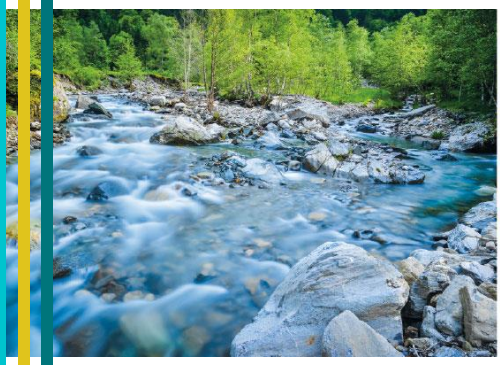

Evaluation of ecosystem-based management responses in AQUACROSS case studies – Executive Summary[1]

Overview

Following the Assessment Framework developed within the project, AQUACROSS case studies investigated how the concept of ecosystem-based management (see Gomez et al. 2017, D3.2) could be made operational for supporting the achievement of the objectives of the EU Biodiversity Strategy to 2020. Ecosystem-based management (EBM) is seen as an incremental piecemeal process, with case studies (CS) aiming to advance on its different principles. As part of the cyclical EBM planning process (Piet et al. 2018, D8.1), case studies identified societal goals based on policy objectives and stakeholder preferences, they described the current socio-ecological system (SES), and proposed an EBM approach based on their analysis. The latter is evaluated for its expected performance against existing alternatives, based on three criteria: (1) effectiveness, (2) efficiency, and (3) equity and fairness.

1 EBM approaches in AQUACROSS case studies

Translating EBM principles into operational management changes the way the SES is analysed and influences the management alternatives that are proposed. The latter are compiled in **EBM plans**, which aim to restore and preserve the resilience and the sustainability of the whole SES, while at the same time achieving other societal goals. EBM plans consist of (1) **measures**, which have the potential to contribute to a predetermined environmental objective, and (2) **policy instruments**, which have the potential to help implement measures, as well as to enhance the capacity of the social system to improve the overall governance of ecosystems.

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[1] *This is the executive summary of AQUACROSS Deliverable 8.2: Evaluation of ecosystem-based management responses in case studies. The full version of this document can be found at www.aquacross.eu in project outputs.*

The detailed assessment of the SES in the case study areas led to tailored approaches, and confirmed the prevailing view that with the ambition to implement EBM for aquatic realms, no standard solutions are conceivable. Whereas AQUACROSS assessments in some case studies led to the proposition of different types of measures compared to current plans (e.g. CS4: Lough Erne – increasing lake water levels and reducing nutrient input from agriculture instead of physically removing invasive alien species), other case studies propose the same measures as in current plans, but allocated differently following a spatial optimisation approach (e.g. CS2: Intercontinental Biosphere Reserve of the Mediterranean (IBRM); CS3: Danube River Basin; CS7: Swiss Plateau – optimising the selection of river restoration sites). Again, in other case studies, the need for adapted policy instruments seemed to prevail as the most important change needed to reach biodiversity targets (e.g. CS8 – considering for example increased monitoring, increased stakeholder involvement as well as financing instruments to share costs).

In comparison to currently ongoing and planned management practices for the same area, case studies advanced on a diversity of EBM components. These include in particular the consideration of ecological integrity, biodiversity, resilience and ecosystem services, the development of multi-disciplinary knowledge, and the building on social-ecological interactions, stakeholder participation[2] and transparency.

2 Evaluation of expected performance

A diversity of tools and methods has been mobilised for the evaluation of the expected performance of the EBM approaches compared to the site-specific baseline situation.

