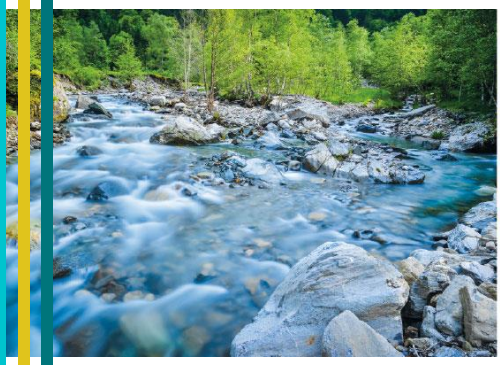


Making ecosystem-based management operational[1]

Overview

Ecosystem-based management (EBM) is an integrative approach that can help to sustainably manage and protect biodiversity by addressing challenges related to governing aquatic ecosystems. While there are many definitions for EBM that all share certain characteristics, AQUACROSS adopted the definition of EBM as "*an interdisciplinary approach that balances ecological, social and governance principles at appropriate temporal and spatial scales in a distinct geographical area to achieve sustainable resource use*". Scientific knowledge and effective monitoring are used to acknowledge the connections, integrity and biodiversity within an ecosystem along with its dynamic nature and associated uncertainties. EBM recognises coupled Socio-Ecological Systems with stakeholders involved in an integrated and adaptive management process where decisions reflect societal choice.

The AQUACROSS Deliverable 8.1 frames the EBM planning process and sets the basis for the evaluation of the performance of EBM towards achieving societal goals (i.e., EU Biodiversity Strategy to 2020). The operational EBM approach follows the AQUACROSS Assessment Framework, which is put into practice in the eight case studies (CS). The Assessment Framework integrates ecological and socio-economic aspects in one analytical approach and, further, considers relevant aspects for management of aquatic ecosystems, specifically in relation to resilience and uncertainty. This reflects that EBM should be considered an incremental piecemeal process as opposed to a single leap from traditional management to EBM. Together with this requirement to develop an EBM approach that can be applied as part of "adaptive management" and "complex adaptive systems thinking" the result is the development of a cyclical AQUACROSS EBM approach that may be advanced with every iteration of the management cycle.

[1] *This is the executive summary of AQUACROSS Deliverable 8.1: Making ecosystem-based management operational. The full version of this document can be found at www.aquacross.eu in project outputs.*

The Deliverable divides the AQUACROSS EBM approach into four distinct phases:

1. Societal goals: Identification of societal goals based on policy objectives and stakeholder preferences.

2. Description of the socio-ecological system: assessment of the current status, thereby explicitly distinguishing between the ecological system and the social system.

3. Planning an EBM response: For the AQUACROSS EBM approach, this planning phase starts with the pre-screening of alternatives and ends with an EBM plan. In this planning phase, we distinguish between the sub-phases "identification and pre-screening" of measures and policy instruments and "evaluation of expected performance" of measures.

4. Implementation, monitoring and evaluation: This is where the implementation of the management coincides with the initiation or continuation of a monitoring and evaluation program.

Bridging Policies

Developing integrated (across aquatic realms, inter-sectoral and across spatial scales) EBM plans for aquatic ecosystems is challenging, among other things due to complexity of the policy context. The management of aquatic ecosystems is guided by several interrelated European directives that are translated into national and local policy goals and objectives that involve several sectors and local agencies. Ideally, the setting of goals and objectives must be founded on those established at the international and/or EU level but tailored to the local level and the stakeholders involved therein.

However, policy objectives are often incompatible and may thus be a source of potential conflicts which eventually threatens cooperation and collective action. Effective stakeholder engagement is crucial to set societal goals (e.g., policy objectives). In order for EBM to be operational, some level of common understanding and consensus is needed between scientists, policy-makers and stakeholders on the status of aquatic ecosystems and how to improve this.

Furthering Science

A commonly agreed upon and shared representation of social and ecological systems (assessed using indicators and targets) is best co-built with stakeholders. Therefore, AQUACROSS furthers science with the aim to provide stakeholders with a scientific knowledge base that can guide management towards the achievement of the societal goals. This involves a shared perception of problems and setting objectives. This dialogue and interaction between scientists and stakeholders builds the knowledge base required to implement EBM and entails the integration of multiple kinds of knowledge, ranging from hard science to storylines.

