COEXIST

Interaction in coastal waters: A roadmap to sustainable integration of aquaculture and fisheries

**Project number:** 245178

**Start date of the project (duration):** April 1st, 2010 (39 months)

---

**Deliverable D4.1**

Framework for Multi-objective Quantitative and Qualitative Evaluation of Marine Spatial Management in Coastal Zones

**Organisation name of lead contractor:** LEI, part of WUR

**Authors:** K. Soma; H. van Oostenbrugge; A.P. van Duijn, M.J. Bogaardt and E. Buisman

**Due date of deliverable:** M12

**Actual submission date:** M12

---

<table>
<thead>
<tr>
<th>Dissemination level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>Public</td>
</tr>
<tr>
<td>PP</td>
<td>Restricted to other programme participants (including the Commission Services)</td>
</tr>
<tr>
<td>RE</td>
<td>Restricted to a group specified by the consortium (including the Commission Services)</td>
</tr>
<tr>
<td>CO</td>
<td>Confidential, only members of the consortium (including the Commission Services)</td>
</tr>
</tbody>
</table>

---

**All rights reserved**

This document may not be copied, reproduced or modified in whole or in part for any purpose without the written permission from the COEXIST Consortium. In addition to such written permission to copy, reproduce or modify this document in whole or part, an acknowledgement of the authors of the document and all applicable portions of the copyright must be clearly referenced.

---

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement no 245178. This publication reflects the views only of the author, and the European Union cannot be held responsible for any use which may be made of the information contained therein.
## List of reviewers

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Implemented by</th>
</tr>
</thead>
<tbody>
<tr>
<td>v.FINAL</td>
<td>20/12/2012</td>
<td>Katrine Soma LEI, part of WUR</td>
</tr>
<tr>
<td>v.5</td>
<td>20/03/2012</td>
<td>Katrine Soma LEI, part of WUR</td>
</tr>
<tr>
<td>v.4</td>
<td>22/09/2011</td>
<td>Arie P. Van Duijn LEI, part of WUR</td>
</tr>
<tr>
<td>v.3</td>
<td>15/09/2011</td>
<td>Juha Grönroos SYKE</td>
</tr>
<tr>
<td>v.2</td>
<td>15/09/2011</td>
<td>Norbert Dankers IMARES, part of WUR</td>
</tr>
<tr>
<td>v.1</td>
<td>30/04/2011</td>
<td>LEI, part of WUR</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

Summary ........................................................................................................................................... 5

1. Introduction .................................................................................................................................... 6
   1.1. General background ......................................................................................................................... 6
   1.2. Aims and objectives ......................................................................................................................... 6
   1.3. Responsibilities of the different partners ........................................................................................... 7
   1.4. How to read this working document ............................................................................................... 7

2. Multi-objective quantitative and qualitative evaluation of marine spatial management .......................... 8
   2.1. Differing impacts in different environments ...................................................................................... 8
   2.2. Multiple management objectives ..................................................................................................... 8
   2.3. Multiple affected stakeholders ......................................................................................................... 8
   2.4. Marine spatial management ............................................................................................................ 8
   2.5. Evaluate the effectiveness .................................................................................................................. 10
   2.6. Evaluate the efficiency ..................................................................................................................... 13
   2.7. Evaluate adaptations and propose improvements .............................................................................. 13

3. Evaluation steps ................................................................................................................................. 15
   3.1. Introduction .................................................................................................................................. 15
   3.2. Step 1: Identify relevant aspects of marine spatial management ......................................................... 16
   3.3. Step 2: Identify marine spatial management objectives (task 4.2) ....................................................... 17
   3.4. Step 3: Arrange relevant objectives into a hierarchy (task 4.3) ......................................................... 18
   3.5. Step 4: Specify preferences by pairwise comparison (task 4.2) ......................................................... 20
   3.6. Step 5: Identify relevant spatial management including status quo (task 4.5) ................................. 21
   3.7. Step 6: Evaluate the effectiveness of marine spatial management (tasks 4.3,4.4,4.6) ............... 22
   3.8. Step 7: Evaluate the efficiency of marine spatial management (task 4.6) ........................................ 25
   3.9. Step 8: Evaluate relevant spatial management scenarios (task 4.7) .............................................. 26

4. Concluding remarks ........................................................................................................................... 28

5. References ......................................................................................................................................... 29

Appendix 1. Stakeholder typology ......................................................................................................... 31
Appendix 2. Overview of required stakeholder involvement .................................................................... 32
Appendix 3. Overview of necessary inputs from other work packages .................................................. 33
Appendix 4. Suggested questionnaire format ........................................................................................ 34
Appendix 5. Stakeholder categories, adapted from Table 3, Deliverable D21. ...................................... 36
List of Figures

Figure 1: Costs and effectiveness of MSP and implementation. .................................................. 9

Figure 2: A ‘mapping out’ phase with identification of all relevant information including objectives, management options, stakeholder preferences and evaluations is made after drafted marine spatial plans appear. After a ‘mapping out phase, a ‘closing down’ phase will appear, where possible agreements and final solutions are made based on transparent information availability.................................................................................................................. 11

Figure 3. Coexist effectiveness framework including multiple effects on multiple objectives (e.g. Objectives 1,2 and 3) for each of many relevant measures (e.g. Measure 1 and 2) and multiple stakeholder priorities (e.g. for manager, stakeholder 2 and stakeholder 3). ............... 12

Figure 4: The different steps in the framework for evaluation. ............................................................... 15

Figure 5: Example of a hierarchy with objectives and key desired outcomes. ................................. 19

Figure 6: Evaluation of spatial management scenarios with respect to effectiveness (step 6C) and cost effectiveness (step 7).................................................................................................................. 27

List of Tables

Table 1: An example of how to present the results ............................................................................. 16
Table 2: Definitions of objectives at different specification levels (adapted from Katsanevakis et al 2011) ................................................................................................................................................. 17
Table 3: Example of how to present outcomes of the multicriteria analysis by applying weighted summation .................................................................................................................. 26
Summary

Given the observed current trend of increased demand for space in European coastal zones, there is a good reason to believe that the competition for appropriate sites for aquaculture and fisheries will continue to increase also in the coming years, emphasising the need for improved management tools supporting policies for space allocation.

The aim of work package 4 is to identify ways to adapt currently applied spatial management to integrate different forms of aquaculture and fisheries in the coastal zone, while taking into account other key users, future developments and exploiting mutual opportunities.

The specific objective of deliverable 4.1 is to develop a framework for multi-objective quantitative and qualitative evaluation of marine spatial management in coastal zones that can be used as a guideline when applying the framework in a total of five case studies in European waters in deliverable 4.2.

Each case study coordinator is responsible for ensuring that the framework is applied to carry out tasks 4.2 to 4.7 (i.e. steps 1 to 8) and for producing a final report.

