Using Cost-Benefit Analysis and Multi-Criteria Decision Analysis to make decisions under the Ecosystem Approach: Guidance Document

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Tim Sunderland and Oliver Hölzinger (2013)

Audience

This document is aimed at non-specialists, who wish to make use of Cost Benefits Analysis (CBA), Multi-Criteria Decision Analysis (MCDA) or a mixture of the two when making decision under an Ecosystem Approach (EA). Both of these tools require experience and theoretical knowledge to be used effectively, so it is recommended the experts are commissioned to do the work. It is important for the lay users who commission the work to understand how best to use the tools in the context, in order to use them most effectively. This is the aim of this document. An appendix provides technical justification for some of the points made, and will be of interest to experts.

What are the tools?

CBA is an assessment of the desirability of a project. CBA is used in the private sector to assess the profitability of a project in narrow profit and loss terms. But the focus of this document is Social Cost-Benefit Analysis, which is used by the public sector to assess whether a project would increase *aggregate social welfare*. This assessment is made by placing a value in pounds against all the costs of the project, and all the benefits. Costs will include all the resources required to produce a project, even if these do not have to be paid for directly. For example, even if you already own the land using it for this project will mean it is unavailable for another one. Costs also include non-market damages such as noise and pollution. Similarly the benefits can include both things people pay for, such as food or access to a cinema, and things they don't, such as a more pleasant urban environment. The value placed on costs and benefits is rooted in neo-classical economic theory. In practice CBA is used as a decision-guide, rather that decision maker, and some senior economists also see it this way (see technical appendix).

MCDA is a method of decision making which explicitly chooses the criteria by which the decision should be judged. It is best practice for these criteria to be agreed on in

consultation with stakeholders. The criteria can be quantitively measured or alternatively given ranking based on a justified qualitative assessment. Each criterion can then be weighted, based on an assessment of its importance and this makes the decision as to the best way ahead. These weightings are explicit judgements, rather than based on objective criteria, and so the level of agreement about weightings will control the level of agreement about the final outcome. Alternatively, some forms of MCDA avoid weighting all together and provide an output in terms of which projects dominate (i.e. score more desirably) other projects on each of the criteria. The output is then a map, or web of dominance relationships. This approach makes trade-offs more explicit than weighting.

What is relevance of the tools to the Ecosystem approach and ecosystem services?

Both tools include benefits and costs which lie outside the market, including those provided by the environment. This is in contrast to assessment of economic impact (contribution to Gross Domestic Product) which omits these factors. This means that both tools are excellent vehicles for incorporating the benefits provided by ecosystems into decision making. But the inclusion of the benefits of ecosystem services is not automatic in either of these tools, and neither is it routinely done. Ecosystem services must be deliberately included.

Similarly both tools have the potential to be used effectively as part of a broad and effective consultation with relevant stakeholders, furthering the aims of the Ecosystem Approach. There is however, nothing automatic about this outcome, and this must be deliberately built into the process.

When and why should I apply the tools?

Both tools should be used when there is a decision to make. Both tools provide a mechanism for setting out expected project outcomes coherently, which supports the development of ideas, effective stakeholder consultation, and decision making. By using both tools within the EA you will contribute to better decision making.

CBA is the required methodology for both appraisal and evaluation in central government (HM Treasury, 2003). It has standardised rules (HM Treasury, 2003) which help people to compare CBAs, and therefore make use of the outputs of your analysis. Additionally, CBA is only methodology which can assess the value for money from an investment, which is often important to justifying funding. The methodology for producing values aims for objectivity – it is not based explicitly on stakeholder or analysis views. CBA is the consideration of the costs and benefits of a particular policy or project. This is to say it compares the 'policy on' situation, with a 'policy off' situation. This requirement makes it difficult to use unless your decision making context it quite tightly defined. CBA becomes very controversial when

attempts are made to use it for strategic decision making. Producing values for CBA is also demanding, increasing the resource required to compare options. CBA is a rigorous and transparent methodology, which explicitly states all of its assumptions. The 'working' however can feel opaque to non-specialist audiences.

MCDA is widely used in academic research in the UK, and for decision making in Europe. There are government guidelines for conducted an effective MCDA (Dodgson et al., 2009), but the methodology is not as standardised as CBA. MCDA does not produce figures that can be compared between analyses. MCDAs use of qualitative ranking for relevant criterion means that it can include criteria which CBA cannot. This makes it more suitable for strategic decision making than CBA. It also makes it possible to use it when the decision itself is less clearly defined and makes it less demanding to consider a wide variety of potential options at a scoping stage.

