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From "Boat to Plate": Creating Value through Sustainable Fish Supply Chain Visibility

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Abstract**—**Environmental concerns about the scarcity of marine resources are critical driving forces for firms aiming to prepare their supply chains for sustainability. Building on previous work, this paper highlights the implementation of good practices geared towards sustainable operations in the seafood department, which were pursued in an exploratory retailer case. Outcomes of the adopted environmentally and socially acceptable fish retailing strategies, ranged from traceability, to self-certification and eco-labelling. The consequences for business were, as follows: stronger collaboration and trust across the chain of custody, improvement of sponsors' image and of consumers' loyalty and, progress in the Greenpeace retailers' evaluation ranking.

Keywords**—**Sustainability in sea food, Supply Chain Traceability, Social Responsibility.

I. Introduction

IN this study, we present empirical research on how the implementation of good practice in fish stock protection might also contribute to corporate sustainability performance (CSP). The following view addresses the pursuance of these practices at a retailer's, as well as in the upstream stakeholders in the supply chain. In fact, Non-governmental Organizations (NGO) have been calling for the maintenance of both an acceptable and sustainable level of fish stocks [1]. Moreover, Government Agencies (GA) and Universities have also investigated excessive fishery as a major threat [2]. As a consequence, this situation demands innovative practice geared towards an environmentally-friendly policy [3] in the business operations of the sponsor of this current research – a large hypermarket chain. This being so, the following research questions arise:

- RQi – Can the retailer influence sourcing and trading sustainable practices along the supply chain?
- RQii – How to make consumer purchasing behaviour more sensitive to seafood sustainability?
- RQiii – How to organize socially acceptable fish retailing, in order to improve the sponsors image with regard to the consumers, the NGOs and GAs?

These questions concern the role of the retailer within the defined scope. At the same time, however, these operations should also target the creation of competitive advantage and profitable results. In short, the objectives of the research are, as follows: (i) to understand and explain the purpose of corporate sustainable practices; (ii) to address the topic positioned within an integrated context by considering its economic, environmental, and social dimensions; and, (iii) to offer corporate decision-makers reliable guidance towards more sustainable business operations in fish retailing.

A case study strategy is pursued at the retailer's, in order to achieve the research objectives. However, establishing the research context is so important that a descriptive survey based on a short questionnaire is also applied to the consumers. This questionnaire aims at collecting the perceptions of a few representative consumers regarding a few economic, environmental, and social dimensions in context. The surveyed consumers were purposefully chosen from among the customers of the store where the exploratory case study took place. This sample is constrained by the duration and location of the study, which were set by the hypermarket sponsor.

While the questionnaire sets a rich context for the situation, the case study permits an in depth understanding of the requirements for sustainable fish retailing. Therefore, socially acceptable operations suggest the design of a working tool that might enable the traceability of the suppliers' activity concerning the several fish species. By using a database implemented in a spreadsheet, reports providing guidance to managers' actions can be generated as a significant outcome. These reports treat, organize, consolidate, and summarize data collected by observation, interviews and internal document analyses. External data sources, such as Greenpeace reports, e.g. ship owners' blacklists, are also used. A traffic-light system (TLS) [4] is implemented to classify the features of fish capture, based on the spreadsheet database. The TLS was also used to provide the consumer with very clear information about how critical the sustainability status of each fish species is. In this situation, the taxonomy is based on the Greenpeace red list which provides information on the species at risk. We should also add that the reported questionnaire is supported by a thorough literature review in order to improve its construct validity. It is also validated by a pilot study. At the same time, the reliability of the case study is improved by keeping the gathered documentation in a file, as well as by creating a case protocol [5]. Lastly, only analytical generalization might be possible because the design chosen for the research mainly addresses the specific situation of the sponsor.

The developed Database helps the retailer to control the

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business procedures of its replenishment sources. In fact, fishermen and fishing boat owners are under both economic and social pressures to comply with the fishery policies of Government Agencies, i.e. to avoid overfishing, illegal fishing, and unsustainable fishing methods. The sponsor and its supply chain are currently pursuing business practices also closely focused on environmental and social dimensions, in addition to a stricter orientation towards profit. Another contribution for the practitioner is the operationalization of real world procedures in order to pursue a corporate performance that is more sustainable because it is strategically aligned with the other stakeholders, i.e. both final customers (consumers) and suppliers. Thus, the proposed Database System is expected to contribute to increasing customer loyalty by implementing a fishery policy that values the sustainability of both ecosystems and sea species, in line with the principles defended by the Blue Ocean Institute [6]. Traffic Light, on the other hand, is a core system that visually reports and highlights the conclusions of the knowledge accumulated and treated in the database. The Traffic Light System (TLS) is included both in the Database and on the labels of the fish that is being sold. Another use of the TLS promotes a very easy way to make the customers aware of the impact their purchasing options have on the species at risk, which, hopefully, makes them much more responsible.

A few limitations arise from the study, as follows:

- TLS implementations that mainly address fish captured in the sea;
- just using a Greenpeace red list;
- self-certification process;
- consumers lack of information;
- weak involvement of all stakeholders and modest use of information technology provide insufficient supply chain transparency and limited trust;
- no real time, on-time information across supply chain;
- sample of purposefully chosen customers;
- constrained robustness of the pilot-test;
- no partnership with scientific institutions;
- no literal and theoretical replication [5].

Limited fish traceability was successfully introduced by providing critical information to the consumers. There is a huge need to develop a Collaborative Planning, Forecasting and Replenishment (CPFR) approach and the consumers did exhibit an unacceptable behaviour pattern. This research proposes continuing the briefing and sensibilization of consumers by both eco-labelling and marking fish according to the Traffic-Light System, following the Greenpeace guidelines. The pursued approach is in line with what most of the competition does. Its usefulness is based on establishing good sourcing, working and trading practices for a chain of hypermarkets and also on diagnosing the state-of-the-art for businesses that might be classified as "followers". It is argued for an innovative contribution that would involve setting three types of consumer profiles, as this might enable the fine tuning of future consumer campaigns and thus improve customer loyalty and business turnover.

