

Building the Mediterranean future together

# TECHNICAL REPORT

Socio-economic assessment  
of four potential new regional  
measures and guidance for  
conducting socio-economic  
assessment of measures  
aiming to achieve Good  
Environmental Status

January 2017



**Socio-economic tools  
for supporting the achievement  
of Good Environmental Status  
of Mediterranean marine waters**



## FOREWORD

This report is the result of work conducted by Plan Bleu as part of the project “Action Plans for Integrated Regional Monitoring Programmes, Coordinated Programmes of Measures and Addressing Data and Knowledge Gaps in Mediterranean Sea (ActionMed)”, funded by the European Commission and coordinated by the Hellenic Centre for Marine Research, Greece. This present report forms the deliverable 3.2 of the “ActionMed” project.



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## ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the coordinator and partners of the project “ActionMed” who have kindly reviewed preliminary reports and provided guidance during the project’s meetings.

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## CITATION

Plan Bleu (2017). Socio-economic tools for supporting the achievement of Good Environmental Status of Mediterranean marine waters. Valbonne, Plan Bleu. (Technical Report).

This publication is available for download from Plan Bleu website: [www.planbleu.org](http://www.planbleu.org)

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# 1 EXECUTIVE SUMMARY

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As part of the project Action Plans for Integrated Regional Monitoring Programmes, Coordinated Programmes of Measures and Addressing Data and Knowledge Gaps in Mediterranean Sea (Action Med), this study aims at providing information on socio-economic characteristics such as effectiveness, costs and benefits of measures to achieve the Good Environmental Status (GES) of the Mediterranean Sea and coast. While the study focusses on the analysis of four selected regional measures, it also provides guidelines on national socio-economic assessments of measures, based on the analysis of three European national programmes of measures' socio-economic analyses and international best practice.

The four regional measures analysed are: the introduction of a plastic bag tax, a no-special-fee as a cost recovery mechanism for port reception facilities for ship-generated waste, fishing for litter programmes and the extension of the current surface of marine protected areas. These measures have been selected in a way to provide examples of socio-economic analysis at the Mediterranean level and to illustrate the applicability and type of results achievable through literature-based cost-effectiveness, cost-benefit and multi-criteria analysis of measures. The selection of the four measures was also guided by the aim to address different types of measures (economic instruments, technical measures, communication measures, command-and-control or management measures) and descriptors and to be coherent with existing programmes of measures and the UNEP-MAP programme of work. The analyses also provide useful information on alternative measures potentially leading to the same effects as the selected measures.

Concerning the introduction of a Mediterranean plastic bag tax, the estimated cost-effectiveness is €670 million for a 95% reduction of incremental plastic bag waste during the first year of implementation. Cost-benefit analysis has been conducted qualitatively and partially quantitatively. In absence of a quantified cost-benefit ratio or net present value, a multi-criteria analysis has been undertaken, showing that the overall impact of the measure is qualified as positive. In fact, the measure's direct costs are borne by consumers who pay the plastic bag tax. Tax revenues easily cover public management costs linked to the administration of the tax, and they could even liberate around €650 million/year to be spent on environmental purposes. The overall employment impact is estimated to be neutral, as possibly lost jobs in the plastic bag manufacturing sector are counterbalanced by jobs created in the manufacturing of reusable bags and bin liners and in the administration of the tax. Similarly, direct economic costs borne by the plastic bag manufacturing sector due to reduced sales are likely to be (over-) compensated by increased sales of reusable bags and bin liners and by savings in the retail sector due to lower storage costs and significantly less purchases of plastic bags. All other impacts, namely on ecosystem services and indirect impacts on different economic sectors, are largely positive and mainly linked to the reduction of plastic bag waste present in marine and coastal ecosystems.

The no-special-fee as a cost recovery mechanism for port reception facilities for ship generated waste has been analyzed qualitatively with regards to cost-effectiveness and cost-benefit considerations. A multi-criteria analysis, comparing six different cost recovery mechanisms for port reception facilities has been realized focusing on environmental and financial/economic characteristics of the different mechanisms. The multi-criteria analysis indicates that the no-special fee scores highest against the selected performance criteria and is thus recommended as the preferred option to recover costs of port reception facilities for ship-generated waste. Only the establishment costs of the measure are borne by the regulator (national or regional institutions) and involve mainly personnel and meeting costs. The running costs of the measure are borne by vessels using the ports where the fee is applied, but the amount of the fee is estimated to be only a very small fraction of overall port dues and shipping costs and would therefore not significantly impact profitability schemes of the maritime transport sector. Positive impacts on turnover and employment are expected in the waste management, handling and treatment sector, while the measure's main benefits would be linked to a significant reduction of chronic pollution from ships, positively impacting ecosystem services and several economic sectors which depend on the quality of the marine and coastal environment.

Fishing for litter initiatives have been studied quantitatively and qualitatively, leading to an estimated cost-effectiveness of relatively large-scale initiatives at an order of magnitude of around €900/ton of fished litter. Cost-benefit analysis has been conducted mostly qualitatively and therefore has been turned into a multi-criteria analysis concluding that the overall impact of fishing for litter programmes is positive. The measure's costs are

mainly administrative costs linked to the management of the initiative(s) and waste management, treatment and disposal costs, which are generally borne on a project basis by public and private donors. The costs to the fishing sector are estimated to be small and mostly linked to the effort and time required to bag the waste and bring it to waste reception facilities at the harbor. Small positive direct employment and revenue impacts can be expected in the waste management and large plastic bag manufacturing sectors and, marginally, for the management of the measure. However, the measure's main benefits are indirect and linked to the improvement of the quality of marine and coastal ecosystems and the services they provide.

The management cost of Mediterranean Marine Protected Areas (MPAs) has been estimated at almost €50 million in annual running costs for a 10% MPA coverage and less than €140 million for a 30% coverage (both including running costs of already existing MPAs). Cost-benefit analysis has been undertaken qualitatively and while it was not possible to calculate a cost-benefit ratio or net present value, the analysis has been transformed into a multi-criteria analysis which concluded that the extension of the current MPA surface would come with an overall positive socio-economic impact. The costs of the measure are mostly management costs, usually borne by public institutions, and foregone revenue – at least in the short-term – within the local fishing sector. The measure's employment impact has been estimated as overall positive as possibly lost jobs in the fishing sector would be overcompensated by jobs created in the management of MPAs (around 3 100 jobs for a 10% coverage and around 8 800 jobs for a 30% coverage, including jobs in already existing MPAs) and in the ecotourism sector. All other socio-economic impacts are also considered to be positive – at least in the long-term - and mainly concern the fishing and tourism sector, society in general and ecosystem services.

On the national level, the socio-economic analyses conducted by two Mediterranean countries (France and Spain) and one other European country (Germany) as part of their programmes of measures have been briefly analysed. The three countries have applied very different approaches to socio-economic analysis, each of them involving a number of limitations and therefore putting into question the applicability and feasibility of full-scale and comprehensive cost-effectiveness and cost-benefit analyses of all new measures contained in national programmes of measures. The study revealed that a multi-criteria analysis approach to socio-economic assessment, including elements from cost-effectiveness and cost-benefit analysis, could be the preferable option for countries, providing good levels of useful information on measures to guide decision making.

Finally, the study calls for regional coordination in the establishment and implementation of national programmes of measures in order to mitigate possible adverse transboundary effects or, on the contrary, maximize transboundary benefits. A strong Mediterranean cooperation would also allow streamlining efforts needed to conduct socio-economic assessment of measures as countries could benefit from assessments conducted in other countries and adapt them to their national context via adequate transfer techniques. As regards regional measures, they would be best coordinated and most efficiently designed in form of a regional programme of measures which ensures coherence of regional measures and facilitates transposing the measures to the national level.

## 2 CONTEXT

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The project Action Plans for *Integrated Regional Monitoring Programmes, Coordinated Programmes of Measures and Addressing Data and Knowledge Gaps in Mediterranean SEA (Action Med)* aims at supporting the development of regional action plans and best practices for integrated monitoring programmes, coordinated programmes of measures and the filling of data gaps for Mediterranean marine waters and thereby improve implementation of the next steps of the Marine Strategy Framework Directive (MSFD), in particular in relation to the review of the initial assessment, the definition of the Good Environmental Status (GES) and the environmental target setting in 2018, including (financial) planning as well as the related integration of data management.

In particular, the project aims a) to tackle the most relevant issues at a regional level, so as to enable a systematic solution of current gaps and shortcomings in relation to Articles 8, 9 and 10 of the MSFD and building on ongoing regional and EU work; b) Develop strategies/methodologies for ongoing assessment of Biodiversity indicators; c) Set the basis for coherent design and implementation of MSFD monitoring programmes; d) Assist EU Member States in Mediterranean in their work on programme of measures and where necessary, to develop project and investment plans; c) to establish an information management system to allow relevant knowledge and data to be updated on a regular basis and used by the Regional Seas Conventions – in this case the Barcelona Convention and UNEP-MAP, the European Environment Agency (EEA) and other interested users for their purposes.

The project is structured in 5 Activities. Activity 1: Systematic solutions of current gaps and needs in relation to articles 8, 9, 10 of the MSFD. Focus on biodiversity, Activity 2: Gaps, needs and actions to implement for national and regional monitoring for MSFD programmes (article 11), Activity 3: Assistance in the preparation of programme of measures, by addressing particular gaps identified both at national and regional level, linking together work on Programmes of Measures (PoM) under the MSFD and under the auspices of UNEP/MAP-Barcelona Convention (the PoM Activity), Activity 4: The information management system for knowledge and data update, Activity 5: Coordination and management, communication, dissemination and sustainability.

This report has been established for activity 3 (the PoM Activity) and focuses in particular on task 3.3 referring to socio-economic assessment. In fact, under the MSFD and as part of the development of programmes of measures to achieve or maintain the good environmental status (GES) of the Sea and coast, socio-economic assessment of measures is a requirement (art. 13.3): “Member States shall ensure that measures are cost-effective and technically feasible, and shall carry out impact assessments, including cost-benefit analyses, prior to the introduction of any new measure.”

The MSFD also calls for regional cooperation and coordination for shared marine regions in its article 5.2, which highlights the need for measures to be coherent, in this case across the Mediterranean basin. This is where the Barcelona Convention, as a Regional Seas Convention, plays an important role. As an example, the Mediterranean Marine Litter Regional Plan, agreed by the Barcelona Convention and providing a framework for marine litter related measures in the Mediterranean, can be cited here.

While the MSFD covers European Member States, the Barcelona Convention has endorsed the Ecosystem Approach (EcAp) for the Mediterranean Sea and coasts, which in turn aims at maintaining or achieving GES in the whole Mediterranean and has been recognized as a guiding principle for the overall work under the Barcelona Convention and plays a central role in UNEP/MAP’s Mid-Term Strategy 2016-2021 (UNEP, 2016). EcAp has been developed in full synergy with the MSFD and is built on a 7-step roadmap and 11 ecological objectives (equivalent to the descriptors under MSFD) being seen as the Mediterranean regional implementation of the MSFD.

Under EcAp, the work on measures is continuous and takes place on the regional and national level. On the regional level, UNEP/MAP carried out an early analysis and presented to the Contracting Parties an EcAp Measures Gap Analysis. On the national level, UNEP/MAP is currently supporting the update of the National Action Plans (NAPs) under the Land Based Sources Protocol of the Barcelona Convention addressing pollution and litter, which will serve as a core basis of the EcAp Programme of Measures on the national level, all over the Mediterranean. The guidelines to updating NAPs under the Barcelona Convention also specifically highlight the need for cost-effectiveness and cost-benefit analyses of measures.

# 3 OBJECTIVES

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The study aims to provide analysis to underpin the revision and update of programmes of measures (PoM) to achieve Good Environmental Status (GES) and facilitate decision making by providing useful levels of information (quantitative and/or qualitative) on effectiveness, costs and benefits of selected measures. In particular, this analysis provides input for the prioritization of issues and actions and the selection of corresponding measures. Furthermore, the analysis aims to serve as a pilot and methodological study for the application of socio-economic analysis to the development of PoM in the Mediterranean. In particular, this analysis focuses on four measures, which have been selected for their relevance with regard to the main regional issues in this matter and which are intended to serve as examples of socio-economic assessment of measures for the Mediterranean region.

- Introduction of a plastic bag tax
- No-special-fee regime for use of port reception facilities
- Reduction of the number and impact of ghost nets
- Extension of the current surface of Marine Protected Areas (MPA)

These measures are assessed at the regional Mediterranean level (subtask 3.3.1).

The four selected measures have been chosen in a way to:

- Address different descriptors
- Demonstrate different types of measures (economic instruments, technical measures, communication measures, command-and-control or management measures)
- Illustrate a maximum of different (types of) methods for analyzing measures (cost-effectiveness, cost-benefit and multi criteria analysis)
- Ensure coherence with the current Mid Term Strategy 2016-2021 of UNEP/MAP under the Barcelona Convention (UNEP, 2016)
- Ensure coherence with already available national PoM of European Mediterranean rim States and provide additional input for measures contained in these PoM

At the national level (subtask 3.3.2), a brief analysis of three approaches to socio-economic assessment as part of the national programmes of measures of three European Member States (Spain, France and Germany) precedes the elaboration of a guidance to socio-economic assessment of national measures. The guidance outlines a proposed assessment scheme and describes conditions for implementation at the national level.

# 4 SOCIO-ECONOMIC ANALYSIS AT REGIONAL LEVEL

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## 4.1 METHODS USED

The general approach to the socio-economic analysis of the four selected regional measures aiming at contributing to the achievement of the good environmental status (GES) of the Mediterranean coast and Sea has been developed based on international best practice. It also took into account the programmes of measures and linked socio-economic assessments developed by EU Member States available at the time of writing this report. The approach adopted for the analysis of the four regional measures has followed the steps below:

### 1. Description of the measure:

- General description of the measure and situating the measure within its DPSIR framework

### 2. Cost-effectiveness analysis

- Evaluation of the theoretical and practical effectiveness
- Evaluation of direct costs for the regulator and for the regulated and identification of funding sources.

### 3. Cost-benefit analysis

- Evaluating costs and benefits qualitatively and – to the extent possible - quantitatively,
- Assessing cost by using cost-data from the cost-effectiveness analysis and adding indirect costs and negative impacts stemming from the following steps, which also reveal the benefits:
  - Assessment of economic and social impacts of the measure (employment impact, revenue generated)
  - Evaluation of the benefits resulting from the improvement of the environment (changes in welfare, employment and value added generated)
  - Assessment of the improvement of the marine and coastal environment itself (benefit transfer from relevant existing valuation studies, assessment of ecosystem services, avoided costs)

### 4. Multi-criteria analysis

- Provide an 'alternative' to defining monetary values for costs and benefits when this was not possible
- Identifying objectives of the measure
- Identifying performance criteria to be used to assess how and to which extent the objectives are likely to be reached by the measure and to compare different measures
- If relevant, criteria may also be weighted according to relative importance and/or they may be aggregated using an adequate scoring system
- Analysis of the measures with regard to the fixed criteria

### 5. Indicate uncertainties and provide recommendations

This is a brief outline of the methodology used under this study. The second part of this report provides methodological guidance for national socio-economic assessments of measures. This guidance has been built based on the regional analysis conducted here and provides more detail about the different steps of the approach.

The assessment has been carried out based on available literature. When applying this approach to the four selected measures, it became clear that significant data gaps led to incomplete information concerning various parameters required to conduct full cost-effectiveness and cost-benefit analyses. Therefore, the approach has been adapted to each measure, taking into account available data. This way, the analyses of the four measures put varying emphasis on and produce different results for either cost-effectiveness, cost-benefit or multi-criteria analysis.

Concerning the first measure, the introduction of a Mediterranean plastic bag tax, a cost-effectiveness analysis has been conducted based on an economic transfer of an Irish case study, which seems to be the world's best studied application of a plastic bag tax, to the Mediterranean. A qualitative cost-benefit analysis of the introduction of a plastic bag tax in the Mediterranean has also been realized, as quantitative information to conduct a full-scale cost-benefit analysis was incomplete. In order to be able to draw a conclusion as to whether the measure's benefits outweigh its costs, the qualitative elements of the cost-benefit analysis have been converted into a multi-criteria analysis. This analysis breaks overall costs and benefits down to different types of costs/benefits and thus allows to facilitate getting a clearer picture of the relative significance of costs and benefits.

With regard to the analysis of the introduction of a no-special-fee for port reception facilities, cost-effectiveness as well as cost-benefit analysis have been conducted qualitatively. A multi-criteria analysis has then been realized to benchmark a no-special-fee system against other cost recovery mechanisms for port reception facilities.

The measure fishing for litter has been analyzed from a cost-effectiveness and cost-benefit point of view. A quantitative indication for cost-effectiveness, based on a Scottish sub-regional initiative, has been provided but it has not been possible to adequately transfer this study to the Mediterranean, due to the heterogeneity of local conditions and structures of costs, effects and benefits. A qualitative cost-benefit analysis has been conducted, which has been turned into a multi-criteria analysis, similar to the one realized for the introduction of a plastic bag tax (see above).

Concerning the fourth measure, the extension of the surface covered by Marine Protected Areas (MPAs) in the Mediterranean, and in the attempt to assess the measure's cost-effectiveness, only costs have been assessed in a quantitative way. It has not been possible to evaluate effectiveness because the objectives of MPAs, against which effectiveness must be assessed, are multiple, mostly non-quantified and variable between different MPAs. A mostly qualitative cost-benefit analysis has also been established for this measure, which has then been transferred into a multi-criteria analysis, similar to the one conducted for the introduction of a plastic bag tax and for fishing for litter.

## 4.2 INTRODUCTION OF A PLASTIC BAG TAX

Measure: Plastic bag tax

Type of measure: Economic/ market-based instrument

Driver: Multiple sectors and society in general

Pressure: Marine Litter (land-based)

Impact: Mostly physical disturbance (plastic bags ~ 8,5% of marine litter)

GES Descriptors: Biological diversity, Contaminants, Marine Litter

### 4.2.1 Description of the measure

A plastic bag tax is an environmental levy on single-use plastic shopping bags, imposed at a fixed per unit rate at the manufacturer or retailer/point of sale of plastic shopping bags to customers.

The primary purpose of a plastic bag tax is to provide an incentive to reduce the use of plastic bags and thus, indirectly, to prevent littering. The introduction of a plastic bag tax is designed to change and explicitly itemize the price of plastic bags and therefore alter the behavior of producers and consumers. A plastic bag tax qualifies as a market-based instrument and in principle as a Pigouvian tax. Pigou (1960) made the now familiar case for environmental taxation. External costs of pollution could be internalized by imposing a tax on the pollutant at the level which reduces emissions to the point where the marginal benefits of internalization equal the marginal costs of abatement. The tax's aim is therefore to correct market inefficiencies which lead to overconsumption. It also raises revenues which can be applied to government budget or earmarked for specific (environmental) uses.

The introduction of a plastic bag tax is in line with UNEP-MAP Regional Plan on Marine Litter Management in the Mediterranean in the Framework of Article 15 of the Land Based Sources Protocol (Decision IG.21/7), aiming

at reducing 20% of beach litter by 2024 and a significant and measurable decrease of other marine litter items and with the Barcelona Convention Decision IG.22/10, Implementing the Marine Litter Regional Plan in the Mediterranean (Fishing for Litter Guidelines, Assessment Report, Baselines Values, and Reduction Targets), Annex I, Appendix 4 (UNEP, 2016).

Furthermore, the European Directive 2015/720 of the European Parliament and of the Council amending Directive 94/62/EC “Packaging Waste Directive” regulates the use of lightweight plastic bags in the EU. It requires Member States to adopt measures to reduce the consumption of plastic carrier bags with a thickness below 50 microns, as these are less frequently reused than thicker ones, and often end up as litter. The Directive also states that these measures may include the use of economic instruments, such as charges, national reduction targets, and marketing restrictions such as bans.

The analysis carried out as part of this study focuses on a tax on plastic bags rather than on a ban mainly for two reasons: (i) the intention here was to analyze an economic/ market-based instrument – an environmental tax- and (ii) results achieved via plastic bag taxes are globally better documented.

## 4.2.2 Theoretical effectiveness

Effectiveness of a plastic bag tax as a measure has been proven in Ireland. According to the Irish Department of Environment, Community and Local Government<sup>1</sup>, the introduction of a plastic bag levy in 2002 at a unit rate of 15 cents, brought the use of bags per capita from an estimated 328 to 21 bags/year. This has fallen further when the levy was raised to 22 cents in 2014 to an estimated 14 bags/capita. In terms of impact, the Irish plastic bag litter declined from approximately 5% of the national litter composition before the levy to 0,22% in 2004 and 2005 (Litter Monitoring Body, 2004, 2005, 2007). Even though the impact of this dramatic decrease in the use of plastic bags on the number of plastic bags ending up in the marine environment has not been quantified, it can be considered significant for the marine environment.

It should be noted that the precise proportion of marine litter attributed to plastic bags is variable and differs depending on the location and the sampling methodology. Some sources state proportions of more than 70% on the continental slope and bathyal plain of the northwestern Mediterranean (Galgani et al., 2011 in UNEP, 2015), or 73% of the plastic waste collected by trawlers along the Tuscany coast (ARPA, ARPAT, DAPHNE II, 2011). A different picture has been drawn as a result of the 2002-2006 International Coastal Cleanup Campaign carried out in the Mediterranean, during which plastic bags accounted for only around 8,5% of overall marine litter found in the Mediterranean during the campaign (UNEP, 2009). There is however a consensus that plastic bag litter is amongst the most visible and persistent components of litter pollution especially throughout the countryside and along coastlines.

Applying a possible 95% decrease of the use of plastic bags (the rate realized in Ireland), a decrease of overall incremental marine litter by at least 8% could be reached if a plastic bag tax was implemented correctly, making sure all prerequisites are met *ceteris paribus* and noting that effectiveness of the measure will vary largely in time and space. It should be kept in mind that this applies for incremental marine litter only and that litter already discarded on land or in the Sea will not be reduced by this measure.

The effectiveness of the introduction of a plastic bag tax also depends on the baseline of plastic-bag related policies and regulations. This analysis is based on a theoretical application of a plastic bag tax at the regional Mediterranean level, with a baseline situation where no plastic-bag related policies are in place.

## 4.2.3 Prerequisites for a successful implementation and practical effectiveness

In order to ensure effectiveness of the measure, and eliminate possible negative side-effects or a shifting of negative externalities, several conditions must be met:

**The rate of the tax has to be fixed at the right amount.** If the tax is too low, the incentive will not be sufficient to refrain from using single-use plastic bags. If the tax is too high, acceptance and credibility of the tax is low. Under ideal conditions, the tax should be set at the optimal level of tax, but even most developed countries lack the

<sup>1</sup> <http://www.environ.ie/environment/waste/plastic-bags/plastic-bag-levy#sthash.0W2XDRra.dpuf>

<sup>2</sup> A Pigouvian tax is a tax levied on any market activity that generates negative externalities (costs not internalized in the market price). Named after English economist Arthur Pigou.

data required to calculate the marginal social cost (negative externalities) associated to plastic bag litter in the environment. In the Irish case, the tax was set in an ad hoc way and therefore cannot be described as a product tax adhering to “Pigouvian” principles. However, in order to provide a real incentive, the Irish plastic bag levy was set more than six times above what was the expected maximum willingness to pay for plastic bags (Convery et al., 2007).

**The definition of bags subject to the tax must be clear and as large as possible** to avoid replacement with similar bags (the aim being to reduce and not just shift negative externalities): The tax must specify the size and volume and materials of the bags subject to the tax, including different types of plastics and “biodegradable” plastics. The tax will be most efficient if extended to all disposable single-use bags, including paper bags, because its primary goal is to achieve a behavior shift to using reusable bags. However, generally, plastic bag taxes do not apply to all kinds of plastic bags. For example, the Irish tax exempted bags of certain sizes, and bags which contain fresh fruit, unpackaged vegetables, meats and certain other products mainly for hygiene reasons. Ideally, the tax should apply to all types of retailers.

