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IS THE PORTUGUESE FISHING SECTOR AS BLUE AS IT SHOULD BE? *An evaluation of the flagship action No.77 in the National Ocean Strategy 2021-2030 roadmap*

Dissertation to obtain a Master's Degree in Law and Economics of the Sea

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ANTI PLAGIARISM STATEMENT

I hereby declare that the work I present is my own work and that all my citations are correctly acknowledged. I am aware that the use of unacknowledged extraneous materials and sources constitutes a serious ethical and disciplinary offence.

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14 de Setembro, 2022

DECLARATION

I hereby declare that the body of the thesis, including spaces and notes, occupies a total of 191.894 characters.

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QUOTING AND OTHER CONVENTIONS

This thesis is written in English.

With respect of quoting and bibliographic organization, this thesis follows the provisions of Portuguese Norms 405-1 and 405-4 of the Portuguese Quality Institute. The cited documents are identified in the bibliographic references, and they are organized by alphabetic order of the author's last name, its title, edition, editors, and by the year of publication. Some materials were consulted on the internet, and those are also duly identified with the identification of the appropriate source, as well as the date when they were accessed.

On a final note, in this thesis there are some direct quotations cited from documents that are written in a language different from the English language. Those were translated by the author of this thesis.

GLOSSARY OF ACRONYMS

- CFP – Common Fisheries Policy
- CIAM – Comissão Interministerial para os Assuntos do Mar
- CINEA – European Climate, Infrastructure and Environment Executive Agency
- DG MARE - Directorate-General for Maritime Affairs and Fisheries
- DGPM – Direção-Geral de Políticas do Mar
- DGRM – Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos
- EEZ – Exclusive Economic Zone
- EMFF - European Maritime and Fisheries Fund
- ESG – Environment, Social and Governance
- EU – European Union
- FAO – Food and Agriculture Organization of the United Nations
- GVA – Gross Value Added
- ICES – International Council for the Exploration of the Sea
- IMP – Integrated Maritime Policy
- INE – Instituto Nacional de Estatística
- IOC-UNESCO – Intergovernmental Oceanographic Commission of UNESCO
- LEK – Local Ecological Knowledge
- MEY – Maximum Economic Yield
- MSFD – Marine Strategy Framework Directive
- MSY – Maximum Sustainable Yield
- NOS – National Ocean Strategy
- OSA – Ocean Satellite Account
- OP – Operational Program
- PIA – Priority Intervention Area
- SDG – Sustainable Development Goal
- SG – Strategic Goal
- SSF – Small-scale fisheries
- TAC – Total Allowable Catches

- UN – United Nations
- UNCLOS – United Nations Conference on Law of the Sea
- UNESCO – United Nations Educational, Scientific and Cultural Organization
- UNGA – United Nations General Assembly
- WOA – World Ocean Assessment
- WWF – World Wide Fund for Nature

RESUMO

A indústria pesqueira portuguesa é um dos símbolos marítimos nacionais, no entanto, enfrenta uma grande lacuna de informação sobre aspectos económicos, sociais e ambientais relevantes. As pescas têm sido pressionadas, mundialmente, a aumentar o seu desempenho sustentável, o que representa um passo crítico, particularmente para um país como Portugal, que tem um dos maiores consumos *per capita* de pescado. A pesca portuguesa tem um impacto significativo na economia nacional, uma comunidade piscatória resiliente, que é maioritariamente composta por embarcações de pesca artesanal que operam localmente. O sector das pescas português tem como alvo uma variedade de espécies e emprega uma vasta gama de artes de pesca, como redes de tresmalho, rede de cerco, armadilhas e arrasto. Como tal, diferentes frotas de pesca podem produzir diferentes impactos no ambiente marinho. O estudo da sustentabilidade da pesca é importante para colmatar potenciais lacunas, criar oportunidades de melhoria e identificar e promover práticas sustentáveis e melhorar aquelas que não correspondem às diretrizes sustentáveis. O objetivo desta tese é analisar e discutir a sustentabilidade da indústria pesqueira portuguesa e o seu apoio político no âmbito da Ação Emblemática No. 77 do Plano de Ação da Estratégia Nacional para o Mar 2021-2030. A análise da sustentabilidade centrou-se nos principais aspetos económicos, sociais e ambientais do setor das pescas português. Com base nestes aspetos, foram desenvolvidos 47 indicadores que permitiriam uma avaliação analítica da sustentabilidade do setor de pescas português. Ao longo desta análise, verificou-se que Portugal apresenta uma falta de informação sobre as dimensões sociais e ambientais do seu setor pesqueiro, e os dados económicos disponíveis não refletem o verdadeiro valor do setor, dificultando o processo de análise. Estas mudanças urgentes não estão abrangidas na Ação Emblemática No.77, e esta ação foi considerada inadequada para cumprir o seu objetivo de transformar o setor pesqueiro português num setor sustentável. Cabe a Portugal melhorar na recolha de dados socioeconómicos sobre a comunidade piscatória e dados ambientais sobre os impactos das artes de pesca e o estado das unidades populacionais de peixes, e na promoção do consumo de peixe local para reduzir a pegada carbónica do setor. Porém, Portugal está no bom caminho para vencer

estes desafios e impulsionar o seu setor pesqueiro para um dos setores marítimos mais sustentáveis.

PALAVRAS-CHAVE:

Pesca, Sustentabilidade, Portugal, Pesca de pequena escala, Conhecimento Local-Ecológico, Estratégia Nacional para o Mar

ABSTRACT

The Portuguese fishing industry is one of the national maritime symbols, nevertheless, it faces a wide information gap on relevant economic, social and environmental aspects. Globally, fisheries have been pressured to increase their sustainable performance, which is a critical step, particularly for a country like Portugal that has one of the highest *per capita* consumption of fish. The Portuguese fisheries have a significant impact in the national economy, a resilient fishing community, which is mainly composed by small-scale fishing vessels that operate locally. The Portuguese fishing sector targets a variety of species and employs a broad range of fishing gears, such as trammel nets, purse seine, traps and trawlers. As such, different fishing fleet can produce different impacts on the marine environment. The study of fisheries sustainability is important to address potential gaps, create opportunities for improvement and to identify and promote sustainable practices and improve the ones that do not meet sustainable guidelines. The aim of this thesis is to analyze and discuss the sustainability of the Portuguese fishing industry and its political support under Flagship Action No.77 of the Action Plan of the National Ocean Strategy 2021-2030. The sustainability analysis was centered on key economic, social and environmental aspects of the Portuguese fishing sector. Based on this aspects, it was developed 47 indicators that would allow an analytical evaluation of the sustainability of the Portuguese fishing sector. Over this analysis, it was found that Portugal has a general lack of information about the social and environmental dimensions of its fishing sector, and the economic data available does not reflect the true value of the sector, which hampers the process of the analysis. These urgent changes are not covered in Flagship Action No.77, and this action was reviewed as shallow to meet its goal of transforming the Portuguese fishing sector into a sustainable one. Portugal has to improve on collecting more socioeconomic data about the fishing community, and environmental data on fishing gear impacts and the status of fish stocks and on promoting the consumption of local fish to reduce the sector's carbon footprint. Still, Portugal is on the right track to overcome these challenges and boost its fishing sector to one of the most sustainable maritime sectors.

KEY-WORDS:

Fisheries, Sustainability, Portugal, Small-Scale Fisheries, Local-Ecological Knowledge, National Ocean Strategy

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INTRODUCTION

The fishing industry¹ is a key topic on international and national discussions on the ocean's health, due to its reputation of overcapacity, food security issues, habitat destruction, poor labor conditions and gender work inequalities². The discussion seeks to find solutions to guide the fishing industry toward a sustainable path, thus giving meaning to the word 'blue' in 'Blue Economy'³.

Capture fisheries provide well over 90 million metric tons of fish every year, delivering a vital supply of food to the world's rising population. Fish provides more than 3.3 billion people with 20% of their average per capita protein consumption (Bennet et al., 2018).

The high rate of seafood consumption in Portugal can be considered as both "a strength and a weakness" Garrido (2018, p. 113). The national sector is supported by the rich fish diet of the Portuguese, which continues to have the highest consumption *per capita*, in Europe (twice the EU's average *per capita* consumption), and one of the highest in the world (almost three times the global average⁴), often competing the third place with Japan (EUMOFA, 2021; FAO, 2022). This fact, aligned with the concentration of people who live in coastal regions, and tourists that visit them, elevates the national fisheries in one of the most important economic sectors in Portugal (Castro et al., 2021; Pita & Gaspar, 2020).

¹ In this thesis, the «fishing industry» is restricted to capture fisheries, hence it excludes the fish processing industry.

² For example, the Second World Ocean Assessment, the FAO report on The State of the World Fisheries and Aquaculture 2022; the 2022 EU Blue Economy Report, the European Commission report 'Towards a sustainable food system', and the UNGA Resolution 66/288 - The future we want.

³ In the 2022 Blue Economy Report, the European Commission states that "[the aim of the Blue Economy is to] provid[e] support to policymakers and stakeholders in the quest for a sustainable development of oceans [and] coastal resources" (EC, 2022, pg. VI). Therefore, the term 'blue' can also mean 'sustainable' and not just a reference to the color of the ocean. However, in this quest for sustainability, the European Commission emphasis the word 'sustainable', when referring to a sustainable approach in the Blue Economy, thus separating the term 'blue' from the term 'sustainable'. In the title of this thesis the word 'blue' is referring to the sustainability of the fishing sector.

⁴ In 2019, Portugal had a *per capita* seafood consumption (live weight equivalent) of 59,91kg, while the European average were 23.97kg, and 20.5 kg worldwide (EUMOFA, 2021).

In 2019⁵, 35.4% of fishery stocks are not within biological sustainable levels, still, in 2019, it was estimated that global discard levels accounted for 10% of the world catches (Pérez Roda et al., 2019). Hence, there has been worldwide efforts to ensure that the fishing industry is performing under a sustainable model⁶. This pursue is particularly relevant for a country that has been deeply marked by its fisheries, and where fish is not only a product, it's a tradition and a cultural symbol⁷.

The Portuguese fishing industry is mostly characterized by small-scale, coastal and artisanal operations⁸, accounting for 83.8% of the total of the national registered fishing vessels, and are a crucial component to the national coastal communities' economies. Small-scale fisheries (SSF) present themselves as a potential sustainable model for fisheries management, when comparing their net benefits (i.e. number of people employed in the fisheries, the proportion of the catch used for human consumption, number of discards) with the outcomes of industrial fisheries (Agapito et al., 2019).

Given the relevance of the fishing industry in Portugal it is important to understand: Is the national fishing sector sustainable? Does Portugal have enough data to adequately assess the sustainability of the fishing sector? Does the fishing community already engage in sustainable practices within their profession? Do Portuguese laws and regulations support a more sustainable fishing sector?

⁵ Most recent data available on biological sustainable levels of the global fishery stocks.

⁶ The European Commission has released documents to incentivize global food systems (including fisheries) to be more sustainable, in particular COM/2021/689 - Contingency plan for ensuring food supply and food security in times of crisis, and the 'Towards a sustainable food system' report, which provides information to help citizens to make sustainable food choices. These documents are a part of the 2021 Farm to Fork Strategy, which addresses food systems challenges toward sustainability.

⁷ "Fisheries and fishers hold a prominent place in the Portuguese imaginary space" ("As pescas e os pescadores ocupam um espaço saliente no imaginário português") (Garrido, 2018, p. 18).

⁸ Defining small-scale fisheries is still an ongoing challenge among literature, because each fishery presents specific characteristics that vary among countries and fisheries themselves. Therefore, there is not a defined concept of what constitutes a small-scale fisheries (Gibson & Sumaila, 2017; Smith & Basurto, 2019). This issue is further developed in chapter 2 of this thesis.

Within this context, this thesis seeks to perform an integrated evaluation of the Portuguese fishing industry, with the purpose of assessing its sustainability based on economic, social and environmental components, and to determine whether Flagship Action No.77⁹, established under the Action Plan roadmap for the National Ocean Strategy 2021-2030, is suitable to achieve the goal of establishing the fishing sector as a sustainable sector by 2030. It is worth mentioning that the national reports on fisheries statistics do not present information to distinguish between small-scale and large-scale fisheries on subjects such as landed and captured fish, their relevance within each fishing fleet, and in economic data, hence when not specified, it should be considered the fishing sector as a whole. However, due to the nature of the composition of the Portuguese fisheries, the thesis will present a greater emphasis on SSF, and their contribution to the evaluation of the three factors assessed in this analysis.

The thesis' methodology is based on secondary research. The main instruments for data collection is: (i) relevant literature (scientific articles, and international and national reports on economic, social and environmental aspects); (ii) legislation (international, EU and national regulations), and (iii) statistical data. Nonetheless, across this study it was identified some obstacles (i) data is spread across the responsible entities for managing different fisheries aspects; (ii) lack of coherent data on fish stock assessments over the existing studies, and (iii) information about sustainable key aspects is absent.

This thesis is divided into four sections.

In order to thoroughly illustrate the Portuguese fishing industry, first it will be described the national fishing fleet composition, main catches, and given the expression of small-scale fisheries in Portugal, it will be introduced the Portuguese small-scale community value to the fishing industry. In an effort to show the legal foundation that supports fisheries' conservation, the next section will present legislation in respect to fisheries management, first at an international

⁹ "To convert Portuguese fisheries into one of the most sustainable and low-impact sectors worldwide by 2030, stimulating the allocation of grants for the promotion of sustainable fishing and eliminating all grants harmful to the conservation of the marine environment".

level, then at an EU level, and last the Portuguese legislation on that matter. The fourth chapter, will serve as the core of this thesis, it will give an overview of the three main components of the sustainability analysis of the Portuguese fishing sector. First, it will be analyzed the economic performance of the fishing sector, by considering four components: fisher's¹⁰ profitability, the balance of trade of the Portuguese fishing market, fisheries' subsidies, and if the national economic assessments have enough data to properly determine the sustainability of the fishing sector. Second, it will be presented a characterization of the social well-being and work-conditions of fish-workers, in which, due to the nature of the Portuguese fisheries, the social characterization will be mainly focus on small-scale fishers. The last component is the analysis of ecological and environmental parameters of national fisheries, such as fish stock assessments, bycatch rates of fishing gears (such as purse seine, trammel nets and trawl¹¹), and the carbon footprint¹² of the Portuguese fishing industry. Following the assessment of these three components, it will be presented a series of indicators that compose a sustainable fishing sector, to serve as inspiration to verify whether the Portuguese fisheries meet those sustainable indicators, with the intention of making a grounded analysis of the sustainability of the Portuguese fishing sector. And, in the last chapter, it will be discussed possible future improvements for the fishing sector to fulfill the gaps identified in the previous section.

This analysis will be crucial to provide an integrated evaluation of the sustainability of national fisheries, whilst examine potential gaps and flaws within the Blue Economy framework of the Portuguese fisheries, and to discuss the need to collect more data on economic, social and biological components of the Portuguese fisheries. Given the importance of the fisheries sector in Portugal, the

¹⁰ In this thesis, it is adopted the term "fisher" instead of "fisherman", when referring to people that work in the fishing industry to promote gender equality.

¹¹ Despite the fact that the Portuguese fishing fleet is mainly composed of three main fleets: polyvalent (multi-gear), purse seine and trawl fisheries, during the analysis for this thesis, it was only found studies about discard rates on purse seine, trammel nets and trawl fisheries.

¹² Carbon footprint represents the totality of GHG emissions within a supply chain (Ziegler et al., 2013). Frequently, and as in this thesis, the fisheries' carbon footprint stands for the amount of CO₂ emissions (referred as "kg CO₂-eq") per ton of fish landed (Sala et al., 2022).

assessment of its sustainability is of the utmost relevance¹³. This thesis will serve as a research starting point, from which it will be relevant to follow with more data on the matter, particularly collecting more information on fisher's perspectives on key aspects, in order to fulfill the information gaps present in this study.

2. THE PORTUGUESE FISHING INDUSTRY

Portugal has an historical tradition in fisheries, and it is an important component of the national culture (Bué Alves, 2017; Garrido, 2018).

One of the most significant fishery segment that forever marked the Portuguese fishing tradition is cod. The cod industry (salted and dried) in Portugal dates back to the 15th century, and its culture is spread around the country in many forms, and it still has a relevant impact in economic and cultural aspects (Almeida et al., 2015; Coelho et al., 2011). For example, the city of Ílhavo in northern Portugal – it has a cod-dedicated museum, cod drying and salt extraction industries (Coelho et al., 2011). Cod represents a significant portion of fish produced by the fish processing industry. In 2020¹⁴, regarding the section of 'salted and dried fish', from the 61.2 thousand tons, cod represented 39 thousand tons (63%), cod. It also represents a big fraction of the frozen fish produced, 22.6% of the total 117.5 thousand tons production (INE, 2022).

The Portuguese fishing sector is one of the most diverse of the EU, which has been “rediscovered, by the growth of tourism, [associated with] the unique advantages of [providing] fresh fish” (Garrido 2018, p. 113).

The Portuguese fishing industry is an integral element of the coastal community economy, in particular in coastal cities that have a higher incidence of SSF. It provides support to several others indirect jobs and employment sectors, such as to local “fishing-related businesses (such as suppliers and sellers of nets, buoys, towing cables, fish boxes, etc.), major supporters of the

¹³ The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF Guidelines) encourages countries to further collect “bioecological, social, cultural and economic [fisheries] data”, because it can be decisive when discussing management approaches (FAO, 2015).

¹⁴ Despite the fact that the report was performed in 2022, the data on the fish processing industry is for 2020 and 2019.

food and tourism industry, supplying fresh fish to local restaurants and being the ‘visiting card’ for many small coastal communities along the Portuguese coast” (Pita & Gaspar, 2020, p. 291).

It is worth mentioning the Portuguese effort to address marine litter from the fishing industry. The project named “*A PESCA POR UM MAR SEM LIXO*” (Fishing for a Sea without Litter) was created by DOCAPESCA, Portos, Lotas, SA - Portos e Lotas, S.A, Associação Portuguesa do Lixo Marinho (APLM), Município de Peniche, Valorsul, S.A. e Ambinatura - Conservação e Manutenção do Ambiente, Lda. The goal of the project is to collaborate with fishers and vessel owners to prevent waste and to help to collect the still remaining marine litter in the sea. It has already the support of 3,157 fishers, and have prevented almost 8,000 m³ of litter from being washed up to the bottom of the sea (DOCAPESCA, Portos, Lotas, SA, 2015).

2.1. The Fishing Segment

The fishing industry has been on national discussions for centuries, in which the management of the sector was a central topic¹⁵ (Garrido, 2018; Pita & Gaspar, 2020). Therefore, fisheries sustainability in Portugal should be placed as one of the priorities for the renewal of the national blue economy, and move beyond written statements in the National Ocean Strategy, and its Action Plan developed by Direção-Geral de Política do Mar (DGPM).

In December of 2021, there were 14,917 registered fishers (in 2020 there were 15,324), but it is estimated that much more people are involved in the fisheries business (e.g. gear manufacturers, restaurants, and tourism) (INE, 2022; Pita & Gaspar, 2020). The Portuguese fishing community has 7,655 registered fishing vessels, from which 3,894 are licensed to practice fishing operations - i.e. fleet authorized to operate a certain fishing gear, in a specific area and for a specific period of time. However, in the last decades the number

¹⁵ The poor state of the Portuguese fisheries were already a concern in the late 18th and beginning of the 19th century. See Lobo, Constantino Botelho Lacerda, «Mémorias sobre a decadência das pescarias de Portugal», in *Memórias Económicas da Academia Real das Sciencias de Lisboa*, t. IV, Lisboa, 1812.

of registered fishing vessels and number of fishers have declined (Figure 1) (Baeta et al., 2009; INE, 2018, 2020, 2021, 2022).

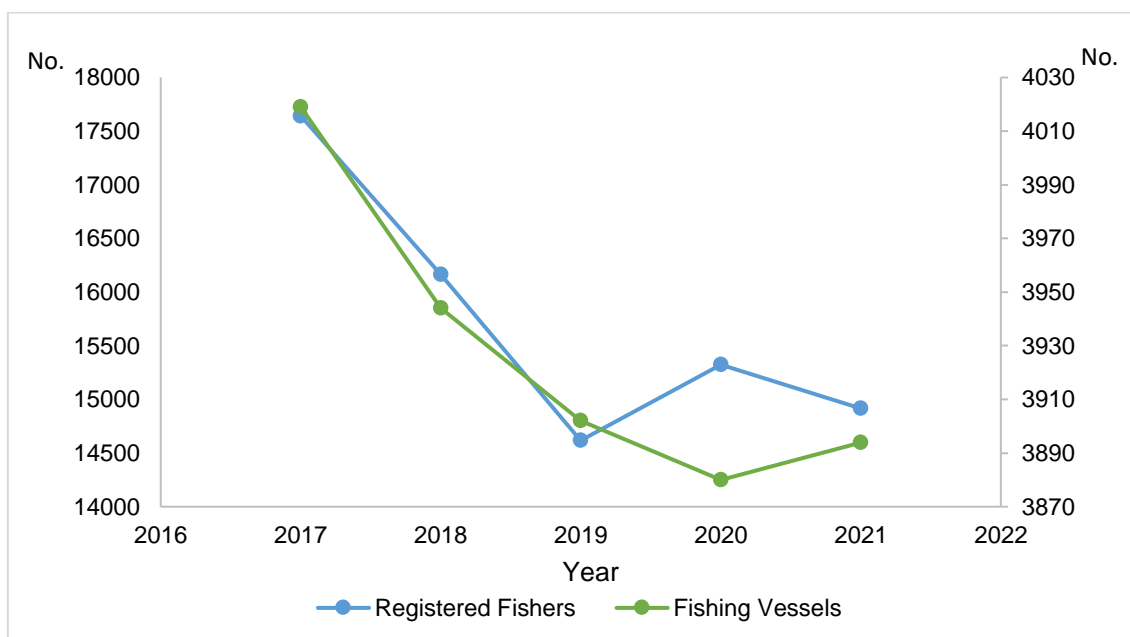


Figure 1 - The Evolution of Registered Fishing Vessels and Fishers in Portugal. Source: (INE, 2018, 2020, 2021, 2022). Note: There is an increase in the number of registered fishers in 2020, as a result of the registration requirement in that year, so more fishers became registered.

In 2021, the Portuguese fleet landed 185,417 tons of fish, which represented a slight increase (+13.2%) from the previous year. In 2021, there were 17 fishery producer organizations (PO), which accounted for 2,059 fishing vessels, about 52.9% of the total licensed vessels in Portugal. The POs accounted for 94 thousand tons of the total landed fish, and had an increased in sardine, horse and chub mackerel landings (INE, 2022). In 2020¹⁶, the fish and aquaculture processing industry produced 239 thousand tons of 'frozen', 'dried and salted', and 'canned' of fish products, and the this industry represented 94% of the total sales of the national fish production (INE, 2022).

