



# Scenario Development Processes in AQUACROSS<sup>1</sup>

## Overview

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This summary provides an overview of the AQUACROSS Deliverable 7.2 which provides a review of the current state-of-the-art in scenario development and analysis together with guidance to scenario development within AQUACROSS case studies. Furthermore, the deliverable provides an overview of the scenario development process and methods within AQUACROSS case studies, and supports the on-going preparation of baseline and policy scenarios (as defined in Deliverable 3.2).

Beyond direct use for AQUACROSS, this deliverable exemplifies how ecosystem-based management in aquatic ecosystems can be supported by participatory scenarios. Following up on the AQUACROSS Assessment Framework (AF), attempts are undertaken with this deliverable to pave the way for innovative means to investigate complex, aquatic social-ecological systems. Further, the deliverable presents an advancement of a scenario characterisation suitable for linking multiple input sources, stakeholder processes and model analysis on a case basis.

The main objective of the Deliverable 7.2 is to describe and explain the scenario building processes, reflecting on different information and data sources, types of stakeholder involvement and scenario uses. The document provides guidance on how to develop scenarios, i.e. possible future trajectories of the system, by combining stakeholder processes and modelling in meaningful ways.

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<sup>1</sup> This is the executive summary of AQUACROSS Deliverable 7.2: Scenario Development Processes in AQUACROSS. The full version of this document can be found at [www.aquacross.eu](http://www.aquacross.eu) in [project outputs](#).

## Building on Science and an understanding of aquatic social–ecological systems as complex adaptive systems

The ultimate goal of building scenarios is to assess outcomes from alternative future trajectories through model analysis or planning with stakeholders, or both, to inform decision making. They are a valuable tool to assess possible alternative future pathways or trajectories of an aquatic “social–ecological system” (SES). Aquatic SES refer to the combination and multitude relationships between aquatic–related physical, biological and human systems, such as a lake, an estuary, a catchment, a marine area, etc.

Aquatic SES are typically conceptualised as complex adaptive systems characterised by multiple, complex interactions across multiple scales. Unexpected behaviour and sudden shifts in outcomes are possible. For example, due to multiple human pressures, lakes can shift from a non–eutrophic to a eutrophic state, leading to significant changes in biodiversity, ecosystem functions and services provided. These changes are often labelled as “regime shifts” to indicate that SES can move between different dynamic equilibrium.

Aquatic SES are continuously changing as the result of these complex interactions and external drivers such as climate change impacts. Management of aquatic SES thus needs to be able to deal with change and adapt to expected developments. Scenario development and analysis can be useful to assess the implications of uncertainty about future development and develop measures that are “robust”, in other words that perform well under a range of possible futures.

Scenarios as decision–support–tools face a challenge: on one side, they must rely on validated data and sound scientific insights as a critical condition for their credibility but, on the other, they must have the ambition to become a shared representation by decision makers for both of social and ecological problems and opportunities and alternatives to deal with them. Even a sound scenario based on scientific methods and proven facts would only be relevant for policy action if co–developed with, or accepted by, actors involved in the decision–making process.

Multiple benefits can result from scenario planning in environmental research as well as in ecosystem service and biodiversity management. Among them, scenario planning fosters long–term, complex, and systemic thinking which allows for exploring the dynamics of SES.

The importance of scenario development and planning for biodiversity and ecosystem services was only recently highlighted within the methodological assessment report on scenarios and models within the Intergovernmental Panel on Biodiversity and Ecosystem Services. We follow up on this report and extend their work within AQUACROSS by linking the methods to the AF with a special focus on measures for ecosystem–based management and the integration of resilience principles.

### Fostering Policy Applications and Business Innovation

Scenarios are designed with an explicit link to realistic policy goals, to screen measures and instruments for improved biodiversity and ecosystem service management. The development of participatory scenarios can have several benefits:

- ▶ Because scenarios are co–developed with stakeholders to ensure relevance, they can help increase awareness about policy relevant issues among selected stakeholders and citizens and increase acceptability of decisions.

