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Blue growth and economics

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Oceans and seas represent over 70% of the earth's surface. Furthermore, living aquaticresources can provide a significant contribution to food, energy, and bio-based products. However, marine ecosystems are subject to increasing pressures and competing usages, resulting from resources over-exploitation and pollution. In order to produce efficient marine management plans, it is essential to consider the total economic value provided by the marine ecosystems. In this review, we are focusing on the Marine Framework Strategy Directive and the European Marine Spatial Planning that are established for the protection and efficient use of the marine area. We present the ecosystem services approach with regards to the marine ecosystem and propose economic methods that capture the marine ecosystem's total economic value in relation to the opportunity cost of marine space. Values should be used to guide policy makers following the European directives and initiatives.

Keywords: maritime spatial planning, cost-benefit analysis, economic valuation, ecosystem services, interdiciplinary research, marine biodiversity

INTRODUCTION

Marine environment plays an important role for international trade and recreational activities, generating wealth and facilitating development. More explicitly, marine resources include for example fisheries, aquaculture, seafood, seaweed, and biotechnology research, oil, gas and renewable energy possibilities, supporting different economic sectors and communities. According to Pugh and Skinner (2002), marine-related sectors such as shipping, fisheries, harbor construction, oil and gas, manufacturing, leisure and recreation as well as research sector generate great added-value for the UK economy. For 1999–2000, the contribution of marine-related activities was estimated at £39bn. In addition, excluding tourism, marine-related activities represented the 3.4% of GDP. According to European Commission[1], the "blue" economy represents roughly 5.4 million jobs and generates a gross added value of almost e500 billion per year.

Nevertheless, marine ecosystems are subject to increasing pressures and competing usages, resulting from recourses overexploitation and pollution. Scientists (for example Kamanlioglu, 2011; Visbeck et al., 2014), note that while all these years human development and economic growth have continued with stable or fast rate, free access to, and availability of, seas and sea services has exerted major pressures on marine resources, ranging from overfishing and increasing resource extraction to various sources of pollution and alterations to coastal zones that often cause the degradation of marine ecosystems and habitats. Recognizing that human activities constitute a threat to the marine ecosystem, global initiatives continue to be implemented for its protection and sustainable use.

Understanding the importance of marine resources and considering their potential contribution to economic growth and development, the European Union (EU) launched a long-term strategy plan in 2012 to support sustainable growth in the marine and maritime sectors, called Blue Growth.

This strategy focuses in developing important sectors that have high potential for job creation and sustainable growth (aquaculture, coastal tourism, ocean energy etc.), as well as provide knowledge, legal certainty and security in the blue economy, such as maritime spatial planning and integrated maritime surveillance.

Before Blue Growth, in 2008, the European Union (EU) adopted the Marine Strategy Framework Directive (MSFD), which aims at achieving and maintaining good environmental status of the European seas by 2020 in relation to marine economic and social activities (European Commission, 2008). Under the MSFD, marine strategies include:

- Marine water current environmental status initial assessment, considering the environmental impacts of human activities
- Definition of the good marine environmental status, including the environmental targets and relevant indicators with regards to biodiversity conservation, hydrographical conditions that do not adversely affect the ecosystem, minimization of eutrophication, reduction in marine litters etc.
- Proposing of a monitoring program for the assessment of progress and regulation of the defined targets
- Program of measures designed to achieve the good environmental status

MSFD requires the application of an ecosystem-based approach, which considers the marine ecosystem services that are linked to the human welfare. It highlights the need to protect the marine environment by introducing the complex connection between the ecosystem and human activities. Hence, this approach recognizes the marine ecosystem benefits for the society, promoting sustainable management solutions with regards to the program of measures defined under the MSFD. This approach will be introduced in further detail in the next section.

In order to choose the most appropriate strategy to achieve good environmental status, it is required to compare the proposed strategies according to their different effects on the marine ecosystem. For this purpose, the effects should be expressed in monetary values. In this article we are presenting the Total Economic Value (TEV) framework, which assists in capturing the total economic value of ecosystem services and informs the policy-makers through the application of economic tools, such as the Cost Benefit Analysis (CBA), with regards to efficient and sustainable marine management plans. Additionally, we are presenting a new area in maritime spatial planning solutions, which is about marine constructions that incorporate different uses of marine recourses and human activities.