**The tax must be visible for consumers.** It must be indicated in the shops and if possible itemized on any invoice, receipt or docket issued to the customer.

**A strong plastic bag manufacturing industry can slow down the introduction of a plastic bag tax.** Stakeholder negotiations for the introduction of a plastic bag tax will be easier in countries which greatly rely on imported plastic bags.

**Consumers tend to show more acceptance for a plastic bag tax when the revenue generated by it is earmarked for environmental purposes.** In order to achieve the ring-fencing of the taxation revenue for the environment, it is important to have a Ministry of Finance open for compromise and a good cooperation between the Ministries of Finance and the Environment.

**The tax should be levied at the right level, in line with the country context.** A plastic bag tax can be levied at different levels: Upstream (the manufacturer or importer pays) or downstream (the tax is collected from the consumers at point of sale by the retailer). If the taxation takes place upstream, it is important that the levy is high enough, to force wholesalers and retailers, including small or big informal outlets, to pass on the extra cost to the consumers by charging for the bags. Another option is to make it mandatory by law that retailers pass the levy paid to manufacturers on to the final consumers. In both cases and to enhance this process, all licensed or formal retail outlets should be compelled by law to enter their charge for the plastic bags on each shopper’s bill or receipt. For both, upstream and downstream taxation, it has to be avoided that the tax is “hidden” in the overall product prices. Countries with a significant informal sector would more naturally choose an upstream taxation, where the tax is collected from a limited number of licensed producers and importers, or even an outright ban. In fact, informal outlets are usually not licensed and do not operate a receipt system which would be necessary to entry the cost of plastic bags as a separate item in the shopping (Mc Donnell et al., 2008). In the case of Ireland, where a tax collection system is already in place for practically all retailers, a downstream collection has been chosen which was able to piggy-back on the existing VAT collection infrastructure with minor additional cost.

**The consultation process must be focused.** The Irish case showed that, at an operational level, interaction with stakeholders (retailers, producers, importers and various trade groups) was continuous and extensive. It was key to make clear to each of the stakeholders involved that a levy was going to be introduced and that the consultation process was aimed at facilitating a smooth introduction as opposed to questioning the principle of introducing the tax itself. Initial opposition to any levy quickly gave way to a level of acceptance.

The introduction of a plastic bag tax implies a change of behavior of both society and specific economic sectors (the retail sector and the plastic bag manufacturers). To increase acceptance of and compliance with the measure, additional communication measures should be taken by the regulators to inform the population and relevant economic sectors about the measure, its rationale and objectives.

As the tax provides a financial incentive for consumers to change their behavior, it can be expected that such behavioral change can take place quickly.

With regard to adoption and compliance at the retail level, it is important to make sure that the tax does not put any additional financial burden on them. In the case of the Irish plastic bag tax, it has been shown that the additional accounting and management effort needed to administer the tax at the level of the retailers is largely counterbalanced by the savings realized through decreased bag and bag storage expenditure, additional income from “permanent” bag sales and additional sales of bin liners (because single-use plastic bags are often used by consumers as bin liners). In Ireland, the plastic bag tax therefore came with a net gain for retailers.

At the plastic bag manufacturer and importer level, the plastic bag tax will bring about a significant decrease of plastic bag demand and thus a dramatic loss of revenue. When the tax is levied downstream, the manufacturers and importers are however not involved in the management of the tax and therefore do not intervene in the overall compliance and adoption. When the tax is levied upstream, meaning that the manufacturers and importers collect the tax from retailers, they do play a major role in the administration of the tax on top of being negatively impacted by a decrease in the demand of their products. They also do not benefit from any tax-linked savings as would the retailers. In this situation, the regulator needs to take special care and support the manufacturers and importers in the administration of the tax and conversion of production to reusable shopping bags and bin liners.

On the side of the regulator, additional effort in terms of communication, administration and enforcement needs to be taken into account (information material and distribution, control visits, management and administration of the tax, possibly software solutions, etc.).

#### 4.2.4 Alternative measures potentially leading to the same effect

Aiming to reduce the use and in extension littering of plastic bags, alternative options can be:

**An outright plastic bag ban.** A plastic bag ban means that the use of single-use plastic bags is no longer allowed for all or certain types of retailers. It should be noted that bans may have other unintended impacts from replacement products. Alternative single-use shopping bags, for example paper bags may have a lesser impact on the marine environment but may be more resource-costly (water) in their production or disposal (landfill cost). Therefore, bans should be thoroughly reviewed before implementation. Plastic bag bans have been implemented in several municipalities and counties of the USA, mainly in California, where the plastic bag tax has been declared illegal. In the USA, bans are often associated to a tax on alternative single-use bags such as paper bags to counter replacement and shift in negative externalities. Plastic bag bans for certain types of plastic bags are also in place in South Africa and Rwanda and will be applied in France starting July 2016.

**A voluntary agreement approach.** In the case of Australia, a voluntary agreement approach has been adopted with plastic manufacturers and retailers, challenging retailers to voluntarily reduce the 6.9 billion bags used each year. Some retailers also introduced their own voluntary levy approach, which proved to be successful, for example IKEA (a retailer of homeware) introduced a 10 cent charge on their plastic bags in Australia while also providing a reusable alternative in 2002, and reported a 97 % reduction in plastic bag use (EPHC, 2002).

**The replacement of traditional plastic bags by biodegradable plastic bags.** A recent UNEP report on biodegradable plastic and marine litter concludes that “the adoption of plastic products labelled as ‘biodegradable’ will not bring about a significant decrease either in the quantity of plastic entering the ocean or the risk of physical and chemical impacts on the marine environment, on the balance of current scientific evidence” (UNEP, 2015). Therefore, the replacement of traditional plastic bags by biodegradable plastic bags appears ineffective and should not be used as a measure to decrease marine litter.

**Establish a plastic bag recycling system.** Such a solution has been implemented in Christchurch, NZ where plastic bags are recycled independently from other recycled waste. However, an application of such a measure throughout the Mediterranean region does not seem feasible, mainly due to two issues: (i) the high investment and management cost of a particular recycling system for plastic bags and (ii) cultural habits, and expected lack of the population’s willingness for taking individual action for recycling plastic bags, especially where few or no other recycling regimes for household waste are in place.

**Fines for littering.** A littering fine is in place in Singapore with a very stringent enforcement and prohibitively high fines. For the Mediterranean region, however, such a measure does not seem feasible, due to the high

enforcement cost, especially in rural and less-crowded areas and due to a probable lack of cultural acceptance of such a measure.

**Receiving a monetary bonus for bringing one's own reusable shopping bags.** This measure is being implemented by some retailers in the USA on a voluntary basis. Retailers would offer a five cent reduction per bag to clients bringing their own reusable shopping bags. However, when comparing a five-cent tax on disposable bag use and a five-cent bonus for reusable bag use, the tax proves to be much more effective than the bonus. In fact, both policies are financially equivalent, with both providing a financial incentive of five cents per bag. They should therefore bring about a similar behavior. But, this is not the case and individuals tend to perceive the loss (tax) more strongly than the gain (bonus) – they are “loss-averse”, which makes the tax more effective than the bonus (Homonoff, 2015).

**Public communication campaigns.** Public awareness raising campaigns against littering and to promote recycling of plastic bags are in place in many countries, for example in Singapore or India.

## 4.2.5 Cost assessment

The cost assessment of the introduction of a plastic bag tax in all Mediterranean rim countries is mainly based on a transfer of costs identified in the relatively well studied Irish case. Table 1 shows the results of an economic transfer of per bag tax amount, annual per capita costs to consumers and total annual plastic bag tax revenue.

### 4.2.5.1 Costs for the regulator

#### 1. For the development, design and launch of the measure

In order to calculate the one-off establishment costs for the regulator, a rate of 10% of the yearly plastic bag tax revenues has been applied to the Mediterranean<sup>3</sup>. This amounts to around €67 million and includes the purchase of new computer systems and additional resources needed to administer the tax at its launch. This calculation does not integrate any data manipulation to mirror economies of scale achieved at the regional level. However, the 10% rate of one-off costs is applied to a GDP-weighted projection of tax-revenues, while it is not expected that one-off costs, especially hardware related costs, are exactly proportional to national per capita GDP. Therefore, this analysis is based on the hypothesis that economies of scale achieved on the regional level are absorbed by relatively higher costs of hardware in countries with lower national per capita GDP.

In addition to these costs, it is realistic to add initial advertising costs associated with a publicity and awareness campaign targeted on one hand at retailers and plastic bag manufacturers and on the other hand at the general public. Based on the Irish experience<sup>4</sup>, the ratio of 3% of first year tax revenue can be applied, which leads to an amount of around €20 million.

#### 2. For the implementation and coordination of the measure

Yearly implementation and coordination costs are calculated based on a ratio observed in Ireland of around 3% of yearly tax revenues<sup>5</sup>. For the Mediterranean region, this amounts to approximately €20 million.

#### 3. For maintenance, monitoring and surveillance of the measure, including prosecution costs

Concerning the Irish tax, enforcement is a responsibility of the local authorities, who make sure that the levy is charged to the end customer, and the revenue commissioners. This has proved to be relatively easy, as the public have ‘bought in’ to the scheme, and report delinquent retail outlets. Monetary data for the enforcement costs is not available. It is however expected that the revenues collected from fines for non-compliance with this law outpace the enforcement costs.

For the purpose of this analysis for the Mediterranean region, enforcement will be considered cost-neutral at the level of the overall measure, even though monetary transfer takes place between retailers and local authorities.

<sup>3</sup> One-off establishment costs in Ireland amounted to €1.2 million while first year revenues of the plastic bag levy were around €12 million. The Mediterranean projections do not take into account an evolution in tax revenues over time, but are based on static yearly tax revenue. Therefore, one-off establishment costs are calculated based on relatively high tax revenue and may be overestimated. economist Arthur Pigou.

<sup>4</sup> Initial advertising costs associated with a publicity and awareness campaign in Ireland were €358,000.

<sup>5</sup> Yearly administration and coordination costs of the Irish plastic bag levy is approximately €350,000.

#### 4.2.5.2 Compliance costs for the regulated

##### 1. Consumers/ general public:

In order to calculate the revenues from a possible plastic bag tax in the Mediterranean, an economic transfer of the data from the Irish case study has been conducted. The Irish data have been transferred to the Mediterranean rim countries weighted with the respective national GDP. In this sense, the plastic bag tax could be levied, in line with national GDP, ranging from the equivalent of €0.01/bag in Palestine to €0.18/bag in France. By doing so and based on an annual per capita consumption of plastic bags after introduction of the tax of 14, a total tax amount of around €670 million could be levied at the scale of the Mediterranean rim countries. This represents the cost to consumers linked to the purchase of single-use plastic bags.

In a larger context, including the yearly purchase of 14 single-use plastic bags, 3 reusable bags and additional bin liners, annual per capita cost is estimated at 0.03% of GDP/capita. This amount can of course be much lower when consumers permanently rely on alternative bags, such as traditional baskets or bags used over several years.

##### **Box 1 : Consumer cost of the Irish plastic bag levy**

In the case of Ireland, revenues from the plastic bag levy were between €12 million and €18.7 million/year between 2002 and 2007 (McDonnell, 2008). The revenues represent the plastic bag taxes paid by consumers. Based on the estimated annual per capita sales of 14 bags in 2014, and the plastic bag tax of 22 cents/bag, the cost to the Irish people in 2014 was €3.08/capita (or a total of €14.2 million)<sup>6</sup>. This does not take into account the “hidden” price previously paid for plastic bags by consumers. In addition, consumers had to modify their shopping habits by bringing their reusable bags with them to do their groceries. In many cases, this implied an initial investment for purchasing such reusable bags. Also, household budget for bin liners is likely to increase for consumers, as many used single-use plastic bags for this purpose prior to the introduction of the tax. The annual per capita budget for bin-liners replacing typical single-use plastic bags used for this purpose is estimated at €5.94<sup>7</sup>. The average yearly expenses for reusable bags are estimated at €3.75/capita<sup>8</sup>. The total expenses per year and per person induced by the introduction of the plastic bag tax in Ireland is therefore estimated at less than €13, which is around 0.03% of annual GDP/capita<sup>9</sup>.

##### 2. Economic sectors:

###### a.i. Retailers

As has shown the Irish case, the plastic bag tax does not induce any net costs but on the contrary comes with a net gain for retailers. Depending on the size and sales turnover of the retailer, the retailer implementation cost attributable to the Irish tax was only between 8% and 40%<sup>10</sup> of bag expenditure before the introduction of the tax. For most retail firms, the revenue collection and reporting is readily and easily integrated with their Value Added Tax (VAT) collection systems, so net additional costs are modest. In addition, retailers now have additional income from sales of bin liners and reusable bags.

The overall impact on retailers has been rated in a survey conducted by Convery et al. 2007, showing an overall neutral or positive effect of the tax in the perception of the retailers.

###### a.ii. Plastic bag manufacturers and importers

Plastic bag manufacturers and importers seem to be the only “losers” of a plastic bag tax, as demand for their products largely decreases and they are likely to eventually run out of business. In the Irish case, however, this impact has not been stated as being significant. Convery et al. 2007 indicate that in Ireland, almost 80% of the

<sup>6</sup> This does not take into account the “hidden” cost previously supported by consumers for plastic bags, spread over the goods bought at retailers. Even if the market price for plastic bags is much lower than the plastic bag tax, plastic bags were not free before the tax.

<sup>7</sup> A roll of 50 cheap 20l bin liners costs around €0.99 at Tesco Ireland. Average consumption of plastic-bags as bin liners is estimated at 300 bags/year and capita (based on a high 90% bin liner-usage rate of the before-tax introduction level of 328 bags/person and year).

<sup>8</sup> A reusable bag at Tesco Ireland costs €1.25. It is estimated that the Irish purchase an average 3 reusable bags/person and year.

<sup>9</sup> With 2014 annual GDP/capita (nominal) of €39,873 according to Government of Ireland.

<sup>10</sup> Calculation based on survey of retailers conducted by Convery et al.2007

plastic bags consumed were imported and the rest has been produced by only 4 companies. Only one of the four firms has gone out of business causing the loss of 26 jobs, but the authors were not able to establish a direct cause-effect relationship between the loss of these jobs and the introduction of the tax.

Also, the net effect on jobs and turnover is most likely not as negative as one could imagine. In fact, many plastic bag manufacturers are quite flexible and can actually shift their activity to the production of reusable bags and/or bin liners for which the demand largely increases with the introduction of a plastic bag tax. Also, the management and administration of the tax requires hard- and software and personnel and therefore creates jobs, too.

Considering the above, the net effect on the regulated economic sectors can be considered as neutral.

Table 1 : Projection of per bag tax amount, annual per capita costs to consumers and total annual tax revenue in Mediterranean countries, based on an economic transfer of the Irish plastic bag tax

Country	GDP/capita in US\$	Population	Bag tax in EUR	Annual tax revenue in EUR	Annual tax cost/capita in EUR
Ireland	49 393	4 616 000	0,22	14 200 000	13,00
Albania	11 108	2 894 000	0,05	2 004 563	2,92
Algeria	14 193	38 934 000	0,06	34 457 879	3,74
Bosnia Herzegovina	10 427	3 818 000	0,05	2 482 451	2,74
Croatia	21 635	4 238 000	0,10	5 717 460	5,69
Cyprus	30 239	1 154 000	0,13	2 175 998	7,96
Egypt	10 533	89 580 000	0,05	58 836 720	2,77
France	39 328	66 218 000	0,18	162 391 477	10,35
Greece	26 851	10 870 000	0,12	18 200 165	7,07
Israel	33 703	8 216 000	0,15	17 266 897	8,87
Italy	35 463	60 789 000	0,16	134 426 776	9,33
Lebanon	17 462	4 547 000	0,08	4 951 129	4,60
Lybia	15 597	6 259 000	0,07	6 087 393	4,11
Malta	29 526	427 000	0,13	786 172	7,77
Montenegro	15 055	622 000	0,07	583 924	3,96
Monaco	145 221	37 620	0,65	340 670	38,22
Morocco	7 490	33 921 000	0,03	15 842 940	1,97
Palestine	2 966	4 295 000	0,01	794 364	0,78
Slovenia	30 403	2 062 000	0,14	3 909 223	8,00
Spain	33 629	46 476 000	0,15	97 460 359	8,85
Syria	?	22 158 000	-	-	-
Tunisia	11 436	10 997 000	0,05	7 842 124	3,01
Turkey	19 788	75 932 000	0,09	93 694 059	5,21
TOTAL		494 444 620		670 252 743	

### 4.2.5.3 Funding

The introduction of a plastic bag tax is almost entirely funded by consumers of plastic bags with a small fraction being financed through fines collected for non-compliance with the law governing the tax at the retailer level. The plastic bag tax provides a significant potential for revenue capture as the costs related to the administration of the tax are easily outpaced by the revenues it generates. There is also scope to deliver what is called a “double dividend” by Pigou (1960) as revenues raised through taxes on environmental “bads” (in this case the plastic bags) are recycled to reduce taxes on or subsidize economic “goods”. This is the case in Ireland, where all revenues from the plastic bag levy are hypothecated into a ring fenced environment fund.

## 4.2.6 Cost-benefit analysis

### 4.2.6.1 Cost-assessment

The cost-benefit analysis is based on the costs assessed during the cost-effectiveness analysis.

### 4.2.6.2 Employment impact

The employment impact of a Mediterranean plastic bag tax is estimated as neutral. In fact, the Irish example shows that while job losses are likely in the plastic bag manufacturing and importing industry (however not more than 26 jobs lost in Ireland according to Convery et al. 2007), these losses are counterbalanced with jobs created in the reusable bag and bin liner industry and in the administration of the tax. In fact, the Irish case supposes a slight but not significant net job creation linked to the plastic bag levy<sup>11</sup>.

### 4.2.6.3 Impacts resulting from the improvement of the marine and coastal environment

The following economic sectors and actors are likely to benefit from the plastic bag tax-induced improvement of the marine and coastal environment:

**Local and national governments** will save money spent for picking up litter, not only on beaches, in harbors and on the coast but also on land.

**The public waste management sector** including landfills will save money because a significant part of the plastic bag-related waste would disappear.

**The recreation and tourism sector** will benefit from cleaner beaches, possibly attracting more tourists. It remains unclear at what density litter starts to deter tourists but it has been shown outside the Mediterranean Sea that a drop in beach cleanliness standards could reduce revenue by up to more than 50% (Ballance et al., 2000).

**The shipping sector** will benefit from the measure because less plastic bag waste will come with less blocked intakes, less disruptions of operations, less required clean-up and repair.

**The measure's impact on the fishing sector** is twofold: (i) the measure is likely to be positive for marine biodiversity and the health of marine species (therefore reduce potentially lost catches) and (ii) less plastic bag waste in the Sea will lead to fewer plastic bags entangled in nets and other equipment or blocking intakes and affecting

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<sup>11</sup> Plastic bag tax-related job loss/creation in Ireland: Estimated net job creation of 11 jobs.

Jobs lost: Jobs are likely to be lost in the plastic bag manufacturing and importing industry. From what is known, not more than 26 jobs were lost in Ireland, which is likely to be overestimated.

Jobs created: In the central administration for the overall administration of the tax: Nine full time equivalents, based on yearly administration costs divided by annual average labor cost.

In the retail sector, to administer the tax: Number of linked jobs unknown, likely to be similar to jobs created in the central administration. Estimate nine full time equivalents.

In local administrations for the enforcement of the tax (plastic bag tax inspectors): Number unknown. Work likely to be executed by existing local tax inspectors. Workload could represent about one day per week for each inspector. For Ireland, it can be expected that one inspector per municipal district would follow-up on the plastic bag tax. With 31 municipal districts, this makes up for around six full-time equivalents.

In the reusable bag and bin liner industry, due to increased demand: No numbers known. Estimate 50% of jobs lost in the plastic bag manufacturing industry transferred to reusable bag/bin liner industry, meaning 13 jobs.

cooling systems (McIlgorm et al., 2011). Mouat et al. (2010) focused on estimating the direct economic impact of overall marine litter on Scottish fishing vessels (i.e. costs of repairs and direct losses in earnings, not indirect losses due to ghost fishing) and estimated that on average marine litter costs the Scottish fishing fleet around 5% of their annual revenue. This is clearly a substantial cost to an industry that is already under high pressure and important in coastal communities. For the Mediterranean region, it is likely that the impact of marine litter on fishery revenues is similar. However, the impact on fishery revenues that can be attributed to plastic bag waste in particular is not known. A rough estimate of this impact can be made when the proportion of plastic bag waste in overall marine litter (around 8.5% in the Mediterranean) is applied to this revenue impact. Based on overall fishery revenues in the Mediterranean rim countries of €3.2 billion (Plan Bleu 2014), the revenue loss due to plastic bag waste would be around €13.5 million per year. However, due to the long life of plastic bags in the Sea, revenue loss due to plastic bag waste would not disappear as soon as a plastic bag tax is introduced. As the dynamics of plastic bag waste degradation and the quantity of land-based plastic bag waste ending up in the Sea even after introduction of a plastic bag tax are poorly known, it is currently not possible to give a precise estimate of the financial benefit of a regional Mediterranean plastic bag tax to the fishery sector.

**The aquaculture industry** will benefit from less marine plastic bag waste leading to less clean-up operations.

**Coastal power stations** using seawater for cooling purposes will benefit from the measure. Marine Litter can cause blockage of cooling water intake screens, increased removal of debris from screens and additional maintenance costs. Determining the extent of these costs is complex, particularly as costs resulting from plastic bag waste are difficult to differentiate from those due to other marine litter or natural debris such as seaweed (Mouat et al. 2010).

Due to a lack of data on socio-economic impacts of marine litter in the Mediterranean in general and plastic bag waste in particular, it was not possible as part of this study to analyze changes in value-added and employment linked to the improvement of the marine and coastal environment. However, it can be deduced from the qualitative analysis above that even a marginal reduction of marine litter can lead to a significant impact and compensate for the cost of the measure.

#### 4.2.6.4 Assessment of the improvement of the marine and coastal environment:

While some literature exists with regard to general marine litter reduction, no information has been found specifically targeting plastic bags, which constitute only part of overall marine litter.

However, with plastic bags representing around 8.5% of marine litter (UNEP, 2009) which can locally amount to more than 70% (Galgani et al., 2011 in UNEP, 2015), they contribute to the degradation of ecosystems, their components, functions and associated services. These environmental impacts occur via:

- Impacts on marine species:
  - ingestion (e.g. plastic bags mainly by turtles)
  - entanglement
  - toxicity (e.g. some additives are endocrine disruptors)
  - the spread of invasive alien species (IAS) travelling via marine plastic bag waste<sup>12</sup>
- Alterations in ecosystem services:
  - Provisioning service: Impacted by death, illness, intoxication and injury of fish, shellfish and turtles caused by marine plastic bag waste. However, as yet there have been no economic assessments to estimate the costs of these impacts (Newman S. et al. 2015).
  - Cultural services: The introduction of a plastic bag tax in the Mediterranean rim countries is expected to have a significant positive impact on cultural services provided by marine and coastal ecosystems, namely aesthetic and recreational services and non-use value (Cheshire et al. 2009). Few studies to date have investigated these issues and establishing exactly how and at what level marine litter in general and plastic bag waste in particular starts to have an appreciable social impact therefore requires more research (Cheshire et al. 2009).

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<sup>12</sup> Based on current information, marine litter is also considered a potential key vector for IAS in the Mediterranean, with 13 established aliens in the Mediterranean known to be able to colonize floating litter and more than 80% of known alien species in the area capable of using litter for further expanding their range (CIESM 2014).

### 4.2.7 Summary of results of cost-effectiveness and cost-benefit considerations

The overall estimated cost-effectiveness of a regional Mediterranean plastic bag tax is €670 million for a 95% reduction of incremental plastic bag waste<sup>13</sup>.