- ▶ They can help the evaluation of impacts under different future trajectories, by assessing different future potential outcomes associated with specific policy decisions.
- ▶ Through the co-development of scenarios, relevant business stakeholders have the opportunity to influence the design of management measures and future legislation and regulations, so that policy-goals are achieved at minimum cost for the business sector.
- ▶ By identifying possible pathways and developments, they can bring more clarity to investors regarding e.g. the future regulatory framework or future opportunities, and can thus help foster business innovation.

## 1 Introduction

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Based on the AQUACROSS framework described in deliverable 3.2, we differentiate between baseline and policy or management scenarios. Whereas baseline scenarios depict current trends and forecast existing management strategies into the future, policy scenarios demonstrate an alternative trajectory with new policy or management strategies in place that go beyond current practice.

Within the Deliverable 7.2, we suggest a stepwise procedure to develop policy or management scenarios from an existing baseline scenario:

1. Choose a relevant **baseline** (agreed with stakeholders) as a reference for policy scenario assessments.
2. Identify problems, challenges, barriers (formulation of an objective) and specify **targets** (as a result from the baseline assessment).
3. Screen **measures** and instruments (partly suggested by stakeholders) suitable to be analysed with scenarios and models.
4. Design and construct alternative **pathways**, or indicator trajectories, i.e. response actions derived from EBM strategies, through models and/or narratives.
5. Build relevant **policy** scenarios and analyse **outputs** with regard to EBM.

Scenarios can be classified according to multiple criteria, such as the goals, treatment of norms, or the function that they have within a participatory process. We identified three approaches to developing scenarios that are of particular relevance for AQUACROSS cases. These can be in different degrees explorative, normative, or descriptive.

Explorative scenarios are characterized by emphasizing alternative future pathways without a predetermined target (Figure 1). It can rather be the objective, to agree on a common target thereafter. Within AQUACROSS, explorative baseline scenarios form an entry point, e.g. through a narrative, to identify the issue at hand linked to a selection of drivers, pressures and response variables of interest.

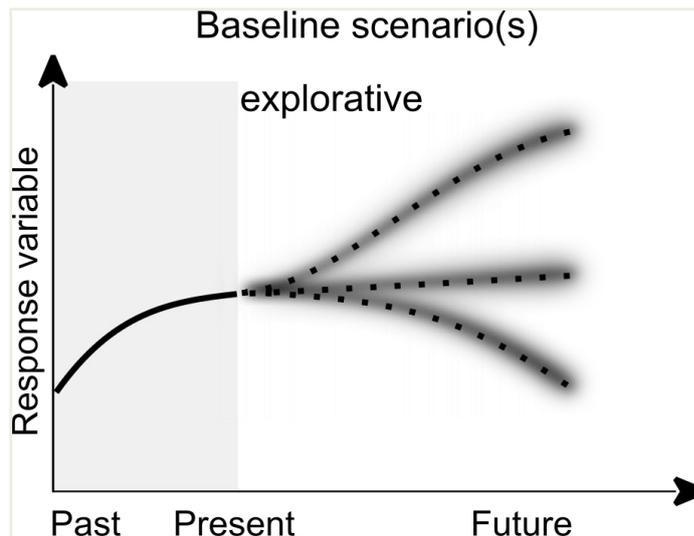


Figure 1: Baseline scenarios in AQUACROSS, showing alternative pathways of system response variables assuming the current management practice but three different external input scenarios (e.g. for socio-economic development). The grey background of alternative pathways denotes the respective uncertainty of the response variable conditional on each external input scenario.

Normative approaches to building scenarios are used when a target has been clearly defined and alternative measures to reach this target need to be assessed (Figure 2). Descriptive approaches in contrast are used to contrast the effect of different implementation measures on the ecosystem or in our case the SES. In this regard, normative and descriptive approaches are best used during the building of policy/management scenarios in AQUACROSS. Depending on the more specific purpose and data availability in each case study, the policy scenarios can become more normative or descriptive.