There are a number of areas of overlap, or potential overlap, between CBA and MCDA. Often there are changes which it is difficult, impossible, or controversial to value in CBA. These are then left unvalued, but stated next to the cost: benefit ratio as something that hasn't been included. This is known as an extended CBA, and is moving towards a hybrid.

The methodology of MCDA allows explicit discussion of the values attached to outcomes. Recently there has been experimentation with use of deliberative (i.e. discussion based) values in CBA. This incorporates this advantage in CBA at the cost of reducing its claim to objectivity. Using MCDA or deliberative CBA carries the risk that your decision will be disproportionately influenced by particular stakeholders.

In a practical decision making context it is likely that the cost of a project will be one of the criteria which are relevant to an MCDA. Once the cost is included as one of the criteria and assigned a weight relative to the other criteria, than these weights implicitly put monetary values on the other outcomes. The process remains MCDA, but the outcome is effectively that of a CBA with all the values arrived at deliberatively (Pearce and Turner, 1990).

Your choice of whether to use CBA, MCDA, or some mixture of the two, will depend partly on your institutional context, partly on the audience you need to justify the decision to, and partly on your views as to whether values are best arrived at through stakeholder consultation, economic theory, or some mixture of the two. There may be advantages to using an MCDA type process for early Appraisal, when many options are still under consideration and then switching to CBA for more detailed analysis when the options have been narrowed down.

Practically, how do I make use of CBA and MCDA?

The table below gives some suggestions as to how to use CBA and MCDA practically. It takes the Rationale, Objectives, Appraisal, Monitoring, Assessment and Feedback (ROAMEF) cycle, which is at the heart of the Treasury's guidelines for Appraisal and Evaluation (HM Treasury, 2003), and makes suggestions against each section. The arrows are to demonstrate that this should be understood as a cycle, rather than a linear process. Within the CBA and MCDA columns the colouring is designed to show where the focus of this tool is within the ROAMEF cycle. If the square is dark green, this is a central focus for the tool. If the square is lighter green, then the tool is relevant, but it's not its central focus. Finally, if the square is white then the tool is not relevant for this part of the cycle. This serves as a reminder that these tools should be used in conjunction with others throughout the policy cycle.

Firstly we will go through how to use MCDA, and then how to use CBA. My recommendations about how to use CBA vary considerably from current practice, and where they do so this will be highlighted. My recommendations about how to use CBA are an attempt to draw on the strengths, and avoid the weaknesses of both CBA and MCDA. This is because MCDA has significant advantages in terms of tractability and accessibility to stakeholders, and is particularly valuable during early appraisal in order to encourage a wide variety of options to be considered. High-quality MCDA will be transparent and rigorous about its evidence base, and test the sensitivity of its analysis to uncertainty, but these are standard features in CBA, and the CBA methodology is helpful here. The use of values from the economics literature can also be used as a method gauging how representative stakeholders are of wider society. Finally and importantly, CBA contains and overall value for money assessment, which is important before a project goes ahead and allows it to be quantitatively evaluated.

Project Cycle	MCDA	CBA
Rationale		• In CBA the high-level rationale is always an improvement in social welfare and defined by economic theory • Each project also requires a specific rationale
Objectives	• Decide objectives	• Decide objectives
Early Appraisal	• Consult relevant stakeholders in order to decide what the relevant decision criteria are and how they should measured • Work with stakeholders to assign weights to a variety of different approaches	• Consult relevant stakeholders in order to decide what the relevant costs and benefits are • Produce scoping values for several different approaches • Test values and plans with stakeholders
Late Appraisal	• Choose the best approach, based on the weightings offered, and test this with stakeholders • Produce fully worked up approach and test with stakeholders	• Produce full valuation for preferred option – including cost: benefit ratio • Consult stakeholders on full valuation and implementation plan
Monitoring	• Collect data which will allow ex-post assessment or the decision against the criteria selected.	• Collect data which will allow ex-post assessment of the costs, benefits and to who these fall
Evaluation	• Reassess the project against the original criteria • Discuss with stakeholders and experts how and why the project delivery was different from anticipated (positive and negative	• Recalculate costs, benefits and to whom these fall based on what actually happened. • Discuss with stakeholders and experts how and why the project delivery was different from anticipated (positive and negative)
Feedback	• Combine lessons learnt from the evaluation with stakeholder feedback to reconsider new projects and/or the continuation of the project. • In the light of experience were the initial rationale/objectives, the most appropriate?	• Combine lessons learnt from the evaluation with stakeholder feedback to reconsider new projects and/or the continuation of the project. • In the light of experience were the initial rationale/objectives, the most appropriate?