The costs and benefits of such a tax are presented in adapted to national contexts. below. Due to a lack of data, many of the impacts of the plastic bag tax have not been quantifiable and are thus not monetized but have been described in a qualitative way. Therefore, it has not been possible to calculate a cost-benefit ratio or net value of the measure. For this reason, adapted to national contexts. also indicates whether a specific item of the cost-benefit analysis comes with a net positive (+), negative (-) or neutral (0) impact and as such contains information typically found in multi-criteria analyses. The table indicates that the overall impact of the measure is qualified as positive.

### 4.2.8 Regional importance

A plastic bag tax is not a typical regional measure per se. The measure can already be effective if implemented at national level. However, its implementation on the regional level comes with several advantages. Marine litter can travel great distances at Sea and easily cross different areas of national jurisdiction. Therefore, the effect of a measure which reduces the amount of plastic bags in marine litter will not be national but (sub-) regional. Furthermore, it can be expected that the acceptability of the measure will be greater if a plastic bag tax is implemented regionally, thus bringing a regional answer to a regional problem.

### 4.2.9 Discussion

The analysis of the implementation of a Mediterranean plastic bag tax comes with a number of questions and uncertainties, for further discussion:

**Cultural role of plastic bags.** The analysis conducted under this study is based on the Irish case of the introduction of a plastic bag tax. However, in the case of a Mediterranean plastic bag tax, the cultural role of plastic bags should be further investigated in order to ensure enforceability and coherence of the measure within society and reduce possible adverse effects not already identified under this study.

**Plastic bag consumption in SEMC.** This analysis is based on an average per capita yearly consumption of 328 plastic bags, number originating from Ireland. While this level of plastic bag consumption is likely to be similar in Northern Mediterranean countries (SEMC), some uncertainties prevail for Southern and Eastern Mediterranean countries. In fact, according to the journalists of France 24, Tunisia claims that around 1 billion plastic bags are consumed in Tunisia each year, bringing the per capita annual consumption to around 90 bags (France 24, 2016). Depending on the sources, the Moroccan annual per capita consumption is stated between around 90 and 900 plastic bags. According to UNESCO, Jordan consumes around 460 plastic bags/capita and year. If a Mediterranean plastic bag tax is introduced, it will be important to know the “baseline” consumption of plastic bags prior to an introduction of the tax.

**Weight versus number.** Another issue for further discussion is the impact of a per kg versus per unit reduction of plastic bag waste. In fact, it is expected that the impacts of both reductions are unequal. For example, light weight plastic bags are more likely to be blown off landfills by the wind and end up in the landscape or in the Sea, not be recycled because of a lack of solidity and often require the use of two or more bags used together to carry heavier items to prevent ripping. These characteristics of light weight plastic bags have led several countries to ban them and impose a specific minimum weight/unit ratio or thickness for plastic bags.

**Compare and couple with current measures.** Many Mediterranean countries are already implementing or planning to implement some type of measure directly or indirectly targeting plastic bags. While this study has been realized with a “no existing measure” baseline assumption, a plastic bag tax could also be coupled with other measures, for example a minimum thickness of plastic or a ban of certain bag types. Some of the measures that are currently implemented in the Mediterranean are:

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<sup>13</sup> All costs for the regulator (€107 million in the first year and then €20 million/year) are more than covered by the tax revenues and are not considered in the cost calculation to avoid double-counting.

- Since July 2016, Morocco is banning all plastic bags, which is a major step as Morocco is said to be the world's second largest plastic bag consumer after the USA.
- Also since July 2016, France bans plastic bags with a thickness of less than 50 microns.
- In 2016, Tunisia decided to ban all plastic bags which are not made out of biodegradable material.
- The same ban has already been in place in Italy since 2011.
- Also in Italy, some local communities provide garbage bags to households for different types of waste which is said to reduce the number of plastic bags consumers use for their groceries. In fact, consumers would stop using plastic bags as bin liners, when bin liners are provided for free and thus they would stop asking for so many plastic bags when they do their groceries.

**Use this case study as an example to assess the socio-economic impact of alternative measures to reduce marine litter impacts.** The assessment carried out above should serve regional and national bodies and structures as an example but it needs to be adapted to more specific situations. The case study highlights different elements that should be further investigated when the introduction of a plastic bag tax is being considered. These elements will provide the needed input to make a tax less theoretical and adapt its design to the relevant context.

#### 4.2.10 Recommendations

International best practice of plastic bag tax has shown that while the administrative burden involved in the implementation of such a tax is not excessive, the impact on both the consumption of plastic bags and on the downstream litter composition is notable. However, for a successful implementation in the Mediterranean region, the following recommendations apply:

**Levy the tax upstream at the manufacturer/importer level.** In the Mediterranean region, informal (non VAT-registered) outlets are numerous. The effectiveness of a plastic bag tax is likely to be highest if the tax is levied at the manufacturer/importer level, thus reducing the administrative effort to a limited number of collection points and which are already VAT registered. Manufacturers and importers would collect the fee from retailers who in turn are obliged to pass the per bag tax on to the final consumers.

**Earmark plastic bag tax revenues for environmental purposes.** International best practice shows that public acceptance of the plastic bag tax is highest when its revenues are earmarked for environmental projects (as opposed to being injected into the overall government budget).

**Get actors on board during consultation.** Public consultation is key for a successful policy. Public consultation for the plastic bag tax should not put the measure into question as a whole but concentrate on implementation modalities which need to be adapted to national contexts.

**Make it a package of instruments and get support from flanking measures.** A package of instruments, including command and control, voluntary and economic instruments rather than a single economic instrument, such as a plastic bag tax, is likely to enhance effectiveness. For instance, the introduction of a plastic bag tax may not work well without a comprehensive education and awareness campaign. In order to avoid adverse impacts on plastic bag manufacturers and importers, a useful flanking measure (financed by the plastic bag tax revenues) could be to aid them to modify their production processes and produce reusable bags instead of single-use bags.

**Getting the tax amount right.** As seen previously, calculating the economically correct tax rate for each country or region does not seem feasible for the Mediterranean. Therefore, the tax rate would most likely be set in an ad hoc way. In order to allow for some flexibility in this regard, a lesson learned from the Irish plastic bag levy is that enabling legislation for the tax should allow for adjustments of the tax amount. In Ireland, it was possible to adjust the levy from €0.15 to €0.22 without any additional legislation, which proved to be of great help to ensure the overall effectiveness of the measure (Waste Management (Amendment) Act, 2001).

**Keep communicating.** The Irish experience has shown that effectiveness of the measures wears off slightly over time (plastic bag revenues slightly increase over time meaning that people increase their plastic bag consumption). A regular communication effort, for example a campaign every one or two years, could counter this tendency.

Table 2 : List of costs and benefits of a regional Mediterranean plastic bag tax

Item	Costs	Benefits	Impact (+/- / 0)
Direct costs	<p>€670 million/year for consumers, which covers the administration fees as follows</p> <p>€107 million one-off costs for the regulator (first year)</p> <p>€20 million yearly costs for the regulator</p>	<p>€583 million raised during first year for environmental purposes</p> <p>€650million/year raised for environmental purposes (except first year)</p>	-
Enforcement	Unknown enforcement costs	Unknown revenues from fines for non-compliance	0
Employment	Unknown number of jobs lost in the plastic bag manufacturing industry	Unknown number of jobs created in the reusable bag and bin liner manufacturing sector and in the administrative sector for the management of the tax	0
Direct economic impact	Plastic bag manufacturers: Loss of revenue from single-use plastic bags	<p>Retail sector: Savings linked to largely reduced purchase of plastic bags and linked storage costs</p> <p>Plastic bag manufacturers: Increased sales of bin liners and reusable plastic bags</p>	+
Indirect economic impact		<p>Savings linked to less beach cleaning and litter picking</p> <p>Savings for waste management due to less waste to be managed</p> <p>Increase in revenues in the recreation and tourism sector due to cleaner beaches</p> <p>Savings in the shipping sector due to less cleaning and repair operations and linked down time</p> <p>Additional earnings in the fishing sector due to improved health and biodiversity of marine species</p> <p>Savings in the fishing sector due to less cleaning and repair operations.</p> <p>Savings in the aquaculture sector due to less cleaning and repair operations.</p> <p>Savings for coastal power stations due to less cleaning and repair operations.</p>	+
Ecosystem services		<p>Provisioning services: Reduced death, illness, intoxication and injury of fish, shellfish and turtles caused by marine plastic bag waste</p> <p>Cultural services: aesthetic and recreational services and non-use value increased</p>	+
Other		Saving of resources (mainly hydrocarbons, water and energy needed in the manufacturing process of plastic bags)	+
<b>TOTAL</b>			<b>+</b>

## 4.3 NO-SPECIAL-FEE REGIME FOR USE OF PORT RECEPTION FACILITIES

Measure: Use of port waste reception facilities at no-special-fee

Type of measure: Economic instrument

Driver: Maritime transport, fishing, tourism (cruise ships)

Pressure: Introduction of heavy metals, POPs, oil

Impact: Contamination by hazardous substances

GES Descriptors: Contaminants, Marine Litter and possibly biodiversity, non-indigenous species, marine food-web and eutrophication

### 4.3.1 Description of the measure

Ships generate different types of wastes, mainly oily residues (generated in the engine departments and in ship tanks, including crude oil, fuel oil, sludge and oil refined products, other than petrochemicals, vegetable and animal oil) and sewage (generated from ship lavatories, kitchen areas etc.) but also residues from bulk products carried on board and domestic and operational solid waste (food waste, packaging materials such as plastic, cans etc., medical wastes, bottles, paper, glass, electronic waste etc. and maintenance waste such as machinery maintenance remains, broken parts, rust, oily rags, paint, packaging materials, as well as cargo-associated waste (pallets etc.) and other harmful solid waste (ash of onboard garbage incineration etc.).

A no-special-fee system aims at discouraging the (illegal) discharge of waste at Sea and is defined as a charging system where the cost of reception, handling and disposal of ship-generated wastes, originating from the normal operation of the ship, as well as of marine litter caught in fishing nets, is included in the harbor fee or otherwise charged to ships calling at port, irrespective of whether wastes are delivered or not (HELCOM, 2007). The no-special-fee therefore qualifies as an indirect fee and at the same time provides an incentive for ships to deliver their waste on shore. It is indirectly aligned with the polluter pays principle, as the overall polluting sector - maritime shipping – pays, but individual ships not generating waste also remain liable to the fee. The central idea of the no-special-fee is that the port fee should not be related to the amount of waste the vessel leaves in port.

A no-special-fee system may or may not be restricted to specific types of ship-generated waste and cargo residues. Furthermore, in order to increase the fee's legitimacy, a port may want to differentiate the fee according to gross tonnage of the vessel, the type of cargo or the number of staff and the quality of on-board waste facilities, as long as the rate of the fee remains transparent and fair and independent of the quantity of waste discharges at port.

Port reception facilities for the disposal of a wide range of ship generated waste and cargo residues are already a requirement under the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) of the International Maritime Organization (IMO). The EU Directive 2000/59/EC for port reception facilities (PRF Directive) aligns with this IMO Convention. Under MARPOL and the PRF Directive there is an obligation to provide port waste reception facilities (PRF), which must be adequate to meet the needs of ships using the port, without causing undue delay. The PRF Directive also requires the delivery of ship generated waste and the implementation of a cost recovery system by the Member States covering the costs of planning for, collecting and disposal of this waste (European Maritime Safety Agency, 2016). Under the PRF Directive, ports must establish cost recovery systems to encourage the delivery of waste on land and discourage dumping at sea. All ships calling at an EU port should bear a significant part of the cost (set at 30 % by the European Commission) irrespective of the actual use of the facilities. The Directive thus prescribes an at least partial no-special-fee for PRF cost recovery. The fees may differ depending on the category, type and size of the ship. The Directive also allows fees to be reduced if the master of the ship can demonstrate that the ship's environmental management, design, equipment and operation produces reduced quantities of ship-generated waste.

At the level of the Barcelona Convention, UNEP-MAP Regional Plan on Marine Litter Management in the Mediterranean in the Framework of Article 15 of the Land Based Sources Protocol furthermore urges Mediterranean rim countries to “in accordance with Article 14 of the Prevention and Emergency Protocol explore and implement to the extent possible by 2017, ways and means to charge reasonable cost for the use of port reception facilities or when applicable, apply No-Special-Fee system.”

This analysis is thus a first step towards this aim and will provide input for further work.

In the Mediterranean, there are about 600 ports and terminals recording ship movements and maritime transport produces around €70 billion in turnover per year and sustains around 550 000 direct jobs (Plan Bleu, 2014). Some Mediterranean ports have already adopted a no-special-fee system. For example, in Cyprus the port authority has put in place a capped no-special-fee in the ports of Limassol, Larnaca and Vasilikos and the port of Algeciras, Spain applies a 100% no-special-fee (Sherrington et al., 2016). However, a comprehensive survey of Mediterranean ports, the characteristics of their PRF and the cost recovery mechanism applied for these facilities is currently lacking. Concerning the cost recovery mechanism, a survey of Mediterranean ports should provide information at two levels: (i) is a fee paid by all port users regardless of whether or not PRF are used, and (ii) is the fee level adequate to cover the costs of PRF and their operation?

### 4.3.2 Theoretical effectiveness

Shipping accounts for about 20% of the global discharges into the sea. On a global level it is assumed that only about 27% of all ship waste is delivered to reception facilities, while the majority is dumped or incinerated on board or at port (Sheavly and Register, 2007). Theoretically, adequate provision and use of port reception facilities (PRF) could absorb these discharges into the Sea and thus avoid the pollution stemming from them. However, it must be noted that (i) for many waste types it is a priori easier and quicker for ships to discharge waste at Sea en route, thus saving time and handling operations; (ii) depending on the type of waste and the distance to the shoreline, not all waste discharges are prohibited in the Mediterranean (the international principle of the “free high Seas” in areas beyond national jurisdiction); and (iii) illegal discharges are often difficult to prove and the risk for offenders to be sanctioned may not be high enough to effectively deter ships from illegal discharges. Considering these observations, it is clear that any effective option for waste delivery at port must be more attractive for ships than the (illegal) discharge at Sea. In order for ships to use PRF, which represents for many waste types an additional effort in comparison to discharging at Sea, ships need an incentive.

The no-special-fee system represents an economic incentive for operators. As the handling of waste is included in the port fees paid by operators, marginal costs for appropriate handling of waste are nil and incentives to discharge at Sea are thus reduced. However, since ships are likely to need to spend more time in port, the effective cost is probably still perceived as non-negligible by ships. Only a well-functioning regional collaboration on pursuing and investigating violations with the majority of illegal polluters being brought to court can provide the needed complementary disincentive to illegally discharge at Sea.

A no-special-fee cost recovery system for PRF has been implemented in the Baltic Sea, with different modalities in the different ports. However, due to a lack of data on the actual disposal of waste in PRF and the quantity of discharges at Sea, the effectiveness of the measure has not been proven empirically, despite a significant decrease in detected oil spills throughout the last 15 years (HELCOM, 2016). Given that solid waste is easier to deliver than oily waste and is often delivered at the same time, it is reasonable to assume that the number of illegal waste discharges at sea also dropped over this period (Øhlenschläger et al. 2013).

### 4.3.3 Prerequisites for a successful implementation and practical effectiveness

#### **Existence of adequate port reception facilities (PRF), waste management plans and basic port administration.**

The first prerequisite for the introduction of a no-special-fee system is the existence of adequate PRF in all ports, along with coherent waste management plans and a basic administration that allows the port authority to charge port dues. However, what constitutes “adequate port reception facilities” is almost impossible to define since the type and capacity of facilities necessary depend on what kinds of vessels regularly call in ports. In smaller ports simple barrels might be sufficient, whereas in many of the larger ports, facilities have to be constructed that cannot only harbor large amounts of waste but also treat different waste types in different ways (Carpenter et al., 2001).

**PRF that allow for swift handling.** Any extra hour a vessel has to stay in port for waste handling operations costs the operator a significant amount of money and may provide an incentive to rather discharge (illegally) at

Sea. This situation is likely to prevail as long as it is quicker for a vessel to discharge at Sea rather than in a port, especially when the risk of being caught while polluting at Sea is negligible. In order to achieve swift handling and avoid undue delay, cooperation between port and ships must be good. Main principles to be respected for a good cooperation are the following:

- **Prior notification:** In order to plan waste disposal in ports, vessels should inform the port prior to calling at port about the types and quantities of waste the vessel has on board and intends to discharge as well as about discharge modalities for the type of ship (for example a ro-ro ferry may require vehicles to drive into the ferry and collect waste there). An example for this prior notification format is the “advance waste notification form” developed and annexed to the European PRF Directive.
- **Safety regulations:** All necessary safety regulations (International Maritime Organization standards and other) must be respected and taken into account when discharging waste at port to avoid undue delay and health and/or environmental hazards.

**Principle of cost recovery.** The collected fee must cover the waste collecting, handling, processing and disposal, including infrastructure investments. This is particularly important to achieve buy-in from port authorities and local governments and to implement the polluter pays principle. Also, the collected fees shall be used for no other purposes than those linked to the planning, construction, operation (costs of handling, treatment and final disposal), maintenance/repair and management of PRF and the no-special-fee system.

**A regionally harmonized fee system.** In order to avoid competitive distortions and “waste tourism” between ports in the Mediterranean, all ports in the region should be economically equally attractive for vessels to discharge their waste. There should be no incentive (including public subsidies) to discharge in one port rather than in another.

**Enforcement of legal frameworks.** Legal frameworks regulating marine pollution from ships in the Mediterranean have been existing for years, in particular the IMO’s MARPOL Convention, the Barcelona Convention and the above mentioned EU Directive. However, their enforcement remains difficult but is crucial for the successful introduction of a no-special-fee charging system. In fact, if the risk of being sanctioned for illegal discharges at Sea remains negligible, vessel operators are easily tempted to dump their waste at Sea rather than using PRF. Currently, efforts to enhance enforcement of the mentioned legal framework are currently led by the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC) and the more recent Mediterranean Network of Law Enforcement Officials pertaining to MARPOL (MENELAS) of which REMPEC serves as the secretariat.

**Willingness of governments and port authorities to implement the system.** The establishment of a new system for waste recovery in ports requires support and willingness of governments and port authorities, especially in the beginning of the implementation of a new system.

**Changes of behavior for compliance and adoption.** The establishment of a no-special-fee system involves changes of behavior of several stakeholders and interaction between them. However, these stakeholders are relatively easy to identify and compliance and adoption of the system is not expected to be problematic if the above mentioned prerequisites are met.

- Central and/or local governments should be involved in the implementation of the measure, mainly in order to set the rules of engagement for ports. This is especially true when an international or regional convention or directive needs to be transposed into national law. Once the legal framework is set, governments do not need to intervene, except for periodical enforcement control at the port(s).
- More directly, the introduction of a no-special-fee charging system involves compliance on one hand by port authorities and overall port services (including possibly private waste operators) and, on the other hand, by vessel operators calling at port.
- In order to ensure transparency of the no-special-fee system, it is recommended that Port Authorities should receive all fee payments and then compensate any private operator. Improved monitoring of ships and their waste record books will be required and a more central role of Port Authorities in waste management may require substantial organizational changes for some Mediterranean ports.

- However, the degree to which port operators will need to change their processes and behavior largely depends on the status quo of each port and is likely to differ significantly between ports. Therefore, compliance and adoption of the no-special-fee system will not be equally simple in all Mediterranean ports and additional capacity building and/or information campaigns for port operators may be necessary in some ports.

#### 4.3.4 Alternative measures potentially leading to the same effect

Port reception facilities and their operation come with a cost for port operators (infrastructure, handling, disposal, etc.) and these costs need to be recovered. The no-special-fee system is one of these cost recovery systems. The list below provides an insight into a variety of cost recovery systems:

**Direct fee.** A direct fee implies that vessels pay only if they discharge waste at PRF. Fees are correlated to the quantity of waste discharged and all costs are directly passed on to the vessel. The system therefore adheres completely to the polluter pays principle. However, a direct fee may promote illegal discharges at Sea to avoid the payment of the fee and therefore prevent the use of PRF. It also comes with a high administrative burden because quantities and types of waste need to be assessed and billed individually to each vessel. Furthermore, no consistency of fees between ports may lead to an unequitable distribution of waste under this cost recovery mechanism.

**Free of charge.** Under this mechanism, vessels do not pay at all for waste disposal at port, which provides a clear incentive to discharge waste at port. However, this system is completely inconsistent with the polluter pays principle and requires tax payers' money to fund PRF and their operation. Vessels may also retain waste from elsewhere to discharge it where it is free of charge (waste tourism).

**Contract.** Under this system, vessels or fleets have contracts for waste delivery with specific ports for a fixed level of waste, which guarantee income for ports and provide proof for exemption of vessels in other ports. It also minimizes the incentive to illegally discharge waste at Sea for vessels covered by such contracts and rewards "cleaner" vessels which can negotiate contracts with lower levels of waste. But the mechanism only applies for specific vessels or fleets and is not suitable for all vessels calling into a port. It still requires different administrative processes for vessels covered by a contract and for other vessels and still requires the assessment of the quantities and types of waste discharged at port to monitor when the contract limits are attained.

**Combined.** This mechanism consists of a fixed fee until a certain threshold of waste and a variable direct fee for quantities exceeding the threshold. It guarantees a certain income for ports from the fixed fee which is charged to all vessels regardless of whether or not they discharge waste. The system thus partially applies the polluter pays principle and may promote waste reduction on board vessels to avoid payment of the variable fee. But the variable part of the fee may also lead to the promotion of illegal discharge at Sea to avoid payment. Finally, the system also comes with a relatively high administrative burden, as quantities and types of waste discharged need to be assessed and billed individually.

**Limited/capped no-special-fee.** This system is similar to the combined fee mechanism except for the fact that it does not contain a variable fee part. It limits the quantities and types of waste that can be discharged by each vessel at a certain level. No waste can be delivered above the fixed limits. The system promotes disposal in port within the defined limits and may promote waste reduction technology on board to allow the vessels to remain within the limits. The measure comes with a guaranteed income for ports as each vessel pays the fixed fee regardless of whether or not waste is actually discharged. This makes the system an indirect application of the polluter pays principle with all vessels which are potentially "polluting" paying the fee. But the system may promote illegal discharge at Sea to avoid exceeding the set waste quantity limits that can be disposed of at port.

There are a number of other cost recovery systems, which can be a mix of different systems. A study conducted for the European Commission DG Environment examines some of them (Sherrington et al., 2016).

In comparison to the cost recovery mechanisms studied here, the 100% no-special-fee makes all vessels make a contribution to the payment of PRF and their operation regardless of whether or not waste is actually discharged. This provides a clear incentive to discharge waste at port because it does not entail any incremental costs to the vessels. The system also guarantees a certain income level to ports and the administration of the fee is relatively

simple, because operators simply collect waste without needing to calculate fees based on the actual amounts of waste delivered. The polluter pays principle is indirectly applied with all port users paying for PRF. However, the system provides little incentives for waste reduction on board and vessels may retain waste from elsewhere to discharge it where it is free of charge (waste tourism), especially when the system is not applied in a harmonized way between ports. Administration costs may rise if vessels which call in frequently negotiate a reduced fee level.

### 4.3.5 Cost assessment

Cost assessment of the no-special-fee system focuses on the costs which are directly linked to the cost recovery mechanism no-special-fee itself. Costs linked to the construction and operation of port reception facilities (PRF), which are already a requirement under MARPOL, are not assessed here. Also, costs related to waste collection, separation and treatment processes or administrative work such as filling in waste notification forms or waste log books on board are not taken into account here, because these processes are not specifically linked to the no-special-fee system but apply to several other cost recovery mechanisms.