The following sections of this paper are: (i) a literature review; (ii) methodology; (iii) analysis of the results concerning the exploratory case study; (iv) discussion of results and, (v) final conclusions that will close the report regarding the research questions and the objectives.

II. Outcomes of the Literature Review

A. State-of-the-Art Sustainable Fishing

The mismanagement of oceans' resources brings serious consequences for life on Earth. Oceans are approaching the environmental recovery threshold. Therefore, this is the right time to change the mindset and to implement their sustainable management.

An increase in scientific research concerning topics, such as acidification [7], ocean warming [8], habitat loss [9], and the appearance of so called "dead-zones" has driven the change in attitudes [10]. Thus, indifference to the marine environment is no longer an option, particularly when we consider the effects of the overexploitation of fisheries [11].

Indeed, a growing global population of over 7 billion has led to an ever-rising demand for seafood and also to a resulting increase in the fishing effort. The latest FAO figures report that 32% of marine fisheries are overexploited, depleted or recovering from depletion, which is a 10% increase since 1970 (vide Fig. 1). A further 53% of fisheries are being exploited to the maximum level and, many of them do not have the management measures in place to prevent over-exploitation [1]. And yet, according to FAO data, the remaining 32 plus 15 percent of fisheries is not enough to overcome the excess fishing pressure and they yield less than their maximum potential production. In short, the increasing trend in the percentage of overexploited, depleted, and recovering stocks and the decreasing trend in underexploited and moderately exploited stocks are serious causes for concern.

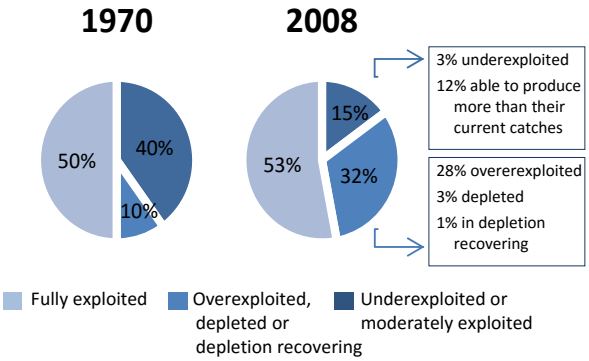

Fig. 1 The increase in fisheries exploitation since 1970 [1]

B. Economic, Social and Ecological Management of Fisheries

Fisheries represent the last major international industry based on the pursuit and capture of wild animals. It is neither primitive nor innocuous, and fishing remains an essential element of the food supply that is vital for the well-being of

hundreds of millions of people [12].

Nowadays, the higher demand levels of fishing are a major threat to the structural and functional (re)organization of marine ecosystems: direct effects involve the reduction of both the temporal and spatial distribution of the target species, habitat damage, and a sharp drop in the average size of captured fish [13]. Indirect effects concern causing or enhancing changes in the fish community structure or differential effects on shoal functional groups [14]. Efforts are currently being made to understand the wider effects of fishing in order to measure them [12] and to set quotas regarding fish stocks [1], [11], because there is increasing evidence of the collapse of many species.

The collection of such data is often quite expensive and it requires a continuous research effort with an adequate monitoring system and, expertise that is not always available. The outcomes of this research must be robust enough not only to support the management of fisheries on a sustainable basis but also to promote higher sustainable levels of both fish stocks and catches. Fisheries are core subjects for the balance of fish stocks in marine ecosystems, and healthy ecosystems are a key element to the continuity of the fisheries business. It is a kind of economic-ecological virtuous circle. Fisheries also involve more socio-economic objectives that come from fishing revenue since they provide employment for millions of people, worldwide – from the fishermen themselves to aquaculture producers and, from traders and intermediaries to wholesalers. This sector could play a fundamental role in preventing and reducing poverty in developing countries [1]. However, sustainably managed fish stocks have to rely on just 19% of the total fish stocks (vide Fig. 1) to ensure the long term feasibility of all these livelihoods. The remaining stock is, in the meantime, being recovered.

The progress made by Government Agencies (GA), Universities, Research Centres and Non-governmental organizations (NGO) is getting results in reducing exploitation rates and, restoring both overused fish stocks and marine ecosystems [2]. The adoption of the Code of Conduct for Responsible Fisheries [15] illustrates this issue.

Control measures for illegal fishing on the high seas, where no state has authority do, however, exhibit serious drawbacks regarding law enforcement [16]. According to Greenpeace [16], the most problematic areas are located around West Africa where “pirates” illegally catch tonnes of fish, destroying the economies of nearby countries. Each year, illegal fishing in the waters of sub-Saharan Africa is estimated to be 1.2 billion euros. Often, the culprits are Chinese, Korean and Taiwanese vessels that have licenses to fish in one zone but, then, exploit another one [18]. Most illegal catches are exported to Europe through the Spanish port of Las Palmas. Illegally caught fish are transhipped at sea onto large refrigerated cargo vessels, where they are mixed with legal catches before being transported to their final destination port [16].

With regard to combating Illegal, Unreported and Unregulated (IUU) fishing, reinforced controls have been developed, such as: (i) the elaboration of an international legally-binding instrument [19] on port measures to prevent and eliminate IUU fishing; this is mainly due to international cooperation, monitoring and control measures applied to the whole chain of fishing and related activities; (ii) a governmental partnership framework that develops a sustainable fisheries policy and responsible exploitation of fishery resources [1]; and, (iii) the search for harmful fishing methods (e.g. like the bottom-trawl), parallel trading and lack of compliance with standards relating to minimum size of captured species [20].

