STATE OF THE BALTIC SEA
– HOLISTIC ASSESSMENT –
First version 2017

ECONOMIC AND SOCIAL ANALYSES IN THE BALTIC SEA REGION

TO BE UPDATED IN 2018

-Supplementary Report to the First Version of the HELCOM 'State of the Baltic Sea' report 2017

HELCOM – BALTIC MARINE ENVIRONMENT PROTECTION COMMISSION

Economic and social analyses in the Baltic Sea region - supplementary report to the first version of the HELCOM 'State of the Baltic Sea' report 2017

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Introductory note

This report contains the method description and summary results for the economic and social analyses in the Baltic Sea region as presented in the first version of the HELCOM 'State of the Baltic Sea' report, which is available at http://stateofthebalticsea.helcom.fi/about-helcom-and-the-assessment/downloads-and-data/.

The results will be further updated in time for the consolidation and finalization of the 'State of the Baltic Sea' report in June 2018, so that the assessment results will be representative of the assessment period 2011-2016.

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Summary

Economic and social analyses illustrate the importance of the Baltic Sea marine environment to society, the contribution the marine environment makes to the well-being of current and future generations, and to national and regional economies. The economic impacts originate from two sources: the use of marine waters and the state of the marine environment. Human activities that are dependent on the sea bring substantial economic benefits, both in terms of their effect on the national economy and employment and more broadly on citizens' well-being. Actions to protect the marine environment may also create economic benefits for economic sectors as well as citizens.

Human activities often create pressures on the state of the marine environment and its ability to provide goods and services. Degradation of the marine environment negatively affects the economic contribution from marine activities and sectors, and also citizens' well-being, for instance through reducing the enjoyment and opportunities for marine and coastal recreation. Moreover, people who value the existence of a healthy marine ecosystem and its species suffer from a decrease in their well-being.

Assessments to address these economic and social aspects of the marine environment can be implemented in many ways. The following report presents the approaches developed for the second HELCOM holistic assessment of the ecosystem health of the Baltic Sea, which is the first example of regional scale analysis in the Baltic Sea area. The assessment is conducted within a common framework, which includes the two types of analyses requested by the MSFD Initial Assessment: the economic and social analysis of the use of marine waters, and cost of degradation.

The approach developed for the use of marine waters analysis relies mainly on the water accounts approach and statistics to measure the economic impact from the use of marine environment. Economic indicators, such as value added and employment, are collected 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. Results from the use of marine waters analysis are presented for fish and shellfish harvesting, aquaculture, tourism and recreation, renewable energy generation and transport infrastructure and shipping. The analysis provides information on the contribution of current use of the marine environment to the economy.

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. Estimates based on value transfer are presented related to

biodiversity and foodwebs. Cost of degradation analysis measures how achieving the good environmental status contributes to citizens' well-being.

Note: This is the supplementary report for the regional economic and social analyses developed under the HELCOM HOLAS II project. The work has been supported by the EU-co-funded HELCOM TAPAS and SPICE projects in 2016-2017. The approach and results are summarized in the first version of the 'State of the Baltic Sea' report (HELCOM 2017a), which will be updated in 2018. They 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.

Chapter 1. Introduction

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. The economic and social analysis of the *use of marine waters*[4] examines the current economic impacts from the activities and sectors present in the marine environment. These 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.

The environmental impacts, including effects of e.g. nutrient loading, marine litter and hazardous substances, reduce society's well-being and benefits from the marine environment in many ways. Environmental degradation may negatively affect the economic contribution from marine activities and sectors, and also citizens' well-being through reducing, for example, the enjoyment and opportunities for marine and coastal recreation. 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.

Economic and social analyses on the use of marine waters and cost of degradation illustrate, from one perspective, the importance of the Baltic Sea marine environment to the well-being of current and future generations and to national and regional economies.

The economic and social analyses of the use of marine waters and the cost of degradation can be interpreted and executed in many ways. This report presents a conceptual framework for the regional use of marine waters and cost of degradation analyses that form the basis for the economic and social analyses in the 'State of the Baltic Sea' report (HELCOM 2017a).

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. Results from the use of marine waters analysis are presented for fish and shellfish harvesting, aquaculture, tourism and recreation, renewable energy generation and transport infrastructure and shipping.

[4] We refer to this later simply using the term *use of marine waters analysis*.

The approach for the cost of degradation analysis 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 cost of degradation estimates for each coastal country are available for eutrophication and recreation. For other descriptors and ecosystem services, such as biodiversity and foodwebs, the framework suggests using value transfer, where cost of degradation estimated in some of the Baltic Sea countries are transferred to those where no estimates exist.

Coherent and comparable approaches and results on the economic and social aspects of the Baltic Sea marine environment have thus far been lacking. The aim of the current assessment has been to provide a regional framework for the economic and social analyses that is applicable at the Baltic Sea level and also supports national implementation of marine policies, such as the EU MSFD. The results are an outcome of expert workshops[5], 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 is organized as follows. First, we present an overview of the framework and concepts used to measure economic and social contribution and impacts. The next two chapters present the detailed methods and results for the economic and social analyses of the use of marine waters and cost of degradation that have been included in the 'State of the Baltic Sea' report (HELCOM 2017a).

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

Chapter 2. Conceptual approach for the regional economic and social analyses

This chapter gives an overview of the approaches for the economic and social analyses of the use of marine waters and cost of degradation used in the 'State of the Baltic Sea' report (HELCOM 2017a). The details are presented in the subsequent chapters. The framework for regional economic and social analyses builds on the conceptual model developed in the HELCOM HOLAS II economic and social analyses workshop in 2015 (HOLAS II ESA WS 1-2015). In the beginning, the aim was to make an adaptation of the Driver-Pressure-State-Impact-Response (DPSIR) model and show how the use of marine waters creates pressures on the marine environment and the ecosystem services it provides, thus causing cost of degradation. 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. It became evident that this kind of analysis was too challenging considering the availability of data and resources for the work, and thus the framework was simplified so that use of marine waters and cost of degradation would be analysed separately without explicitly linking them to each other (Figure 1).

