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Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Carolus, J. F., Hanley, N., Olsen, S. B., & Pedersen, S. M. (2018). *A Bottom-up Approach to Environmental Cost-Benefit Analysis*. University of St. Andrews. Discussion Papers in Environment and Development Economics, No. 2018-03

University of St. Andrews

Discussion Papers in Environment and Development Economics

http://www.st-andrews.ac.uk/gsd/research/envecon/eediscus/

Paper 2018-03

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JEL codes: B41, D61

A bottom-up approach to environmental Cost-Benefit Analysis

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ABSTRACT: Cost-Benefit Analysis is a method to assess the effects of policies and projects on social welfare. CBAs are usually applied in a top-down approach, in the sense that a decision-making body first decides on which policies or projects are to be considered, and then applies a set of uniform criteria to identifying and valuing relevant cost and benefit flows. This paper investigates the possible advantages, prerequisites and limitations of applying CBA in what may be considered an alternative, "bottom-up". Instead of starting out with a pre-defined policy option, the suggested approach begins with the underlying environmental problem, and then assesses costs and benefits of various strategies and solutions suggested by local and directly affected stakeholders. For empirical case studies concerning two river catchments in Sweden and Latvia, the bottom-up CBA approach utilises local knowledge, assesses plans which are not only developed for local conditions but are also likely to be more acceptable to local society, and sheds additional light on possible distributional effects. By not only benefitting from, but also supporting participative environmental planning, bottom-up CBA is in line with the growing trend of embedding stakeholder participation into environmental policy and decision-making.

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KEY WORDS: Environmental Planning, Stakeholder Approach, Participatory Approaches, Ecosystem Services, Water Framework Directive, Catchment Management

ACKNOWLEDGEMENTS: This work was partly carried out in the BONUS MIRACLE project and has therefore received funding from BONUS, the joint Baltic Sea research and development programme (Art 185), funded jointly by the European Union and the Innovation Fund Denmark, Forschungszentrum Jülich GmbH, Latvian Ministry of Education and Science, Polish National Centre for Research and Development, Swedish Environmental Protection Agency, and Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS).

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1 INTRODUCTION

By accounting for market and non-market costs and benefits, Cost-Benefit Analysis (CBA) is a method to assess the effects of policies and projects on social welfare. In CBA, all costs and benefits are monetarised and translated into a single number, the net present value (NPV). This index is usually interpreted in a straightforward manner: a positive NPV means that the social benefits outweigh the social costs of the assessed policy or project. Implementation of the policy or project is thus justified as it represents an efficient reallocation of resources that increases social welfare. Moreover, NPVs can be used to consistently rank a set of mutually-exclusive alternatives. Together with its theoretical foundation in welfare economics through the Kaldor-Hicks compensation test, these features make CBA a highly demanded and widely applied approach to policy and project evaluation world-wide (Hanley & Barbier, 2009).

Usually, a CBA is applied as top-down approach, meaning a central decision-making body (such as a Finance ministry) issues guidance on which policies or projects are assessed, and how the costs and benefits to society are identified and then measured. CBA outcomes are used in the policy development process and as a driver of regulatory decision-making, although rarely as the single decision criterion (Atkinson et al., 2018). In this paper, we contribute to the literature by suggesting a bottom-up CBA approach as an alternative. A bottom-up CBA, we argue, allows a more informed development of regulatory policies. Instead of starting with a policy or project option, this approach begins with an environmental problem, and then assesses costs and benefits of strategies identified by “local” stakeholders in pursuit of addressing this problem. While a top-down CBA can be used to assess the trade-offs of an already-defined set of projects or policies, the bottom-up approach takes advantage of additional case-specific knowledge, and assesses strategies which might be more likely to be accepted by the local society, and are better adapted to local conditions. Moreover, it facilitates the disclosure and possibly triggers discussions of distributional concerns to be considered in policy development, which is not a primary focus of top-down CBA (Hahn & Tetlock, 2008). By not only benefitting from, but also encouraging and supporting stakeholder engagement, bottom-up CBA is in line with the growing trend of embedding stakeholder participation into environmental policy and decision-making (e.g. Reed et al., 2009).

Setting the system boundaries is a decisive step of every CBA and of crucial importance for the results and recommendations that may be obtained (e.g. Pearce et al., 2006). System boundaries establish the terms of reference, referring to both the scope of the object of assessment (the project), and the population whose well-being should be considered. Typically, the latter consists of a national population. In the bottom-up approach, the focus is on selecting those stakeholders whose strategies and preferences in terms of an environmental problem are to be analysed. In doing so, a balance of arguments is needed to enable practical feasibility for the bottom-up approach. First, it needs to be ensured that the boundaries are set in a way that a changing environmental condition primarily affects the welfare of the population within the spatial system, while possible impacts outside the system are secondary at the most and therefore, in this context, deemed negligible. Second, the boundaries need to allow the inclusion of all groups with areas of responsibility being directly connected to the environmental problem, which therefore embody the key agents who should be involved in addressing the problem. While consideration of different groups ensures the capturing of diverse interests and solution options, the inclusion of directly affected agents ensures that those who are most affected by a project get to participate in its appraisal and in implementing solutions, creating a sense of ownership to solutions which is likely to increase the chances of successful problem solving. The proposed bottom-up CBA approach is illustrated by two case studies, the Helge and Berze river catchments, located in Sweden and Latvia respectively.

After providing a background on CBA in Section 2, the potential role of bottom-up CBA in environmental planning, and the associated conditions to ensure its validity and practicability are outlined in Section 3. In Section 4 we empirically investigate the application of bottom-up CBA based on the two case studies, followed by the discussion of the results in Section 5. In Section 6, the circumstances under which bottom-up or top-down CBA approaches should be preferred are discussed, whilst conclusions follow in Section 7.

2 CBA AND THE POLICY PROCESS

In the history of CBA, opinions are divided over whether the outcome of the CBA is the decision or just an input to decision making. There has also been discussion over whether it is the preferences of individuals (consumer sovereignty) or decision-making agents (political sovereignty) which should be relevant for the decision making (cf. Banzhaf, 2009). CBAs are usually conducted in what we refer to here as a top-down approach. This means that a central decision-making body decides on the set of policies or projects, which costs and benefits to society are to be assessed, and how to value these impacts. For instance Arrow et al. (1996) stress that "values […] assigned to program effects […] should be those of affected individuals" (p. 222), yet argue that, in order to compare the evaluated regulatory decisions across multiple areas of government (e.g. health, transport, energy), there is a need of overall consistency in terms of which impacts to include and what prices to use to value them, which implies a top-down approach. This means that, even when ensuring some participation due to consumer sovereignty, a conventional CBA does not usually allow for much influence over decision-making by those parties impacted by the project (Pearce et al., 2006).

The influence of CBA in real-world decision-making is somewhat limited, yet is the method increasingly used as a tool to inform public policy decisions (Hahn & Tetlock, 2008; Hockley, 2014; Pearce et al., 2006). Hahn and Tetlock (2008) identify an important contribution of CBA in the process of policy development, for instance by preventing the adoption of "economically unsound regulations" (p.79) and eliminating "obviously bad proposals" (Hockley, 2014, p. 285). Apart from its role in the policy formulation stage, Atkinson et al. (2018) have identified cases with CBA as one tool within regulatory decision-making.