#### 4.3.5.1 Costs for the regulator

The introduction of a no-special-fee system will require a coordination and administration effort from the regulator. Most of the administrative effort will occur during the design and launch of the system, especially if the system is to be implemented in several ports or at the regional level in a harmonized way (one-off costs). In this case, the regulator should ensure appropriate training and capacity building of port operators and the development of guidelines (in a consultative and participatory way) for harmonized procedures along ports. These efforts will induce typical administrative costs such as personnel costs, mission costs and meeting costs.

Once the no-special-fee system is launched, the regulator will bear monitoring and enforcement costs, as well as possible prosecution costs for non-compliance with the system (that is to say with the no-special fee system in particular and not with overall regulations on waste discharges). However, once the one-off costs of the launch of the measure are paid, the rolling costs of the measure are likely to be small for the regulator, with port operators being responsible for the day-to-day administration of the measure.

#### **Box 2 : HELCOM's Baltic Strategy on Port Reception Facilities for Ship-generated Waste**

Similar to the Barcelona Convention in the Mediterranean, the Baltic Sea has its regional Seas convention, the so-called Helsinki Convention (HELCOM). Under HELCOM, the Baltic Strategy on Port Reception Facilities for Ship-generated Waste has been developed and concretized through 13 recommendations, which are HELCOM's legal instruments. The HELCOM recommendations provide a detailed framework for the management, treatment, recycling and notification of ship-generated waste, taking into account but going much further than the legal frameworks provided by the MARPOL Convention and EU Directive 2000/59 for port reception facilities. In particular, recommendation 28/1 specifies the harmonized application of the no-special-fee system to ship-generated waste (all MARPOL Annex V waste types) in the Baltic Sea area. Even though HELCOM's recommendations are not legally binding, they still prove that its Member States have agreed on its content, as recommendations are always made under consensus. Especially because HELCOM's recommendations are not legally binding, their content can be designed in a more comprehensive way than it would be the case in a binding law. Notwithstanding the "soft-law" character of the HELCOM Strategy and its recommendations, the latter still play a major role in the design, implementation and revision of the European Directive 2000/59 for port reception facilities (PRF Directive, see above). The implementation of the different HELCOM provisions in Baltic ports are enhancing their acceptance and consolidation and are likely to greatly influence national, European and international legislation in the long term (Stoefen, 2011).

#### 4.3.5.2 Compliance costs for the regulated

Costs occur to vessels and ports, as follows:

##### • Ports

Based on the assumption that adequate port reception facilities are already in place in line with MARPOL, additional costs occur for ports mainly with regard to administrative costs. However, when switching to a no-special-fee system, incremental administrative costs linked to this cost recovery mechanism largely depend on the cost recovery mechanism which is currently in place. The no-special-fee system may come with higher or lower administrative costs than the current cost recovery system.

As the no-special-fee mechanism aims at incentivizing vessels to discharge their waste at port reception facilities, the no-special-fee is likely to lead to a higher volume of waste delivered at ports. This may require larger PRF installations than currently in place in some ports, but the costs linked to the construction and operation of such PRF should be covered by the fee and not lead to net costs. However, one could also argue that “adequate” PRF as per MARPOL should already be tailored to receiving the waste volumes yielded by the no-special-fee and that any additional costs linked to a possible capacity enlargement of PRF are rather a sign of inadequacy of the facilities with regard to MARPOL than a result of the no-special-fee.

##### • Vessels

Compliance cost for vessels using PRF under a no-special-fee system are difficult to estimate, due to the complex pricing system applied in the different ports and the heterogeneous nature of shipping activities. In fact, the list price of a service and the actual price that a port user is paying can vary significantly due to various rebates, adjustments and discounts applied according to the type and size of ship, the duration of the stay at port, the frequency at which the vessel calls at a specific port, etc. (Meersmann et al., 2014). Given this complex situation, it has not been possible under this study to estimate the costs of a no-special-fee system for the shipping industry.

However, analysis of the pricing scheme applied at the Baltic port of Riga (Latvia) in 2016 suggests that the maximum proportion of the no-special-fee in the overall port dues is a maximum of around 6% (Riga Port Authority). In fact, unlike a direct fee, the no-special-fee is paid by all vessels calling at a port and can therefore be relatively small. Furthermore, the proportion of the total port dues in the overall cost supported by shipping operations is only a relatively small fraction. It therefore seems unlikely that the introduction of a no-special-fee system would substantially alter the profitability scheme of maritime shipping in the Mediterranean.

If there is one “loser” under a no-special-fee system, it is the vessel which does not discharge any waste at port but still needs to pay the no-special-fee for a service it does not use.

#### 4.3.5.3 Funding

The no-special-fee system is itself a cost recovery system for PRF. However, even if the fees will eventually cover PRF investment and operation costs, the initial investment must be made in a way or another. Funding may originate from a private operator of the facilities, the port authority itself, local or national governments, commercial banks or development banks and agencies.

If applied to a regional level, financing through regional mechanisms and/or development banks and agencies may be a cost-effective solution. Under such a scenario, the simultaneous or progressive establishment of PRF and a harmonized cost recovery mechanism such as the no-special-fee system in several ports within one region will achieve economies of scale and a significant learning curve.

## 4.3.6 Cost-benefit analysis

### 4.3.6.1 Assessment of additional economic and social impacts

Other than the costs listed above, the no-special-fee is also likely to have a positive economic and social impact at the level of port operators: In comparison to other cost recovery mechanisms, the no-special-fee is probably the measure that maximizes the volume of waste delivered to ports, which in turn is likely to induce an additional waste handling effort creating additional turnover and jobs in the waste management, handling and treatment sector. However, while it has not been possible to quantify these impacts, they are expected to be relatively small.

With regards to administrative costs linked to invoicing vessels for waste delivered etc. and depending on the cost recovery mechanism currently in place, it is unlikely that the no-special-fee system will have a significant impact on turnover or jobs because the administrative burden linked to the measure is neither exceptionally high nor low.

It is not expected that the measure will have a significant impact on employment in the shipping sector, as tasks linked to the implementation of the no-special-fee are likely to be carried out by already existing personnel on board during normal operation.

### 4.3.6.2 Impacts resulting from the improvement of the marine and coastal environment

In comparison to the implementation of other cost recovery mechanisms for PRF, the no-special-fee system is likely to further reduce waste voluntarily discharged by vessels at Sea during normal shipping operations. These operations are estimated to account for over 70% of the oil entering the Sea from marine transportation, with the remainder stemming from accidental pollution. The impacts of accidental pollution from ships at Sea are relatively well studied and economic data of damage caused by such pollution is available (e.g. Prestige accident). However, the type of pollution targeted by the no-special-fee – voluntary discharge of waste at Sea - is profoundly different to accidental pollution. The latter is generally very localized and concentrated and mainly consist of oil pollution while voluntary discharge usually takes place in a much more dispersed and diffuse way and includes a larger panel of pollutants. The impacts per ton of discharged waste are very different in these two cases. For this reason, it is not reasonable to attempt to transfer economic valuation studies of impacts of accidental oil spills to the voluntary “operational” discharge of waste at Sea which is targeted by the no-special-fee system.

However, voluntary pollution from ships during normal operations, while appearing much less dramatic than accidental oil spills, gives rise to a number of chronic pollution problems. This can particularly be problematic in environments such as ports and harbors and along major shipping lanes. Statistics show that 80% of oil spills occur in harbor waters (Miola et al. 2009). Oil spills continue to be the most visible waste discharge of vessels, but other pollutants may be just as hazardous. Chemical discharges for example generally receive less public attention because they are less visible. Furthermore, there are less hazardous but highly visible discharges such as the dumping of macro waste at Sea.

Literature review conducted as part of this study did not reveal any economic valuation studies covering the impacts of this voluntary pollution occurring during normal operations of ships. Also, the incremental capacity of the no-special-fee system to reduce waste discharges at Sea beyond the quantities that could be achieved by the implementation of other cost recovery mechanisms is not known and it is therefore not feasible to evaluate impacts of the pollution reduction.

It is however likely that the introduction of the no-special-fee can have positive impacts on tourism and recreational activities in places with high concentrations of ship-generated waste, such as in the vicinity of ports or on beaches with for example tar ball concentrations. The measure may also have positive impacts on the fishery sector as chronic pollution affecting the health of fish stocks is likely to decrease.

#### 4.3.6.3 Assessment of the improvement of the marine and coastal environment

The no-special-fee mainly targets chronic pollution stemming from normal shipping operations. It may yield incremental reduction of this pollution if compared to other cost recovery mechanisms of PRF because it eliminates disincentives for waste disposal at port. An improvement of the marine and coastal environment is most likely to occur along major shipping lanes and ports, where this pollution takes place and will depend on factors such as weather conditions, time of the year (season), quantity and type of discharge, the location of the discharge in terms of ambient conditions and physical characteristics, speed at which the pollutants are diluted or dissipated by natural processes etc. (ITOPF, 2014).

The measure is expected to have a positive impact on the overall health of marine and coastal ecosystems, as ship-generated waste, which is targeted to be reduced through the no-special-fee, may lead to

- Physical smothering with an impact on physiological functions including for seabirds (Kees, 2007)
- Chemical toxicity giving rise to lethal or sub-lethal effects or causing impairment of cellular functions including reproduction
- Ecological changes, primarily the loss of key organisms from a community and the takeover of habitats by opportunistic species
- Indirect effects, such as the loss of habitat or shelter and the consequent elimination of ecologically important species (ITOPF, 2014)
- Indirect effects on overall food-web interactions including microbial food webs (Ameer et al. 2008)

Literature review conducted as part of this study did not reveal any economic studies transferrable to the improvement of the marine and coastal environment as a consequence of the introduction of a no-special fee system in the Mediterranean. However, the expected impacts are linked to different ecosystem services, such as provisioning services (impact on fisheries), cultural services (aesthetic impact of waste washed ashore on beaches, for example tar balls) and possibly supporting services (bio-chemical interactions of waste, especially sewage, in nutrient cycling).

#### 4.3.7 Performance matrix and multi-criteria analysis for cost recovery mechanisms for PRF

The MARPOL protocol foresees that ports be equipped with adequate port reception facilities (PRF) for waste. However, ports are free to define their cost recovery mechanism to finance such PRF. This chapter aims at providing insight into different cost recovery options and comparing them against several performance criteria. Scores are based on the assumption that preferences tend towards a mechanism's capacity to:

- Minimize waste discharge at Sea and therefore
  - Maximize waste disposal at PRF
  - Maximize waste reduction on board
- Cover the costs of PRF in an equitable way and maximize positive economic impacts where possible and therefore
  - Adhere to the polluter pays principle
  - Minimize administrative burden
  - Guarantee income for ports
  - Maximize the net positive economic impact, including employment

The scores in the table below indicate the options' performance against the performance criteria, where 0 is the lowest and 2 the highest performance with regard to the above mentioned preferences.

Table 3 : Multi-criteria analysis of different cost recovery mechanisms for port reception facilities

Mechanism	Environmental objectives		Total environmental objectives	Economic and financial considerations				Total economic/ financial considerations	Grand Total	Comment
	Encourages waste disposal at PRF	Incentive to reduce waste on board		Adheres to polluter pays principle	Administrative burden	Guaranteed income for ports	Employment +economic impact			
Direct fee	0	2	2	2	0	0	0	2	4	
Free of charge	2	0	2	0	2	0	2	4	6	
Contract	1	1	2	2	0	2	1	5	7	Applies only to certain vessels
Combined fee	1	1	2	2	0	1	1	4	6	
Capped fee	1	1	2	2	0	1	1	4	6	
No-special-fee	2	0	2	1	1	2	2	6	8	

The multi-criteria analysis produces scores between 4 and 8 on a scale that goes from 0 to 12. The fact that none of the options has reached the maximum score of 12 points shows that all listed options come with trade-offs and that there is no single option that comes with a high performance for all criteria. This leaves room for decision makers to choose either the option that maximizes the overall (unweighted) score or the one which achieves high scores on criteria which are particularly coherent with the policy makers’ objectives. Such preferences for specific criteria can also be included in the calculation of the overall score by applying a weighted approach giving more or less importance to criteria in line with specific objectives.

In the case of a generalized cost recovery mechanism for PRF in the Mediterranean, it can be assumed that an option’s capacity to reduce pollution is the paramount objective but that its feasibility depends just as strongly on its economic and financial viability. Therefore, a weighting could be envisaged to give the same importance to environmental objectives and economic and financial considerations (in the non-weighted approach, economic and financial considerations make up for a higher score than the environmental objectives). However, as in this case, the overall environmental performance of all listed options is the same for all options (a score of 2 out of 4), a weighting of this criterion would not change the score-based ranking of the options.

While producing a ranking of options, the multi-criteria analysis also allows showing comparative strengths and weaknesses of individual options. In the case of the no-special-fee, the most obvious weakness is its performance concerning the provision of incentives to reduce waste on board vessels (score 0). Such comparative weaknesses can in some cases be countered by flanking measures that can be implemented by decision makers to “adjust” options. For example, in order to maximize the positive environmental impact of the no-special-fee, an award system for vessels with waste reduction facilities/procedures on board may be implemented, granting discounts on the port fees for those vessels. However, such an award system will need to be taken into account in the overall calculation of the no-special-fee so that discounts for “green” vessels do not hinder ports to cover all costs linked to PRF.

### 4.3.8 Regional relevance of the measure

Implementing a no-special-fee cost recovery mechanism for port reception facilities is a genuine regional measure in the quest of achieving GES. In fact, it targets a typically regional problem and is most effective if implemented at the regional level.

The no-special-fee is levied locally at the port level. However, operational or voluntary pollution from ships, especially when it occurs on the open Sea, is a transboundary issue and takes place in a much more diffuse way. Such pollution does not necessarily take place exactly where the waste is created and waste can thus be “imported” or “exported” in between Mediterranean and non-Mediterranean countries. In fact, by being integrated in overall port dues, the no-special-fee which aims at reducing the discharge of operational waste by ships at Sea, applies to any vessel calling at port, regardless of the flag it sails under or the country it called last.

The implementation of a no-special-fee system for port reception facilities will be most effective and efficient if conceived and realized on the regional Seas level for several reasons:

- In order to minimize incentives for ships to discharge waste at Sea and to avoid “waste tourism”, ports in a regional Sea will benefit from a harmonization of PRF and the linked fee system in all major ports in the region.
- Financing schemes: In a region of various ports of different sizes and types, co-operation between the ports in terms of PRF can be beneficial and reduce effort and costs. For example, cost recovery may be grouped/centralized (one agency or PRF manages all financing for a several PRF) or de-centralized (each PRF organizes its own cost recovery). For the decentralized option, it is important that the types of PRF and the fee level should be similar.
- Harmonized processes: A regional harmonization of processes will improve the overall efficiency of PRF on the regional level. PRF will become more efficient if all actors involved are well accustomed with the procedures involved in the discharge of waste at port. Other than a harmonized fee system, especially a harmonized prior notification system and format for waste to be delivered along with harmonized waste management plans will improve overall efficiency of waste disposal in ports.

### 4.3.9 Recommendations

The analysis conducted as part of this study suggests that the main hurdle to be overcome for a successful implementation of a no-special-fee cost recovery mechanism in Mediterranean ports is not so much related to the cost to be paid by individual vessels but rather to overall port efficiency and swift waste collection and administration. In fact, it is likely to be costlier to vessel operators if waste discharge at port requires additional time and effort spent at port than it is to “just” pay the no-special-fee. Therefore, it is recommended that the efficiency of the overall waste collection system should be maximized, even if this increases the investment to be recovered by the no-special-fee (which would mean an increase in the rate of the fee to be paid by vessels).

Øhlenschläger et al. (2013) list the following efficiency determinants of waste collection systems in ports:

- The price of the waste collection services and the applied cost recovery system (degree of indirect fee) in place at the port
- The efficiency of the waste collection system in the port and the ease for ships to deliver waste (i.e. whether the agent has to deal with several waste operators, or a ‘one stop shop’ service is provided by one operator)
- The design and efficiency of the waste notification system
- The port authority’s involvement in ship waste handling (taking responsibility, control and monitoring)
- The inspection regime in the port regarding waste delivery

#### **Box 3 : How the administration of waste disposal can be a disincentive to discharge waste at port**

“In addition to the lack of time available to dispose of waste, the administration of waste disposal can be a burden and a disincentive to discharge waste. For example, in many EU ports a number of approved waste operators are available and the shipping agent has to be in contact with several authorities and waste operators in order to secure safe waste disposal of different types of waste. Thus the shipping agent has to fill out the waste notification form and then independently organize all waste collection. In these ports the choice of operators contributes to the complexity of the ship waste system, therefore it would be more efficient if there were fewer or even just one operator appointed to receive waste. Not only would this reduce the burden for ships, but if fewer operators were available the ‘information/paper flow’ and ‘money flow’ would be easier for the responsible Port Authority managing the system to handle. The competitive element could be introduced through the selection process, i.e., via tendering. In such a system the agent provides notification of what waste is to be delivered and the responsible authority then ensures that:

The inspection authorities are informed

- The waste operator(s) are informed
- The waste is collected
- A receipt is issued and signed by waste operator and ship captain
- The shipping agent is invoiced according to an existing price list or quotation (if needed).”

(Øhlenschläger et al, 2013)

The no-special-fee should normally apply to all vessels calling at a port. However, a port may want to exempt certain types of vessels from the fee. While this practice should be transparent and limited to a small number of vessels, it can be coherent to exempt a ship engaged in regular services and calling frequently at a port, so as to serve traffic between the same two or more ports. Such an exemption should be based on the fulfillment of the following conditions:

- It is ensured that the waste disposal requirements will be met on the ship's own account
- The notion of "regular services" must be well defined
- Evidence of the ship's scheduled traffic and evidence of the vessel's waste management practice (contract, receipts, copy of garbage record book, oil record book etc.) can be provided
- The other ports on the vessel's regular route are informed about the exemption.

Multi-criteria analysis conducted as part of this analysis has shown that the no-special-fee cost recovery mechanism for port reception facilities is the most preferable mechanism of those compared in the analysis. However, experience from Belgian ports shows that a flanking measure can be added to the no-special-fee system and even more increase the incentive to discharge waste at port: a reduction of the no-special-fee in case waste is actually disposed, or reversely, an award granted for actual use of port reception facilities (Public Waste Agency of Flanders-OVAM).

Similarly, and to increase the no-special-fee's performance in terms of incentivizing waste reduction on board, ports could, as a flanking measure, provide awards for "green" vessels with waste reduction facilities and procedures on board.

## 4.4 FISHING FOR LITTER

Measure: Fishing for litter - marine litter prevention and clean-up

Type of measure: Technical, communication/ awareness raising

Driver: General land based activities, fisheries, shipping, tourism, ...

Pressure: Marine Litter

Impact: Mostly physical disturbance

GES Descriptors: Marine Litter and possibly biodiversity and commercially exploited fish

### 4.4.1 Description of the measure

Fishing for litter initiatives have a twofold aim: to remove marine litter from the marine environment and to raise awareness of marine litter issues, particularly within one of its main stakeholders – the fishing sector - where the measure helps to prevent littering due to Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG). The main actors in fishing for litter initiatives are the fishermen who are provided with bags and waste reception facilities at port to collect litter that accumulates in their nets and other fishing gear during normal fishing activities and to dispose of unwanted fishing gear. The collected waste is then either recycled or disposed of on land. Fishermen participate on a voluntary basis while harbors and ports assist with the handling of waste and distribution of waste. One of the major advantages of this measure is the fact that it does not require any additional fishing activity or specific operations at Sea. This is why such fishing for litter initiatives are referred to as passive measures, in contrast to active measures such as active retrieval of litter through specific operations.

UNEP/MAP Regional Plan on Marine Litter Management in the Mediterranean in the Framework of Article 15 of the Land Based Sources Protocol urges Mediterranean rim countries to "explore and implement to the extent possible the 'Fishing for Litter' system, in consultation with the competent international and regional organizations, to facilitate clean-up of the water column and the sea floor from marine litter caught incidentally and/or generated by fishing vessels in their regular activities including derelict fishing gears". Furthermore, currently available national programmes of measures under the EU Marine Strategy Framework Directive, such as the French programme of measures, specifically include measures aiming at awareness raising and involvement of professional fishermen in efforts to reduce marine litter.

The OSPAR Convention in the North Atlantic has agreed in Recommendation 2010-19 on common principles for the reduction of marine litter via fishing for litter initiatives and proposes practical guidelines for fishing for litter initiatives.

#### 4.4.2 Theoretical effectiveness

Effectiveness of fishing for litter initiatives has been proven repeatedly, through several initiatives, such as:

- DeFishGear project (2014-2016): In local relatively small-scale initiatives, 600kg of marine litter have been collected during a more than one-year fishing for litter initiative on Corfu Island, Greece and 188kg collected in Izola and Koper (Slovenia) over a two-month period.
- In Scotland, during the period 2008-2011, more than 240 tonnes of waste have been collected via a large-scale regional fishing for litter initiative. During the period 2011-2014, another 374 tonnes of marine litter have been collected (KIMO, 2014).

It is difficult to estimate the proportion of marine litter that can potentially be collected via fishing for litter initiatives. This is amongst others due to the considerable spatial variability of marine litter. In fact, UNEP-MAP (2015), states that marine litter accumulation rates vary widely and are influenced by many factors, such as the presence of large cities, shore use, hydrodynamics, and maritime activities, sometimes reaching over 100 000 items/km<sup>2</sup> (Galvani et al., 2000).

Fishing for litter initiatives would clearly only take place on fishing grounds where the vessels normally operate. It is obvious that fishing for litter initiatives, which are curative measures to clean up marine litter, cannot eliminate all marine litter alone. It can be assumed that they would not have any significant impact on the creation of new marine litter originating from sources other than the fishing sector.

#### 4.4.3 Prerequisites for a successful implementation and practical effectiveness

**Size of participating fishing boats.** Fishing vessels involved in fishing for litter programmes need to have enough room on board to accommodate large bags or containers in which the waste is collected. This can potentially be a problem for artisanal small-scale fisheries which are prevalent in the Mediterranean. However, experience from the DeFishGear project (mentioned above) shows that even small-scale fisheries can effectively implement fishing for litter programmes.

**Appropriate port reception facilities.** The waste fished during fishing for litter initiatives needs to be handled and disposed of. Therefore, adequate port reception facilities are a requirement. These facilities are either already present at participating harbors or they are specifically set up to accommodate the fished waste.

**Communication plan.** A communication plan should be developed and implemented to promote the initiative and to raise awareness of fishermen and the fishing sector to the impacts of marine litter. Only convinced fishers will participate in an initiative that requires their volunteer work.

**Monitoring.** To evaluate cost-effectiveness of a fishing for litter programme, it is important to monitor a number of parameters, such as the number of vessels and harbors involved, the weight of the collected marine litter and if possible its type (plastic, fishing gear, etc.).

#### 4.4.4 Alternative measures potentially leading to the same effect

Fishing for litter initiatives can be considered as measures with a double-dividend because they are at the same time curative and preventative: On one hand, they reduce the amount of different types of marine litter by recovering it during fishing operations and, on the other hand, they raise awareness amongst fishermen concerning the impacts of abandoning and discarding fishing gear at Sea, thus preventing a possibly significant proportion of fishing gear to be discarded at Sea.

Alternative measures for the reduction of overall marine litter are numerous and target various actors and circumstances. They can reach from extended producer responsibility, to plastic bag taxes (see above), product bans, improvement of enforcement of certain legislations, waste management infrastructure investments, product design, or awareness and communication campaigns. This study did not allow to analyze all of them and thus only takes a closer look at measures targeting abandoned, lost or otherwise discarded fishing gear (ALDFG).

Despite regulatory efforts, namely the MARPOL Convention and its Annex V regulating the dumping of garbage by ships which also specifically prohibits the abandonment or dumping of fishing gear and the EU regulation n° 1224/2009 of 20 November 2009 regulating the retrieval of lost fishing gear in article 48, ALDFG continues to be a problem all over the World's Oceans and Seas.

An extensive list of measures to reduce ALDFG and their impact has been established in 2009 by UNEP and FAO in a common report (UNEP and FAO, 2009) and can be divided into three categories: Preventative measures, curative measures and mitigation measures.