THE ECONOMIC VALUE OF MARINE ECOSYSTEM SERVICES

Human activities negatively affect the marine ecosystems and oceans by polluting and overexploiting its resources, which all impact on the marine food web and could lead to largely unknown consequences for the biodiversity and survival of marine life forms. According to WWF, “For centuries people have regarded them as an inexhaustible supply of food, a useful transport route, and a convenient dumping ground—simply too vast to be affected by anything we do.” We simply present major pressures and threats to the marine environment and its ecosystem services:

- Unsustainable Fishing and Aquaculture

The overfishing might represent the largest threat to ocean life and habitats, resulting in inefficient food supply, and loss of biodiversity. Apart from the major declining in fish stocks, aquaculture activities are related to polluting farm discharges, and increased parasite loads.

- Tourism, Shipping Sector, Energy Sector, and Economic Development

Intense human activities put pressure to marine life, habitat, and environment. Garbage, fertilizers, industrial chemicals, and other human made products pollute the marine ecosystem. Humans also extract from the seafloor oil, gas and minerals. The drilling poses major threat to sensitive marine habitats and species. In addition, heavy traffic, CO_2 emissions, oil spills, and ship groundings are a few examples of negative effects that endanger marine habitats around the world.

- Climate Change and Inadequate Protection

EU has introduced the Natura 2000, which is an EUwide network of nature areas being currently under protection. Natura 2000 is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitat Directive and also incorporates Special Protection Areas (SPAs) designated under the Birds Directive. However, the rising sea levels and temperature of marine water due to climate change put extra pressure to the marine habitats. Marine biodiversity is at risk because of inadequate plans for the protection of vulnerable marine areas. Accordingly, marine resilience related to the marine ecosystem’s ability to respond to natural and man-made disasters, has been negatively affected (European Commission, 2014).

Hence, human-based effects put major pressure on the marine environment and threat its provision of ecosystem services. Based on Defra (2007), ecosystem services are separated in (a) provisioning, which include products obtained from the ecosystem, (b) regulating services, which are benefits obtained from regulation processes of the ecosystem, (c) cultural services, which are non-tangible benefits, and (d) supporting services, which are services necessary for the production of all the other ecosystem services. For example, for the marine ecosystem, fish, and raw materials are included in the provisioning services. Climate regulation and water purification are included in regulating services. In addition, recreation, aesthetic and educational services are cultural services. Finally, nutrient cycling is a supporting service for the marine ecosystem.

According to ecosystem services approach, the marine ecosystem’s structure and processes produce services that benefit humans. This means that changes in ecosystem services are translated to changes in human welfare and could be expressed in monetary terms (see also Price, 2007). Applying the ecosystem services approach in decision-making is essential for the economic analysis of a project or policy. This approach assists on considering the generated environmental and socio-economic benefits (positive or negative), apart from financial costs and revenues. Hence, economists try to elicit these values and express them in monetary terms to use them for the evaluation of policies and marine management plans.

Visbeck et al. (2014), suggest that the ocean provides humanity with both animate and inanimate services. Despite the use-value derived from animate ecosystem-services, ocean provides a number of non-tangible ecosystem services that include aesthetic and cultural values. However, as long as these services are not traded in the market, it is difficult to value the social and environmental externalities that society, industries and any human activity produce to the ecosystem services.

The Total Economic Value (TEV) framework consists of valuation methods that express the values of non-market resources in monetary terms. The valuation methods are based on either consumer preferences elicitation (see Hedonic price method and Travel Cost method) or use stated preferences techniques (see Contingent valuation method and Choice Experiment).

An overview of the values and methods used to derive the Total Economic Value of marine resources is presented in the **Figure 1** below.

Direct use value corresponds to value that affect utility directly and are reflected in the market. Apart from direct use value, resources have indirect use value and option value, as well non-use values. With respect to non-use values, altruistic value and bequest value reflect the need to protect the resource for others and future generations, accordingly. In addition, existence value derives from the knowledge of the existence of a resource.