At the same time, and to prevent illegal fishery outcomes from entering the supply chain, the NGO Greenpeace has developed and recommends the following two initiatives: (i) the traceability of fishery products; and, (ii) the use of Greenpeace Blacklists, i.e. lists of boats that are not authorized to fish or that have already been punished for illegal fishing activities. All blacklists name the fishing vessels and fish transport vessels, including their owners or operators and companies on the Official International Blacklists. This information is based on the official registries of IUU fishing that are publicly available and accessible in Greenpeace webpage [16].

Developing frameworks for achieving responsible sustainability is imperative with regard to operationalizing knowledge and enforcing good practice across the supply chain, from fishermen to retailers [1]. These frameworks should enable a transition to sustainable fisheries’ management in the form of support for fishery improvement projects, demand for certified origin of seafood and its traceability up the supply chain. The private sector should also be fully committed to these actions in order to contribute to the quick recovery of shoals from extremely low population levels.

C. Retailers and Supply Chain Sustainability

In the fish supply chain, the captured fish is sent to market through processors, distributors and retailers before ending up in the consumers’ hands (Fig. 2). The effort of the producer (fishing fleet) is depicted as providing feedback to the ecosystem model by impacting fish abundance and catches of both target and non-target species [21]. Aquaculture units can also be incorporated as either producers or processors as being best suited in individual applications [22]. In this way, the liability for insuring the chain sustainability with an environmentally-friendly policy [3] belongs to all the participating parties, in business operations across the whole supply chain (vide RQi).

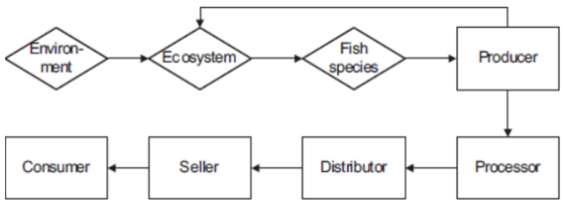

Fig. 2 Schematic value chain flows from sea to consumer for a single fish species [22]

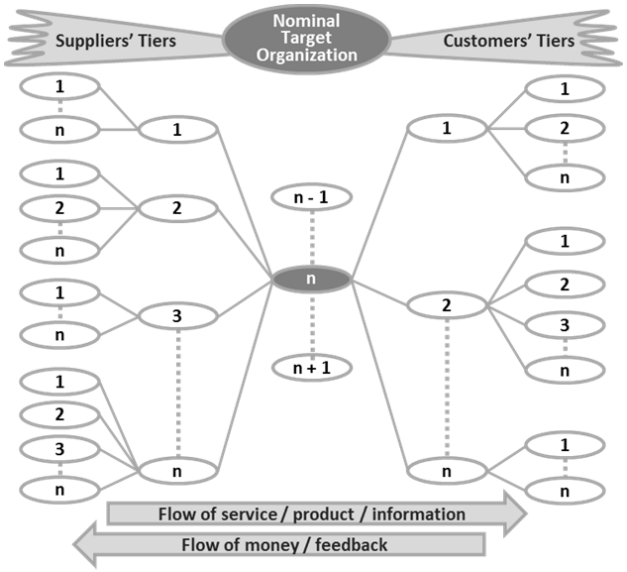

Fig. 3 Schematic of a generalized supply network [27]

Environmental pressures constitute the driving forces at work to improve the sustainability of supply chains [23], [24]. Environmental damage is not often acknowledged since (i) it does not impact market price formation in the early stages of imbalance; (ii) it occurs too far away from the marketplace; and, (iii) the product is not yet scarce. Thus, a clear link between supply chain strength and a firm's environmental performance becomes explicit [25] and supply chains must become integrated by considering both upstream and downstream stakeholders (RQi). Connolly and Caffrey suggest the existence of additional tiers both upstream and downstream, which are not shown in Fig. 3. In fact, business processes and management components of the supply chain are closely inter-related with the depicted structure [26]. In this context, due to their strategic position and market influence, retailers play a core role in driving supply chain environmental sustainability [28], [29]. Indeed, retailers are drivers of Fair Trade, offering substantial contributions towards achieving sustainable development [30], by the provision of information, user-friendly tools, and the spread of sustainable practices (RQii). Retailers usually avoid risk since they are very sensitive to the social or environmental problems of consumers. Moreover, according to [31] the high and unpredictable price of damaging marine biodiversity has led to a growing social awareness and demands for the sustainability of the fish species being consumed. Thus, retailing has progressed towards not offering threatened fish species, refusing illegal fishing, criticizing destructive capture methods and offering more environmentally friendly alternatives (RQi). However, the results of the Greenpeace survey on fish procuring policies adopted by major retailers, in Portugal, drew strong criticism from all the Portuguese hypermarkets canvassed. In fact, until as recently as 2008, strategies concerning fish procurement were still not made available to the public. Worse, perhaps, they were non-existent, despite their importance in the retail landscape [31]. Finally, according to [32], supply chain management (SCM) might also help companies to pursue environmental responsibility. However, few studies have analysed the relevance of SCM in contributing to environmental sustainability (RQi).

D. Robust Management of Fisheries: Monitoring, Informing and Enforcing

Clear standards are helpful for setting milestones, agreeing on end-objectives, and promoting the definition of responsibilities for partners upstream of the supply chain. Retailers could apply several strategies to drive environmental improvement in the fish supply chains, such as: fish traceability; product certification; environmental criteria for suppliers; dissemination of better practices across suppliers; promoting eco-labelling of captured fish; local sourcing; and, optimization of logistics [32]. Secondly, the market-based approaches of retailers might push and empower customer choice with regard to sustainable consumption. In turn, this change in consumer attitude might influence and be transferred upstream of the supply chain to the remaining stakeholders, thus increasing the incentive to entail strategies regarding the demand for sustainable seafood [33] (RQiii).