## PREVENTATIVE MEASURES

**Gear marking.** Gear marking is a relatively simple measure to indicate ownership of fishing gear thus avoiding conflicts between fishers and inform competent authorities. However, for the measures to be effective, gear marking needs to be systematic and applied by all fishers, thus requiring a minimum of regulation and enforcement.

**On-board technology to avoid or locate gear.** Fishing vessels increasingly use GPS and sea-bed mapping technology with acoustic instruments which bring about benefits in terms of both reducing initial loss (by avoiding known obstacles) and improving the location and subsequent recovery of lost gear. Many large-scale fisheries also use transponders for satellite tracking of vessels and gear where these transponders have been attached to marker buoys or floats. Transponders are an added cost for fishers and are therefore more likely to be used with large and/or expensive gear and less so with artisanal fisheries. In fact, transponders seem less relevant for small-scale or coastal fisheries, where inshore location with landmarks and less expensive GPS can be used for bearings. However, in many fisheries, a wider use of transponders could facilitate the location of lost gear at reasonable additional cost.

**Port State measures.** Port State Measures (PSM) are requirements established or interventions undertaken by port states which a (foreign) fishing vessel must comply with or is subjected to as a condition for use of ports within the port state. These measures typically target Illegal Unreported and Unregulated (IUU) fishing. IUU fishing, is potentially a significant contributor to ALDFG problems as illegal fishers are unlikely to comply with regulation including any measures to reduce ALDFG. Those engaged in IUU fishing are also assumed to be key contributors to abandoned gear.

**Onshore collection/reception.** Appropriate reception facilities (disposal bins on docks or providing fishing vessels with special bags for old fishing gear) are a prerequisite for fishing gear waste to be disposed on land and thus reduce the likelihood that a fisher will discard unwanted gear at Sea. Similar to the no-special-fee investigated above, regulation 7 of the MARPOL Convention applies to the issue requiring that "the Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of garbage, without causing undue delay to ships, and according to the needs of the ships using them." Cost recovery mechanisms to be applied to such waste reception facilities should be designed in a way that creates no disincentive for fishers to dispose their waste at the facilities at port and no incentive to rather discard at Sea.

**Award schemes for disposal of old or retrieved gear.** Some authorities have created positive incentives through reward schemes for disposal of old, retrieved or unwanted gear in reception facilities at port. The authority would purchase waste fishing gear returned to port by fishers, which can be highly effective in terms of disposal and recovery of gear but may be costly to authorities. Unless a specific cost recovery mechanism is adopted (such as a fee included in overall port fees paid by all port users), the cost of this measure would not normally be supported by the fishing sector and the polluter-pays principle would not apply.

**Reduced fishing effort, soak time, vessel numbers.** It can be expected that an overall reduction of the fishing effort would lead to a reduced amount of ALDFG. Measures to reduce the fishing effort could be limiting fishing time and the time gear spends in the water (soak time), or the amount of gear per vessel, the number of vessels, etc. However, it is unlikely that ALDFG would be a primary driver for applying measures to reduce the fishing effort. It would rather be a subsidiary impact.

**Spatial management.** Zoning schemes of active and passive fishing, in fishing zones and in areas of high marine traffic can help to reduce conflicts by actively segregating marine users or by better ensuring that marine users are informed about the likely presence of fishing gear in the waters. Such measures reduce the likelihood that gear is damaged or moved and the navigational hazard of fishing gear.

**Awareness raising.** Awareness raising activities on problems linked to ALDFG will lead fishermen to take better informed decisions and can thus potentially reduce the amount of ALDFG in the Sea. Awareness raising can also support the development and implementation of other ALDFG linked measures. Information campaigns can take place on all levels (local, national, regional) and target fishermen, but also port operators, other marine users or the general public.

## CURATIVE MEASURES

Curative measures are measures taken to clean up marine litter ex-post.

Generally, fishers would make every possible attempt to locate and recover their own gear as it normally has a significant economic value. They would however compare the needed effort with time and fuel costs necessary to do so and sometimes will decide not to or just not be able to locate or recover the gear.

**Locating lost gear.** The first necessary step in cleaning up ALDFG is to locate the gear. This can be done through active or passive efforts:

- Clear reporting schemes, encouraging different sea users to report lost or located gear/objects
- Land-based surveys (normally done by volunteers)
- Sea-based surveys (often very costly):
  - Remote sensing
  - Video sensing
  - Side scan sonar (sea-bed mapping)
  - Regular retrieval patrols
- In general, it is most efficient to target a survey area or hotspot prior to conducting detailed and costly surveys. This can be done via modeling techniques, local knowledge or anecdotal information.

Once ALDFG is located, Sea users can be informed about its location to avoid for example navigational hazards linked to the gear, or/and the ALDFG can be retrieved. Prior to retrieval, it should be investigated if the removal does not cause more harm to the environment than simply leaving the object where it is. In fact, sometimes, ALDFG have become an artificial habitat and an integral part of the local ecosystem and its removal would cause more harm than benefit.

#### **Box 4 : Derelict fishing gear removal in Puget Sound, Washington (USA)**

From 2004 to 2007, the Northwest Straits Initiative in Puget Sound, Washington (USA) surveyed and removed derelict fishing gear while also estimating the costs and directly measurable benefits of the gear's removal. The programme estimated that each m<sup>2</sup> of net surveyed and removed cost US\$1.23. Surveying and removing derelict pots and traps cost US\$193 each.

The benefits of derelict pots and traps removal were determined by estimating the commercial value of the crabs and other species that were saved from mortality over a one-year period, totalling US\$248/pot or trap. For derelict nets, the commercial value of fish and other species were estimated for a ten-year period, totalling US\$6,285/net. The cost-benefit ratios were positive, measuring 1:1.28 for pots / traps and 1:1.27 for derelict nets. Researchers acknowledged that, given the expected long-term lifespan of these mainly synthetic-based derelict gears, negative impacts may continue for many years or decades beyond the 10-year period used in this cost-benefit analysis.

Monetary values were not assigned to the many indirect benefits that occurred due to the derelict gear removal including: human safety, impediments to vessel navigation, habitat restoration, reduction in mortality of non-commercial and protected or endangered species, and pollution removal. If the monetary value of these benefits were calibrated, the cost-benefit ratios would be more positive. Researchers point out that the cumulative costs of not removing derelict gear will likely increase in the future.

Source: <http://nwstraitsfoundation.org/>, consulted August 16th, 2016

**Active retrieval of ALDFG.** If ALDFG is located and the decision for active retrieval is made, different options are available: retrieval with creepers or grapnels to snag nets or scuba divers to manually remove the gear. Remotely operated vehicles (ROV) can also be an option to remove ALDFG. Active retrieval campaigns can be very costly, because they require specific activities, human resources and use of expensive equipment. Therefore, prior to launching an active retrieval campaign, it should be investigated if the costs linked to the planned activities are reasonable in comparison with the benefits they can provide. For example, where the density of ALDFG is low and/or when the exact location of the waste is unknown, costs for retrieving ALDFG can be disproportionate.

## **MITIGATION MEASURES**

**Reducing efficiency of ghost nets, for example biodegradable materials.** The longevity of ALDFG in the Sea depends largely on the materials used to produce it. In this sense, work is underway to speed up commercial adoption of durable gear that incorporate bio-degradable elements, such as cotton or other biodegradable rope for example. Furthermore, some countries prescribe the use of fish traps and pots constructed with biodegradable escape mechanisms which disintegrate when left under water too long thus preventing the trap from continuing to fish. Such technological modifications of gear are likely to be easier and at this stage cheaper for traps and pots than for nets.

**Reduced ghost catches of incidental catch species.** The idea behind this measure is that ALDFG can have bycatch rates of non-targeted species (cetaceans, turtles, seabirds) that are similar to active fishing gear. Measures that reduce bycatch in active fishing are thus also likely to reduce ghost fishing of bycatch. For example, acoustic beacons (pingers) and reflectors in nets, can be interesting options but their effectiveness can rapidly decrease once discarded or lost (pingers running out of power). Therefore, bycatch reduction measures should be designed in a way to remain effective even if the gear is no longer being fished actively. For example, the use of barium sulfate to reflect sound in nylon nets is currently being investigated and "weak" ropes that are operationally sound, but break when encountering marine mammals can also be used (UNEP, 2009).

## 4.4.5 Cost assessment

### 4.4.5.1 Costs for the regulator

In the Barcelona Convention Decision IG.22/10, Implementing the Marine Litter Regional Plan in the Mediterranean (Fishing for Litter Guidelines, Assessment Report, Baselines Values, and Reduction Targets), Annex I, Appendix 4 (UNEP, 2016) indicates that 10 fishing for litter projects implemented in different regional Seas in the period 2000- 2015 come with mid-scale costs per ton of collected litter in the range of 800 to 5,200 euros. Given the large variation in the available data on costs of already implemented projects, these figures should only be used as indicative. A sound approach in designing a new Fishing for Litter initiative would be to do rough project-specific cost estimation considering primarily the price of waste removal and treatment per ton of marine litter. Staff time for project management and costs of necessary bags and possibly containers/ port infrastructure (if non-existent) should also be included.

According to Decision IG.22/10 (UNEP, 2016), total costs of fishing for litter schemes largely depend on the following:

- Scope of the scheme (How many participating vessels/ fishermen/ ports?)
- cost recovery mechanism of treatment and final disposal costs of collected litter (e.g. does the initiative pay to waste companies for this service or is it provided as a contribution of participating entities – local governments, port authorities or others?)
- State of port infrastructure (Reception facilities available free of charge and accessible at times suitable for fishermen?);
- Staff time needed to prepare and implement the project.

#### Box 5 : A fishing for litter initiative in Scotland

Costs of fishing for litter activities are relatively well documented for an initiative led by Kimo International, covering the Scottish coastline. In Scotland, during the period 2008-2011, more than 240 tons of waste have been collected via this regional fishing for litter initiative costing £196 105 (around €229,000<sup>15</sup>). During the period 2011-2014, another 374 tons of marine litter have been collected in the same area for a cost of £263,732 (around €316,000<sup>16</sup>), involving 14 harbours and 210 trawler boats. This brings cost efficiency to just above £800/ton (around €930/ton) for the 2008-2011 period and just above £700/ton (around €830/ton) for the 2011-2014 period. The difference in cost-efficiency between the two periods can be explained by a learning curve effect and a reduced need during the second period for informing participating fishers having already participated in the first period.

More detailed cost-related data is available for the currently ongoing third phase of the Scottish project as shows the table below. It should be noted that the costliest item of the initiative is linked to skip rental and waste disposal costs, and a significant proportion of this item is due to “landfill tax” that needs to be paid in Scotland for waste taken ashore and brought to a landfill. It would be worthwhile for new fishing for litter initiatives to consider ways to exempt waste stemming from fishing for litter initiatives from such a “landfill tax”.

<sup>15</sup> Converted with www.oanda.com rate of December 31, 2010, then rounded)

<sup>16</sup> Converted with www.oanda.com rate of December 31, 2013, then rounded)

Table 4 : Cost structure of the 2014-2017 Scotland Fishing for Litter initiative, in £

Item	2014-2015	2015-2016	2016-2017	Total £
Project coordinator salary	22 455	23 130	23 825	69 410
Estimated NI and pension contributions	4 120	4 260	4 380	12 760
Skip rental and waste disposal costs	40 000	43 000	46 000	129 000
Bags	8 000		2 000	10 000
Admin	8 500	8 500	8 500	25 500
Advertising& Education	3 000	2 500	2 500	8 000
Campaign PR	1 620	1 680	1 735	5 035
Website	1 725	50	50	1 825
Travel and subsistence	5 000	5 000	5 000	15 000
Audit	1 500	1 500	1 500	4 500
Insurance	800	800	800	2 400
Subscriptions	150	150	150	450
Stationary	1 000	500	500	2 000
Telephone	700	700	700	2 100
Freight	1 400	900	900	3 200
Bank charges	100	100	100	300
Final report	-	-	1 000	1 000
Management Fee	3 000	3 000	3 000	9 000
<b>TOTAL</b>	<b>103 070</b>	<b>95 770</b>	<b>102 640</b>	<b>301 480</b>

Source: [www.kimointernational.org](http://www.kimointernational.org)

In a first approach, it can be assumed that cost structures of fishing for litter initiatives in the Mediterranean would follow a similar cost structure with necessary adjustments to national and local average salaries and waste disposal costs. Notwithstanding the variability of average salaries in the Mediterranean, and based on fishing for litter initiatives designed in a way that is similar to the Scottish initiative in terms of scale, the cost of fishing for litter initiatives for the regulator can be estimated at around €900/ton of litter retrieved.

#### 4.4.5.2 Compliance costs for the regulated

In the case of fishing for litter initiatives, regulated actors are fishers on one hand and harbours (and harbour staff) on the other hand. Under the Scottish initiative, fishers and harbour staff volunteer their time and they are not paid for their participation in the initiative. This does however not mean that there is no cost for the regulated.

- The cost for fishers is linked to the effort and time required to bag the waste and bring it to waste reception facilities at the harbour. Assuming that only fishing boats with sufficient space for transporting the fished waste would participate in a fishing for litter initiative, and assuming that additional fuel consumption to transport the additional weight linked to the fished waste is not significant, transport costs of fished waste is considered as non-significant. The “fishing” of litter itself does not require any additional effort because the initiative targets waste being fished as part of normal fishing operations. The detaching of waste off the nets does also not imply any specific effort, as fishers would do it anyways.
- The cost for harbour staff is linked to the handling of the fished litter once brought by the fishers to the waste reception facility. Literature review did not reveal any estimate of the effort that represents the waste handling of fished litter at harbours and it has thus not been possible to quantify it. The handling effort, if significant, is likely to be recovered by harbour via the general harbour fees.

In the Mediterranean, the fishing sector employs around 230 000 fishers (Plan Bleu, 2014), and many of them could potentially participate in fishing for litter activities.

#### 4.4.5.3 Funding

There is a wide range of experiences as to funding possibilities for fishing for litter schemes. Port authorities, national governments (in particular marine management/ protection authorities), local and regional authorities, appear to be the most frequent funders. Furthermore, costs of such schemes are often covered through various partnerships and projects involving waste disposal companies, private sector as well as NGOs and specialised public funds (UNEP, 2016).

The Scottish fishing for litter initiative, for example, is funded over three-year periods and by around 15 financing partners from the private and public sectors, including port authorities, offshore energy companies including wind parks, fishermen trust, government institutions, etc. It should be noted that the funding of the initiative is neither permanent nor institutionalized.

Other funding models for fishing for litter initiatives could however be envisaged. For example, a no-special-fee system (see above) including the cost of fishing for litter in the overall harbor dues paid by all harbor users could be a solution. Additionally, it could be worthwhile to consider to exempt fished waste from landfill taxes, which would contribute to significantly reduce the cost of fishing for litter initiatives.

### 4.4.6 Cost-benefit analysis

#### 4.4.6.1 Assessment of additional economic and social impacts

Other than the economic impacts assessed above, fishing for litter initiatives can generate permanent employment in the overall management of the initiative, as it is the case for the Scottish measure. However, this employment impact remains very small, but positive. More indirectly, as shown in Table 4, fishing for litter can create revenue mainly in the waste management sector (skip rental, transport), in the advertising and PR sector and in the large plastic bag industry (manufacturing of large bags to accommodate the fished waste).

Furthermore, the output of fishing for litter initiatives, the fished waste, can either be disposed of or (parts of it) can be reused, recycled or generate energy through combustion. The primary aim of fishing for litter initiatives is to remove marine litter from the Sea and coast and the reuse, recycling or combustion of the waste can be a revenue-generating flanking measure.

#### 4.4.6.2 Impacts resulting from the improvement of the marine and coastal environment

Fishing for litter initiatives can reduce the amount of overall marine litter. The extent of the “cleaning power” of fishing for litter programmes is however unknown and likely to vary largely according to local conditions and fishermen participation. Fishing for litter is selective in the recovery of waste, as small items are unlikely to be fished and only larger items with certain characteristics can be effectively fished during normal fishing operations. For example, fishing for litter would neither retrieve microplastics nor large containers that fell off ships (the latter being possibly located during fishing for litter programmes). However, fishing for litter will indirectly impact three main economic sectors: the fishing and aquaculture industry, tourism and maritime transport.

Research undertaken so far aiming at estimating the socio-economic impacts of marine litter has generally focused on the qualitative description of direct losses borne by economic sectors. While only few and rather anecdotal quantitative information is available, relevant observations and conclusions can still be drawn.

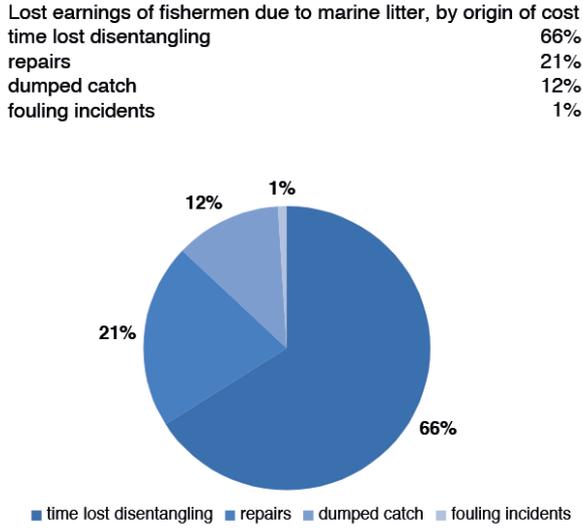
**Fishing and aquaculture.** There is a twofold impact of marine litter on the fishing sector, due on one hand to the damage and immobility of fishing gear and boats and on the other hand to the reduction of potential catches caused by marine litter. As fishing for litter programmes target both the cleaning up of waste present in the Sea and awareness raising of fishers leading to less dumping of waste by the fishing sector, fishing for litter can reduce

the amount of marine litter and hence the impacts caused by it.

- Damage and immobility of fishing gear and boats.** Data on the cost linked to damage and lost fishing time due to immobility of fishing gear and vessels is not systematically collected and can only be estimated. In Scotland, Mouat et al. (2010) calculate a cost of €17,000 to €19,000/fishing boat and year due to marine litter, making up for around 5% of revenues. *Figure 1* below shows that lost earnings due to the time dedicated to clearing litter from nets would make up for 66% of the economic impact of marine litter (calculated using the average value of 1 hour’s fishing time as estimated by vessels surveyed), the cost of repairs to fishing gear and nets for 21%, the value of dumped catch for 12% and the cost of fouling incidents for 1%.
- Reduction and contamination of potential catches.** Marine litter can have a significant impact on fish stocks due to entanglement in floating plastics or in derelict fishing gear (ghost fishing), ingestion and exposure to toxic materials (Watkins et al., 2015). Quantification of such impacts is difficult and likely to vary largely depending on local conditions and species.
- Aquaculture impact.** In the aquaculture sector, it is expected that fishing for litter will reduce the economic impact of marine litter, which has been estimated in a Scottish survey by Mouat et al. (2010) to represent around €580/operator and year. *Figure 2* indicates the cost structure of marine litter to aquaculture in this survey, with 56% of costs linked to the need to clean propellers, 35% for repair or replacement of damaged propellers and 9% for removing litter from cages and mussel lines.

In the Mediterranean, the fishing sector generates an annual direct turnover of around €3.2 billion, reaching €9.7 billion if the indirect economic impact is taken into account and a gross value added of around €2.2 billion (Plan Bleu, 2014). Fishing for litter initiatives could contribute to sustaining this economic and social importance in the Mediterranean.

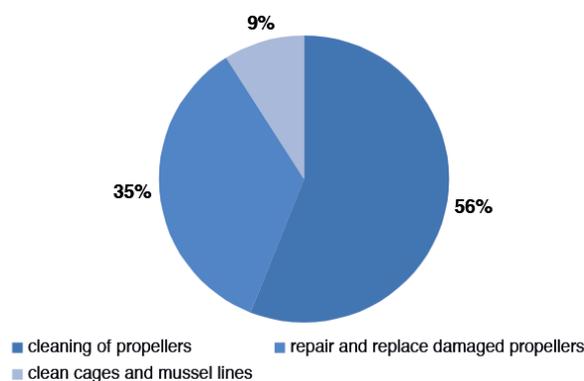
Figure 1 : Economic impact of marine litter to fishermen due to marine litter, by origin of cost (example from questionnaire to Scottish fishermen by Mouat et al., 2010)



Source: Adapted from Mouat et al. (2010).

Figure 2 : Economic impact of marine litter to aquaculture, by origin of cost (example from questionnaire to Scottish aquaculture industry by Mouat et al., 2010)

Lost earnings in aquaculture due to marine litter, by origin of cost	
cleaning of propellers	56%
repair and replace damaged propellers	35%
clean cages and mussel lines	9%



Source: Adapted from Mouat et al. (2010).

**Tourism.** Marine litter can have multiple socio-economic impacts on tourism, all of which could be reduced via fishing for litter programmes. There is a prevailing difficulty to provide a general estimate of socio-economic impacts of marine litter in tourism because available data shows very variable results which depend on many locally specific variables. However, it can be expected that the most significant impact is of aesthetic origin, as the visible presence of marine litter may represent a reason not to visit a certain marine or coastal area. A reduced numbers of visitors leads to lost revenues for the tourism sector which in turn can lead to a loss of jobs in the local economy. This can potentially be catastrophic in the Mediterranean, one of the biggest tourist regions in the world, where coastal tourism makes up for a significant proportion of value added and employment of the region with a turnover of around €250 billion and more than €8 million jobs (Plan Bleu, 2014). More than for aesthetic reasons, tourists are also more likely to visit clean coastal and marine areas for health reasons. Recreational activities, such as diving or pleasure boating, which represent significant local revenues in some places, are also impacted by marine litter. To state an example, marine debris is estimated to cost the tourism sector in the APEC region US\$622 million (McIlgorm, 2009). It should nevertheless be noted that fishing for litter does not involve any beach cleaning initiatives and that the measure only acts on waste at Sea that can be washed ashore.

**Maritime transport.** The shipping sector is impacted upon by bearing risks related to collisions with floating waste and interference with equipment, such as propeller damage, entangled anchors or blocked intakes. These risks can lead to rescue costs to aid vessels with fouled propellers or blocked intakes and high immobility costs for entangled vessels or vessels that have been victim of collision. As an example for rescue costs only, an estimate for the UK calculated that 286 rescue operations to vessels with entangled propellers cost between €0.8 million and €2.2 million (Mouat et al. 2010). Fishing for litter would avoid part of these costs through retrieving and locating waste at Sea and along the coastline and ports.

#### 4.4.6.3 Assessment of the improvement of the marine and coastal environment

Similar to the plastic bag tax studied above and by reducing overall marine litter, fishing for litter programmes can contribute to restoring ecosystem state and functions impacted by marine litter.

- Impacts on marine species:
  - ingestion
  - entanglement
  - toxicity
  - the spread of invasive alien species (IAS) travelling via marine litter<sup>17</sup>

• Alterations in ecosystem services:

- Provisioning service: Impacted by death, illness, intoxication and injury of fish, shellfish and turtles caused by marine litter. However, as yet there have been no economic assessments to estimate the costs of these impacts (Newman S. et al. 2015).
- Cultural services: Fishing for litter programmes in the Mediterranean rim countries are expected to have a significant positive impact on cultural services provided by marine and coastal ecosystems, namely aesthetic and recreational services and non-use value (Cheshire et al. 2009) linked to quality of life. Few studies to date have investigated these issues and establishing exactly how and at what level marine litter starts to have an appreciable social impact therefore requires more research (Cheshire et al. 2009).

#### 4.4.7 Summary of costs and benefits

The table below summarizes cost and benefits arising from fishing for litter programmes, noting that benefits are generated via the “double-dividend” of fishing for litter initiatives which reduce marine litter in two ways, namely (i) by retrieving litter already present in the ecosystem, and (ii) by avoiding the abandonment of additional waste from the fishing sector via awareness raising.

