Theme 3: Framework for economic and social analyses (ESA) in the Baltic Sea region

*This is an interim deliverable from the TAPAS project that is coordinated by HELCOM and co-financed by the European Union in 2016-2017.*

# Interim deliverable 1: Framework for economic and social analyses (ESA) in the Baltic Sea region

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## Table of Contents

Summary ........ 3
1. Introduction ........ 4
2. Conceptual models and approaches for the regional economic and social analyses ........ 6
2.1 Conceptual models preceding HELCOM TAPAS ........ 6
2.2 Conceptual model of HELCOM TAPAS ........ 10
2.3 Approaches for the economic and social analyses ........ 11
3. What do we gain? Use of marine waters analysis ........ 13
3.1 What is meant by the use of marine waters analysis? ........ 13
3.2 How to assess the use of marine waters? ........ 13
Approach developed to assess the regional use of marine waters ........ 14
3.3 Results ........ 16
Fish and shellfish harvesting ........ 17
Marine aquaculture ........ 17
Tourism and leisure ........ 18
Recreation ........ 18
Offshore wind energy ........ 19
Marine transport and related infrastructure ........ 19
3.4 Discussion ........ 21
Recommendations on how to improve the usability of statistics and indicators for use of marine waters analysis ........ 22
4. What is at stake? Cost of degradation analysis ........ 24

4.1 What is cost of degradation? ..... 24
4.2 How to assess the cost of degradation? ..... 24
Valuing the consequences to citizen's well-being ..... 25
Approach developed to assess the regional cost of degradation ..... 26
4.3 Cost of degradation results ..... 29
Eutrophication ..... 29
Recreation ..... 30
4.4 Discussion ..... 30
5. Discussion and lessons learnt ..... 32
References ..... 35

# Summary

Theme 3 "Framework for economic and social analyses (ESA) in the Baltic Sea region" in the HELCOM TAPAS project developed an approach for the regional economic and social analyses to be used in the 'State of the Baltic Sea' report that is developed under the HELCOM HOLAS II project and will be prepared by June 2017 and updated in 2018. The approach and data can also be used in the Initial Assessment reporting of the EU Marine Strategy Framework Directive in 2018. The proposed approach is an outcome of expert workshops, literature review and data collection to provide a practical application of the concept.

The framework includes the two types of analyses requested by the MSFD Initial Assessment: the use of marine waters and cost of degradation analyses. The approach developed for the use of marine waters analysis relies mainly on the water accounts approach and statistics to collect economic indicators for the sectors and activities present in the marine environment. These statistics are complemented with information on the non-market value of marine and coastal recreation, in line with the ecosystem services approach. To illustrate the framework in practice, data are collected for the following sectors/activities: fish and shellfish harvesting, aquaculture, tourism and leisure, energy production and transport for Finland and Estonia.

The cost of degradation approach employs a mix of the thematic and ecosystem services approaches. Estimates of cost of degradation rely on economic valuation studies on changes in the state of the marine environment with regard to relevant descriptors of good environmental status and ecosystem services. Baltic Sea wide studies, providing value estimates for each coastal country, are preferred when they are available. This is the case for cost of degradation related to eutrophication and recreation. For other descriptors and ecosystem services, the framework suggests using value transfer, where cost of degradation estimated in some of the Baltic Sea countries are transferred to those where estimates do not exist.

# 1. Introduction

This is a report of the project "Development of HELCOM tools and approaches for the Second Holistic Assessment of the Ecosystem Health of the Baltic Sea (HELCOM TAPAS)" funded by the European Commission and its Theme 3: "Framework for economic and social analyses (ESA) in the Baltic Sea region". The main objectives of the theme were to build capacity for economic and social analyses (ESA) and to propose an approach for the regional economic and social analyses for the EU Marine Strategy Framework Directive (MSFD) Initial Assessment reporting in 2018 and for the HELCOM second holistic assessment of the ecosystem health of the Baltic Sea (HOLAS II) in 2017. Thus, the development of the approach and the analyses was made in close collaboration with the HELCOM TAPAS project partners and HELCOM Contracting Parties. This was achieved by organising two HELCOM TAPAS ESA workshops that allowed the co-development and relevance check of the approach and results. The framework and findings of the project were also presented in 2016 at the HELCOM HOLAS II and GEAR meetings, HELCOM-VASAB Marine Spatial Planning Working Group meeting, and 15$^{th}$ Meeting of the Working Group on Programme of Measures, Economic and Social Analysis (POMESA).

The focus of the HELCOM TAPAS ESA is on the MSFD Article 8c that requires analyses on the use of marine waters and cost of degradation. These economic and social analyses illustrate, from one perspective, the importance of the Baltic Sea marine environment for the society. We use the sea in many ways: for fish and shellfish harvesting and aquaculture, for tourism and recreation, as transportation routes and as a space for energy production. These sea-dependent activities bring substantial economic benefits, both in terms of their effect on the national economy and employment and more broadly on society's well-being. These benefits are the focus of the *use of marine waters* analysis, which examines what kind of economic benefits and to what extent they are derived from the activities and sectors present in the marine environment. The human activities also create pressures that affect the state of the marine environment and its ability to provide goods and services for human well-being. These pressures are assessed in terms of their environmental impacts in the MSFD Initial Assessment and in the HELCOM HOLAS II assessment. The environmental impacts, including nutrient loading, marine litter and hazardous substances, may reduce society's well-being, e.g. by reducing recreation opportunities. Moreover, citizens who value the existence of a healthy marine ecosystem and its species suffer from a decrease in their well-being. The reduction in human well-being caused by the deterioration of the marine environment is the focus of the *cost of degradation* analysis. The pressures may also negatively affect the economic contribution from the use of marine waters. For example, overharvesting of fish stocks will decrease the contribution of the fisheries sector to national economies in the long run. The existing data and tools are inadequate to account for such costs of degradation, thus they are beyond the scope of the present report. However, these could be taken into account by developing numerical bioeconomic models.

This report presents a conceptual framework showing linkages between and examples of the use of marine waters and cost of degradation analyses. Use of marine waters data are collected for selected sectors for Estonia and Finland, and cost of degradation estimates are presented for selected degradation themes and ecosystem services (eutrophication and recreation). The results are an outcome of expert workshops[1], literature review and data collection to provide a practical application of the concept. The chosen approaches are in line with the guidance document provided by the European Commission's Working Group of Economic and Social Analyses of the MSFD (WG ESA 2010). The report also sheds light on the interpretation of the

[1] The workshop outcomes can be found here: HELCOM ESA WS 1-2015, TAPAS ESA WS 1-2016, TAPAS ESA WS 2-2016.

economic indicators used, identifies gaps in available methods and data, and provides some information on initiatives and projects to overcome these gaps in the future.

The work of HELCOM TAPAS will be continued in HELCOM SPICE project in 2017. In SPICE, data are collected for additional countries in the Baltic Sea Region for the use of marine water analysis, and for additional degradation themes/descriptors of good environmental status for the cost of degradation analysis.

# 2. Conceptual models and approaches for the regional economic and social analyses

## 2.1 Conceptual models preceding HELCOM TAPAS

The conceptual model for the regional economic and social analyses first developed in the HELCOM HOLAS economic and social analyses workshop in 2015 (HOLAS II ESA WS 1-2015) was an adaptation of the Driver-Pressure-State-Impact-Response (DPSIR) model. It shows how the economic activities create pressure on the marine environment and the ecosystem services it provides. Ecosystem services are tangible and intangible services provided by the ecosystem that are utilized directly or indirectly for human well-being. Some examples of marine and coastal ecosystem services are food (fish, shellfish), raw materials, energy, and marine and coastal recreation (see Ahtiainen & Öhman 2013 for more information).

In principle, the use of marine waters analysis could be conducted by developing economic indicators for the activities causing pressures, and the cost of degradation analysis could be conducted by estimating the change in the value of ecosystem services provided by the Baltic Sea in the current and the good environmental state (Figure 1).

The HOLAS II ESA workshop then tested the concept ad hoc by developing a toy model for eutrophication (Figure 2). The activities causing eutrophication were selected from the MSFD Annex III. Eutrophication status could be assessed using HELCOM core indicators and the impact of eutrophication to ecosystem services could be identified for example using UK NEA ecosystem service classification. Finally, the economic impact eutrophication has on the ecosystem services could be assessed based on the economic value of the respective goods and benefits.

Model 1:

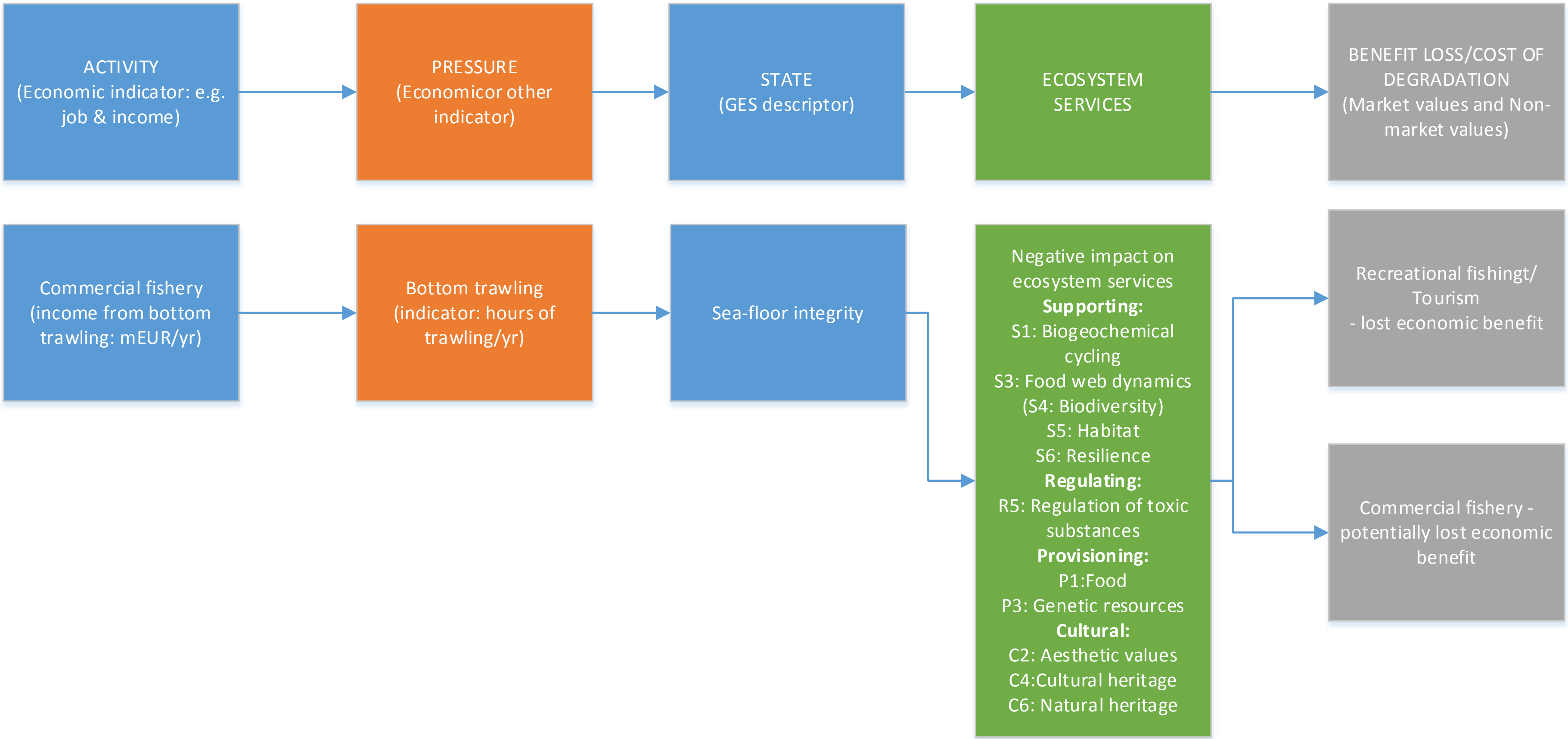


***Figure 1a. The first of the conceptual models discussed in the HELCOM ESA workshop 1-2015. Model 1 includes the environmental state between pressures and ecosystem services (source: HOLAS II ESA WS 1-2015 report).***

Model 2:

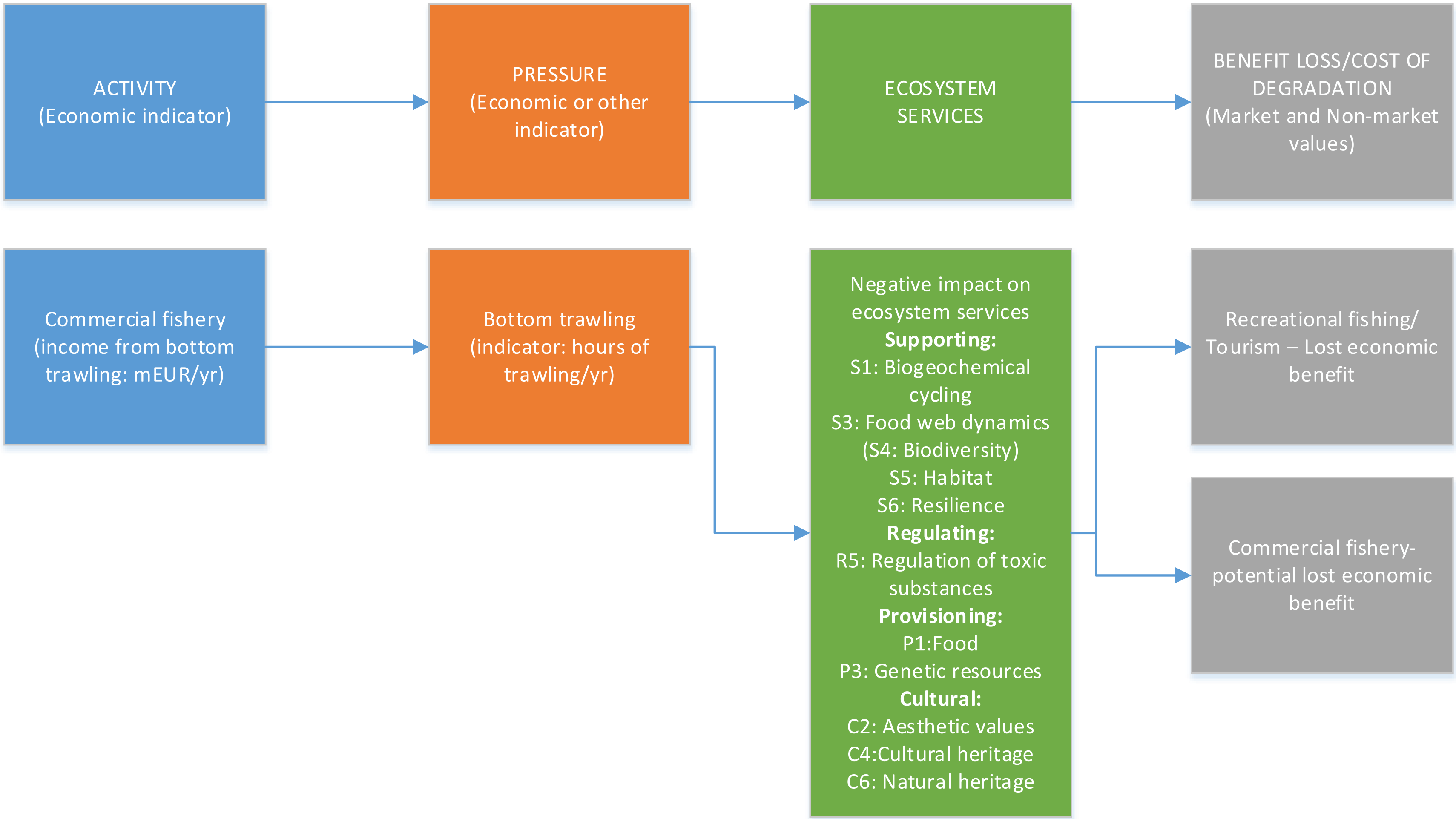


***Figure 1b. The second of the conceptual models discussed in the HELCOM ESA workshop 1-2015. Model 2 links pressures directly to ecosystem services (source: HOLAS II ESA WS 1-2015 report).***

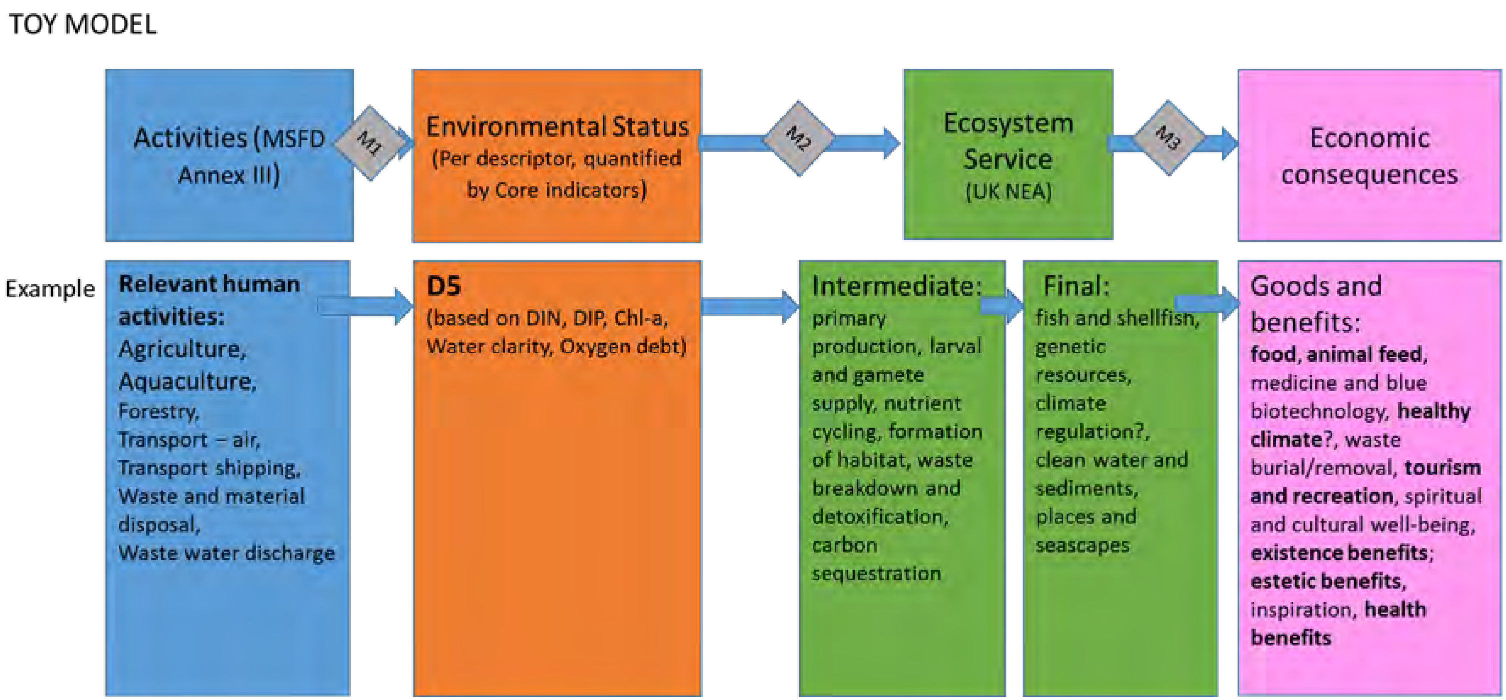


***Figure 2. Demonstration of the conceptual model. Blue boxes list potential activities affecting eutrophication, orange boxes list the core indicators assessing eutrophication status, green boxes list intermediate and final ecosystem services and pink boxes the economic consequences (source: HOLAS II ESA WS 1-2015 report).***

## 2.2 Conceptual model of HELCOM TAPAS

The finding of the first TAPAS workshop (TAPAS ESA WS 1-2016) was that there are no tools, models or data to conduct an analysis strictly following any of the conceptual models developed in the workshops preceding the HELCOM TAPAS project. Such an analysis would identify the level of economic activities that would lead to the achievement of the good environmental status, and assess both the monetary contribution of the economic activities to the economy and their effect on the environmental values. Thus, the HELCOM TAPAS conceptual model does not provide links between the use of marine waters and the cost of degradation analysis, but examines them separately (Figure 3). It is important to note that such integrated analysis is not a requested by the MSFD, but would provide a more holistic view on the links and feedbacks between the Baltic Sea marine environment and societies around it. The first steps towards such integrated analysis covering the grey boxes will be taken in the HELCOM SPICE project[2] in 2017. An analysis showing how the state of the Baltic Sea affects the economic performance of the different activities would be a worthy extension of the planned further work.