The relevant steps that will be followed in the generic framework are to:

1. identify relevant aspects of marine spatial management
2. identify marine spatial management objectives
3. arrange relevant objectives into a hierarchy
4. specify preferences by pairwise comparison
5. identify relevant spatial management including status quo
6. evaluate the effectiveness of marine spatial management
7. determine the cost effectiveness; here referred to as efficiency, of marine spatial management
8. evaluate relevant spatial management and propose improvements

The application of this generic framework in each of the case study areas will enable comparison of case study results and synthesis in work package 5.
1. Introduction

1.1. General background

European initiatives to initiate and facilitate marine spatial planning are appearing (e.g. Beliore et al. 2006, Schultz-Zehlen et al. 2008, European Commission 2008 and European Commission 2013). Coastal areas are subject to an increase in competing activities and protection (Natura 2000, Marine Strategy Framework Directive) and are a source of potential conflict for allocation of space. The maintenance and/or the development of small-scale coastal fisheries and aquaculture are highly dependent on the availability and accessibility of appropriate sites. Activities include not only fisheries and aquaculture, but also tourism, wind farms, Marine Protected Areas, etc. Expectedly, the competition for such sites will increase, emphasising the need for improved management tools supporting policies for space allocation along the entire European coastline.

1.2. Aims and objectives

The aim of work package 4 is to identify ways to adapt currently applied spatial management to integrate different forms of aquaculture and fisheries in the coastal zone, while taking into account other key users (e.g. tourism, wind farms, aggregate extraction, shipping) and future developments and exploiting mutual opportunities.

For each case study, Work package 4 will evaluate the currently applied marine spatial management of coastal activities and propose improvements based on scenarios.

The objectives are to:

- evaluate the **effectiveness** of the currently applied marine spatial management of coastal activities in achieving aquaculture and fisheries specific objectives within the framework of sustainable development of coastal zones;
- evaluate the **efficiency** of the currently applied marine spatial management of coastal activities in achieving aquaculture and fisheries specific objectives within the framework of sustainable development of coastal zones;
- evaluate **adaptations** to the currently applied marine spatial management and planning process in achieving aquaculture and fisheries specific objectives within the framework of sustainable development of coastal zones;
- propose **improvements** to the currently applied marine spatial management and planning process that will benefit the aquaculture and fisheries sectors specifically, and within the framework of sustainable development of coastal zones, limit the potential impact on other users as well as exploit mutual opportunities.

The specific objective of deliverable 4.1 is: **to develop a generic framework that can be considered as a guideline to be applied in each of the case study areas.** The framework is suited to assist and complement the other European initiatives attempting to initiate marine spatial planning among European countries.
The idea behind applying a generic framework in each of the case study areas in deliverable 4.2 is to enable comparisons of case study contexts, results and synthesis in work package 5.

### 1.3. Responsibilities of the different partners

- Deliverable 4.1: LEI, part of Wageningen UR, has taken the lead in developing the framework (with support from the other partners) and has produced this internal working document.
- Deliverable 4.2: Each case study coordinator is responsible for ensuring that the framework is applied to carry out tasks 4.2 to 4.7 and that a final report is produced for each case study.
- Deliverable 4.3: LEI is responsible for taking the lead in producing and submitting a peer-reviewed paper on the development of the framework.

### 1.4. How to read this working document

This working document contains a generic framework for multi-objective quantitative and qualitative evaluation of marine spatial management in coastal zones. Whereas chapter 2 explains some relevant concepts, chapter 3 elaborates on tasks 4.2 to 4.7 as described in the description of work (DOW). Certain changes have been made from the text in the DOW in order to better structure the different steps. The headings of each of the 8 steps as well as some sub-steps, include a reference to the corresponding task in the DOW. In order to facilitate the application of the framework, a ‘To do’ list is prepared for each step, summarising the main activities. Chapter 4 includes concluding remarks regarding the production of the final report and the work to be carried out in work package 5.

Whenever a reference is made to tasks or deliverables this refers to the tasks and deliverables as mentioned in the DOW.
2. Multi-objective quantitative and qualitative evaluation of marine spatial management

2.1. Differing impacts in different environments

All coastal activities affect and are affected by the natural, economic and social environments in which they are based. Different management options have different impacts on the different components of these environments, including marine spatial management. Depending on where (e.g. in which case study) and how marine spatial management is applied it can have dissimilar impacts on the natural, economic and social environments (Pascoe et al, 2009).

2.2. Multiple management objectives

Management of coastal activities is inherently complex. Management decisions are generally based on the degree to which a management option achieves a limited number of objectives. In contrast, as managers of a national natural asset – the marine environment – policy makers need to be concerned with the impacts on the natural habitat, fish stocks, profitability of different industries and, in some cases, social impacts on local communities, cultural implications, recreational fishing opportunities, and political considerations (Pascoe et al, 2009). A structured approach to evaluation of marine spatial management in coastal zones clearly relates to the multiple management objectives set during the planning phase (IOC, 2006).

2.3. Multiple affected stakeholders

Many different stakeholders are affected by marine spatial management, and different opinions related to the importance of different management impacts form a potential source of conflict. Successful management for one stakeholder may cause failures for others (Pascoe et al, 2009). Identifying the relative importance of the different types of outcomes of any management option to different stakeholders is therefore important when attempting to develop a solution acceptable to the differing groups (Pascoe et al, 2009). Multicriteria analysis is a useful technique to incorporate stakeholder preferences when evaluating marine spatial management to propose and discuss possible improvements (Munda, 1995; Renn, 1999; Soma, 2003; Soma, 2010). In a policy setting, stakeholders can be involved in assigning weights, i.e. to judge on relative importance of different objectives.

2.4. Marine spatial management

According to the Intergovernmental Oceanographic Commission¹ (IOC), Marine Spatial Planning (MSP) is only one element of the marine spatial management (Fig. 1).

¹See: www.unesco-ioc-marinesp.be/+marine_spatial_planning_msp
spatial management is therefore not a synonym for MSP. The marine spatial management includes elements of implementation of spatial measures, enforcement, monitoring, evaluation, research, public participation, and financing in addition to planning, - all elements of which must be present to carry out effective marine spatial management over time.

![Sea use management diagram](image)

**Figure 1: Costs and effectiveness of MSP and implementation.**

In Fig. 1 Marine Spatial Planning (MSP) is shown as a sub-activity of sea use management. The MSP process usually results in a comprehensive plan or vision for a marine region. Such a plan announces spatial measures such as zoning maps and regulations (e.g. a permit or licensing system). These spatial measures specify where and when human activities can occur (IOC, 2009).

Douvere and Ehler (2010) present the following types of spatial measures that can be implemented through MSP:

- Areas or zones open for specific activities all of the time, or during specific times, e.g. commercial fishing, oil and gas development, military operations.
- Areas or zones closed for specific activities all of the time, or during specific times, e.g. commercial fishing, sand extraction, cables and pipelines.
- Areas or zones open to all development all of the time e.g. multiple use areas.
• Areas or zones closed to all development all of the time e.g. strictly protected areas.
• Designation of security zones, precautionary areas, safety zones, rights-of-way.
• Designation of critical habitat, environmentally or ecologically sensitive areas e.g. fish spawning area.
• Designation of a Particularly Sensitive Sea Area (PSSA).
• Limiting activities in areas adjacent to cultural, spiritual, and archaeological sites.
• Special protection measures for areas of the high seas.