The table below shows that benefits of fishing for litter initiatives are likely to outweigh costs. This has also been estimated by the OSPAR Commission which states in an assessment that ‘financial costs of running the scheme are not onerous compared to benefits it brings’.

Table 5 : Costs and benefits of fishing for litter initiatives

Item	Costs	Benefits	Impact (+/- / 0)
Direct economic impact	For the regulator (coordination of the initiative, advertising and PR, waste transport etc.): ~ €900/ton of waste retrieved Participating fishers: Time and effort required to bag waste and bring it to waste reception facility Harbors: Time and effort to locally receive and handle fished waste (possibly recovered via harbor fees)	Revenue generated in the waste management sector (skip rental, transport), in the advertising and PR sector and in the large plastic bag industry (manufacturing of large bags to accommodate the fished waste) Possibility to reuse/recycle waste or to incinerate for energy.	-
Employment		Small non-significant potential for job creation for coordination of initiatives	0
Indirect economic impact		Fishing sector: Unknown earnings linked to (i) reduced damage and immobility of equipment and boats, (ii) increased availability and health of fish stocks Tourism: Unknown earnings linked to higher attractiveness of cleaner Sea and coastline Maritime transport: Avoided rescue and immobility cost due to entanglement/collision/interference with waste	+
Ecosystem services		Provisioning services: Reduced death, illness, intoxication and injury of fish, shellfish and turtles caused by marine litter Cultural services: aesthetic and recreational services and non-use value increased	+
TOTAL			+

<sup>15</sup> Based on current information, marine litter is also considered a potential key vector for IAS in the Mediterranean, with 13 established aliens in the Mediterranean known to be able to colonize floating litter and more than 80% of known alien species in the area capable of using litter for further expanding their range (CIESM 2014).

#### 4.4.8 Regional relevance of the measure

Fishing for litter programmes target marine litter, which is a regional issue with litter being able to travel long transboundary distances. Fishermen are the main actors of such programmes and they depend on fish stocks which are often shared between Mediterranean rim countries.

If fishing for litter programmes are implemented in several fishing harbors across countries, a regional coordination can possibly lead to economies of scale in terms of (i) procurement costs of large bags needed to transport the waste, (ii) advertising and PR costs (iii) management costs of the initiative and (iv) exchange of best practices.

However, it has to be noted that fishing for litter initiatives still need to be adapted to the local contexts and interactivity with local fishermen remains key to ensure effectiveness of the measure.

#### 4.4.9 Discussion

**A cost-effective curative measure.** Fishing for litter initiatives are a curative measure to reducing marine litter. Cost-effectiveness can be expected to be similar to fishing for litter initiatives conducted elsewhere (in Scotland approximately €900/ton of waste fished). In general, curative measures tend to be less cost-effective than preventative measures. However, fishing for litter has the advantage of piggy-backing on normal fishing operations, thus requiring only a small additional effort from fishermen. Also, fishing for litter comes with a preventative component of awareness raising amongst fishermen, which is non-negligible. Considering this, fishing for litter is likely to be one of the most cost-effective curative measures against marine litter and possibly even more cost-effective than some preventative or mitigation measures. Due to the relatively low number of actors involved and few trade-offs, fishing for litter can be a measure of choice to combat marine litter.

**A general data gap.** There is a general data gap on socio-economic aspects of the proportion of marine litter that could be reduced by fishing for litter. To date, it cannot be mathematically proven that fishing for litter programmes have a positive net present value, but qualitative analysis conducted under this study suggests that benefits outweigh the costs.

**Application of polluter pays principle.** Measures to achieve the good environmental status tend to be most successful if the polluter pays principle is applied. In the case of fishing for litter, as litter from multiple origins can be fished (ALDFG, but also all other types of solid waste such as domestic or industrial), the number of polluters is very high and it is almost impossible to identify all Sea and land-based polluters. The fishing sector is one of the polluters paying their part of the overall cost of fishing for litter measures via the effort made to retrieve, bag and bring to port the waste they fish. Costs incurred by harbours, if significant, are likely to be retrieved via general harbour fees paid by all harbour users who are also potential polluters. The remaining costs (coordination, management, advertising and PR, waste management costs) need to be covered through other sources of funding but the lack of knowledge about the actual polluters makes it impossible to completely apply the polluter pays principle.

#### 4.4.10 Recommendations

**Ensure personal contact with fishermen.** The DeFishGear project as well as the Scottish fishing for litter initiative have illustrated that personal contact with boat skippers and crews was essential to firstly promote the benefits of the programme to individuals in the industry and secondly to get their commitment to participate.

**Involve the media.** Fishing for litter programmes are likely to attract publicity via different media. In Scotland the Fishing for Litter brand proved to communicate well, especially amongst fishers. This does not only encourage the fishing sector to participate but also highlights the marine litter issue to the general public.

**Valorise the fished waste.** Identifying a recycling route for the fished waste, or increased incineration for energy can valorise the fished waste and generate additional revenue.

**Locating non-fished waste.** In some cases, fishermen notice the presence of waste at Sea that they are not able

or willing to retrieve. In this case, a fishing for litter initiative should provide for a reporting mechanism through which fishers can inform the responsible authorities about the location and type of waste observed, so that it can be retrieved by other means or marked if representing a navigational hazard.

**Getting the mix of prevention, mitigation and clean up measures right.** To effectively combat all marine litter, curative measures such as fishing for litter will relatively quickly come to a point when marginal costs of litter reduction will exceed marginal benefits. This is where cleaning up the litter does not make sense anymore economically and should be stopped. Getting to this point can still allow to significantly reduce marine litter present in fishing areas, but should be supported by often more cost-effective preventative and mitigation measures which will prevent more litter to accumulate in the first place and reduce its impact. Decision makers should thus mix different types of measures to combat marine litter.

## 4.5 EXTENSION OF THE CURRENT SURFACE OF MARINE PROTECTED AREAS (MPA)

Measure: Extension of the surface of marine protected areas (MPA)

Type of measure: Command-and-control/zoning and spatial control/management measure

Driver: Fisheries, tourism and recreation, maritime traffic

Pressure: Selective species extraction, different kinds of pollution

Impact: Biological disturbance

GES Descriptors: Biodiversity, commercially exploited species, marine food webs, Sea floor integrity

### 4.5.1 Description of the measure

The establishment of Marine Protected Areas (MPAs) is a measure aiming to provide long-term protection, enabling restoration and the careful use of coastal and marine areas. MPAs regulate the different uses of coastal and marine ecosystems and can target multiple objectives such as biodiversity conservation, resource conservation (mainly fisheries), fostering sustainable tourism and creating new job-generating activities. Currently, almost 114 600 km<sup>2</sup> of the Mediterranean are covered by MPAs, making up for about 4,56% of its surface. Less than 0,1% of the Mediterranean surface is covered by a no-take zone (Gabrié et al., 2012).

The measure examined under this study is the extension of the MPA surface coverage in the Mediterranean from the current 4,56%, to 10% (Aichi target for 2020) and respectively 30% (recommendation from World Parks Congress hosted by IUCN in 2014).

Furthermore, with regards to the MSFD, Art. 13.4 states that “programmes of measures established pursuant to this Article shall include spatial protection measures, contributing to coherent and representative networks of marine protected areas [...] as agreed by the Community or Member States concerned in the framework of international or regional agreements to which they are parties.”

### 4.5.2 Theoretical effectiveness

In the context of MPAs, effectiveness is the degree to which management actions are achieving the goals and objectives of the protected area. As different MPAs have different and multiple objectives with or without specific targets and indicators against which effectiveness could be gauged, MPA effectiveness cannot be uniquely described.

In the Mediterranean, in a study led by MedPan in 2012, more than half (56%) of 80 surveyed MPAs do not have a management plan. Practically, without a management plan and clear objectives, MPA effectiveness cannot be assessed (Gabrié et al., 2012). Having said this, 22% of these MPAs reported being in the process of developing their management plan and an improvement in the ability to assess MPA effectiveness can thus be expected in the near future.

In the same study, and concerning the objectives of MPAs, the conservation of biodiversity (91% of MPAs), of key habitats (49%) and key species (26%) remain the main objectives for all MPAs in the study. 45% of the sampled MPAs also indicated that fisheries management is one of their top four priorities.

There is today a general consensus about the effectiveness of well-managed MPAs with no-take areas as a tool for fisheries management (Guidetti et al., 2014), especially for sedentary species which can gain good protection from spatial protection measures (Roberts et al., 2010). Fisheries management can have multiple objectives (Rodriguez-Rodriguez, 2016):

- limiting or eliminating fishing mortality by human capture
- protecting specific life phases of protected species
- boosting the replenishment of surrounding areas through the spillover effect of fish or larvae migrating across MPA boundaries (see Box 6)
- serving as a source and/or sink for fish eggs and larvae to improve recruitment
- protecting habitat, food web integrity and biodiversity
- reducing bycatch and discards
- reducing competition between user groups
- building resilience of fish stocks

The effects of MPAs on fish stocks within and outside of no-take zones have also been studied by Gell et al. (see Gell et al., 2003). Supported by several international case studies, including some examples in the Mediterranean, they found that “reserves promote large, rapid and sustained build-up of biomass of commercially important species within their boundaries”, that “dramatic increases in body size have also been reported inside reserves” and that “increases in animal abundance and size in marine reserves translate into increased reproductive potential”. The paper also highlights that these effects are especially high for relatively sedentary species who spend much of their lives in the reserve but that more mobile animals also benefit significantly from no-take zones. In fact, for some rather mobile species, part of the population might show high levels of site fidelity, whilst the other part would undertake significant movements. The proportion of the population that remains in a relatively small area may ensure a high reproductive capacity within the no-take zone while the more mobile individuals could export the benefits beyond the MPA. Even for species with extensive mobility, such as tuna, which may require unfeasibly large MPAs to be completely protected, MPAs can provide protection at vulnerable stages and seasons, such as nursery grounds, spawning sites or aggregation sites (Roberts et al., 2010). Generally, biodiversity and ecosystem quality and resilience will grow as the size of and legal restrictions in the reserve increase, with big no-take MPAs achieving greater ecological benefits in terms of biomass production than small, multiple-use MPAs (Roberts et al., 2010).

Even though effectiveness of MPAs regarding other objectives than fisheries management has not been empirically proven in a way that applies for several different MPAs, MPA objectives can be the promotion of non-extractive recreational activities and eco-tourism, awareness raising and education, the preservation of historic heritage (shipwrecks, archaeological sites...) or the preservation of cultural heritage (protecting traditional activities and lifestyle of local maritime communities). While biodiversity conservation is a goal commonly shared along all MPAs, Gabrié et al. note that, in the Mediterranean, sustainable management objectives linked to the issues on sustainable tourism and fishing are more often targets set by MPAs in the northern basin whilst objectives targeting education and awareness raising are more frequently cited for MPAs in the South.

However, effectiveness of MPAs, even if they are well-managed, well-designed and adequately funded, can still be null if impacted by major events outside the scope of the MPA, such as oil spills or the expansion of alien invasive species over hundreds of kilometres which can take place irrespectively of MPA boundaries (Rodriguez-Rodriguez, 2016).

### 4.5.3 Prerequisites for a successful implementation and practical effectiveness

The creation or extension of MPAs entails a change of behaviour of stakeholders in the concerned area. The extent to which behaviour must be changed depends on the MPAs design and the restrictions it imposes on human uses. However, in most cases, it is likely that fishers are the most concerned by the extension or creation of an MPA, needing to restrict and/or modify their fishing habits. Furthermore, shipping operators might need to modify their shipping routes. Certain tourism activities such as charter fishing, may be restricted or forbidden in the MPA area and may need to relocate or adapt their practices.

In this context, the success and the degree of enforcement of an MPA depends to a large extent on the support of marine users and communities and their attitudes towards the equity of the MPA's rules. These in turn can be influenced by education and awareness raising activities. Therefore, communicating about the importance of the ecosystem for humans, its status, main threats and mitigation actions plays an important role for the effectiveness of an MPA (Cuttelod et al., 2008).

In order to provide accurate information on which MPA managers base their decisions, a solid evidence base is required. Hence, monitoring and research will increase effectiveness of MPAs and, providing a baseline against which progress can be assessed, allow for effectiveness assessment.

Finally, in order for an MPA to be able to work effectively, political will and appropriate funding, also covering surveillance and enforcement, are crucial (Rodríguez-Rodríguez et al., 2015).

### 4.5.4 Alternative measures potentially leading to the same effect

When looking at alternative measure to creating or extending MPAs in the Mediterranean, the main objective pursued by the MPA has to be clearly identified.

If conservation is the MPAs objective, suitable alternatives are very scarce if not non-existing. A last-resort option for preserving marine species can be gene banks and in rare cases aquariums which can avoid the total extinction of some species, but such measures do not preserve the role a species plays in its overall ecosystem and thus cannot preserve the overall equilibrium of an ecosystem.

If management of fisheries is the objective, common alternative measures to the creation of an MPA with a no-take zone have been listed by Rodríguez-Rodríguez (Rodríguez-Rodríguez, 2016):

- catch limits/ regulation of total allowable catch
- fishing effort limits (limited number of boats or gear or type of gear, restrictions on number of trips, etc.)
- restrictions on the size of fish that can be caught
- access controls (licenses)
- allocation of shares in a fishery in terms of catch, effort, or space, such as Territorial Use Rights in Fisheries (TURFs) which could be considered a type of MPA in certain cases
- time-area-gear type closures, which can be a form of MPAs (dependent on permanence, aims and other restrictions).

### 4.5.5 Cost assessment

#### 4.5.5.1 Costs for the regulator

Costs for the regulator consist of one-off establishment costs and operational/ management costs. Literature review did not reveal quantified information on one-off establishment costs, but it can be expected that these costs include (i) acquisition costs if part of the new or extended MPA is privately owned (though this is rarely the case for marine areas), (ii) transaction costs associated with negotiating modalities and level of protection, including time and staff involved in stakeholder negotiations, and (iii) education and outreach costs to inform users of new zoning schemes and requirements.

Data availability on the operational/ management costs of MPAs is generally much higher, but still far from being complete.

In the Mediterranean, the 2012 Status of MPAs in the Mediterranean Sea provided some information on running costs of MPAs, but it has to be noted that only very few of the surveyed MPAs provided this type of information (Gabrié et al., 2012). Of those who responded, budgets differ vastly with 7 MPAs whose operating budget is between 20 000 and €100,000/ km<sup>2</sup>, 8 between €10,000 and €20,000/km<sup>2</sup>, and 15 MPAs between €1 and €10,000/km<sup>2</sup> (Gabrié et al., 2012).

Balmford et al. studied running costs of MPAs on the global scale. Recurrent annual expenditure on the MPAs sampled, expressed per km<sup>2</sup>, varied widely and ranged from zero to US\$28 million/km<sup>2</sup> and year (in year 2000 dollars), (Balmford et al., 2004). A regression model applied to the data found that only three variables could predict almost all of the variation in total MPA running costs (Balmford et al., 2004). Almost 80% of the variability could be explained by the size of the MPA. In fact, running costs per km<sup>2</sup> are lower in bigger MPAs, achieving significant economies of scale. The study furthermore found that adding the parameters distance from inhabited land (running costs are decreasing with increasing isolation of the MPA) and purchasing power parity (MPA running costs increase with increasing purchasing power parity), independently of MPA size, significantly improved the model and together, provided a representative proxy for MPA running costs.

Similarly, Ban et al. studied the operating costs of marine protected areas of the Commonwealth (Ban et al., 2009). Management costs ranged from AUS\$ 0.97/km<sup>2</sup> to AUS\$ 32,877 /km<sup>2</sup> and year. The following drivers/ predictors of MPA operating costs identified under this study were:

- Area of the MPA (surface): The bigger the surface of an MPA, the lower its management costs
- Number of years since establishment: The older the MPA, the lower the management cost
- Percentage of area designated as a special purpose area (for example restrictions on fishing gear or a recreational zone): The higher the percentage, the higher the management costs
- Number of zones within an MPA: More zones come with higher management costs
- IUCN protection level: Higher protection level comes with lower costs

Due to a lack of data, it has not been possible under this study to deduct similar cost functions for MPAs in the Mediterranean Sea at this stage. Future surveys of MPAs in the Mediterranean may be able to produce the data needed to fill in the blanks to build a cost function. Building on the experience of Ban et al. and Balmford et al., it is recommended to collect data on the following parameters: operational/ management costs per year, surface of the MPA, age of the MPA, IUCN level of protection, number of zones within the MPA, presence and area of special purpose areas within the MPA, distance from inhabited land and purchasing power parity of the country in which the MPA is located. The presence of islands may also be a driver of management costs, as they potentially increase management costs (invasive species management, increased monitoring for seabirds and turtle nesting, enhanced visitor management, fire management). Furthermore, when collecting this data, it is recommended to also survey employment in MPA management and enforcement. Some of these parameters have been surveyed by Gabrié et al. in the status report on MPAs in the Mediterranean (Gabrié et al., 2012): IUCN categories of protection, age and surface area.

However, an order of magnitude of costs linked to different levels of MPA coverage in the Mediterranean area can be deducted from the model developed by Balmford et al. The results of the global model application show that, although overall running costs of an MPA network increase with coverage, economies of scale mean that MPA mergers can achieve considerable cost savings (Balmford et al., 2004). One of the models used by Balmford et al. modelizes an increase in MPA coverage through randomly positioning additional km<sup>2</sup> of MPAs and allowing them to merge with neighbouring MPA km<sup>2</sup>, then achieving economies of scale and reducing marginal management costs per km<sup>2</sup>. This model is based on a rather conservative approach, because, in reality, decision makers are likely to position new km<sup>2</sup> of MPA not randomly but in a way that favours mergers of MPAs and extensions of existing ones. Be that as it may, application of this model to a global extension of MPAs to a coverage of 10% and 30% estimates global annual MPA running costs at just above US\$5 billion and US\$14 billion respectively (in year 2000 US\$).

The Mediterranean Sea represents less than 0,8% of the global marine surface (Plan Bleu, 2005). Based on the hypotheses that average purchasing power parity, MPA size and distance to inhabited land are similar in the Mediterranean Sea and globally (these three variables being the main factors of variance of management cost in the Balmford et al. study), the cost of the different MPA coverages can be extrapolated from the global estimate to a Mediterranean estimate. For a 10% coverage, estimated running costs, converted into year 2016 US\$<sup>18</sup>, are thus around US\$55 million (€48.5 million) for a 10% MPA coverage and US\$155 million (€136.8 million) for a 30% MPA coverage in the Mediterranean in a conservative scenario where economies of scale and learning curve of MPA management are low. These cost estimates are not incremental and include management costs of already existing MPAs.

#### 4.5.5.2 Compliance costs for the regulated

The regulated actors who are supporting direct costs are mainly professional fishers, but also recreational fishers and the maritime transport sector.

##### **PROFESSIONAL FISHERS**

The main cost of MPAs to fishers is stemming from the prohibition of fishing in the no-take part of the MPA which reduces catch, *ceteris paribus*, in the short term. The economic importance of this drawback varies according to the degree of dependency of fishers on the no-take zone (Alban et al., 2008). Additionally, fishers are likely to increase their operational costs because they may need to travel to fishing grounds located further away in order to maintain their level of catches. Furthermore, fishing in unfamiliar places will increase the time fishers require to look for fish, which in turn results in less time available for catching fish. Fishers may also experience an increased risk associated with their fishing activity if they need to go fishing further offshore. It can be expected that the costs linked to these impacts are relatively more important for small boats which have less alternatives to their fishing grounds than larger boats (Alban et al., 2008). Especially when MPAs are created in places with subsistence fishing, where a significant part of catches is not marketed, it can be difficult to evaluate the costs for those fishers linked to the implementation of the MPA.

Moreover, transfers of fishing effort and fishing zones may create new fisheries conflicts, which are likely to induce socioeconomic costs (Holland 2000).

##### **RECREATIONAL FISHING**

Recreational fishers will be impacted through a loss in leisure linked to the prohibition to fish in the MPA. Unless recreational fishing takes the form of charter fishing, it is a non-market activity which can be valued through the willingness to pay of recreational fishers. This can be done via methods such as contingent valuation method and/or travel cost method. In the case of charter fishing, the price paid by customers to chartering providers before the creation of an MPA can express the economic value.

##### **MARITIME TRANSPORT**

Some MPAs may prohibit the transit of specific types of vessels through the protected area. Vessels can thus be forced to modify their shipping routes, potentially leading to higher fuel consumption and longer shipping time.

#### 4.5.5.3 Funding

According to the status report on Mediterranean MPAs (Gabri   et al., 2012) funding of the sampled MPAs is mainly from government (89% of MPAs) and a few MPAs get funding from NGOs and international donors, while 36% of MPAs are self-financed, which is still too little to ensure the sustainability of MPAs who have no other resources, including some countries in the South or the North-East. The commitment of the private sector is currently low (mentioned by only 8 MPAs). However, other types of funding and management arrangements can be useful avenues to facilitate the extension of the current Mediterranean MPA surface. In this sense, Plan Bleu and the French development agency AfD are currently working on a project aiming at exploring public-private partnerships as an innovative solution in the management and funding of protected areas in the Mediterranean.

Furthermore, for a future extension of the MPA coverage in the Mediterranean, the introduction of user fees can

<sup>18</sup> Inflation factor 2016/2000 = 1,3867 as per the US Bureau of Labor Statistic's annual Consumer Price Index (CPI)

represent a way to regulate access to the MPA while at the same time providing income for the MPA to cover (part of) the management and conservation costs. A user fee can also be a tool to prevent overcrowding and linked negative impacts. However, actual revenues from user fees are often relatively low and can be considered unsuitable for marine recreational activities in some places. Therefore, a user fee should always take into account local conditions and attitudes. Successful applications of user fees for MPAs do exist. For example, in the Tubbataha Reef National Marine Park in the Philippines, after two years of fee collection, the total fee collected covered 28% of the annual running costs and nearly 41% of the core costs to protect the reefs (Alban et al., 2008).

Moreover, fines for non-compliance with MPA regulations can also contribute to MPA funding.

## 4.5.6 Cost-benefit analysis

### 4.5.6.1 Assessment of additional economic and social impacts

Other than the costs indicated above, the creation or extension of MPAs has an economic impact on recreational fishing and a major social impact on employment in MPA management.

#### EMPLOYMENT IN MPA MANAGEMENT

Most of the costs of MPAs borne by the regulator are linked to personnel cost for the management and enforcement of the MPA and its regulations. In this sense, MPAs generate jobs close to their location. Balmford et al., estimate that a global MPA coverage of 30% would lead to a creation of around 830 000 full-time jobs in MPA management, which is the estimated direct employment impact. Extrapolated to the Mediterranean, this would mean a creation of around 3 100 full-time jobs under the 10% coverage scenario and around 8 800 full-time jobs under the 30% coverage scenario, including already existing jobs in the management of current MPAs.

### 4.5.6.2 Impacts resulting from the improvement of the marine and coastal environment

The sectors and stakeholders that are impacted by the improvement of the marine and coastal environment are mainly fishers, and actors of the tourism industry.

#### FISHERS

Fishers are the economically most affected stakeholders of MPAs in the short term, because their activity will be regulated (limited or prohibited) in the MPA, thus eliminating sources of revenues. In the medium-long term, MPAs can provide direct benefits by contributing to the restoration of overfished stocks and by decreasing the risk of stock collapse (Alban et al., 2008). This assumption is based on the mechanism that biomass in the no-take part of the MPA will increase, which in turn is likely to induce a net transfer of biomass from the no-take zone to adjacent fishing zones. This phenomenon is called the spillover effect (see Box 6 below). This would then lead to an increase in catches per unit of effort in the zone neighboring the no-take zone, which should overbalance the negative impact of the fishing ban in former fishing grounds (Alban et al., 2008). Also in the long-term, the MPA would decrease the vulnerability of fish stocks and favor stability in catches.