To maintain adaptability of the analysis and present all the available information, the framework combines several approaches for the use of marine waters and cost of degradation analyses. The chosen approaches, illustrated in Figure 2, are in line with the WG ESA guidance document (WG ESA 2010) and will be further elaborated in the next sections.

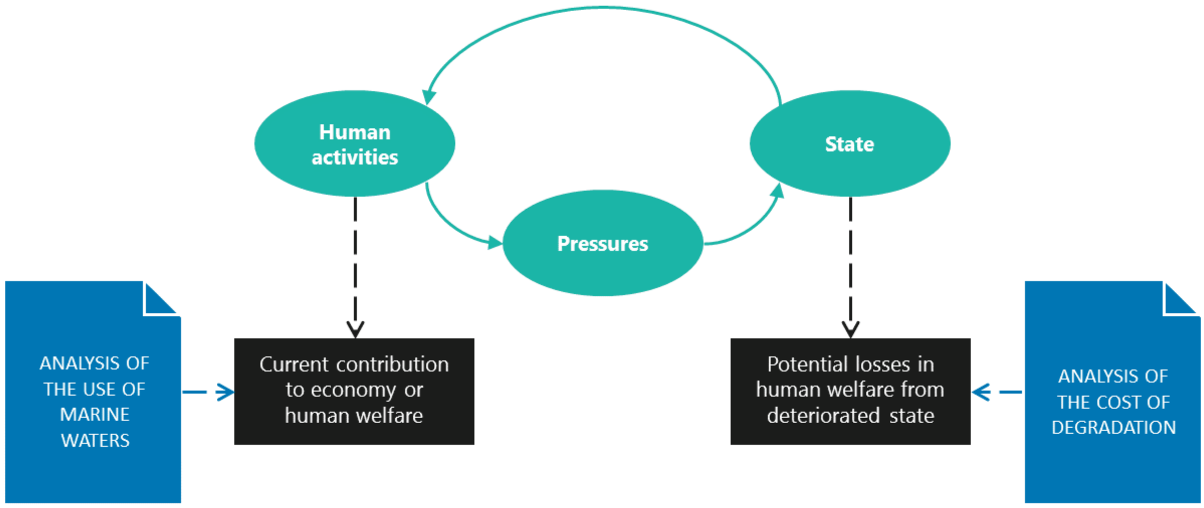

Figure 1. Conceptual model used in the HELCOM HOLAS II economic and social analyses. At present, the results of the analyses do not reflect the links between activities, pressures and state of the marine environment (or vice versa).

USE OF MARINE WATERS ANALYSIS

Contribution of selected **activities** on regional and national economies and human welfare

APPROACHES
1) Marine water accounts
2) Ecosystem services

ACTIVITIES & SERVICES
1) Fish and shellfish harvesting
2) Aquaculture
3) Tourism and leisure
4) Energy production
5) Transport

MAIN INDICATORS
1) Gross value added
2) Employment
3) Consumer surplus

COST OF DEGRADATION ANALYSIS

Impact on citizens' well-being of not achieving the **good environmental status**

APPROACHES
1) Thematic
2) Ecosystem services

THEMES & SERVICES
1) Eutrophication
2) Recreation
3) Biodiversity (underwater meadows and foodwebs)

INDICATORS
1) Willingness to pay
2) Consumer surplus

Figure 2. HELCOM HOLAS II uses mixed approaches for the use of marine waters and cost of degradation analyses.

2.1 ECONOMIC MEASURES USED IN THE REPORT

The results from the use of marine waters and cost of degradation analyses are mainly measured in monetary terms. However, it should be noted that, in most cases, the monetary estimates presented in this report are not additive or directly comparable, since they measure different effects and are calculated using different approaches and methods (as further explained in the following sections). The following presents a short description of the concepts used to measure economic and social contribution: economic impact, economic value and price.[6] This information is important to keep in mind when viewing and interpreting the results.

Economic impact represents the money and employment generated by an activity, in other words, the economic contribution the activity makes to the economy. While economic impacts do not, strictly speaking, provide information about economic values, they are easily measured, and thus widely used in assessing the economic importance of activities and sectors.

Economic value means the resource's or good's contribution to the well-being of an individual or the society at large, and can be measured using people's maximum willingness to pay for the good. Since 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 for it. 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 goods 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 and social impacts from the activity, i.e. the contribution the activity makes to the national economy. One exception is the analysis of 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.

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[6] For a more detailed discussion of similar issues, see Pendleton (2009).

Chapter 3. What do we gain? Economic and social analysis of the use of marine waters

What is meant by the economic and social analysis of the use of marine waters?

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 marine 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 the transport and energy sectors, use the sea for space, but are not themselves affected by the state of the 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 excludes land-based activities from the analysis.

The socio-economic analysis on the use of marine waters measures the economic impact from the use of the sea in the current state. In this analysis, this impact 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 the uses may have on the quality of the marine environment or the activities themselves. Thus, the 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.

In the economic and social analysis of the use of marine waters, 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 for 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.

3.1 APPROACH FOR ASSESSING THE REGIONAL USE OF MARINE WATERS

The assessment of the use of marine waters in the 'State of the Baltic Sea' report (HELCOM 2017a) utilises 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 data and 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 *Valuing the consequences to citizens' well-being* in Chapter 4).

The approach can be characterized as follows:

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, 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 representing the 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

A shortcoming of employing only the marine water accounts approach is that the statistics exclude uses of the environment that are non-consumptive and/or are hard or impossible to measure using market prices. To overcome this, the approach employed in this report is to supplement the existing statistical indicators with indicators found from the scientific literature that measure economic benefits from non-market uses (i.e. recreation).

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.