Besides of its straightforward interpretation and the possibility of including impacts that might otherwise be ignored (Sunstein, 2000), ex-ante CBAs come not only with a high data demand, relying on predictions of future variables and estimations of monetary values of non-market goods, but also with the equally challenging problem of quantifying the physical effects of a project. Bertram et al. (2014), amongst others, argue that closing all existing data gaps needed for a comprehensive CBA is not achievable, and relying on current data does not solve the underlying uncertainties. Likewise, and due to practical and methodological challenges of environmental valuation, Klauer et al. (2016) consider a full-scale CBA to be warranted only in cases where considerable effort is justified. Finally, a "lack of participation can easily engender opposition to a project or policy, making it difficult to implement and costly to reverse", while greater "[p]articipation may . . . produce better policy and project design" (Pearce et al., 2006, p. 285). However, top-down CBA does not do much to encourage such participation. An alternative way would consequently be the use of CBA as bottom-up approach. By extending the conception of consumer sovereignty, it is possible to take on board not only the preferences or choice of affected individuals regarding the valuation of impacts, but also regarding their preferences in terms of strategies of how these impacts can be best managed.

3 AN ALTERNATIVE: "BOTTOM-UP CBA"

Instead of starting with a policy decision, a bottom-up approach analyses the "multitude of actors who interact at the operational (local) level on a particular problem or issue" and focuses on the "strategies pursued by various actors in pursuit of their objectives" (Sabatier, 1986, p. 22). Such problems or issues therefore serve as the starting point of a bottom-up approach, and thus determine the relevant actors. Being commonly accepted as one component in environmental planning (Human & Davies, 2010), the benefits of including local stakeholders in policy planning processes go beyond its democratic value and the possibilities of describing societal values in an improved way (Beierle & Konisky, 2001). There is evidence that bottom-up approaches may result in advantages in terms of information and implementation, for instance due to harnessing local knowledge which in turn enhances innovation, effectiveness, or trustworthiness amongst stakeholders (Beierle & Konisky, 2001; Graversgaard et al., 2017; Ostrom, 2010). Participative planning is also in line with political guidelines such as the Water Framework Directive or Principle 11 of the Convention on Biological Diversity (Convention on Biological Diversity, 1993; European Commission, 2003).

Focusing on a specific environmental problem, a bottom-up CBA approach enables local stakeholders to discuss their knowledge, views, preferences and perceptions of the problem, and to subsequently suggest problem-solving strategies. The costs and benefits of the suggested strategies, as experienced and perceived by the stakeholders, are then be assessed and fed back into the participatory process. Stakeholders could then discuss this new input, i.e. the outcome of the CBA, and accordingly re-evaluate, validate and potentially adjust their suggestions for problem solving strategies. Such a bottom-up CBA approach would allow stakeholders to not only decide upon (i) the strategies to be assessed, but also (ii) which impacts should be considered as relevant for the welfare of the respective society. By contrast, in a top-down approach, both decisions (i) and (ii) are left to external experts (cf. Arrow et al., 1996).

3.1 CONDITIONS FOR USING BOTTOM-UP CBA

We argue that the validity and practicability of bottom-up CBA rests on meeting three main conditions, which are now outlined.

Condition 1: No pre-defined choices

In line with the underlying assumption that local stakeholders decide upon the actions to address an environmental problem which will be included in the CBA, the first condition is that such actions (that is, possible projects or policies) are not pre-defined by the analyst or regulator. This condition is crucial to achieve the main objectives of the bottom-up approach, which are (1) to generate strategies to address an environmental problem which represent the preferences of local stakeholders and are formulated within and adapted to the context of local conditions, as well as (2) to reveal the costs and benefits of these strategies as experienced and perceived by the affected actors.

Condition 2: Identification of relevant stakeholders

The results obtained from the bottom-up CBA are dependent upon the input of the selected stakeholders. Therefore, identifying who the stakeholders consist of in each case is key. Compared to top-down CBA, the subject of the analysis in the bottom-up approach is how affected stakeholders prefer to deal with an environmental problem, which therefore dictates the set of stakeholders (Reed et al., 2009). Consequently, the second condition is to include all stakeholders who are relevant to the environmental problem. Building on Freeman (1984) and Savage et al. (1991), this comprises individuals, groups or other organisations that can affect or are affected by either the environmental problem or its resolution. This includes economic actors with agency, along with victims and beneficiaries impacted by (i) the environmental problem itself, (ii) the changing condition of the problem, or (iii) the suggested strategies producing such a change.

Depending on the subject of the analysis, the number of stakeholders may be very high, and so for practical reasons only a sub-set can be included in the process. However, if the included stakeholders do not represent the interests of the society at large, i.e. every stakeholder matching the second condition, neither will the outcome of the CBA. To ensure the completeness of interests when limiting the number of participants, who comes forward as being representative of each stakeholder group should be carefully considered. Dealing with an environmental problem, this may include participants from farmers' unions, environmental NGOs, local agencies or other interest groups, reflecting diverse interests and stakes in the problem. Nevertheless, if the number of relevant participants is unfeasibly large, there might be a need to define additional criteria, such as geographical, demographic or impact-related boundaries (Reed et al., 2009). Such restrictions, however, come with limitations for the bottom-up CBA, which will be revisited in the third condition.

To be able to react to emerging findings during the participative process, for instance if strategies developed as part of the bottom-up CBA process to address the environmental problem have an effect on or are affected by new stakeholders, the analysis requires a dynamic process where stakeholders can continuously be added or replaced. In general, the selection can be done by different means, such as stakeholder mapping (Bryson, 2004), focus group interviews, snow-balling sampling or social network analyses (Reed et al., 2009).

Condition 3: Representative scale

In order to ensure that selected stakeholders fully represent all parties who are directly connected to the environmental problem but also that not “too many” parties participate to make the process workable, it may be necessary to restrict the geographic scale of a bottom-up CBA. This can be problematic for two reasons. First, many environmental problems are characterized by transboundary impacts and are therefore likely to affect social welfare beyond customarily-defined system boundaries which will often be administrative borders. For instance, emissions of a coal-fired power plant can have an impact on regional air pollution. CBA, however, considers only impacts occurring and being identified by the stakeholders within the defined boundaries which will often be delineated by municipality, regional or country borders. Impacts outside the defined system boundary will thus be neglected, even if they occur as a result of the (non-)implementation of strategies within the system boundaries, such as an improved filter on the power plant, or a law allowing to keep it in operation without any changes. Second, use or non-use values of goods or bads which are generated within the system boundaries, yet are held by actors outside the boundaries, may be neglected.

The third condition consequently implies that bottom-up CBA may only be considered as sufficiently comprehensive if (i) the defined system boundaries allow the inclusion of all relevant stakeholder groups, as defined in the second condition, (ii) most of the costs and benefits are experienced or held by people within the defined system boundaries, and (iii) impacts outside the system are marginal. We refer to such a situation as achieving a useable representative scale.

However, if conditions (1) – (3) cannot be met, it may still be both practical and useful to undertake a partial, bottom-up CBA. This may apply if the main intention is to use bottom-up CBA as a tool to support stakeholder participation, or if the fields of application are environmental matters with apparent and significant national or international non-use values which, however, come at a cost for local actors.