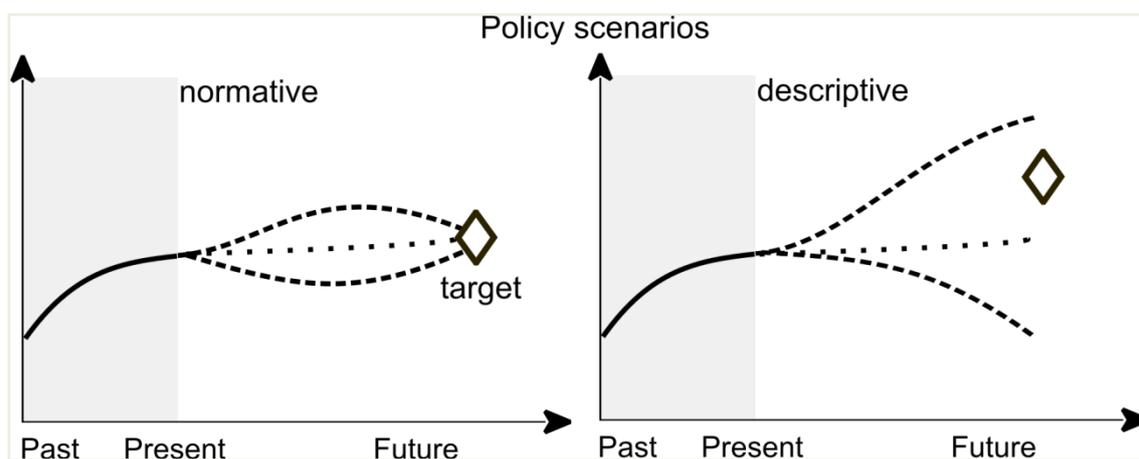


Figure 2: Alternative pathways (dashed lines) compared to the baseline scenario (dotted line). Within each case study are some scenarios more normative (left side) in the way that the target is set first, and the question is about how to get there. Other case study scenarios are more descriptive for the purpose of policy or measure screening, where the question is about how the measures affect the system. Similar to the baseline scenario the policy scenarios may be subject to uncertainty and may show different trajectories in response to external input scenarios (not shown in this Figure for clarity).

## 2 Developing scenarios and analysis in AQUACROSS case studies

As case study activities are at different stages and progress at different pace, deliverable 7.2 presents a snapshot of how scenarios were developed or used so far, or which type of scenarios are foreseen in the near future. The main purpose was to clarify the role in which scenarios are connected to stakeholder involvement and model analysis (Table 1).

Table 1 Framing of targets for scenario development in AQUACROSS case studies

Case Study	Objective and target	Stakeholder involvement
<b>1: North Sea</b>	Conservation of seafloor habitat.	They identify issues/topics and thus shape knowledge base and phrase issues they deem most relevant.
<b>2: Andalusia–Morocco</b>	Decision support for policy processes to identify a suite of potential locations for a multifunctional Green and Blue Infrastructures (GBI). Target definition with stakeholders ongoing.	Stakeholders are consulted for exploring their expectations, collective goals, perceptions, social acceptance and the feasibility of measures that are proposed. This would help us in defining the biodiversity, ecosystem status and ecosystem services objectives, select the conservation features and constraints.
<b>3: Danube</b>	Hydromorphological alterations and their effects on ecological status. Conserve a) biodiversity (birds) in Danube delta and, b) biodiversity (fish, inverts) in tributaries, c) biodiversity in protected areas along the navigable stretch of the Danube River. Targets derived from WFD and Biodiversity strategy.	They are involved by drafting (and later redefining) the scenarios and thus including their insights. The benefit is that they learn about complex problems and some trade-offs could be transformed into synergies.
<b>4: Lough Erne, Ireland</b>	Increase access for recreational activities and reduce invasive species in the system is the objective by stakeholders.	Stakeholder workshops in summer 2017. They get to explore ways to reduce invasive species and improve recreation access to lake.
<b>5: Vouga river, Portugal</b>	Management of Natura 2000 areas from freshwater to coastal waters focused on EBM measures.	Participatory methods to co-develop scenarios, allows for inclusion of stakeholder expectations.
<b>6: Rönne å catchment, Sweden</b>	Implications of water governance on the co-production of ESS. Exploring ways to improve management to increase multifunctional landscapes.	Scenarios are created based on workshops and interviews, and stakeholder benefits are knowledge exchange, new contacts and improved collaboration.
<b>7: Swiss Plateau</b>	Improving the ecological state of rivers at the Swiss plateau while taking costs of management measures and ESS trade-offs into account and including external input scenarios for considering future changes in boundary conditions such as socio-economic development and climate change.	Stakeholders are involved to derive information about current management policies and their state of implementation, management objectives, and for discussion of the results of our analysis. They will benefit from learning from our predictions about the current state of knowledge about the effects of different management strategies under different external input scenarios.
<b>8: Azores</b>	Managing trade-offs among fishing, tourism (diving, whale watching) and multiple-uses: e.g. fishing, tourism, ferries and, biodiversity. No defined targets yet.	Aiming to include stakeholders in the development and assessment of scenarios. Their benefits would be identification of trade-offs (benefits & costs) that are associated with different measures.