#### Box 6 : Scales of MPA spillover effect

Gell et al. suggest that there is good evidence that spillover of juveniles and adults and export of eggs and larvae benefit fisheries around several MPAs around the world while scales of spillover vary depending on species and ecosystem characteristics and can extend a few hundreds of meters to hundreds of kilometres for more mobile species (Gell et al., 2003).

However, Alban et al. put forward that there is to date no general agreement if, in reality, the benefits stemming from the spillover effect are actually high enough to balance the loss of (part of) the fishers' former fishing grounds and that there is still a need to survey more systematically the decision criteria of fishers, regarding the choice of their fishing zones (Alban et al., 2008). The potential benefit from the spillover effect also depends on biological characteristics of the targeted fish stocks, such as space mobility, natural mortality and recruitment,

and the level of the fishing effort in the fishing zone neighboring the MPA. In fact, if this fishing zone is not regulated and under open access, the increase in catches per unit of effort will induce an increase in fishing effort until the benefit normally resulting from the spillover effect is null. Regulating the fishing zone next to the MPA by limiting the fishing effort can avoid this and thus economically and biologically improve the situation of the fishery (Boncoeur et al., 2002).

The creation of an MPA can also impact the price for fish, due to a possible variation of quantities landed, due to a shift in size and species composition of catches and due to an “ecologically good” image of the fishing zone allowing landings to be sold at higher prices (Charles, 2001).

All of the arguments listed here are likely to have positive or negative impacts on the overall socio-economic performance of the fishing sector in the Mediterranean, which employs around 230 000 fishers and generates an annual direct turnover of €3.2 billion and a gross value added of €2.2 billion (Plan Bleu, 2014).

## **TOURISM**

MPAs provide a variety of opportunities for recreational activities such as diving and snorkelling, kayaking, sailing, marine mammal or bird watching, etc. Tourism linked to these activities is often referred to as ecotourism. For these activities, it is common that the satisfaction and thus the attractiveness and willingness to pay increases with the quality of the ecosystem. Thus, ecotourism can be a way to translate the benefits of ecosystem preservation into economic terms and reconcile ecosystem protection with economic development (Alban et al., 2008). Income generated through ecotourism may contribute to funding the MPA and cover part of its management costs or to fund compensation for fishers who lost their fishing grounds. It can also provide indirect revenues and jobs by stimulating the local economy if local communities take part in the operation of ecotourism related activities. This indirect economic impact can increase the social and political acceptability of an MPA project. For example, it is not uncommon in Mediterranean MPAs that fishermen take on an additional activity as tourism operators during the high season (Mangos et al., 2013).

Furthermore, ecotourism can play an educational role and promote environmentally friendly behavior among tourists, providing visitors with visible pieces of proof of effectiveness of MPAs.

However, tourism and ecotourism in and around MPAs need to be closely monitored in order to avoid an uncontrolled increase in the number of tourists which could lead to overcrowding. Congestion can lower the quality of the ecosystem and, by contradicting the objectives of the MPA, in turn decrease the attractiveness of the MPA to tourists. In this context, access fees, permits for specific activities or zoning of activities can be useful to control visitor affluence and mobility within the MPA. Limiting the carrying capacity of an MPA can in turn result in lost revenues for the tourism industry in the short term, which can in some cases be compensated by extended stays and an increase in individual spending (Mangos et al., 2013).

In fact, the impact of the creation of an MPA on tourist numbers remains often limited and visitors are generally more attracted by the notoriety of the sites than the desire to discover the MPA of which they are often unaware (Mangos et al., 2013). However, diving attractiveness for example can be largely enhanced by the creation of an MPA which will increase the overall celebrity of the site.

## **SOCIETY IN GENERAL**

One of the main goals of MPAs in the Mediterranean is biodiversity preservation (Gabrié et al., 2012), which has generally acknowledged non-use values. On one hand, there is an option value, which in turn can be seen from two angles: First, the traditional definition which is stemming from the possibility of future use of the biodiversity, which can be seen as an insurance premium warranting availability of resources in the future. Second, the preservation of biodiversity in a context of imperfect information and uncertainty concerning the role and utility of biodiversity, a value can be attributed to the information gained by delaying a decision concerning the use of a resource that results in irreversible effects. In this context, creating or extending an MPA can be seen as an application of the precautionary principle and a service rendered by the protected ecosystems is the provision of information about their functioning and roles (Alban et al., 2008). On the other hand, MPAs also preserve the existence value of biodiversity reflecting the benefit people receive from knowing that the ecosystem in question exists.

### 4.5.6.3 Assessment of the improvement of the marine and coastal environment

The creation or extension of MPAs can preserve and restore the following ecosystem services:

#### CULTURAL SERVICES

In terms of cultural services, the extension of the MPA surface in the Mediterranean can provide recreational amenities, which have a positive impact on ecotourism activities such as diving, recreational boating, etc. This ecosystem service has been evaluated to be the most substantial benefit generated, accounting for between 80-90% of the benefits from ecosystem services assessed by Plan Bleu as part of the 5 Mediterranean case studies (Mangos et al., 2013).

Another cultural service provided by MPAs can be the preservation of historic heritage such as shipwrecks, archeological sites or the preservation of cultural heritage by protecting traditional activities and lifestyle of local maritime communities (Alban et al., 2008).

#### REGULATING SERVICES

MPAs can protect seagrass meadows, which have an important CO2 storage capacity. In this sense, MPAs can provide regulating services and contribute to mitigating climate change (Mangos et al., 2013).

#### PROVISIONING SERVICES

MPAs can favor the provisioning of food for professional and subsistence fishing via an increase in fish stocks and resilience in the medium-long term.

### 4.5.7 Summary of costs and benefits

Item	Costs	Benefits	Impact +/- / 0
Direct costs	<p><u>For the regulator:</u>                      One-off establishment costs: (i) acquisition costs if relevant, (ii) transaction costs for negotiating modalities (iii) education and outreach                      Running management costs per year: Almost €50 million for 10% MPA coverage and almost €140 million for 30% coverage</p> <p><u>For the regulated (damage costs):</u>                      Fishers: Cost linked to (i) catch reduction in the short term, (ii) possibly increased operational costs/ risk linked to travelling further to fish, (iii) time lost exploring new fishing grounds, (iv) possibly new fisheries conflicts                      Recreational fishing: (i) charter fishing: lost revenue due to closure of fishing area/ relocation costs, (ii) lost value for non-charter recreational fishing                      Maritime transport: Possibly increased fuel costs and time lost due to longer shipping routes</p>		-

Item	Costs	Benefits	Impact +/- / 0
Employment	Unknown number of jobs possibly lost in the fishing sector	3 100 jobs in MPA management for 10% MPA coverage 8 800 jobs in MPA management for 30% MPA coverage Unknown number of jobs created in the ecotourism industry	+
Indirect economic impact		<u>Fishers:</u> In the medium-long term: Increase in fishing productivity from an increase in catches per unit of effort in the zone neighboring the no-take zone and increased stability in catches (if fishing is regulated a minimum in the zone adjacent to the no-take area) Possible additional revenue from an increase in prices for landings due to increased size and change in species composition and ecologically better image <u>Tourism:</u> Unknown revenue from new opportunities for non-extractive recreational activities ecotourism <u>Society in general:</u> Unquantified option value of preserved biodiversity: availability of resources for future use and information gained by delaying a decision concerning the use of resources that results in irreversible effects. Unquantified existence value	+
Ecosystem services		<u>Cultural services:</u> (i) provision of recreational amenities, (ii) preservation of historic heritage (shipwrecks, archeological sites), (iii) preservation of cultural heritage (protecting traditional activities and lifestyle) <u>Regulating services:</u> CO2 capture by preserving posidonia meadows <u>Provisioning services:</u> Providing (long-term availability of) seafood in the zones neighboring the no-take zone	+
TOTAL			+

#### 4.5.8 Regional relevance of the measure

Coastal and marine resources evolve independently of national boundaries. Therefore, conservation will be most effective if taking into account biological rather than political boundaries and a multinational or better a regional approach to conservation is thus highly relevant. Furthermore, effectiveness of MPAs is generally increased if the MPAs are established within a network promoting cooperation and synergies and connected by the movement of

species. The utility of establishing such networks also highlights the regional relevance of extending the current Mediterranean surface of MPAs.

#### 4.5.9 Discussion

**A general data gap and a high variability of local conditions.** There is a general data gap on socio-economic aspects of MPAs worldwide and in the Mediterranean. This situation is even more aggravated by the high variability of local conditions (fish stocks, importance and type of fishing activity, state of the local ecosystem, dependency of local communities on their fishing activity and other marine uses regulated by an MPA, support from local stakeholders, etc.). To date, it cannot be mathematically proven that the extension of the current Mediterranean MPA surface has a positive net present value, but qualitative analysis conducted under this study suggests that benefits outweigh the costs.

**Measuring effectiveness.** In an attempt to assess cost-effectiveness of the extension of the current MPA surface in the Mediterranean, the cost assessment suffered from a general data gap. Furthermore, the assessment of MPA effectiveness has also proved to be very challenging, mainly because MPAs in the Mediterranean rarely have fixed objectives and quantified targets against which effectiveness could be evaluated. Rather than on effectiveness, information is – if available – focusing on effects of MPAs.

**Precautionary principle, irreversibility and lack of alternatives.** Many values and benefits were not quantifiable under this study. But this does not mean that they should not be taken into account when a decision to create or extend an MPA is being considered. For example, option values of MPAs, which are linked to the concept of irreversibility, can be considerable and can outweigh the costs linked to the management of an MPA. This is especially true because there are no real alternative solutions to marine biodiversity conservation other than creating an MPA.

#### 4.5.10 Recommendations

**Complement MPAs with flanking measures.** MPAs alone will neither guarantee biodiversity conservation nor deliver sustainable fisheries. They must be complemented with other measures aiming at preserving marine and coastal ecosystems. For example, concerning fisheries management, MPAs need to be supported by an overall adequate fishing effort in the Mediterranean, decreased reliance on destructive fishing methods and clear and reasonable allocations of fishing rights and responsibilities (Gell et al., 2003).

**Enhance monitoring and reporting.** One of the main challenges encountered when assessing the effectiveness of MPAs is the fact that they often do not have any set, let alone quantified, targets against which effectiveness can be gauged. Therefore, it is recommended that MPAs in the Mediterranean implement and follow monitoring and reporting strategies which will allow not only to evaluate their effectiveness but also to orient decisions in an adaptive way, in line with the recommendations from the 2012 Forum of Marine Protected Areas in the Mediterranean “Mediterranean MPAs management and governance systems’ effectiveness is assessed regularly (every 4-5 years).”.

**Include the spatial variability of costs in MPA planning.** Scientists have extensively studied the spatial variability of biological benefits of (potential) protected areas, focussing on how conservation plans affect biological objectives. However, conservation plans always come with a cost and much less attention has been given to the spatial variability of costs of protected areas, which can be highly significant. At a time when financial resources for conservation are particularly scarce, ignoring the economic side of creating or extending MPAs leads to lost opportunities to achieve conservation targets more efficiently, or, as an alternative, maximize the level of conservation for a given budget (Naidoo et al., 2006). In the case of MPAs, such planning can namely reduce predicted damage costs such as fishery losses (Richardson et al., 2006) or other conflicts related to the different uses of the concerned area, which in turn can reduce the required enforcement effort. Investigating opportunities to make conservation more efficient, Naidoo et al. also found that the spatial variability of MPA costs is possibly

higher than the spatial variability of MPA biological benefits (Naidoo et al., 2006). This finding should induce a shift in conservation research and planning, giving more importance to economic considerations when creating or extending MPAs, thus leading to new ways to obtain biological benefits in the most efficient manner possible. Making investments more efficient, these economic considerations are also likely to attract more funding. Similarly, by limiting economic trade-offs, MPAs which have included economic considerations in their planning process are also likely to be more easily accepted by stakeholders thus leading to easier enforcement and MPA negotiations.

#### **Box 7 : Reducing costs of conservation plans for endangered species in the USA**

One of the best-known examples of making conservation more efficient by including economic considerations in its planning involves endangered species in the USA. “After a team of ecologists had shown that endangered species are clustered geographically and suggested conservation priorities based on this result, a team of economists pointed out that the acquisition costs of conservation also vary across space and that by including both costs and biodiversity in reserve design algorithms, biological targets could be achieved at 25–50% of the costs of plans that only considered the spatial heterogeneity of biodiversity” (Ando et al., 1998 in Naidoo et al., 2006).

**Involve stakeholders and consider spatial variability of social implications.** In many places in the Mediterranean, stakeholder consultations go without saying and are part of today’s standard procedures within MPA planning. However, this might not be the case everywhere and it is worthwhile to mention that involvement and dialogue with local stakeholders such as fishing cooperatives, tourism operators, etc. during the planning process and management of the MPA can provide significant benefits. It will improve awareness of stakeholders about the issues linked to the creation of an MPA and awareness of planners about the role the concerned area plays for local communities. This in turn will increase lead to an MPA design that respects local economic and social conditions, limits conflicts and facilitates enforcement. Similarly, to the spatial variability of biological benefits and costs, social implications are also likely to be largely variable in space and should be considered when planning the creation or an extension of an existing MPA. Also, compensation schemes for the changed distribution of benefits due to the establishment of the MPA are avenues to be explored (Mangos et al., 2013).

**Continue to explore economic considerations for the extension of the current MPA surface in the Mediterranean.** Early 2016, the Barcelona Convention has officially adopted the roadmap “Towards a comprehensive, ecologically representative, effectively connected and efficiently managed network of Mediterranean Marine Protected Areas by 2020” (“MPA roadmap”), which had previously been finalized during the 2012 Forum on Marine Protected Areas in the Mediterranean (Montbrison et al., 2012). The roadmap defines strategic objectives and actions to achieve the Aichi target 11 (conservation of 10% of coastal and marine areas). In addition to the MPA roadmap and particularly in a view to extend current MPAs and create new ones in the Mediterranean, analysis conducted above has made a case to further explore linked socio-economic aspects. Therefore, it is proposed to launch a project aiming at assessing the management cost linked to a respectively 10% and 30% MPA coverage in the Mediterranean by collecting relevant data from MPA managers and developing a regression curve to extrapolate management costs. Additionally, the project could include the development of technical guidance for MPA planners aiming to facilitate the inclusion of socio-economic considerations and spatial variability in the planning of new MPAs or the extension of existing ones. The technical guidance would aim at (i) aligning these MPAs as much as possible with efficiency and sustainable development principles (achieving the highest possible overlap of zones where an MPA would be most beneficial/the least costly in environmental, economic and social terms) and (ii) reducing damage costs (see sub-chapter Summary of results of cost-effectiveness and cost-benefit considerations) incurred by marine users such as fishers and tourism operators.

## 5. SOCIO-ECONOMIC ANALYSIS AT NATIONAL LEVEL

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### 5.1 EXAMPLES OF NATIONAL SOCIO-ECONOMIC ANALYSES OF MEASURES UNDER THE MSFD

Under the European Marine Strategy Framework Directive (MSFD) Member States are required to develop a programme of measures designed to achieve or maintain GES. When drawing up their programme of measures, Member States are requested to give due consideration to sustainable development and, in particular, to the social and economic impacts of the measures envisaged. They shall ensure that measures are cost-effective and technically feasible, and carry out impact assessments, including cost-benefit analyses, prior to the introduction of any new measure.

While the MSFD calls for a socio-economic assessment of measures, it is not specified in detail how these assessments should be conducted. Therefore, as part of the currently available programmes of measures under the MSFD, countries have chosen different approaches to conduct such assessments on the national level. The following sections give a quick overview of three different examples of how countries have interpreted the requirement to conduct the socio-economic assessment of measures. It does not provide a detailed analysis but aims at showcasing that the approaches used by countries are very different.

#### 5.1.1 Spain

For instance, Spain has developed a cost-effectiveness and cost-benefit analysis of new programmes, plans, projects, actions, activities and initiatives supporting the achievement of GES.

To analyze costs, available information on the budgets of identified measures has been collected. Knowledge gaps have been filled with the help of a questionnaire filled in by relevant administrations. The costs have then been categorized with the help of a scale ranging from 1-5 (1= very high cost, 2= high, 3=moderate, 4=low, 5=very low cost).

To analyze effectiveness of measures, the mitigation effect of the measures regarding the 18 MSFD individual pressures has been analyzed with the help of a reversed scale ranging from 1-5 (1=very low effect, 2=low, 3=moderate, 4=high, 5=very high). Thus a score between 1-5 has been attributed for each pressure and the average has been calculated for the 18 pressures to come up with a unique score of effectiveness.

To analyze benefits stemming from the measures, their effect on the 9 economic activities below has been assessed on the same scale from 1-5 and the average of the 9 scores has been calculated to build a unique score to describe benefits of a measure. The list of sectors includes the 8 marine economic sectors from the initial assessment and the plastic industry:

1. Aquaculture
2. Fishing
3. Port infrastructure
4. Shipbuilding
5. Recreational boating
6. Oil and gas
7. Maritime transport
8. Tourism and
9. The plastic industry

The Spanish socio-economic assessment of new measures provides two cost-effectiveness scores for each measure:

- The first one is calculated by adding the cost score and the unique effectiveness score. The cost-effectiveness score is thus always between 2-10, but is biased by the fact that it evaluated effectiveness of the measures towards all pressures at the same time (see example in Table 6). In reality, measures are mostly more targeted to a specific or limited number of pressures.
- The second one is calculated by adding the cost score and the score attributed to the one most relevant pressure for the measure in question. This cost-effectiveness score is thus targeted on the effectiveness of a measure on one single pressure and will still be between 2 and 10 (see example in Table 7).

The cost-benefit analysis has been conducted with the same logic. The cost score has been added to the average benefit score of a measure regarding the 9 economic activities. The overall cost-benefit score is thus situated between 2-10 (see example in table 8).

It should be noted that, by using a scoring system instead of monetary and unit terms, the cost-effectiveness and cost-benefit analyses conducted for the Spanish programme of measures, are actually types of multi-criteria analyses. Also, the published documents in relation to the Spanish programme of measures do not provide sufficient information to have a complete picture about what the scores actually include. For example, it seems likely that the benefit analysis does not take into account ecosystem services and non-use values and it is also not clear if damage costs to regulated economic activities find their place in the assessment. With the information available on the assessment conducted, it seems more that economic activities which are not at all impacted by a measure obtain the same score as an activity which is impacted negatively (for example the same benefit score is obtained for the fisheries sector and pleasure boating). Only direct positive impacts seem to be rewarded in the analysis.

The scoring system that has been applied here shows cost-benefit scores between 2-10. However, this does not allow to judge if benefits outweigh costs or not – the net present value or cost-benefit ratio cannot be calculated when using this type of scale. Moreover, a possible improvement of the scoring system would be to add information about the employment and overall social impact of a measure, to complete the picture.

Having noticed a number of limitations to the approach to cost-effectiveness and cost-benefit analysis applied to the Spanish programme of measures, one important criterion to be kept in mind for this type of analysis is the applicability of the approach. In fact, Spain has identified a way to compare cost-effectiveness and costs and benefits of all of the new measures contained in its programme of measures under a single framework. This approach is feasible within a limited time and with limited resources, two conditions which are unfortunately prevailing these days in most countries. In sum, the approach is relatively easily applicable and feasible but should be used bearing in mind that it does not provide a complete picture and comes with a number of limitations of which decision makers need to be aware.

### 5.1.2 France

The French programme of measures has been designed by façade. Only the Mediterranean programme has been considered here. It includes measure fact sheets for new and adopted but not yet (completely) implemented measures. Some of these fact sheets include indications about cost-effectiveness while cost-benefit considerations are very rarely mentioned. Some of the fact sheets do provide some information about direct costs linked to the measure, but these indications are not established by using a unique methodology or approach. Non-use values and ecosystem services do not seem to be treated as part of socio-economic assessment conducted under this programme of measures. However, the programme of measures indicates several times that socio-economic assessment would be done at a later stage.

### 5.1.3 Germany

As part of the development of its programme of measures, Germany has established measure fact sheets which include a certain quantity of information regarding cost-effectiveness and cost-benefit analysis of measures. Depending on the measures, the degree to which the assessments have been conducted varies largely. For example:

- Measure UZ4-02 is actually a family of measures and is called “fishery measures”. It includes several measures (fishery management in Natura 2000 sites, establishment of no-take zones within offshore-wind parks, common fishery policies, support for the development of ecosystem friendly fishing gear). The cost assessment lists the types of direct costs (development, launch, coordination and implementation). The effectiveness analysis lists relevant bibliography as proof for effectiveness. In terms of cost-benefit analysis, it is mentioned that costs can occur to the fishing sector and tax payers (through administrative costs to be borne by public administrations). Benefits can occur for the fishery and tourism sector and private households (via achievement of general environmental objectives of society). The fact sheet indicates that a more in-depth socio-economic assessment may be conducted once the different components of the measure have reached a higher level of concretization. Neither the costs and benefits nor the measure’s effectiveness have been quantified here.
- Measure UZ5-06 “establishing the fishing for litter concept” is much more detailed. Costs have been assessed on a per port basis, including education and awareness raising costs with:
  - During the introductory phase: €7,500/year in personnel costs and €4,500/year in other costs
  - Once the system is established: €4,000/year in personnel costs and €2,000/year for other costs.

The effectiveness analysis lists relevant bibliography as proof for effectiveness, amongst others KIMO, which has also served as a main reference for the regional analysis undertaken as part of this study. As part of the cost-benefit analysis, additional expected costs are indicated to be possible in the fishery sector (working time). Benefits may occur for tourism, fisheries, aquaculture, maritime transport, in the health system and for private households (via achievement of general environmental objectives of society). The fact sheet indicates that a more in-depth socio-economic assessment may be conducted once the different components of the measure have reached a higher level of concretization.

The German programme of measures comes with an annexed guidance for the socio-economic assessment which comprehensively lists the parameters to be assessed. It includes all elements which are typically part of cost-effectiveness and cost-benefit analyses, including non-use values and ecosystem services (which is why this guidance document was of great help for the development of this study’s methodology). However, the current programme of measures and measure fact sheets give only partly satisfaction to the ambitious guidance document. The socio-economic assessments in the measure fact sheets usually do not spread over more than a few paragraphs and provide little information about the mechanisms and conditions which influence the costs and benefits. Unless decision makers are provided with more detailed information on socio-economic analysis of measures which has not been published, it is likely to be difficult to base decisions on the information currently provided in the measure fact sheets.