Figure 3 shows that the results from the use of marine waters and cost of degradation analyses are measured in monetary terms. However, the monetary numbers shown in the results section are not additive or directly comparable, since they measure different things and are calculated using different approaches and methods that will be further explained in the following sections. The reader should keep in mind differences between price, economic value and economic impact.[3] Economic value means the resource's contribution to the well-being of an individual or the society at large. Economic value can be measured using people's maximum willingness to pay for the good. Since the willingness to pay is not equal to the market price, economic value is not the same as market price. Related measures of economic welfare are consumer and producer surplus. Consumer surplus is the monetary gain obtained by consumers because they are able to purchase a product for a price that is less than they would be willing to pay. Producer surplus is the monetary gain to producers from being able to sell at a market price that is higher than the cost of production.

Measuring the willingness to pay for products is difficult, and thus prices and revenues are often used as proxies for economic values. The problem in focusing on market prices is that some aspects of the resource that create economic value are ignored. The value of these non-market goods and services cannot be deduced based on market prices, because they are not sold in the market. The marine and coastal environment provides many non-market values, main examples being marine and coastal recreation and the values derived from the existence of a healthy ecosystem.

In this report, the concepts are used as follows. For the use of marine water waters analysis, we mainly use proxy indicators, such as gross value added and employment, to measure the economic impacts i.e. the economic contribution an activity makes to the economy. The exception is recreation, for which we measure the economic value based on consumer surplus (i.e. the difference between the consumer's total willingness to pay and the total amount they pay for the good). In the cost of degradation analysis, we measure economic values based on people's willingness to pay for environmental changes and consumer surplus.

[2] SPICE is an EU co-financed project that is coordinated by HELCOM and that will be implemented in 2017.
[3] For a more detailed discussion of the same issue, please see Pendleton (2009).

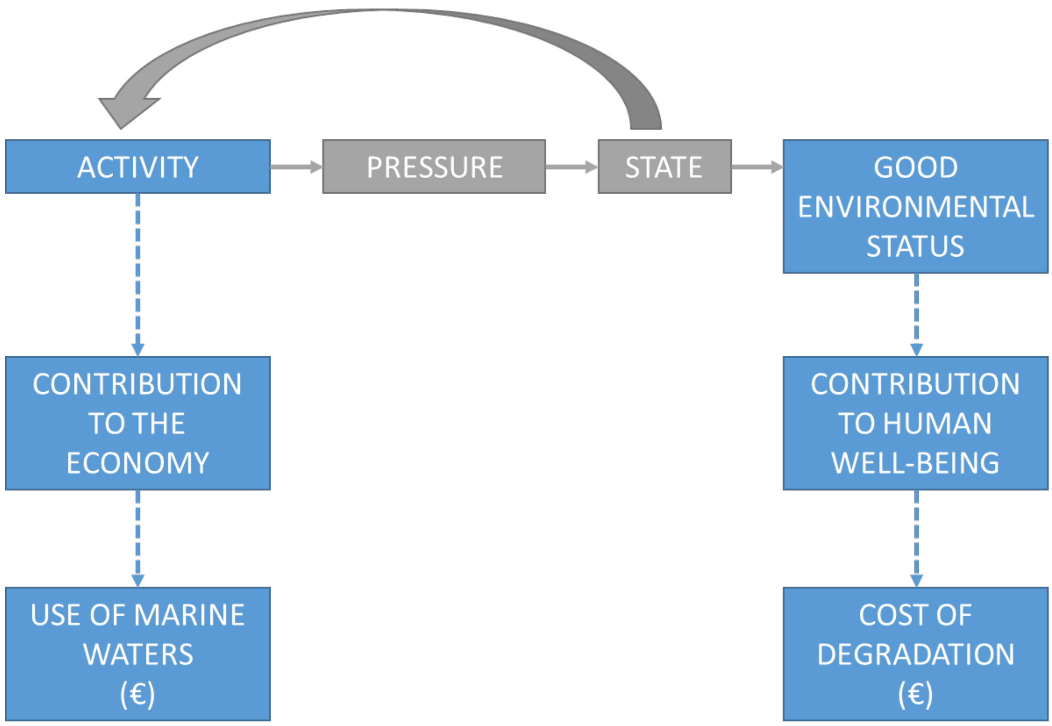


***Figure 3. Conceptual model used in the HELCOM TAPAS analysis (components included shown in blue). The TAPAS conceptual model does not provide links between activities and state of the marine environment (or vice versa).***

## 2.3 Approaches for the economic and social analyses

The use of marine waters and the cost of degradation analyses can be interpreted and executed in many ways. Moreover, in practice, there is no single approach available that could be chosen to conduct both the use of marine waters and cost of degradation analyses[4]. The European Commission Working Group on Economic and Social Assessment (WG ESA) published a non-binding guidance document to support the Member States in their task (WG ESA 2010), providing a non-exhaustive list of different approaches for the two analyses. In the EC review of the MSFD Initial Assessment of 2012 the main criticism to the Baltic Sea countries was the lack of regional cooperation. The use of marine waters and the cost of degradation analyses were carried out using various approaches and from national perspectives, whereas the regional viewpoint was missing. To fill this gap, the HELCOM TAPAS project, together with the HELCOM Contracting Parties, aimed to develop analyses that could be used in the national analyses and reporting, but also applied to the regional context. The feedback from the Contracting Parties showed that there are differences in the national guidelines for the application and acceptance of some methods. This will hamper the use of some of the TAPAS results in some Contracting Parties. However, the HELCOM TAPAS project has prioritized approaches and methods that are able to provide regional analyses with the existing data sets.

To maintain adaptability of the analysis and present all the available information, TAPAS combines several approaches. The chosen approaches illustrated in Figure 4 are in line with the WG ESA guidance document (WG ESA 2010) and will be further elaborated in the next sections.

[4] In the future, the different initiatives for natural capital accounting like the KIP-INCA may provide data and frameworks to combine the analyses.

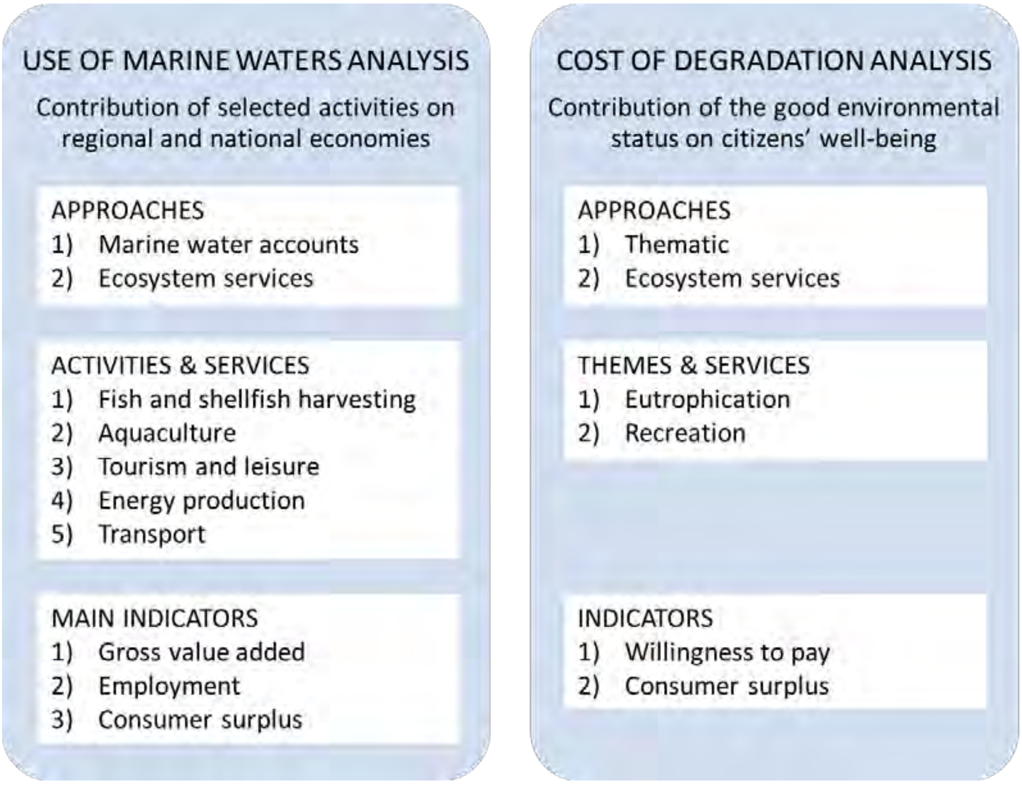


***Figure 4. HELCOM TAPAS uses mixed approaches for the use of marine waters and cost of degradation analyses.***

# 3. What do we gain? Use of marine waters analysis

## 3.1 What is meant by the use of marine waters analysis?

As a society, we utilise the marine waters in different ways. Our various economic sectors use the sea - its resources, space, energy, etc. – and profit from doing so. As individuals, we are also employed by these economic sectors, purchase or obtain goods and services from these sectors, and enjoy using the sea and coastal areas for recreation and other purposes.

While bringing certain socio-economic benefits to society, the use of marine waters also creates pressures on the marine environment. Some activities, such as fishing and recreation, are dependent on the state of the marine environment, meaning that they require a certain level of environmental quality to continue as activities. Other activities, such as those in the transport sector, use the sea as a space, but are not themselves affected by the state of marine environment. Some sectors, such as agriculture, impact the marine environment (use the sea as a sink) but are not present there.

For this study, *use of marine waters* is defined as any human activity using the marine or coastal environment. This is a more narrow definition than that which is used by the European Commission's Working Group on Economic and Social Assessment, which defines use of marine waters to be "any human activity using or influencing the marine space and/or ecosystem goods and services provided by marine waters" (WG ESA 2010).

The socio-economic analysis on the use of marine waters measures the economic impact (i.e. contribution) from the use of the sea in the current state. In this analysis, this contribution is measured using economic indicators which are, for the most part, based on market values. These indicators and their values do not specify the negative impacts these uses may have on the quality of the marine environment or the activities themselves. Thus, this socio-economic analysis of the use of marine waters analysis should be seen as a piece of the overall picture of how the society and the marine environment are linked.