As MSP can only influence the spatial distribution of human activities, it has to be complimented by other measures (Douvere and Ehler, 2009). These are management measures that can influence the inputs to human activities (e.g. limitations on fishing activity and capacity), the processes of human activities (e.g. requirement for “best environmental practice”), or the outputs of human activities (e.g. tonnage limitations on mineral extraction). These other measures need to be taken in conjunction with spatial measures (Douvere and Ehler, 2009). Although these other management measures are not the primary focus of the evaluation of marine spatial management in work package 4, they are part of the context in which spatial measures are implemented. In practice these other measures can potentially influence (negatively or positively) the degree to which a spatial measure, and ultimately the sum of currently applied spatial measures, contribute to achieving the objectives of marine spatial management (i.e. the effectiveness of marine spatial management).

2.5. Evaluate the effectiveness

While effort is made for the developments of marine spatial planning in European countries, it is not always clear how the future possibilities should be designed and defined. Who should have the future rights to marine natural resources - where and when? As a result there is an increasing need for possibilities to evaluate and understand the effectiveness of marine spatial management operating around the world (Stelzenmüller et al, 2012).

Effectiveness can be understood as ‘the degree to which management actions are achieving the goals and objectives of the marine spatial management’ (adapted from Hockings et al, 2000). Effectiveness encompasses essential properties including ‘salience’, ‘credibility’ and ‘legitimacy’ (Fritz, 2010). Whereas ‘salience’ relates to the perceived relevance of information - the extent the system provides information that decision-makers think they need, ‘credibility’ addresses the perceived technical quality of the information in terms of validity and accuracy. ‘Legitimacy’ concerns the perception of interested parties in terms of supporting the policy decision, which will depend on the fairness of the process (Varjopuro et al, 2008).

Central to effectiveness of marine spatial management is assessments of long-term impacts on natural resources as well as for the people who depend on them (Pomery et al, 2005). Effectiveness evaluations also incorporate improvements through learning, adaptation, and the diagnosis of specific issues influencing whether goals and objectives are being achieved.
Effectiveness evaluations of protected areas that are socially contentious or under frequent public scrutiny also involve a mechanism to encourage accountability.

Effectiveness evaluations have a long history specifically for the managements of Marine Protected Areas (MPAs). In 2000 The World Conservation Union (IUCN's) World Commission on Protected Areas—Marine and the World Wide Fund for Nature jointly initiated the MPA Management Effectiveness Initiative (MEI), an international collaborative project designed to create a methodology for planning and conducting performance evaluations of MPA management effectiveness. The initiative identified and described a set of relevant biophysical, socioeconomic and governance indicators. The growing interest in effectiveness evaluations has been driven in part by a wide interest in using objective evaluation to assess future needs and adapt current practices (Pomery et al., 2005). In the Coexist project, the need to do this is not limited to marine spatial areas evaluation, but is developed as an approach to a wider notion of marine spatial management, aiming at improving the effectiveness of management efforts and related human resource allocation. Closures such as future possibilities for Natura 2000 areas, as well as wind parks, can be central to the analysis.

Marine spatial management plans in their most advanced formats at national levels at present consist of suggested plans that still need final approval. In most European waters they still need to be developed. In this process transparent treatment of information is necessary as a basis for final policy decisions, where consensus are to be reached and conflicts solved, based on best available information. In order to obtain ‘salience’, ‘credibility’, ‘legitimacy’ as well as ‘transparency’, one of the main ideas of the evaluation framework developed in Coexist is the need of incorporating a ‘mapping out phase’ where all relevant information is provided including identification of relevant objectives, management options, stakeholder preferences as well as economic, social and ecological evaluations (See Fig. 2).

Figure 2. A ‘mapping out’ phase with identification of all relevant information including objectives, management options, stakeholder preferences and evaluations is made after drafted marine spatial...
plans appear. After a ‘mapping out phase, a ‘closing down’ phase will appear, where possible agreements and final solutions are made based on transparent information availability.

To understand the logical thinking behind the evaluation framework, it is helpful to look at Fig. 3. When implementing a measure (e.g. Measure 1) we observe that this has a certain impact on an objective (e.g. objective 1), which we refer to as an ‘effect’, indicating the extent to which the measure is positive or negative to this particular objective. However, as we have many objectives, including ecological, social and economic ones at different detail levels, we will have an effect on each of them; some positive and some negative when implementing a measure. Note that if we do not differentiate between the objectives, we implicitly assume they are equally important. However, they are not, as they will have different importance in different contexts and to different people. We therefore want to find relative importance to each objective by including the preferences of relevant stakeholders in a specific context (e.g. managers, stakeholder 1 and 2).

Note that an opinion about what is more and less important is highly subjective, and it is not an intention of the framework to find out ‘what is more important overall’, as ‘overall’ agreements are not expected in the conflicting context where we operate. In the contrary, the intention with this framework is to show how the preferences differ across stakeholders. When this is clarified and reported, it is up to the policy makers to make the final priorities about which stakeholder is more important. Thus, we do not want to judge on which person is more or less important, as this falls outside the scope of research.

Finally, it is not enough to only look at one measure, as more than one are relevant (measure 2, etc.), including the different effects that they will cause. Hence, effectiveness of a measure is found by looking at effects on a series of objectives with different importance scores to different people. This implies that for each measure, many effectiveness values will be presented.

Figure 3. Coexist effectiveness framework including multiple effects on multiple objectives (e.g. Objectives 1, 2 and 3) for each of many relevant measures (e.g. Measure 1 and 2) and multiple stakeholder priorities (e.g. for manager, stakeholder 2 and stakeholder 3).

The framework can be seen as a certain discipline of the many existing forms of Multicriteria Analysis (MCA). While acknowledging that MCA is a suitable tool in multi/inter-disciplinary
In contexts, Munda (2004) stresses that we should bear in mind that public participation is a necessary component but not a sufficient one. Participation techniques are a tool for improving the knowledge of the problem at hand and not for receiving inputs to be used uncritically in the evaluation process. Social participation does not imply lack of responsibility. Ethical judgements are unavoidable components of the evaluation exercise. These judgements always influence heavily the results. As a consequence, transparency on the assumptions used is essential. In an MCA framework, it is possible to assure that the rankings obtained are consistent with the information and the assumptions used.

MCA was traditionally seen as an aggregation technique of scores and weights, with many different ways of doing this aggregation (such as WEIGHTED SUMMATION, MAUT, AHP, REGIME, EVAMIX, ELECTRE, PROMETHEE and NAIADE). Because the different aggregation techniques tend to receive at the same final ranking of alternatives, the choice of aggregation depends on the character of the data sets in terms of mix qualitative and quantitative information, as well as fuzziness (Soma, 2010). Note that MCA is not necessarily about statistical representation, but it can be used to find representative and agreed solutions.

In MCA the principal aim is not inevitably to discover a solution, but to construct or create something which is viewed as liable to help “an actor taking part in a decision process either to shape, and/or to argue, and/or to transform his preferences, or to make a decision in conformity with his goals” (constructive or creative approach) (Roy, 1996). Thus the method as such is just a framework, which of course has to be consistent. As always, a computation is something different than a decision, and therefore, outcomes on each step in the framework, and not only a final ranking of possible future scenarios, must be seen as results to be provided as decision support to a policy maker.

