions is a strength of participatory application. The method can be/has been applied to cross-scale analysis, e.g. international, national and local perspectives can be assessed using similar framework. A range of open source software is available for conducting MCDA.
	7. Extent to which the tool is open to interpretation and application in a variety of forms	The general structure of MCDA (7 stages outlined above) can be conducted in a number of ways to

(that reflect 'cultural' differences)	reflect cultural needs/differences, e.g. accommodate non-literate participants (e.g. using Matrix Ranking). The final ranking or preferences towards management options could be misinterpreted as indicating consensus, which may be a false premise. Therefore, mathematical treatment and representation of responses require careful consideration. For this reason, many users emphasise the use of MCDA as a qualitative tool for structuring discussion around decision options (e.g. Reed et al., 2008).
<b>Developing and selecting tools</b>	
8. Is the tool dependent on a specific funding source? How onerous is the application procedure? What are the chances of success?	Software applications are available to support implementation of MCDA, but it is not dependent on these, and there are open source options available. However, careful method selection and process design are critical as these influence outcomes. 'Success' depends on definitions – whose perspective, whose goals. It is also a decision-support tool, so 'success' resides in the quality of the process rather than negotiated decisions that may result from use of MCDA outputs.
9. Does skills development (essential or optional?) and support exist for the tool or is there a body to ensure the optimal and correct use of it?	Skills development is essential to ensure correct/optimal use of this tool, especially if software is going to be used as part of the process. There is no obvious support system. Although much literature exists on the different methods and how to apply them, there is far less on the applicability of particular methods to specific contexts (i.e. which methods are likely to be most effective when). Therefore careful prior literature reading or training is critical to ensure effective process design and application.
10. Extent to which current statutory hooks can be exploited by the tool or will benefit the quality or application of the tool (e.g. NNPF's duty to cooperate, SUDS, ecol. networks)	The need to take into account multiple values provides a strong hook for use of MCDA although the absence of evaluation literature for MCDA means that there is limited guidance to draw on to ensure the quality of the application. This includes lack of existing applications and potential difficulties of applying MCDA to complex ES contexts.
<b>Informing resultant policies effectively</b>	
11. Extent to which the tool informs or improves policies/decisions. What does the tool cover? (full range of positive and negative economic, social and environment impacts / tradeoffs?)	Tool informs policies/decisions by representing a range of perspectives, including positive and negative environmental, social and economic impacts. This provides a basis for negotiated or deliberated compromise and potentially provides a transparent 'audit trail' for the decision-making process. Having said this, the tool can only be used with relatively limited group sizes, meaning that to inform policy

	decisions it is essential to ensure effective representation of stakeholder interests in the MCDA workshop
12. How does the tool link into the planning system (applications and processes). At what cost / extra burden?	MCDA is likely to be most effective when applied as part of a wider planning process. It can incorporate various evaluation tools (e.g. cost-benefit analysis, choice experiments, risk assessment) to assist evaluation of how different options are likely to affect criteria of importance to participating stakeholders. Length of process and levels of participation can be varied to suit planning context, although implications for fair representation must be considered. The additional skills required to design/run MCDA within a broader planning process will incur costs in terms of skills and transaction costs (liaison with planners), but many parts of MCDA and traditional planning process may overlap/have mutual relevance, e.g. stakeholder identification and engagement. Therefore, MCDA can provide a structured process for undertaking various aspects of the planning process.
<b>Delivering management objectives</b>	
13. Suitability or capacity of the tool to assist with managing visitor needs and pressures within protected areas / the considered area? How?	Can be applied as a means of assessing possible impacts of different visitor needs and pressures on conservation goals, e.g. developing visitor facilities, impacts of permit/visitor quota management strategies
<b>Local ownership/new governance</b>	
14. To what extent can the tool assist in developing statutory plans (local and management plans) and improve ownership and use by publics?	The method is most effective when conducted as part of wider planning process, particularly by involving planning authorities and public to ensure that differing interests are transparently and systematically considered. This can allow consideration of trade-offs required to negotiate acceptable compromise between different interests.
15. To what extent does/could the tool contribute to a new form of community governance in management of the environment?	Useful as a tool to support decision-making processes, provided structured process is acceptable, relevant information and necessary skills are available, and methodological issues are considered, i.e. skilled facilitation is important.
<b>Improved tools: understanding flows, interconnections and spatial issues</b>	
16. Capacity to improve spatial understandings of the flows and interactions of various ecosystem services between sectors and at different scales	Consistent framework can be used to assess differences between sectors and scales, but the method is not ideally suited to highly complex situations, unless modelling (with appropriate acknowledgement of uncertainty) is acceptable to represent and assess feedbacks between highly interconnected aspects of ecosystems, e.g. ecological