## 3.2 How to assess the use of marine waters?

In the use of marine waters analysis, human activities and sectors present in the marine environment are described using economic indicators to illustrate their economic importance and the benefits derived from the use of marine waters. There are two approaches to assessing the use of marine waters (WG ESA 2010):

1) Marine water accounts (MWA) approach:
    a) Identify and describe the region of interest.
    b) Identify and describe the economic sectors using marine waters.
    c) Identify and, if possible, quantify the economic benefits derived from the economic sector's use of the marine waters, e.g. in terms of production value, intermediate consumption, value added, number of employees, and compensation of employees.
    d) Identify and, if possible, quantify impacts on the environment generated by these sectors.

2) Ecosystem services (ES) approach:
    a) Identify ecosystem services of the marine areas in cooperation with the analysis of status and the analysis of pressures and impacts on the marine environment.
    b) Identify and if possible quantify and value the welfare derived from the ES using different methods to estimate the use and non-use values of these services.
    c) Identify the drivers and pressures affecting the ecosystem services.

### Approach developed to assess the regional use of marine waters

In the HELCOM TAPAS project, we have utilised a mixed approach which builds mainly on the marine water accounts but combines components of the ecosystem services approach to the analysis, in line with the WG ESA guidance document (WG ESA 2010). Both approaches were utilised by HELCOM countries in their 2012 MSFD Initial Assessment reporting. The mixed approach leans heavily on statistics, but complements them with non-market values and non-sectoral activities when possible (ecosystem services approach). The emphasis on the marine water accounts approach is a consequence of data availability: statistics for marine sectors and activities are more readily available than ecosystem service values. To increase comparability across the Baltic Sea region, sources providing data for most or all of the coastal countries have been used. Indirect use values and non-use values, mentioned in the ecosystem service approach, have not been included due to lack of data (for the definition of these values, see section 4.2, *Valuing the consequences to citizen's well-being)*.

**Approach for assessing the regional use of marine waters**

General

- Utilise mixed approach - marine water accounts approach, complemented by ecosystem service approach with non-market values
- Identify and describe the different uses of the marine waters
- Evaluate whether the activity exerts a pressure and is dependent on the state of the marine environment based on the Baltic Sea pressure and impact index (BSPII) for pressures, and expert assessment and literature review for dependence
- Prioritise activities and sectors based on the above, as well as on data availability

Indicators and data

- Present socio-economic indicators for each activity describing the contribution of marine uses on the economy
- Select indicators for which standardised data is available across several Baltic Sea countries to ensure harmonisation (it should be noted that for the majority of the sectors, Russian data were not available)
- Include value added and employment indicators when available
- Include alternative indicators of activity when socio-economic indicators are unavailable
- Record data source, indicator methodology, and information about year, anomalies, etc.
- Present the indicator specific data for each sector/activity at the country level

Evaluation

- Assess the data quality and availability and provide recommendations for improvement

### *The human activities and sectors*

The sectors are prioritised based on those which have been deemed relevant to the Baltic Sea in HOLAS II and to the MSFD Annex III (list of activities and sectors) and those that:

- create significant pressure to the marine environment
- derive significant benefits from the use of the marine environment, and/or
- are dependent on the environmental state of the Baltic Sea.

For the current report, the pressures of the activity on the Baltic Sea have been assessed based on conclusions from the State of the European Seas report (EEA, 2015) using a Yes/No answer categories. However, the pressures for the Baltic Sea will be assessed in the future using the Baltic Sea pressure and impact index (BSPII) and the conclusions from HOLAS II. Dependence of the activity on the state of the Baltic Sea is based on expert assessment within the HOLAS team.

Based on these criteria, the selected sectors / human activities include (Table 1)

1) fish and shellfish harvesting
2) aquaculture
3) tourism and leisure
4) energy production
5) transport

***Table 1. Human activities and sectors, sub-activities and data availability for the use of marine waters analysis***

| Human activities / sectors | Sub-activities or sub-sectors | Depend on environmental state | Pressure on environmental state | Data available |
|---|---|---|---|---|
| **Extraction of living resources** | Fish and shellfish harvesting | Yes | Yes | Fish and shellfish harvesting |
| **Cultivation of living resources** | Aquaculture | Yes | Yes | Aquaculture - Finfish mariculture |
| **Tourism and leisure** | Tourism | Yes | ? | Tourism - accommodation |
| | Recreation | Yes | Yes | Marine and coastal recreation |
| **Energy production** | Renewable energy generation | No | Yes | Off-shore wind energy |
| **Transport** | Transport: infrastructure | No | Yes | Transport infrastructure |
| | Transport: shipping | No | Yes | Freight shipping |
| | | ? | Yes | Passenger shipping |

### *Socio-economic indicators*

The socio-economic indicators describe the importance (or economic impact) of the activity or sector present in the marine environment. The indicators presented were selected based on availability across several countries within one source, as well as including both economic and social aspects. As indicators, value added shows the contribution of the sector to the national economy from a macro-economic perspective, while employment indicators are more related to the social impacts from the use of marine waters. When available, we have included indicators which can be linked to pressures and activities assessed in spatial terms in

HELCOM HOLAS II, e.g. value of landings. In order to include the citizen perspective, we have included non-market values for human activities when possible. The following indicators represent annual data and the data sources include Eurostat, industry associations, and regional studies.

1) *Value added* is a measure of productivity which shows the contribution of the activity or sector to the national economy. *Gross value added* (GVA) is included in the WG ESA Guidance (WG ESA 2010) and is used when available. It shows the value of the goods and services that have been produced minus the cost of all inputs and raw materials that can directly be attributed to production. The Scientific, Technical and Economic Committee for Fisheries (STECF) uses GVA and defines it using the following formula for fisheries: *GVA = income from landings + other income – energy costs – repair costs – other variable costs – non variable costs (*STECF 2016b)*;* and as follows for aquaculture*: GVA= turnover + other income – energy costs - livestock costs - feed costs - repair and maintenance – other operational costs (*STECF 2016a). Eurostat uses the indicator *value added at factor costs,* which "is similar, but does not fully correspond" to GVA (STECF 2016a). *Value added at factor costs* is defined as the "gross income from operating activities after adjusting for operating subsidies and indirect taxes. Value adjustments (such as depreciation) are not subtracted." (Eurostat 2017).
2) *Employment* is a proxy for a social indicator included in the WG ESA Guidance (WG ESA 2010). We utilise the indicator - *number of persons employed* when possible, as it is used by Eurostat Structural Business Statistics (SBS), as well as the Scientific, Technical and Economic Committee for Fisheries. *Number of persons employed* is the sum of number of employees receiving compensation for work and unpaid persons employed. It should be noted that STECF calls it "total employees" which is the defined the same as number of persons employed.
3) Non-market valuation data were used to complement the statistics to assess the economic benefits from marine and coastal recreation. The relevant indicator is *consumer surplus*, which describes the economic benefits people obtain from recreation. Consumer surplus measures the difference between the consumer's total willingness to pay and the total amount they pay for the good. Market prices or statistics of the tourism sector are either insufficient or inappropriate for capturing the full economic importance of sea-based recreation, as many recreational activities do not show in these prices or statistics.
4) When the above socio-economic indicators were not available, other indicators, such as *turnover* or *value of landings* is used. Turnover is defined as "totals invoiced by the observation unit during the reference period, and this corresponds to market sales of goods and services to third parties" (STECF 2016a) and value of landings is used as a proxy for income derived from landings calculated using price and quantity data (STECF 2016b).
5) When socio-economic indicators were unavailable, *quantitative indicators of activity* were used. Though they do not show economic significance, they can be converted into an economic figure using assumptions and conversion factors. Keeping record of non-economic data can also show sectoral and activity trends (growth or decline of activity) over time.

## 3.3 Results

This section presents the results of the use of marine waters analysis for the selected activities and sectors for Estonia and Finland to illustrate the framework. Presenting the data per country shows where the activities take place and what kind of economic and social impacts they have. We also discuss the possibilities to expand the analysis to regional scale.

The indicators that are available vary for the different sectors. For most of the sectors, there are data for employment and value added. However, they are lacking for renewable energy (offshore wind) and transport infrastructure. Also, it should be noted that as recreation is not a sector, but rather a human activity using the coastal and marine environment, the socio-economic indicator for recreation (consumer surplus) is different in that it indicates the economic benefits derived by citizens from taking part in this activity.

## Fish and shellfish harvesting

Fish and shellfish harvesting is a sector involved in the extraction of living resources (Table 2). The socio-economic data describes commercial small-scale fleet (SSF) and large-scale fleet (LSF) fishing which takes place within the Baltic Sea waters. Small-scale fleet uses vessels shorter than 12 meters using static gears, while large-scale fleet fishing includes vessels larger than 12 meters using static gears or all vessels using towed gears. There were an estimated 6,500 active vessels in the Baltic Sea in 2014 (STECF 2016b) (compared to 6,256 active vessels in 2013 (STECF 2015)). The Finnish fleet was the largest (1 764 vessels). Estonian, Finnish and Latvian marine fisheries are fully dependent on the Baltic Sea region, while other member states vessels operate also in other marine fishing regions (STECF 2016b). Only Baltic Sea related vessels and statistics are listed in Table 2.

The value of landings in the Baltic Sea region is €40 million for the Finnish fleet) and €15 million for the Estonian fleet). For the fish and shellfish harvesting sector, there would be data available in the 2016 Annual Economic Report on the EU Fishing Fleet for all countries except for Russia, so it is possible to expand the analysis. Furthermore, due to the reduced number of vessels and/or enterprises in Germany and the Baltic States, data which are considered sensitive (on distant-water fleets) were not delivered to STECF (STECF 2016b). This has an impact on the regional level analysis.

***Table 2. Socio-economic indicators related to fish and shellfish harvesting (data from the year 2014).***

| Country | Annual value of landings (thousand €) | Estimated annual gross value added (GVA) (million €) | Number of persons employed, 2014 |
|---|---|---|---|
| **Estonia** | 14 544 | 9.3 | 2 070 |
| **Finland** | 40 359 | 15.5 | 1 847 |

Source: Scientific, Technical and Economic Committee for Fisheries (STECF) (2016). All monetary values have been adjusted for inflation; constant prices (2015).

[a] STECF does not report on Russia.

## Marine aquaculture

Marine aquaculture is a sector involved in the cultivation of living resources (fish and shellfish) in the marine environment. It is a capital-intensive sector due to the equipment needed. Figures on marine aquaculture are only reported for Finland, as Estonian figures are not available or marked as zero in the STECF national data tables (STECF 2016a) (Table 3). The reports include also other EU countries, so there are possibilities to expand the analysis.