For the evaluation of **effectiveness**, the expected performance is compared to the environmental objectives, which a case study aims to reach – and to the performance of the current management approach towards reaching the same objectives. In the case studies that have a strong modelling component (e.g. CS2, CS3 and CS7), effectiveness indicators are included in the modelling approach as important part of the optimisation criteria. In the North Sea case study (CS1), the AQUACROSS linkage framework (see Costea et al. 2018 (D4.2) and Teixeira et al. (D5.2)) has been used as a basis for a (semi-quantitative) risk-based assessment. In other case studies, the knowledge base on biophysical relationships and the missing information on expected impacts of measures did not allow for a quantitative evaluation of effectiveness. In the Azores case study (CS8), a qualitative approach has been chosen to identify the drivers and pressures which will be influenced by the proposed policy instruments.

The evaluation of **efficiency** looks at the costs of measures and at changes in ecosystem services that are induced by their implementation within the ecological system. Estimates of financial costs have been made in several AQUACROSS CS, and have partly been included in the modelling exercise (e.g. restoration costs in CS2). In the Lough Erne (CS4) and the Swiss Plateau (CS7) case studies, a cost-effectiveness analysis has been carried out. In the Danube river basin (CS3) a

[2] *An evaluation of the involvement of stakeholders in the AQUACROSS case studies is undertaken as part of the project. It aims, amongst others, at identifying best practice in how to consider stakeholder views and inputs in the context of EBM.*

cost-benefit-approach has been followed. In CS2 (IBRM), ecosystem services have been taken into account qualitatively through the use of the ARtificial Intelligence for Ecosystem Services modelling platform (ARIES). The appraisal of the expected quantitative changes in ecosystem service provision following the implementation of the proposed EBM plan, however, remained challenging in all of the case studies, due to uncertainty regarding the importance of biophysical effects of measures. Despite difficulties in estimating financial implications and changes in ecosystem services, efforts for evaluating efficiency provide good starting points for more in-depth assessment and data collection exercises. Collected elements feed furthermore in stakeholder discussions, and increase transparency of decision making processes by clarifying areas which are subject to uncertainty.

Finally, the evaluation of **equity and fairness** investigates how costs and benefits are allocated among different groups of the society. Reflections concentrated either on the spatial allocation of interventions compared to the baseline situation (e.g. CS2, CS3 and CS7), or on the main stakeholder groups which would either need to bear the costs of measures – or which would benefit from improved ecosystem services (e.g. CS6 and CS8).

What are the results of the evaluation?

Evaluating the expected effectiveness of measures in reaching environmental improvements requires sound knowledge on biophysical links as well as good data availability. Uncertainty linked to the best choice of methods and the sufficiency of data is omnipresent in the exercise. The latter is also particularly true for the modelling approaches, which are applied in several AQUACROSS case studies. In addition, results from spatial optimisation models are to a considerable extent dependent on some decisions taken by modellers (e.g. regarding the target level for biodiversity which is chosen), or limited through some shortcomings which which cannot be handled by the models (e.g. difficulties in considering ecological connectivity in river systems) (Kakouei et al. 2018, D7.3). Having these limitations in mind, which are not AQUACROSS specific, all evaluation results from the CS show a better performance for their EBM solutions compared to the baseline situation in terms of effectiveness.

The results of the cost-effectiveness analysis (efficiency) show that the EBM approaches allow for a better budget allocation when accounting for ecosystem services or biodiversity aspects within the optimisation modelling (CS2 and CS7). In the case of the Danube (CS3), results indicate that restoring sites proposed through the optimised selection strategy are both more effective and less costly. The spatial optimisation approach applied both in CS3 and CS2 implicitly considers trade-offs between ecosystem services that are (a) rather compatible with nature conservation objectives (e.g. recreation, or partially flood protection) versus (b) extractive / provisioning ecosystem services, which are rather incompatible, as they intervene with the ecosystem. Taking these trade-offs into account reduces costs imposed on those which currently benefit from these provisioning services. In the Irish CS (CS4), cost-effectiveness analysis allowed the identification of win-win-measures.