## 3 Example cases for scenario processes

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Chapter 4 in Deliverable 7.2 provides two example cases of scenario development processes within AQUACROSS. The first case explores Green and Blue Infrastructure (GBI) in Andalusia (Spain) and Morocco with maps for optimal allocation of management zones as main output. Stakeholders are engaged iteratively in the whole research process but the alternative scenarios are mainly based on models. The second case of Rönne å catchment in Sweden investigates social-ecological co-production of aquatic ecosystem services and pathways to reach best-practice water governance. Knowledge co-development with stakeholders is a fundamental element throughout the process and results in narratives as a main output. So, labelling the scenario processes as “model-based” vs. “narrative-based” is still a matter of an ongoing discussion because the examples do not represent pure types and do always to a degree mix multiple methods for input analysis and output production.

Providing example cases aims to give the reader an understanding of the diversity of scenario development processes within AQUACROSS. Each case describes the research design, methods and outcomes. Thereafter follows a comparative discussion about strength and weaknesses that aims to assist the other case studies in their scenarios processes.

## 4 Outlook

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This deliverable presents a snapshot on the scenario development processes in AQUACROSS case studies with a focus on stakeholder engagement at different steps and scenario characteristics that link to the AQUACROSS framework. The goal in most of the AQUACROSS case studies is to map out the expected consequences from existing policies on biodiversity and ecosystem services levels through scenario analyses. In summary, from observing the AQUACROSS case studies in their scenario development processes, it can be said that scenario development is to different extents embedded in the overall analysis. In some cases, there is a clear strength in linking quantitative, often also spatial, data on biodiversity indicators and related ecosystem services with models to estimate their levels under future policies. Other cases highlight more the dynamic aspects of human interaction with aquatic systems, accounting for changing behaviour under different policy options. For those latter cases, the scenario development process is framing the model analysis which can only highlight subsets of considered future changes.

The following questions are expected to be answered when all cases have developed their policy scenarios:

- ▶ To which degree can normative or descriptive scenarios elicit improvements of ecosystem-based management?
- ▶ Which feedbacks are considered or which types of change anticipated?
- ▶ Does the type of governance, participation and learning play a role?
- ▶ When do stakeholders benefit most from the scenario development process?
- ▶ To which degree are scenarios according to the AQUACROSS framework more holistic than the models that help analysing them?



The next step in AQUACROSS is to link the scenarios to model analyses (D 7.3). This will then map out which model approaches have been used in AQUACROSS case studies to develop forecasts of biodiversity features and ESS for baseline and policy scenarios. In a broader context, lessons learned from scenario development processes will be revisited in the upcoming task on scenario assessment (D 8.2) and the update of the AQUACROSS framework (D 3.3).

## AQUACROSS Partners

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