3.2 The Role of Bottom-up CBA

Following Hockley (2014, p. 289), who noted that "[d]emand for CBA will be highest if it helps decision makers deliver consequences demanded by citizens and/or if citizens directly incentivise its use", CBA can be an ideal tool to foster participative environmental planning when the stakeholders themselves support the process and the outcome of the CBA. These symbiotic characteristics are more likely associated with bottom-up than with top-down CBA, and may result in practicable, targeted and accepted policy recommendations with clear implications regarding their possible impact on society's welfare. By drawing on the mechanisms describing possible impacts on the output quality of participatory environmental planning, as summarised by Kochskämper et al. (2016), the role of bottom-up CBA in terms of the integration of local knowledge, stakeholder dialogue, and acceptance is outlined below. Furthermore, the role of CBA in integrating bottom-up outcomes in policy making is addressed.

Integration of local knowledge

By assessing costs and benefits of strategies suggested by different stakeholder groups in pursuit of targeting self-identified pressures related to an environmental problem, the integration of local knowledge is the linchpin of a bottom-up approach. Stakeholders can provide more specific information, which might go beyond the knowledge of external or high-level experts (Kochskämper et al., 2016). Their experience with local settings is particularly beneficial due to the high degree of heterogeneity in local environmental conditions. It is therefore believed that local stakeholders can identify case-specific pressures more accurately, and have a deeper understanding of the practicability and performance of possible response strategies. Besides identifying possible solutions, stakeholder input can relate to determining relevant benefits and costs, as well as their values. Furthermore, they may be better informed about the range of possible direct and opportunity costs of the strategies, if they would affect their professional or interest areas (e.g. impacts on agricultural land quality).

Stakeholder dialogue

By definition, one would expect stakeholders to prioritise their own wellbeing over a broader society's welfare. However, by developing a better understanding of each other's interests and preferences, stakeholders are more likely to develop new solutions that maximize mutual gains, often including environmental benefits (Ansell & Gash, 2008; Brody, 2003; Delli Carpini et al., 2004; Kochskämper et al., 2016). Environmental concerns are nevertheless subjected to and frequently offset by competing interests, both within and outside a participative planning process (Albert et al., 2017; Kochskämper et al., 2016). An economic perspective can support the integration of the values of nature conservation into decision-making (Albert et al., 2017), for instance due to two crucial attributes of CBAs. First, multiple impacts which emerge from implementing certain strategies can be considered. Second, monetary valuation can be "a pragmatic tool to guide analysis and to allow informed comparisons" (Sunstein, 2000, p. 1094). As cost and benefit values are expressed in comparable and consistent terms both across stakeholders and over time, a bottom-up CBA enables stakeholders to consider impacts beyond those most apparent for one interest group yet not necessarily for another. In other words, by drawing on monetary terms detached from interests, the discussion may not only be about determining the most important impacts, but also about finding strategies with impacts generating the highest overall benefits.

The participatory process is no guarantee that the different involved interest groups will necessarily agree on strategies, as evidenced by Kochskämper et al. (2016). However, "CBA is a way of encouraging people to think about, describe and then measure the multiple impacts of different policies and projects in a consistent manner. In principle, this can be done in a very transparent way which encourages debates over the important parameters of a decision" (Hanley & Barbier, 2009, p. 308). While, from a CBA point of view, it is objectively evident if a strategy benefits society or not, these very discussions shed light on the preferences and reasons for aversion by single stakeholders or groups. Disagreement can for instance occur regarding the practicability of the actions, or the reasonability and valuation of the impact assumptions. Moreover, stakeholders might agree with the assumptions regarding an action, yet disagree with the implementation (from an executor point of view) or non-implementation (from a victim or beneficiary point of view). Such cases would occur if private costs exceed private benefits. Consequently, the CBA process facilitates disclosure and triggers discussions of the distributional effects of costs and benefits. Furthermore, by assuming that the stakeholder participation is embedded in a process with delegated power to influence decisions such as the participatory planning of the Water Framework Directive, one could imagine that presenting strategies with a demonstrably negative NPV (which might indicate disproportional costs of the action) would decrease the likelihood of their implementation. Bottom-up CBA as such would encourage stakeholders to reconsider and search for better solutions.

Acceptance and implementation

A participative planning process fosters dialogue amongst various interest groups and may therefore support outcomes with an increased acceptance by both stakeholders and policy makers (Kochskämper et al. (2016) and references therein). By ensuring early involvement and increasing transparency, both listed by Rowe and Frewer (2000) as evaluation criteria of participation processes, a bottom-up CBA can support the building of acceptance amongst stakeholders, for instance in terms of the costs and benefits identified as relevant by other stakeholders. By revealing and including "different, often opposite, views and interests regarding a problem" and converting them into coherent and comparable units, the CBA can contribute in "making problem definitions more adequate and broadly supported" (Bulkeley & Mol, 2003, p. 151). In addition to supporting the generation of acceptance, the CBA itself reflects the outcome of the participation, and thus pictures (to some extent) accepted strategies.

4 EMPIRICAL CASE STUDIES

To empirically assess the process of bottom-up CBA, we applied this method in two case examples. Both cases, the Helge River in Sweden and the Berze River in Latvia, experience issues related to water quality, which constitutes the focal environmental problem of the bottom-up CBA. Both catchments require actions to improve the water quality. Table 1 provides a brief overview of the characteristics of the two case examples.

Table 1 Case study areas

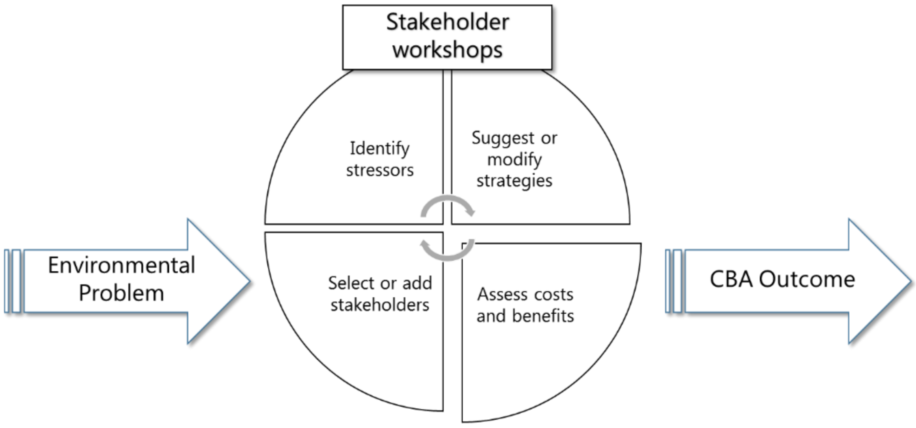
	Berze River catchment (Latvia)	**Helge River catchment (Sweden)**
Country	Latvia	Sweden
Area	904 km^2	4 725 km^2
Inhabitants	26,500 (50 % in urban areas)	131,000 (97 % in urban areas)
Land use	50 % agriculture, 42 % forest	65 % forest, 15 % cropland, 7 % grazing land, 2 % urban area
Identified water quality problems according to the Water Framework Directive	Bad and poor ecological quality with respect to nutrients	Eutrophication of surface water due to phosphorus and nitrogen. Some waters have problem with heavy metals (mercury)

Source: BONUS MIRACLE (2015)

The application of bottom-up CBA in both examples is desirable due to two reasons: First, as evidenced by the Water Framework Directive or the Marine Strategy Framework Directive, there is a demand for both CBA and stakeholder involvement in cases like this[1]. Second, over-exploitation of water resources is a typical example for a market failure, which, for instance in the case of eutrophication, leads to insufficient incentives to reduce nutrient discharge. By internalising costs and benefits, the CBA can reveal this market failure and be used to assess possible remedies.