***Table 3. Socio-economic indicators related to marine aquaculture (data from the year 2014).***

| Country | Annual turnover (million €) | Annual gross value added (GVA) (million €) | Number of persons employed, 2014 |
|---|---|---|---|
| **Estonia** | 0* | 0* | 0* |
| **Finland** | 20.2 | 4.8 | 89 |

Source: Scientific, Technical and Economic Committee for Fisheries (STECF) (2016).
* only or mainly produce freshwater aquaculture and marked as 0 in STECF national data tables

## Tourism and leisure

The coastal and marine tourism and leisure sector covers a wide range of sub-sectors including accommodation, food and drinks, and leisure activities such as boating, fishing, going to the coast/beach etc. In many cases, it if difficult to separate the extent of the coastal and marine tourism from tourism that is not dependent on the marine and coastal environment, as the activities are not limited only to those which take place in the sea, but also includes those at the coast alongside the sea. However, marine tourism and recreation are dependent on the state of the sea, which is not true for all tourist activities taking place along the coast. In our analysis, we describe the coastal tourist accommodation sub-sector, available from statistics, (Table 4) and supplement these data with recreation values in the Baltic Sea (Table 5).

Our coastal tourist accommodation figures (value added and employment in Table 4) are based on a calculation using the share of the number of nights spent at tourist accommodation establishments in coastal area of the total nationally. Eurostat defines coastal areas as “municipalities bordering the sea or having half of their territory within 10 km from the coastline.”

The total value added at factor cost from accommodation for coastal tourism for the Baltic Sea is €156 million in Finland and €79 million in Estonia. Data exist for other EU member states around the Baltic Sea as well.

***Table 2. Socio-economic indicators related to tourism accommodation (data from the year 2014) [a].***

| Country | Share of the number of nights spent at tourist accommodation establishments in coastal areas of the national total number of nights spent (coastal/total), 2014 [a] | Annual value added at factor cost from coastal tourism accommodation sector (million €) [b] | Number of persons employed in coastal tourism accommodation, 2014 [b] |
|---|---|---|---|
| **Estonia** | 79% | 79 | 5 159 |
| **Finland** | 38% | 156 | 4 526 |

Source: Eurostat (2014), ([b] tour_occ_nin2c and [c] sbs_na_sca_r2)
[a] Figures are derived from calculating the percentage of nights spent at tourist accommodation establishments in coastal areas of the national total number of nights spent at tourist accommodations (tour_occ_nin2c).
[b] Figures are derived from applying the share of nights spent at tourist accommodation establishments in coastal areas to national annual value added at factor cost and number of persons employed figures (sbs_na_sca_r2)

## Recreation

In order to complement the statistics of coastal tourism, we have used estimates of the benefits derived from recreation visits to the Baltic Sea. These estimates (Table 5) were derived from a Baltic Sea wide travel cost study on the value of recreation. The annual consumer surplus measures the total value of recreation visits made to the Baltic Sea or its coast during a year. The table also reports the average number of recreational trips to the Baltic Sea per person based on people's responses in the travel cost survey.

The total annual recreational benefits of Baltic Sea visits are notably higher in Finland than in Estonia. The study provides similar data for all Baltic Sea countries, so regional analysis is possible.

***Table 5. Consumer surplus from marine and coastal recreation and average number of annual recreational trips to the Baltic Sea (data from the year 2010)***

| Country | Annual consumer surplus from Baltic Sea recreation visits (million €) | Average number of annual recreational visits to the Baltic Sea per person |
|---|---|---|
| **Estonia** | 150 | 1.8 |
| **Finland** | 1040 | 4.0 |

Source: Czajkowski et al. (2015)

## Offshore wind energy

Offshore wind energy is a sub-sector of the renewable energy production sector which takes place offshore. Offshore wind energy refers to the development and construction of wind farms in marine waters and the conversion of wind energy into electricity (European Commission 2013). It is a new industry that is considered to have much growth potential.

For offshore wind energy, non-monetary figures can be used to describe the sector as there are no other socio-economic indicators available. The capacity of installed offshore wind power and the number of existing off-shore wind turbines can be used to show the current situation, while the number of offshore wind turbines approved or under construction and their capacity show development. While data are available, they cannot at this moment be published (Table 6 is thus empty). However, it is likely that the data can be included in the HOLAS II State of the Baltic Sea report.

***Table 6. Socio-economic indicators related to off-shore wind energy***

| Country | Capacity of installed off-shore wind power (megawatts) | Number of existing off-shore wind turbines | Number of off-shore wind turbines approved or under construction | Capacity of Off-shore wind turbines approved or under construction (megawatts) |
|---|---|---|---|---|
| **Estonia** | | | | |
| **Finland** | | | | |

Source: HELCOM (2017)

## Marine transport and related infrastructure

Marine transport can be divided into transport infrastructure and shipping, which includes both shipping of passengers and freight. These two sectors are interrelated as shipping utilises transport infrastructure. Transport infrastructure includes ports, as well as activities done in relation to ports, such as dredging, cargo handling, and the construction of water projects. The shipping transport can be seen to cover shipbuilding and repair industry.

There is no monetary data available for transport infrastructure, namely ports. In many countries, port authorities are public bodies and economic statistics are not available for this sector. For our analysis, we utilise non-monetary data to describe the sector, including the number of ports, total port traffic, gross weight of goods handled in all ports and passengers embarked and disembarked in all ports (Table 7). As there is no harmonised reporting method between countries, some countries report ports which belong to a cluster individually and others as a cluster (Walhström et al. 2014).

While port traffic indicates to some degree pressure on the marine environment, it does not cover some of the other activities which are associated with ports, such as dredging.

***Table 7. Socio-economic indicators related to transport infrastructure (ports) (data from the year 2013 (Baltic Port List) and 2014 (Eurostat)).***

| Country | Total port traffic (thousand tonnes, 2013) [a] | Number of ports (2013) [a, c] | Annual gross weight of goods handled in all ports (thousand tonnes, 2014) [b] | Annual number of passengers embarked and disembarked in all ports (thousand passengers, 2014) [b] |
|---|---|---|---|---|
| **Estonia** | 42 908 | 11 | 43 578 | 13 654 |
| **Finland** | 106 070 | 39 | 105 537 | 18 487 |

Note: This table includes ports handling a minimum of 50 000 tonnes of cargo and international traffic.
[a] Source: Wahlström et al. (2014).
[b] Source: Eurostat (2014) (mar_mg_aa_cwh)
[c] Some port clusters reported as individual ports, while others reported as clusters.

The socio-economic indicators for the shipping transport sector include both the value added at factor cost from and the number of people employed by the sea and coastal freight and passenger transport (Table 8). The total value added from sea and coastal freight water transport in Finland is €403 million. In Estonia the data are confidential.

Estonia does not report shipping statistics when the data “allow for statistical units to be identified” (Eurostat, undated a), e.g. when there are too few actors to protect anonymity of the data. Data are available for other EU member states, so analysis can be expanded, but some countries may have marked the data as confidential.

***Table 8. Socio-economic indicators related to shipping (data from the year 2014).***

| Country | Annual value added at factor cost from sea and coastal freight water transport (million €)[a] | Number of people employed annually by sea and coastal freight water transport activities[a] | Annual value added at factor cost from sea and coastal passenger water transport (million €)[b] | Number of people employed annually in sea and coastal passenger water transport[b] |
|---|---|---|---|---|
| **Estonia** | confidential | confidential | 11.7 | 670 |
| **Finland** | 403 | 3 502 | 278.6 | 5 739 |

[a] Source: Eurostat (2014) (mar_pa_aa)
[b] Source: Eurostat (2014) (sbs_na_1a_se_r2)

## 3.4 Discussion

The use of marine waters analysis aims at identifying key uses of the sea. The approach used in this study utilises existing statistical information to measure the contribution that the sectors make to the national economy. This marine water accounts approach was the main approach applied by the Baltic Sea region countries in 2012, when the MSFD Article 8 assessment was conducted for the first time. The advantage of the marine water accounts approach is that the economic sectors and their activities can relatively easily be linked with the list of activities used in the HOLAS II assessment. Moreover, the data are derived from the existing system of national accounts, allowing for comparisons across countries, and the indicators used in this report are similar to the indicators used to measure blue economy and blue growth (EC, 2016). The marine water accounts approach is complemented with estimates on the economic value of Baltic Sea recreation, in line with the ecosystem approach for the use of marine waters analysis.

The results can be used to show the total economic impact per country (Finland and Estonia) from each human activity or sector described), and regional analysis is possible when the data are amended to include all/most Baltic Sea countries. It should be kept in mind, however, that for many of the sectors, only one main sectoral activity has been included for each sector. The activity included has been determined by the availability of data. For example, in this analysis, shipping infrastructure is represented by the number of ports per country, as well as the port traffic indicators. However, the analysis does not include value added or employment, both of which are theoretically possible to calculate, but not included due to a lack of data. Additionally, related activities, such as dredging, which is a shipping infrastructure activity having significant environmental impact, are not included in the analysis due to the lack of data. Thus, in some cases the figures cover only parts of the sectors, and thus may underestimate the economic impact of the sectors.

For HELCOM HOLAS II assessment, the use of marine waters can provide an initial analysis of the economic indicators for the activities using the sea and causing environmental pressures. Although not possible currently, with improved information about the links between the activities, pressures, state and economic values, it would be possible to show in the future how the economic value from the activities changes depending on the state of the Baltic Sea. EU countries have the possibility to include the relevant parts of this analysis in their MSFD reporting to the EC.

Comparison of the indicators between sectors is possible in terms of employment, as the total employment indicator is available for many of the sectors. However, for value added, the indicators gross value added and value added at factor costs are similar, but not the same indicator and thus not completely comparable. However, they are comparable between tourist accommodation and shipping (passenger and freight). Further, the value added at factor costs of fish and shellfish harvesting and aquaculture could, in principle, be compared.

Also, comparisons can be made between countries for the data available within a sector as the indicators for one sector are harmonised. Such a comparison can indicate which nations engage in such activities (e.g. aquaculture, shipping infrastructure and wind energy). For some sectors, (e.g. fish and shellfish harvesting) the indicators are not confined to activities within the national waters or specific sea basins, but rather activities take place throughout the Baltic Sea. This is clear, for example, with shipping, but also for fish and shellfish landings, which describe the value of fish landed by each country's national fleet within the Baltic Sea. Thus, this describes the economic impact of the activity for a specific country, but does not link it to the specific basins of the Baltic Sea.