**2.6. Evaluate the efficiency**

Efficiency can be defined as the extent to which the desired effects (= results and impacts) are achieved at a reasonable cost (Eureval, 2006). When evaluating the efficiency of marine spatial management, costs (e.g. expenditure, time, effort, governmental support) will be determined and compared with the extent to which spatial management objectives are achieved. To evaluate the efficiency, various aspects need to be addressed, including the costs of the MSP process and the cost of implementing the marine spatial plan (Fig. 1).

**2.7. Evaluate adaptations and propose improvements**

In each case study area possible alternatives to currently applied spatial management will be evaluated in order to identify possible improvement to spatial management in different natural, economic and social environments (i.e. case studies). Possible adaptations to currently applied spatial management will be made on the basis of both the review of current management regimes and plans and the review of best governance practices from work package 2. Future scenario’s (from work package 1) will be used to reflect on the
different alternatives, in order to assess the extent to which adaptations to spatial management will improve the effectiveness and efficiency of spatial management, in light of future uncertainties. The improvements specifically focus on the aquaculture and fisheries sectors, and within the framework of sustainable development of coastal zones, limit the potential impact on other users as well as exploit mutual opportunities. Different adaptations will be evaluated and subsequently ranked according to stakeholders preference.
3. Evaluation steps

3.1. Introduction

A framework containing different steps is needed for the evaluation of marine spatial management. The proposed steps are outlined in Fig. 3. This framework for evaluation provides the relevant steps to be undertaken in work package 4 in order to carry out the tasks 4.2 – 4.7 and to produce deliverable 4.2. The eight steps will be explained in more detail in the following paragraphs.

In the framework, multicriteria analysis will be applied as a technique to incorporate stakeholder preferences (Munda, 1995; Renn, 1999; Soma, 2003; Soma, 2010). The results of applying this framework to evaluate marine spatial management of coastal activities can be summarised in a table. An example can be seen in Table 1 with marine spatial management measures, objectives, indicators, different stakeholder preferences (weights) and impact evaluation scores.

Figure 4: The different steps in the framework for evaluation.
Table 1: An example of how to present the results

<table>
<thead>
<tr>
<th>Objectives (step 2 and 3)</th>
<th>Weights (step 4)</th>
<th>Indicators (step 6A)</th>
<th>Spatial management alternatives (step 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td></td>
<td></td>
<td>Effects (step 6B)</td>
</tr>
</tbody>
</table>

Whereas experts will do most of the work in the steps 1 to 8, stakeholder involvement will frequently occur throughout the process, but will be particularly central to step 4, in particular, when preferences of the objectives are identified. A step by step overview of stakeholder involvements needed in work package 4 is provided in Appendix 2.

### 3.2. Step 1: Identify relevant aspects of marine spatial management

Step 1 builds on the tasks and deliverables of work packages 1, 2 and 3. An overview of specific information from these three work packages, that is necessary to carry out the tasks in work package 4, can be found in Appendix 3.

When identifying these relevant aspects, it is important to keep in mind that this evaluation does not only focus on fisheries or aquaculture specific spatial measures. Other spatial measures, such as the allocation of zones for the construction off offshore wind farms, affect fisheries and/or aquaculture and are therefore included.

**‘To do’ list, step 1: Some suggestions to case study leaders:**

- See Deliverable D21, section 4 under your case study, second column. You will see a list of laws relevant to the sectors.
- See D1.4 - Task 1.4. Section 3. You will find a description of the spatial management plans relevant to your case study.
- Write a paragraph to all of them, including the name of the law, and the main general objectives of each law, as well as the target groups. Limit each paragraph to a maximum of 150 words.
- Put all the laws in the reference list at the end.
- Case studies with less resources can provide shorter texts on this step.
3.3. Step 2: Identify marine spatial management objectives (task 4.2)

A fundamental requirement for evaluating effectiveness of spatial management is identifying clear objectives. Effectiveness is then determined by evaluation against those objectives. Therefore, for every case study area marine spatial management objectives will be identified. We will distinguish between objectives that are set at different jurisdictional levels (e.g. international, European, national). Although a time limit can encourage different objectives as they have different time spans, it can be useful to define 2020 as a target year. Note that stakeholders indirectly give a time preference when stating their preferences in step 4, for example, if stating that (short-term) profit is more important than the long-term conservation of marine ecosystems. The objectives identified in this step can be further specified as indicators in step 6A.

Within each case study area, partners will identify spatial management objectives and distinguish between several levels of management objectives (Pascoe et al, 2009). Higher order objectives are more generic, whereas lower order objectives are refinements of the higher level objectives. An overview of definitions of objectives can be found in Table 2.

Table 2: Definitions of objectives at different specification levels (adapted from Katsanevakis et al 2011)

<table>
<thead>
<tr>
<th>Level</th>
<th>Name and Synonym</th>
<th>Criteria</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High level objective/goal</td>
<td>Purpose, aim, or the anticipated result which guides action. This is broad and unspecific</td>
<td>sustainable use of the North Sea</td>
</tr>
<tr>
<td>2</td>
<td>General objective</td>
<td>more specific, but still general. Specifies sector and activity. Gives a trend or process (increase or decrease of an indicator)</td>
<td>increase of the share of renewable energies; increase of space for aquaculture</td>
</tr>
<tr>
<td>3</td>
<td>Specific objective</td>
<td>gives a certain value to be achieved, but &quot;long term goal&quot;</td>
<td>no use (0% of energy supply) of nuclear power; 10 operating fishing boats per harbour; 50 boats fishing for place in the Dutch fleet, 500 fishermen per country</td>
</tr>
<tr>
<td></td>
<td>Operational objective/ key desired outcome</td>
<td>a short-term goal; defining a clear, often measurable, outcome of a process (SMART objectives: Specific, Measurable, Achievable, Realistic, Timelined). This is the objective to reach a certain value (threshold) of an indicator at a certain time. The threshold comes from the society/politics.</td>
<td>20% of energy supply from offshore wind farms in the year 2020; 50% of fisherman under the age of 50 until 2015;</td>
</tr>
</tbody>
</table>

For each case study area spatial management objectives from different jurisdictional levels can be derived from the glossary of spatial management tools from work package 1 and the review of the current policy framework and management regimes and plans from work package 2 (Appendix 3). In case not all spatial management objectives can be derived from these reviews, they can be identified with the policy and regulatory stakeholders at the appropriate jurisdictional level (Appendix 2). For each case study area, spatial management objectives should include aquaculture and fisheries specific objectives, management objectives, and sustainability objectives for use of the coastal zone.
‘To do’ list, step 2: Some suggestions to case study leaders:
- Do step 3 before writing this text in detail because steps 2 and 3 are interconnected. After having made a selection of objectives in the hierarchy in step 3, it probably gets clearer to you what must be written here.
- Explain the scope and why the objectives have been selected.
- For each objective, write an explanation in a paragraph of a maximum of 150 words.
- Write a complete list of references to each objective, as most objectives are found in many different texts or explained by experts.
- List all references in the reference list.