Accordingly with the EU Fish Market 2021 report, the most consumed fish species in the Portuguese 'household' are: clams; european seabrass; gilthead seabream; hake; mackerel; miscellaneous shrimps; octopus; salmon; sardine; and scabbardfish.

¹⁶ Most recent information available.

Concerning the Portuguese fisheries management, it is based on an annual total allowable catches (TAC) and quotas system, in accordance with the Common Fisheries Policy (CFP)¹⁷. In addition, the EU can stipulate regulations on technical measures (i.e. minimum landing sizes, minimum mesh sizes, allowable percentages for by-catch species and target species, area closures and bans on the use of specific gear) and other restrictions to limit the fishing activity, such as prior administrative authorization for the acquisition or construction of new fishing vessels and use of fishing gear, and annual fishing licenses.

Portugal has one of the largest Exclusive Economic Zone (EEZ) in the European Union (EU), with an extension of 1.7 million km²¹⁸. Portuguese waters, and subsequent EEZs, are spread between the mainland area, the area of the Autonomous Regions of Azores and Madeira¹⁹ (Leitão et al., 2014). These areas have been studied for its coastal upwelling²⁰ characteristics, which have also been associated for its impacts on marine coastal environments and on marine biology, namely fisheries, due to its effects on fisheries recruitments (Leitão et al., 2019). The Portuguese fishing areas are ‘blessed’ by a rich biodiversity, which allowed the sector to evolve to target a wide range of species, which characterizes a fishing fleet (or a *métier*) that rely on different fishing gear (Baeta et al., 2009).

The coastal, artisanal fishing segment is more prone to use a higher variety of fishing gear (e.g. gillnets and trammel nets, dredges, trawls, traps, seines, and polyvalent vessels) (DGRM, 2019), to not only adapt to the diverse biodiversity, but to adjust to the species’ seasonality.

¹⁷ The Common Fisheries Policy is the fisheries policy of the European Union, through which the fishing fleet and stocks are managed based on a set of rules that promote sustainability. The Common Fisheries Policy is further developed in chapter 3.2.1.

¹⁸ The Portuguese EEZ might be extended to approximately 4 million km². In 2009, Portugal submitted to the United Nations a proposal for the extension of the Portuguese continental shelf, which will increase its current size by 2.15 million km² (Santos et al., 2015).

¹⁹ The Portuguese mainland area is under the ICES Division IXa to ICES Division IXb, the Azores region is categorized as ICES Sub-area Xa.2, and the Madeira area is under CECAF Division 34.1.2.

²⁰ Coastal upwelling can be defined as a “wind-driven phenomenon with strong repercussions on the temperature and biology of the ocean upper layer, occurring at appropriate places and times of the year along the eastern sides of the major ocean basins” (Ambar & Dias, 2008, p. 141).

Despite the diversity, the fishing activity in Portugal mainly consists of three fleet segments: the purse seine fleet, the trawl fleet, and the multi-gear (polyvalent) fleet (Cardoso et al., 2015). Still, the Fishery Statistics report performed by the National Statistics Institute (INE, in Portuguese) and DGRM do not distinguish between the percentage of each fleet among SSF and LSF, with the exception of the polyvalent métier.

2.1.1. The National Fishing Fleet

In 2021, the Portuguese fishing fleet landed 185,417 tons of fish, which represented a 13.2% increase from 2020 that was due to an increase in volume of catches in national waters (INE, 2022). In Portugal, the fishing community has a substantial discrepancy in its composition – 83.8% are small-scale fishing vessels, whilst only 2.2% consists of large-scale ones (more than 100 GT). Unfortunately, in INE's report or in any other cited bibliography, there is no detailed information to indicate what percentage of landed fish is from SSF and LSF, which would improve the understanding about how much these two segments really contribute to the national fishing sector.

In respect to the Portuguese fishing fleet, by the end of 2021, from the registered fishers, 64.5% were registered in the polyvalent fishing, 14.1% in purse seine fishing, 10.8% in trawl fishing, and 10.6% in inland fresh waters. However, to perform fishing activities, the fishing vessel must own valid fishing licenses in a specific gear. Regarding, the fishing licenses granted in 2021, 48.8% were licenses for hooks, 27.4% for nets, 12.6% for traps, 4% for trawlers, 1.8% for purse seine, and 5.4% for other gears (INE, 2022).

The purse seine fishing fleet was responsible for 47.5% (66,708 tons) of the total landings in 2021. This fleet is mostly used to capture small pelagic species, such as sardine (25,801 tons), european anchovy (9,225 tons), and horse mackerel (8,288 tons) (INE, 2022).

Despite being a fishing fleet that has attracted a lot of attention from scientists, due to its potential negative impact on the marine environment²¹, the trawl fishery fleet accounted, in 2021, for 12.1% (16,991 tons) of the total landings. This segment targets a variety of species, from small pelagic fish as horse mackerel, crustaceans as red and rose shrimp, to cephalopods as octopus. However, in this last year there was an increase of crustaceans catches in this métier and a decrease of small pelagics (INE, 2022).

And finally, the multi-gear (or polyvalent) fleet is the most significant fishing fleet in Portugal, both in number of fishers registered in this métier (64.5% of those registered), and in landings (40.5%, corresponding to 56,863 tons). 84 percent of this fleet consists of small-scale fishing vessels operating, and of those 90.8% work with static gear (non-active), such as hooks, nets, traps and pots. In 2021, it registered higher landings of tuna (11,579 tons), octopus (6,962 tons), and chub mackerel (4,626 tons) (INE, 2022).

The favorable conditions of the country have pushed Portugal into being one of the most prominent seafood consumers worldwide (Almeida et al., 2015). In 2019²², Portugal consumed 59.91kg of seafood *per capita*, which is an outstanding amount when compared with the average *per capita* consumption of the EU (23.97 kg of live weight) (DGPM, 2020; EUMOFA, 2021). Besides consuming almost triple in seafood products than the all EU average, Portugal consumers also spends a little bit less than three times the amount of money than the EU-27 average individuals spend on fishery and aquaculture products²³ (European Commission & DG MARE, 2021).

²¹ Campos, A. et al. Deep-sea trawling off the Portuguese continental coast—Spatial patterns, target species and impact of a prospective EU-level ban. *Marine Policy*, 128, (104466) 2021. Fonseca, P. et al. Bottom trawl codend selectivity for cephalopods in Portuguese continental waters. *Fisheries Research*, 59(1–2), 2002, pp. 263–271. Monteiro, P. et al. Discards of the Algarve (southern Portugal) crustacean trawl fishery. *Hydrobiologia*, 449, 2001, pp. 267–277.

²² Most recent information available.

²³ Portugal spends EUR 371 *per capita* every year, on fishery and aquaculture products, and the EU's average is EUR 133.

2.2. The Portuguese Small-Scale Fisheries

The fishing sector in Portugal is of utmost socio-economic importance for coastal communities, many of which are somewhat dependent on this economic sector. As aforementioned, fisheries contribute directly and indirectly to employment and income in coastal communities, specially by creating an increase in tourism opportunities to local restaurants and shops (Pita, 2014).

The Portuguese fishing industry is characterized by a high prevalence of small fishing vessels (83.8% of the total registered vessels), operating a vast array of fishing gears and targeting a multitude of species (INE, 2022; Pita, 2014). In INE's Fisheries Statistics report ('Estatística de Pesca' in Portuguese), there is no information about the number of fishing vessels that are under the category of small-scale and large-scale, this data is available, however, in DGRM's website. According with the excel sheet "Julho2021" available in their website²⁴, there is 293 fishing vessels registered under the category size of "equal or greater than 12 meters" (large vessels), and 2742 in the "under 12 meters" category (small vessels).

Despite the efforts, there is still no commonly agreed definition of SSF among literature. There is, however, one formal definition of "small-scale coastal fishing" provided by Regulation (CE) No 508/2014, on the European Maritime and Fisheries Fund (EMFF), Article 3, paragraph 14, defines SSF as "fishing carried out by fishing vessels of an overall length of less than 12 meters and not using towed fishing gear". This definition is thus applied to the territory of the EU.

Some authors also attempt to create a clear concept of what SSF implies. Pauly (2018, p. 2) defines small-scale fisheries as a "[fishing] sector, consisting of artisanal, subsistence and recreational fisheries, which strongly differ from the highly mobile industrial fisheries". However, that definition portrays a reality that simply does not apply to all SSF worldwide, it definitely does not well represents the Portuguese SSF scenario. In broader terms, the FAO Voluntary Guidelines

²⁴ Available at: <www.dgrm.mm.gov.pt/>. Accessed: September 3, 2022. The most recent information on the number of the Portuguese registered fishing vessels' sizes is from 2021, the 2022 excel sheet does not provide this information.

on SSF characterizes this sector in which the fishers are self-employed, the majority of their catches is for consume within their households or local communities, and are also important for the foundations of local culture and traditions.

In order to bring some harmony to SSF definitions, Gibson & Sumaila (2017) established a creative and ground-breaking framework in which is possible to assess the «degree of small-scaleness²⁵» of any fishery. In this study it is selected 17 common SSF features (vessel, economic and social features) that are described in literature. This approach adjusts to any fishery, and determine its scale of SSF, based on local characteristics that change from one country to another (Nakamura et al., 2021).

Regardless of the definition, SSF have consistently shown that they are sustainable operations²⁶. SSF operations are near-shored - thus consuming less fuel than large-scale fisheries (LSF) which operate in further from the shore - and serve as food suppliers to not only the fishers themselves but also to the local community. Artisanal fisheries typically operate under a more efficient and more selective fishing gear²⁷. Pauly (2018) believes that, artisanal fisheries can replace industrial fisheries within their communities, under a proper and adequate fisheries management. In this circumstances, fish stocks would be exploited by fishers who have a vested interest in the preservation of the coastal stock to which they depend on.

²⁵ The title of the paper.

²⁶ “Commonly, small-scale fisheries are identified as embodying alternative values of social and ecological sustainability in opposition to the dominant narratives of progress” (Johnson, 2006). “[T]he sector continues to generate income and serve the nutritional needs for millions of families worldwide. In some instances, SSF provide routes out of poverty for both men and women, and act as engines of growth at local and national levels. Furthermore, SSF also have broader nonmonetary values, and play an important role in maintaining the identity, culture and the wellbeing of coastal communities” (Cohen et al., 2019).

²⁷ Small-scale, artisanal fisheries can present low discard rates, since it traditionally used highly selective fishing methods, such as fish traps and non-active nets (Lloret et al. 2018) reported. However, some studies have point out that small-scale fisheries can also report significant quantities of discards due to the remaining active trawl fleet in the country (cf. Borges et al., 2001).

Concerning the Portuguese fishing community, it consists mostly of family-owned, generational²⁸, small-scale fisheries. (European Commission et al., 2021).

In the end of 2021, Portugal had 14,917 registered fishers across 45 harbors and 163 ports all around the country, and 7,655 registered fishing vessels, from which only a little more than half (3,894 vessels) actually are licensed to fish. From the 7,655 registered fishing vessels, 83.8% of those are vessels with lower gross tonnage (<5 GT), which are considered to be from SSF. And 84% of the fishing licenses released in 2021 were granted to fishing vessels under 10 meters – i.e. small-scale fishing vessels (INE, 2022).

The big portion of the total fleet is composed mostly of small-scale fishing vessels (under 12m, but the majority of vessels has between 5.5 and 7 m in total length), low tech, operating locally, employing a diversity of, mostly passive, gears, such as set gillnets, trammel nets, set longlines, handlines, pots, traps, and targeting multiple species (DGRM, 2020; Pita & Gaspar, 2020). From the fishing licenses granted, 90.8% of those operate with passive polyvalent fishing gear (hooks, nets and traps) in small-scale vessels (INE, 2022).

Small-scale fishing operations are highly dependent on weather conditions, seasons and the marine ecosystem itself, which all have differences across not only the year, but within a single day (Castro et al., 2021). Hence fishers do not operate on a stable all year-round basis, implying that are subject to significant stops, particularly during the winter season which hampers revenues and income (Gaspar et al., 2014). Furthermore, the profit during the 'fishing season' has to cover a variety of aspects: crew's salary; social security; and the 'share of the boat' - i.e. fuel, operational costs, fishing gear, food, and possible repairs that the vessel might need. However, the crew's salary is only handed out to the workers after deducting the 'boat' share, which is also known

²⁸ In a study performed by Pita et al. (2010), 75 fishers were interviewed to assess their willingness to leave the fishing sector. Among other questions, one of them had the purpose to examine the weight of family tradition in fishers' willingness to enter the fishing sector. 68 percent of the fishers interviewed stated that they started to work in fisheries as a part of the family heritage.

as the fishing share system and is commonly used among small-scale fisheries (Pita & Gaspar, 2020).

Frequently, fishers have a dawn-to-early morning departure (Johnson, 2013), where they leave on the beginning of the high-tide and they return on the beginning of the low-tide. The fishing trip involves heavy work of placing the fishing gear to the correct location and collect the ones that are already full. After the work on-board the fishing vessel, there is also significant amount of off-record and unpaid work (e.g. mending nets, preparing gear, baiting gear, and cleaning gear) done by the fisher, family, friends, or its crew, which reduces the overall operational costs (Pita & Gaspar, 2020).

The Portuguese small-scale fisheries communities are facing a portray of economic instabilities, lack of interest from the young population to work at sea and high operational costs, making it difficult to improve the sector and hence, push it toward sustainability²⁹. In fact, one of the weak points and threats to the national fishing sector is the lack of interest of the younger generations in joining the sector (MAR2020, 2020). Younger people tend to have a greater sensitivity to preservation, hence the income of a younger workforce would not only guarantee the future of the sector, but guarantee a more sustainable one. However, attract young people to fisheries, the sector has to provide job stability, opportunities for professional development, and security regarding their professional future (Branco, 2018).

Despite the harsh work conditions, in the Pita et al. (2010) study, it was shown that Portuguese fishers enjoy the life at sea, reporting that it would be needed an increase of 51% of their current income, in order for them to consider leaving the sector. Even so, the study also stated that Portuguese fishers' households are less depend on fisheries than the Greek and Scottish fishers communities analyzed.

²⁹ The Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries (SSF Guidelines) encourages countries to further collect "bioecological, social, cultural and economic [fisheries] data", because it can be decisive when discussing management approaches (FAO, 2015).

2.3. National Ocean Strategy 2021-2030: Strategic Goal 4 And Flagship Action No.77

The Portuguese National Ocean Strategy (NOS, also referred as 'The Strategy') is the government's overarching policy framework for maritime affairs. The NOS has emerged from the "need to properly manage the maritime areas under national jurisdiction [...] through a comprehensive and integrated long-term policy, using an intersectoral, interdisciplinary and truly transversal ocean approach (Comissão Estratégica dos Oceanos, 2004, p. 7). This report calls for a clear strategy that promoted a safe, healthy and sustainable ocean, "embracing the mission to reinstate Portugal as the maritime nation of the European Union (Comissão Estratégica dos Oceanos, 2004, p. 20). Following a path that started off with the National Ocean Strategy of 2006, Portugal now has had three versions of this document (2006-2016; 2013-2020; and 2021-2030). Each version presented a new ocean and coastal areas development model that brought Portugal one step closer to meet the challenges of the promotion, growth and competitiveness of the sea economy.

The Strategy is the main political tool that guides the national maritime policy toward an integrated approach (DGPM, 2021a). Over this decade Portugal, as the rest of the world, will have to deal with several major ocean challenges - biodiversity loss, habitat destruction, resource exploitation and climate change, hence an overarching cross-sectoral management strategy is key. Aligned with the goals of the UN 2030 Agenda, the NOS 2021-2030³⁰ developed 185 actions, which are organized around ten major Strategic Goals (SG) for the decade³¹, anchored in scientific knowledge, the need to protect the ocean and sustainable economic use. In an effort to achieve the SGs, the NOS presents thirteen priority intervention areas (PIAs)³² that represents sectors or sets of sectors and ocean-

³⁰ The NOS 2021-2030 was approved under Resolução de Conselho de Ministros No. 120/2021, 1 September 2021.

³¹ Chapter 4, NOS 2021-2030, page 22.

³² Chapter 5, NOS 2021-2030.

related areas which “need to, stimulus, and support to bolster them and help them contribute towards reaching the SGs” (DGPM, 2021a, p. 39).

Chapter 6 of the Strategy presents several define concrete and quantifiable targets that sought to control and monitor NOS. Among those, one particularly relevant target is under SG4 - *Invest in Guaranteeing Sustainability and Food Security*³³ that hopes “[to] keep 100% of fishing stocks within sustainable biological limits, following the parameters from the scientific assessment (i.e. ICES), adjusting the limits of the fishing effort to those levels”. Chapter 7 draws attention to the relevance of monitoring and assessing the NOS regularly, namely because it ensures that the goals and target established in the strategy are met, and that the NOS is effectively implemented.

Besides the NOS, DGPM also produced an Action Plan that will serve as a roadmap for the implementation of this strategy, its goals and targets, as well as a basis for its monitoring and evaluation. Among the Action Plan measures, 30 of them were identified and considered to be flagship actions³⁴, based on its scope and high effect multiplier potential. Under SG4 and PIA5 - Fisheries, Aquaculture, Processing and Commerce - the Action Plan identifies, among others, Flagship Action No.77, which aims at “*convert Portuguese fisheries into one of the most sustainable and low-impact sectors worldwide by 2030, stimulating the allocation of grants for the promotion of sustainable fishing and eliminating all grants harmful to the conservation of the marine environment*”.

3. THE LEGAL FOUNDATION THAT ADVOCATES FOR THE ADOPTION OF A SUSTAINABLE FISHERIES MANAGEMENT APPROACH

3.1. International Framework

³³ Also under PIA3 - Biodiversity and Marine Protected Areas and PIA5 - Fisheries, Aquaculture, Processing and Commerce – page 45.

³⁴ Table 1, NOS 2021-2030, Chapter 9, page 87.

Managing worldwide fisheries require long-term commitments, patient and compromises, but action is deeply necessary. The ‘tragedy of the commons’³⁵ has proven to be more true than just a theoretical scenario, for example the Peruvian anchovy in 1970s (Schreiber, 2012) and the Canadian cod stock in 1990s (Sterner, 2006). Both stocks suffered from a very severe case of overfishing and the constant disregard of the advices given by the science community.

To guarantee the security of ocean resources, such as fisheries, the international community has been developing a complex network of international and regional agreements and conservation tools of hard and soft law that have set governments into a path of a sustainable use of the ocean (Sovacool, 2009). Nonetheless, one of the most important and extensive, overarching piece of legislation in regard to the marine environment and its use is the 1982 United Nations Convention on the Law of the Sea (UNCLOS Convention). In regards the fishing industry and its practices, the most relevant legal instruments are the 1995 UN Fish Stocks Agreement, and also in 1995 the Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries³⁶.

It is also worthy of mentioning the 1995 Jakarta Mandate on Marine and Coastal Biological Diversity, in which it was acknowledged the urgency of action to combat the ocean’s crisis and it emphasized the adoption of an integrated marine and coastal management³⁷. The Jakarta Mandate has also been referred as ‘*the global consensus on the importance of marine and coastal diversity*’. And last, but not least, in 1960, the establishment of the Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO) – a United Nations’

³⁵ In 1968, Garrett Hardin published an article, in which he developed the ‘the tragedy of the commons’ theory to illustrate his perspective of the consequences that unrestricted freedom would cause on resource exploitation. The tragedy is caused by the irrational individual greed of the users. The ‘the tragedy of the commons’ theory is commonly used in fisheries, since the ocean can be easily perceived as an unrestricted space.

³⁶ In 2001, FAO released the International Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated fishing.

³⁷ Decision II/10 paragraph 2 and paragraph 3, on conservation and sustainable use of marine and coastal biological diversity - UNEP/CBD/COP/DEC/2/10.

body dedicated to create a strong global network of ocean areas of expertise in order to better understand and protect the marine environment.

3.1.1. The 1982 United Nations Convention on the Law of the Sea

The basic international legal framework with regards to States obligations and rights within their maritime activities and space is provided by the United Nations Convention for the Law of the Sea (UNCLOS) (1982). This Convention marks a very important first step that led to the first codification of the legislation for the sea.

Until 1982, the topic of the protection and preservation of the marine environment and its resources had attracted little attention. But at the third UN Conference (also known as the 'United Nations Convention for the Law of the Sea'), that scenario changed - policymakers and stakeholders started a significant shift in the way the topic 'marine environment' was handled. That is one of the reasons why UNCLOS is considered to be one of the most important milestones in the codification of the international law of the sea - through reforming the old fashioned post-damage control and introducing a preventive approach.

The preventive approach is coded in articles 192 and 193, where it declares that States have the right to exploit natural resources in within their waters (article 193), whilst under the obligation to protect and preserve the marine environment at all its extension (article 192).

Even though fisheries are not a main topic of discussion, there is one article dedicated to the «*Conservation of living resources*» - Article 61. This article declares that "coastal states shall determine the allowable catch of the living resources in its exclusive economic zone", which seems to suggest the establishment of total allowable catches (TAC). Article 62 (2) further declares that coastal State should determine its capacity to harvest the living resources of the EEZ.

Furthermore, coastal states must adapt conservation measures in order to prevent overexploitation – article 61 (2). Article 61 (3) further determines that the conservative measures "shall also be designed to maintain or restore populations

of harvested species at levels which can produce the maximum sustainable yield [(MSY)]. The term MSY is not defined by UNCLOS, but is generally known in the scientific community, which have presented some definitions on the matter. WWF (2011, p. 1) defined MSY as “the highest possible annual catch that can be sustained over time, by keeping the stock at the level producing maximum growth [for a given fish stock]”. However, the use of MSY levels as a fishery management tactic has been criticized for not fulfilling environmental, economic, social and political goal and objectives (Rindorf et al., 2017).

Nonetheless, while determining TAC levels, is one vital measure to ensure that living resources are protected and kept at or near sustainable levels, conservation measures are not limited to the obligation to establish catch limits (Winter, 2009). 90% of all commercially exploitable fish stocks are harvested within 200 miles of the coast, hence the conservation of living resources in the EEZ is of utmost importance (Tanaka, 2012).

Another very importance reference is the extension of responsibility beyond national jurisdiction. Besides managing living resources in their own exclusive economic zone (EEZ), to ensure long-term usage, all States have a share of accountability in the conservation of living resources in the high seas (article 118). Accordingly with article 87 (1)(e), States enjoy the freedom of fishing in the high seas, that are subject to conservation and management measures laid down in section 2, of part VII. Since the high seas are open to every State, article 118, goes one step further and declares that “States shall cooperate with each other in the conservation and management of living resources in the areas of the high seas”. And, as in the EEZ, States should determine MSY levels and other conservation measures to species that are harvested in the high seas (article 119(1)).