The sectors selected for the analysis based on these criteria are shown in Table 1. The pressures exerted on the Baltic Sea by an activity were assessed based on conclusions from the State of the European Seas report (EEA, 2015) using a Yes/No answer categories. Dependence of the activity on the state of the Baltic Sea is based on expert assessment within the HOLAS II team. All the activities mentioned in Table 1 have been included in some way in Chapter 3 'Human activities and the ecosystem' in the 'State of the Baltic Sea' report (HELCOM 2017a).

Table 1. Human activities and data availability for the use of marine waters analysis.

Theme	Activity	Depend on environmental state	Pressure on environmental state	Data available	In the 'State of the Baltic Sea' report
Extraction of living resources	Fish and shellfish harvesting	Yes	Yes	Fish and shellfish harvesting	Yes, Ch3
Cultivation of living resources	Aquaculture (marine)	Yes	Yes	Aquaculture - Finfish mariculture	Yes, Ch3
Tourism and leisure	Tourism	Yes	Yes	Tourism - accommodation	Yes, Ch3 (only description)
	Recreation	Yes	Yes	Marine and coastal recreation	Yes, Ch3, Box 3.3
Production of energy	Renewable energy generation	No	Yes	Offshore wind energy production	Yes, Ch3
Marine transport	Transport infrastructure	No	Yes	Transport infrastructure	Yes, Ch3
	Transport - shipping	No	Yes	Freight shipping	Yes, Ch3
		?	Yes	Passenger shipping	Yes, Ch3

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 in order to include 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 the 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 other parts of 'State of the Baltic Sea' report (HELCOM 2017a) e.g. value of landings. In order to include the citizen perspective, we have included non-market values for marine and coastal recreation. The data sources include Eurostat, industry associations, regional studies and national statistics.

- '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 a recommended indicator 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) also 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 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). According to STECF this indicator "is similar, but does not fully correspond" to GVA (STECF 2016a).

- Employment is a proxy for a social indicator (WG ESA 2010). When possible, we use the indicator 'number of persons employed', as it is used by Eurostat Structural Business Statistics (SBS) as well as by STECF. 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 uses the expression 'total employees', which is defined the same as number of persons employed.

- Non-market valuation data are 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 (in this case recreation). 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.

- When the above socio-economic indicators are not available, other indicators are 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 for the fisheries sector as a proxy for income derived from landings calculated using price and quantity data (STECF 2016b).

- When socio-economic indicators are unavailable, quantitative indicators of activity are used, for example, number and capacity of installed off-shore wind power or number of ports. Although they do not measure economic significance, they can be converted into economic figures using assumptions and conversion factors. Keeping record of non-economic data can also show sectoral and activity trends over time (growth or decline of activity).

3.2 RESULTS OF THE USE OF MARINE WATERS ANALYSIS

The results of the use of marine waters analysis are shown for the activities and sectors and countries for which data have been available. The data are presented per country to show where the activities take place and what kind of economic and social impacts they have, and finally, the aggregate numbers of the economic indicators for the Baltic Sea region are shown in the result tables.

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 energy) and marine transport infrastructure. Also, it should be noted that recreation is not a sector, but rather a human activity using the coastal and marine environment, and hence the socio-economic indicator for recreation (consumer surplus) is different in that it indicates the economic benefits obtained 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 and large-scale fleet 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.

For fish and shellfish harvesting, data specific to the Baltic Sea were available in the 2016 Annual Economic Report on the EU Fishing Fleet (STECF 2016b) for all countries except for Russia. 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. This has an impact on the regional level analysis.

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). Among the EU member states, Estonian, Finnish and Latvian marine fisheries are fully dependent on the Baltic Sea region, while other EU member states vessels operate also in other marine fishing regions (STECF 2016b). Only vessels operational in the Baltic Sea are included in the statistics (Table 2).

The value of landings in the Baltic Sea region was in total €218 million in 2014 (STECF 2016b), compared to the €260 million in 2012 (STECF 2015). The highest total values for fish and shellfish landed by national fleets from the Baltic Sea waters are by the Polish fleet (€48 million), Swedish fleet (€44 million), and Finnish fleet (€40 million), and the lowest total values are by the Estonian fleet (€15 million) and Lithuanian fleet (€4 million). The value of landings is similar in size to the value of estimated revenue (STECF 2016b). Gross value added for the Baltic Sea area totalled €95 million in 2014, compared to €121 million in 2012 (STECF 2015), with the highest values originating in Sweden (€23 million) and Poland (€23 million). The lowest values were for Lithuania (€0.7 million) and Germany (€5 million).

In terms of employment, the commercial fishing sector related to the Baltic Sea waters employs an estimated total of 9450 people. It should be noted that the full-time equivalent employment is almost half of this number (5 076), as the full-time equivalent estimates are significantly different from the number of persons employed, in all countries other than Poland. Poland (2 485), Estonia (2 070) and Finland (1 847) have significantly higher number of persons employed in its fleets operating in the Baltic Sea region than the other countries. Lithuania has the lowest with 337 persons employed (STECF 2016b).

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

Country	Annual value of landings (million €)	Estimated annual gross value added (GVA) (million €)	Number of persons employed
Estonia	14.5	9.3	2 070
Finland	40.4	15.5	1 847
Denmark	32.8	12.6	357
Germany	15.1	5.1	896
Latvia	19.5	7.2	607
Lithuania	4.2	0.7	337
Poland	47.9	21.7	2 485
Sweden	43.5	22.7	854
Russia a	not available	not available	not available
TOTAL	218	95	9 453

Source: Scientific, Technical and Economic Committee for Fisheries (STECF) (2016b). 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. Economic impacts from aquaculture are presented only for Finland, Denmark and Sweden (STECF 2016a, SwAM 2017).