3.4. Step 3: Arrange relevant objectives into a hierarchy (task 4.3)

Objectives are often unclear or too general to directly serve as a basis for evaluating effectiveness (Day et al., 2003). Therefore, it is important to articulate these more generic higher order objectives, into clearer more specific objectives, which define the tangible results that would be expected if the objectives were fully realised. Such statements then provide a practical basis for evaluating spatial management effectiveness. If the present state of knowledge does not allow objectives to be specified, there is a need to establish interim surrogates (which initially may be relatively simplistic), together with a process for progressively improving the surrogates until the knowledge base becomes sufficient to enable meaningful statements of desired outcomes to be developed (Day, 2008).

Fig. 4 provides an example of objectives at different specification levels that have been arranged into a hierarchy. Similar grey scales are provided at each of the four levels. In each case study area, the number of levels as well as shape of the hierarchy, must be decided depending on the particular case study context. Arrows suggest that additional objectives and/or levels could be relevant.
The processes of articulating general objectives into more specific objectives will require some forms of interaction with different stakeholders. For instance, stakeholders from different industries (i.e. operational stakeholders), but also policy, regulatory, science and advocacy stakeholders (Appendix 2). It will be helpful to arrange the objectives into one or more hierarchies (see an example in Fig. 4). Presentation in a hierarchy facilitates an open and systematic consideration of all relevant aspects. Furthermore, a hierarchy also assists by informing and structuring different arguments during the processes (Saaty, 2001; Soma, 2010). For instance, the objectives mentioned in a spatial management plan can be more general, while objectives that are related to a specific spatial measure can be more specific. When developing this hierarchy in each case study, it is necessary to keep in mind that objectives in each category must be comparable on a scale of importance to prepare for step 4 (Soma 2003). For instance, stakeholders can be asked to judge on what is more important: food security or safety at sea? It must be noted that in this context, it may be less logical for stakeholders to compare the importance of ecosystem conservation to for example children’s education. When the hierarchies are finalised in each case study, they can be fit into the first column in Table 1, although reflecting the different levels by separate columns.
‘To do’ list, step 3: Some suggestions to case study leaders:

- The objectives are already explained in step 2, so you do not need to explain everything one more time.
- Explain how you argued during the selection and arrangements of the different specifications of objectives to the particular case study context.
- Explain why some information was left out.
- Provide the hierarchy in a figure, to get enough space you may have to use A3 format.

3.5. Step 4: Specify preferences by pairwise comparison (task 4.2)

Following the identification of objectives, they will be weighted in a process involving different categories of stakeholders (Appendix 1 and 5). Stakeholders are expected to have different opinions about which objectives they find most important. An advantage of involving stakeholders in the analysis is that differences in stakeholder preference become clear, and potential areas of disagreement can be identified. When relevant objectives have been arranged into a hierarchy, stakeholders will be asked to judge the relative importance (i.e. their preference) by assigning weights. Assigning weights is a way of asking stakeholders to make a judgement about their preference for certain objectives. The weights that will be assigned in step 4 to objectives can be inserted in the 3rd column of Table 1.

A format will be used as a basis for clearly formulating questions in a questionnaire (Appendix 4). The format is linked to the structure of the hierarchy of objectives. The questionnaire must be tested to include further suggestions and to make it applicable in practice. At each level in the hierarchy the objectives are compared with each other (similar grey scales in Fig. 4). The objectives listed under different higher level objectives are not directly compared with each other (e.g. low costs and safety) (Soma, 2003). However, they are compared indirectly at a higher level.

A pairwise comparison technique enables stakeholders to compare two objectives at the same time on a scale of importance. Other weighting techniques exist that require simultaneous comparison of alternatives. However, since the comparison of multiple alternatives can be challenging, a pairwise comparison technique is applied here. A quantitative scale will be used to rank the objectives. The alternatives with the highest scores are then determined and suggested as the most important objective for a specific group of stakeholders (Saaty, 2001; Soma, 2003).

By comparing two objectives at a time on a quantitative scale, the priorities are spread over the relevant objectives. As this approach is based on the assumption that a total of 100% importance priorities exists for an individual stakeholder (or stakeholder group), each of these sets of preferences sums up to 100%. In appendix 4 a modified version of the weighting technique developed by Saaty (2001) is applied (4, 3, 2, 1, 0, 1, 2, 3, 4) for comparing the objectives two at a time. As the original scale (9, 8, 7, 6, 5, 4, 3, 2, 1, 2, 3, 4, 5, 6, 7, 8, 9) has been proven too long the applied scale is shorter than the original scale (Soma, 2003). This method may be associated with the Analytic Hierarchy Process (AHP) approach, but there are several differences (Saaty, 2001). Besides applying a shorter scale, this method is further simplified by asking individual stakeholders for only one set of priorities. Regardless of the number of different policy options we will assume that each stakeholder
has only one main set of priorities. From a mathematical point of view, this approach might be judged less interesting. However, we argue that it is more applicable to a real world situation (for additional information see Soma, 2003).

The relative weights that have been assigned to the objectives at different levels will then be analysed by, for instance, the computer program Expert Choice\(^2\) or Definite (Janssen and van Herwijnen, 2011). First of all, the questionnaire results (Appendix 4) will be organised in an Excel sheet. When the geometric averages for each stakeholder category are calculated, the relative importance of each alternative will be assessed.\(^3\) The results will be inserted in the column with the title weights in Table 1. The computer programs Expert Choice or Definite (Janssen, 1992) can also be used for these calculations. The Expert Choice software can also be used to calculate the inconsistencies of the responses. Consistency implies that: if \(a > b\), \(b > c\) then \(a > c\). However, if the responses from the survey shows that \(a > b\), \(b > c\) and \(a < c\), this is inconsistent (see website for additional information).

<table>
<thead>
<tr>
<th>‘To do’ list, step 4: Some suggestions to case study leaders:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The questionnaire is based on the hierarchy presented in step 3 and the format shown in appendix 4.</td>
</tr>
<tr>
<td>• Look at the list of stakeholders in Deliverable 2.1, Table 3, and fill in number of stakeholders included as explained in appendix 5, and rate of response.</td>
</tr>
<tr>
<td>• Check that you have representatives for all sectors and sub-sectors. (See table in appendix 5).</td>
</tr>
<tr>
<td>• Translate questionnaire into country language.</td>
</tr>
<tr>
<td>• Send the questionnaire to Coexist facilitator, who will put it online.</td>
</tr>
<tr>
<td>• Interview the selected stakeholders preferable by sending emails, by phone or face to face.</td>
</tr>
<tr>
<td>• Responses in online version are automatically sent to Coexist facilitator, who will return to you an excel sheet including all responses.</td>
</tr>
<tr>
<td>• Apply the computer programmes Definite, Expert Choice or Excel to estimate weights.</td>
</tr>
<tr>
<td>• The preferences should be presented in figures, with bars summing up to a total of 100% and broken down into colours to reflect the shares of priorities to each stakeholder for comparison.</td>
</tr>
<tr>
<td>• Each figure should have an explanatory text.</td>
</tr>
</tbody>
</table>

### 3.6. Step 5: Identify relevant spatial management including status quo (task 4.5)

This step builds on step 1 as we want to define a status quo situation regarding existing context, including spatial allocation and/or relevant measures in terms of, for instance, permits, quotas subsidies to certain activities, and also to develop a set of 4-7 relevant future scenarios. Note that whereas the term spatial measure would include any measure impacting spatial distribution, such as permits and quotas as well as defining particular areas for specific purposes, the term spatial closure refers to marine areas defined for specific purposes. Marine Protected Areas (MPAs) and wind farm areas would be typical spatial closures. Spatial closures will have an impact on the fishery- and aquaculture sectors, if they are excluded from these areas.