		interactions, cultural/management-ecological interactions, systems with high variability or uncertainty (see response to Task 5 above).
	17. Capacity of the tool to reconcile assessments of options and benefits across different scales (and sectors)	See response to no. 6 above.
	18. Extent to which the tool is capable or can be manipulated to work across sectoral and administrative boundaries	Well-suited to incorporating views and resource issues across boundaries, although see caveat re complexity in Task 5 and no. 16 above. Information needs must also be considered, e.g. spatial concentrations/gaps in information may prevent uniform assessment across scales/sectors.
	19. Extent to which the tool can handle data shortages and gaps (or is effectiveness considerably compromised?)	A strength of the method is that uncertainties and gaps in knowledge can be explicitly identified. Expert opinion or modelling can be used to address these, but wider acceptability of these approaches/inputs must be considered. Fuzzy MCDA approaches have been developed to accommodate uncertainty and knowledge gaps. Scoring can use a scale that explicitly requests participants to indicate how confident they are that particular options may have desired outcomes.
	20. To what extent has/could the tool put landscape/nature conservation and designated species/sites on the radar (positively or resulting in resentment?)	The method has been used in conservation planning and to manage conflicts between conservation and cultural interests. Conservation applications can be applied purely to design of management options that address conservation goals, or design that takes into account multiple environmental/social/economic interests.
<i>Please add any further comments here:</i>		

### Task 7: A SWOT analysis of the tool

<p><b>Referring back to the relevant policy and academic literature (listed in Task 3), plus your own expertise (listed in Task 4) and the way in which the tool is</b></p>	<p><b>Strengths</b> <i>(of the tool in delivering intended outcomes)</i></p> <ul style="list-style-type: none"> <li>• Supports complex decision-making processes with diverse groups of decision-makers</li> <li>• Able to cope with incomplete or “fuzzy” data and make uncertainty explicit</li> <li>• Makes the assumptions and decision criteria of different participants explicit and can facilitate an explicit discussion of individual/group priorities around the reasons for taking a particular decision</li> <li>• Easily integrates into existing decision-making processes e.g. planning system and provides quantitative outputs that are attractive to policy-makers</li> </ul>
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<p><b>situated within the priority questions/criteria (listed in Task 6), please complete a summary SWOT analysis ensuring that each point is well justified</b></p> <p><i>Where possible, this analysis should reflect the tool's past and current application, as well as its effectiveness in policy and decision making processes</i></p>	<p><b>Weaknesses</b> <i>(factors that detract from the tool's ability to deliver intended outcomes)</i></p> <ul style="list-style-type: none"> <li>• Struggles to cope with decisions that involve a large number of options or criteria – when considering the impact of a decision on a range of different ecosystem services, this may require more criteria than can effectively be managed as part of a workshop process</li> <li>• Struggles to cope with complex decisions in which different options or criteria are likely to interact with one another (e.g. trade-offs between ecosystem services) or where there are feedbacks in the system</li> <li>• The tool is often used in a highly quantitative manner to arrive at a false consensus that does not satisfy participants</li> <li>• MCDA has been criticised for failing to capture qualitative and subjective elements of decisions, and focussing too much on elements that can be easily made explicit and quantified</li> </ul>											
	<p><b>Opportunities</b> <i>(consider opportunities for application of the ecosystem approach and services)</i></p> <ul style="list-style-type: none"> <li>• MCDA may be combined with computational modelling of ecosystem services to capture feedbacks and prioritise ecosystem services to include as decision criteria</li> <li>• MCDA may be used in a more qualitative way to structure discussion around decisions and decision criteria and ranked outputs from MCDA software may be used as the basis for group discussion rather than feeding directly into decisions</li> </ul>											
	<p><b>Threats</b> <i>(factors which negatively affect the tool and its outcomes)</i></p> <p><i>Classify these by their “seriousness” and “probability of occurrence” in the table below, and pay particular attention to the threats associated with potential use of ecosystem approach/ecosystem services.</i></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #e0f2f7;">Threat</th> <th style="background-color: #e0f2f7;">Seriousness (high, medium, low)</th> <th style="background-color: #e0f2f7;">Probability of occurrence (high, medium, low)</th> </tr> </thead> <tbody> <tr> <td>False consensus reached</td> <td>High</td> <td>Medium</td> </tr> <tr> <td>Decision over-simplified in relation to ecosystem services</td> <td>Medium</td> <td>Medium</td> </tr> <tr> <td>Qualitative and subjective elements of a decision may be overlooked</td> <td>Medium</td> <td>High</td> </tr> </tbody> </table> <p>Please add further comments here:</p>	Threat	Seriousness (high, medium, low)	Probability of occurrence (high, medium, low)	False consensus reached	High	Medium	Decision over-simplified in relation to ecosystem services	Medium	Medium	Qualitative and subjective elements of a decision may be overlooked	Medium
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False consensus reached	High	Medium										
Decision over-simplified in relation to ecosystem services	Medium	Medium										
Qualitative and subjective elements of a decision may be overlooked	Medium	High										
<b>Guidance</b>	<i>Please now use the remainder of the document (box below) to make any general comments, observations or analyses of the tool</i>											
<b>Further comments</b>												