MCDA

MCDA process carries no inherent high-level rationale, and is entirely open to be shaped by those that use it. The rationale and objectives (problem formulation) will

stem from a wider strategic narrative and MCDA will become relevant at the appraisal stage. MCDAs lower data demands make it ideal for exploring a wide variety of alternative solutions at early appraisal stage.

It may be difficult to work out which ecosystem services are likely to be affected. If so it may be helpful to conduct an assessment of the land use change, land management change, resource requirements and waste production entailed by the proposal. Each of these will then point to possible changes in ecosystem service provision.

Stakeholder engagement is critical to the effectiveness and credibility of MCDA. The quality of the decision produced by depends on a) the correct criteria being selected b) the criteria being accurately scored or ranked and c) the correct weights being put on the criteria (when weights are used). This means that high-quality stakeholder engagement is critical to it's effectiveness as a decision support tool. Stakeholders should be involved in selecting criteria, they should 'reality-check' rankings and scorings, and be involved in setting weights. The process by which stakeholders with differing interests and opinions are included is therefore a significant challenge. Transparency is therefore required about the process of aggregating different views to form weights.

The quality and status of the underpinning evidence is also crucial, and these may range from peer-reviewed papers through to samples of expert opinion. The origin and status of the evidence base, and any assumptions used, should be clearly spelt out. Where assumptions are a significant influence on the final result, the sensitivity of the final result of using different assumptions should be calculated.

The criteria selected should guide the monitoring programme, with the aim of assessing whether they key criteria have turned out as expected. (Ref monitoring guidance). Often it will not be possible to capture data relating exactly to the criteria concerned, and some proxy figure will need to be collecting. Monitoring indicators should be agreed with relevant stakeholders, which will ensure they are relevant and should make collecting them more efficient.

Where MCDA is applied to high-level strategic issues, such as the UK's energy policy, no evaluation will be possible. This is because it is not possible to develop any meaningful baselines for what would have happened without the project or policy. Evaluation using MCDA should use the same criteria as the appraisal in order to ensure 'fair' comparability. However MCDA contains no valuation of costs and benefits and so is only able to compare the predicted outcome with the actual outcome in terms of criteria. This assessment can form the basis of a qualitative assessment of whether the project has performed better or worse than expected, but this cannot by quantified as it would be in CBA. It would be inappropriate to compare the project with the proposals rejected in the appraisal stage because these did not happen and so it would not be a like for like comparison. Stakeholders need

to be involved in both the assessment of the project or policies performance against the criteria and in developing an overall view as to the performance of the project. This assessment will provide feedback for the future of this decision area.

CBA

At the detailed level CBA cannot provide a rationale, and this must (and does in practice) come from elsewhere. But it is important to remember that at the conceptual level the rationale for CBA is fixed by the method, and this rationale is to increase societal welfare according to economic theory. Specific objectives will come from previous experience and a wider narrative about problems and opportunities. Other tools will help to refine these.

It may be difficult to work out which ecosystem services are likely to be affected. If so it may be helpful to conduct an assessment of the land use change, land management change, resource requirements and waste production entailed by the proposal. Each of these will then point to possible changes in ecosystem service provision.

It is very important that CBA starts as early as possible in the appraisal process, whilst there is still significant opportunity to alter the design or the project of policy. CBA's significant data demands often act as a barrier to this, due to the level of work required. The solution is therefore to use *scoping values,* first order approximations of the true value, in order to allow these values to guide further refinement of the plans. Once options have been limited to a few front runners, more accurate values can be developed, and one a final scheme is chosen more rigour still is required.

CBA requires the explicit statement of the assumptions used to produce the result. When these assumptions have a significant impact on the result they should be recalculated using several different assumptions in order to show the sensitivity of the result to the assumption. These uncertainties must be clearly reported the summary results, rather than hidden by simply taking the central estimate. Where uncertainties are unquantifiable or tenuously quantifiable this should be spelt out.

CBA presents difficulties for decision making for Sustainable Development, because the values it captures are those of the current generation. This is exemplified by the use of a formal *discount rate*, which is a percentage by which future benefits are reduced per year they are into the future. The standard *discount rate* in the UK reduces benefits and costs fifty years into the future to less than two per cent of undiscounted value. Many CBAs limit themselves to a 25 year time horizon in anyway. As will be becoming obvious the results of CBA are very sensitive to the discount rate, which is concerning because it is the hardest input to justify objectively (Weitzman, 2001). There we recommend developing values based on both the *standard discount rate* and a *sustainability discount rate* of zero for a timeframe of

200 years. This should alert you to any significant sustainable development issues. A technical justification for the *sustainability discount rate* is contained in the appendix, because our recommendation differs from central government guidance.