---

\(^2\) Expert choice 15 days free download on web: http://www.expertchoice.com/academic-program/free-trial.

\(^3\) For instance, the geometric mean of two numbers, say 2 and 8, is just the square root of their product; that is \(\sqrt{2 \times 8} = 4\).
The idea is that we want to compare the status quo situation with the other scenarios in the impact assessment in step 6B&C, in the cost effectiveness analysis in step 7 as well as in the final evaluation in step 8.

In order to quantitatively evaluate the effectiveness of the current situation and relevant future scenarios of marine spatial management, the theoretical models (e.g. Fishrent) from work package 3 need to be linked to spatial closures.

‘To do’ list, step 5: Some suggestions to case study leaders:
- List relevant measures to your case study
- Describe existing measures in a status quo situation
- Describe relevant combinations of measures to a future context in some 4-7 scenarios
- Are they appearing as spatial closures? Then you can draw them on a map.
- Are areas closed to some activities? (areas assigned for Natura 2000, wind farms, aquaculture, etc)

3.7. Step 6: Evaluate the effectiveness of marine spatial management

In this framework the evaluation of the effectiveness of marine spatial management has been divided into several steps and sub-steps. Most of these steps can be recognized in table 3. Step 6 is divided into three sub-steps (6A, 6B and 6C). Two of the sub-steps are presented in Table 1 as to select indicators (sub-step 6A) and effects on respective objectives with different scenarios (sub-step 6B). These two sub-steps are important to prepare for a valid evaluation of the effectiveness in sub-step 6C, and to assess the degree to which a spatial measure, and ultimately spatial management contributes to achieving the objectives of spatial management.

Sub-step 6A: Select indicators (task 4.3)

If intention is to estimate indicator values as effects on objectives with different scenarios, instead of applying qualitative impact scores on objectives directly, it is necessary to first identify indicators for each objective. Then the indicators will be used to measure the effects. The IOC (2006) defines indicators as quantitative/qualitative statements or measured/observed parameters that can be used to describe existing situations and measure changes or trends over time. Their three main functions are simplification, quantification and communication. Three indicator types appear; reflecting the three elements of marine spatial management of coastal activities, namely governance, ecological and socioeconomic indicators.

In this sub-step, indicators will be selected that can be used to practically measure the effects on the natural, economic and social conditions in the coastal zone. These indicators are identified as measured parameters associated with respective objectives, listed in a hierarchy of objectives (Fig. 4 and Table 3, 5th column). As it is not practical to directly measure all the attributes that relate to a case study area, a limited number of representative indicators need to be selected in each case study. In each case study the
feasibility and importance of the indicators will be evaluated separately. According to the IOC (2006, p. 11) characteristics of good indicators may be different when viewed from a scientific or a management perspective.

From a scientific perspective, effective indicators should have the following characteristics:

- Readily measurable;
- Cost effective;
- Concrete (or tangible);
- Interpretable;
- Grounded on scientific theory;
- Sensitive;
- Responsive; and
- Specific (or unambiguous).

From a management perspective, indicators should be:

- Relevant to management objectives;
- Clearly linked to the outcome being monitored;\(^4\)
- Developed with all those involved in management; and
- Part of the management process and not an end in themselves.

Governance performance indicators will be developed in work package 2. In line with the above mentioned characteristics of good indicators, the decision to select specific indicators may depend on the available models and data from work package 3.

### ‘To do’ list, step 6A: Some suggestions to case study leaders:

- This step is optional, and decide on whether you need the indicators; will you apply qualitative or quantitative effects?
- For each objective in the hierarchy, see if you can find something which can be measured, for instance, income or profit, or good environmental state parameters.
- Only for each objective at lowest level in the hierarchy, add one (or more) indicator(s).
- Specify the indicators in a column in Table 1 headed ‘indicators’.

#### 3.7.1. Sub-step 6B: Identify effects (task 4.4)

The effects can be derived in two different ways; 1) by applying quantitative estimates, or by 2) assigning qualitative effects. Hence, if estimated effects are not made available by means of other work packages or literature, qualitative effects can be used.

1) **Quantitative effects.** Quantitative effects can only be estimated if indicators have been identified in step 6A. The actual impacts on the selected indicators with the different scenarios identified in step 5 will be measured in terms effects. Selected indicators will be used to measure effects on the natural, economic and social conditions in the coastal zone.

The models that can be used to estimate the effects, as well as the data required to run them, are selected and collected in work package 3 (Appendix 3). For instance, in several of

---

\(^4\) This indicator is not only important from a management perspective, but also from a scientific perspective.
the case studies, costs and revenues of different industries are identified and used in a spatial bio-economic model. The output of such a spatial bio-economic model can be used as impact scores in this sub-step.

2) Qualitative effects. With qualitative effects, you do not need to identify indicators, and can skip 6A. Qualitative effects can be determined with the help of policy and science and advocacy stakeholders (Appendix 2). For example, an ordinal scale (-4,-3,-2,-1,0,1,2,3,4) can be applied where -4 is very large negative impact, -3 is large negative impact, -2 is moderate negative impact, -1 is low negative impact, 0 is no impact, 1 is low positive impact, 2 is moderate positive impact, 3 is large positive impact and 4 is very large positive impact. An ordinal scale is a scale in which data is shown simply in order of magnitude since there is no standard of measurement of differences.

‘To do’ list, step 6B: Some suggestions to case study leaders:
- See if it is possible in your case to estimate quantitative effects by applying relevant indicators (changing effect values in the different scenarios)
- If not, use the ordinal scale explained in the text.
- Invite experts to judge on the scores if effects are not obvious.
- Case studies with less resources can provide qualitative effects.

3.7.2. Sub-step 6C: Evaluate the effectiveness (task 4.6)

This sub-step will evaluate the effectiveness of each of the scenarios identified in step 5 by combining outcomes in step 4; the weights, with outcomes in step 6B; the effects. This means that the degree to which a scenario, and ultimately spatial management, contributes to achieving the objectives of spatial management will be assessed (Fig. 1). The objectives were identified in steps 2 and 3 and the sets of different stakeholder priorities were assigned by weights in step 4. Subsequently the effects on objectives or selected indicators with the relevant scenarios were assigned in sub-step 6B. Both weights and effects are thus jointly included in the analysis here by using multicriteria analysis (e.g. weighted summation; for additional information see Janssen and van Herwijnen, 2011). Using the different stakeholder perspectives we can assess the effectiveness of spatial management from the perspective of different groups of stakeholders. In this way we are identifying the relative importance of the scenarios to different stakeholders.