E. Product Certification, Eco-Labelling and the Traffic Light System (TLS)

Eco-labels are seals of approval given to products that are less harmful to the environment than some similar competitors [34]. The principal objective of eco-labelling is to create a market-based incentive for sustainable management of fisheries by creating consumer demand for seafood products from well-managed stocks. It is possible to distinguish between two subcategories of multiple attribute labels; one that mainly focuses on the fishing stage, (arrows 1–3, in Fig. 4) and another one that addresses the 'environmental' impacts in the whole life cycle of the products (arrows 1–5, in Fig. 4) [21], [22].

Type II environmental labels of the International Organization for Standardization (ISO) are based on "self-declared" or "self-certified" environmental claims made by producers, importers and retailers about products and services. This is done on a voluntary basis [35], [36], and is based on their own product standards. These standards could be based on sustainability criteria related to specific environmental issues against which a fishery would be evaluated.

Product certification and eco-labelling, while interrelated and serving the same goal, nevertheless have important differences as currently applied in fisheries. Product certification is commonly a measure mandated by governments, often mutually agreed upon by regional fisheries management organizations, to ensure that only legally harvested and reported fish landings can be traded and sold on the domestic or international markets. Product certification does not necessarily involve a product label at the retail level [37].

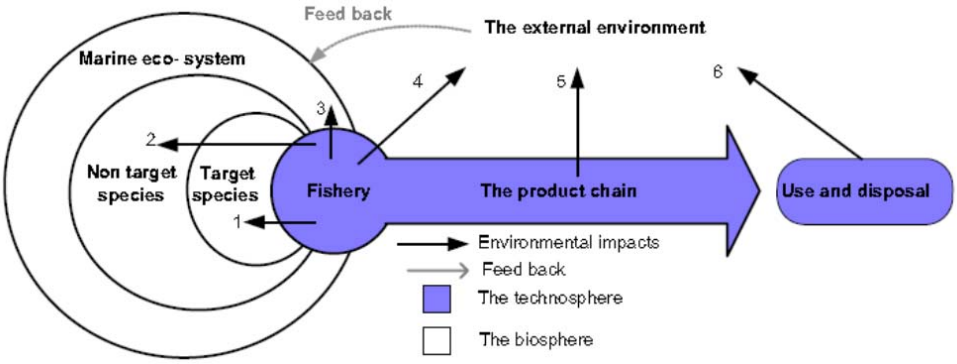

Fig. 4 Environmental impacts at different life cycle stages of seafood products [21]

The TLS [4] was found to be a useful visual tool, to operationalize effective monitoring and reporting quickly and cheaply. It supports the decision making process by: (i) describing the pressures affecting the ecosystem; (ii) allowing timely risk analyses and global assessments concerning fisheries management; (iii) updating retailers on issues concerning fisheries' sustainable capture and trade; (iv) tracking progress towards meeting management objectives; and, (v) by clearly communicating trends in both complex outcomes and management processes, to a non-specialist final consumer audience.

In short, there is a growing awareness that retailers have a vital role to play in promoting more sustainable patterns of consumption. And, in Portugal, 70% of fish sold is bought in hypermarkets [31]. Moreover, the vast majority of consumers visit food retail outlets on an almost daily basis [38], [39] (RQi). So, food retailers should design schemes to provide consumers with more and better information to help them make decisions when purchasing seafood (RQii). At the same time, retailers are the active intermediaries between primary producers, manufacturers, and consumers and, as such, they are in a singularly powerful position to drive sustainable consumption (RQiii).

III. Research Methodology

A. Case Study in a Large Retailer

The research sponsor is a leading retail company that owns super and hypermarkets throughout Portugal. The company believes that taking measures to preserve the environment is a distinctive competence that could contribute to the sustainable development of their business, whilst fulfilling a Social Responsibility. To this end, the company has been developing a fish procurement policy to recover from initial competitive disadvantage by defining both responsible and sustainable trading business practices. The overall aim is to stop selling the species in risk [40]. Therefore, the sponsor's policies have been driven by a long-term approach to risk management, in which, as many uncertainties and threats as possible might be controlled. For instance, the sponsor is taking the first steps in this direction by committing to a 10% reduction in fish caught by trawling and contributing towards eliminating illegal fishing by ceasing to do business with firms on the Greenpeace blacklist. Conformance with these criteria was checked every year. This strategy is expected to contribute to both business sustainability and value creation.

The described pilot-test was carried out in the fishery department of a store chosen by the sponsor as being representative, regarding size, area, location, population and product assortment. Investigated products concerned fresh (sea waters and aquaculture), frozen and dried (cod) fish.

B. Data Collection

Data were collected from several critical sources, as follows: (i) documents, databases and the sponsor's website were searched for motivations, advantages and goals of the sponsor's fishery policy, in order to find out the previous sustainability strategies of the company; (ii) the ranking of the sponsor and other retailers was checked on the Greenpeace website to benchmark the sustainability levels and healthy competition; (iii) 'Docapesca de Matosinhos' and 'Docapesca de Peniche' were two of the visited suppliers used to trace the sources of the supplied fish; (iv) suppliers' blacklists were downloaded from the Greenpeace website; these were cross-checked with the sponsor's suppliers to eliminate the blacklisted ones; (v) the Whole Foods Market was visited, in London, in order to understand and assess its decision making system; two portals were also consulted; (vi) 153 purposefully chosen customers of the sponsor were surveyed; the applied questionnaire was about seafood purchasing behaviour, ability to identify the species at risk of extinction and environmental protection policies: reactions and perceptions. The results coming from the PASW Statistics Software were sufficient to define a very first exploratory consumer profile, which enabled the sponsor to focus its policies.

IV. Analysis of Results

A. Survey – Consumer Perceptions about Seafood Sustainability

153 of the sponsor's customers selected by convenience sampling were questioned in a structured interview. The store, study duration, and working shift were chosen by the sponsor. Thus, generalization of the results was compromised. In this exploratory survey, although the data was quantitative, the

analysis was qualitative, because statistical significance was not addressed. Therefore, the average values registered in the graphics might only be interpreted in a qualitative way.