CBA is often conducted without any stakeholder consultation, or are consulted on once they are fairly developed[1]. Instead we recommend that you should consult relevant stakeholders at the initial stage of deciding which costs and benefits are relevant. This may create challenges in terms of valuation for your economists. There are two solutions for difficult to value costs and benefits. Firstly, a first order approximation of the value may be used, if this is clearly highlighted. Secondly, the cost or benefit may be reported outside the central cost: benefit ratio in an extended CBA. Stakeholders should certainly be consulted again, before a final decision is made, but depending on the scale of your project there may be several worthwhile iterations of asking for views on your economic values and resulting decisions.

For some 'difficult to value' costs or benefits you may decide to use deliberative valuation. This has significant advantages when the public do no immediately know what value they place on a cost or a benefit without further discussion. There are significant risks however. The way the discussion is framed may lead people towards a high or a low value. Alternatively your sample may be unrepresentative of the wider population, either due to insufficient attention to selection or through deliberate stakeholder capture. Our view is that provided these risks are actively managed deliberative valuation has an important contribution to make to the participatory decision making we are seeking under the ecosystem approach. In fact, we would go further and suggest that all values produced for the CBA should be subject to 'reality checking' with stakeholders. This is a complex process and would require explaining the scientific and economic evidence underpinning the values to stakeholders. Values should not be changed simply because stakeholders do not like them, because this would undermine the integrity of the process. However, where values are based on assumptions, and alternative plausible assumptions can be used, this maintains the transparency of the CBA.

The CBA process can obscure the social justice implications of a project or policy, unless the distribution of costs and benefits is explicitly considered[2]. We therefore recommend that it is explicitly considered, in quantitative terms if possible, but it not in qualitative terms. There is an additional problem however, in that the CBA process measures what people are willing to spend on a benefit, which effectively gives you one 'vote' per pound of your income. If not corrected for this will place greater weight on the preferences of wealthier people. There is a procedure for

[1] This is the case for Regulatory Impact Assessments, which are based on CBA.

[2] Consideration of the distribution of costs and benefits is one of the strengths of the Regulatory Impact Assessment (IA) process. The IA library contains completed IAs and could be referred to for an example (ref)

correcting for this 'income effect' in central government guidance (HM Treasury, 2003), called equity weighting, and we recommend that it is used.

Policy of project monitoring is not part of the CBA process, but the CBA process should provide a guide as to what data should be sought to evaluate the project later. Effectively, it is important to be able to assess whether the significant costs and benefits have turned out as expected. Often it will not be possible to capture data relating exactly to the benefit concerned, and some proxy figure will need to be collecting. Monitoring indicators should be agreed with relevant stakeholders, which will ensure they are relevant and should make collecting them more efficient.

When evaluating a project using CBA the evaluation should be as close to the original appraisal as possible in terms of its categorisation of costs and benefits, and the assumptions used. This is important because it allows fair comparison of the evaluation with the appraisal. If knowledge has moved on sufficiently by the evaluation stage that you know that some of the previous assumptions were wrong, then the sensitivity of the analysis to that assumption should be conducted in the evaluation and clearly stated. As before there are significant advantages to testing all the values and findings with stakeholders, but this should be a simpler process because assumptions are already agreed and there is no need for deliberative valuation. The evaluation, plus the wider dialogue with stakeholders will provide important feedback, either to the future of the original policy or project, or to future policies and projects.

Further important considerations

The valuation approach is CBA assumes that all decisions are marginal. That is to say that the cost or benefit of the change is considered rather than the resulting total. This is the correct way to make decisions unless there is a risk of cumulative impacts, or threshold effects, which can cause systems to 'jump' to a radically different state (positive or negative). Under these circumstances CBAs marginal assumptions become unhelpful. MCDA does not have the same formal problem in the way that changes to the natural environment are considered, but it's certainly still possible that cumulative impact or threshold effects are not captured. Agreed national limits and regulation are the most obvious indicator of cumulative impact or threshold effects, but users of CBA/MCDA should make checking for this part of their dialogue with experts and stakeholders. Where they do exist it will be difficult to quantify their impact, but it is possible that they could make an otherwise desirable approach undesirable.