Business Innovation

While certain challenges must be addressed through amendments to policy and further coordination between policy realms, other areas can offer opportunities for businesses to close this gap. Societal goals need to be identified and prioritised. One of the main challenges is to identify cooperative responses rather than competitive ones. This requires effective stakeholder engagement in which a common understanding of potential management alternatives and their

effectiveness is created, as well as some transparency concerning the division of responsibilities (roles) and resources. The role of AQUACROSS in this step is to convey knowledge in such a way that it can be understood and used by stakeholders, including businesses, to screen out alternatives and understand the foreseeable consequences of the different courses of action.

The four phases of the AQUACROSS EBM approach

Phase 1 – Societal goals

This phase describes the concrete steps to carry out a policy characterisation of the CS and the definition of policy objectives and societal goals distinguishing:

1. Key threats: This step aims to provide a brief overview of the key threats that may compromise the achievement of societal goals for the protection of biodiversity. A threat typically consists of a list of human activities and the pressures that impacts the ecosystem. This selection should not only reflect the most significant threats, but also their social significance and importance for local actors.

2. Key policies: This step aims to provide an overview of the existing and most relevant policies. This description should include their objectives, targets, current deficits or gaps (difference between current state/status and policy targets), management strategies, administrative body in charge, scale of implementation, stakeholder groups, and funding. Criteria that can be used to select for each local area the most relevant policies include in particular:

    - The identification of specific policies that increase the main threats, i.e. human activities and their pressures leading to the loss of biodiversity in local areas (i.e., key sectoral policy);
    - The identification of specific policies that mitigate the main threat leading to the loss of biodiversity in local areas (i.e., key environmental policy);
    - The identification of best practice specific policy examples, or parts of it, that can be used to promote effective restoration and protection of the type of aquatic ecosystems occurring in local areas;
    - The identification of specific policy that prevents or creates challenges to effective restoration and protection of aquatic ecosystems.

    Policies do not work in isolation. Thus policy instruments can be used collectively to tackle a particular pressure or driver, as part of a well-designed policy mix. Such combinations of policies should be considered when selecting the ones most relevant.

3. Key synergies and conflicts: This step aims to provide an overview of the ways in which the key policies mitigate the threat(s) or reinforce the threat(s), an assessment of the key synergies and conflicts between identified policies, and an evaluation of policy gaps (integrative assessment), which should result in a good understanding of the key opportunities and challenges for developing and implementing alternative EBM options.

Phase 2: Description of the socio-ecological system

The description of the socio-ecological system (SES) constitutes the knowledge base of the AQUACROSS EBM approach, which includes a description of the current status and how this will develop under the current management regime (i.e., baseline scenario) but also allows an evaluation of the performance of any alternative management decisions aimed at achieving the societal goals. In order to inform the decision-making process, this knowledge base needs to be fit for purpose. To that end we have developed two sets of criteria that cover:

- The ecological system in terms of its capacity to co-produce the ecosystem services and abiotic outputs demanded by society. This involves an understanding of the ecological system including its ecological integrity and biodiversity and the human activities and their pressures which co-produce the services demanded by society while simultaneously causing an impact that may compromise achieving societal (environmental) goals. To avoid inaction from overwhelming complexity, a "relevant SES" should be developed, which differs from the "comprehensive SES" in that it only includes those relevant components and their potential linkages for which adequate knowledge is available.
- The social system in terms of its processes and their institutional actors on which the development and implementation of EBM depends. Current drivers and pressures are the outcome of multiple individual decisions regulated by institutions and can therefore be understood as the outcome of a social process in which the ecosystem users, i.e. scientists, managers, authorities, third parties and other stakeholders, who play a differential role in defining the collective or societal goals. Similarly, the planning of the EBM response up to its implementation is based on the collaboration of science, policy and other stakeholders whereas the implementation of the management plans is primarily done by the managers and the users with some input from science.

Phase 3: Planning an EBM response

The main purpose of the planning phase of the EBM response is to achieve societal goals and preserve or restore the resilience and the sustainability of the whole SES consisting of both the ecosystem components and their interactions (i.e., ecological system), but also the governing institutions and markets (i.e., social system). This is why the final outcome of this phase, the EBM plan, consists of two interconnected and structured (yet well differentiated) sets of actions:

- Measures which are integrated into a Programme of Measures (PoM)

  A measure (or environmental measure) is any action with the potential to contribute to a predetermined environmental objective, i.e. to bridge the gap between the current and the desired status of the **ecosystem**. Each measure is defined by a specific configuration, i.e. human activity(s), pressure(s) and ecosystem component(s) that determine its interaction with the ecological system. The impacts of these measures over ecosystems can either be direct, such as in the restoration or protection of ecosystems, or indirect, as a result of targeting pressures, the regulation of the activities of co-producing ecosystem services or affecting their driving factors. Rather than single measures, changes required to take the status of ecosystems to the level required to achieve the societal goals can only be the joint outcome of the successful implementation of a suite of measures, i.e. a PoM.