We are also giving brief definition for each of the above presented techniques based on Pearce (2002):

- Market Valuation Techniques: These techniques are market based, which means that the good is already traded in the market. Hence the estimation of the good's value is based on market data and prices that are easy to be found.
- Revealed Preferences Techniques: These techniques are based on observed people's behavior, which follows a utility maximization process. How much people value an environmental attribute or good is reflected by another good which is traded in the market. Hedonic price method and travel cost method are revealed preferences techniques and can be used for standard market good valuation as well as non-market good valuation.
- Stated Preference Techniques: These techniques, in contrast to the revealed preferences techniques, elicit people's willingness to pay or accept a good or attribute of a good. There are survey based techniques and include contingent valuation and choice modeling. Contingent valuation method is used when we want to value a non-market good, while choice modeling

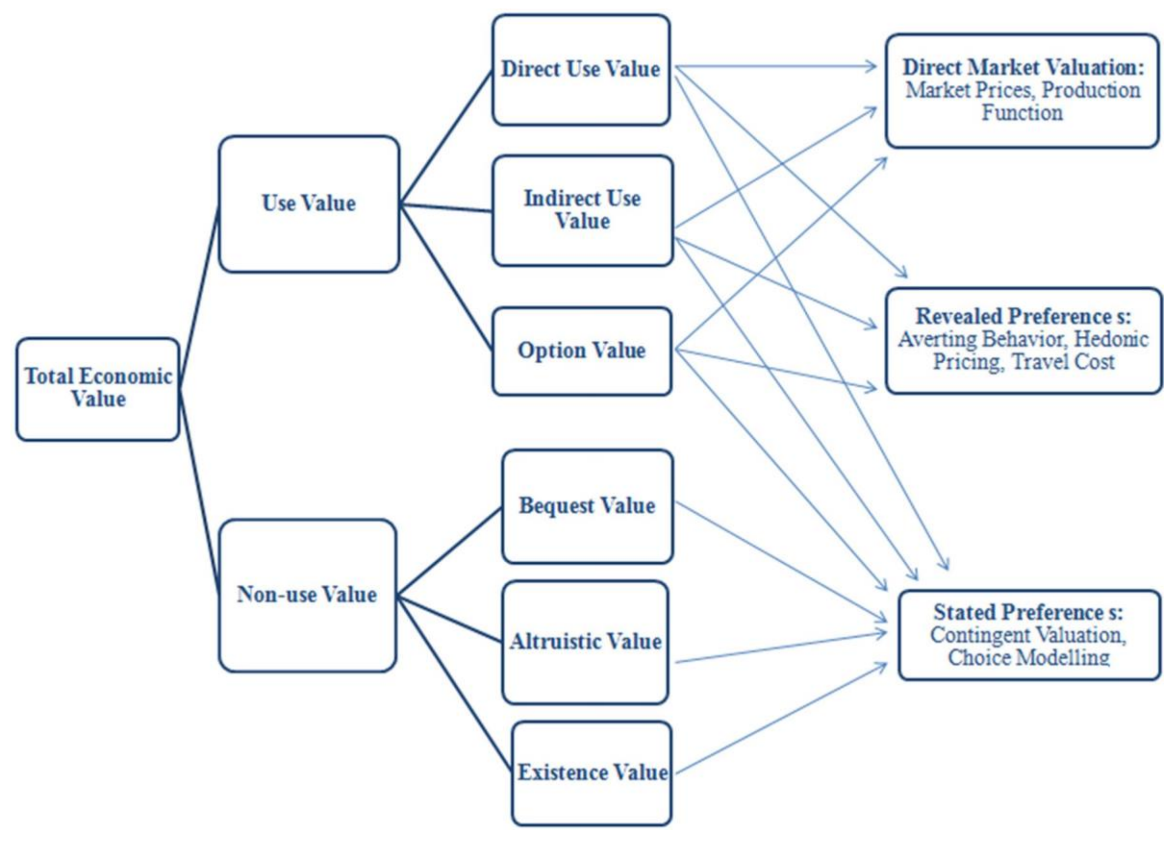

FIGURE 1 | Total economic value framework (Bertram and Rehdanz, 2013).

is used when we want to value attributes of a non-market good.