It is good to note that there is one finfish and one shellfish farm in the German waters of the Baltic Sea, but the production volumes and other types of data are confidential, and thus there is information only on the location of the farms. For all the other countries, the production is assumed to be zero (and thus the turnover, gross value added and employment), based on the national production and sales data reported to STECF. Shellfish aquaculture is not included in the figures, as STECF does not report shellfish data separately for marine and freshwater regions. Of the Baltic Sea countries, Denmark, Germany and Sweden are involved in shellfish aquaculture, but it has a lower significance in the Baltic Sea than finfish aquaculture. For example, Denmark produces blue mussels in the Baltic Sea with an annual turnover of 1.3 million euros.

Marine finfish aquaculture had a total turnover of €79 million in 2014, divided mainly between Finland and Denmark (Table 3). The whole value for Denmark, Finland and Sweden can be attributed to the Baltic Sea.

In Denmark, marine production of rainbow trout and trout eggs in sea cage farms is the second most important type of aquaculture after land based production of trout. The Danish marine production of rainbow trout is located in the Baltic Sea along the southern cost of Jutland and a few production sites along the cost of Zealand. In Finland, marine aquaculture consists of rainbow trout production in cages.

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

Country	**Annual turnover (million €)**	**Annual gross value added (GVA) (million €)**	**Number of persons employed**
Estonia	0*	0*	0*
Finland	20.2	4.8	89
Denmark	57.4	9	155
Germany	confidential	confidential	confidential
Latvia	0*	0*	0*
Lithuania	0*	0*	0*
Poland	0*	0*	0*
Sweden	1.6	0.535	12
Russia [a]	not available	not available	not available
TOTAL	79	14	256

Source: Scientific, Technical and Economic Committee for Fisheries (STECF) (2016a), except Sweden: SwAM (2017).
* only or mainly produce freshwater aquaculture and marked as 0 in STECF national data tables
[a] STECF does not report on Russia.

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 and fishing. 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 coastal tourism accommodation, available from statistics, (Table 4) and supplement these data with values of coastal and marine recreation in the Baltic Sea (Table 5).

The coastal tourist accommodation figures (value added and employment in Table 4) are available for all countries except Russia. Eurostat defines coastal areas as “municipalities bordering the sea or having half of their territory within 10 km from the coastline.” Eurostat provides statistics on the number of nights spent at tourist accommodation establishments in the coastal area, as well as the number of nights spent at tourist accommodation establishments nationally. This enables calculating the share of nights spent at coastal areas of the total nights (coastal/total) (Table 4). Eurostat also provides the total value added at factor cost and employment statistics for accommodation. However, in order better represent the tourism related to the sea, the national value added and employment figures are multiplied with the share of coastal accommodation. For example, in Finland 38% of the value added and employment in the national tourism accommodation is attributed to the coastal areas.

It should be noted that as value added and employment data related to *tourist* accommodation is only reported by Lithuania and Sweden, we have used the value added and employment data related to accommodation, which is reported by all the EU countries. These indicator values are of similar magnitude for Lithuania and Sweden. Furthermore, for countries bordering more than one sea area (Germany and Denmark), the figures include all coastlines, as the Baltic Sea coastline is not differentiated from other sea coastlines. Figures for Russia are not available as the data source is Eurostat.

The total value added at factor cost from accommodation for coastal tourism for the Baltic Sea is €4 797 million, with the highest values originating in Germany (€2 345 million) and Sweden (€1 121 million). The lowest values for value added were found in the Estonia (€79 million), (Latvia €63 million), and Lithuania (€16 million). Total number of persons employed in this sector is 176 000 persons. The highest employment is found in Germany (97 668) and Sweden (29 326), while the lowest employment is in Finland (4 526) and Lithuania (1795).

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

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) [a]	Annual value added at factor cost from coastal tourism accommodation sector (million €) [b]	Number of persons employed in coastal tourism accommodation [b]
Estonia	79%	79	5 159
Finland	38%	156	4 526
Denmark [c]	91%	771	16 013
Germany [c]	18%	2 345	97 668
Latvia	83%	63	5 377
Lithuania	24%	16	1 795
Poland	25%	246	16 457
Sweden	62%	1 121	29 326
Russia [d]	not available	not available	not available
TOTAL		4 797	176 321

Sources: [a] Eurostat (2016e) (tour_occ_nin2c) and [b] Eurostat (2016d) (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). Related NACE code: 55.1; 55.2; 55.3: Hotels; holiday and other short-stay accommodation; camping grounds, recreational vehicle parks and trailer parks.

[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). Related NACE code: 50 Accommodation.

[c] Includes coastal accommodation in both the Baltic Sea and North Sea.

[d] Eurostat does not report on Russia.

Recreation

In order to complement the statistics of coastal tourism, we have used estimates of the benefits from recreational visits to the Baltic Sea marine and coastal areas. These estimates (Table 5) were derived from a Baltic Sea wide travel cost study on the value of recreation (Czajkowski *et al.* 2015). The annual consumer surplus measures the total value of recreation visits made to the Baltic Sea and 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 benefits of the Baltic Sea recreation visits in 2010 were €15 billion. The highest estimated values originate from Germany (€5.1 billion) and Sweden (€4.4 billion), while the lowest estimated values were found in Latvia (€110 million) and Estonia (€150 million). The average number of annual recreational visits per person was highest in Sweden (6.4 trips) and Denmark (6 trips), while the lowest average was found in Russia (0.5 trips) and Poland (1.1 trips).

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 value of Baltic Sea recreation visits (million €)	Average number of annual recreational visits to the Baltic Sea per person
Denmark	720	6.0
Estonia	150	1.8
Finland	1040	4.0
Germany	5140	1.2
Latvia	110	2.6
Lithuania	190	1.7
Poland	2070	1.1
Russia	940	0.5
Sweden	4430	6.4
TOTAL	14 790	

Source: Czajkowski *et al.* (2015)

Renewable energy generation

Offshore wind energy is a sub-sector of the renewable energy production sector which takes place in the sea. 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 and number of existing offshore wind turbines can be used to show the current situation, while the number of offshore wind turbines approved or under construction and their capacity illustrate future development. In Table 6, the first two columns include those offshore wind turbines that generate power. The last two columns depict the number and capacity of those wind turbines that have been approved or are under construction. In addition to these, there are dozens of proposed windfarm areas, for some of which an application has been submitted. For example, according to the data, there are no existing offshore wind turbines in Poland, but 40 have been proposed.