Understanding consumer perception is an important driver for a future consumer campaign. The questions, therefore, covered three areas, as follows: i) relevance of capture method and species at risk as purchasing criteria; ii) general consumer behaviour towards sustainability practice, i.e. price variations of species offer; and iii) consumer behaviour when purchasing popular species.

1) Purchasing Criteria

The average importance allocated to each purchasing criteria by respondents in a scale ranging from 1 (not important) to 4 (very important) was depicted in Fig. 5.

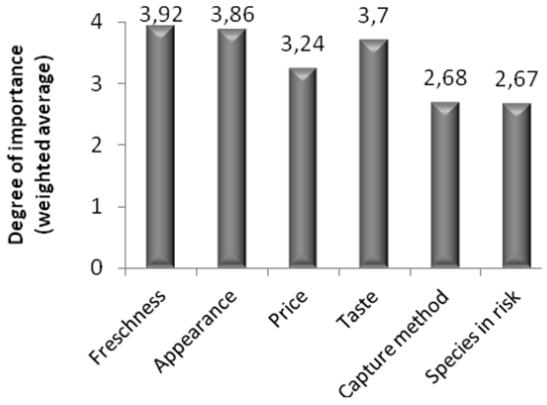

Fig. 5 Average importance allocated to each purchasing criteria.

Sustainability criteria – capture method and species at risk – showed a relevant qualitative smaller degree of importance perception compared with the others. However, respondents still showed high sensitivity, i.e. two thirds of the scale (≈ 2.7 out of 4), which might mean that any potential consumer campaigns towards sustainability would have some kind of impact.

2) Sustainability Practice and General Respondents' Behaviour

The average agreement allocated to each business practice by respondents on a scale ranging from 1 (totally disagree) to 4 (totally agree) is depicted in Fig. 6.

The qualitative differences between the average scores allocated to two groups of practices can be seen. Furthermore, many respondents agreed that species at risk should not be sold or, at least, there should be less on offer. However, as many respondents still thought that if the species was being captured by sustainable fisheries, it should be made available, even if it was at risk. Perhaps, some information to the consumer is required since the qualitative differences between the average scores were noticeable.

A significant number of respondents argued for species at risk to become more costly. Only half of the respondents agreed that they should come from aquaculture, which showed a relevant improvement opportunity.

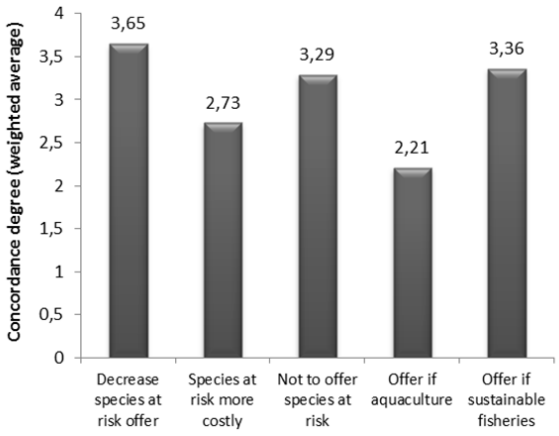

Fig. 6 Average agreement owed to each sustainability practice

3) Specific Respondents' Behaviour when Purchasing Popular Species

Species at risk that are part of a traditional national diet were chosen from a list compiled by Greenpeace [40] (red, in the species TLS) and the ones regularly purchased were identified (yes/no). Species at risk status was only perceived by 19% of the respondents (Fig. 7). Supplying some information could have motivated respondents to change their consuming patterns, e.g. checking desire, abstaining from consuming, replacing the species at risk, choosing aquaculture.

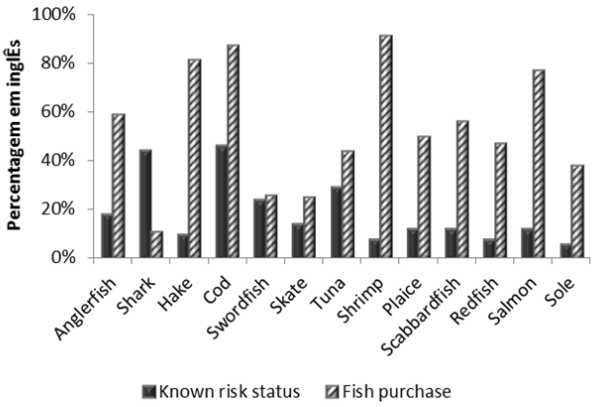

Fig. 7 Respondents' knowledge about seafood species at risk on offer and being purchased

Different motivations for high consumption rates were identified: cod is considered a national dish; hake is a very popular fish because it can be cooked in several ways, it is cheap, healthy and recommended by the nutritionists; shrimp has become popular lately because income levels have risen sharply and salmon is consumed due to drop in price (aquaculture). There were two misunderstandings, as follows: the species at risk was the oceanic salmon and fresh tuna consumption was only high as a canned product. To sum up, some difficulties might be anticipated with regard to changing the consumption patterns of cod, hake, shrimp, and tuna in Portugal.