The bottom-up CBA development process included several stakeholder workshops in both case areas, in which the assessed costs and benefits of suggested strategies, the strategies themselves, and the stakeholder composition were discussed, adjusted and validated (
Figure 1).

Figure 1 Bottom-up CBA development process



System Boundaries and selected stakeholders

The geographical and hydrological river catchments were set as system boundaries for the bottom-up CBA, which is seen as ideal to facilitate the cooperation of all relevant actors (European Commission, 2016). Most of the impacts of potential actions occur within the respective catchments. Selected stakeholders were directly connected to either the water quality of the respective river catchment, or to management strategies developed throughout the CBA process (Table 2). It is notable that the Berze River case included a high share of public sector participants of centralised institutions, whereas the stakeholder groups in the Helge River case consisted mainly of decentralised institutions.

Table 2 Represented stakeholder groups and agencies

Stakeholder Group	Agencies (Helge)	Agencies (Berze)
Public Sector	▪ Water Association, Helge River ▪ District Council, Kristianstad ▪ Swedish Forest Agency ▪ Initiative Model Forest in Helge å ▪ Environment Committee, District of Hässleholm ▪ Nature Management School in Osby ▪ Municipal Office of Osby	▪ Ministry of Environmental Protection and Regional Development ▪ State Environmental Services ▪ Ministry of Agriculture ▪ Rural Support Service ▪ Latvian Environment, Geology and Meteorology Centre ▪ Health Inspectorate ▪ Municipalities

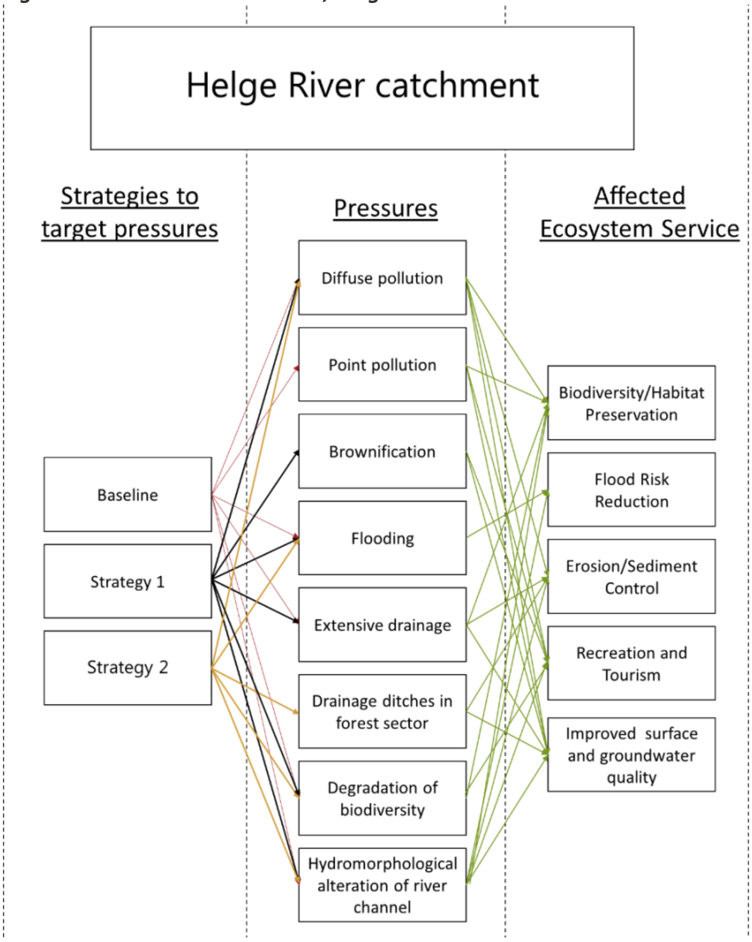
[1] For instance, the Water Framework Directive emphasises the role of both public participation and economic analyses to balance the various interests and increase enforceability (European Commission, 2016). It thereby suggests CBA as one way of identifying disproportionate costs (European Commission, 2009). The EU Marine Strategy Framework Directive requires member states to conduct CBAs before new measures are implemented (European Commission, 2008).

		▪ County Councils, Jelgava and Dobele
Civil Society	▪ Swedish Society for Nature Conservation (SSNC), Kristianstad ▪ Swedish Society for Nature Conservation (SSNC), Kronoberg	▪ Latvian Fund for Nature ▪ Baltic Environmental Forum
Private Sector	▪ Farmers ▪ Forest-Owner association ▪ Regito Research Center on Water and Health	▪ Farmers Parliament and Farmers ▪ Hydropower plant Operators ▪ Wastewater treatment plant operators ▪ Property Management Group

Management Strategies

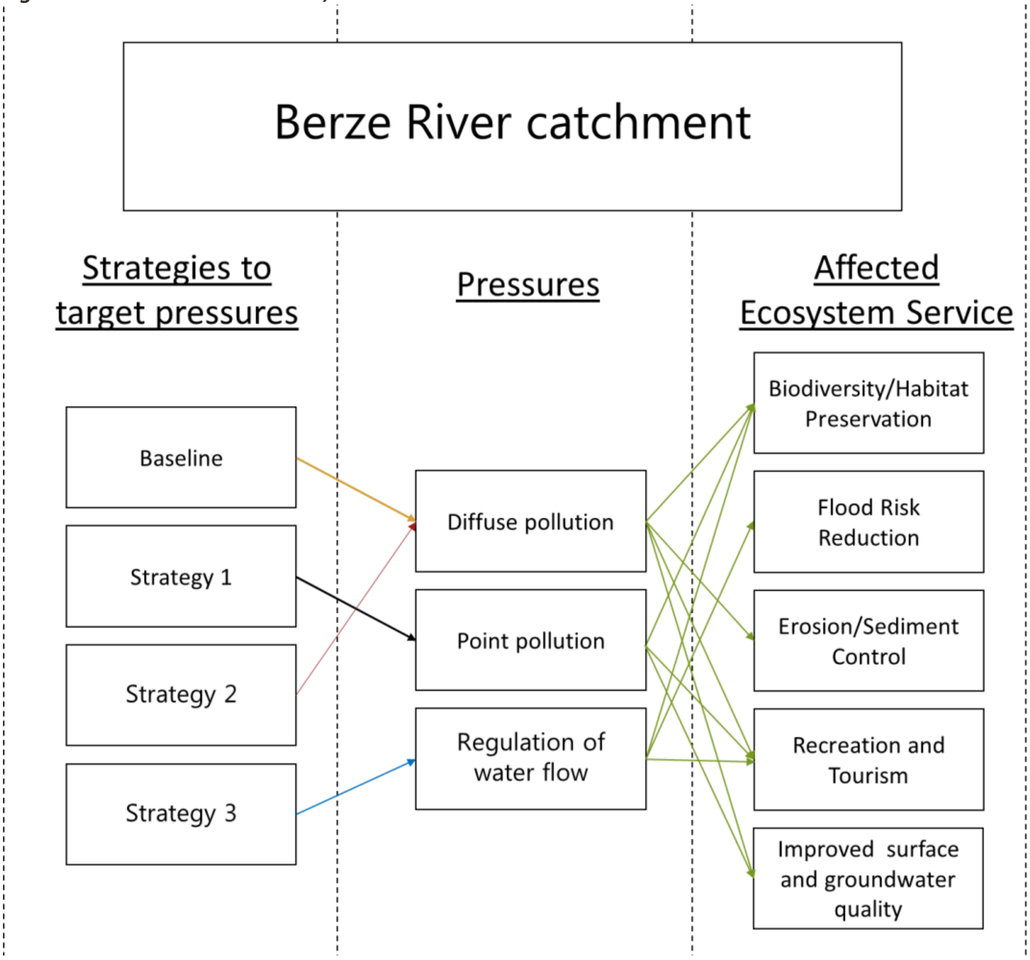
Following the bottom-up approach, the stakeholders first identified pressures which they perceive as causal factors of poor water quality within the system. Reaching a common ground on the pressures sets a frame for the strategies to reduce such pressures, as subsequently suggested by the stakeholders. Based on the inputs of the stakeholders, the relevant benefits of management actions in terms of ecosystem services which are compromised by the pressures were identified as illustrated in Figure 2 and Figure 3. Based on the identified pressures, the stakeholders suggested and then discussed measures which would, in their opinion, reduce these pressures and thus affect the environmental problem positively. Due to their preference to focus on the short- and medium-term over the longer-term implications, the stakeholders decided to set the time horizon for analysis as from now to 2030, which means that only costs and benefits occurring during this period will be considered in the subsequent CBA.