3.1.2. 1995 United Nations Fish Stock Agreement

The 1995 United Nations Fish Stocks Agreement (UNFSA) took effect in December of 2001. The Agreement builds on the fundamental principle laid down on article 64, in UNCLOS, regarding cooperation to protect highly migratory species.

The Agreement covers the conservation and management of straddling and migratory fish stocks under (e.g. cod, halibut, pollock, jack mackerel and squid), and beyond areas under national jurisdiction (e.g. tuna, swordfish and oceanic sharks) (article 3). The Agreement has been ratified by 77 countries, which most of them include top fishing countries worldwide, as it is considered to be a symbol of good practice among fishing countries (United Nations, 2010).

Article 5 displays the general principles of the Agreement, in which States should cooperate in order to adopt measure to conserve and manage straddling and highly migratory fish stocks (article 5(a)), to minimize pollution (article 5(f)), to protect biodiversity (article 5(g)), to prevent overfishing (article (h)) and, based on the best available scientific data (article (b), and (k)).

In addition, article 5 (c) laid down the foundation to establish the precautionary approach to conservation measure, which is described under article 6.1. The precautionary approach, as well as any fishery management decision making process, should be based on the best scientific information available. Furthermore, States should share this information so that conservation approaches can be improved jointly. The duty to cooperate, in regard to the conservation and management of straddling fish stocks and highly migratory fish stocks, among States can be found in articles 9 and 10 (Meltzer & Fuller, 2009).

3.1.3. Code of Conduct for Responsible Fisheries

One key instrument in the implementation progress of international fisheries policy is the Food and Agriculture Organization of the United Nations. In 1995, it adopted a voluntary Code of Conduct for Responsible Fisheries (hereinafter referred as 'The Code'), which "provides principles and standards applicable to the conservation, management and development of all fisheries", including "the capture, processing and trade of fish and fishery products, fishing operations, aquaculture, fisheries research and the integration of fisheries into coastal area management" (article 1.3). The Code, which was established under a wide scientific and policy consensus, sets out clear ethical and scientific principles and standards applicable to the conservation, management, and

development of all fisheries with the explicit aim of ensuring the sustainable and equitable exploitation of aquatic living resources (Pitcher et al., 2008).

The Code, as in UNCLOS, also presents the notion of a “precautionary” approach, in regards to the conservation and exploitation of marine resources, and fisheries management³⁸. However, in the Code the ‘precautionary approach’ is fully expressed, whereas in UNCLOS is only deducible from the implications of articles 192 and 194. Besides the approach, the Code has a particularly interesting twist to the usual State’s obligation to be guided by the best scientific data available.

Nonetheless, the availability of scientific data can be challenging. The scientific community has long criticized the lack of marine data, and even when it exists, it might not be publicly available because of data protection or political reasons (Muller-Karger et al., 2018). Moreover, the lack of investments in marine science research is also a big obstacle to obtain more data (Polejack, 2021). In spite of these reasons, those do not constitute a valid reason to not comply with conservation measures. States must act in favor of the protection and preservation of the marine environment³⁹.

Lastly, article 7.2.2, in the Code, lay down general principles within the mantra of good environmental/sustainable behavior in the fishing industry. Among them, there are the generally accepted principles of promoting fishing practices that can guarantee resources security and availability throughout generations, for example: the notion that States should take more actions to

³⁸ This concept can be found in article 6, paragraph 5 as a ‘General Principle’, and article 7, para.5. describes the precautionary approach specifically for fisheries.

³⁹ “States and sub-regional and regional fisheries management organizations should apply a precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment, taking account of the best scientific evidence available. The absence of adequate scientific information should not be used as a reason for postponing or failing to take measures to conserve target species, associated or dependent species and non-target species and their environment.” – Article 6.5.

prevent overfishing⁴⁰; to promote use of more selective and environmentally-friendly fishing gear⁴¹; and to protect small-scale fisheries⁴².

3.2. European Union Framework

The EU has a very unique legislative hierarchy within its Member States⁴³ and there is an interesting structure in regards to maritime affairs that is laid down in the Treaty on the Functioning of the European Union (TFEU). The EU established an overarching commitment “to promote economic and social progress and a high level of employment and to achieve balanced and sustainable development” (TEU Article 2).

The EU has exclusive competence in relation to ‘the conservation of marine biological resources under the common fisheries policy’⁴⁴ and shared competence regarding other aspects of fisheries, environment, transport, energy and research (Cavaliere et al., 2011). Which implies that only the EU has competences to legislate within the scope of conservation measures, and Member States can only act to the extent that the rules adopted by the EU authorize them to. Consequently, Member States are generally “no longer entitled to exercise any power of their own in the matter of conservation measures in the waters under their jurisdiction”⁴⁵ (Proelss & Houghton, 2012).

⁴⁰ *ibid.* Article 7.1.8; 7.2.2 a).

⁴¹ *ibid.* Article 7.2.2 g).

⁴² *ibid.* Article 7.2.2 c).

⁴³ Consolidated Version of the Treaty on European Union [2008] OJ C115/13, art 5, para 2 - Under the principle of conferral, the Union shall act only within the limits of the competences conferred upon it by the Member States in the Treaties to attain the objectives set out therein. Competences not conferred upon the Union in the Treaties remain with the Member States.

⁴⁴ This legal ground has basis on Article 3 (1) (d) of the Treaty on the Functioning of the European Union (TFEU), the conservation of marine biological resources under the CFP is subject to the exclusive competence of the European Union.

⁴⁵ Articles 3 (2) and Article 216 TFEU clarify that the EU's competence also covers adherence to international agreements addressing the conservation of marine biological resources. Article 191 (2) TFEU further requires that EU environmental policy is based on the precautionary principle and the principle of preventive action in order to achieve a high level of environmental protection.

The EU has traditionally been one of the major global markets for fish products, which increased with the addition of Spain and Portugal (Bretherton & Vogler, 2008). The North-East Atlantic is the EU's primary fishing area, and it is overseen by the North-East Atlantic Convention for the Protection of the Marine Environment (OSPAR). The Convention instructs State parties to establish an ecologically coherent network of protected areas that will contribute to the protection of marine resources that are, inherently, in motion. Hence, the responsibility of protecting those resources can fall over more than one individual state (Wakefield, 2010).

The EU is a leading actor in sustainable development, adopting more than 200 pieces of legislation that have direct repercussions on marine environmental policies and management, the protection of the marine environment by addressing the effects of human activities, such as fisheries (French et al., 2015). More recently, in 2018, the EC decided to reevaluate its fisheries control system, and released COM(2018) 368, which aimed to bridge the gaps between the CFP and other EU fisheries regulations.

The EU marine policy framework has as its structural pillars the Common Fisheries Policy (CFP), the Marine Strategy Framework Directive (MSFD)⁴⁶, and the Integrated Maritime Policy (IMP)⁴⁷. Despite the CFP being a very important instrument in fisheries management in the EU, the MSFD and IMP are also noteworthy.

The MSFD lays down a framework for its Member states, in which they should undergo any necessary measure to achieve or maintain good environmental status in the marine environment (Article 1 (1)). The MSFD is also aligned with fisheries management needs. Annex I - *Qualitative descriptors for determining good environmental status*, Descriptor 3 determines that in order to determine Good Environmental Status, “[p]opulations of all commercially exploited fish and shellfish [should be] within safe biological limits” (Raicevich et al., 2017). Both, the 2013 reformed CFP and the establishment of the MSFD are

⁴⁶ In 2008, the European Commission approved the Marine Strategy Framework Directive (Directive 2008/56/EC).

⁴⁷ In 2007, the European Commission released COM(2007) 0575, introducing the Integrated Maritime Policy for the European Union.

interrelated, and both linked to IMP, together these policies foster an integrated fisheries management based on science data (Rätz et al., 2010).

The IMP also stresses the importance of managing fisheries in the EU, by meet fish stocks at MSY levels, combat Illegal, Unreported and Unregulated (IUU) fishing, and last to ensure that the CFP echoes the ecosystem-based approach. Moreover, the IMP points out that fisheries management should consider the wellbeing of coastal populations, the status of the marine environment, and the connection of fishing with other activities more thoroughly.

3.2.1. Common Fisheries Policy

The Common Fisheries Policy (CFP) - Regulation (EU) No 1380/2013 "is, as one of the most integrated policies of the European Union, a showcase of European policymaking" (Lado, 2016). The objective of the CFP is to provide for the conservation and management of fishery resources while maintaining and strengthening the fishing industry. The CFP covers all fishing activities, aquaculture, and the processing and marketing of fish products carried out in member States' territory, in EU fishing waters, or by EU vessels. The CFP limits the exploitation of fisheries by, for instance, restricting the volume of catches (e.g. by establishing total allowable catches (TACs) and dividing them up as quotas among EU members) and restricting fishing effort (e.g. by limiting the number of vessels and the time spent at sea) (Rocha, 2012). Besides, it still encourages Member States to set technical regulations on fishing methods, data collection, subsidy schemes, and nearly all other aspects of fisheries management⁴⁸. Whilst the EU provides some guidance⁴⁹, Member States decide how TACs and other fishing opportunities are subdivided and distributed at national level, including what methods or criteria are used in this process (Carpenter & Kleinjans, 2019).

⁴⁸ Regulation (EU) No 1380/2013 of the European Parliament and of the Council on the Common Fisheries Policy¹ (the Basic Regulation) sets out objectives for annual proposals for catch and fishing effort limits to ensure that Union fisheries are ecologically, economically and socially sustainable.

⁴⁹ To control the allowed fishing opportunities, the European Union has established fishing licenses under the Council Regulation 2874/93 that provides a managing system to monitor landing, selling, transporting and storing fish, and records landing and sales of all operators across the industry within the EU and within the waters subject to the sovereignty or jurisdiction of the member States.

In 2013, the European Parliament voted for the reform of the CFP that came into force at January 1, 2014. The previous version of the CFP was criticized by the literature because it did not cover or provided adequate support to still dominant issues of the fishing industry, such as the impact of heavy subsidies that promoted further damages to the marine environment, the incapacity to effectively deter overfishing practices and fleet overcapacity. Therefore, in 2013, those flaws were revised and a new CFP was introduced on the Regulation (EU) No 1380/2013 of the European Parliament and of the Council, and took effect on 1 January 2014⁵⁰(Lado, 2016). The CFP revised version accorded small-scale fisheries more significance, and put greater emphasis in local development, which is reflected in the objective “contribute to increased productivity, to a fair standard of living for the fisheries sector including small-scale fisheries”. Furthermore “Member States should endeavor to give preferential access for small-scale, artisanal or coastal fishermen”. Another significant change towards a more fair and transparent fisheries management is the reward of sustainable fishing operations with priority access to resources, as set out in article 17.

Furthermore, the EU has failed to meet the legal deadlines to properly manage fish stocks. These deadlines were further underpinned by other international legal commitments such as the United Nations Sustainable Development Goals⁵¹. For example, the MSFD aims at achieving the ‘Good Environmental Status’ by 2015, which upon failure was deferred to 2021, a goal that has met another unsuccessful performance. Moreover, the concept of what constitutes a good environmental status in marine waters lies on each member state to define, which has been a slow progress towards the implementation of

⁵⁰ Regulation (EU) No 1380/2013 Of The European Parliament And Of The Council of 11 December 2013 on the Common Fisheries Policy, amending Council Regulations (EC) No 1954/2003 and (EC) No 1224/2009 and repealing Council Regulations (EC) No 2371/2002 and (EC) No 639/2004 and Council Decision 2004/585/EC.

⁵¹ Under SDG 14, target 14.4 states that: “By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield”.

the Directive (Wakefield, 2019). Another deadline postponed is the commitment to end overfishing⁵², which is due to the EU's tendency to set fishing limits higher than those reported by scientific advice. In spite of that, the trend is decreasing⁵³ (The PEW Charitable Trusts, 2017).

3.3. Portuguese Legal Framework

3.3.1. Portugal in the International Maritime Agenda

Recently, Portugal has reaffirmed its 'presence' on the international maritime agenda by hosting the 2022 UN Ocean Conference, in Lisbon.

Regarding other international commitments, Portugal is engaged in UNCLOS⁵⁴, in the OSPAR Convention, the UN Convention on Biological Diversity (UNCBD), the Indian Ocean Tuna Commission (IOTC), the UNFSA, and the CFP and IMP of the European Union (Ribeiro et al., 2017; United Nations, 2017). Furthermore, Portugal has an active role in its responsibility with respect to the Agenda 2030 for Sustainable Development, adopted by the United Nations in September 2015. Within the SDG 14, Portugal has pledged to reduce by-catches and discards from fisheries by 2023, to improve the certification system for local fisheries to comply with sustainable practices, and to continue to raise awareness for a sustainable fish consumption (INE, 2020b).

It is also worth mentioning the Lisbon Treaty relevance in the EU fisheries management. The Lisbon Treaty entered into force in 2009, and granted co-decision making competences to the European Parliament in the CFP (Zimmermann & Rosén, 2019). The Treaty presented fisheries as an important matter, and thus, it was introduced into the 'Agriculture' sector, in this way it was defined a common agriculture and fisheries policy. However, the Treaty dealt with

⁵² Acting in accordance with the procedure laid down in Article 251 of the Treaty. It is evident that pressure on natural marine resources and the demand for marine ecological services are often too high and that the Community needs to reduce its impact on marine waters regardless of where their effects occur.

⁵³ According with The PEW Charitable Trusts (2017), in 2014 the fishing limit was 58% higher than the recommended, and in 2017, it decreased to 55%.

⁵⁴ Decree of the President of the Republic No. 67-A/97, October 14, 1997.

fisheries products the same way as agriculture ones, referring everything as 'product', which effected decisions concerning the fishing sector (Wakefield, 2010).

In 1982, Portugal signed and ratified⁵⁶ the United Nations Convention on the Law of the Sea and the Agreement Relating to the Implementation of Part XI of 1982 UNCLOS⁵⁶. Portugal has also defined its national maritime areas, under Lei No. 34/2006, of June 28, making Portugal the third largest costal EU-State and ninth worldwide.

Portugal joined the EU in 1986 and has since implemented a fisheries policy within the framework of the EU CFP. After Portugal implementation of the CFP, fishing was no longer perceived as an sector in which the ultimate goal was to maximize profit of the captured product, but rather become a sector regulated through the balance of biological and economic sciences, and access restrictions (Garrido, 2018).

Portugal has maintained a long record in the international maritime agenda:

- In 1990, the Portuguese Government proposed an agreement for the protection of the waters and coasts of the Northeast Atlantic⁵⁷
- In 1997, entered into force UNCLOS and the Agreement Relating to the Implementation of Part XI;
- In 1998, the Independent World Commission on the Oceans (IWCO) led by the Portuguese government approved the «The Ocean: Our Future» report; in 2003, Portugal ratified the 1995 UNFSA on Straddling and Highly Migratory Fish Stocks;
- In 2006, it was presented the first National Ocean Strategy (NOS);

⁵⁶ In the Resolução do Conselho de Ministros No.83/98, it is expressed that Portugal's participation in UNCLOS represents "a clear statement of the country's desire for a peaceful use of the ocean, rational management of its resources and protection of the marine environment, through the cooperation of all States at the service of each nation and of humanity in general".

⁵⁷ The Lisbon Treaty was signed between Portugal, Spain, Morocco and the European Union.

- In 2007, it was established the Comissão Interministerial para os Assuntos do Mar (CIAM in Portuguese), and it was established the first high seas marine protected area - “Rainbow”;
- In 2013, presented the revised 2006 version of the NOS (NOS 2013-2020), and DGPM and INE started to elaborate the Portuguese Ocean Satellite Account;
- In 2014, Lei de Bases do Ordenamento e Gestão do Espaço Marítimo Nacional⁵⁸ (LBOGEM), Lei No. 17/2014, on April, 10; and Portugal “banned”⁵⁹ trawling gears;
- In 2015, Portugal signed the newly-released United Nations General Assembly (UNGA) Resolution 70/1, Transforming our world: the 2030 Agenda for Sustainable Development, on 25 September; and Portugal promulgated Decreto-Lei No. 38/2015 that developed the national marine spatial planning and defined specific instruments;
- In 2018, Portugal integrated the High Level Panel on Building a Sustainable Ocean Economy;
- In 2021, the most recent NOS was approved⁶⁰, it was created the action plan for the NOS⁶¹.

Portugal also participates actively in the Organization for Economic Co-operation and Development’s (OECD) project ‘The Future of the Ocean Economy’, which aims to conduct a global forward-looking assessment of the ocean economy to 2030, with particular emphasis on the development of emerging ocean-based activities. Participation in such an OECD project makes a significant contribution to Portugal’s international visibility as a committed oceans player. It also increases the national knowledge of ocean strategic planning and strengthens the community network (Ribeiro et al., 2017).

⁵⁸ Lei No. 17/2014 defines the fundamental law for marine spatial planning for the Portuguese maritime space.

⁵⁹ Portugal still continues to approve regulations for bottom trawling, such as Portaria No. 66/2017, February 13, 2017, which defines landing sizes, total captures and mesh sizes. It will be developed in section 4.3.2.1.

⁶⁰ Resolução do Conselho de Ministros No. 68/2021, May 6.

⁶¹ Resolução do Conselho de Ministros No. 120/2021, August 12.

And last but not least, Portugal was one of the pioneers (jointed with Canada) in establishing a dedicated satellite account for the ocean – Satellite Ocean Account (OSA) (Fenichel et al., 2020), in which it is described the direct and indirect production and consumption of goods and services related to maritime economic activities. The OSA is based on a set of economic indicators also find in the SEAMInd Platform⁶² (INE & DGPM, 2020).

3.3.2. Portugal/Domestic Maritime Legislation

In Portugal, there are several bodies/entities responsible for fisheries management. In the top of the chain there is the Ministry of the Sea, which is responsible for implementing domestic fisheries policies and delegate them to the State Secretariat for Fisheries. The Directorate General for Natural Resources, Security and Maritime Services (DGRM), the national authority for fishery, assists with the implementation of policies. DGRM's mission is to develop maritime security and services, including the maritime-port sector, the implementation of fisheries policies, aquaculture, the manufacturing industry and related activities, the preservation and knowledge of marine resources, as well as ensuring the regulation and control of the activities carried out in these areas.

The Portuguese Institute for the Sea and Atmosphere (IPMA), proposes technical measures in order to protect and maintain stocks. DOCAPESCA, PORTOS, LOTAS, SA S.A., a state-owned company, is responsible for organizing the first sale of fish, and supporting fishing and fish ports. Another relevant institution is the Directorate-General for Maritime Policy of the Ministry of the Sea (DGPM). The mission of the DGPM is to develop, evaluate, and update the NOS, to prepare and propose national sea policy in its diverse components, to plan and organize the maritime space in its multiple uses and activities, to monitor and participate in the development of the European Union's Integrated

⁶² The SEAMInd Project is an instrument developed by DGPM, dedicated to identify a set of indicators selected to monitor the results of maritime policies, such as the National Ocean Strategy. One of the objective of this project is to also develop a publicly-open digital platform to store and organize maritime data.

Maritime Policy, and to encourage national and international cooperation in maritime affairs.

Another relevant entity is the Inter-ministerial Commission for the Maritime Affairs (CIAM)⁶³. CIAM is led by the Portuguese Prime-Minister, and is focused on coordinating, managing and decision-making of public cross-sectoral maritime policies. Even though, CIAM has created the institutional foundation to properly promote and manage maritime affairs in the Portuguese maritime space, the governmental entity has not been very active in the national maritime agenda.

Concerning the legal framework for the national fisheries management, Decreto-Lei No. 73/2020, of September 23, establishes the legal regime for the exercise of professional activity in commercial maritime fishing and the authorization, registration and licensing of vessels or vessels used in the fishing activity. The licensing to engage in fishing activity is provided for in this Decreto-Lei, as well as the conditions for the exercise of fishing, which amended Despacho No. 14694/2003, of July 29 and Despacho No. 16945/2009, of July 23. Decreto-Lei No. 278/87, of July 7⁶⁴ and Decreto Regulamentar No. 43/87, of July 17 defines conservation measures applied to fisheries and natural resources (changed by Decreto-Lei No. 383/98, with respect to management and penalties). The types of fishing gear allowed are described in article 19 of Decreto-Lei No. 73/2020 of 23 September⁶⁵.

A note-worthy piece of legislation is the Decreto-Lei 78/2021, of 24 September that transposes Directive (EU) 2019/904 of the European Parliament and of the Council, of 5 June 2019, on the reduction of the impact of certain plastic products on the environment, in particular on the aquatic environment and on

⁶³ Resolução do Conselho de Ministros No.14/2016, of March 16.

⁶⁴ Amendments made by Decreto Regulamentar No. 28/90 of September 11, Decreto Regulamentar No. 30/91 of June 4, Decreto Regulamentar No. 7/2000 of May 30, Decreto Regulamentar No. 15/2007, of March 28, and Decreto Regulamentar No. 16/2015, of 16 September.

⁶⁵ Article 19 of establishes the fishing gear that can be carried out in territorial sea, EEZ and maritime inland waters: a) harvest; b) lines; c) traps; d) trawlers; e) shore seine; f) purse seine; g) trammel nets. (Decreto-Lei No. 73/2020 of September 23). In addition, for more specific cases, there are specific regulations, such as Portaria No. 172/2017 of May 25, on the art of 'xávega'.

human health. This legislation also addresses the use of plastic in fishing gear, in order to promote the use of fishing gear made of sustainable materials⁶⁶.

In regard to how fisheries are managed in Portugal, Garrido (2018, p. 129) condemn Portugal for having a long history of employing inconsistent policies. The author points out that the national fisheries management is “oriented towards the management of distant fisheries and the realities of a national fleet composed mainly of small-scale fishing vessels”. Moreover, Pitta e Cunha (2011, p. 58) also criticizes Portugal tendency to organize governmental matters on a vertical hierarchy structure, and that Portugal should implement a cooperation agreement between maritime-related ministries. Therefore, both authors emphasize the need to create not only, more consistent policies, but also that those should be implemented and enforced through horizontal cooperation among maritime sectors.

4. SUSTAINABILITY OF THE PORTUGUESE FISHERIES: A THREE CORE OBJECTIVE ASSESSMENT

The evaluation of the fishing sector has been mainly focus on the analysis of biological conditions to try to offer new approaches that might minimize fisheries' impact on the marine environment. And while it is true that a big part of the fishing industry is fish, the other part are humans. Still, social aspects are rarely evaluate, which are key to assess progress on social-ecological outcomes, hence it is urgent to design a social-ecological system framework that expresses the interaction between resources, policies and the community, to assure effectiveness and compliance (De Young et al., 2008). This integrated analysis can also be known as Environment, Social and Governance (ESG), the concept uses performance indicators to assess environmental goals, social values and needs, to serve as input for policy-making processes (Nõmmela & Kaare, 2022).