TABLE I
CONSUMER PROFILES

Consumer profile	Definition	Description
i) Not sensitive	Consumer not sensitive to the species risk, after having been informed	If the species availability is reduced, goes out of the product assortment, or price increases, this customer is expected to run away to the competition
ii) Fully devoted	Consumer fully devoted to the species protection, after having been informed	If sustainability is pursued this customer might exhibit a proactive behaviour; it is expected to stop consuming or to replace a risk specie either by a non-risk, or by aquaculture
iii) Me too	Consumer that is more and more aware of the species risk, but only after a continuous information effort	if species are captured by sustainable fisheries, this customer might accept to purchase it and it might be retained by actions targeting the loyalty improvement

TABLE II
DATABASE MODEL TO IMPLEMENT A TRACEABILITY POLICY ADOPTED BY THE SPONSOR

TLS of the Capture Method	Supplier	Product	Scientific Name	Capture Zone	Fishing Method	Boat List	Owner	Statement on the issue of quotas	Port List
…	…	…	…	…	…	…	…	…	…
Green	"X_1"	SNAPPER	*Pagrus pagrus*	Atlantic North	Long lining	CRISTIANO	"Y_1"	Catch Certificate	Rio de Janeiro
Yellow	"X2"	HORSE MACKEREL	*Trachurus trachurus*	Atlantic North	Purse seines	CARLOS APARÍCIO	"Y_2"	Catch Certificate	Peniche
Red	"X_2"	HAKE	*Merluccius paradoxus*	Atlantic North	Trawl	GALATADA	"Y_3"	Catch Certificate	Canárias
…	…	…	…	…	…	…	…	…	…

Note: Names of suppliers, boats and companies have been disguised for confidentiality reasons.

4) Overall Analysis of the Survey Results

Consumers appeared to have been buying a relevant amount of seafood without being aware of the risk status of the species. Table I describes three expected behaviour types if consumers were more aware of the sustainability issues concerning the species (RQii).

Defining a retailer policy according to these three consumer profiles might result in a better match with the consumer purchasing behaviour. Thus, it would be important to design a more robust survey as regards construct validity. The above identified consumer profiles could, then, be refined through an in depth socio-demographic characterisation. This should be followed by a thorough definition of the adequate variables to assure seafood sustainability, as previously exemplified in the exploratory survey. Moreover, internal validity should also be taken into consideration by establishing stronger relationships among the variables. In this way, both better discrimination between the several categories measured and statistical relevance might enhance the explanatory power. The policies chosen by the retailer, concerning sustainable seafood consumer campaigns, would thus be focused on the consumer profiles through a credible investigation. These campaigns might also align the producer with a sustainable integrated policy for the whole supply chain, which would be driven by the marketplace.

B. Design of a Database to Implement a Traceability Policy

Consumer profiles (ii) and (iii) mentioned the requirements for sustainable fishery, i.e. adequacy of capture methods and/or ship-owners' compliance with blacklists. Thus, the threat to species would decrease, species at risk stocks would tend to recover, and the others would be better protected. In this way, and in accordance with Greenpeace recommendations [31], [40], data that were collected, treated and recorded in a database enabled greater control and easier access to the organized information concerning the traceability of both fish capturing and some processing activities. The developed database is made up of the attributes considered in the fields of the model expressed in Table II.

The colour codes used in the table come from treating and categorizing the several species according to the method of fishing and further implementing a TLS methodology to accept or reject a supplier. While red concerns trawling capture, the green included manual fishing, long lining, hooks on branch lines (snoods), Danish seines, fishing with creels and buckets. Finally, the yellow classification regarded capture methods other than the ones mentioned and also, multi-method fishing used together in the same boat.

While a few suppliers gave confidentiality as an argument for not providing the information required, others said it was because of difficulties due to their position in the supply chain. Perhaps there could be some enforcement through the introduction of a contractual clause as a qualifying criterion. This could help overcome difficulties relating to a retailer-led green supply chain.

C. Product Certification and Eco-Labelling for Fisheries Sustainability

The label would have a self-declaration/self-certification of the safety, quality, and sustainability of supplied fish, thus assuring, it comes from sustainable fisheries. This would correctly describe the species without re-labelling, state the capture date and the species' risk, assure traceability within the chain of custody, and that there was no transhipment at sea of illegally caught fish. Although, the eco-label only focused on the fishing stage, i.e. on the target species (vide arrow 1, Fig. 4), consumers at the Point of Sales were directed to purchase products that had fewer ecological impacts. Thus, eco-labels operationalized a market-based approach that attempted to guide consumer behaviour towards more sustainable seafood. At the same time, the principal objective of product certification and catch documentation was

accomplished, i.e. to prevent, discourage, and eliminate IUU fishing [1] since only legally harvested and reported fish landings could be traded. In short, the retailer influenced both sourcing by product self-certification and trading by eco-labelling. It could, therefore, be argued that sustainable practices along the supply chain have been implemented by this assignment (RQi).

D. Business Impact – Greenpeace Ranking

Our sponsor progressed from the fourth position (2008), in the Greenpeace Supermarket Ranking, to second, in 2010 (Fig. 8).

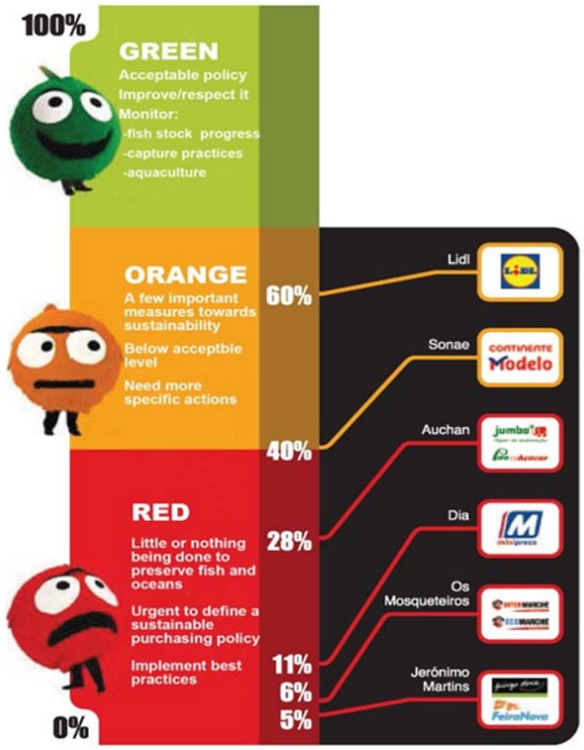

Fig. 8 Results of the Third Supermarket Ranking [49]

The reported research was carried out during 2010 and so, it also played a relevant role in the definition of a more sustainable policy for fish procurement and trading by our sponsor, with regard to excluding IUU fishing, seafood traceability and eco-labelling, preservation of risk species, SC visibility improvement.