- Policy instruments which are integrated into an Implementation Plan (IP)

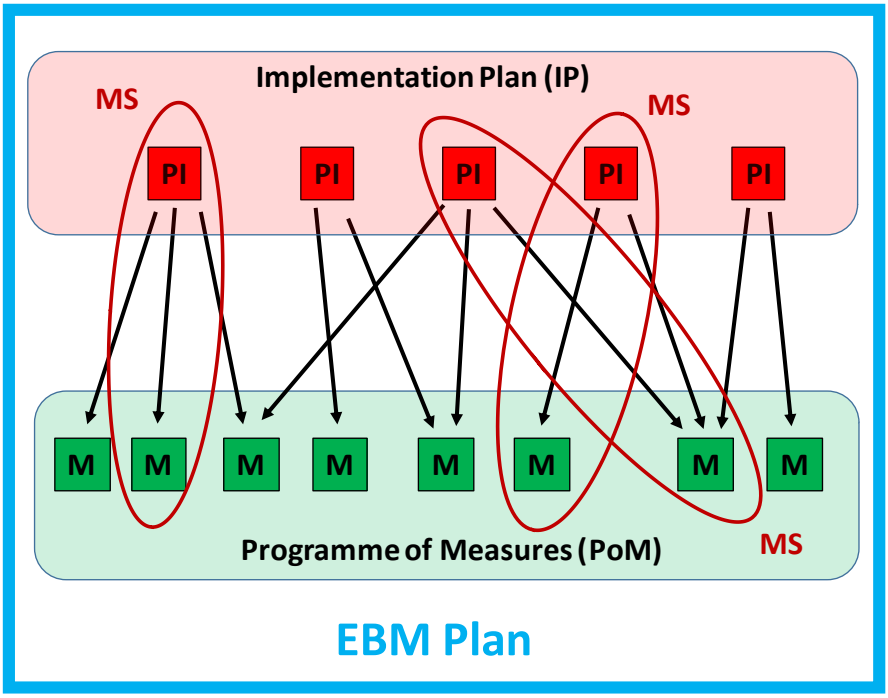
  A Policy Instrument is any action with the potential to contribute to the implementation of the PoM directly or indirectly through an improvement of the institutional set-up. These policy instruments encompass any action designed to improve decision support systems in place, to overcome institutional lock-ins, adapt the legal framework, change water users' behaviour, foster cooperation among stakeholders, develop alternatives to improve the financial feasibility, promote the adoption and swift diffusion of alternative technologies, enforce regulations, etc. Policy instruments are thus not defined on a measure-by-measure basis but rather for the PoM as a whole.

Any combination of a policy instrument and a measure is called a management strategy (MS). The EBM plan therefore consists of many different management strategies (see Figure 1).

For consistency in defining measures, AQUACROSS provides a typology to classify both measures and policy instruments. For instance, measures can be classified according to: (1) where in the SES the measure intervenes, (2) the type of intervention, (3) the time horizon when results are expected; (4) the environmental objective they are aimed to contribute to or (5) by the type of intervention. Similarly, policy instruments can be classified distinguishing e.g. (1) legislative instruments, (2) regulatory instruments, (3) economic instruments, (4) information, awareness-raising and public engagement, and (5) monitoring and research.

Finally, before measures can be considered for the next phase, we recommend a pre-screening to ascertain a priori the various issues that may prevent the management plan from being implemented. A suite of pre-screening criteria are proposed in the Deliverable.

Figure 1: Diagram explaining the elements that make up an EBM plan



Phase 4: Implementation, monitoring and evaluation

For the evaluation of individual EBM plans (PoM + IP), the AQUACROSS evaluation process typically involves three steps:

1. Identification of indicators and their targets

This is where each CS will need to select their CS-specific suite of indicators with a target aligned to the societal goals which they aim to achieve. This target usually represents a healthy state, pristine condition or sustainable level which may be characterised by reference points (or reference levels). To that end we apply a framework compatible with different levels of scientific understanding and data availability which emphasises practical approaches that can be used to evaluate ecosystem status at local, regional, or even global scales. A set of decision trees[2] provide guidance for choosing among three types of reference points (or levels) to use in the assessment of the current ecosystem state:

- *Functional relationships:* a reference level based on an understanding of its functional relationship with environmental conditions. This therefore requires at least an understanding of the functional relationship.
- *Time-series approaches:* a reference level of the same ecosystem or ecosystem component based on some historical status representing a desirable status, e.g. pristine or sustainably exploited. This therefore requires at least a long enough time-series.
- *Spatial comparisons:* a reference level of a comparable ecosystem or ecosystem component elsewhere in the region or across the globe. This requires a comparable situation elsewhere.