While the data have been accepted by the countries, the year the data originates from is not clear and may differ between countries. This makes especially the figures on the planned wind turbines rather uncertain.

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

Country	Number of existing offshore wind turbines	Capacity of existing offshore wind power (megawatts)	Number of offshore wind turbines approved or under construction	Capacity of offshore wind turbines approved or under construction (megawatts)
Estonia	0	0	not available	not available
Finland	7	32	1	3
Denmark	341	885	20	80
Germany	102	339	160	735
Latvia	0	0	not available	not available
Lithuania	0	0	not available	not available
Poland	0	0	not available	not available
Sweden	81	182	349	1853-2069
Russia	not available	not available	not available	not available
TOTAL	531	1438	530	2671-2887

Source: HELCOM (2017)

Marine transport

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. Some data are available for all coastal countries, and some for the EU member states.

Transport infrastructure

There are no monetary data available for evaluating transport infrastructure (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 (Wahlström *et al.* 2014).

It should be noted that while Russia has a low number of ports in the Baltic Sea compared to Finland and Sweden, it has the three largest ports in terms of total traffic. Also, most of the high traffic ports are on the eastern part of the Baltic Sea (Wahlström *et al.* 2014). While port traffic to some degree indicates pressures 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 marine transport infrastructure (ports) (data from the year 2013 (Wahlström *et al.* 2014, Baltic Port List) and 2014 (Eurostat))

Country	Number of ports (2013) [a, d]	Total port traffic (thousand tonnes, 2013) [a]	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) [c]
Estonia	11	42 908	43 578	13 654
Finland	39	106 070	105 537	18 487
Denmark	47	80 268	74 956	23 599
Germany	17	51 959	52 994	11 478
Latvia	6	70 480	71 836	802
Lithuania	2	42 385	41 105	280
Poland	8	64 282	68 744	2 224
Sweden	63	161 580	166 857	26 218
Russia	6	216 034	not available [e]	not available [e]
TOTAL	**199**	**835 966**	**625 607**	**96 742**

[a] Source: Wahlström *et al.* (2014), Baltic Port List.
[b] Sources: Eurostat (2016b) (mar_mg_aa_cwh), except Denmark: Statistics Denmark (2017) and Germany: Federal Statistical Office of Germany (2017a). NACE code unspecified.
[c] Sources: Eurostat (2016a) (mar_pa_aa), except Denmark: Statistics Denmark (2017) and Germany: Federal Statistical Office of Germany (2017b). NACE code unspecified.
[d] Some port clusters reported as individual ports, while others reported as clusters.
[e] Eurostat does not report on Russia.

Shipping

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 for the region from freight transport is €4.3 billion and from passenger transport €2.2 billion. In 2011, there were an estimated 42 million international ferry passengers in the Baltic Sea (HELCOM 2015). Around 25% of the shipping in the Baltic Sea takes place under the flag of one of the Baltic Sea coastal countries, according to HELCOM data from the automatic identification system for vessels (AIS).

For value added from sea and coastal freight water transport, Germany has the highest value added with €3.4 billion, but this figure includes all marine shipping and is not specific to the Baltic Sea. Finland has the next highest at €403 million. Latvia and Lithuania have the lowest values. For value added from sea and coastal passenger water transport, the numbers are more evenly spread, with Sweden having the highest value added followed by Finland and Denmark. The total number of people employed is 24 300 for freight transport and 24 500 for passenger transport.

It should be noted, however, that for Germany and Denmark, these figures relate to all ports and shipping transport, not just the Baltic Sea related ports or shipping transport. No figures for Russia are available for the indicators coming from Eurostat. Also, many countries do not report shipping statistics when the data "allow for statistical units to be identified" (EU 2009), e.g. when there are too few actors to protect anonymity of the data. In this case, data has been marked as "confidential" by countries. Together, these issues affect the regional totals.

Table 8. Socio-economic indicators related to marine 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 €)** [a]	**Number of people employed annually in sea and coastal passenger water transport** [a]
Estonia	confidential	confidential	11.7	670
Finland	403	3 502	278.6	5 739
Latvia	12	197	confidential	606
Lithuania	30	1 333	confidential	confidential
Poland	100	1 403	27.3	734
Sweden	287	3 847	333.2	8 519
Russia[c]	not available	not available	not available	not available
Denmark [b]	*confidential*	*not available*	*517.3*	*5 653*
Germany [b]	*3 420*	*14 027*	*1 049*	*2 615*
TOTAL	4 252	24 309	2 217	24 536

[a] Source: Eurostat (2016c) (sbs_na_1a_se_r2). Related NACE codes: 50.1 Sea and coastal passenger water transport, 50.2 Sea and coastal freight water transport.
[b] Includes shipping transport both the Baltic Sea and North Sea.
[c] Eurostat does not report on Russia.

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

What is cost of degradation?

Cost of degradation means the change in citizens' 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 beach 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, 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 (Figure 3).