Figure 2 Assessment Framework, Helge River catchment



Source: Own figure (inspired by Bertram et al., 2014; Grizzetti et al., 2016)

Figure 3 Assessment Framework, Berze River catchment



Source: Own figure (inspired by Bertram et al., 2014; Grizzetti et al., 2016)

It is necessary to establish a baseline ("business as usual" scenario) which reflects the current and future status of the environmental condition without additional societal response (Börger et al., 2017). Table 3 presents the baseline and possible future strategies suggested by the stakeholders. The baseline shows the measures related to water quality which are already or will be implemented to the end of the current EU Common Agricultural Policy (CAP) period in 2021. This includes measures of the first and second pillar of the CAP, the Water Framework Directive, and, in the case of the Helge River, measures by the County Administration and the municipalities. The alternative strategies represent potential additional measures, as suggested by the local stakeholders. To allow for comparisons, the baseline measures are assumed to continue until 2030, while the potential measures are assumed to be implemented in 2021 and last until 2030.

In the Helge River case area, the developed set of strategies are not mutually exclusive as they focus on different areas of the river. The suggested measures are reported in Table 3. While the measures of the first strategy focus on the restoration of the aquatic ecosystems, the second strategy targets sustainable water management in forestry, which is the dominant land use practice and seen as a major source of nutrients and organic matters discharge.

Table 3 Stakeholder-suggested measures

Measure		Scope	Unit
Helge River Catchment			
Baseline measures			
Liming	by doser	4262.4	tons/year
	by boat	673.6	tons/year
	by air	365.5	tons/year
Buffer Strips		181	ha
Wetlands		210	ha
Individual Sewage Emission	Reduction to normal level	5431	facilities
	Reduction from normal to high level	1657	facilities
Non-productive field margins in agricultural landscape		300	ha
Upgrade or removal of traditional water regulating dams		78	units
Strategy 1			
Stormwater Ponds		15.35	Ha
Flood plain		150	ha
Wetlands		597.4	ha
Phosphorus Wetlands		58.65	ha
Riparian Zones		400	ha
Re-Meandering		82.5	km
Strategy 2			
Restoring Wet Forest		35,000	ha
Transition from coniferous to broadleaved forest		500	ha
Riparian Zones in Forest Landscape		600	ha
Fishway or Removal of Migration Obstacle	Size 1	3.1	m
	Size 2	184.48	m
	Size 3	31.3	units
Culvert Replacement		4	units

By contrast, the strategies developed for the Berze River catchment, reported in Table 4, focus on specific pressures. These relate to separate stakeholder groups and consist of fewer measures. The first strategy aims to decrease point source pollution due to discharges from wastewater treatment plants (WWTP), while the second strategy targets diffuse pollution by reducing nutrient run-off from agricultural land. Due to diverse stakeholder preferences, two alternative versions of the second strategy were developed;
While all other measures are alike, the width of the ecological buffer strips along the main stem is 10 meters in Strategy 2a, and 5 meters in Strategy 2b. The objective of the third strategy is to decrease the pressure of water regulation due to hydropower plants.

Table 4 Stakeholder-suggested measures

Measure	Scope	Unit
Berze River Catchment		
Baseline measures		
Crop Diversification	41,134	ha
Ecological Focus Areas	2,930	ha
Perennial Grassland	1,201	ha
Organic Farming	1,305	ha
Strategy 1		
Rural WWTPs [100 - 300 PE]	3	units

Strategy 2a		
Ecological Buffer Strips [2 + 10 m]	741	ha
Sedimentation Ponds	4	ha
Optimisation of fertilizer use – 20% reduction of mineral fertilizer application	32,320	ha
Strategy 2b		
Ecological Buffer Strips [2 + 5 m]	540	ha
Sedimentation Ponds	4	ha
Optimisation of fertilizer use – 20% reduction of mineral fertilizer application	32,320	ha
Strategy 3		
Fishways	5	units

Identification of Physical Impacts of the Strategies

While results for the mitigation of nutrients exist for the respective measures and catchments (Table 5 and Table 6), expert elicitation was used to assess the likely impacts in terms of the additional ecosystem services (Table 7 and Table 8). The experts chosen for assessing the qualitative impacts on ecosystem services are researchers from the Stockholm Environment Institute (SEI) and Linköping University (LIU) for the Helge River catchment, and from the University of Latvia for the Berze River catchment. All of them were involved in projects covering the respective catchment. The assessment is therefore based on both scientific knowledge (e.g Maes et al. (2016) or the NWRM catalogue[2]) and experience with the respective catchment. Since this assessment may be considered a qualified guess that is inherently uncertain, we chose a qualitative ranking of the relative impact according to a negative, none, low, medium or high impact. Furthermore, the impact on the whole catchment is considered, i.e. the spatial scale of the measure is taken into account. The rating describes the experts' overall assessment of the likely impacts caused to the implementation of the strategies, compared to no implementation (Table 7 and Table 8).

Table 5 Total nutrient mitigation at the river outlet, Helge catchment

	Total N reduction (in kg/year)	Total P reduction (in kg/year)
Baseline	18,077	2,083
Strategy 1	88,089	5,563
Strategy 2	4,500	135

Source: MIRACLE project results

Table 6 Total nutrient mitigation at the river outlet, Berze catchment

	Total N reduction (in kg/year)	Total P reduction (in kg/year)
Baseline	2,115	79
Strategy 1	687	184
Strategy 2a	86,474	2,654
Strategy 2b	86,474	2,455
Strategy 3	0	0

Source: MIRACLE project results

Table 7 Experts' rating of impacts in Helge river catchment

Ecosystem Service	Baseline	Strategy 1	Strategy 2
Biodiversity/Habitat Preservation	Medium	Medium	High
Flood Risk Reduction	Low	Medium	High
Erosion/Sediment Control	Medium	Medium	High
Recreation and Tourism	High	High	Medium
Improved surface and groundwater quality	Medium	Medium	High