Table 6 : Extract from Spanish Programme of measures socio-economic assessment, cost-effectiveness analysis with weighted effectiveness score

Measure	Pressures (see Annex 1)																		Cost-effectiveness					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Efficiency average	Cost		CEA		
ActionMed Project	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	3,00	M	3,00	M	6,00	
Declare new Marine Protected Areas (MPAs)	H	H	H	H	H	M	M	L	L	M	M	M	M	M	M	M	M	M	VH	3,28	M	5,00	VL	8,28
Reduction of plastic bag consumption	VL	VL	VL	VL	VL	VL	VH	VL	VL	M	VL	VL	VL	VL	VL	VL	M	M	1,56	VL	2,00	H	3,56	

Table 7 : Extract from Spanish Programme of measures socio-economic assessment, cost-effectiveness analysis with targeted effectiveness score

Measure	Priority pressure	Effectiveness on priority measure		Costs		CEA
ActionMed Project	18	3,00	M	3,00	M	6,00
Declare new MPAs	16	3,44	M	5,00	VL	8,44
Reduction of plastic bag consumption	4	3,50	H	2,00	H	5,50

Table 8 : Extract from Spanish Programme of measures socio-economic assessment, cost-benefit analysis

Measure	Economic sector									Cost-benefit analysis				
	1	2	3	4	5	6	7	8	9	Benefit		Cost		CBA
ActionMed Project	VL	VL	VL	VL	VL	VL	VL	VL	VL	1,00	VL	3,00	M	4,00
Declare new MPAs	VL	VL	VL	VL	VL	VL	VL	M	VL	1,22	VL	5,00	VL	6,22
Reduction of plastic bag consumption	L	VL	VL	L	VL	L	VL	M	M	1,78	VL	2,00	H	3,78

## 5.2 GUIDELINES FOR SOCIO-ECONOMIC ASSESSMENTS OF MEASURES AT THE NATIONAL LEVEL

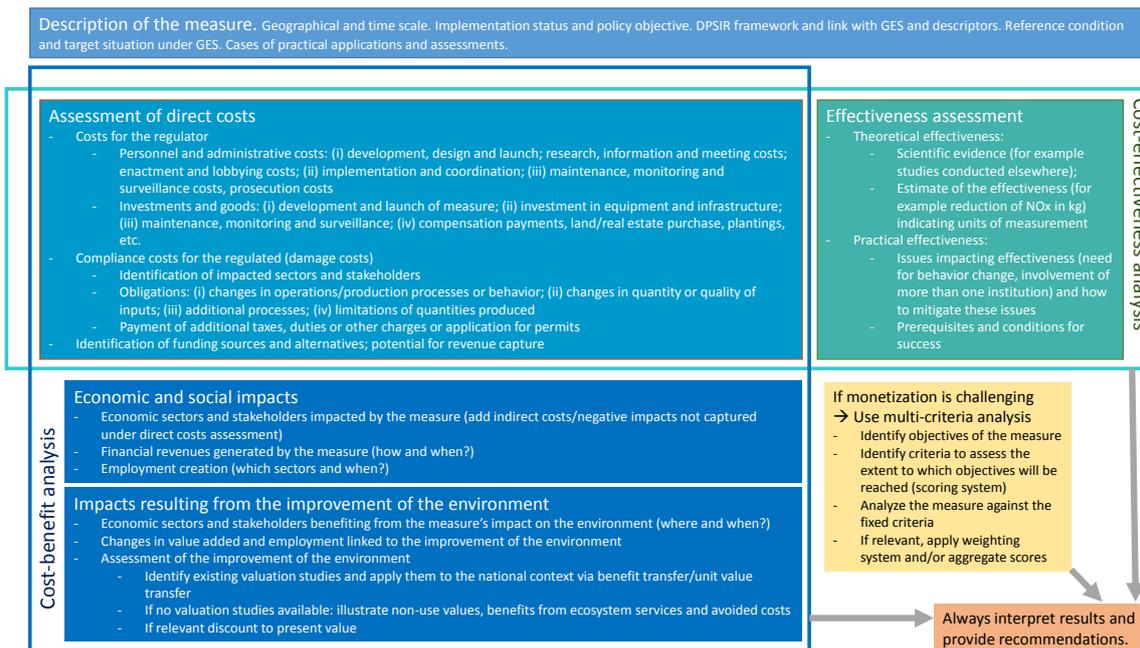
While socio-economic analysis is a requirement of the MSFD, Member States remain responsible of deciding how they want to conduct it. This gives a lot of flexibility to countries who can cater the analysis' methodology to their individual needs and possibilities. Prior to defining a country's approach to the socio-economic analysis, the country should be aware of its objective, and provide answers to the following questions (non-exhaustive list of questions):

- What will we do with the results of the analysis?
- Do we need to justify a measure and convince stakeholders about its feasibility/ usefulness?
- On the contrary, do we want to explain why a measure will not (yet) be implemented?
- Do we need a means to compare different measures to choose the most relevant one or prioritize them?
- Do we want to anticipate and identify possible bottlenecks or challenges of a measure to ensure a more fluid implementation?
- Do we want to avoid costs and/or ensure their "just" distribution?
- Do we want to identify when and where flanking measures would be most beneficial?

The answers a country gives to these questions are likely to vary both according to the country context and depending on the descriptor or individual measure (and its implementation status) in question. A great variability of resource availability to conduct socio-economic assessments is also generally the case, tending to limit the allocation of resources to socio-economic assessment of measures to a minimum. Given this context, it is likely that countries are not willing or in the position to produce a detailed cost-effectiveness or cost-benefit analysis for all measures contained in their programmes of measures. Therefore, it seems reasonable that the approach to socio-economic assessment of measures should be flexible enough to allow examining some measures in detail and others more coarsely.

The methodological guidance developed in this chapter takes these elements into account. It is based on the methodology used for the regional analysis under this study and it is mainly grounded in best practices with regard to cost-effectiveness, cost-benefit and multi-criteria studies. Figure 3 shows a flowchart which takes up the main steps of the proposed methodology. It may be followed entirely or only partially.

Figure 3 : Guidance scheme for cost-effectiveness, cost-benefit and multi-criteria analysis of measures on the national level



## 5.2.1 Description of the measure

The first step to conducting any type of analysis should be the description of the measure, which will briefly situate the measure within the DPSIR framework, indicate the geographical scope and timescale, implementation status, linked policy objective and the measure's link with the GES and its descriptors. It should normally also include a description of the reference condition from the initial assessment which the measure is meant to influence and the target situation under GES. In fact, measures are intended to fill this gap between reference condition and GES target. A description of relevant cases or practical application of the measure and linked assessments can be useful as well.

## 5.2.2 Cost-effectiveness analysis

The cost-effectiveness analysis starts by assessing the measure's effectiveness, that is to say to indicate if a measure can actually lead to its intended result. The steps to assessing effectiveness are the following:

### EVALUATING THEORETICAL EFFECTIVENESS

- Provide scientific evidence for effectiveness of the measure. Identify studies on the subject, if possible in similar ecosystems/regions, search for estimates of the effectiveness of the measure and define units of measurement (for example reduction of NOx in kg)
- Reflect on alternative measures leading to the same or similar result

### EVALUATING PRACTICAL EFFECTIVENESS

- Identify any issues possibly impacting the effectiveness of the measure during its design or implementation, especially likely to occur when more than one institution is involved in the measure (coordination and sharing of responsibilities) or when a change of behavior of concerned stakeholders is required (reliance on information, communication and support). Therefore, check:
  - Actors responsible for the design and implementation of the measure
  - Stakeholders involved in the implementation (who and how?)
  - Change of behavior of society, economic sectors etc. required? If so how to inform them?

- How to mitigate the occurrence of these issues? For example, list flanking measures in the field of communication and awareness raising.

### **EVALUATING DIRECT COSTS (FINANCIAL COSTS)**

- Costs evaluated here are direct financial costs caused by the measure itself and incurred by the regulator and the regulated.
  - Costs for the regulator
  - Human resources / personnel / administrative costs for the regulator
  - For the development, design and launch of the measure, research, information and meeting costs, enactment and lobbying costs, costs linked to application for permits
  - For the implementation and coordination of the measure
  - For maintenance, monitoring and surveillance of the measure, including prosecution costs
- Investments and goods
  - For the development and launch of the measure, including for exercise purposes
  - Investments in abatement equipment
  - For maintenance, monitoring and surveillance of the measure
  - Investments for compensation payments, land/real estate purchases, plantings, ...
- Compliance costs for the regulated
  - Which economic sectors or other stakeholders are impacted by the measure (see table below)?
  - Does the measure imply any communication obligations? If so, what are the linked financial/organizational requirements?
  - Does the measure imply any other obligations?
  - Changes in operations/ production processes or behavior?
    - Changes in the quantity or quality of inputs (abatement equipment, human resources, machines, raw materials, other investment)?
    - Additional (production) processes, for example surveillance?
    - Limitations of quantities produced?
  - Does the measure require any payments of taxes, duties or changes in prices? Application for permits?
- Funding
  - What are the funding sources? What is the cost per funding source? Are there any alternative funding sources?
  - Is there potential for revenue capture (for example through fines, taxes, etc.)?

### **5.2.3 Cost-benefit analysis**

Cost-benefit analysis should be done in two steps: a descriptive analysis and a quantifying (and monetizing) analysis. Data availability and homogeneity largely impact the feasibility and significance of CBA and in particular of the monetization of impacts. However, qualitative information can also provide valuable inputs for decision makers and can constitute the basis for a multi-criteria analysis.

#### **COST ASSESSMENT**

Data from the cost-effectiveness analysis (above) should be used here. Additionally, indirect costs or negative impacts, not captured under the cost-effectiveness analysis, should be identified during the following assessment of costs and benefits.

#### **ASSESSMENT OF ECONOMIC AND SOCIAL IMPACTS (CHANGES IN WELFARE)**

To determine these impacts, the following questions should be answered:

- Economic impacts:
  - Which economic sectors or social groups are impacted by the measure? How and when?
  - Does the measure bring about financial revenues? For whom, how and when?
  - Does the measure create employment? How many jobs? In which sector(s)? When?
- Impacts resulting from the improvement of the marine and coastal environment on economy and society, taking into account the concept of total economic value (use and non-use values)
  - Which economic sectors benefit from the measure's impact on the marine and coastal environment? Where? Over which time span? How does society benefit from the improvement?
  - Changes in value added and employment linked to the improvement of the marine and coastal environment?

## ASSESSMENT OF THE IMPROVEMENT OF THE MARINE AND COASTAL ENVIRONMENT

- Identify relevant already existing valuation studies and apply them to the national context via benefit transfer/ unit value transfer
  - Positive testing: Check if relevant studies are available and applicable
  - Selection of values and units and attribution to economic/ societal sectors which benefit from them
  - Identification of the reference value of the study and conversion to reference unit per pressure or sector
  - If relevant, adapt to national purchasing power (level of income and price)
  - Establishment of a reference to unitary values for pressure reductions (unit reduction of pressure)
- If no relevant valuation study is available, illustrate the ecosystem goods and services of the marine and coastal environment
  - Benefits stemming from the goods and services the marine and coastal ecosystems provide. These include provisioning services (food, water, minerals, etc.), regulating services (air quality, climate change, etc.), cultural services (aesthetic, recreation, etc.) and supporting services (primary production, nutrient cycling, etc.). Quantify impacts of the measure on specific ecosystem services, assess the effects on human welfare and value the changes in ecosystem services
  - Use of different techniques, according to the circumstances and available data (market price, cost-based approach, hedonic pricing, travel cost, revealed or stated preferences etc.)
  - Indicate avoided costs (costs of degradation under no-measure scenario)
  - Indicate if additional benefits are leveraged for other descriptors than the one targeted by the measure

If relevant, values should then be discounted to present value (rate according to timeline, approximately 2%).

### 5.2.4 Multi-criteria analysis

Multi-criteria analysis and its different techniques have been extensively studied in a manual for the use of MCA by the UK Department for Communities and Local Government (Department for Communities and Local Government, 2009). The methodology proposed here is mainly derived from the recommendations of this UK manual, which can also be of great help for national socio-economic assessments of measures.

Both cost-effectiveness and cost-benefit analysis are analytical ways of comparing different forms of input or output, normally by giving them monetary values, and might themselves be regarded as examples of multi-criteria analysis. However, in this case, multi-criteria analysis concentrates on techniques which do not involve giving all of the inputs, outputs and outcomes explicit monetary values, although data from cost-effectiveness and cost-benefit analyses can be included. The multi-criteria analysis here will represent an 'alternative' to defining monetary values for costs and benefits when this is not possible or desired.

The multi-criteria analysis will allow decision makers to put emphasis on their judgement, in establishing objectives

and criteria and estimating relative importance weights. The subjectivity involved in this process can be a matter of concern. Its foundation, in principle, is the decision makers' own choices of objectives, criteria, weights and assessments of achieving the objectives, although 'objective' data such as observed prices can also be included. However, the multi-criteria analysis can bring a degree of structure, analysis and flexibility to decision making beyond the practical reach of cost-effectiveness and cost-benefit analysis. One limitation of the multi-criteria analysis approach is that it cannot show if an action adds more to welfare than it detracts (positive or negative net present value). This is also the case with cost effectiveness analysis, where the 'best' option can be inconsistent with improving overall welfare, so doing nothing could in principle be preferable (Department for Communities and Local Government, 2009).

The following process is proposed to be applied to multi-criteria analysis of the chosen measures (see, as an example, Table 3 multi-criteria analysis of different cost recovery mechanisms for port reception facilities):

- Identifying objectives of the measure. In the example in Table 3, the objectives are minimizing economic cost and maximizing environmental benefits.
- Identifying performance criteria to be used to assess how and to which extent the objectives are likely to be reached by the measure and to compare different measures. In case of the example in Table 3, performance criteria are the measure's capacity to encourage waste disposal at port, the degree to which measure provides an incentive to reduce waste on board of vessels, the degree to which the measure adheres to the polluter pays principle, the administrative burden of the measure, the degree to which the measure guarantees income for ports and the capacity to create employment and generate revenue. Criteria may also be weighted according to relative importance and aggregated using a scoring system.
- Analysis of the measures (inputs, outputs, outcomes, impact) with regard to the fixed criteria. Depending on the measure, the analysis can offer a number of ways of aggregating the data of individual criteria to provide indicators of the overall performance of a measure. In the case of the example in Table 3, scores from 0 to 2 have been attributed to each performance criterion and each measure. Scores have then been aggregated to build a single performance indicator for each measure. Scores have not been weighted under this analysis.
- As a last but important step, it is recommended to indicate any uncertainties about parameters used in the multi-criteria analysis and to provide recommendations on how to use the analysis' results in the decision making process.

## 6 CONCLUSIONS

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The socio-economic analysis of four regional measures aiming at achieving or maintaining GES in the Mediterranean has clearly shown that measures generally come with trade-offs between ecological objectives and economic activities and public costs as well as with varying distributional effects of costs and benefits. The complexity of these issues is one of the main difficulties decision makers encounter when designing measures and/or programmes of measures aiming at achieving or maintaining GES in the Mediterranean. Evaluating these trade-offs and distributional effects with the help of cost-effectiveness, cost-benefit and multi-criteria analyses provides tools to help decision makers understand the socio-economic implications of measures and therefore supports the design of appropriate policies and coherent programmes of measures in view of achieving GES in the Mediterranean. The analyses can provide input for the prioritization of issues and actions and the selection of corresponding measures, and in particular help to choose those measures which maximize benefits and achievement of GES for a given budget.

The analyses conducted under this study provide examples of different types of socio-economic assessment of measures. Estimates of cost-effectiveness have been provided for most of the measures. However, it has been very difficult to conduct full-scale cost-benefit analysis, due to a lack of data and data specificity. Therefore, qualitative analysis generally prevails throughout the assessments. Even if this study did not produce quantified cost-benefit ratios, it highlights costs and benefits in a qualitative and partially quantified way. The results of the analyses are still useful inputs for decision makers, elucidating possible trade-offs and distributional effects of costs and benefits linked to the selected measures.

Under the MSFD, socio-economic assessment of new measures is a requirement. On the national level, a quick screening of two Mediterranean countries' and one other European country's programmes of measures revealed that this assessment has been made using very different methods, which is a logical consequence of the MSFD's open approach to socio-economic assessment of measures, providing no particular guidelines on how the assessment should be conducted. None of the surveyed programmes of measures includes full-scale cost-effectiveness and cost-benefit analyses, but qualitative and/or partially quantified information has been included. It has been pointed out that the socio-economic assessments carried out under these three programmes of measures have several limitations. In general, information contained in the assessments would gain substantively from information about mechanisms and factors influencing the costs, benefits and effectiveness of the measures.

However, when analysing the countries' programmes of measures, the applicability and feasibility of conducting socio-economic assessment of measures also needs to be taken into account. Realizing comprehensive socio-economic analysis including indirect impacts and ecosystem services assessment requires a lot of time and resources and is dependent on a certain data availability. The level of effort required becomes even clearer when looking at the number of new measures subject to the mandatory assessment (22 new measures for the French Mediterranean façade, 95 for Spain and 31 for Germany). This is why it is likely that comprehensive and full-scale analyses of measures are very challenging or even, at this stage, impossible for countries to undertake. They need to find a more pragmatic approach and compromise, while focusing on the assessments' main goal: to provide useful inputs for decision making. Given this context, it is likely that a multi-criteria assessment which includes elements from cost-effectiveness and cost-benefit analysis appears to be a realistic compromise to comprehensive and full-scale cost-effectiveness and cost-benefit analysis.

Special attention should furthermore be given to national measures with transboundary impacts. For example, the German programme of measures specifically states that transboundary impacts of national measures are not considered in the socio-economic assessment that has been conducted. By doing so, the analysis neglects any possibly significant positive and/or negative socio-economic impacts taking place beyond the country's waters. In this sense, it could be beneficial to set up a mechanism by which countries would indicate and report on the regional Mediterranean level (for example under Regional Seas Conventions, in this case the Barcelona Convention) any measures with socio-economic impacts beyond national waters. Such a mechanism would allow countries to coordinate efforts and possibly mitigate adverse effects.

Regional measures are normally already led by or with a regional body. However, countries normally transpose the regionally decided measures into their national programmes of measures and would then undertake a

national socio-economic assessment. In such a case and in order to avoid duplication of efforts and to produce more coherent results, it could be more efficient if socio-economic assessment was carried out directly on the regional level, or at least coordinated on the regional level, with inputs provided from the countries.

Furthermore, different countries are likely to include the same or comparable measures in their respective programmes of measures. Given the amount of resources and effort required to conduct socio-economic assessments of measures, a recommendation would be to create and share on the regional level a place where (pieces of) analysis can be found so that they can be adapted to other countries via different transfer techniques.

Regional coordination could thus largely enhance the overall effectiveness and efficiency of programmes of measures, eventually leading to a regional programme of measures. In fact, the analyses undertaken by this study point out at several stages that there are many opportunities to combine different measures or add flanking measures to a main measure and thus achieve better results. This is also true from a funding perspective: For example, a regional plastic bag tax, such as the one examined under this report, could potentially generate around €650 million each year. This budget would then be available to finance other measures for which funding requires an input (one-off or continuous) from public institutions, for example fishing for litter programmes or the management of Marine Protected Areas. These measures, analysed under this study, could be financed by the revenues generated from a regional plastic bag tax (less than 10% of the tax revenues would already cover the running costs of protecting 10% of the Mediterranean Sea surface with Marine Protected Areas).

Finally, if socio-economic information about measures is difficult to obtain prior to the measure's implementation, it is potentially much easier to have this information ex-post or during a measure's implementation if adequate monitoring and reporting following up on socio-economic impacts of measures, is taking place. Therefore, decision makers might follow an adaptive approach, choosing to implement a relatively non-controversial measure which is widely accepted by stakeholder and which is not projected to involve any disproportionate costs and then monitor closely the socio-economic implications as it is being implemented. The information obtained this way can be very useful in the ex-ante assessment of other more controversial measures but potentially more efficient measures.

# ANNEXES

## Annex 1 : List of 8 MSFD pressure themes and 18 individual pressures

N°	Pressure theme	N°	Individual pressure
1	Physical loss	1	Smothering (e.g. by man-made structures, disposal of dredge spoil)
		2	Sealing (e.g. by permanent constructions).
2	Physical damage	3	Changes in siltation (e.g. by outfalls, increased run-off, dredging/ disposal of dredge spoil)
		4	Abrasion (e.g. impact on the seabed of commercial fishing, boating, anchoring)
		5	Selective extraction (e.g. exploration and exploitation of living and non-living resources on seabed and subsoil).
3	Other physical disturbance	6	Underwater noise (e.g. from shipping, underwater acoustic equipment)
		7	Marine litter
4	Interference with hydrological processes	8	Significant changes in thermal regime (e.g. by outfalls from power stations)
		9	Significant changes in salinity regime (e.g. by constructions impeding water movements, water abstraction)
5	Contamination by hazardous substances	10	Introduction of synthetic compounds (e.g. priority substances under Directive 2000/60/EC which are relevant for the marine environment such as pesticides, antifoulants, pharmaceuticals, resulting, for example, from losses from diffuse sources, pollution by ships, atmospheric deposition and biologically active substances)
		11	Introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, from pollution by ships and oil, gas and mineral exploration and exploitation, atmospheric deposition, riverine inputs)
		12	Introduction of radio-nuclides
6	Systematic and/or intentional release of substances	13	Introduction of other substances, whether solid, liquid or gas, in marine waters, resulting from their systematic and/or intentional release into the marine environment, as permitted in accordance with other Community legislation and/or international conventions
7	Nutrient and organic matter enrichment	14	Inputs of fertilisers and other nitrogen — and phosphorus-rich substances (e.g. from point and diffuse sources, including agriculture, aquaculture, atmospheric deposition)
		15	Inputs of organic matter (e.g. sewers, mariculture, riverine inputs)
8	Biological disturbance	16	Introduction of microbial pathogens
		17	Introduction of non-indigenous species and translocations
		18	Selective extraction of species, including incidental non-target catches (e.g. by commercial and recreational fishing)

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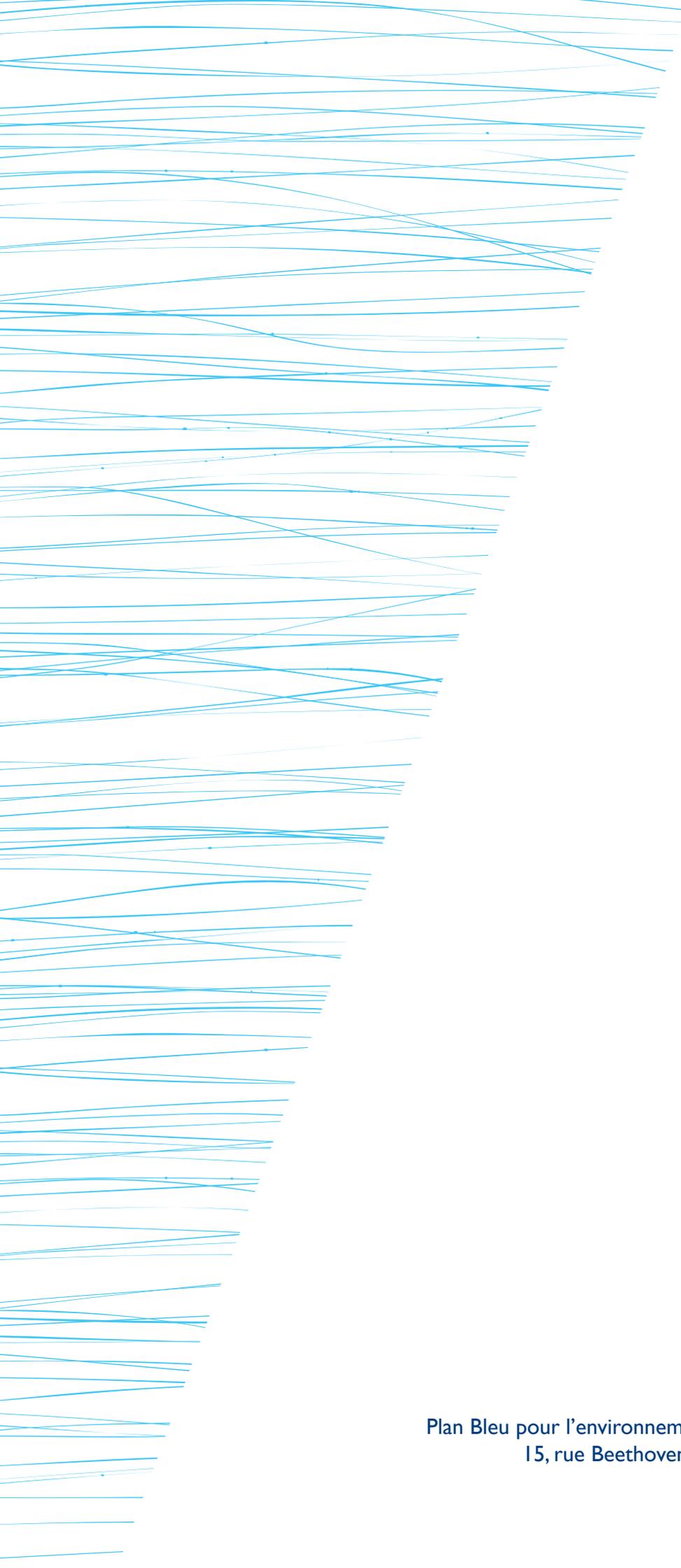
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