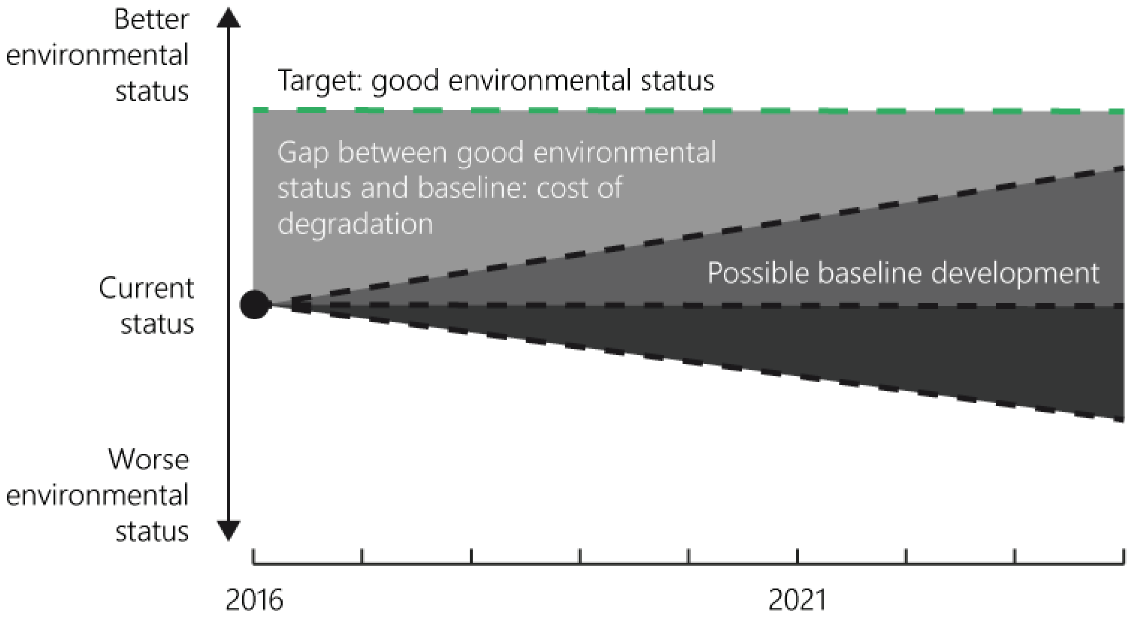

Figure 3. Illustration of the cost of degradation concept. Cost of degradation results from the difference between the current/baseline environmental status and the good environmental status.

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 service approach is the most ambitious of these, followed by the thematic approach and the cost-based approach. All approaches call for some kind of valuation to assess the consequences to human well-being, but the ecosystem service 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. Monetary estimates of the damage or maintenance costs 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 between 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 both the ecosystem and thematic approach can be presented in monetary terms, when possible, but also described quantitatively or qualitatively.

4.1 VALUING THE CONSEQUENCES TO CITIZENS' 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 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, the benefit (or value) transfer method is becoming more and more common in policy analysis (Johnston *et al.* 2015). It entails using existing research results to assess environmental values in locations for which value estimates are not available.

Some may criticise the methods used to assess cost of degradation. Value transfer is considered to produce less reliable estimates than original valuation studies. Critique can also be directed at 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.[7]

[7] Denmark has expressed a hesitation to using stated preference methods and the value transfer method to assess the cost of degradation.

4.2 APPROACH FOR ASSESSING THE REGIONAL COST OF DEGRADATION

The following approach has been developed for assessing the cost of degradation in the Baltic Sea region for HELCOM HOLAS II.

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 achieving good environmental status (as in HELCOM BSAP/EU MSFD) to evaluate the reliability of the estimates
- Assess the cost of degradation in monetary terms if possible (if 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 value transfer across countries to obtain regional estimates when there are no studies covering the entire Baltic Sea area

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 have been 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.

The cost of degradation estimates are presented in Chapters 3, 4.1 and 5.6 in the 'State of the Baltic Sea' report (HELCOM 2017a).

Available regional estimates

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. The cost of degradation estimates with regard to recreation are presented in Chapter 3, and with regard to eutrophication in Chapter 4.1 of the 'State of the Baltic Sea' report (HELCOM 2017a).

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 other, previously unstudied sites. In the case of the Baltic Sea, this implies transferring the cost of degradation estimates across countries. An example of the value transfer approach is presented for biodiversity and foodwebs (see Table 9).

Table 9. Details of the studies that are used to assess cost of degradation.

Regional estimates are available							
Descriptor/ ecosystem service	**Focus of valuation**	**Study year**	**Area**	**Countries**	**Original value estimates**	**Source**	**In the 'State of the Baltic Sea' report (HELCOM 2017a)**
Eutrophication	Reducing the effects of eutrophication	2011	Entire Baltic Sea	All 9 coastal countries	WTP, €/person Denmark: 32 Estonia: 24 Finland: 42 Germany: 25 Latvia: 6 Lithuania: 9 Poland: 12 Russia: 9 Sweden: 76	Ahtiainen *et al.* (2014)	Yes, Ch4.1
Recreation	Improving (perceived) environmental quality by one unit	2010	Entire Baltic Sea	All 9 coastal countries	Total value, million € Denmark: 54 Estonia: 12 Finland: 84 Germany: 411 Latvia: 9 Lithuania: 18 Poland: 167 Russia: 171 Sweden: 336	Czajkowski *et al.* (2015)	Yes, Ch3, Box 3.3
No regional estimates: value transfer							
Descriptor	**Focus of valuation**	**Study year**	**Area**	**Countries**	**Original value estimates**	**Source**	**In the 'State of the Baltic Sea' report (HELCOM 2017a)**
Biodiversity and foodwebs	Increasing the amount of healthy perennial vegetation and size of fish stocks	2011	Finnish-Swedish archipelago, Lithuanian coast	Finland, Lithuania, Sweden	WTP, €/household Healthy vegetation Finland: 105 Lithuania: 44 Sweden: 209 Fish stocks Finland: 81 Lithuania: 35 Sweden: 169	Kosenius & Ollikainen (2015)	Yes, Ch5.6, Box 5.6.1

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 is used in Chapter 5.6 of the 'State of the Baltic Sea' report (HELCOM 2017a). The related text describes the approach, and the visualization of the results clearly separates between the estimates that are based on original valuation studies and those based on value transfer.[8]

[8] Denmark has expressed a hesitation to using the value transfer method to assess the cost of degradation.

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.

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

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

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

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

Data sources:

CPI data: OECD (2016). Consumer prices – all items. Accessed 29.6.2016.