The Ecosystem Approach contains a commitment to take the intrinsic value of nature into account in decision making. CBA is an anthropocentric decision-making tool and therefore cannot take intrinsic value into account. Within CBA intrinsic value is

sometimes dealt with by removing certain decisions from the calculation of what is possible, based on national regulation to protect nature for its intrinsic value. Alternatively, significant changes to nature which do not appear to have significant anthropocentric value can appear without a value as part of an extended CBA. Economic theory suggests that people hold non-use values for nature that is the value of its existence even if they will never see or use it. This is as close as CBA can get to intrinsic value, but it comes from a fundamentally different worldview.

Technical appendix

Incorporating the Ecosystem Services Framework into CBA

The Ecosystem Services Framework is now the standard recommended method for considering environment changes in central government, and guidance on how to do so is included as a supplement to the Green Book – the Government's manual on Appraisal and Evaluation (HM Treasury, 2003, Dunn, 2012). This guidance is best practice, but it needs a trained economist to fully make sense of and apply it. Using the guidance will require a broad understanding of the EA and the guidance contains many helpful links.

How CBA is understood

Traditionally neo-classical economists have understood CBA to provide the 'right' answer. That is the project which offers the best cost: benefit ratio for a given investment is the one which will most increase social welfare. This belief requires strong assumptions about the perfection of markets and people's rational decision making ability, and places a high degree of trust in the quality of the analysis. Unless distributional and equity issues are explicitly considered, it also means ignoring these. Some senior economists now argue that CBA should be understood as a useful exploration of costs and benefits, but should not be understood as a rational decision-maker (Turner, 2007). This understanding fits with government practice in that projects do go ahead which show negative cost: benefit ratios, but strong political will is required to drive them through. This issue of how CBA is understood is important to implementing an EA, because CBA effectively has an inbuilt understanding of how people's individually expressed preferences add up to improved social welfare, which is in tension with the deliberative approach in EA.

Justification for a *sustainable development discount* rate of zero

There is provision within the Green Book for producing a sensitivity discount rate. That is to ask 'how would these results look different with a different discount rate?' The guidance calls for a sensitivity discount rate to be used in project which 'involve very substantial and, for practical purposes, irreversible wealth transfers between

generations' (Lowe, July 2008). This seems unduly restrictive, as a wide variety of projects, when the cumulative impact is considered, may have significant impacts on future generations. Therefore a sensitivity discount rate should be calculated for all projects to show the sensitivity of the conclusions to our assumptions about the future.

The official guidance recommends removing the pure time preference (impatience) element of the standard discount rate, which lowers it to 3 per cent (Lowe, 2008). This approach however retains two assumptions which we might wish to question. It assumes that the long-term growth rate of the economy over 30 years will be 2 per cent per year. It also assumes that all forms of capital are substitutable with each other – that is to say that increased material consumption will compensate for reduced environmental quality or health. These assumptions seem insecure enough to test the sensitivity of our recommendations to them. Therefore a sensitivity analysis should be conducted which uses a sensitivity discount rate of zero. Using a rate of zero creates a problem in that costs and benefits therefore stretch forever into the future, and so an arbitrary time horizon will need to be selected, and we recommend 200 years. For results calculated under this sensitivity discount rate it is the orders of magnitude of the values that are significant. Clearly, there may also be costs and benefits which are significant and unquantifiable, and these should be clearly reported.

References

Dodgson, JS, Spackman, M, Pearman, A & Phillips, LD 2009. Multi-criteria analysis: a manual.

Dunn, Helen 2012. Accounting for environmental impacts: Supplementary Green Book guidance. HM TREASURY & DEFRA. http://www.hm-treasury.gov.uk/d/accounting_environmental_impacts.pdf.

HM Treasury 2003. The Green Book: Appraisal and Evaluation in Central Government. London.

Lowe, Joseph 2008. Intergenerational wealth transfers and social discounting: Supplementary Green Book guidance. HM TREASURY. http://www.hm-treasury.gov.uk/d/4(5).pdf.

Lowe, Joseph July 2008. Intergenerational wealth transfers and social discounting: Supplementary Green Book guidance. HM TREASURY. http://www.hm-treasury.gov.uk/d/4(5).pdf.

Pearce, DW & Turner, RK 1990. *Economics of natural resources and the environment*, Johns Hopkins Univ Pr.

Turner, R.K. 2007. Limits to CBA in UK and European environmental policy: retrospects and future prospects. *Environmental and Resource Economics,* 37**,** 1, 253-269.

Weitzman, M.L. 2001. Gamma discounting. *American Economic Review,* 91**,** No.1, 260-271.