Hence, effectiveness is found by aggregating effects and stakeholder preferences to find a relative ranking value of the different scenarios. A stacked bar graph is generated when applying a multicriteria analysis, for instance weighted summation, to aggregate effects and weights. A weighted summation of cardinal entities, is implying essentially an additive linear utility structure. In other words; \( v_{ij0} = \sum_{j=1}^{J} \sigma_{ij0} w^*_j \), if scenario \( v_{i0} \) is positive, scenario \( i \) is more effective compared with scenario zero (0), i.e. status quo, given weight \( w^* \) for stakeholder \( j \) and effect \( \sigma \) for scenario \( i \) and stakeholder \( j \).
The scenarios with the highest ranking value on the stacked bar graph is the more effective one, compared with the other scenarios. Several scenarios will obtain a status as more effective depending on whether more than one effect table is applied, as well as with the many sets of stakeholder preferences (see step 4). With high preference- and effect values the relative ranking on the stacked bar graph value will also be high. The scale should be regarded as an index, as it just informs with respect to relative differences of the results. We therefore refer to it as a ranking index value, where negative values indicate less effectiveness of scenarios compared with present, and positive values indicate more effectiveness compared with present.

Note that challenges occur related with the standardisation of the different units of the effects into a same scale. The different units may not be commensurable; i.e. comparable on one scale (Munda 2003). Moreover, when applying a qualitative scale (e.g. from very negative to very positive effects; from -4 to +4), experts should be included when judging on the latitudes for each effect, as to decide when they should be judged extremely high and when they should be low.

The multicriteria analysis will hence provide a set of rankings of more and less effective scenarios based on the ranking index value. Although a modified version of AHP is appropriate to assign the weights, we suggest that weighted summation is used to calculate the final ranking. We suggest this because the procedures for weighted summation are more simple and clear for the purposes of these case study applications.

The evaluation of the effectiveness of the currently applied spatial closure, will constitute a baseline that will be used in step 8 in order to propose improvements.

\textbf{`To do' list, step 6C: Some suggestions to case study leaders:}

- Start DEFINITE software and insert data (effects and weights) prepared in an excel sheet
- Apply pairwise comparison, and include data adapted to the longer scale
- Aggregate weights and effects with Weighted summation
- Apply sensitivity analysis
- Present results in tables and figures and include explanatory text.

\textbf{3.8. Step 7: Evaluate the efficiency of marine spatial management (task 4.6)}

In this step a Cost-Effectiveness Analysis (CEA) (Levin and McEwan, 2001), will be used to evaluate the efficiency of marine spatial management of coastal activities. CEA can be defined as an analysis which compares several interventions or several options, in terms of both implementation cost and the achievement of the intended result/impact (Eureval, 2006). CEA can be used to answer questions, such as: "Could more effects have been achieved at the same cost?", or "Have other interventions obtained similar effects at a lower cost?", or "Was it possible to achieve more effects at a lower cost?" (Eureval, 2006). The
cost-effectiveness of marine spatial management of coastal activities will be determined in every case study area.

To determine the costs of the marine spatial management a table must be prepared for the public sector costs. An example is shown in Table 3. For example, costs that are the result of the participation of the executive agencies and the operational stakeholders in the planning process, need to be included. Governments can always decide to compensate (part of) the private costs and/or to tax part of the private revenues. The costs can be split in two categories, namely personnel and material costs. Personnel costs include the costs for the human resources required for developing a particular marine spatial plan. Material costs refer to the costs for all materials (housing, equipment etc.) that were used to develop the marine spatial plan (Levin & McEwan, 2001). If costs in Euros cannot be calculated based on the data collected in work package 3 estimations need to be made. Estimations can be made on the basis of data on:

- Material, personnel and time involved in the planning process.
- Costs of comparable marine spatial plans in other case studies.
- Costs of the MSP process in the same case study area in the past.

Table 3: Example of how to present the public sector costs of the marine spatial management.

<table>
<thead>
<tr>
<th>Cost categories</th>
<th>Scenarios; 1; 2; 3; 4 in Euro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs Personnel implementation</td>
<td>1</td>
</tr>
<tr>
<td>Costs Personnel monitoring and control</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
</tr>
<tr>
<td>Total costs</td>
<td></td>
</tr>
</tbody>
</table>

‘To do’ list, step 7: Some suggestions to case study leaders:

- Find estimates for salaries for implementation, control and monitoring.
- See if some other costs are important related with material costs
- Provide the numbers in a table as described in the text
- Explain assumptions, estimates and weaknesses made to arrive at the costs.

3.9. Step 8: Evaluate relevant spatial management scenarios (task 4.7)

Based on the outcomes of the effectiveness analysis in step 6C that are based on stakeholder preferences and effects (ranking index value), as well as the cost-effectiveness of implementation for public administration in step 7 (euro), i.e. here referred to as efficiency, we are demonstrating the differences in a diagram in this section. The idea is to show that scenarios scoring high on effectiveness may be less attractive in terms of requiring high public costs, and the other way around. In Fig 5. we can see an example of the evaluation of the four relevant scenarios of marine spatial management. Whereas Scenario 1 is favourable as it has relatively low costs and scores positively on effectiveness, scenario 2 is a lot more favourable in terms of effectiveness, but would require higher costs for public administration. Moreover, scenario 4 scores the highest on cost effectiveness, but is less
attractive in terms of effectiveness. In this example, scenario 3 is the worst choice, as it is expensive to implement and not favourable in terms of effectiveness.

![Diagram](image)

**Figure 6: Evaluation of spatial management scenarios with respect to effectiveness (step 6C) and cost effectiveness (step 7).**

A final choice of marine spatial management is left to politicians, as they are responsible for deciding on budgets. However, the rather easy evaluation demonstrates some basic principles; the attractiveness and importance analysed by means of effectiveness is valuable on a different scale than what is seen as cost effective, on a monetary scale. Both dimensions are of relevance to final policy making.

Based on the exercises throughout steps 1 – 8 it should be possible to propose relevant and well-grounded adaptations and improvements to currently applied marine spatial management in the specific contexts of the case study area.
4. Concluding remarks

4.1. Reporting

The outcomes of the different steps should be compared and discussed for each case study. All assumptions and simplifications that were made should also be addressed here explicitly. Moreover, the method and the way it was applied should be carefully described. This is to prepare for submission of an article in an international journal as well as inputs to work package 5.

4.2. Work package 5

In work package 5, special attention will be given to a comparison of effectiveness and the cost effectiveness of spatial management across case studies. This will allow the identification of additional suggestions for improvement of spatial management. Comparison of all other steps across case studies will also be part of work package 5.

Besides, as some case studies have a specific focus (e.g. disease modelling or nutrients) work package 5 will also take lessons from individual case studies and investigate how these lessons can be beneficial to other case studies.