PPP data: Eurostat (2016). Purchasing power parities (PPPs), price level indices and real expenditures for ESA 2010 aggregates [prc_ppp_ind]. Updated 16.6.2016, accessed 21.6.2016. Except Russia: OECD (2016). Purchasing Power Parities for GDP and related indicators. Accessed 21.6.2016.

GDP data: Eurostat (2016). Main GDP aggregates per capita [nama_10_pc]. Updated 16.6.2016, accessed 21.6.2016. Except Russia: OECD (2016). Gross domestic product (GDP). Accessed 21.6.2016.

4.3 RESULTS OF THE COST OF DEGRADATION ANALYSIS

The following sections present examples of regional analysis of the cost of degradation. The values reflect the losses in citizens' well-being of not achieving a good environmental status of the marine environment. As the estimates cover only a limited number of degradation themes and ecosystem services, the analysis does not provide a complete overview of the regional cost of degradation for the Baltic Sea area. However, the estimates represent the best currently available information for the regional cost of degradation analysis.

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 captured a variety of eutrophication effects, including water clarity, blue-green algal blooms, underwater meadows, fish species composition and oxygen deficiency in the sea bottom. The change in eutrophication was described using all of these effects.

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 baseline and target state are projected by marine models. 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 10 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. The results indicate that each year, 3.8 - 4.4 billion euros are lost in citizens' welfare in the Baltic Sea region due to eutrophication.

Table 10. Cost of degradation from eutrophication

Country	Cost of degradation (€/person/year, 2015 euros)[1]	Population (18-80 years old in 2015)	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

Source: Ahtiainen *et al.* (2014)
1 The range for the cost of degradation estimates comes from the 95% confidence intervals for the value estimates reported in the original study.
Population data from 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 in general. Thus, the estimates in Table 12 represent the change in citizens' recreational values from the perceived 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, but nevertheless, the value estimates can be used as a proxy for the cost of degradation related to recreation.

Table 11 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. The results suggest that the value of coastal and marine recreation in the Baltic Sea could increase by 1 - 2 billion annually if the environmental conditions improved.

Table 11. Cost of degradation related to recreation.

Country	**Cost of degradation (M€/year, 2015 euros)[1]**
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

Source: Czajkowski *et al.* (2014)
1 The range for the cost of degradation estimates comes from the 95% confidence intervals for the value estimates reported in the original study.
All value estimates are primary (no value transfers).
Value estimates in PPP adjusted 2015 euros.

Biodiversity and foodwebs: healthy perennial vegetation and fish stocks

The valuation study for biodiversity and foodwebs valued the benefits of increasing the amount of healthy perennial vegetation (such as underwater meadows) and the size of fish stocks in the Finnish-Swedish archipelago and the Lithuanian coast (Kosenius & Ollikainen 2015). The discrete choice experiment study was conducted in Sweden, Finland and Lithuania in 2011. Thus, primary cost of degradation estimates are available for these three countries, and these estimates have been transferred to the other six coastal countries to produce a regional estimate of the cost of degradation.

Kosenius & Ollikainen (2015) present their estimates as one-time payments per household in 2011. Thus, the estimates were first converted to 2015 euros and expressed in annual values per person assuming the payment would be made for the next 10 years. These value estimates were then transferred to the six remaining countries correcting for PPP and using the GDP per capita ratio between the countries. The Finnish value estimate was transferred to Denmark and Germany, and the Lithuanian estimate to Estonia, Latvia, Poland and Russia (see Table 12). The choice of which estimates to transfer and where was made based on average income levels.

The results suggest that citizens' welfare would increase 1.8 – 2.6 billion euros annually, if the state of the perennial vegetation and fish stocks improved. It is worth noting that there is more uncertainty about these estimates compared to the estimates for eutrophication and recreation, as some of the values are based on benefit transfer.

Table 12. Cost of degradation related to perennial vegetation and fish stocks. Note that estimates for Finland, Lithuania and Sweden are based on original valuation studies and data collection, and estimates for the six other countries are based on value transfer from Finland (Denmark and Germany) and Lithuania (Estonia, Latvia, Poland and Russia)

Country	Cost of degradation (€/person/year, 2015 euros)[1]	Population (18-80 years old) in 2015	Cost of degradation (M€/year, 2015 euros)
Estimates based on original data			
Finland [a]	10 – 13	4.151	42 - 54
Lithuania [a]	4 – 6	2.267	9 - 14
Sweden [a]	18 – 26	7.316	132 - 190
Estimates based on value transfer			
Denmark [b]	10 - 14	4.28	43 - 60
Estonia [b]	3 - 5	1.011	3 - 5
Germany [b]	13 - 18	64.164	834 - 1155
Latvia [b]	3 - 5	1.553	5 - 8
Poland [b]	4 - 6	29.789	119 - 179
Russia [b]	7 - 11	90.787	636 - 999
Total		205.318	1822 – 2663

Source: Kosenius & Ollikainen (2015)
Population data from 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.
1 The range for the cost of degradation estimates comes from the 95% confidence intervals for the value estimates reported in the original study.
a Estimate based on original study and data, b Estimate based on value transfer.
Value estimates are in PPP adjusted 2015 euros.

Chapter 5. Discussion

The framework and results of the regional economic and social analysis of the use of marine waters and cost of degradation presented in this report illustrate, from one perspective, the contribution the Baltic Sea marine environment makes to the society in terms of well-being of current and future generations and national and regional economies. The development work on the economic and social analyses has aimed to develop analyses that could be used in the national analyses and reporting, but also applied to the regional context. The work has prioritized approaches and methods that are able to provide regional analyses with the existing data sets.

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 also 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. This section discusses the analyses, their limitations and knowledge gaps, and future work.

5.1 POSSIBILITIES AND LIMITATIONS OF THE USE OF MARINE WATERS ANALYSIS

The economic and social analysis of the use of marine waters has identified key uses of the sea, utilising mainly existing statistical information to measure the contribution the marine sectors and activities make to the national economies and the entire Baltic Sea region. The same approach (marine water accounts) was applied by many of the Baltic Sea region countries in the 2012 MSFD initial assessment. The marine water accounts approach is complemented with estimates on the economic value of Baltic Sea recreation, in line with the ecosystem service approach for the use of marine waters analysis.