⁶⁶ See also Flagship Action No.90: “By 2021, ban certain single-use plastics for which more sustainable alternatives exist and promote the reduction of plastic use, reuse and recycling” (DGPM, 2021).

The new Blue Economy Report suggests a few transformations that would allow maritime sectors to reduce their impact on the marine environment. Fisheries are identified in 4 of the 6 main objectives of the selected transformations (i) switch to a circular economy and reduce pollution – through the adoption of sustainable standards for fishing gear design, (ii) preserve and restore biodiversity and ecosystems – to increase fish stocks; (iii) ensure sustainable food production – enforce a stronger fisheries control and promote research; and (iv) improve management of space at sea – improve communication among fish operators, stakeholders and scientists (European Commission, 2022, p. 37). The authors Fletcher et al. (2005), also emphasize that in order to establish a framework to describe fisheries sustainable development, it is critical to apply ecological processes, community well-being, and institutional and economic frameworks.

In light of these aspects, and considering the importance of fisheries in national and global food systems, assessing its components is of the utmost relevance, to identify possible weaknesses and areas to improve. Therefore, in this chapter, it will be discussed how sustainable is the fishing sector in Portugal by analyzing economic, social and environmental aspects of the sector and reviewing if Flagship Action No.77 is suitable to achieve the goal of establishing the fisheries sector as a sustainable sector by 2030.

4.1. The Fishing Economy in Portugal

In Portugal, Blue Economy data on fisheries can be found in three main documents: (i) The Economy of the Sea report that is yearly performed by DGPM, in order to conduct the evaluation of the National Ocean Strategy's goals and targets; (ii) the national Ocean Satellite Account (OSA); (iii) Fisheries Statistics report - performed by DGRM and INE. Across these several reports already conducted and available, it is quite clear the astonishing growth of the impact of the economy of the sea in the national account. In 2013, the blue economy represented 3.1% of the Total Gross Value Added (GVA) (EUR 4.7 billion)

(DGPM, 2019, p. 12), whilst, in 2018⁶⁷, it accounts for 5.4% Total GVA, 4.0% Direct GVA (EUR 7.1 billion) (DGPM, 2021b).

The national fishing and aquaculture sector represented 25.1% of Blue Economy GVA (2016-2018), and 33.8% of Blue Economy jobs (2016-2017) (DGPM, 2021b, p. 18). Concerning only fisheries, the Economy of the Sea Report stated that Portugal has 4,290 fishing companies, which employ 12,760 people – making it the second largest provider of employment in the Blue Economy after tourism.

In 2006, after presenting the first NOS, DGPM and the Portuguese Ministry of the Sea also created the Portuguese Observatory for the Blue Economy⁶⁸ – a monitoring platform that defines what activities should be monitored, how and how frequently, whilst compiling data. Through this observatory, DGPM provides reliable economic, social and ecological information on selected indicators of the ocean economy to the public. Under this Observatory, INE with the support of DGPM also developed the OSA. The Portuguese OSA is a paramount instrument that supports decision and policy making related to the sea (including the NOS), and it provides information for EU's maritime policy instruments, such as the IMP and MSFD, and it displays the Portuguese economic and social impact in the context of the Sea Economy (European Commission, 2022, p. 206).

In 2021, the Portuguese fishing fleet captured 185,417 tons of fish, of which 140,562 were fresh and chilled fishery that represented EUR 335,044 thousand sold in auction sites, referred in Portuguese as 'lotas' (a 27.8% increase in comparison to 2020) (INE, 2022).

The most consumed seafood products are salted/fresh water fishes that are also the ones with the lowest prices on the market (around 1.83 €/kg), and with higher landings, like horse mackerel, sardine, chub mackerel. However, in 2021, the average price for landed fresh and chilled fishery products decreased from 2.30€/kg (in 2020) to 2.28€/kg (INE, 2022).

⁶⁷ Most recent information available.

⁶⁸ More information is available at: <www.dgpm.mm.gov.pt/observatorio>. Accessed: September 4, 2022.

In Portugal, fishers do not or should not perform 'direct' sales to potential customers, they must deliver all landings to an auction site (lota) - DOCAPESCA, PORTOS, LOTAS, SA S.A. (in mainland), Lotaçor (in Azores) and Regional Directorate for Fisheries (in Madeira), where it is performed first-sale auctions, where registered buyers can acquire fresh-caught seafood products. In Matias (2013), the author builds on the idea that this system has transparency flaws and pushes even further the gap between the earnings of the fishers and those of the system.

In spite of its impact on Blue Economy accounts worldwide, the fishing sector has reportedly shown economic flaws that are currently hampering the path toward sustainability in the sector. One of the obstacles still to overcome is the 'lack of sustainable assessment', meaning that currently there is an absence of information regarding sustainable operations in the fishing sector.

For example, data on subsidies allocated to the fishing sector are extremely relevant, to assess what type of activities are governments supporting – fishing activities that further endanger the marine environment and fisheries biomass, or are aligned with sustainable standards (SDG 14.6) (Schuhbauer et al., 2017). Another significant economic barrier to sustainability is the low income that fishers gain. Béné & Friend (2011) stated that policy should be guided to provide more support to small-scale fisheries communities, since fishers still have a huge gap in earnings. And finally, because, in 2018, 67 million tons of fish were traded globally, making fishing products one of the most traded food commodities in the world (Asche et al., 2015; Vianna et al., 2020). Hence, the industry has the potential to have a substantial impact on the global carbon footprint, and to address the fishing trade market is to also tackle key environmental challenges (Sumaila, 2017).

In a final note, it is worth mentioning the national financing projects to support fisheries. MAR2020 is the main program that presents financing initiatives targeted at meeting the economic, environmental, and social needs and problems affecting the fisheries, aquaculture, and processing sectors from 2014

to 2020. The MAR2020 Operational Programme (OP)⁶⁹ has seven central priorities, the first one is related to increasing environmental awareness and promoting more investments in the fishing sector. The MAR2020 OP had a EUR 508 million budget for public support, from which EUR 392 million comes from the EMFF and EUR 116 million from national contribution. At the end of 2021, the MAR2020 OP had executed EUR 414 million. In regards to its first priority, this program has a budget of EUR 151 billion to support investments in the strategic goals for this priority, which include: increasing cooperation between fishers and the scientific community; ensuring educational programs about sustainable practices of fishing operations, and resource conservation; improve fishing working conditions and reduce the overall impact of the fishing sector (Ernst & Young; Augusto Mateus & Associados, 2020; INE, 2021).

Under Priority 1 – “Promote environmentally sustainable, resource efficient, innovative, competitive and knowledge-based fisheries”, there were 2083 approved operations, however only 7 were being put into execution: (i) Onboard Investments and Selectivity, (ii) The Start of Young Fishers Activity, (iii) Innovation and Knowledge Transfer between Scientists and Fishers, (iv) Protection and Restoration of Biodiversity, (v) Investments in Fishing Ports, Landing Sites, Auctions and Shelters, (vi) Temporary Terminations, and (vii) Definitive Restriction of Fishing Activities. Of the approved projects, 396 are vessel modernization projects aim to improve working conditions, and promote conservation and safety among workers, and 138 are in relation to fishing ports, landings sites, auctions and shelters.

Finally, the MAR2020 OP has reported positive outcomes in the selected indicators. The goal of reducing 10% of accidental catches in the national fleet was surpassed (by the end of the OP, fisheries registered a 34.8% reduction), and the defined goal to improve fuel efficiency during fishing activities (-25L of fuel/Tons of catch) was achieved and exceeded (-286.7 liters of fuel/Tons of catch) (MAR2020, 2021).

⁶⁹ The OP MAR2020 is an operational program integrated into Portugal 2020, the Partnership Agreement concluded with the European Commission to achieve the objectives set out in the EU Strategy for 2020.

In an effort to analyze the economic performance of the fishing sector in Portugal, it will be discussed the availability of sustainable economic data, the economic benefits of the national fleet, subsidies' allocation, and the analysis of the ratio of exports/imports of the national fishing industry.

4.1.1. Economic Obstacles to Achieve a Sustainable Fishing Industry

4.1.1.1. Low Profitability in Fisheries

One of the main challenges in Portugal's pursuit of a sustainable fishing industry is to improve social and working conditions for its small-scale fisheries.

Pita & Gaspar (2020, p. 300) described some of these economic issues as “low revenue from fishing (e.g. high operational costs, such as fuel prices), (...) problems related to the marketing and commercialization of products, poor management (...) high operational costs over the last few years, overexploitation of resources, and an increasingly high dependence on a limited number of species in some parts of the country (e.g. octopus)”.

The authors also highlight, in addition to the above Matias, C (2013) statement, the unfair economic situation of small-scale fishers, in which the community has been struggling with profit, since the prices at auction for the fishers have remained fairly unchanged over the last years and blame these low prices on lobbying from middlemen” (Pita & Gaspar, 2020, p. 301). This profit is vastly important to the fisher, not only because their income depends on the outcome of fish sales, but also because fishers do not have a stable monthly income. In spite of this unsteady salary, fishers have continuous expenses, like boat maintenance, purchase of fishing gear and gas. To aggravate this situation, and as a result of the unstable situation in west Europe, since the beginning of 2022, oil prices have increased abruptly. Consequently, among others, the EU fisheries sector has been suffering from these price increases (European Commission, 2022). The 2022 EU Blue Economy report stated that the EU-27 fishing fleet, and 40% of the EU's small-scale fleet, will continue to be hampered by these increases, and might registered profit losses in the amount of EUR 0.3 billion (European Commission, 2022, p. 60).

In Portugal, the only data on fisher's average salary is available on Pordata website, however is an average month salary for the 'agriculture, animal production, hunting, forestry, and fisheries' sectors (For 2020, the monthly average salary was EUR 949.7, and EUR 945.9 in 2019)⁷⁰. Thus, it is not available an estimate of the average monthly salary of the fishing sector alone, let alone of fishers' salary or an average of their expenses. This absence can be due to the fact that these informations can be difficult to obtain, to estimate the profitability of the fishing sector it could be used, instead, the difference between the prices of which the fisher sells its products and the price that the auction site sells to their customers. However, the first piece of information is not available, which puts the accessibility of this indicator one step behind, aside from that it hampers the system's transparency, since few informations are available.

4.1.1.2. The Balance of Trade on the Portuguese Fishing Market

One very important economic aspect of Fisheries' Blue Economy sustainable performance is the commercial balance or balance of trade (i.e. the difference between the monetary value or traded quantity of a nation's exports and imports).

In this thesis, the analysis of the Portuguese Commercial Balance is limited to the ratio between imports and exports of fisheries' products.

Fish is among the most traded food commodities, but the trade scale is rather one-sided. Developed countries are extremely dependent on seafood imports for their seafood consumption, whereas developing (low-income) countries have to rely on local products and on the supply provided by local fisheries. Therefore a critical next step to the modernization and globalization of the fishing sector is to ensure that we can secure fish availability for the locals in developed countries, whilst ensuring the flow of trade in a sustainable manner (Thilsted et al., 2016).

⁷⁰ This information is available at: <www.pordata.pt/>. Accessed: August 24, 2022.

In fact, the global fish production⁷¹ has not been increasing in several years (Figure 2), despite the ever increasing high consumption and demand for seafood products. Thus, some national fishing sectors have come extremely dependent on imports from other countries. In fact, in 2020⁷², the EU trade of fisheries and aquaculture products picked to a maximum of EUR 31.17 billion – the highest in the world, however, the EU is also the largest importer of seafood in the world⁷³. Its self-sufficiency in meeting a growing demand for seafood products from its own waters is around 30% (i.e. EU citizens consumed more than three times as much as they produced) (EUMOFA, 2021).

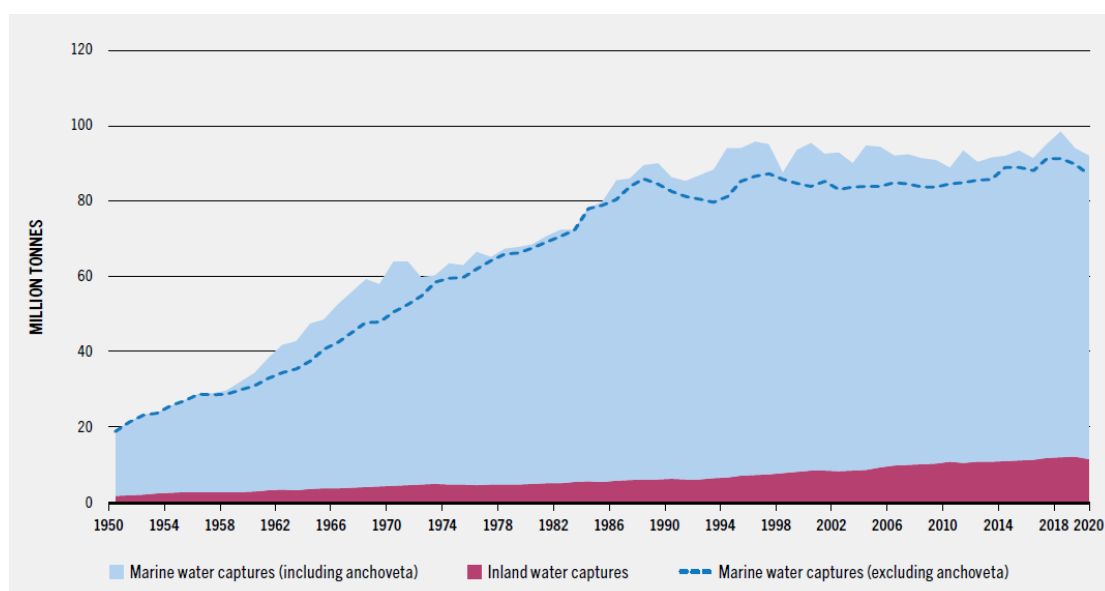


Figure 2 - Trends in Global Captures in Fisheries.
Source: (FAO, 2022, p. 12).

⁷¹ Despite this general stagnation on the production side, the economic performance of the sector has been increasing overtime. Partly thanks to the overall improvement on the stocks in the North-East Atlantic and low fuel prices for the primary sector; together with the consumers' high demand and willingness to pay for high-quality seafood products for the processing and distribution sectors.

⁷² Most recent available data.

⁷³ From the EUR 31.17 billion and 8.72 million tons of fish products traded, in 2020, 78% of the total value (EUR 24.21 billion) and 71% of the total volume (6.15 million tons) are accounted from imports (EUMOFA, 2021).

The Portuguese fishing market is characterized by the steady “high levels of consumption in the internal market”, nonetheless, Garrido (2018, p. 113) considers this market feature as “both a strength and a weakness”.

Despite being one of the biggest fish consumers worldwide, the Portuguese fishing market has a higher tendency for consuming imported products rather than national ones (Figure 3). This imbalance can reflect an unsustainable fish consumption and consumer choices, which directly impacts the carbon footprint of the fishing sector (an imported product has more percentage of carbon emitted than a local one) (Avetisyan et al., 2014). One of the biggest contributors to the asymmetry in the fishing commercial balance is due to the high consumption of cod in Portugal (Almeida et al., 2015). Salted and dried cod represented 10.5% of imports in the “salted and dried products” category, only salted cod corresponded for 5.0% and frozen cod stood for 6.3%. Overall, cod alone represents almost one-quarter of the total imports (INE, 2021).

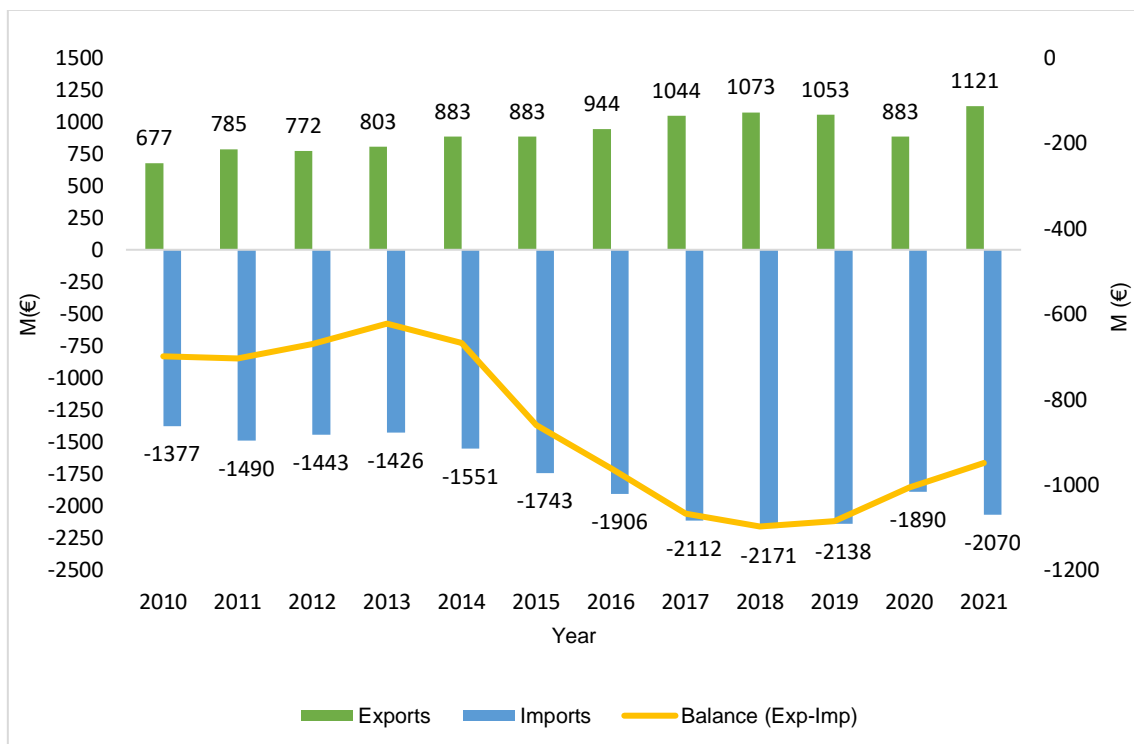


Figure 3 - Commercial Scale of the Portuguese Fishing Sector.
Adapted from DGPM (2021b) and INE (2022).

However, it is worth mentioning that in 2021, the Portuguese fishing industry exportations stood at EUR 1120.9 million, which reflected a 22.3% increase and a recovery from the COVID-19 impact from the previous year. An

increase of exports had a positive impact in the national fisheries commercial balance, yet a higher increase is needed to transform negative balance into a positive one (INE, 2022).

4.1.1.3. Fisheries' Subsidies

The fishing and aquaculture sector are among the maritime sectors of the blue economy that receives the highest monetary state aid⁷⁴, which goes against the proposals of the 2030 Agenda for Sustainable Development⁷⁵. According to the Sumaila et al., (2019) study governments spend an estimated amount of USD 35 billion worldwide every year to support the fishing sector, which can represent about 20% of the total value of all marine fish caught at sea. Still, subsidies' allocation are one-sided toward Large-Scale Fisheries (LSF), while SSF are constantly overlooked (Cohen et al., 2019).

In 2018, only 19% of the total global fisheries subsidies, in an amount of USD 35.4 billion were given to SSF (USD 6.6 billion), whereas LSF were provided with USD 28.8 billion (Schuhbauer et al., 2020; Sumaila et al., 2019). Furthermore, Schuhbauer et al. (2020, p. 1) takes on the possibility that “this unequal distribution of government support exacerbates the ongoing political and economic marginalization of SSF, globally”.

In the European case, the EMFF has a EUR 6.14 billion budget for the fishing and aquaculture sector.

If, on one hand, those subsidies are a fundamental help to not only sustain employment, but to fulfill some income gaps during ‘close seasons’, bad weather conditions (especially in regard to small-scale fish-workers), on the other hand if subsidies are not properly allocated, it might contribute and even incentivize overfishing practices, otherwise known as ‘harmful subsidies’ (European Commission, 2020). One good example to illustrate the difficulty of achieving this

⁷⁴ In this theses when referred ‘fisheries subsidies’, the concept follows the explanation provided in Sumaila et al, 2016: “financial transfers, direct or indirect, from public entities to the fishing sector, which help the sector make more profit than it would otherwise”.

⁷⁵ “By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies” (target 14.6).

balance is the case of fuel or vessel modernization subsidies - costs of inputs. In both cases, those subsidies would actively reduce operational costs, (i.e. the reduction of fuel prices or to improve the overall vessel, thus reducing the likelihood of damages), whilst may incentivize overexploitation (e.g. more time to fish, or fishing in more distant waters).

Even though, these two aspects are crucial factors that continue to hamper artisanal fisheries yield, some studies on the manner⁷⁶ indicate that a more sustainable option is to 'decomple'⁷⁷ fishing subsidies by income support; however OECD data shows that only 22% of the support is provided to decoupled actions (OECD, 2020).

Harmful subsidies are a big obstacle to achieving a sustainable fishing sector since these subsidies allow unsustainable operations and activities to continue to perpetuate directly or indirectly negative environmental impacts upon the marine environment. The European Commission has made the banishment of harmful subsidies one of the targets under its published Mission Starfish 2030: Restore our Ocean and Waters⁷⁸. Under one of the main objectives, – revamping governance – one of the targets (target 17) is to guide the EU toward an effective ocean governance. For the purpose of achieving this target, Mission Starfish committed to, by 2025, eliminating all harmful fisheries subsidies (including fuel and vessel construction) (European Commission et al., 2020).

Despite the commitments, the EU's fishing sector is still a heavily subsidized sector, in the majority of those subsidies being capacity-enhancing

⁷⁶ Cisneros-Montemayor, A. M. et al. Changing the narrative on fisheries subsidies reform: Enabling transitions to achieve SDG 14.6 and beyond. *Marine Policy* (117), 2020. Cisneros-Montemayor, A. M. et al. Strategies and rationale for fishery subsidy reform. *Marine Policy* (69), 2016, p. 229-236.

⁷⁷ Cisneros-Montemayor, et al., (2016, p. 232) defines a decoupled subsidy as “a transfer of income to subsidy beneficiaries without any conditions or specific uses, the key point being that payments are not linked directly to increases in fishing effort”.

⁷⁸ Mission Starfish 2030: Restore our Ocean and Waters was drafted by the European Commission as a way to emphasize the need to protect the ocean and its biodiversity as soon as possible, by discussing current ocean's issues. As the starfish itself, the Mission also has 5 overarching objectives to be achieved by 2030: (i) filling the knowledge and emotional gap, (ii) regenerating marine and freshwater ecosystems, (iii) zero pollution, (iv) decarbonizing our ocean, and waters (v) revamping governance.