- Benefit Transfer: Apart from primary research techniques, we can apply a benefit transfer which transfers adjusted values derived from other studies that have conducted primary research.

Although the valuation techniques presented could be imperfect or controversial, they provide useful information to policy makers (Ledoux and Turner, 2002). Identifying the TEV of the ecosystem is important for the MSFD and for every each policy-making that involves a change in the ecosystem services, in order to be able to internalize externalities produced by human activities applying economic public and private policy instruments, such as taxes, subsidies, and green investment. Assessing the available options and management plans can be done by using economic tools, such as CBA. CBA compares discounted flows of costs and revenues (financial, socio-economic, and environmental) and identifies if a project or proposed plan can be sustainable in time and space.

THE OPTION VALUE OF MARITIME SPATIAL PLANNING

As it is already mentioned the multiple marine-human activities constitute great pressure to the marine ecosystem. Effective maritime spatial planning aims to alleviate this problematic situation, proposing alternatives for mitigation of the negative effects and to restore the affected marine ecosystem. Maritime spatial planning is about the place and time marine human activities exist. It reduces conflicts between sectors and creates synergies between different activities. It secures coordination between countries and enhances cross-border cooperation, while protecting the environment by identifying the impact and opportunities for multiple use of space.

According to OECD's project "The Future of the Ocean Economy"[2], apart from the establishment of ocean sectors such as shipping, shipbuilding, fisheries, traditional ocean and coastal tourism and ports, the emerging ocean-based sectors of offshore wind, offshore oil and gas, ocean energy, marine bio, aquaculture, seabed mining, ocean monitoring, ocean related tourism, and leisure activities. The emerging sectors represent sources of economic growth and employment creation, resulting in future implications for ocean eco-systems and sustainability, as well as implications for managing the ocean activities.

In line with future development and the goals of efficient spatial marine planning, Europe has already funded European projects (The Ocean of Tomorrow[3]: MERMAID Project, TROPOS Project, H2OCEAN Project) related to construction and implementation of multi-use offshore platforms that combine energy extraction technologies, aquaculture and recreational activities in the sea. Economically, these platforms—apart from reducing financial costs—have the potential to support economic and social development, associated with energy and food security. In addition, these platforms are able to decrease the negative environmental effects derived from human activities that are allocated in different places in the sea. The different functions incorporated in a multi-use platform host opportunities mitigation, since one function could potentially mitigate for the negative effect produced by the other.

According to European Commission's Report on the economic effects of Maritime Spatial Planning[4], the maritime activities that are currently taken place in European seas areas include dumping zones, fisheries, marine aggregates, maritime services, maritime works, nautical cables and pipelines, navy and coast guarding, offshore activities, offshore supply, recreational boating, renewable energy, seaports, shipping and tourism. In addition, environmental and cultural aspects affected by these maritime activities are related to coastal protection (construction of dykes, beach nourishment, dune rehabilitation, protection against climate change), protection of marine areas for

TABLE 1 | Summary of monetary values for each service per biome (values in Int.$/ha/year, 2007 price levels; de Groot et al., 2012).

	Marine	Coral Reefs	Coastal Systems	Coastal Wetlands
Provisioning Services	102	55,724	2396	2998
1 Food	93	677	2384	1111
2 Water				1217
3 Raw materials	8	21,528	12	358
4 Genetic resources		33,048		10
5 Medicinal resources				301
6 Ornamental resources		472		
Regulating services	65	171,478	25,847	171,515
7 Air quality regulation				
8 Climate regulation	65	1188	479	65
9 Disturbance moderation		16,991		5351
10 Regulation of water flows				
11 Waste treatment		85		162,125
12 Erosion prevention		153,214	25,368	3929
13 Nutrient cycling				45
14 Pollination				
15 Biological control				
Habitat services	5	16,210	375	17,138
16 Nursery service		0	194	10,648
17 Genetic diversity	5	16,210	180	6490
Cultural services	319	108,837	300	2193
18 Esthetic information		11,390		
19 Recreation	319	96,302	256	2193
20 Inspiration		0		
21 Spiritual experience			21	
22 Cognitive development		1145	22	
Total economic value	491	352,249	28,917	193,845

[2]http://www.oecd.org/futures/oceaneconomy.htm.