The advantage of the marine water accounts approach is that the economic sectors and their activities can relatively easily be linked to 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 indicators in the present results cannot typically be compared between sectors. On exception is employment, as the total employment indicator is available for many of the sectors. For value added, the indicators 'gross value added' and 'value added at factor costs' are similar, but not the same, 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 be compared for those countries for which data are available.

Also, comparisons can be made between countries for the data available within a sector, as the indicators for one sector are harmonised across countries. Such comparisons can indicate which nations engage in the activities and the extent of the activities (e.g. aquaculture, shipping infrastructure and wind energy). For some sectors the indicators are not confined to activities that take place within the national waters or specific sea basins, but they rather 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, the estimates describe the economic impact of the activity for a specific country, but do not link it to the specific sub-basins of the Baltic Sea.

There are some additional limitations to the use of marine water accounts 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.

Available data

Availability of data has limited the analysis in many ways. For many of the sectors, only one main sectoral activity has been included due to the availability of data. Related activities, such as dredging that is related to shipping infrastructure and has a significant environmental impact, are not included in the analysis due to the lack of data. Monetary indicators, or indicators of employment have not been available for all sectors. For example, shipping infrastructure is characterized by number of ports and port traffic indicators, and the offshore wind energy sector by the number and capacity of wind turbines.

A shortcoming with the existing statistical information is that it only provides proxies for the economic value of the marine environment as it measures economic impact (value added and employment) rather than economic values per se. Another major issue is that the analysis does not give any insights into the sustainability of the use of marine waters. With improved information about the links between the activities, pressures, state and economic values, it could in the future be possible to show how the economic value from the activities changes depending on the state of the Baltic Sea. A holistic economic and social analysis, in support of the ecosystem approach, would identify a balance between the economic and environmental impacts.

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

The analysis of the use of marine waters has revealed several shortcomings and limitations in the indicators and data available for the marine water accounts approach. The following list includes suggestions on how to improve the coherence and validity of the statistics for the regional 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 due to 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).

5.2 POSSIBILITIES AND LIMITATIONS OF THE COST OF DEGRADATION ANALYSIS

The cost of degradation analysis has examined losses in welfare due to the deterioration of the Baltic Sea marine environment, and presented estimates for a selected descriptors of good environmental status (eutrophication, biodiversity and foodwebs) 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.

It should be noted that the cost of degradation estimates should be 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 separate studies which may have some overlap in the valued ecosystem components of the marine ecosystem. In addition, two different approaches are used to assess the cost of degradation (thematic and ecosystem service approach) which also overlap in terms of valued ecosystem components.

The estimates for eutrophication and recreation presented here 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. An example of value transfer is presented for assessing the cost of degradation from biodiversity and foodwebs.

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 together 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. Another option is to conduct new international valuation studies for selected descriptors/ecosystem services in all coastal countries, showing the economic value of marine protection to provide holistic and ecologically and economically sound marine management and policies.

Uncertainties

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 the estimates for these differences.

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 can also be 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.

5.3 APPLICABILITY OF THE ECOSYSTEM SERVICES APPROACH

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. 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. Current knowledge is, however, insufficient to fully apply the ecosystem services approach to the regional use of marine waters and cost of degradation analyses. We have been able to employ the ecosystem service approach exclusively for marine and coastal recreation, as there was a recent multi-country study focusing on recreational use and values in the Baltic Sea area (Czajkowski *et al.* 2015).

In many cases, the existing information on economic values is not in a format that supports the ecosystem services approach. 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. An alternative 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, but is difficult to apply due to the current lack of data. The shortcomings of the system of national accounting are known 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) is building marine ecosystem accounting (EC 2016a). Thus, it seems likely that in the future, marine ecosystems and marine ecosystem services will be assessed and valued in a coherent manner, making estimates available for the use of marine water analysis.

Full application of the ecosystem services approach in the cost of degradation analysis is likewise impossible. There are two obvious knowledge gaps: 1) descriptions of the baseline and good environmental status of the Baltic Sea in terms of ecosystem services, and 2) economic valuation studies that estimate the effect on human well-being from the change in the provision of ecosystem services in the baseline and good status. First steps towards this kind of analysis have been taken in the form of reviews and case studies (Söderqvist & Hasselström 2008, Ahtiainen & Öhman 2014 and Hasler *et al.* 2016), but a comprehensive examination would be required to fully apply the ecosystem services approach in the regional cost of degradation analysis. 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.

5.4 SUGGESTIONS FOR FURTHER WORK

The conceptual framework developed for the economic and social analyses in HOLAS II, as presented in this report, together with the data collated to support regional scale analyses, pave way for further analyses and work, 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 could 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. Similarly, the economic and social analyses to support the MSFD can benefit from the increasing interest in and resources for the use of the marine environment and resources that might lead to better data collection and statistics beneficial for the economic analyses of marine protections as well.

From a holistic perspective, economic and social analyses would ideally show linkages and feedbacks between the use of marine waters analysis (describing the contribution marine sectors and activities make 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). This 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 will be taken in the HELCOM SPICE project[9] in 2017, which aims at examining whether integration of the economic indicators of the use of marine waters analysis with the Baltic Sea Pressure and Impact Index is possible. An analysis showing how the state of the Baltic Sea affects the economic performance of the different sectors and activities would be a worthy extension of the planned further work.

The approach applied in HELCOM HOLAS II 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. Potential additional sources for new information are ongoing regional research projects and new statistical information. Moreover, the development of environmental economic accounts and marine ecosystem accounts may, in future regional assessments provide regionally coherent data and framework for economic and social analyses.

[9] SPICE is a HELCOM coordinated project implemented in 2017, co-financed by the EU.

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