The position occupied by the sponsor's hypermarkets had resulted from fulfilling criteria, established by Greenpeace, after the Code of Conduct for Responsible Fisheries [41] targeting the recovery of the global stock level of seafood by 2015. These results suggested that the retailer had been pursuing a socially acceptable fish retailing policy. It was both clear and confirmed that its image among consumers as well as NGOs, like Greenpeace had improved (RQiii).

V. Discussion of Results

A. The Sponsor's Positioning in the Greenpeace Ranking for Portuguese Retailers

Many institutions are working together to develop strategies targeting change in consumption patterns throughout the marketplace; this is in addition to government regulation to improve fishery production [42]. Our sponsor improved its position in the Greenpeace qualitative ranking for Portuguese retailers (Fig. 8) by voluntarily complying with its guidance. In fact, supermarkets can be the driving force to push local fisheries towards sustainability at a faster rate than is currently being pursued by government [43].

B. Product Certification and Eco-Labelling for Fisheries Sustainability

Using the "Greenpeace Seafood Red list" to find out the species at risk might be questioned, so too might just using lists of recommendations, websites and reports to differentiate between sustainable and unsustainable species [42]. Moreover, [22] suggest that fishing quotas should be as dynamic as the behaviour of shoals is. They should be periodically re-evaluated and include both non-target species and the ecosystem, as a whole. The eco-labelling carried out in this research, only focused on the target species (arrow 1, Fig. 4) of the "Red List" leaving a margin for improvement.

Christensen and collaborators [22] illustrate the required holistic approach by considering what effect the eventual overfishing of a particular predator in a food web (e.g. Tuna), would have on the population of their preys (e.g. Mackerel). And, moreover, the effect the consequent population increase of this prey, as a predator itself, would have on other species (e.g. Mackerel, on the Clam population). They also draw up the economic impact the ecosystem balance has on job creation (Fig. 9). Therefore, stopping overfishing and allowing the stocks to rebuild would increase their productivity and it would maximize revenues for the industry and commerce in the long run [44]. Thus, the sponsor's path could be improved by keeping track of the flow from production to trade within a broader context (social, economic and ecological).

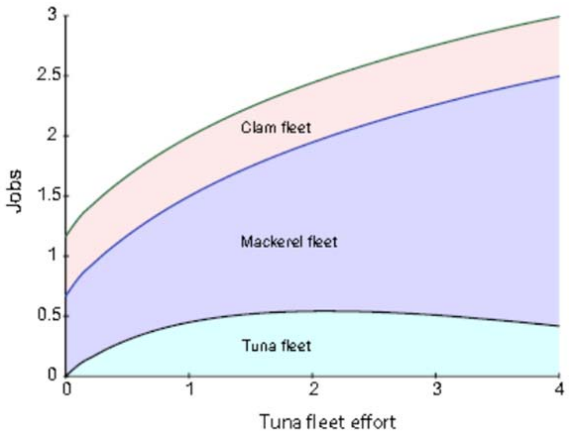

Fig. 9 Number of jobs as a function of the effort of the tuna fleet [22]

The natural progress of "self-declared"/"self-certified" environmental labelling by producers was towards "environmental labels [...] based on voluntary multi-criteria product life-cycle assessment of environmental effects with verification through a third party" [37]. Thus, the sponsor will soon need to choose a third party certifier. According to [20] the Marine Stewardship Council (MSC) has become the world's most established fisheries' certifier and is taken more seriously by scientists than many other organisations. However, they consider that objections to MSC certifications have been growing [45], with some scientists from Greenpeace, the Pew Environment Group, and some national branches of the World Wide Fund (WWF) protesting over various MSC procedures or certifications. MSC certification was also questioned by retailers like Waitrose (in 2009) and Whole Foods (in 2010) with their refusal to deal with certified fisheries [20].

C. Supply Chain, Visibility, Traceability & IT as Promoters of Trust and Sustainable Views

Marine resources can be better managed when fishers and other resource stakeholders are more involved in management and co-management [46]. Focusing only on species can hide the identity of, and variability among, producers and fisheries [42]. Iles also argues that many internal policies and activities are not transparent to outsiders. Finally, the MSC advocates a "boat to plate" approach to certification which implies a requirement for traceability [20].

Calling for the involvement of all stakeholders in a shared holistic view focused on the customer is, without question, the right course (Fig. 10). Moreover, providing visibility leveraged by information technology was found to be a significant step towards trust and, therefore, to building a credible approach to sustainability. It was not enough just to accept the suppliers' word regarding their sustainable practices, as an act of pure faith. The sponsor should make sure that there is evidence and visibility of the upstream activities supported by periodic random audits carried out by credible third parties and, also, by adequate real-time IS/IT solutions, since paperwork is becoming increasingly questionable. In fact, nowadays, it is possible to track vessels on the ocean, even in real-time. If this is not done, however, the reasons might be as follows: (i) no financial resources; or, (ii) lack of political will, due to high economic interests (?); or, (iii) insufficient social/market pressure.

Despite the research sponsor being of very limited size in the international context, an effort should be made to lead its supply chains towards transparency and trust, and to go further than designing a database to record the self-reported activity of the fisheries (vide Table II). Information dissemination, labelling and credible means of signalling are rising in importance as a way to provide feedback to customers and other stakeholders about the environmental quality, as well as the social and economic benefits of both seafood and supply chain processes [47], [48]. Consumers would then more easily understand the need to consume more fish from aquaculture and, be prepared to pay more for dearer wild-caught seafood products (Fig. 5) Thus they would act as demand regulators, i.e., accept self-imposed limits on fish consumption, stop purchasing certain species, or refrain from buying sustainably caught species [42].