(also referred as harmful) ones, where the status of the marine environment is not considered a priority. In a recent study⁷⁹, it demonstrates the EU effort and evolution to combat such issue, and despite its exasperated slow progress, the EU has reducing its capacity-enhancing subsidies, while increasing beneficial ones. Based on Arthur et al. (2019) there are several types of subsidies that might fall under the ‘harmful subsidy’ category, such as fuel subsidies, vessel purchase and construction and modernization.

In August 2021, the Portuguese government approved Portaria No.178-A/2021 of August 26, and more recently in the 2022 State Budget⁸⁰ in which it is declared a fuel subsidy to small-scale fisheries (artisanal and coastal), so that fuel prices can be reduced. Hence it will support fishers to reduce the total cost by decreasing taxes applicable to fuel-consumed by fishing activities (also under article 93 of ‘*Código dos Impostos Especiais de Consumo*’ approved by Decreto-Lei No. 73/2010 of June 21). This approval could be perceived as against international and the national agenda and goals for sustainable fisheries, more particularly, at glance, it seems to contradict the current NOS goals and the second aim in Flagship Action No.77: “encouraging the allocation of subsidies to the promotion of sustainable fisheries and eliminating subsidies harmful to the conservation of the marine environment”.

On the one hand, literature has portrayed ‘fuel subsidies’ to be naturally ‘harmful’, since they encourage fishers to prologue their stay at sea, which implies more time fishing and a large amount of captures and biomass removal (Sumaila et al., 2008)⁸¹.

⁷⁹ Skerritt, D. J. et al. A 20-year retrospective on the provision of fisheries subsidies in the European Union. *ICES Journal of Marine Science*, 77(7-8), p. 2748.

⁸⁰ Proposta de Lei No. 116/XIV/3rd.

⁸¹ “(...) fuel subsidies to the fishing sector could subvert the workings of the market and completely negate the expected sustainability value of a fuel price increase” (Sumaila et al., 2008, p. 834-835).

On the other hand, this scenario might not be applicable to small-scale fisheries. In an interview with a local fisher, Sandra Lázaro⁸² explained that coastal, artisanal fishers “cannot spend more time because what dictates [fishing] time is the river’s tide”, furthermore small-scale fishers traditionally work at the same spot over a large period of time or even during all their fishing activity. Thereby, fuel subsidies may not act as an incentive to fish for longer periods of time, because small-scale fisheries schedule is commonly tide-dependent, hence the fuel subsidy would only reduce the total fishing costs, thus increasing the overall earnings and profits of small-scale fishers.

Once again, the lack of data or accessibility on subsidy information in the Portuguese fisheries has restricted the analysis on the sustainable economic performance of the sector (Schuhbauer et al., 2017). Furthermore, upon that information, it would be useful to also provide data about not only the discrimination on LSF and SSF subsidies, but as well as what is being subsidized and are those considered capacity-enhancing, ambiguous or beneficial ones.

4.1.1.4. Lack of Sustainable Assessment

A critical gap in economic statistics (not only in Portugal) is the lack of a thorough analysis, in which there is a breakdown of the total blue economy income to properly express how much profit comes from sustainable operations and activities. This data deficiency masks the ‘true value of the ocean’, by combining all fisheries’ income, hence hiding the profit of sustainable activities, which in consequence can result in rewarding unsustainable practices (Stuchtey et al., 2021).

This flaw can arise from the traditional and sectoral evaluation system of the economic impact. Namely through the expression of economic measures such as GDP and GVA. These types of information completely neglect externalities produced by maritime sectors and their operations. It is fundamental

⁸² Sandra Lázaro is an artisanal fisher that works in Setúbal, Portugal. She is a 49 year-old fisher that has been working at sea and inside of a fishing boat since she was 2 years-old. She works in a small fishing vessel and uses fishing nets and traps to catch a high variety of species (as dictated by seasonality). Sandra talked to me in March, 25, 2022.

to conduct a deep assessment of the negative externalities (e.g. pollution (underwater noise, waste production, carbon dioxide emissions or perturbations on marine habitat), and positive externalities (e.g. carbon uptake, marine conservation actions or impact on biodiversity). After the assessment, these externalities should be considered when analyzing the economic performance of the Portuguese fishing industry. In addition, the acknowledgment of the benefits produced by natural resources (e.g. resource production), that affect not only sectors that directly or indirectly profit from those, but also the impact of those benefits in human life, is absent (Guerry et al., 2015; Picazo-Tadeo & Prior, 2009).

Without those valuable informations to estimate fisheries' natural capital, the economic performance of the fishing sector will remain incomplete (Stuchtey et al., 2021).

4.2. The Portuguese Fishing Community

Melo (2015, p. 42) wrote a book on the life of a few fishers in the Northern region of Portugal. The author describes being a fisher as a “[high] risk profession, incredibly demanding in physical and schedule terms, [that] is at the end of the profit scale gained from the fresh fish market [chain]”. The fishers presented in this book have similar stories⁸³ – they started working at sea at a very young age, they are fishers as a part of a family heritage and tradition (most of the men in their families are fishers), and they absolutely love their work⁸⁴, despite its hard conditions. The author also reported very early-departure fishing trips and the long harsh hours of their work. For example, in one of the studied fishing vessels: ‘*Neptuno*’, fishers worked from 1a.m from 7-8p.m on weekdays and every other weekend (Melo, 2015, p. 16).

⁸³ Nelson Caçador is a 54 year-old fisher that has been a fisher since he was 18, and he is following the family steps, as his great-grandfather, grandfather and father were fishers. Paulo Simão Matias that has been a fisher since he was 13 years-old. And José Constantino a fisher from Nazaré, since he was 20 years-old and he is a third generation fisher.

⁸⁴ “The sea is a part of me. There was something that was missing in me, and [the sea] gave it to me. It gives me peace” (Melo, 2015, p. 52).

Frequently, fishers have a dawn-to-early morning departure (Johnson, 2013; Melo, 2015), where they leave at the beginning of the high tide and return at the beginning of the low tide. The fishing trip involves heavy work of placing the fishing gear in the correct location and collecting the ones that are already 'full'. After the work undertaken during the fishing trip, fishers still have to take on a considerable amount of work that needs to be done before the next trip. These tasks mainly consist of repairing damaged gear, cleaning and preparing gear, which are performed at the fishing port by the fishing crew, at home by themselves or with the help of their family, or within a group of fishers that help each other (Pita & Gaspar, 2020).

As aforementioned, fisheries do not provide a stable workplace. The ability to go on a fishing trip is highly dependent on the status of the environment, such as weather conditions, seasonality and on the ecology of marine fauna (e.g. reproductive seasons, high levels of toxins in seafood) that is present all year-round (Castro et al., 2021). These changes can cause significant breaks in fishing operations, which frequently occur during winter, and consequently can reduce income (Gaspar et al., 2014). Despite these monetary setbacks, fishers still have to put money aside for a number of aspects, such as salary (for themselves and the crew), fuel, fishing gear, and taxes (Pita & Gaspar, 2020). Therefore, fishers must account for periods of financial losses and manage their money accordingly.

4.2.1. The Importance of Considering Human Aspects into Fisheries Management Approaches.

People are the engine of sustainable development, thus it is vital to pursue a world that is fair (SDG5), equitable (SGD10) and with human living condition for all (SDG1, SDG2, SDG3 and SDG8), through economic growth supported by social empowerment and environmental protection (UNGA, 2013).

Fisheries management approaches should insert human aspects and request further social science studies into consideration because this industry has multiple effects on worldwide livelihoods, and more seriously on small-scale fishing communities, and so, political arrangements should pursue the fulfillment of social needs (Clay & McGoodwin, 1995; De Young et al., 2008).

There is an increasing recognition and interest in the importance of social sciences in fisheries management as an opportunity to address some of the industry's problems. However, social concerns have been around for decades – INE & DGPA (1998) had already reported the lack of acknowledgment of social components in fisheries management plans. Furthermore, the failure to recognize the importance of people aspects is even probably one of the origins of those problems (Bailey et al., 2017).

Considering the fact that the success of fisheries management policies is extremely dependent on human willingness to change ongoing behaviors, such as the use of resources and the use of destructive fishing gear. Thus, not addressing social factors and fisher's voices can undermine the ultimate ecological goal of a management goal, and consequently (Fulton et al., 2011).

This perspective to fisheries management is known as the 'livelihoods approach' and was presented by Allison & Ellis (2001). The theory appealed to decision-makers to pay more attention to fishers, namely where they live, their earnings and fishery-based economies. The 'livelihood approach' has increased in literature to complement the ecosystem-based approach, in which the major focus is to protect the 'household' of marine resources. This would allow stakeholders and policy-makers to build a strong foundation through empirical research to the other side of fisheries, the side of "people's income-generating and subsistence activities" (Allison & Ellis, 2001, p. 380), because this approach provides information about demographics (e.g. age and gender structure); sociocultural (e.g. gender roles in the practice); economic (e.g. income, degree of fishery dependence, fish-based economies, expenses); policy (e.g. national policy goals for fisheries, governmental support).

The information above-mentioned is particularly relevant to not only improve policies but also to combat poverty, because, like (De Young et al., 2008) made it clear "[p]overty can be viewed both as impacted by inadequate fisheries management (a result of depleted fish stocks, etc.) and as a constraint in improving fisheries management". The 'livelihood' approach would be a particularly relevant option to bring into the Portuguese fisheries management,

since this approach would create an opportunity to address a number of social problems that the national fishing industry is currently facing (e.g. gender and age imbalance work structure and low income⁸⁵). Fisher's cooperation, willingness and well-being improve as knowledge increases, moreover, it strengthens the basis to pursue and aspire further well-being improvements (Chuenpagdee & Mahon, 2013). Besides, it would enable decision-makers to discuss additional alternatives to reduce fishing effort/stocks pressure, while providing a different source of income for fishery-dependent people/communities (De Young et al., 2008; Hilborn et al., 2020).

4.2.2. Social Conditions of Fisheries in Portugal

Across the analyze of the structure of the 14,917 Portuguese fishers, it is quite clear that the majority of the employed community is composed of middle-aged people (55.9% of the total is among the "35 to 54 years old" group), and the other half is split between the ages groups of "16 to 34 years old" (22.7%) and "55 years or older" (21.3%). Furthermore, the percentage of elderly ("55 years or older") people employed in the national fishing sector is increasing⁸⁶, thus jeopardizing the preservation and continuation of the industry (INE, 2022).

In addition, INE (2022) also provided information in regard to the average age in each fishing fleet. Fishers registered in trawl fisheries, 14.0% are under the category of "55 years or older", 63.1% have "35 to 54 years old", and 22.9% have "16 to 34 years old". In purse seine fishing fleet, for the "55 years or older", "35 to 54 years old", and "16 to 34 years old", there is 19.7%, 61.0%, and 19.4% of fishers registered, respectively. And finally, in the polyvalent fleet, 21.3% have more than 55 years, 55.2% have between 35 to 55 years, and 23.5% have between 16 to 34 years (INE, 2022).

⁸⁵ In the cited bibliography it is frequently referenced the "low income" in the Portuguese fisheries (Garrido, 2018; Pita, 2014; Pita & Gaspar, 2020), however, there is no precise data on the average earnings that the Portuguese fishers generate. The information available related to that matter is the average salary of the 'agriculture, animal production, hunting, forestry, and fisheries' sectors, as stated above.

⁸⁶ In 2019, the percentage of fishers registered in the age category of "55 years or older" was 20.8% (INE, 2021), in 2020 increased to 21.2%, and now it stands at 21.3% (INE, 2022).

The study carried out by Gaspar et al. (2014) about the socio-economic characterization of small-scale coastal Portuguese fisheries, was particularly relevant, because it shown a little bit of the fishers' voices and concerns. Regarding the lack of workforce renewal, the interviewed fishers pointed out that the toughness of the job and being considered among the community as a "lesser" profession as reasons why young people are not leant towards working in fisheries.

One of the biggest social issues within the Portuguese fishing industry is the gender gap between female and male labor. Whilst the industry might be perceived as a male-dominant one, the reality is that is not that straightforward (the misrepresentation of female work in fisheries is also an issue also felt worldwide⁸⁷).

On the one hand, female work is very often overlooked not only within the community but within fisheries governance as well, because many women play a key role in onshore, time-consuming tasks (e.g. helping in the construction of traps, cleaning the material, sorting the catch by weight, mending nets and help in the maintenance of the boat) (Santos, 2015). On the other hand, it is true that most deep-sea fishing vessel crews are mostly composed of men, whereas in coastal small-scale fisheries women have a bigger representation and play more important roles among the fishing community (Kleiber et al., 2017).

In this sense, it would be helpful to have data about gender distribution among the sector, however, that data does not appear in any national fisheries-related report (Economy of the Sea Report or the NOS), or databases (INE). The gender data is somewhat disclosed and examined in the Fisheries Statistics Report performed by INE, in table 1.8 about work accidents, which does not present enough information about women's presence in fisheries work. A possible solution to overcome this data gap is by analyzing gender in fisheries licenses, which would allow knowing how many of the 14,917 Portuguese fishers

⁸⁷ See Frangoudes, K. et al. Situated transformations of women and gender relations in small-scale fisheries and communities in a globalized world. *Maritime Studies*, 18, no.3, (2019): 241–248.

registered are women. In fact, addressing human aspects is a crucial step forward toward achieving some of the SGs⁸⁸ presented in the NOS 2021-2030, such as the one laid out in action No.66: “Promote equal access to professions to maritime professions by jobs, adopting measures that combat discrimination and inequality for women and foster equality and encourage the corresponding”. In the social portray of the Portuguese fishing community introduced by Melo (2015), the gender inequalities are blatant. From the several men mentioned in the book (interviewed fishers and mentioned male fish-workers onboard), just two female figures emerge – Rosa, the wife of one of the male fishers, and commander Cristina Alves, in which it is described her struggles among a male-dominant profession.

Besides gender inequalities, fishers also deal with social contempt with respect to their behaviors toward the environment. Braga et al. (2017) performed a study in Peniche, where it was conducted a series of questions to local fishers to assess their knowledge on the biology and ecology of local species. It was found that fisher’s local ecological knowledge⁸⁹ (LEK) in these matters was considerably extensive, and still fishers presented a desire to improve their understanding of fisheries’ biological knowledge, so that they could better predict ecological patterns and improve fishing efforts.

⁸⁸ SG6 - Promote Health and Wellbeing: “the health of the ocean is, in various ways, directly linked to the health and wellbeing of humans” (DGPM, 2021a, p. 29)., and in SG8 - Improve Education, Qualification, Culture and Ocean Literacy: “We must develop strategies to value cultural heritage that will contribute towards future education, science, land management, environmental, and tourism policies (DGPM, 2021a, p. 33).

⁸⁹ Local Ecological Knowledge (LEK) is the accumulation of fishers’ perception about the environment, natural resources and management practices, acquired through experience and providing records of past and present environmental conditions that can be transmitted between generations (Silva et al., 2020).

It has become more customary⁹⁰ to assess how a local community engages with the ecosystem's natural biological resources based on their perceptions of the resource, as a conservation method in wildlife studies (Kideghesho et al., 2007). Moreover, it is a way to complement the existing scientific knowledge on fisheries (e.g. species' and habitat's ecology and biology), since managing fisheries addresses species along with the users' management of this resource. Therefore, more information about fisheries (besides scientific data) can improve the international and national quest for sustainability in the fishing sector (Silva et al., 2020).

Further studies have to be conducted in Portugal to understand fishers' knowledge of their target biological resources, and assess how the social dimension is linked to policy effectiveness. One of the ongoing examples of this types of studies is currently being developed in Algarve (Southern Portugal), within the octopus' fishing community.

4.2.2.1. The Portuguese Artisanal Octopus Co-Management Fisheries: Joining Forces Between Fishers and Decision-Makers

In Portugal, the octopus fishery uses a traditional small-scale fleet with non-active gear, such as traps and pots, and is one of the main fishing activities in the Algarve (Southern Portugal). Currently, the octopus fishery is only managed by size restrictions, such as minimum landing weight, and gears used⁹¹ (P. Silva et al., 2019).

The octopus fishery management was criticized for being inadequate, and 'short-sighted' that overlooked data on the local small-scale fishing community.

⁹⁰ Silvano and Begossi (2012) have studied fishers in Brazil. And have found that not only, the LEK of Brazilian fishers complement the scientific knowledge on fisheries, but also to be extremely relevant in decision-making processes in local fisheries management. The authors emphasize the relevance of LEK in managing resources as a way to improve the management system, despite this being a general opinion among literature, not all authors agree (cf. Murray et al., 2006).

⁹¹ Portaria No.27/2001 of January 15,2001 stipulates 750g as the minimum landing weight for octopus. Gear restrictions are related to the number of traps, baited or non-baited, allowed per boat.

For this reason Pita et al. (2015), brought attention to the need to incorporate information about socioeconomic conditions, the sustainability of the sector, and about the evolution of the sector in Portugal.

However, Portugal's octopus fisheries case is a very strong example of LEK, in which science and fisher join forces to improve resource management. According to a recent study on the matter, “[i]nvolving fishers in the decision-making process would contribute to developing reliable management measures, increase fishers' sense of “intellectual property” of the measure and, as such, compliance with such measure”. Through this study, it became evident that local fishers do have some degree of ecological (e.g. behavior and abundance of fish) and biological (e.g. reproductive season) knowledge of their target-resource, while still preserving groundwork knowledge that is used on a daily basis, such as “optimize catches and minimize effort” (Silva et al., 2019; Silvano & Valbo-Jørgensen, 2008).

This year, led by Associação Natureza Portugal in association with World Wide Fund for Nature (ANP|WWF) in partnership with Instituto Português do Mar e da Atmosfera (IPMA), Centro de Ciências do Mar (CCMAR) of the University of Algarve (UAAlg) and Environmental Defense Fund, and co-funded by MAR2020 and Oceano Azul Foundation, the co-management octopus fisheries plan, named ParticiPESCA, had begun to take shape. The project involves about 700 fish-workers and 14 local fisheries organizations, and it is expected as described above, that the greater involvement and co-responsibility of the fishing community will result in better resource conservation.

Fisheries co-management is one strong solution to achieve a goal set in the PIA5 - *Fisheries, aquaculture, processing and commerce*: “It is also important to elevate the profession and promote the upskilling of fishers and their representatives by investing in training, as well as in technical and professional certification, to include concepts of environmental sustainability” (DGPM, 2021a, p. 49). Empowering local fishers is giving locals the power to be sustainable and to own their profession in a more holistic form, besides subsistence, thus making progress into accomplishing Flagship Action No.77.

4.3. Assessment of Portuguese Fisheries' Environmental Sustainability

Fisheries, as a critical source of nutrition, are responsible for providing a significant share of the food supply for human consumption offer an opportunity to improve nutrition while lowering environmental impacts, in line with SDGs and NOS goals⁹² (Bennett et al., 2021). It is imperative to keep the species and ecosystems that support these fisheries, as well as fish themselves, in healthy and productive states, in order to guarantee long-term sustainable harvests (i.e. protection and prevention of fish stock) (Buonocore et al., 2020; Gephart et al., 2021). As Bué Alves (2022, p. 71) eloquently expressed: “We protect the fish today to protect the fishers of tomorrow”. Maintaining the balance between production capacity and fisheries conservation and is one of the challenges facing the sector, with emphasis on the issues of overfishing, accidental catches, which results in the rejection of fish (by-catch) (DOCAPESCA, Portos, Lotas, SA, 2020).

The Portuguese fisheries ‘preventive’ system is based on the EU system described on the EU Common Fisheries Policy, which is regulated by quotas and total allowable catches (TAC)⁹³ that are recommended by ICES scientists. This management system presents restrictions upon fishing areas, fishing gear (e.g. standard mesh sizes), minimum catch sizes for some species, maximum percentages of incidental catches, and fishers has the obligation to record and declare catches and landings (Hill & Coelho, 2001; Leitão et al., 2014).

Based on Garrido (2018, p. 89), albeit the author states that “the regulation of fishing gear and effort tools were, and [still] are key issues”, they might not be the most adequate for preserving fish stocks. Considering that a little bit further in his book, the authors reports that in a “study [performed] by the journal Marine Policy, between 2001 and 2015, the majority of TACs defined by [the Agriculture

⁹² Fisheries have an effect on others SDG than just the SDG 14 related to marine biodiversity, it can also have an impact on SDG 2, on improving nutrition, and SGD 12, on ensuring a sustainable consumption and production of resources.

⁹³ Article 3 of the EU Regulation 170/83. Council Regulation (EEC) No 170/83 of 25 January 1983 establishing a Community system for the conservation and management of fishery resource.

and Fisheries Council]⁹⁴ were above the values recommended in the scientific opinions of ICES” (Garrido, 2018, p. 97). Thereby, to improve fisheries management it is crucial to, on the one hand, examine the ‘whole package’ of information (e.g. fishing gear, mesh sizes, fishing effort, fish stock assessments, etc.) and to, on the other hand, ensure that ICES recommendations are followed and complied with (Begg et al., 1999).

Portuguese fisheries are known for its diversity in fishing gear, a variety of target species, and it’s very affected by season. And as a result, data collection can be especially challenging⁹⁵. Still, the extensive academic work performed by several authors (Batista et al., 2009; Borges et al., 2001; Fonseca et al., 2002; Monteiro et al., 2001) have studied the impact of the different types of fishing gear employed by fishers across Portugal, in a specific target species or region, demonstrated that despite the low impact on the marine environment, the Portuguese fishing sector can improve on its accidental catches and discards. By-catches can affect biodiversity and community structure and hence it is of the utmost importance to monitor fishing gear to estimate its likelihood to increase or decrease accidental catches (Borges et al., 2001; Gonçalves et al., 2007; Millar et al., 2019).

However, there is another key factor in fisheries’ sustainability that is also linked to other maritime sectors. In 2019, the High Level Panel for a Sustainable Ocean Economy drafted a report that addressed five ocean-based areas that are considered to be a great source of greenhouse gases (GHG) emissions. CO₂ is undoubtedly the most significant GHG, since it has deeply impacted ocean systems⁹⁶. One of the areas identified in the report is ocean-based food system,

⁹⁴ The AGRIFISH Council brings together ministers from each EU member state. The Agriculture and Fisheries Council adopts legislation on fisheries policy, the setting of annual Total Allowable Catches (TACs) and quotas for each species, and on the allocation of fishing opportunities.

⁹⁵ Pita et al. (2019) performed a study in which it was compiled worldwide studies on how to improve data collection on SSF, and the main reasons why such essential information is still missing.

⁹⁶ Heinze, C., et al. The ocean carbon sink-impacts, vulnerabilities and challenges. *Earth Syst. Dynam.* 6, 2015, p. 327–358. Gattuso, J. P., et al. Contrasting futures for ocean and society from different anthropogenic CO₂ emissions scenarios. *Science*, 349(6243), 2015, p. 45-55.

which includes wild capture fisheries, where it is discussed the main contributing factor for GHG – fuel use. To this end, estimate the carbon emissions in the fishing sector is crucial to determine the impact of ocean-based foods, and thereby provide more information that could help to shift our diet towards low-carbon diets (Gephart et al., 2021).