There are some drawbacks to the use of marine waters approach. First, the effect of the status of the sea on the economic performance of the analysed sectors is not described or measured. Second, the use of the sea as a sink for pollutants is still hard to trace from national statistics. Third, the present System of National Accounting (SNA) excludes uses of the environment that are non-consumptive and/or are hard or impossible to measure using market prices. For example, statistics for the tourism sector are presented through statistics related to tourist accommodation, but these do not include or describe appropriately marine and coastal recreation. To overcome this, the approach employed in this report is to supplement the existing statistical indicators with indicators found from scientific literature that measure economic benefits derived from recreation. Fourth, the existing System of Environmental-Economic Accounting and its compulsory accounts (i.e. Environmental Protection and Expenditure account, Environmental Goods and Services account, Environmental Taxes account and/or Air Emissions account) have not been used to analyse the environmental impacts of the marine sectors or the monetary transactions by the sectors in responding to the management of the marine resources.

Another approach for the use of marine waters analysis would be to identify and define economic indicators for the ecosystem services provided by the sea. This ecosystem services approach would describe the linkages between the marine ecosystem and economic sectors more thoroughly. However, this is hard to apply due to the lack of data. The shortcomings of the system of national accounting have been known for a long time and there have been several initiatives to extend the accounting system to consider the environment. The System of Environmental-Economic Accounting Experimental Ecosystem Accounting (SEEA-EEA) is an integrated statistical framework for organising biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this information to economic and other human activities. The EU Biodiversity Strategy expects Member States to map and assess the state of the ecosystems and their services, assess the economic value of the services and integrate them into accounting systems (EC 2014b). The knowledge innovation project on an integrated system of natural capital and ecosystem services accounting in the EU (KIP-INCA) project is building marine ecosystem accounting (EC 2016a). Thus, it seems likely that in the future marine ecosystems and their services will be assessed and valued in a coherent manner, and also available in the use of marine water analysis.

## Recommendations on how to improve the usability of statistics and indicators for use of marine waters analysis

1) *Working across nations and statistical organisations to harmonise data and terminology*
   Harmonized data and terminology across countries and statistics are needed to obtain comparable information across countries for the entire marine region. For example, for employment indicators, "total employees" used in STECF is equivalent to the "number of persons" employed in Eurostat Structural Business Statistics (SBS) (EC 2016b). Furthermore, there are organisations collecting cross-country data which would be useful to use, e.g. recreational fishing data gathered by ICES. However, we have left out these indicators differing

survey designs used by the various countries in collecting the data. The ICES report discusses the need for improved reliability of data reported (ICES 2015).

2) *Disaggregation of national statistics between regional seas*
National data related to marine uses and activities needs to be reported separately for each regional sea. In the Baltic Sea region, this is an issue for Denmark and Germany which have coastlines also on the North Sea. In many cases, these countries report aggregate statistics on marine uses without separating between the seas.

3) *Differentiating between inland/freshwater and marine activities in national statistics*
For some marine activities, data are not broken down according to whether they take place in the marine environment or inland/freshwater environment. This type of aggregation can lead to an overestimation of the economic benefits originating from the use of marine waters, and makes it challenging to include data on these activities. This is relevant to statistics on marine aquaculture, which for some reason include freshwater aquaculture in some countries; freight and passenger water transport, which also includes transport on great lakes; as well as the definition of coastal tourism. It also applies to the following sectors which have not been covered in this report, but are relevant to the use of marine waters: extraction of crude petroleum and natural gas and support activities, and mining. This disaggregation has been overlooked in previous reports of blue economy and growth, e.g. (EC 2013; EC 2014a).
In addition, in Eurostat, coastal areas are currently defined as "municipalities (LAU-2) bordering the sea or having half of their territory within 10km from the coastline." However, all tourism and accommodation activities taking place in this territory cannot be considered marine related. Thus, a more refined definition of the coastline should be agreed upon.

4) *Encouraging all Baltic Sea region countries to report the data*
Presenting comparable information across countries requires that all countries report the data to authorities that make review reports. In the Baltic Sea region, lack of data is a problem especially in the case of Russia, which is not object to the reporting requirements of Eurostat or EU.

5) *Utilising the existing environmental economic accounts*
More systematic use of environmental economic accounts, as well as water and ecosystems services accounts would support several EU policies and Regional Seas Conventions, but national governments and intergovernmental institutions themselves need further guidance on how to utilise the relevant knowledge available from existing statistics and environmental economic accounts related to water and marine issues. At the same time there is a need to develop the existing environmental accounts and accounts in the pipeline (water and experimental ecosystem accounts).

# 4. What is at stake? Cost of degradation analysis

## 4.1 What is cost of degradation?

Cost of degradation means the change in citizen's well-being from the deterioration of the marine environment. Degradation causes many adverse effects that affect human-well-being directly or indirectly, including:

- increased water turbidity, more frequent blue-green algal blooms and oxygen deficiency in bottom waters
- reduction and changes in fish stocks
- contamination of fish and seafood
- increased litter on the beaches and in the sea, and
- loss of marine biodiversity.

Noticeable effects of degradation are decreased possibilities for marine and coastal recreation, reduction in the quality and quantity of food and other products available from the sea, losses to recreation and fishing industries, adverse effects on human health, and reduced biodiversity, ecosystem health and marine resources for the enjoyment of current and future generations.

Degradation of the marine environment reduces the ecosystem's ability to produce goods and services, which in turn affects human well-being. As the aim of marine policies is to achieve good environmental status (GES), which means that seas are clean, healthy and productive, cost of degradation can be assessed based on the benefits forgone or damages resulting from not achieving a good environmental status (GES) of the marine environment. Thus, cost of degradation measures the change in people's well-being for moving from the current or baseline status of the marine environment to the good environmental status.

Assessment of the cost of degradation is part of the economic and social analyses for the initial assessment of the EU Marine Strategy Framework Directive (Art. 8.1c).

## 4.2 How to assess the cost of degradation?

There are three general approaches to assess cost of degradation (WG ESA 2010):

1) Ecosystem service approach
   a. Define good environmental status (GES) and the baseline (= the development of environmental status given business as usual) and their difference in terms of ecosystem services
   b. Describe the consequences to human well-being

2) Thematic approach
   a. Identify degradation themes (e.g. marine litter, eutrophication)
   b. Define the present state and the target state (e.g. the GES boundary or threshold value for an indicator) and their difference
   c. Describe the consequences to human well-being

3) Cost-based approach
    a. Assess the costs of measures currently implemented to prevent degradation of the marine environment

The ecosystem approach is the most ambitious of these, followed by the thematic approach and the cost-based approach. All approaches necessitate some kind of valuation to assess the consequences to human well-being, but the ecosystem and thematic approaches involve valuing the benefits forgone if the state does not improve, while the cost-based approach focuses on the costs of improvement measures. Thus, the cost-based approach does not measure the actual well-being lost due to marine degradation, but rather the funds that are used to improve the state of the sea at present. Cost-based approaches could be used as proxies for the cost of degradation when the thematic or the ecosystem services approach cannot be applied. The monetary data for the damage cost and the maintenance cost approaches to measure environmental degradation could be derived from the framework of the System of Environmental-Economic Accounting (United Nations 2003, 2012, Schroer 2007), e.g. the environmental protection expenditure account (EPEA) and statistics on the environmental goods and services sector (EGSS).

The main difference between the ecosystem and thematic approach is in the focus of valuation. The ecosystem service approach focuses on describing and valuing the difference in ecosystem service provision in the baseline and GES. In the thematic approach, the cost of degradation is assessed in terms of degradation themes (i.e. environmental problems), and there is no need to value ecosystem services. Another major difference is in the definition of the gap. In the ecosystem approach, one examines the difference between the baseline and GES at the target year. In the thematic approach, the difference is between the present and target conditions (i.e. GES). A combination of the ecosystem and thematic approaches is also possible, depending on the available knowledge. The consequences to human well-being in the ecosystem and thematic approach can be presented in monetary terms, when possible, but also described quantitatively or qualitatively.

## Valuing the consequences to citizen's well-being

In the ecosystem service and thematic approaches, the economic (monetary) assessment of the cost of degradation requires valuing how changes in the marine environment impact human well-being. In many cases, the value of environmental changes cannot be observed from markets or market prices, and thus environmental valuation methods have been developed for this kind of analysis. The aim of these methods is to estimate the effects of environmental changes on human welfare in terms of citizens' willingness to pay for these changes. The willingness to pay represents the benefits (or losses) associated with the environmental change. Environmental valuation methods estimate either use values, non-use values or both. Use values are related to the (direct or indirect) use of the environment. One example of these are recreation values. Non-use (or existence) values are values people hold even though they might not use the environmental resource at all. They are associated with preserving the ecosystem and its species in good health, and giving others in current or future generations the opportunity to enjoy the environment.

There are, in general, two types of valuation methods: stated preference and revealed preference methods (see Champ et al. 2017). Stated preference methods are based on carefully constructed surveys that ask people's willingness to pay for well-defined changes in the environment (Bateman et al. 2002). These methods are the only ones that can capture both use and non-use values. Revealed preference methods are based on observing people's behaviour to determine environmental values (Bockstael et al. 2007). They are able to estimate use values related to the environment, for example recreation values. In addition to these two, benefit transfer method is becoming more and more common in policy analysis (Johnston et al. 2015).

In entails using existing research results to assess environmental values in locations for which value estimates are not available.

## Approach developed to assess the regional cost of degradation

The HELCOM TAPAS project has developed the following approach for the cost of degradation analysis in the Baltic Sea region.

**Approach for assessing the regional cost of degradation**

General

- Use mainly the thematic approach, combined with the ecosystem service approach
- Examine the cost of degradation separately for each descriptor of good environmental status (grouping overlapping descriptors when appropriate) and ecosystem service
- Use the baseline and target scenarios specified in the existing valuation studies. Discuss how well these scenarios correspond to those of HELCOM BSAP/EU MSFD to evaluate the reliability of the estimates
- Assess the cost of degradation in monetary terms if possible (economic valuation studies are available), and if not, quantitatively or qualitatively

Data and studies

- Include both stated and revealed preference valuation studies
- Use international valuation studies to ensure comparability across countries
- Use studies covering all coastal countries when possible
- Use benefit transfer across countries when needed to obtain regional estimates

Evaluation

- Assess how well the studies are suited for the assessment (e.g. scenarios and environmental change, geographical coverage, time frame)

Ecosystem services

- Present additional information on ecosystem services when available (illustrations, graphs, maps, qualitative assessments)

The assessment of cost of degradation is based on economic valuation studies that value the benefits of improving the state of the Baltic Sea. If the state does not improve, these benefits are lost, and thus they can be interpreted as the cost of degradation. The valuation studies estimate people's willingness to pay for a specific environmental change, either using surveys (stated preference studies) or by observing people's behaviour (revealed preference studies).