Finally, work package 5 will extrapolate generic conclusions that are valid beyond the marine regions of the case studies.
5. References


## Appendix 1. Stakeholder typology

<table>
<thead>
<tr>
<th><strong>Operational stakeholders</strong></th>
<th>Groups whose core activities and economic performance is closely related to exploiting or using marine resources or marine areas, <em>i.e.</em> engaged in or related to fishing, mariculture, marine renewables, aggregates, oil/gas, etc. industries;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indirect stakeholders</strong></td>
<td>Members of the public who passively interact, <em>e.g.</em> through aesthetic appreciation, with the marine area in question or have an indirect stake in it (hold existence values, bequest values, etc.);</td>
</tr>
<tr>
<td><strong>Policy stakeholders</strong></td>
<td>Responsible authorities or bodies who have to put forward the legal framework and policies related to strategic objectives for marine areas, <em>e.g.</em> national governments, EC, international bodies;</td>
</tr>
<tr>
<td><strong>Regulatory stakeholders</strong></td>
<td>Bodies or agencies that manage marine or coastal areas, <em>e.g.</em> management bodies of MPAs, fisheries regulatory and enforcement authorities;</td>
</tr>
<tr>
<td><strong>Science stakeholders</strong></td>
<td>Engaged in research activities, <em>e.g.</em> universities.</td>
</tr>
<tr>
<td><strong>Advocacy stakeholders</strong></td>
<td>Engaged in advocacy and/or research activities, <em>e.g.</em> environmental NGOs.</td>
</tr>
</tbody>
</table>

*Source: adapted from MESMA project*[^1]

[^1]: See: [http://www.mesma.org](http://www.mesma.org)
Appendix 2. Overview of required stakeholder involvement

<table>
<thead>
<tr>
<th>Step</th>
<th>Aim</th>
<th>Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>To identify objectives</td>
<td>Policy and regulatory</td>
</tr>
<tr>
<td>3</td>
<td>To specify objectives</td>
<td>Operational, policy, regulatory, science and advocacy</td>
</tr>
<tr>
<td>4</td>
<td>To weight objectives</td>
<td>Operational, policy, regulatory, science and advocacy</td>
</tr>
<tr>
<td>5</td>
<td>To specify relevant marine management</td>
<td>Policy and science stakeholders</td>
</tr>
<tr>
<td>6A</td>
<td>To specify relevant indicators for each objective</td>
<td>Policy and science stakeholders</td>
</tr>
<tr>
<td>6B</td>
<td>To identify effects</td>
<td>Operational and science &amp; advocacy</td>
</tr>
<tr>
<td>6C</td>
<td>To advice on standardisation of different units</td>
<td>Operational and science &amp; advocacy</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>To evaluate adaptations</td>
<td>Operational, policy, regulatory, science and advocacy</td>
</tr>
</tbody>
</table>
## Appendix 3. Overview of necessary inputs from other work packages

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
| 2    | 1.4: Glossary of spatial management tools  
     | 2.2: Review of the current policy framework  
     | 2.3: Review of current management regimes and plans |
| 3    | -    |
| 4    | -    |
| 5    | 1.1: Characterization of marine ecosystems  
     | 1.2: Matrices of interactions  
     | 1.4: Glossary of spatial management tools  
     | 2.1: Review of legal frameworks  
     | 2.2: Review of the current policy framework  
     | 2.3: Review of current management regimes and plans  
     | 2.4: Stakeholder analysis and mapping  
     | 2.5: Institutional analysis |
| 6A   | 3.1: Data and information |
| 6B   | 3.2: Natural and human component of fisheries  
     | 3.3: Natural and human components of aquaculture  
     | 3.4: Assessment of the effect of fisheries and aquaculture at different scales on the environment  
     | 3.5: Natural and human component of other activities  
     | 3.6: Adaptation and improvement of models |
| 6C   | 3.1: Data and information |
| 7    | 3.1: Data and information |
| 8    | 1.3: Inventory of possible combinations of different forms of aquaculture and/or fisheries and other activities  
     | 1.5: Future scenario’s for fisheries, aquaculture and other activities  
     | 2.6: Review of best governance practices using MSP  
     | 2.X: Societal acceptance of activities and combinations  
     | 3.1: Data and information |
Appendix 4. Suggested questionnaire format

This is an example of what the questionnaire format could look like, using the example presented in Fig. 4 as a basis.

**Sample:** Note that this is not a statistical analysis as it is assumed that interviewees represent a group’s vision about what is important. Therefore we have no minimum required number of interviewees. However, it would be a mistake to leave out relevant groups. Besides, it is better to have more interviewees from each group to see the extent to which members of one group actually agree with each other.

**Time frame:** Ideally no time frame should be set. Note that whilst some groups have strong short term interests, others will have strong long term interests. None of these should be excluded. Nevertheless, in some situations it may be necessary to define a time horizon and a horizon of 10 years can then be used.

1. **Demographic questions**
   a. Organisation/Firm/Employer

Example of a pairwise comparison of two key desired outcomes listed at same level in the hierarchy shown as an example in Fig. 4:

**Pairwise comparison:** An example of a pairwise comparison technique is shown below. Two key desired outcomes in the hierarchy in Fig. 4 are compared at one time. If they are equally important - draw a circle around 0. If one is more important than the other, draw a circle around a number further up on the scale, depending on how much more important you consider it to be. (4 = much more important, 3 = more important, 2 = some more important, 1 = little more important, 0 = equally important).

<table>
<thead>
<tr>
<th>Food security</th>
<th>4</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** This is just an example of what the questions could look like. The tables will become longer with more key desired outcomes in the hierarchies developed in each case study. Based on earlier experience, we suggest that a maximum of seven key desired outcomes should be compared at a time, i.e. included under one question and in one table. This is to avoid large inconsistencies in responses, and should be kept in mind when developing the hierarchy (Fig. 4).
### 1. Weighting objectives (Level 1)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic viability</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Culture and lifestyle</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Ecosystem conservation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2. Weighting key desired outcomes - economic viability (Level 2)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>High resource rent</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Low costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3. Weighting key desired outcomes - culture and lifestyle (Level 2)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food security</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4. Weighting key desired outcomes - ecosystem conservation (Level 2)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coral ecosystems</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Water quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 5. Weighting key desired outcomes - ecosystem conservation - water quality (Level 3)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel use of fishers</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Industry activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6. Weighting key desired outcomes - ecosystem conservation - water quality - industry activities (Level 4)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical factory</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>Oil industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7. Weighting policy options (Level 1)

<table>
<thead>
<tr>
<th>Policy options</th>
<th>Economic viability</th>
<th>Economic viability</th>
<th>Culture and lifestyle</th>
<th>Ecosystem conservation</th>
<th>Ecosystem conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>etc……</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
<td>4 3 2 1 0 1 2 3 4</td>
</tr>
<tr>
<td>etc……</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

etc……
Appendix 5. Stakeholder categories, adapted from Table 3, Deliverable D21.

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>SUB-SECTOR</th>
<th>EXAMPLE North Sea (nr of stakeholders)</th>
<th>Your case study?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Agency</td>
<td>Fisheries</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recreation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ocean Energy</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planning</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>Aquaculture</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fisheries</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ocean energy</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>NGOs</td>
<td>Nature</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Recreation</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>