At last, it is important to mention that the WWF has developed a ‘good practices’ guide, in which it contains information about each fish stock in a color scheme⁹⁷. And, the SOS Ocean Card produced by the ‘Oceanário de Lisboa’, which also provides information about the sustainable fish choices in Portugal (Bué Alves, 2022, p. 90).

This section will try to present an integrated analysis of the Portuguese fisheries’ environmental impact, by reviewing the national fish stocks assessment, the impact of the fishing gear employed and the carbon footprint of the sector.

4.3.1. Portuguese Fisheries’ Stock Assessment

In Portugal, the Portuguese Institute of Sea and Atmosphere (IPMA)⁹⁸, the Department of Oceanography and Fisheries (DOP) of the University of the Azores, the Regional Directorate for Sea Affairs (DRAM) of the Azores and the Regional Directorate for Sea affairs of Madeira (DRM), are responsible for providing information about stock status, and their conservation levels (INE, 2020b). Still, data on fish stocks are also provided by DGRM, DGPM and INE, which will be also presented in this thesis, respectively. Moreover, the commitment to assess fisheries’ stocks is reflected under one of the main goals of SG4 - “[t]o keep 100% of fishing stocks within sustainable biological limits, following the parameters from the scientific assessment (i.e. ICES), adjusting the

⁹⁷ This guide is available at guiapescado.wwf.pt. It presents a color scheme to advice consumers about the right and wrong fish choices in the Portuguese market.

⁹⁸ IPMA has a dedicated department that manages scientific investigations on marine fishing resources, the Department of the Sea and Marine Resources. More specifically, the Fisheries Resource Modeling and Management Division is responsible for the scientific monitoring of the state of exploitation of fishing resources exploited by the national fleet.

limits of the fishing effort to those levels”, in the NOS 2021-2030 Action Plan. And is also subject under one of the objectives of Regulation (EU) No 1380/2013, of 11 December 2013, on the CFP – “restoring and maintaining populations of fish stocks above biomass levels capable of producing maximum sustainable yield⁹⁹”.

In Portugal, fisheries are monitored through fishing logbooks, dock-side monitoring, digital record-keeping at auctions, and for larger vessels, vessel monitoring systems. Besides fishers’ information, Portugal also conducts research programs to provide further guidance to fisheries management (Sonderblohm, 2015). In order to assess the state of exploitation of fish stocks it should include scientific information on growth, reproduction rates, the current stock condition, and the level in which the stock is sustainably exploited. Based on these data, it is also established mathematical models that are used to predict how the stock would respond to changes in fishing effort (INE, 2020b).

4.3.1.1. Fish Stocks Assessment Information Provided by IPMA

IPMA delivers, commonly, every year¹⁰⁰ an extensive report, in which it is reported the current status of national fish stocks, and it provides scientific advice for the management of stocks in the next year. The report does not have an easy-reading presentation, thus, is not accessible for the general-public, besides it does not provide an overall information of the total fish stock’s status. One has to read each individual species’ details, through the scientific information provided, and check each stock status.

In the assessment performed by IPMA (2020a), there is a lot of information absence¹⁰¹, in relation to fish mortality and biomass, fishing efforts and reproductive rate. This situation is particularly present among the national fishery resources, where none of them have biological information. Furthermore, the report also advises Portugal to reduce accidental catches of the fleet, primarily

⁹⁹ Article 2, paragraph 2.

¹⁰⁰ However, the most recent available IPMA’s report is from 2020.

¹⁰¹ This information is available in the ‘comments’ section under each fish species. But for a clearer and quicker view of the information available for each species, see the previous report (2019).

among the bottom longline and bottom trawl fleet, which produces high numbers of shark species by-catch.

4.3.1.2. Fish Stocks Assessment Information Provided by DGRM

In 2019, DGRM reported “positive developments in the abundance and availability of species important to fisheries in Portugal” (DGRM, 2019, p. 1). It was also reported, in 2019, a 29% increase (in relation to 2018) in fishing opportunities (quotas) for TAC species¹⁰², such as “horse mackerel, megrim, red seabream, skates/rays, anglerfish and Norway lobster”. The report also stated that this increase is a direct reflection of “the good state of the stocks”, and the information delivered by ICES (DGRM, 2019). Nonetheless, little information is provided on the status of fish stocks.

4.3.1.3. Fish Stocks Assessment Information Provided by DGPM

DGPM also provides some information on national fish stocks available in the fisheries-related SEAMInd Volume (Volume V) (DGPM, 2015). In this volume, there are at least three indicators in regard to stock assessment: “Proportion of fish stocks exploited above the limits of biological sustainability”, “Number of fish stocks with analytical assessment exploitable at the level of maximum sustainable yield”, and “Number of fish stocks managed according to the Precautionary Approach”.

In respect to: “Proportion of fish stocks exploited above the limits of biological sustainability”, this indicator measures the ratio between the number of fish stocks that are being exploited above the limits of biological sustainability and the total number of fish stocks with fishing possibilities. In 2015, 4 of the (30.8%)¹⁰³ 13 stocks assessed were being exploited above the limits of biological sustainability – over-exploited. The numbers of this indicator has decrease of the

¹⁰² Annex IA of Regulation (EU) 2019/124, January 30, 2019.

¹⁰³ This data is provided by IPMA- ICES/ACOM.

years (in 2014, there were 38.5% of over-exploited fish stocks), however, there were only 13 stocks subject to assessment, and, furthermore, there is not a stock correlation over the years, since DGPM have stated, in the report, that different stocks are assessed in different years (DGPM, 2016, p. 156). However, the assessment of 13 stocks, and therefore the extrapolation that there were “only” 38.5% of over-exploited fish stocks, can be considered an over reduction of the fish stock exploited by the national fleet, which are around 66 species (Costa et al., 2020).

Relating to the “Number of fish stocks with analytical assessment exploitable at the level of maximum sustainable yield”, which calculates the ratio between the number of stocks with analytical assessment exploitable at the level of maximum sustainable yield (ICES Category 1), and the total of assessed stocks. Both in 2014 and 2015, it was reported that, from the 39 fish stocks assessed, 18% were being exploited at the MSY level (DGPM, 2016, p. 160). Yet, the assessment of 39 fish stocks, is to evaluate just slightly above half of the total fish stocks capture by the national fleet.

And finally, regarding the “Number of fish stocks managed according to the Precautionary Approach”. This indicator compares the ration between the number of stocks under ICES Category 5 and 6 (managed under the precautionary approach), and the total number of stocks, without considering the ones with analytical assessment exploited at the level of maximum sustainable yield. In 2014, there was 38% of fish stocks managed based on the precautionary approach, and in 2015, it decreased to 22%, which reflects a positive note on fish’s stock evaluation (DGPM, 2016, p. 161).

4.3.1.4. Fish Stocks Assessment Information Provided by INE

And finally, the INE also published an extensive study to evaluate the implementation of the SDG of Agenda 2030, in Portugal, during the period from 2010 to 2020. To monitor SDG14, the report presented three stock assessments groups, of the most economical relevant stocks that are attributed to Portugal. This study presents the results from the assessment by ICES.

The first assessment presented was stocks analyzed under ICES Category 1 (Figure 4):

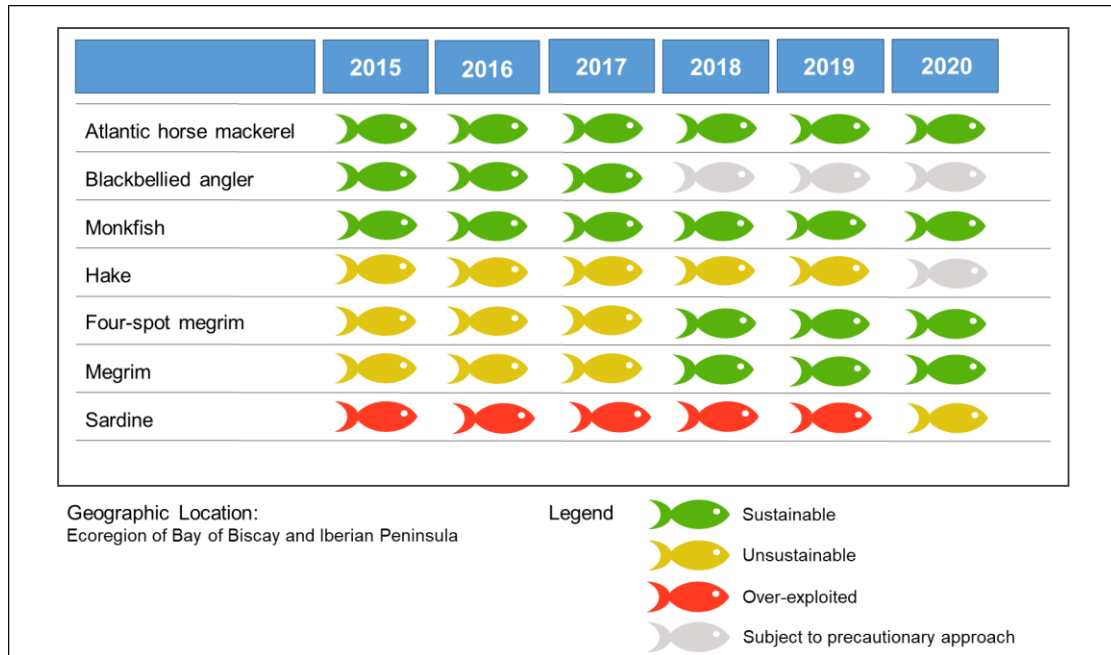


Figure 4 - Proportion of fisheries managed stocks with analytical evaluation (ICES Category 1). Source: INE (2020).

Within this group, the contrast between sardines and the other species immediately stands out, as an overexploited stock. However, the report states that the sardines is currently under a recovery plan that aims to recover the stock to sustainable levels until 2023. Meanwhile, between 2015 and 2019, biomass has increased by 52%. This recovery plan is being developed by both Portugal and Spain, under Portaria No. 5126-A/2022¹⁰⁴, and under the CFP principles, by emphasizing a precautionary approach to a joint co-management of the sardine stock.

The recovery plan report has indicated a 31.6% increase in sardine's biomass from 2015 to 2017. Portugal is responsible for implementing six

¹⁰⁴ Fishing for sardines (*Sardina pilchardus*) is reopened from 00:00 on May 2, 2022. 2 — The global limit of sardines caught with the seine gear by the Portuguese fleet for the year 2022 is 29,400 tons, to be distributed in accordance with the provisions of paragraph 3 of article 3 of Despacho No. 5126-A/2022, of April 29, members of recognized producer organizations (POs) for sardines and the group of vessels whose shipowners or owners are not members of recognized POs for sardines, corresponding to each of the groups, respectively, 28 959 tonnes and 441 tonnes.

conservation measures¹⁰⁵, such as fleet restriction (i.e. only the purse-seine fleet is authorized to catch sardines), sardine fishery can only operate under a specific season, landings and area restrictions – to avoid juvenile catches, and finally to improve cooperation between fishers and researchers (DGRM, n.d.).

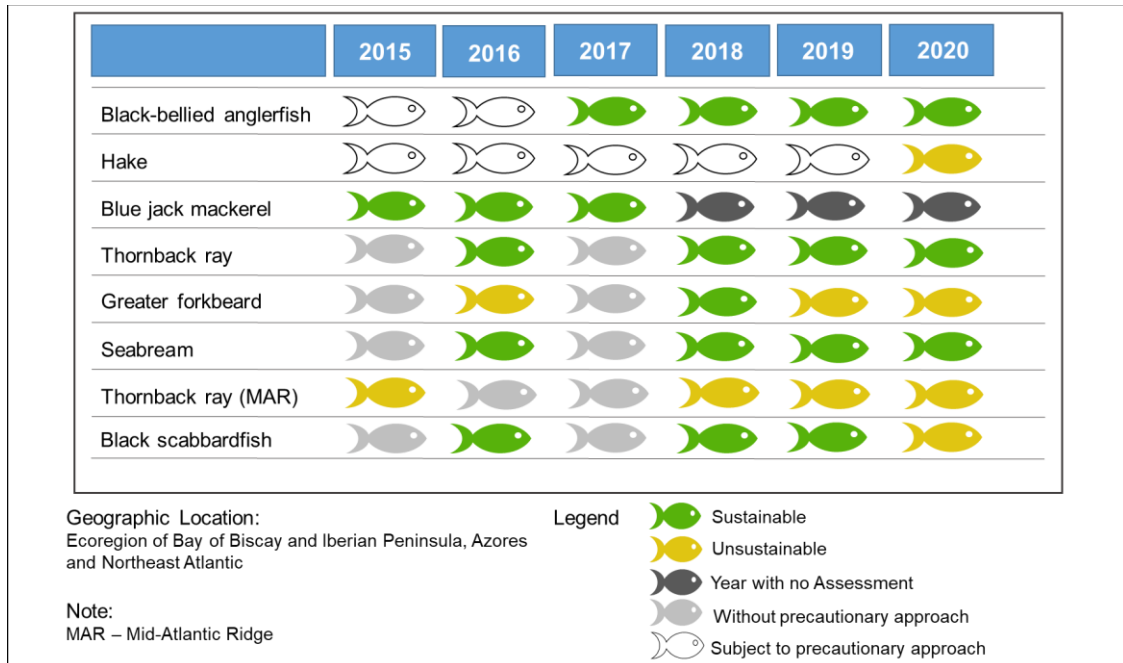


Figure 5 - Proportion of fisheries managed stocks with evaluation based on a precautionary approach (ICES Category 3).
Source: INE (2020).

For this second group (Figure 5), the fish species evaluated are from the Iberian Peninsula, Azores and the Northeast Atlantic. The Blue jack mackerel stands out, as a concern, due to its absence of assessment since 2018. Within this group there is a significant amount of stocks considered to be at unsustainable levels – 4 out of 8 fish stocks.

One aspect to consider is the seemingly contradictory information between this assessment and the previous one presented, about the hake stock assessment. In this ICES Category, Hake is considered to be ‘subject to analytical assessment’ from 2015 to 2019, and in 2020 changed to unsustainable levels; however, in the previous chart presented, hake has the inverse assessment.

¹⁰⁵ According to Portaria No. 251/2010 of May 4, and respective amendments: by Portaria No. 294/2011 of November 14, Portaria No. 173-A/2015 of June 8, and Portaria No. 34-A/2016 of February 29.

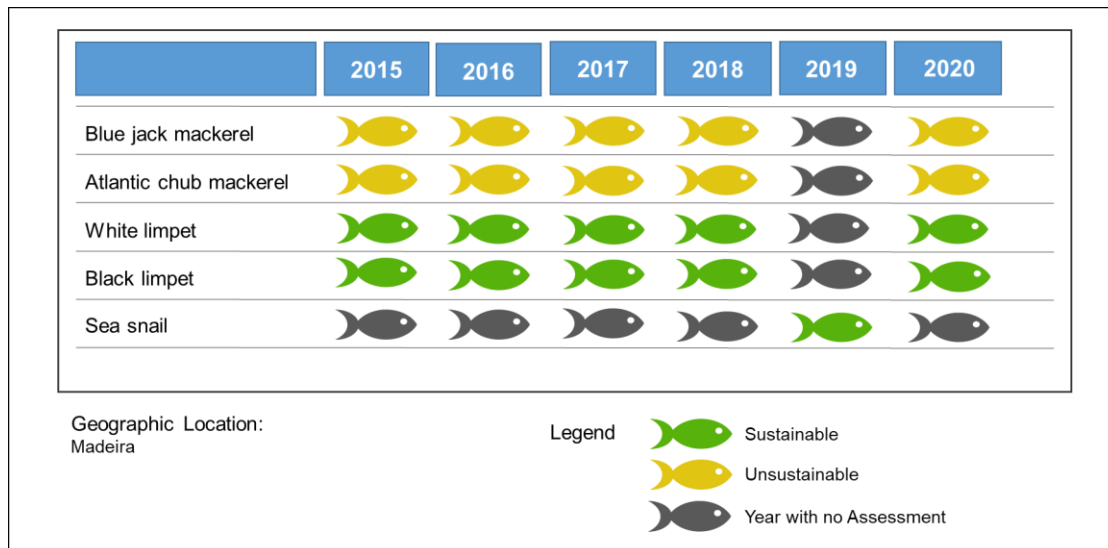


Figure 6 - Proportion of fisheries managed stocks with national level analytical evaluation (ICES Category 3).
Source: INE (2020).

In this last group (Figure 6), the assessment is from Madeira, one of the Portuguese archipelagos.

One aspect to be considered is the differences between the assessments of the Blue jack and the Atlantic mackerel, in the different regions. In Figure 5, the Blue jack mackerel, in Peninsula Iberica, Azores and Northeast Atlantic, is considered to be managed at sustainable levels, with the exception of 2019, in which there was no assessment. Whilst in Madeira, the same stock is being managed at unsustainable levels, however, there was also not an assessment in 2019. And the Atlantic mackerel, is considered to be sustainably managed in the Biscay Bay and Iberica Peninsula, whereas in Madeira, the stock is at unsustainable levels.

And finally, the sea snail stock has not being assessed as it should. Since the report has chosen economic relevant stocks, thus sea snail stock should have, as the rest of the stocks considered, been assessed.

Froese et al. (2021) performed a broad study on the Northeast Atlantic fish stocks' status, in which it was estimated that, in 2018¹⁰⁶, Portugal had a 25% of overfished stocks, and 21.4% of stocks were below the level that can produce

¹⁰⁶ Most recent information available in the article.

maximum sustainable yields. Nonetheless, Portugal ranked first with the least percentage of overfished stocks, among other countries such as Iceland, Norway.

4.3.2. Fishing Techniques, Gears, and Their Environmental Impact

The NOS 2021-2030 defined, in its Action Plan, a specific measure to promote the use of selective, biodegradable and low-impact fishing gear (Action No.78): *“Reinforce the use of selective fishing gear, proven to be biodegradable in the marine environment and of low impact on ecosystems and on the species most vulnerable to accidental capture”*.

The scarce studies on bycatch and discard rates on the Portuguese fisheries, may be due to the high variability of fishing fleets, types of gear, target species, fishing locations, different fishing seasons, and habitats. These characteristics limit the ability of performing comparison studies between fisheries and gears (Tsagarakis et al., 2014; Uhlmann & Broadhurst, 2015). However, there is still some literature work on the Portuguese fishing gear, especially on trawl fisheries (Millar et al., 2019), Campos et al., 2021b, Fonseca et al., 2002), and purse seine (Wise et al., 2007), and more specifically on their impact on accidental catches.

Across these works, it is possible to extrapolate that the overall gears and techniques used in the Portuguese SSF present a low percent of accidental catches, with the exception of trawl fishing métiers¹⁰⁷.

On the other hand, traps are considered to be one of the most selective gears (i.e. with fewer discards). Because, as a non-active gear, traps cause less habitat disturbance than others active gears, and present low catch rates per trap, and per fishing vessel (Vasconcelos et al., 2019).

¹⁰⁷ Borges et al. (2001, p. 104) studied by-catches in 5 Portuguese fishing fleets. In which it was found that “[the] mean discard rates per trip of were 0.13, 0.20, 0.27, 0.62 and 0.70, respectively, for trammel nets, demersal purse seines, pelagic purse seines, fish trawls and crustacean trawls”.

In Portugal, as in SSF around the world, it is common for fishers to keep a portion of their catches to their personal consumption¹⁰⁸, either because the catch is a part of the accidental ones, or because they have low commercial value at the fishing dock (Baeta, 2009). However, in national reports there is not an indication of the percentage of the total catch that is later considered by-catch or considered as discard¹⁰⁹, which would help in the analysis of the sustainability of the national fishing sector.

4.3.2.1. Purse Seine

Borges et al. (2001) and Almeida et al. (2014) have published articles on the discussion of the potential impact of the Portuguese purse seine fishing fleet on accidental catches. The results were promising.

Borges et al. (2001) performed a study on 14 demersal and 13 pelagic purse seiners, which presented, on average, low discard rates, from 20 to 30% of the total catch. On one of the trips, it was recorded a discard of 20 thousand kg of mixed low commercial value species such as chub mackerel, seabream, and mackerel, and another fish trip with 8,000kg of chub mackerel and sardine were discarded. On average, demersal purse seine presented a 11229 kg amount of discards, and the pelagic purse seiners, 5509 kg. On a final note in the study, it was indicated that 81% of the total biomass discarded in this fleet were fish and cephalopods, plus 43 species of invertebrates and 3 species of algae were always recorded in discards counting's.

In a similar manner, Almeida et al. (2014) also reported low discard rates during this study. The discards recorded were mainly of non-target small pelagics, such as chub mackerel. However, this study raised an interesting question in

¹⁰⁸ Caraballo, M. et al. By-catch Study of the Puerto Rico's Marine Commercial Fisheries. Gulf and Caribbean Fisheries Institute Proceedings, (2007): 139-150. Santos, A. Fisheries as a way of life: Gendered livelihoods, identities and perspectives of artisanal fisheries in eastern Brazil. *Marine Policy*, 62, (2015): 279–288. Poe, M. et al. Subsistence fishing in a 21st century capitalist society: From commodity to gift. *Ecological Economics*, 116, (2015): 241–250.

¹⁰⁹ In INE's Fisheries Statistics Report, it is stated that the total weight landed of fish takes in consideration discards and by-catch.

regard to slipping (i.e. when fish is released or fall of the nets before coming onboard¹¹⁰). Discard rates can be significantly higher if slipping were considered as a discard, therefore the authors stresses the need to conduct further monitoring studies, in order to properly assess discards in this fishery.

4.3.2.2. Trammel Nets

Trammel nets are an extremely versatile gear, which can be used to capture a wide variety of species, and it is commonly used in European waters (Gonçalves et al., 2007), as well as in the Portuguese artisanal fisheries (Baeta et al., 2010).

This gear is managed through Portaria No. 594/2010 of July 29, which determines the number of nets, mesh sizes, time period in which their use is allowed and areas.

In Portugal, most of the studies related to trammel net fisheries are from the southern coast of Portugal (mainly in Algarve)¹¹¹. In spite of the fact that trammel nets have a high catch rate, this gear is rather selective and present low discard numbers (Borges et al., 2001). Nonetheless, a 2009 study in the west coast of Portugal, demonstrated that among 37 fishing trips of trammel net fisheries, 59.6% of total catches were considered discards. The most important species caught by this métier, during the study, were cuttlefish and sole, and

¹¹⁰ Marçalo, A. et al. Mitigating slipping-related mortality from purse seine fisheries for small pelagic fish: Case studies from European Atlantic waters. *The European Landing Obligation: Reducing Discards in Complex, Multi-Species and Multi-Jurisdictional Fisheries*, (2018): 297–318.