The valuation studies were identified based on several extensive literature reviews conducted in the Baltic Sea area in the recent years (Söderqvist & Hasselström 2008, Turner et al. 2010, COWI 2010, Ahtiainen & Öhman 2014, Hasler et al. 2016). Results of these valuation studies are reported either in journal articles or project reports. In an ideal case, the regional assessment of the cost of degradation would rely on international valuation studies that covered all nine coastal countries, valued the environmental change in the entire Baltic Sea and presented national level benefit estimates. This would allow for both national and regional estimates of the cost of degradation.

*When regional estimates are available*

Studies on the cost of degradation that cover the entire Baltic Sea marine area and all nine coastal countries are available only for eutrophication (thematic approach) and recreation (ecosystem service approach) (see Table 9). The cost of degradation estimate for eutrophication comes from a stated preference valuation study conducted in 2011 (Ahtiainen et al. 2014). The cost of degradation estimate for recreation is based on a revealed preference valuation study in 2010 (Czajkowski et al. 2015). These Baltic-wide studies are used to provide regional estimates of the cost of degradation in this report. For other themes or ecosystem services, there are no valuation studies that would cover all Baltic Sea countries.

***Table 9. Details of the regional studies that can be used to assess cost of degradation.***

| Descriptor | Focus of valuation | Study year | Area | Countries | Source |
|---|---|---|---|---|---|
| **Eutrophication** | Reducing the effects of eutrophication | 2011 | Entire Baltic Sea | All 9 coastal countries | Ahtiainen et al. (2014) |
| **Ecosystem service** | **Focus of valuation** | | **Area** | **Countries** | **Source** |
| **Recreation** | Improving (perceived) environmental quality by one unit | 2010 | Entire Baltic Sea | All 9 coastal countries | Czajkowski et al. (2015) |

*When there are no regional estimates: value transfer*

Regional cost of degradation estimates are readily available only for eutrophication and recreation, as these have been examined in Baltic-wide studies. Assessing the cost of degradation related to other descriptors and ecosystem services for the entire Baltic Sea region requires value transfer. Value transfer means using existing value estimates to infer values in another, previously unstudied site. In the case of the Baltic Sea, this implies transferring the cost of degradation estimates across countries. In the future, the value transfer approach can be used to assess the cost of degradation related to biodiversity and foodwebs (see Table 10).

***Table 10. Details of a study that can be used to assess cost of degradation using value transfer.***

| Descriptor | Focus of valuation | Study year | Area | Countries | Source |
|---|---|---|---|---|---|
| **Biodiversity and foodwebs** | Increasing the amount of health perennial vegetation and size of fish stocks | 2011 | Finnish-Swedish archipelago, Lithuanian coast | Finland, Sweden, Lithuania | Kosenius & Ollikainen (2015) |

The value transfer approach entails transferring mean willingness to pay (WTP) from one or several countries of the Baltic Sea to the other countries (where estimates are not available), adjusting for differences in price levels, currencies, and income. The country where the cost of degradation estimate originates from is called the *study country*, and the country where the estimate is transferred to is called the *policy country*.

When transferring, original cost of degradation estimates (from the study country) need to be adjusted to express the value estimates in the same year, currency and price level, and to account for the effect of income level on the cost of degradation estimates (see information box below on value transfer). The value estimates are first adjusted to year 2015 using country-specific consumer price indices (CPIs). Then they are converted to common currency (euro) using purchasing power parity (PPP) adjusted exchange rates, which allow cross-country comparisons by eliminating price level differences. The estimates are also adjusted for income differences across countries, assuming that the willingness to pay is a constant share of income (income elasticity of WTP is one). This is done by multiplying the primary estimate with the ratio between the gross domestic product (GDP) per capita in each country and the GDP per capita in the study country. These are all standard adjustments in international value transfers.

When value estimates are available from several countries, i.e. there are several possible study countries, the study country needs to be chosen. The choice of the appropriate study country should be based on the similarity between the study and the policy country, as this correspondence is crucial for the reliability of the value transfer. A practical approach is to base the choice on the average income level of the countries, and transfer value estimates between countries with similar income levels.

All value transfers rely on strong assumptions. Here it is assumed that the cost of degradation estimated in one (or few) countries can be used to assess the cost of degradation in other countries with small adjustments in price levels and income. This is not necessarily the case, as additional factors, such as differences in cultural issues, attitudes and use of the Baltic Sea may cause further divergence between the estimates across countries. These factors have been observed to have a significant effect on WTP in empirical valuation studies. Adjustments for these differences are not yet standard practice in value transfers, and information on which to base the adjustment factors is not readily available, and thus they are not performed.

**Value transfer approach**

Cost of degradation estimates (i.e. estimates of mean willingness to pay) are transferred from one or several countries of the Baltic Sea (*study countries*) to the other countries (*policy countries*), adjusting for inflation and differences in price levels, currencies and income. Adjustments are needed to express the value estimates in the same year, currency and price level, and to account for the effect of income level on the cost of degradation estimates. Additional adjustments may be necessary to change household values to individual ones, and to express one-time estimates in annual values.

$$CoD_{policy\ country} = CoD_{study\ country} * CPI\ factor * PPP\ factor * GDP\ factor$$

$$Consumer\ price\ index\ adjustment\ (CPI)\ factor = \frac{CPI_{2015}}{CPI_{study\ year}}$$

$$Purchasing\ power\ parity\ adjustment\ (PPP)\ factor = \frac{1}{PPP_{study\ country}}$$

$$Gross\ domestic\ product\ adjustment\ (GDP)\ factor = \frac{GDP\ per\ capita_{policy\ country}}{GDP\ per\ capita_{study\ country}}$$

## 4.3 Cost of degradation results

This section present estimates of cost of degradation for eutrophication and recreation, for which Baltic Sea –wide studies are available. Other degradation themes/descriptors of good environment status, such as biodiversity and foodwebs, can be covered if value transfer is used.

### Eutrophication

The cost of degradation from eutrophication was assessed based on the benefits forgone if the Baltic Sea does not reach the good environmental status with regard to eutrophication. An international stated preference contingent valuation study (Ahtiainen et al. 2014) elicited citizens' willingness to pay (WTP) for achieving a good eutrophication status in the Baltic Sea (good status was said to be achieved in all other sub-basins except for the northern Baltic Proper). The study was conducted in each of the nine coastal countries in 2011. The willingness to pay represents the benefits of reaching GES. If the GES is not reached, these benefits are lost, meaning that the benefits can be interpreted as the cost of degradation.

The study has appropriate geographical coverage as it has been conducted in all nine coastal countries and considers a change in the condition of the entire Baltic Sea. The target state corresponds closely to that of achieving a good environmental status of the sea, as the study states that GES is reached in all other sub-basins except the northern Baltic Proper. The time frame is somewhat longer than in current policies, as it is set to year 2050 in the study. Reaching the GES earlier than 2050 might bring about even greater benefits, as people generally place more value on goods and services they obtain sooner.

Table 11 presents the country-specific estimates of the cost of degradation from eutrophication per person and for the national adult population. The value estimates are expressed in 2015 euros, and the national estimates are calculated by multiplying the mean willingness to pay per person with the adult population in 2015 to express the total cost of degradation in the country in question.

***Table 11. Cost of degradation from eutrophication.***

| Country | Cost of degradation (€/person/year, 2015 euros)[1] | Population (18-80 years old in 2015)[2] | Cost of degradation (M€/year, 2015 euros) |
|---|---|---|---|
| **Denmark** | 29 – 37 | 4.28 | 125 – 158 |
| **Estonia** | 21 – 30 | 1.011 | 21 – 31 |
| **Finland** | 42 – 46 | 4.151 | 176 – 189 |
| **Germany** | 25 – 28 | 64.164 | 1572 – 1781 |
| **Latvia** | 5 – 6 | 1.553 | 8 – 9 |
| **Lithuania** | 9 – 10 | 2.267 | 19 – 22 |
| **Poland** | 12 – 13 | 29.789 | 368 – 383 |
| **Russia** | 11 – 12 | 90.787 | 1028 – 1129 |
| **Sweden** | 60 – 92 | 7.316 | 440 – 674 |
| **Total** | | 205.318 | 3760 – 4380 |

[1] The range for the cost of degradation estimates comes from the 95% confidence intervals for the value estimates reported in the original study.

[2] Eurostat, except Russia: Russian Federation Federal State Statistics Service. Russian population includes the population who is over 15 years old in Western Russia, i.e. Central, Southern, North Western, Ural and Volga federal districts.

All value estimates are primary (no value transfers).
Value estimates in PPP adjusted 2015 euros.

### Recreation

The cost of degradation estimates for recreation are based on a revealed preference travel cost study with the data collected using a survey in all nine coastal countries in 2010 (Czajkowski et al. 2015). The study estimated the change in the value of Baltic Sea recreation from a one-step change in the (perceived) environmental status of the Baltic Sea. This was based on the predicted change in the expected number of trips to the Baltic Sea when the perceived environmental conditions change. Thus, the estimates in Table 12 represent the change in citizen's recreational values from a deterioration of the Baltic Sea marine environment.

The study covers all coastal countries and considers recreation in the entire Baltic Sea. It is difficult to assess how well the environmental change in the study corresponds to achieving GES, as it is based on the respondents' perception of a one-step change in the environmental status of the Baltic Sea. The responses were measured on a Likert scale from 1 ("very bad") to 5 ("very good"). The average perceived environmental status was "rather good" in Germany and "neither bad nor good" in the remaining eight countries. Thus, a one-step change means in most cases an improvement from "neither bad nor good" to "rather good". How well these perceptions correspond to the actual current status and the good environmental status is unclear.

Table 12 presents the cost of degradation estimates related to recreation. The value estimates are expressed in 2015 euros. The national cost of degradation estimates are calculated using the change in the number of recreation trips to the Baltic Sea per year and the value (consumer surplus) per trip in the country in question.