Evidence from case studies with regards to the evaluation of equity and fairness did not allow determining whether EBM approaches improve equity. However, available information indicates that they help change the perspective on a given problem, by increasing transparency about who will benefit from the proposed changes and who might bear the costs.

3 Pre-conditions for ensuring a successful implementation of EBM

Prospects for further adoption of EBM are positively correlated with the degree of institutional coordination in place, the ability to assess and compare the effectiveness of integral responses, the capacity to integrate knowledge on the SES in a way that can actually be taken up by stakeholders and, last but not least, the social ability to put all this at the service of social debate in order to build cooperative decisions.

AQUACROSS results tend to suggest that EBM is rather better considered in higher-level institutions, which have the possibility to take a more global vision on management decisions. Cooperation agreements among stakeholders, which define a set of welfare relevant objectives that can be reached through enhancing and protecting ecosystems, seem to be a suitable tool to support the implementation of EBM approaches.

Among the factors that may impede the adoption of EBM is the impression that single-purpose, traditional options solve problems without creating new ones. EBM deals with reshaping ecosystem processes and functions and the outcomes of these processes are often uncertain. To inform complex EBM approaches, scientific knowledge needs to apply a transdisciplinary and integrated perspective and consider the whole SES. Science needs to provide knowledge on why things happen and how they could be improved, and should clearly target the practical needs of decision makers.

4 Conclusions

Some key messages are summarised in the following:

- EBM is a complex endeavour, requiring a cyclical approach, and a stepwise advancement on EBM principles. Aspiring incremental, partial improvements with possibilities for adaptations will render the implementation of EBM more feasible and realistic. AQUACROSS case studies provide good examples for others aiming at progressing towards EBM.
- Results of the AQUACROSS work emphasise the need to more systematically differentiate between different types of ecosystem services. Due to existing trade-offs, the overall goal of enhancing and protecting ecosystem services needs further refinement.
- The knowledge produced in AQUACROSS is particularly useful and relevant for describing and critically analysing the current situation of the SES. However, generated knowledge is less developed for assessing the dynamics of the system, indicating how ecosystem services and benefits would change when specific status components are affected. This methodological challenge is not specific to EBM, but acknowledging its effect on several ecosystem services at once is particularly important to promote the implementation of EBM compared to single-purpose measures.

- Any ambition to look at a management problem from a more holistic perspective, taking both the ecological and the social system and their interactions into account, necessarily increases complexity as well as uncertainty linked to assessments. AQUACROSS case studies show that, even in situations with important knowledge gaps, information generated helps provide a critical look at different options for addressing biodiversity and water management issues. Co-developing solutions with stakeholders, as an integral part of EBM, plays a particularly important role.
- EBM approaches show both better effectiveness and efficiency compared to existing management practices in the case study areas. EBM implementation, however, is a social and political challenge rather than merely a technical one. On the institutional side, the successful implementation of EBM entails breaking institutional silos and building coordination mechanisms within and across policy domains. On the technology side, EBM requires comprehensive solutions rather than individual ones coping with one problem at a time. On the knowledge side, EBM faces us with the challenge of mobilising transdisciplinary scientific knowledge in a way that stakeholders can use in order to support collective policy responses.

5 Outlook

The results of the work undertaken within AQUACROSS case studies seem to highlight that the failure to meet the EU Biodiversity Strategy to 2020 objectives is largely based on the lack of knowledge and suitable assessments to inform policy choices on ecosystem restoration options. Only a better understanding of how the ecological systems work and interact with humans will enable us to design effective policy/restoration action that will bring real ecological benefits.

At the same time, policy makers need to realise that almost every other public policy choice they make impacts biodiversity and nature. Coherence is achieved when the final decision has considered all potential impacts. The balance of decisions could change with a higher effort in the identification of co-benefits that are often ignored because the system fails to acknowledge them due to narrow focus policy assessments or political decisions. In addition, identified win-win measures should be rendered compulsory for the next phase of the EU Biodiversity Strategy to 2020.

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