[2] http://nwrm.eu/measures-catalogue

Table 8 Experts' rating of impacts in Berze river catchment

Ecosystem Service	Baseline	Strategy 1	Strategy 2a	Strategy 2b	Strategy 3
Biodiversity/Habitat preservation	Low	Low	High	Medium	High
Flood Risk Reduction	Low	None/Negligible	Medium	Medium	Low
Erosion/Sediment Control	Medium	None/Negligible	High	High	None/Negligible
Recreation and Tourism	None/Negligible	Low	Medium	Medium	High
Improved surface and groundwater quality	Low	Low	Medium	Medium	None

Valuing Impacts

Whenever original benefit information is missing for the respective case area, CBA methodology makes use of transferred benefits (value transfer). Czajkowski et al. (2017) argue that, in the context of water quality in the Baltic Sea region, an income adjusted value transfer performs the best. Consequently, the following formula was used to transfer benefits in the two case studies, to express environmental impacts of the prospective measures in monetary terms:

$$WTP_{transferred} = WTP_{study}\left(\frac{Income_{transferred}}{Income_{study}}\right)^{elasticity} \quad [1.1]$$

An income elasticity of value of unity was applied, which was identified as leading to the lowest transfer errors (Barton, 2002; Czajkowski et al., 2017; Czajkowski & Ščasný, 2010; Lindhjem & Navrud, 2015; Pearce, 2006). The income is based on the gross domestic product per inhabitant at 2016 market prices, as indicated by the European Commission (2017). Furthermore, as valuation studies often measure the willingness to pay for a positive (or negative) change versus the status quo, the experts' rating scales, which consist of five levels, must be adapted if necessary. This is done as follows:

Table 9 Conversion legend

Valuation Study	Rating
Positive Change	High Impact
	Medium Impact
Status Quo	Low Impact
	No Impact
Negative Change	Negative Impact

Relatively to other ecosystem services, a wide range of primary valuation studies related to aquatic ecosystems is available (Markandya, 2016), which allows for benefit transfer for most of the impacts. Databases, such as the Environmental Valuation Reference Inventory (EVRI) or the TEEB Valuation Database provide a useful overview of various options in this regard, for instance in terms of what studies are available, and how to allocate unit values to the respective ecosystem services. To include the most suitable values, and to reduce the potential transfer errors which may occur due to transferring from too dissimilar sites (Kaul et al., 2013), the following priorities were set to identify and select valuation studies: similar site in (1) the same country, (2) in one of the other MIRACLE case study countries[3], and (3) in a country within the Baltic Sea Region.

[3] Germany, Poland, Latvia and Sweden

Table 10 Monetary benefit values (before and after transfer)

Ecosystem Services	Benefit	Original Unit Value	Transferred Unit Value (to Berze)	Transferred Value (to Helge)	Source
Biodiversity/Habitat Preservation	High number of different species of plants and animals, their population levels, number of different habitats and their size in the river ecosystem in the next 10 years.	4.6 Zloty [2007]/household/month	8.7 EUR [2016]/person/year	246.0 SEK [2016]/person/year	Birol et al. (2008)
	Habitat for endangered and protected species (Forest)	8.0 EUR [2004]/person/year	not used	129.5 SEK [2016]/person/year	Meyerhoff et al. (2009)
	Landscape diversity (Forest)	4.6 [2004]/person/year	not used	14.2 SEK [2016]/person/year	
	Species diversity (Forest)	12.5 [2004]/person/year	not used	190.3 SEK [2016]/person/year	
Provision of Food Recreation and Tourism Biodiversity	Improve fish variety from “moderate” to “very high”	42.2 SEK [2014]/person/month	15.8 EUR [2016]/person/year	543.8 SEK [2016]/person/year	Ek and Persson (2016)
	Improve fish variety from “moderate” to “high”	25.5 SEK [2014]/person/month	9.6 EUR [2016]/person/year	329.3 SEK [2016]/person/year	
	Change fish variety from “moderate” to low”	-287.6 SEK [2014]/person/month	-107.6 EUR [2016]/person/year	-3709.8 SEK [2016]/person/year	
	Non-use Value - Salmons passing fish ladders (salmon increase between 1000 – 6000 per year)	51.0 SEK [2004]/person/year	2.2 EUR [2016]/person/year	77.2 SEK [2016]/person/year	Håkansson (2009)
	Access to the riverbank for recreational purpose	6.6 Zloty [2007]/household/month	12.5 EUR [2016]/person/year	352.9 SEK [2016]/person/year	Birol et al. (2008)
Flood Risk Reduction	Reduce flood risk from “high” to “low”	14.5 Zloty [2007]/household/month	27.4 EUR [2016]/person/year	775.4 SEK [2016]/person/year	
Surface water quality Erosion/Sediment Control Recreation & Tourism	Erosion Prevention Grassland	49.0 Dollar [2007]/ha/year	15.72 EUR [2016]/ha/year	541.87 SEK [2016]/ha/year	de Groot et al. (2012)
	Erosion Prevention Woodlands	13.00 Dollar [2007]/ha/year	not used	143.8 SEK [2016]/ha/year	
	Improve water clarity from "moderate" to "clear"	106.4 SEK [2014]/person/month	35.1 EUR [2016]/person/year	1347.1 SEK [2016]/person/year	Ek and Persson (2016)
	Change of water clarity from “moderate” to “turbid and colored”	-199.8 SEK [2014]/person/month	-67.2 EUR [2016]/person/year	-2577.9 SEK [2016]/person/year	
Surface and groundwater quality (Ecological Status)	Benefits of Nitrogen (N) and Phosphorous (P) reduction	10.5 EUR (1995)/kg N reduction	21.3 EUR (2016)/kg N reduction	190.0 SEK [2016]/person/year	Interwies et al. (2012) based on Turner et al. (1999)

Applying the Net Present Value Test

To account for time preferences of individuals and following the national official recommendations, a social discount rate of 5 % is used for Berze River catchment (Ministry of Finance Latvia, 2016), and 3.5 % for Helge River catchment (Swedish Transport Administration, 2016). While the baseline strategies result in negative NPVs in both cases, all suggested strategies for improving water quality show higher benefit-cost ratios (BCR) and, except of Strategy 2a and 2b in the Berze River catchment, a positive NPV[4].

Table 11 and Table 12 give an idea about the distributional impacts of implementing possible measures relative to the baseline. Assuming that (a) no support mechanisms exist (as for instance the EU payments for some baseline measures), and (b) the respective land owning or controlling group must bear all costs related to a measure, it becomes evident that costs and benefits are not experienced by the same actors. For example, Strategy 3 for the Berze River catchment shows by far the highest BCR. However, while the hydropower sector is assumed to be responsible for all costs related to establishing fish ladders, the respective actors gain little, if at all, from the resulting benefits due to an improved biodiversity, recreation or tourism. Furthermore, the CBA results reveal the challenges in terms of potential conflicts amongst the different actor groups when it comes to agreeing on a single strategy. In the case of the Helge River catchment, the agricultural sector has to bear the largest share of the costs in Strategy 1, while this applies to the forestry sector if Strategy 2 would be implemented. Although some re-distribution/compensation mechanism might be implemented, the breakdown of the costs and benefits sheds light on the complexity of distributional effects which occur when implementing measures to improve environmental problems: Even if resulting in positive NPV, the strategies produce both losers and winners from a welfare economics point of view.

However, the CBA results do not only transparently expose the cost and benefit implications of implementing strategies, but also the potential weaknesses of the environmental planning process. For instance, the stakeholders were not constrained by a financial budget. Strategy 2 for the Helge River catchment illustrates the resulting issue clearly. While the total benefits of Strategy 2 are the highest, its total costs exceed the costs of Strategy 1 by a factor of almost 6.