[3]http://ec.europa.eu/research/bioeconomy/pdf/ocean-of-tomorrow-2014_en.pdf.

[4]http://ec.europa.eu/maritimeaffairs/documentation/studies/documents/economic_effects_maritime_spatial_planning_en.pdf.

sustainable use and conservation of biodiversity and preservation of cultural heritage. The report recognizes possible coordination efficiency and effectiveness for governments, lower costs for companies and enhanced investment climate with regards to the direct benefits from maritime spatial planning. Indirect effects derive from combining activities and uses, supporting the argument that multi-use platforms can be beneficial if they are environmentally sustainable and economically profitable. In addition, marine spatial management reflects the importance of efficient ecosystem-based management in the marine environment (see Douvere and Ehler, 2001; Douvere, 2008).

Less human impact and higher availability of marine space due to efficient marine spatial planning and the implementation of multi-use offshore marine platforms, produces benefits that are related to the option value of future use of the marine ecosystem. Today's biodiversity would have an option value, in the sense that biodiversity conservation corresponds to an insurance premium (Folke et al., 1996; Barbier et al., 2009). Accordingly, option value can be defined as "the added amount a risk averse person would pay for some amenity, over and above its current value in consumption, to maintain the option of having that amenity available for the future, given that the future availability of the amenity is uncertain" (Bulte et al., 2002). We can elicit the option value by estimating people's willingness to pay today in order to reduce the potential loss of an ecosystem service in the future.

Hence, important environmental benefits derive from safeguarding environmental areas that are no more negatively affected by excess human activities. Taken from Pay Peters and Hawkins (2009), the estimated average mean WTP for conservation of 14 marine protected areas is $6.75 per day, which means that in a case of no conservation needed and following the benefit transfer method, this results in positive economic benefits. According to Nunes et al. (2010), who followed a meta-analysis study, the average values for beach recreation and non-consumptive recreation in estuarine waters are $178.9 and $ 83.5 per person per year, respectively. The average values for recreational fishing and recreation in coral reef ecosystems are $408.7 and $700.4 per person per year, respectively. Hence, providing more space for recreational activities results in positive economic benefits as well.

If we concentrate on the option value of open space deriving from the application on multi-use platforms, we will need to value positive environmental effects related to less greenhouse gas emissions from reducing traffic, less traffic accidents, higher biodiversity in areas that could be free from human activity and offshore constructions, as well as less disturbance for marine organisms and animals. Nevertheless, we should not exclude negative values generated by the multi-use offshore platforms, since they are still structures in the sea that are able to affect negatively the biodiversity and pollute the marine environment. All these effects can be expressed in monetary terms according to their scale (local, regional, international) (**Table 1**). de Groot et al. (2012), summarize monetary values for most of the marine ecosystem services, which can be affected by technological synergies such as multi-use platforms. For example, we can implement a multi-use platform that incorporates energy production and aquaculture, instead of implementing separately an aquaculture system and an offshore wind farm. Assuming that this could save about 1000 hectares of space, only considering the genetic diversity that could be protected, results in $5000 ($5 \times 1000$) economic benefits each year (2007).

CONCLUSION

In this paper we are focusing on the Marine Framework Strategy Directive and the European Marine Spatial Planning that are established for the protection and efficient use of the marine area. We have presented the ecosystem services approach with regards to the marine ecosystem and we have given an overview of the Total Economic Value framework. Ecosystem services values should be used to guide policy makers following the European directives and initiatives.

In addition, as part of sustainable use of marine environment, we recommend for marine projects assessment to focus on estimating the option value due to efficient use of ocean space. At the end of the day, a decision will be made based on social, economic and environmental aspects. This is a holistic approach that enables relevant drivers and players.

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