¹¹¹ Erzini, K., et al. Catch composition, catch rates and size selectivity of three long-line methods in the Algarve (southern Portugal). *Bol. Inst. Esp. Oceanogr*, 15(4), 1999, p. 313–323. Erzini, K., et al. An experimental study of gill net and trammel net “ghost fishing” off the Algarve (southern Portugal). *Marine Ecology Progress Series*, 158(1), 1997, p. 257–265. Erzini, K., et al. Quantifying the roles of competing static gears: Comparative selectivity of longlines and monofilament gill nets in a multi-species fishery of the Algarve (southern Portugal). *Scientia Marina*, 67(3), 2003, p. 341–352. Gonçalves, J. M. S. et al. Discards from experimental trammel nets in southern European small-scale fisheries. *Fisheries Research*, 88(1–3), 2007, p. 5–14.

among the most accidental caught species there were species of ray, octopus and sole (Batista et al., 2009).

Trammel net fisheries have also reported elasmobranchs as a main bycatch species (Baeta et al., 2010; Gamito et al., 2016). Coelho et al (2005) illustrated that across 20 fishing trips, elasmobranchs bycatches represented 4.3 percent of total catches. However, bycatches were not discarded, in this study, it was also observed fishers retaining their bycatch for personal consumption.

To attain more sustainable fisheries, several measures are commonly implemented to reduce the incidental catch of non-target species and/or discards, such as prohibiting or limiting the use of certain gear types in specified areas or seasons, delimiting zones reserved for traditional fishing activities, and technical measures consisting of changes in the design or rigging of fishing gears. Among the latter, improvement in both size and species-selection is a key objective in commercial fisheries.

Over the last two decades a high number of gear modifications have been tested in Portuguese trawl fisheries, aimed at increasing the selectivity of deep-sea crustaceans such as nephrops (a lobster species) while reducing bycatch and discards (Millar et al., 2019). To reduce discards of the trammel net fishery existing regulation should be enforced, namely in which respects to nets soak time in order to minimize the amount of damage fishes, allowing them to be sold (Gonçalves et al., 2007). A decrease in soak time during the warmer months could also contribute to higher quality of the landings since at higher water temperatures fish and invertebrates degrade faster and this small fleet does not have refrigerated storage on board.

The length of time trammel nets are permitted to remain in the water is limited in order to reduce spoilage and subsequent discarding of commercial species (Borges et al., 2001).

In order to understand the impact of fisheries on these species, the assessment of elasmobranchs bycatch and discards is an important step towards the development of a management program to ensure the sustainability of these resources, especially in multispecies fisheries as trammel net fishery.

4.3.2.3. Trawl Fisheries

In 2014, there were 79 licensed trawlers in Portugal, holding in total 25 licenses to catch crustaceans and 103 licenses to catch fish. As a single trawler may have more than one fishing license, it is estimated that no more than 31% of the trawling fleet targets crustaceans (Pardo et al., 2017). Crustacean trawling has a bad record of reporting a high rate of discards, a performance also seen in others trawl fisheries (Millar et al., 2019).

In Portugal, trawl fishing gear is regulated under Portaria No.1102-E/2000, November 22, and Portaria No.349/2013 of November 29. These regulations laid down the characteristics of the three types of trawl gear.

In 2014, under Portaria No.114/2014 of May 28, Portugal had apparently banned bottom trawling. Which might seemed true because, in this regulation it is expressly stated that Portugal only authorizes the practice of line and hook gears, with the exception of purse seine gear (article 4^o.) Which would seemed that other gears, such as trawling, would not be authorized to be practice in Portuguese waters, however, article 5^o defines the conditions for the bottom longline fleet¹¹². In addition, the regulation provides a map that provides visual information on where bottom fishing is, in fact banned¹¹³ (mostly far-shore).

Finally, Portugal still continues to approve regulations for bottom trawling, such as Portaria No. 66/2017, February 13, which defines landing sizes, total captures and mesh sizes. And IPMA (2020) also provides information on species that are caught by bottom longline and trawling.

In Portugal a crustacean trawl fishery¹¹⁴ takes place off the south and southwest coasts at depths between approximately 150 and 700m (Fonseca et al., 2007) for Norway lobster (*Nephrops norvegicus*), rose shrimp (*Parapenaeus*

¹¹² Bottom longlines are a type of static bottom gear that despite not being actively mobile, during retrieval bottom longlines move across the seabed, thus generating possible negative impacts upon the habitat and fauna (Clark et al., 2016).

¹¹³ Pardo et al. (2017) study on bottom trawling in Portugal states that Portaria No.114/2014 of May 28, has banned bottom fishing in over 2 million km².

¹¹⁴ Regulated by Portaria No.43/2006 of January 12, 2006.

longirostris) and other deepwater shrimps such as red shrimp (*Aristeus antennatus*) (Fonseca et al., 2017).

Costa et al. (2008) studied the impact of bottom trawling in Portugal¹¹⁵, by assessing the impact of fish and crustacean trawl fisheries, in 165 fishing operations in the Algarve. The study concluded that, in both fisheries, the percentage of bycatch was higher than the target catches. Despite possibly being considered equally unsustainable, fish trawling presented 80.4% of the total weight, in kg, caught, being by-catch, whereas, crustacean trawling had a 59.5%. Moreover, the study also detected changes in by-catch rates throughout seasons – around 90% in winter, but 27% in the summer.

In another study that examined the environmental impact of the octopus SSF in Algarve. One of the components analyzed was seafloor disturbance caused by the fishing gear used in the octopus fishery. The study indicated that octopus fishery with pots and traps did not present any significant seafloor disturbance, whilst the trawl fishery accounted for a seafloor disturbance of an area with 1950 m²/kg of octopus landed (Almeida et al., 2022).

A report from the Calouste Gulbenkian Foundation has indicated the urgent need to ban or seriously restrict trawling in Portuguese fisheries, in order to ensure the preservation of fish populations, the viability of the marine economy in Portugal, and the possibility of higher future fishing harvests from more productive seas. Thus, the Portuguese government needs to be bolder in promoting the sustainability of national fisheries, and definitely ban bottom trawling in Portugal, whilst encouraging more holistic studies on the impact of this fleet in the national fish resources.

4.3.3. Carbon Footprint of the Fishing Sector – Fuel Use and Gear Impact

Fisheries' carbon footprint can be assessed in three areas: fisheries commercial balance, fuel consumption of the fishing fleet, and gear impact on the environment.

¹¹⁵ Cf. Portaria No.114/2014 of May 28.

Reducing food system's GHG emissions is central for meeting global emission targets¹¹⁶. In Europe, for example, the objective is to reach zero emissions by 2050, and with an intermediate target reduction of 50-55% by 2030 (European Commission, 2019). Concerning fisheries, the European Commission in accordance with Mission Starfish 2030's target 11, has recommended that all fishing vessels should be converted to non-fossil fuels by 2030 (European Commission et al., 2020).

Fisheries can increase their profit and long-term sustainability through different strategies, such as fuel consumption reduction, catching high-value species, reducing time at sea, or catching larger size fish, whilst dealing with constraints, such as emissions, bycatch limitations, or catch quotas, among others (Bastardie et al., 2022; Granado et al., 2021).

Fishing fuel consumption and emissions per landed ton of catches increased up to 20% between 1991 and 2011, due to an increase in fishing effort worldwide without an increase in fish landings (Granado et al., 2021; Parker et al., 2018). For capture fisheries, reducing fuel use presents itself as a great opportunity to improve one of the primary environmental stressors of the sector (Gephart et al., 2021). Monitor and reducing fuel use, or even provide carbon-free alternatives in fishing vessels is extremely important to combat climate change scenarios, such as the ones foreseen by Lotze et al., (2018). In this study, it is estimated that within the best-case climate scenario, there will be no increase in fish biomass, hence fishing effort can only be maintained or increase¹¹⁷, which will impact fuel consumption (Granado et al., 2021; Parker et al., 2018).

On the other hand, and related with section 4.1.1.2 of the thesis, seafood is one of the most traded commodity on a global scale. Seafood has no longer geographical barriers, and those sold at markets could have travel hundreds to thousands of miles by sea or air. Besides the transportation on itself, non-local

¹¹⁶ The United Nations has developed the Net-Zero Coalition, under which the UN promises to cut GHG emissions to as close to zero as possible. More information is available at: <www.un.org/en/climatechange/net-zero-coalition>. Accessed: July, 17 2022.

¹¹⁷ Since there will be no more fish available, or even a decrease in fish stocks, to catch the same amount of fish, fishers have to spend more time at sea, more fuel, and more gear.

seafood have to be refrigerated during the trip, and some of the most industrialized vessels, even have the whole process from catch to frozen on board. The more stages, the more energy, and hence the larger the carbon footprint (Madin & Macreadie, 2015).

Small-scale and large-scale fishing vessels have different fuel-use consumption rates. SSF operate typically for a local community, fishing individuals or households wherein it is employed simpler gears, fishing boats with low fuel capacity, non-active and simple gears that are deployed in one area, and then, after some hours or days the gears are collected, and most of the catches are sold locally near the fishing site (Ayilu et al., 2022; Granado et al., 2021). Besides, SSF make short fishing trips with low fuel consumption per mile, and catch smaller quantities, and do not have refrigeration system onboard (Granado et al., 2021). Meanwhile, LSF uses powerful motorized vessels, active and more complex fishing gear, the vessels also have light and refrigeration systems on board, for ice supply, and cooling storage. The large-scale fishing fleet also undertakes fishing trips at greater distances and for longer periods of time. Therefore, SSF and LSF are perceived as low and high-energy consumers, respectively (FAO, 2015).

In Portugal, data on fuel consumption and energy use is scarce, nevertheless, there is some scattered information related to that matter.

The fisheries' volume of the SEAMInd Project provides an indicator related to "Carbon Intensity of the fishing and aquaculture sector" (indicator 38), which estimated GHG emissions' efficiency, through the ration between the value of the GHG emissions and the GVA value of the fishing and aquaculture sector. From 2010 to 2013¹¹⁸, the ratio of GHG emissions per GVA of the fishery and aquaculture sector have decreased (from 1.52 to 1.38 kg CO₂-eq/ EUR) (DGPM, 2016). However, these values are conjoint numbers of both the fishing and aquaculture sector, and unfortunately, Portugal does not have a specific fisheries carbon emissions analysis, which would represent a step forward to the development and integration of carbon information to the overall fisheries impact assessment.

¹¹⁸ Most recent data available.

Concerning fishing gear's carbon intensity, there is one published article that analyses the carbon footprint of the common octopus fishery in Algarve (Southern Portugal). Almeida et al. (2022) carried out a study with a group of 22 vessels of the local fleet (less than 15m). The study concluded that not only small-scale fishing was responsible for a bigger share of the landings, but the fuel use intensity was inferior (0.58 L of fuel per kg of octopus), when compared with industrial fishing (0.91 L of fuel per kg of octopus). Overall, the carbon footprint of the Algarve's octopus fisheries that uses non-active gear (i.e. traps and pots) reported an estimate of 3.1 kg CO₂-eq per kg of octopus, which was compared with the results of a similar study¹¹⁹ that estimated a 7.7 kg CO₂-eq for 1kg of octopus caught from trawl fisheries.

Carbon and GHG data is essential for policy-makers, stakeholders and consumers, to provide conscious choices to shift decisions and guide the market toward carbon-friendly fishing products (Gutiérrez et al., 2012; Madin & Macreadie, 2015). In order to present a full picture of fuel use in the Portuguese fishing fleet, more studies have to be conducted, namely of the fuel use of both SSF and LSF, and the carbon impact of each national fishing fleet. In return, this information would also complement the sustainability assessment of the Portuguese fishing sector.

5. DISCUSSION: CAN THE PORTUGUESE FISHING INDUSTRY BE CONSIDERED 'BLUE'?

Throughout the thesis, it was examined the relevance of economic, social and environmental aspects of the Portuguese fisheries, and how or if those components are aligned with a sustainable fishing sector model. In this next section it will be discussed whether these aspects meet the sustainable objectives laid down in Flagship Action No.77, under the NOS 2021-2030.

¹¹⁹ Vázquez-Rowe, I., et al. Environmental assessment of frozen common octopus (*Octopus vulgaris*) captured by Spanish fishing vessels in the Mauritanian EEZ. *Marine Policy*, 36, no.1, (2012): 180–188.

5.1. Is the Portuguese Fishing Sector a Sustainable Sector?

In this thesis it was examined economic, social and environmental aspects of the fishing sector, in order to answer the question that was established as a foundation for this thesis: “*Is the Portuguese Fishing Sector as Blue as it Should Be?*”, however, for an easy-reading experience it will be presented a series of literature-based indicators, which also reflect the research undertook for this thesis. Besides, the list of indicators that will be presented next allows future studies to conduct a deep and systematic analysis on the sustainability of the Portuguese fishing industry, through the verification of those selected indicators.

The key purpose of establishing a set of indicators that reflect a sustainable fishing sector is to contribute to a practical and objective evaluation process of assessing the Portuguese fishing sector, and to inspire action to more effectively to achieve sustainability goals (Gallic, 2002; OECD, 2003).

The indicators here presented are organized by four areas – environment, economic, social and governance – that also reflect the four components to fisheries management: environmental protection of fisheries, economic growth, social development and governance improvement. Which is also aligned with the targets of the SDG14 (Said & Chuenpagdee, 2019).

5.1.1. Proposal for Suitable Indicators to Complete the Sustainability Assessment of the Portuguese Fishing Sector

The indicators selected are a result of compiled information of various scientific articles, and international and national reports and documents.

One of the inspirations for the development of this collection of indicators was the EU Taxonomy. The EU Taxonomy is a classification system that sets a list of environmentally sustainable economic activities. Moreover, the EU Taxonomy also hopes to provide, in parallel with each activity, criteria that would ultimately determine whether that activity can be qualified as ‘environmentally

sustainable'¹²⁰. Altogether, the EU Taxonomy aims to provide some support to investors, stakeholders and companies to guide their potential investment decisions to the activities selected by this list (The Aquaculture Advisory Council, 2021). Unfortunately, there is no list, nor criteria for economic activities related to fisheries, there is, however, one for the aquaculture sector.

It was reviewed three main documents that have developed sets of indicators as a mean to evaluate the fishing sector. First, Volume V of the SEAMInd Project developed by DGPM introduces indicators that will serve as a foundation to monitor the results of the NOS 2013-2020 in regard to 'Fisheries, Aquaculture and the Fish Processing Industry'. Secondly, the Strategic Environmental Assessment on the Ex-ante Assessment of the OP of the EMFF provides evaluation criteria and indicators to assess sustainability in fisheries. And at last, the European Commission published in 2021, a report on sustainable criteria for blue economy sectors, being one of them fisheries¹²¹. The report organizes the selected criteria and indicators in accordance with four areas: economic, social, environmental and governance, which served as an inspiration for the organization followed in this thesis' proposal.

Table 1 - Proposal of Indicators to Assess the Sustainability of the Portuguese Fishing Sector

Type	Indicator	Reference
E C O N O M I C	GVA of the national fishing sector	EC & CINEA (2021)
	GVA of the national fishing sector (only from sustainable operations)	EC & CINEA (2021)
	Value of fish products sold at auction sites	DGPM (2016)
	Value of fish products sold by auction sites to their customers	DGPM (2016)
	Direct jobs in the fishing industry	EC & CINEA (2021); INE (2022)
	Indirect jobs affected by the fishing industry	EC & CINEA (2021); Pita & Gaspar (2020)
	National fishery production (EUR)	EC & CINEA (2021); INE (2021)
	National fishery production (weight)	EC & CINEA (2021); INE (2021)

¹²⁰ Regulation (EU) 2020/852 of the European Parliament and the Council.

¹²¹ See Table 11, pg. 40-41.

	Imported fishery products (EUR)	EC & CINEA (2021); INE (2021)
	Exported fishery products (EUR)	EC & CINEA (2021); INE (2021)
	Commercial balance	EC & CINEA (2021); INE (2021)
	Subsidies/public funds allocated to the fishing sector	DGPM (2016); Cisneros-Montemayor et al. (2020); Sumaila et al. (2012)
	Revenue from fisheries' companies	DGPM (2016); INE (2021)
	Average wage of fishers	DGPM (2016)
	Average fishers' operational costs	Pita & Gaspar (2020)
S O C I A L	<i>Per capita</i> consumption of fish	DGPM (2016, 2021b)
	Gender gap	EC & CINEA (2021); Pita & Gaspar (2020); Kleiber et al. (2017); Santos (2015)
	Fishers' household dependency on their catches	EC & CINEA (2021)
	Licensed fishers by age group	DGPM (2016); INE (2021)
	Composition of the national fishing fleet (n°, GT, kw) by segment	DGPM (2016); INE (2021)
	Incentives for young people to join the fishing industry	EC & CINEA (2021); Pita & Gaspar (2020); Gaspar et al. (2014)
	Fishers' operational costs	Pita & Gaspar (2020)
E N V I R O N M E N T	Biodiversity assessment on target-species	Boyd & Charles (2006); Buonocore et al. (2020); Teresa et al. (2015)
	Target species abundance	Boyd & Charles (2006); Buonocore et al. (2020)
	CO2 emissions from fishing vessels	EC & CINEA (2021); Gephart et al. (2021); DGPM (2016)
	Carbon intensity from the fishing sector	DGPM (2016); Gephart et al. (2021)
	Fuel use efficiency (L of fuel/ton of fish landed) in fishing vessels	DGPM (2016); Gephart et al. (2021)
	Proportion of stocks exploited at 'Maximum Sustainable Yield' levels	EC & CINEA (2021); DGPM (2016)
	Number of stocks managed according to the precautionary approach	DGPM (2016); INE (2020)
	Energy consumption	EC & CINEA (2021)

	Use of selective fishing gears	EC & CINEA (2021); Teresa et al. (2015)
	Use of non-destructive fishing gears	EC & CINEA (2021); Teresa et al. (2015)
	Direct effect of fishing gear on ecosystem	Boyd & Charles (2006); Batista et al. (2009); Borges et al. (2001); Fonseca et al. (2002); Monteiro et al. (2001); Teresa et al. (2015)
	Direct effect of fishing gear on non-target species (accidental catches)	Boyd & Charles (2006); DGPM (2016); Teresa et al. (2015)
	Discard rate	Borges et al. (2001); Gonçalves et al. (2007); Millar et al. (2019); Teresa et al. (2015)
	Effects of fishing on the marine environment and marine food webs	Boyd & Charles (2006)
	Extent of coastal and marine habitat positively/negatively impacted by fishing	EC & CINEA (2021)
	Quality of fished versus unfished areas	Boyd & Charles (2006)
	Waste generated by fishing gear	EC & CINEA (2021)
G O V E R N A N C E	Sustainability label or certificate for fishery products	EC & CINEA (2021)
	Participation in information and training sessions about sustainability	EC & CINEA (2021)
	Measures taken for climate change adaptation in fisheries management	EC & CINEA (2021)
	Multiannual management plans in place and implemented	EC & CINEA (2021); Teresa et al. (2015)
	Policies and measures to pay compensation to fishers during 'closed seasons' or days with bad weather conditions	EC & CINEA (2021); Teresa et al. (2015)
	National plan of action for illegal, unregulated, and unreported landings	EC & CINEA (2021)
	Quota system in place and implemented	EC & CINEA (2021)
	Fishing vessels equipped with electronic positioning and catch reporting device	EC & CINEA (2021)

	Number of projects in scientific research and technological development relevant to fisheries	DGPM (2021b); INE & DGPM (2020)
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5.1.2. Checklist of the Proposed List of Indicators in the Portuguese Fishing Sector

In Table 2, it will be assessed if the sustainable indicators displayed in Table 1 are met in the Portuguese fishing industry.

In the first column, it is presented the respective indicator. In the second column, it is indicated if Portugal has the adequate information to evaluate the indicator (“Yes” if it has, “No” if it has not, or “Partial” if the information available is not enough). And finally, the last column presents relevant notes (e.g. legal regulations and data) related to the indicator in question.

Table 2 - Sustainability Checklist on the Portuguese Fishing Sector

Indicator	Does Portugal has data for the indicator?	Notes
GVA of the national fishing sector	Partial	The fishing, aquaculture fish processing industries and fisheries' retail represented 25.1% of the total Blue Economy's GVA (2016-2018). There is no data on the fishing industry alone. In: DGPM (2021b)
GVA of the national fishing sector (only from sustainable operations)	No	
Value of fish products sold at auction sites (fisher's revenue)	No	
Value of fish products sold by auction sites to their customers	Yes	The average price for fresh and chilled fishery products is 2.28€/kg. In INE (2022).
Direct jobs in the fishing industry	Yes	In 2021, there were 14,917 registered fishers.
Indirect jobs affected by the fishing industry	No	

National fishery production (EUR)	Yes	In 2021, the sector made EUR 335,044 thousand. In: INE (2022).
National fishery production (weight)	Yes	In 2021, 185,417 tons In: INE (2022).
Imported fishery products (EUR)	Yes	In 2021, Portugal spend EUR 2,070 million in imported fishery products. In: INE (2022) and DGPM (2021b).
Exported fishery products	Yes	In 2021, exports of fishery products stood at EUR 1,121 million. In: INE (2022) and DGPM (2021b).
Commercial balance	Yes	Negative (EUR -949.0 million). In: INE (2022) and DGPM (2021b).
Subsidies/public funds allocated to the fishing sector	No	
Revenue from fisheries' companies	Partial	The information available is only in regard to the fish processing industry and aquaculture. In: INE (2022).
Average wage of fishers	No	
Average fishers' operational costs	No	
<i>Per capita</i> consumption of fish	Yes	In 2019, Portugal had a <i>per capita</i> consumption of 59.91kg. In: (DGPM, 2021b).
Gender gap	Partial	However, those studies merely describes the fishing industry as male-dominant. In: Pita (2014), and Pita & Gaspar (2020).
Fishers' operational costs	No	
Licensed fishers by age group	Yes	This information is presented in INE (2022).
Composition of the national fishing fleet (No., GT, kw) by segment	Yes	This information is presented in INE (2022).
Incentives for young people to join the fishing industry	No	
Biodiversity Assessments on target-species	Yes	Stock assessments performed by IPMA (2020)

Target species abundance	Yes	Species' abundance is present in the fish stock assessment performed by IPMA (2020)
CO2 emissions from fishing vessels	Yes	Estimates on carbon emissions from the fishing and aquaculture sector. There is no data of the fishing industry alone. In DGPM (2016).
Carbon intensity from the fishing sector	Yes	Estimates on carbon emissions from the fishing and aquaculture sector. There is no data of the fishing industry alone. In DGPM (2016).
Fuel use efficiency (L of fuel/ton of fish landed) in fishing vessels	No	The OP MAR2020 execution report states that, by the end of the OP MAR2020, the fuel use efficiency in the fishing industry had a reduction of 286.7 L of fuel per ton of fish land ¹²² .
Proportion of stocks exploited at Maximum Sustainable Yield levels	Partial	In IPMA (2020), this information is scattered across each fish species. DGPM (2016) provides this information only in regard to 39 fish stocks (indicator 80). INE (2020) does not provide information on all the national fish stocks.
Number of Stocks managed according to the Precautionary Approach	Yes	In 2015, DGPM (2016) reported that 22% of the fish stock without analytical assessment were managed under the precautionary approach (indicator 81). INE (2020) does not provide information on all the national fish stocks.
Energy consumption	Yes	In 2013, the fishing and aquaculture industry had 20.07 MJ/EUR performance. There is no data of the fishing industry alone. In DGPM (2016).
Use of selective fishing gears	Partial	The majority of SSF uses selective gear

¹²² Results from the Execution Report of the Operational Program MAR2020. Available at: <www.mar2020.pt/relatorios-de-execucao/>. Accessed: August, 23, 2022.