Table 11 Costs and Benefits Summary[5], Helge river catchment (Present Value (PV) in million SEK, 3.5 % social discount rate)

Costs and Benefits	Baseline (2017 – 2030)	Strategy 1 (2021 – 2030)	Strategy 2 (2021 – 2030)
Total costs	854.773	328.055	1,868.961
Total benefits	264.544	2,541.001	3,297.560
Costs to			
Agricultural Sector	not applicable	256.281	0
Forestry Sector	not applicable	0	1,754.578
Hydropower Sector	not applicable	0	114.382
Others	not applicable	71.774	0
Benefit			
Biodiversity/Habitat Preservation	-	565.285	776.064
Flood Risk Reduction	-	-	761.920
Erosion/Sediment Control	-	-	2.430

[4] In a sensitivity analysis, we found that the signs of the NPV of all strategies do not change if the time period is extended to 2050 and 2100, or the social discount rate is changed to any value between 0 and 25 %, ceteris paribus.

[5] The full CBA spreadsheets are available from the authors upon request.

Recreation and Tourism	-	346.805	422.637
Water Purification	264.544	305.183	10.771
Reduced Water Colouration	-	1,323.728	1,323.728
NPV	519.229	2,212.946	1,428.590
BCR	0.31	7.75	1.76

Table 12 Cost and Benefits Summary, Berze river catchment (PV in million Euro, 5.0 % social discount rate)

Costs and Benefits	**Baseline (2017 – 2030)**	**Strategy 1 (2021 – 2030)**	**Strategy 2a (2021 – 2030)**	**Strategy 2b (2021 – 2030)**	**Strategy 3 (2021 – 2030)**
Total costs	28.330	0.360	35.320	34.918	0.405
Total benefits	11.218	0.688	32.247	29.890	6.915
Costs to					
Agricultural Sector	not applicable	0	35.320	34.918	0
Hydropower Sector	not applicable	0.360	0	0	0.405
Benefit					
Biodiversity/Habitat Preservation	-	-	4.324	3.224	4.324
Flood Risk Reduction	-	-	4.840	4.243	-
Erosion/Sediment Control	10.339	-	0.077	0.057	-
Recreation and Tourism	-	-	2.203	2.203	2.592
Water Purification	0.879	0.688	20.802	20.163	-
NPV	-17.112	0.329	-3.074	-5.029	6.510
BC ratio	0.40	1.91	0.91	0.86	17.06

5 EXPERIENCES GAINED FROM THE CASE STUDIES

Were the "Conditions for Use" met?

Earlier in the paper we set out three conditions which we argued should be met if a full-scale application of bottom-up CBA was warranted. These conditions were (i) no pre-defined choices (ii) identification of relevant stakeholders and (iii) representative scale. As evidenced by the Water Framework Directive, which emphasises public participation and does not dictate pre-defined measures, the first condition is fulfilled: stakeholders in both case study areas could freely decide upon strategies to improve water quality in their respective river catchment without any further restrictions apart from the strategies achieving such improvement. On the contrary, the CBA results reveal that setting some guidelines, such as financial budget constraints, might be reasonable to improve the likelihood of integrating the outcomes in actual policy making.

The second condition is more difficult to answer. Whilst the underlying environmental problem determined the selection of stakeholders in both case studies, and the included actors certainly match the definition of affecting or being affected by either the insufficient water quality or the change of it, completeness is uncertain. However, allowing that (1) stakeholders could continuously be added, (2) spatial and demographic differences were considered, and (3) actors from the public sector, civil society and private sector were represented, the likelihood of having overlooked important stakeholders is minimal. Yet, for instance the high share of public sector participants of centralised institutions in the Berze River case study may have caused the suggestion of rather conventional measures, compared to the strategies in Helge River, where the stakeholder groups appeared to be more balanced and consisted mainly of decentralised institutions.

Choosing an appropriate scale is the third condition for the bottom-up CBA. The Helge River represents a share of 0.39 %, and the Berze River 0.04 % of the rivers' water inflow to the Baltic Sea. In terms of nutrient flows, the choice of setting the geographical and hydrological river catchments as system boundaries thus ensures that impacts outside the system boundaries may be considered marginal. However, due to the complexity of ecosystem services, it is difficult to estimate the relevance of additional physical impacts beyond the catchment level. An indication can be given by the values held by people for the consequences of water quality improvements. For instance, the wetland area "Kristianstad Vattenrike", which is partly situated in the Helge catchment, is a preserved UNESCO Biosphere reserve with "landscapes and biological values of regional, national and international importance" (UNESCO, 2011) and various endangered or rare species (UNESCO, 2006). This is indicative of significant values being held by society outside the river catchment. The total benefits from the implementation of water quality improvement measures are thus likely to be under-represented in the outcome of the bottom-up CBA.

Integration of local knowledge

The integration of local knowledge can be observed in both case study areas, and at different stages of the CBA. Due to the explicit consideration of local stakeholder suggestions, the analysed strategies are generally perceived as practicable and shaped by local knowledge in terms of feasibility and costs. However, while the additional and specific knowledge input is likely to improve the output quality of the CBA, uncertainties regarding some costs and the actual impacts remain.

Pressures: The integration of additional local knowledge into the process became evident during the identification of the relevant pressure. Due to the considerable role in national and EU legislation, nutrient pollution and flooding were initially expected to be the main pressures in both catchments. However, based on the perception of affected stakeholders, the regulation of the river flow was additionally identified as problematic in Berze River. Water colouration[6] appeared to be the dominant issue in Helge River with the widest negative impact on various actors.

Strategies: Measures in both case areas were added, removed or revised throughout the CBA process. In general, the strategies in Berze consist of rather conventional measures with a focus on the exact location and scope. By contrast, measures suggested in Helge additionally consist of innovative measures, which are in such form not yet implemented in the area, such as riparian zones or wetlands in forest landscapes. In the Berze River case, an example in which local knowledge turned out to be particularly valuable was in developing strategies to reduce point-source pollution. While the performance of the existing Waste Water Treatment Plants (WWTPs) was seen as insufficient so that upgrading of WWTPs and the connection to remaining households was initially suggested, it was identified as irrelevant after further stakeholder investigations which detected that further upgrades would not be technically feasible. Consequently, outdated and underperforming WWTPs were identified and suggested to be renewed, as evidenced by strategy 1.

Costs: stakeholders appeared to have a good understanding of possible costs of the strategies, either based on own or their networks' knowledge. In the Helge River case, where existing cost information of innovative

[6] also referred to as "brownification" (e.g. Tuvendal & Elmqvist, 2011)

measures was largely unavailable due to a lacking experience, stakeholders could for instance indicate the opportunity costs in terms of respective land prices or gross margins in areas where the implementation would be feasible. While this allows for making qualified approximations, investment or administration costs in such cases often remain uncertain.

Impacts: The local stakeholders had a clear understanding of what impacts they wanted to achieve, yet sometimes different opinions on how to achieve them.