***Table 12. Cost of degradation related to recreation.***

| Country | Cost of degradation (M€/year, 2015 euros) |
|---|---|
| **Denmark** | 51 – 70 |
| **Estonia** | 11 – 16 |
| **Finland** | 76 – 109 |
| **Germany** | 384 – 544 |
| **Latvia** | 9 – 11 |
| **Lithuania** | 14 – 22 |
| **Poland** | 151 – 232 |
| **Russia** | 30 – 736 |
| **Sweden** | 297 – 415 |
| **Total** | 1024 – 2155 |

All value estimates are primary (no value transfers).
Value estimates in PPP adjusted 2015 euros.

## 4.4 Discussion

This section has characterized an approach to provide a regional assessment of the cost of degradation of the Baltic Sea environment, and presented estimates for a selected descriptor of good environmental status (eutrophication) and an ecosystem service (recreation).

The cost of degradation estimates can be used to illustrate what is at stake if the state of the Baltic Sea does not improve with regard to eutrophication and environmental quality related to recreation. They are of relevance when conducting the HELCOM Second holistic assessment of the ecosystem health of the Baltic Sea (HOLAS II) in 2017. In addition, the estimates may be used in the EU Marine Strategy Framework Directive reporting on the cost of degradation in 2018.

The estimates are better used separately – summing them together to provide an estimate of the "total" cost of degradation could lead to double-counting. This is because the estimates originate from two separate studies which may have some overlap in the environmental improvements and thus value estimates. In addition, the studies feed into different approaches to assess the cost of degradation (thematic and ecosystem services approach).

The cost of degradation estimates can be updated when more research results are available. For example, ongoing BONUS and other projects (such as BONUS BALTICAPP) will provide new benefit estimates in the near future, which can be used to update the assessment.

The presented estimates for eutrophication and recreation are applicable to both regional and national level analysis, as both studies have been conducted in all Baltic Sea countries. The situation is different for other themes and ecosystem services, for which there are no cost of degradation estimates from every country, and value transfer is recommended to obtain a regional estimate. National cost of degradation analysis would preferably rely on national studies, as value estimates from original valuation studies are considered more reliable than transferred results. The problem with this approach is that it is questionable whether national values, originating from studies employing different methods, definitions and analyses, can be summed to produce a regional estimate of the cost of degradation. Thus, for regional analysis of these themes and ecosystem services, value transfer is needed in order to have comparable results across countries and to enable summing the national estimates to obtain an aggregate cost of degradation estimate for the entire Baltic Sea region.

There is some uncertainty in the cost of degradation estimates. One source of uncertainty is that the baseline and target scenarios and the study areas specified in the valuation studies do not fully correspond to those of marine policies, e.g. HELCOM Baltic Sea Action Plan or EU Marine Strategy Framework Directive. Even though these differences in the scenarios and areas could be identified, there are no simple approaches to correct for them.

Some may also criticize the methods used to estimate cost of degradation. Value transfer is considered to produce less reliable estimates than original valuation studies. Critique has been directed to survey-based stated preference methods used to estimate the cost of degradation from eutrophication. The most common issues mentioned include biases in hypothetical responses, no effect of the size of the environmental change on values, and differences in value estimates between different value measures (e.g. Hausman 2012). These critiques have largely been answered in Carson (2012). Proponents have argued that survey-based valuation studies are a practical alternative in cases where values cannot be based on market behaviour and prices, which is the case for many features of the Baltic Sea environment. Thus, comprehensive estimates of the cost of degradation caused by eutrophication cannot be obtained without using stated preference methods.

# 5. Discussion and lessons learnt

The HELCOM TAPAS project has developed a conceptual framework and assessed and collected data to deliver regional economic and social analyses for the use of marine waters and cost of degradation in the Baltic Sea region. The framework will be used for the 'State of the Baltic Sea' report (HOLAS II) in 2017 and findings can also be used for the EU Marine Strategy Framework Directive Initial Assessment reporting in 2018. As resources were limited in the TAPAS project, data have been collected for Finland and Estonia for the use of marine waters analysis, and for eutrophication and recreation in the cost of degradation analysis. However, the data collection will be complemented in the HELCOM SPICE project in 2017 to include all Baltic Sea region countries in the use of marine waters analysis and add other degradation themes/descriptors of good environmental status in the cost of degradation analysis.

The framework and results presented in this report pave way for further work on economic and social analyses, e.g. on the cost-effectiveness and cost-benefit analyses of the programmes of measures (MSFD Article 13). For example, the approach and results of the cost of degradation analysis can be used in cost-benefit analysis as the estimate of the economic benefits of achieving the good environmental status. Besides the requirements of the MSFD, there are clear connection points to maritime spatial planning and the development of blue growth indicators. MSFD economic and social analyses can also benefit from the increasing interest in the use of the marine environment and resources that might lead to better data collection and statistics that are beneficial for the economic analyses of marine protections as well.

Although not required by the MSFD, economic and social analyses would ideally show linkages and feedbacks between the use of marine waters analysis (describing the contribution marine sectors and activities to the economy) and the cost of degradation analysis (identifying the economic benefits forgone if the good environmental status of the marine environment is not achieved). As the existing tools, models and data do not enable such a holistic analysis, the TAPAS project has applied a pragmatic approach, collecting as much data as possible and applying feasible methods to conduct the analyses. This is the first attempt for regional economic and social analyses for the Baltic Sea area. In order to fulfil the objective of developing a regional approach and collecting data that is comparable across all Baltic Sea region countries, compromises were necessary.

A clear conclusion from the work is that data availability limits the analyses in practice. Not all marine uses can be characterized with existing statistics and economic indicators. Data issues are even more evident for the cost of degradation analysis, as value estimates are available only for few degradation themes and good environmental status descriptors. Additionally, existing information guides the selection of approaches for the analyses. Current knowledge is insufficient to fully apply the ecosystem services approach to the regional use of marine waters and cost of degradation analyses. As a concept, the ecosystem services approach would allow for a holistic analysis of the socio-ecological linkages between the Baltic Sea countries, their economies and citizens, and the sea. We have been able to employ the ecosystem service approach exclusively for marine and coastal recreation. However, this was only possible due to a recent multi-country study focusing on recreational use and values in the Baltic Sea area. In many cases, the existing information on economic values is not in the ecosystem services format. This is especially true for the use of marine waters analysis, where existing statistics provide information on the economic and social impacts of marine uses to the national economy and businesses as outlined in the marine water accounts approach. Applying the ecosystem services approach in the use of marine waters and cost of degradation analyses would require identifying marine and coastal ecosystem services and their contribution to human welfare. This necessitates additional valuation studies that focus on marine and coastal ecosystem services, preferably international ones that produce comparable information across the Baltic Sea region. In addition to this, for the cost of degradation analysis, the good environmental status and the business as usual scenario would have to be defined using ecosystem services.

The HELCOM TAPAS approach is adaptable for updating the results with reasonable effort when new information and research findings become available. In the short term, a step towards an integrated ecological-economic framework for economic and social analyses can be taken in the HELCOM SPICE project in 2017, which aims to examine whether integration of the economic indicators of the use of marine waters analysis with the Baltic Sea Pressure and Impact Index is possible. Potential additional sources for new information are research projects, such as BONUS BALTICAPP and ESMERALDA (Horizon 2020), and new statistical information. Moreover, the development of environmental economic accounts and marine ecosystem accounts may, in future MSFD assessment rounds, provide regionally coherent data and framework for economic and social analyses.

HELCOM TAPAS has also aimed at building capacity for the economic and social analyses under HELCOM and increase collaboration between economists working with marine protection issues in the Baltic Sea region. HELCOM TAPAS project organized two workshops with experts responsible for national economic and social analyses. One of the key obstacles of creating synergies and making sure that the project delivers results that are also relevant for the national MSFD analyses was the fact that all Baltic Sea Member States of the EU have a different timetable for the analyses. At the beginning of the TAPAS project, none of the countries had started the analyses. Some countries had initiated the process, but majority had no information on who would conduct the work and with what resources.

Participants found the workshops useful as the exchange of information on methodological development and potential new data sources was valuable. TAPAS work was also presented and discussed in two HELCOM HOLAS II meetings arranged in 2016. In general, the work was supported and the value of economic analyses was acknowledged more broadly, as HELCOM decided to establish an expert network for economic and social analyses. Another finding from the interaction between the TAPAS project and the HOLAS core team was that it was unclear how the results of the use of marine waters analysis and the cost of degradation analyses were used in the first round of the MSFD. Thus, in the future, the capacity building should also include training and education of non-economists on the meaning and understanding of the economics of marine protection. Possibly, this would allow showing the potential and usefulness of economic analyses in marine protection, for example in marine spatial planning. Creating an interdisciplinary working culture in MSFD work and Regional Sea Conventions is paramount also for bridging the gap between natural scientific assessments and economic and social analyses, and for fully applying the ecosystem-based approach of managing marine resources.

As a starting point for the interdisciplinary discussions, the present report has explained the different concepts and indicators used in the economic analysis. The aim has been to show that although economic analyses use money as a measuring stick, the same stick can be used to measure different things, also environmental values. The present report has supplemented the existing statistics with state-of-the-art scientific results from peer-reviewed papers.

The problem with the existing statistical information is that it only provides proxies for the economic value of the marine environment and does not give any insights into the sustainability of the use of marine waters. Indicators in the System of National Accounts, such as the gross value added, describe the economic impacts but do not consider the environmental impacts. A holistic economic and social analysis would try to identify a balance between the economic and environmental impact. A further issue with existing data on the economic value of good status of the marine environment is that the values suitable for regional analysis have so far been derived only for specific themes such as eutrophication. Thus, international studies showing the economic value of marine protection would be needed to provide holistic and ecologically and economically sound marine management and policies.

The Baltic Sea is a common pool resource for its surrounding countries, and as shown, for example, by the climate negotiations, sustainable management of common resources is the ultimate challenge. The key is to motivate all parties and stakeholders to act on the common long term interests instead of the individual short term interests.

In addition to differences in national interests, there are differences in national interpretations and guidelines on methods and approaches acceptable for the economic and social analysis. This creates complications and difficulties in harmonization of regional analyses. To overcome such challenges the regional analyses must be conducted in close collaboration with the countries involved. This requires active participation and resources from all parties and acknowledging the fact that regional analyses may depart from the national perspectives.

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