Use of non-destructive fishing gears	Partial	The majority of SSF use non-destructive gears. And under Portaria No.114/2014 of May 28 bottom trawling has area gear and seasonal restrictions.
Direct effect of fishing gear on ecosystem	Partial	The majority are from the southern Portuguese coast - Algarve
Direct effect of fishing gear on non-target species (accidental catches)	Yes	The OP MAR2020 execution report states that, by the end of the OP MAR2020, the fishing industry had a 34.8% reduction in accidental catches.
Discard rate	Partial	Few studies are conducted on this matter, not enough to evaluate the whole sector.
Effects of fishing on the marine environment and marine food webs	Yes	However, there is not enough studies to properly assess the impact of the Portuguese fisheries in the national marine environment. In Baeta et al. (2010); Baeta, Costa, et al. (2009b, 2009a).
Extent of coastal and marine habitat positively/negatively impacted by fishing	No	
Quality of fished versus unfished areas	No	
Studies on waste generated by fishing gear	No	There is international report on the matter ¹²³ , but not national ones.
Sustainability label or certificate for fishery products	Yes	'Comprovativo de Compra em Lota' ¹²⁴ label and the Marine Stewardship Council (MSC) ¹²⁵ certification.

¹²³ The 2020 WWF report, Stop Ghost Gear: *The most deadly form of marine plastic debris*.

¹²⁴ DOCAPESCA has created their own sustainable fishing label – 'Comprovativo de Compra em Lota' (Proof of Purchase in the Auction Site, in English). Through this label, the consumer has proof that fish has been caught in national waters, with respect for its season. Plus, it provides information about the location from where it was caught, and the fishing gear used. Hence, the consumer has all the information to make a conscious choice.

¹²⁵ The MSC is an international non-profit organization that set up a sustainable label to promote sustainable fishing. To become certified, these fisheries must comply with requirements across three principles: only fishing healthy stocks, being well-managed so stocks can be fished for the long-term, and minimizing their impact on other species and the wider ecosystem.

		Action No.75 of the Portuguese NOS also pledges to further invest in fishery products sustainable certification.
Participation in training and information-sharing sessions about sustainability	Partial	DGPM (2021b) provides information on the number of people registered in FOR-MAR courses. But, these courses are not specifically oriented towards sustainability.
Measures taken for climate change adaptation in fisheries management	No	
Multiannual management plans in place and implemented ¹²⁶	Yes	Management plans for eel and sardines, and multiannual management plans for black scabbardfish, sea brass, megrins, anglerfish, hake, norway lobster, red sea bream, and common sole ¹²⁷ .
Policies and measures to pay compensation to fishers during 'closed seasons' or days with bad weather conditions	Yes	Decreto-Lei No. 61/2014, of 23 April, combined with Decreto-Lei No. 52/2017, of 26 May, regulates the Fisheries Professional Salary Compensation Fund ¹²⁸ .
National plan of action for illegal, unregulated, and unreported landings	No	In 2021, Portugal ranked ¹²⁹ at 114 th of 152 countries worldwide (from worst to best) in the IUU global analysis ¹³⁰

¹²⁶ Regulation (EU) 2019/472 of the European Parliament and of the Council, of 19 March 2019, establishes a multiannual plan for stocks fished in the Western Waters and adjacent waters, and for fisheries exploiting those stocks.

¹²⁷ Information available at: <www.dgrm.mm.gov.pt/en/web/guest/planos-de-recuperacao/gestao/acao-e-ajustamento-de-esforco-de-pesca>. Accessed in September, 09, 2022.

¹²⁸ The daily amount of support wage compensation is equal to 1/30 of the minimum monthly wage guaranteed to workers (amount not specified); Payment of compensation is limited to a maximum of 60 days per year; the payment of wage compensation is only due from the 4th day of immobilization of the vessels. In the existence of bad weather conditions that prevent fishing safely, for at least 3 consecutive days or 7 interpolated days, within a period of 30 days.

¹²⁹ The Global Initiative Against Transnational Organized Crime and Poseidon Aquatic Resource Management Ltd., developed an IUU Fishing Index, in which countries worldwide are ranked based on coastal, flag and port characteristics prone to IUU practices. However, there is an absence of data provided by Portugal in respect to IUU Fishing (Macfadyen & Hosch, 2021).

¹³⁰ According with Council Regulation (EC) No 1005/2008, of 29 September 2008, a certificate should be presented when importing fishery products into the European Union. Paragraph 15 of the Regulation states that this certificate must contain information of the flag State of the fishing vessel that caught the products concerned, and it must be verify if those vessels comply with international law of the conservation and management of fisheries.

Quota system in place and implemented	Yes	Individual quotas, pooled quotas, individual transferable quotas
Fishing vessels equipped with electronic positioning and catch reporting device	Yes	The fishing logbook is an obligation that is applicable for some EUs fishing vessels that exercise their activity in water under the EU or its Member-States sovereignty ¹³¹ .
Number of projects in scientific research and technological development relevant to fisheries	Partial	In 2013 ¹³² , there were zero projects in scientific research and technological development relevant to fisheries. In: DGPM (2016).

5.1.2.1. A Sustainability Review of the Strong and Weak Points of the Portuguese Fishing Industry

Of the 47 indicators presented in Table 2, Portugal had a positive performance in 23 indicators, which reflects a positive position towards fisheries' sustainability.

Besides the positive notes of Table 2, Portugal still counts in a few more encouraging factors that will further help to shape the national fishing sector, namely: (i) the creation of the OSA, a dedicated satellite account for the ocean; (ii) the promotion and adherence of the environmental awareness program on marine litter – “*A Pesca por um Mar Sem Lixo*”; (iii) a fishing community that uses, mainly, non-active fishing gear and report low discard rates; (iv) a fishing community that has a great sense of LEK; and (v) the establishment of the SEAMInd project that developed a good starting point of indicators for the fishing sector.

Nonetheless, despite the positive aspects, Portugal can still further improve its national fisheries. From the selected indicators, Portugal has not yet achieved 24 of them (indicated with “No” and “Partial”), due to the lack of data on the indicator's subject. The absent information on these indicators is imperative

¹³¹ Council Regulation (EC) No.1224/2009.

¹³² Most recent information available.

to be reviewed and accomplished in order to meet the proposed sustainable goals. Namely by analyzing the following weakness: (i) the OSA lacks a more comprehensive analysis of the fishing industry; (ii) lack of economic studies on fisheries' natural capital; (iii) the carbon footprint of the fishing industry needs to be included in economic reports; (iv) lack of studies on socioeconomic factors of the fishing sector in Portugal (e.g. fisher's income, gender equality, operational costs); (v) gaps in fish stock assessments' data; and (vi) insufficient information on the impacts caused by the deployed fishing gear of the national fleet (e.g. habitat alteration and discard rates).

Therefore, in this analysis, Portugal exhibits a negative performance across key objectives. From the 47 indicators selected to assess the sustainability of the sector, Portugal does not have sufficient data on 24 (a little more than half) of them, which hampers the analysis and, thus the performance of the fishing sector.

In addition, in 14 out of the 24 'negative' ones, data is completely absent. Portugal has still not provided information on socioeconomic aspects of its fishing community, on the environmental impact of the sector, and does not have a fisheries' economy that reflects an integrated analysis of these factors.

In order to really know the value of the fishing sector, Portugal must separate the economic income of fishing operations indicated as sustainable, from the harmful ones, and it has to assess the carbon footprint of the sector (e.g. by-catch, habitat alteration and fuel use), and that information must be inserted into the sector's economic performance. And to understand the social impact of the sector in its fishing community, and the impact that the community can have on the sector, Portugal must collect information on fisher's salary, expenses and their knowledge to help them achieve a sustainable and more profitable fishing sector.

5.2. Is Flagship Action No.77 Suitable for the Ultimate Goal of Establishing a Sustainable Fishing Sector in Portugal?

The NOS 2021-2030 pledged, under Flagship Action No.77, to "*convert Portuguese fisheries into one of the most sustainable and low-impact sectors*

worldwide by 2030, stimulating the allocation of grants for the promotion of sustainable fishing and eliminating all grants harmful to the conservation of the marine environment". However, the phrasing is a little too vague to contribute to a practical 'action'.

For instance, there is not enough information on how to transform the Portuguese fisheries into a sustainable sector. The details on the Flagship Action provide that this transformation should or could pass by cutting out all harmful subsidies to the fishing sector, and direct the existing ones to sustainable fishing operations. However, without a proper definition of what a "sustainable and low-impact" fishing sector represents, which is absent either in NOS and in the Action Plan, the action on itself becomes a little void.

Furthermore, as aforementioned, in order to be converted into a sustainable fishing sector, the Portuguese fisheries still have to overcome some challenges. Namely, its negative commercial balance, a fishing community that is becoming older, lack of data on gender equality on the fishing workforce, few studies on environmental impacts of fishing gear, insufficient carbon data, and stock assessments are scarce and not coherent among the existing reports.

Consequently, restricting the process of transforming a whole industry to a sustainable one, to subsidy's reforms is to completely neglect a vast compilation of other components that allow a holistic evaluation of fisheries sustainability, such as environmental, social, and others economic components. Therefore, across the evaluation of the fisheries components presented in this thesis, it became clear that the basis of Flagship Action No.77 is inadequate and incomplete to meet the ultimate goal of converting Portuguese fisheries into one of the most sustainable and low-impact sectors worldwide by 2030. However, and in spite of these flaws, it is also reasonable that, within the limits of defining an action for a NOS, the action should not be too extensive that becomes too vague, but it should include more key aspects. Or at least, the Portuguese NOS should include more fishery-related actions to overcome such gaps. The sustainability transformation of the fishing sector, has to be divided into smaller and objective actions, in particular, across environmental, social and economic areas.

5.3. The Future for a Sustainable Portuguese Fishing Sector: How to Improve and What Needs to be Achieved?

The Portuguese fisheries are an important component for national coastal communities because not only they act as a provisioning ecosystem service (i.e. food supply), but they also represent a substantial part of their income, employment and is an integral element of the national culture (Bué Alves, 2017; Kenny et al., 2018; Pita & Gaspar, 2020). Therefore, it is critical to improve the fishing sector and to make it a successful sector in the long-term.

The debate on how to restructure the fishing industry, so that it could meet the sustainable goals set in various commitments, is not recent and it is an international concern. Many authors have attempt to describe aspects in which they believe must be upgraded and revised to stimulate a sustainable fishing sector.

Pauly et al. (2003) defined three points of improvement: markets, policy and sustainability. In respect to markets, a revision on subsidies are in need, to such extent that fishers could maximize their revenue. Which would consist on the elimination of harmful subsidies, especially on LSF. Concerning policy changes, the authors emphasized the urgency to fulfill social gaps and inequalities, and environmental concerns. Gear regulations should be more restrictive, and their compliance should be better enforced and monitored to reduce their impact upon marine biodiversity and environment. And at last, in regard to sustainability, the article calls for a reorganization in fisheries' management system into bottom-up governance to better support and empower local resources.

Cusack et al. (2021) summarizes fisheries' future challenges as to improvements in catches accounting systems, regulations' compliance, and stock assessments and to increase transparency and traceability in the supply chain.

On the other hand, Pierre & Thomas (2017) believe that the future fisheries' improvements must be aligned with technological and digital advances, but in a way that could be combined with traditional fishing gear to better integrate local fishers in this new era of transformation. Through this combination, it would be possible to collect more information on catches and gear impact.

However, the real question is: how can these theoretical hypothesis become a real step towards a sustainable fishing sector in Portugal? The future of the national fishing sector will rely on improving a series of economic, social and environmental aspects that should have political support to further strengthen these changes. A positive note on these improvements is that they are connected, for example, developing more selective gear can increase on the number of valuable catches for fishers, which, consequently, impacts fishers' profit (economic and social improvements) and reduce accidental catches (environmental improvements).

Additionally, future studies could built on the indicators selected in this thesis and work on providing data for those that do not have data yet. Or even, create a model that can transform these indicators into a scoring system to evaluate the economic, social, and environmental performance of the Portuguese fisheries, and detect problematic areas to improve on.

5.3.1. Economic Improvements

Bué Alves (2022, p. 26) states that Portugal should improve on its fishing fleet, due to the incredible gap between the number of fishing vessels and the amount of captured fish. The author believes that Portugal has enough fishing vessels to increase the national fish production, however, since the majority of the fleet is composed of small fishing vessels, they cannot onboard large quantities of fish. Thus, the author suggests that Portugal should invest in a more efficient fleet that would capture more fish, and help to correct the negative commercial balance of the fishing sector. However, this approach might not be the most appropriate. Increasing the national fishing fleet does not exactly correspond to an increase in catches, but it could increase the sector's unsustainability. The Portuguese negative commercial balance is not, mainly, an issue of insufficient catches, it is rather an issue of overconsuming fish that cannot be catch in national waters, like cod. Hence, increasing the national fishing fleet would increase the pressure in national fish stocks that might not be consumed.

A good solution to promote the consumption of local fish is by improving data sharing among fishers, retailers and the public. Enhancing the coordination between what customers want and what fish can be caught within the current season, would allow fishers to optimize their profit by directing the fishing effort toward the market's needs. Additionally, it might influence customers to choose local and national fish. Portugal might be to the right path on a technological answer for this issue. *PROJECTO KARAPAU* is a digital platform for fishers and fish consumers. Through this platform, fishers can register their daily catches, define prices for their products, and customers can access the platform, choose and pay for fresh and locally caught products. In this way, customers are directly purchasing fish from the ones who work to capture it.

Thus, the next step should consist of promoting communication among national groups of fishers and some economic sector (e.g. restaurants) to improve resource allocation (Kroetz et al., 2022). This approach would also provide an opportunity to address fisheries' products traceability (i.e. the ability to fully trace products from the selling point to its origin) and deliver a product that the customer knows its steps through the supply chain, which, if advocating for sustainability, are few (Cusack et al., 2021). Furthermore, it would also enable researchers to conduct studies on the carbon footprint of the Portuguese fishing industry by analyzing traceability data, like the information about selling and origin locations and the gear used to capture that product.

Another critical economic gap in the Portuguese fisheries is the lack of environmental data in economic assessments. This is an important step to continue to develop a system that assigns economic values to ecological services (e.g. fish) and to internalize fisheries' negative externalities (e.g. discards, fleet overcapacity, carbon data), which is crucial to comprehend the cost of a sustainable fishing sector, and how much the sector would benefit from sustainable changes (Caddy & Cochrane, 2001).

5.3.2. Social Improvements

Concerning the fishing community, further research is needed to better understand not only social aspects, but socioeconomic outcomes of the fishing activity.

For once, the available studies and research are currently lacking information on female roles in the fishing sector. National fisheries' reports should make the effort to better account for the work undertaken by female fishers, in order to better represent this group within the industry and achieve gender equality. For example, Portugal should promote more investigations similar to the one conducted by Melo (2015), where researchers can obtain data about the fishing sector dynamics and way of living, in the different fishing fleets and communities. In addition, these social studies could also bring some insights into the fishers' willingness to change ongoing behaviors and materials to adjust their craft toward sustainability, and more information about fisher's ecological knowledge of their practice and its environmental impacts.

Additional information is also needed in regard to fishers' operational costs and salary, in order to assess how much of their income has to be allocated to their work expenses such as buying new gear and new materials, boat repairs, renewing fishing licenses, to analyze the true profit of the fishing industry.

Another social concern of the Portuguese fishing sector is the ongoing decline of the age of the national fishing community. Therefore, improving the sector's sustainability should also pass by the implementation of policies and measures that would encourage young people to join the sector. Moreover, young people would be more incentivized to be a part of the fishing community if there were more information available about the fishing sector (e.g. salary, subsidies and social conditions).

5.3.3. Environmental Improvements

In respect to environmental improvements, one critical gap in the available articles on the Portuguese fishing sector is the insufficient data on the fishing gear used by the national fishing fleet. It would be a great step forward to promote and

establish more scholarships and funds for scientific research about discard rates and the carbon footprint of each fishing fleet, which could be used to review the gears and adjust them if necessary, to decrease accidental catches or their impact on the bottom of the marine environment.

Portugal also needs to complete a carbon footprint analysis of its fisheries, since the GHG emissions values provided by Volume V of the SEAMInd Project account for both the fishing and aquaculture sector. Hence, the accomplishment of an integrated analysis of the carbon and fuel efficiency of the fishing sector alone is a crucial step to assess the gross impact of the Portuguese fisheries.

Future technological developments might be needed to empower fishers in their profession. Technological advances might allow fishers to be more selective in their catches by adding gear modifications¹³³, which consequently will increase their profit by increasing high-value catches and reducing potential discards. More than connecting fishers with new technological devices, it is equally important to strengthen fishers' biological and ecological knowledge of their target resources and share data on the economic profits of a sustainable fishery. Setting minimum catch sizes or mesh sizes has not been enough to mitigate the impacts of fishing gear, fishers should know the economic losses or gains in engaging in certain behaviors and actions, to empower fishers to adopt the most suitable option for them and for the industry. Nonetheless, these types of technologies are still too expensive for small-scale fishers, therefore, reducing the costs of modern tracking systems is a critical step to increasing the implementation of these new technologies. Plus, if there were studies on the economic losses endeavored by fishers due to discards and accidental catches, fishers could then evaluate both scenarios (with and without electronic report systems), and assess the most beneficial one.

¹³³ See Suuronen, P. (2022). Understanding perspectives and barriers that affect fishers' responses to bycatch reduction technologies. *ICES Journal of Marine Science*, 79(4), 1015–1023.

The fishing industry desperately needs to improve on reporting systems¹³⁴. One possible solution might be the implementation and enforcement of electronic logbooks on board fishing vessels or through a digital application for fishers' portable devices. Digital fishing records can contribute to better fish stock management by making it possible to trace catches, it will also improve fishing operations' control and enforcement. These electronic report systems can also collect data on the volume and location of catches, thus providing a good source of data for future fisheries' investigations about gear selectivity and efficiency (Pierre & Thomas, 2017).

¹³⁴ In Portugal, DGRM has developed the Electronic Fishing Journal+ (DPE+ in Portuguese) available for fishers but not to install on board fishing vessels, which further simplifies the use of the electronic fishing diary. More information available at: <www.dgrm.mm.gov.pt/en/diariodepescaelettronico>. Accessed: September, 9, 2022.

CONCLUSION

Along this thesis, it was ascertained that the Portuguese fisheries plays an important role in the national culture, economy and communities. However, environmental concerns have been arising as to the sector's sustainability and its impact on the marine environment. Therefore, the assessment of the national fishing industry impacts in the national economy, society and marine environment is essential for the persistence and success of this sector.

The Portuguese fishing industry is an integral element of coastal communities' economy, thus the preservation of fishing resources is also the key to preserving fisheries' jobs.

In this circumstances, this thesis questioned if the Portuguese fishing sector was a sustainable one and what were its impacts upon the national economy, on the Portuguese fishing community and on the marine environment. And within this framework, this thesis also addressed the official Portuguese commitment regarding a sustainable fishing sector, which is pledged under Flagship Action No. 77 of the NOS 2021-2030.

Concerning the referred question, unfortunately, there is no straightforward answer. Mostly, due to the lack of critical data that would allow the assessment of the sustainability of the Portuguese fishing industry. In fact, throughout this thesis, it was found that Portugal has a serious gap in fishery-related data. And given the importance of the fishing industry in the country, which is mainly materialized in Portugal's *per capita* consumption of fish and the number of people employed in fisheries, Portugal should be more focused on the success of this industry.

The available data portrayed a fishing industry that is mainly composed of small-scale fisheries, it is becoming increasingly older, and a Portuguese society that mostly consumes imported fish. The lack of, or insufficient information on the impacts of the fishing gears employed by the sector, and on socioeconomic aspects, such as fishers' salary and expenses was surprising. Of the 47 indicators assessed, 14 of them do not have data and 10 have insufficient information on the subject, which reveals that the information available is not enough to properly

determine if Portugal has a sustainable fishing sector. However, the lack of information might suggest that it does not. Hence, obtaining data for those indicators is crucial.

Nevertheless, the analysis performed in this thesis also examined some of Portugal's positive factors that pushes the country towards the direction of achieving a sustainable fishing sector. Such as having a good basis, like the OSA, from which it could improve and include additional data that reflects the sustainable performance of maritime activities; and a fishing community that collaborates with the scientific community and shows interest in improving their knowledge of the resources and environment from which they profit.

Yet, the negative aspects seemed to overshadow the positive ones, due to their relevance to a sustainable sector. The Portuguese fishing industry and the governmental bodies responsible for its management need to quickly shift the paradigm from an industry that only takes value from the ocean to an industry that also adds value to the marine environment. An important step is to separate the available information between small and large-scale fisheries, and among fleets, in order to understand which fishing activities are operating in a sustainable manner and those that need to be improved. Another key aspect is to develop political actions that support the transformations of the fishing sector and work past written statements that might be too vague to see some practical actions. Transforming the Portuguese fishing sector into a sustainable one, should not be an action, like Flagship Action No.77, it should be a group of actions that work together to achieve that goal, such as the ones identified in this thesis.

In this sense, this thesis aimed to contribute to the improvement and success of the Portuguese fisheries, by discussing possible solutions to fulfill the gaps identified in this analysis.

Therefore, the results of this research have identified gaps in the current available academic research, and it will encourage the discussion of the need to increase and further support more comprehensive and multidisciplinary social studies among small-scale fishing communities, and to establish a solid connection between economic, social, environmental and political sciences. The outcome of this study may provide some basis for future studies on this subject, in particular, in verifying if the proposed indicators in this thesis can effectively

assess the sustainability of the Portuguese fishing sector, upon the fulfillment of the absent data. Besides, future studies should focus on creating an objective and practical system to evaluate fisheries, for example by developing a scoring system that would display the economic, social and environmental performance of the fishing industry, thus highlighting priorities to achieve sustainability.

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