Stakeholder dialogue

By converting complex data sets and connections into easily interpretable outcomes, the CBA supported dialogue in both case studies, mainly due to highlighting the importance of considering multiple benefits and revealing how assumptions and uncertainties influence outcomes and conclusions. By developing a dynamic, spreadsheet-based CBA template which could be altered during stakeholder meetings, stakeholders could discuss possible outcomes of the strategies by means of changing the working assumptions, such as benefits, time horizons, physical impacts, or costs and scopes of measures. Using CBA to foster discussions did not necessarily lead to reaching agreement amongst the stakeholders in terms of best practices; different sentiments remain. In Helge, actions to restore a natural river flow were intended to promote biodiversity, yet an opposing group acknowledged that changing the flow might be counterproductive, as biodiversity-rich grassland areas could be flooded. As evidence regarding the precise biodiversity effects was not available, the CBA was unable to produce decisive recommendations, but it still supported dialogue by presenting and contrasting existing valuations of grassland and river biodiversity, as well as values of additional benefits emerging due to river restoration or keeping grasslands (e.g. de Groot et al., 2012). The CBA was in practice not able to shed light on every disagreement nor provide evidence for the optimal solution, but discussions and concerns of stakeholders around these uncertainties illuminated key issues which policy makers should consider when considering or promoting certain measures.

Acceptance and implementation

Although bottom-up CBA may increase the acceptance of implementing certain measures, stakeholders resisted some of the measures discussed on grounds of cost. The willingness to implement costly strategies goes hand in hand with two factors, namely compensation and the demand for evidence. Compensation usually needs to fully cover the expenses of the implementation and maintenance of any implemented measure, including administrative costs and lost incomes. Otherwise the uptake of measures is unlikely. This is exemplified by buffer strips in the Berze River catchment, which are, although seen as appropriate and beneficial, are not implemented on a broad scale due to insufficient payments. Interestingly, some stakeholders took the view that the required compensation must not necessarily be of monetary nature, but could be achieved by different means: The forestry sector in Helge indicated the willingness to allow forest areas to be flooded, if, in exchange, fish ladders (by-passes) are installed at hydropower plants.

Compensation is however not the only requirement to reach a willingness to implement measures. The Helge River case revealed the demand for more evidence. The forestry sector is seen by most stakeholder groups as a main source of organic matter discharge to the river, yet evidence on what really causes water colouration is missing. While stakeholders of the forest sector expressed willingness to implement measures, as pictured in strategy 2, they also required scientific proof that these measures would really result in positive impacts.

In conclusion, even when a bottom-up CBA raises acceptance by showing that social benefits of a certain strategy would outweigh the costs, non-coercive implementation remains unlikely if private costs exceed private benefits unless compensated from the social surplus. Hence, redistribution mechanisms need to be considered. In addition, research suggests that the implementation of voluntary agri-environmental measures might be compromised due to concerns farmers concerns over social disapproval for being paid for "doing nothing" – as might be seen to be the case with land retirement to reduce nutrient pollution (Burton et al., 2008). Working with bottom-up CBA might lead to a change of perceptions of stakeholders by highlighting the positive impacts of such measures. This could lead to an increased willingness to implement voluntary environmental measures.

6 PERSPECTIVES ON THE APPROACHES: BOTTOM-UP, TOP-DOWN OR BOTH?

The case studies suggest that bottom-up CBA supports participatory processes, and generates additional local knowledge beyond existing information, which may serve as input to facilitate better and more well-informed decision-making. The remaining question is when the bottom-up CBA approach should be applied, and under which circumstances the top-down CBA, or a combination of both methods can be beneficial.

From the welfare economics perspective, the interpretation of bottom-up CBA outcomes is in fact equal to that of top-down approaches, since it simply re-applies the Kaldor-Hicks test to a differently-defined group of winners and losers. Furthermore, when it comes to monetary valuation, the use of social discount rates or the calculation of NPV, the outcome of bottom-up CBA is likely to entail similar uncertainties to a top-down CBA. What differs is who suggests the strategies to be assessed, and who decides what should be considered as relevant for the welfare of the respective society. Contrary to the conventional top-down approach, bottom-up CBA leaves these decisions to local and directly affected stakeholders.

The choice which approach should be applied thus depends on the aim of what should be appraised. If the intention is to assess how social welfare is affected by an already-defined set of projects or policies, a top-down CBA must be used. Alternatively, if the intention is to generate strategies to address an environmental problem, whereas such strategies should represent the preferences of stakeholders, and are both formulated within and adapted to the context of local conditions, as well as to reveal the costs and benefits of these strategies as experienced and perceived by the affected actors, the bottom-up approach should be used. In this way, the outcome is, at least to some extent, more likely to be accepted by local people, which is not necessarily the case for environmental policies developed by top-down experts (Carr, 2002; Smith, 2008).

However, due to assessing different settings and thus generating different findings, top-down and bottom-up CBA are not mutually exclusive. By providing local insights, bottom-up CBA can deliver complementary information for decision-makers, supporting and increasing the quality of top-down CBAs, which may be required when it comes to projects or policies affecting a larger scale. For instance, Hanley and Black (2006) found that benefits of implementing the Water Framework Directive in Scotland generally outweigh the costs, but also indicate hotspots: Impact, cost and benefit estimates were shaped by a high degree of uncertainty, possibly induced by varying ecological and socioeconomic factors in large-scale analysis. By providing local information, the bottom-up approach can validate the assumptions of top-down CBA and thus reduce possible conflicts.

If the input variables and outcomes across both approaches do not match, the CBAs will transparently point out where the assumptions differ, which may increase the understanding of discrepancies amongst external decision-makers and local stakeholders. In such cases, two possible scenarios emerge for decision-makers who draw on findings of both approaches: On the one hand, the stakeholders' perceptions may turn out as reasonable and should therefore be, in one way or another, accounted for. This can either be achieved by adapting the projects or policies, which are assessed in the top-down approach, to better match local preferences, or by using the newly generated information to develop compensation, support or tax schemes. On the other hand, stakeholders' perceptions may be distorted, for instance due to neglecting budget constraints or variables which affect wider societal welfare. This information can inform decision-makers as to where to raise awareness or counter possible misinformation, such as relevant costs or benefits the stakeholders are not considering or aware of. This in turn may increase the societal acceptance of new policies or projects.

If all input variables in both CBA approaches are similar, and yet the outcome is not, applying both approaches gives further indications on distributional effects. The sub-set of society represented by the bottom-up CBA, may lose (or win) due to implementing a certain strategy, while the wider society, represented by the top-down CBA, may gain (or lose).

7 CONCLUDING REMARKS

A bottom-up CBA is a beneficial approach to generate and assess strategies which represent the preferences of local stakeholders and address a given environmental problem. A bottom-up CBA represents a useful complement to a conventional top-down CBA, as it assesses different settings and thus generates different insights. Since it draws on many of the same economic principles as top-down CBA (such as monetary valuation and social discounting), the bottom-up CBA delivers insights which can be incorporated within a broader CBA analysis. The advantages of bottom-up CBA go beyond the assessment of perceived costs and benefits of strategies addressing an environmental problem. As the evaluated strategies are formulated within and adapted to the context of local conditions, and as both the strategies and the impacts represent the preferences and the perception of the local society, policy-makers gain valuable information of what measures may be feasible and which impacts are perceived as important. This additional knowledge can be used to adjust top-down policies, improve support or tax mechanisms, or to raise societal awareness in terms of important yet neglected impacts, costs or benefits. Moreover, bottom-up CBA can support participative environmental planning by fostering stakeholder dialogue and increasing acceptance, for instance by increasing transparency in decision-making, and contributing to making their outcomes more valid from a political perspective.

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