These indicators and their targets can then be applied to assess the effectiveness of an individual measure, PoM or entire management plan in terms of their contribution to bridge the gap between baseline conditions and target conditions that would meet the environmental policy objectives.

2. Forecasting and scenarios

Environmental management decisions are based on the prediction of consequences that different management scenarios will have on the likelihood to achieve policy objectives. Such predictions can be derived from expert knowledge, transfer of experience from similar cases, or from models (mathematical, conceptual or otherwise). As (the outcome of) the management decision needs to be justified to the public guidance is provided that help decide if a model is suitable for decision support.

3. Evaluation of management plans

This is based on a comparison of the future performance of an alternative management plan to that of the existing (or "business-as-usual") management plan in terms of their

[2] *A support tool to identify decisions and their possible consequences, outcomes, costs and utility*

outcome (i.e., indicators representative of some policy objective). This evaluation is based on the outcome-oriented criteria:

- *Effectiveness- hitting the environmental target:* This is defined by the contribution of a management plan to bridge the gap between baseline conditions and target conditions that would meet the environmental policy objectives.
- *Efficiency - making the most for human wellbeing:* This refers to the capacity of citizens and social institutions to take advantage of existing opportunities (determined by technology, resource endowments and actual availability, physical and human capital, etc.) to improve human wellbeing in a sustainable way.
- *Equity and fairness - sharing the benefits:* The distribution of benefits and costs across stakeholders must be perceived as fair. Besides the contribution of the management scenarios, if any, to social equity, the legitimacy, or the acceptability of the management plan, requires the perception that its consequences are fairly distributed among the affected parties.

Outlook

Deliverable 8.1 provides the basis to make EBM operational in each of the AQUACROSS case studies and as such is based on all previous outputs of the AQUACROSS project. The work in the project has included the delivery of information on the policy objectives and the consideration of participation of stakeholders in the CS-specific EBM approaches. Furthermore, the previous project work has led to an understanding of the socio-ecological systems, building on a common conceptual basis of AQUACROSS Concept and Assessment Framework, merged with the most recent relevant literature.

An important part of the description of the SES is to identify the main threats (i.e., human activities and their pressures) that compromise the achievement of the societal goals. To that end, we developed a risk assessment methodology that is flexible enough to be applied across case studies. This then guides the development of an appropriate management response followed by a more detailed evaluation of the management options using the forecasting tools developed in AQUACROSS and the exploration of financial models to foster innovation uptake. The lessons learned from this process will in turn provide insights for the review and refinement of the AQUACROSS Assessment Framework, as well as the policy recommendations to be developed within the project in the future.

AQUACROSS Partners

Ecologic Institute (ECOLOGIC)—Germany

Leibniz Institute of Freshwater Ecology and Inland Fisheries (FVB-IGB)—Germany

Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO)—France

Stichting Dienst Landbouwkundig Onderzoek (IMARES)—Netherlands

Fundación IMDEA Agua (IMDEA)—Spain

University of Natural Resources & Life Sciences, Institute of Hydrobiology and Aquatic Ecosystem Management (BOKU)—Austria

Universidade de Aveiro (UAVR)—Portugal

ACTeon – Innovation, Policy, Environment (ACTeon)—France

University of Liverpool (ULIV)—United Kingdom

Royal Belgium Institute of Natural Sciences (RBINS)—Belgium

University College Cork, National University of Ireland (UCC)—Ireland

Stockholm University, Stockholm Resilience Centre (SU-SRC)—Sweden

Danube Delta National Institute for Research & Development (INCDDD)—Romania

Eawag – Swiss Federal Institute of Aquatic Science and Technology (EAWAG)—Switzerland

International Union for the Conservation of Nature (IUCN)—Belgium

BC3 Basque Centre for Climate Change (BC3)—Spain

Contact	aquacross@ecologic.eu
Coordinator	Dr. Manuel Lago, Ecologic Institute
Duration	1 June 2015 to 30 November 2018
Website	http://aquacross.eu/
Twitter	@AquaBiodiv
LinkedIn	www.linkedin.com/groups/AQUACROSS-8355424/about
ResearchGate	www.researchgate.net/profile/Aquacross_Project2

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