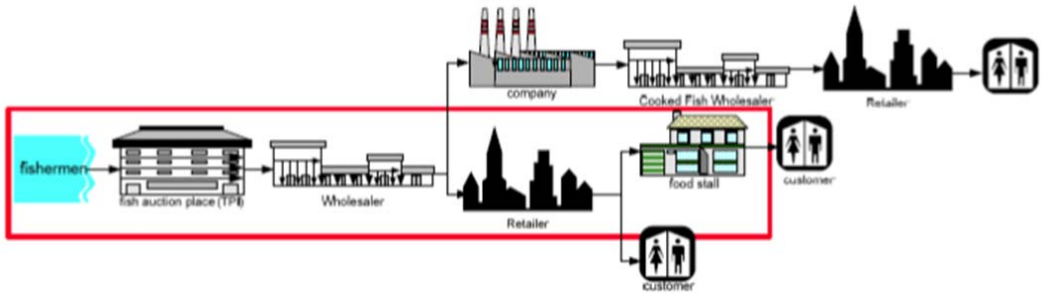

Fig. 10 Red square: sample of sea fishery for consumption supply chain. Source: [50]

Our sponsor has progressed from fourth place (2008), in the Greenpeace Supermarket Ranking, to second in 2010 (Fig. 8).

VI. Final Conclusions

This paper addressed state-of-the-art fish retailing practices, employed to achieve better management of marine resources. The research succeeded in understanding the consumers' view and managed, to some extent, to introduce fish traceability. However, neither CPFR approaches, nor IS/IT solutions are in place.

The research purpose was exploratory and a pilot-store was chosen by the sponsor, as representative. 153 customers, selected by the convenience sampling method, were questioned. Thus, a broad generalization of the results is not possible. The average values plotted in the graphics were interpreted in a qualitative way. So, statistical significance was not addressed. Further work to overcome some of the study limitations was identified, as follows: to make the pilot-test more robust, it would be of longer duration; the test period would be chosen to include/exclude special seasons or events; it would cover other stores and/or involve improving critical store procedures.

The exploratory survey disclosed the potential consumer awareness of purchasing criteria close to sustainability. In the future, a more rigorous statistical survey should be carried out, to check the absolute level of importance of these criteria for

the consumers. Consumer campaigns could be reinforced and multiplied accordingly. If the criteria, concerning sustainability, prove not to resonate with consumers, then the consumers may need to be better informed in order to become sensitive to the problem, in the first place (RQii). The questionnaire further revealed that consumers appeared to be open to some action regarding species at risk, such as reducing offer, increasing price, or practising sustainable fishery. Action should be taken to make aquaculture more popular, as is already the case with species like salmon, sea bream and bass (RQii). Perhaps, this will happen in the same way as with chicken. Nowadays, practically everybody is happy to eat the abundant, half-priced hens coming from the poultry farming industry. The positive point was that respondents appeared to be prepared to accept a financial penalty, with regard to consuming seafood species at risk, in exactly the same way consumers pay double for free- range chicken.

Finally, the survey highlighted consumers' willingness to purchase species at risk that were captured by sustainable fishery, which generated what appeared to be a clear demand for information. Consumers appeared to have no information concerning the risk status of many popular species that were offered by the sponsor. Two actions were taken in order to provide more information to the consumer, as follows: (i) a 'first' Traffic Light System (TLS), concerning the sustainability of the fisheries, was supported by a purposefully constructed database based on the Greenpeace blacklist; (ii) a 'second' TLS was built to classify the species at risk based on the Greenpeace Red lists. The fishing quota could have been addressed depending on the periodic dynamics of shoals, and it should also have included the non-target species and the ecosystem, in addition to the target species. Despite the fact that the database supported by partners' self-evaluation is current practice in the industry, strong criticism arose with regard to the transparency of the process in the chain of custody. In fact, the schemas implemented to operationalise retailers' influence on sourcing and trading sustainable practices (RQi) were found to be insufficient. Thus, recommendations were made regarding progress towards eco-labelling based on third party certification with, in this context, the role of the Marine Stewardship Council (MSC) being discussed as a popular and credible certifier entity. Finally, a supply chain approach leveraged by information technology, as a promoter of visibility and, therefore, of trust, was also discussed as a more sustainable view.

The "boat to plate" MSC approach to certification supported by modern IT systems to track both vessels and activities across the supply chain, in realtime, was proposed. This should provide both transparency and evidence of sustainability practices, with the aim being to deal with modern consumer pressure within a CPFR environment. The consumers should also be taught to act as demand regulators, to consume aquaculture fish rather than wild-caught seafood, to self-impose consumption limits, to stop buying species at risk, and to be prepared to pay more for the wild species. We contend that retailers do appear to have a core role as regulators of the supply chain, since they can act as perfect mergers of the upstream and downstream interests, by orchestrating both consumer and producer convergent campaigns (RQi). In this way, the retailer role should go far more beyond than just promoting the progress towards balanced marine ecosystems based on an effort to stop selling the species in risk or, merely eliminating the blacklisted fisheries (RQiii).

As regards the economic dimension, one argues that there is a relevant contribution to the practitioner, i.e. the sponsor. In fact, three types of consumer behaviour were anticipated, if the level of consumer awareness increased, as follows: not sensitive, fully devoted and me too. This consumer segmentation needs to be confirmed by designing a more robust survey, where an in depth socio-demographic characterisation would be carried out, as well as, a thorough definition of both the adequate variables to assure seafood sustainability and their relationships. In this way, the retailer might be able to design more customised policies to deal with different consumer needs, in order to assure their loyalty by adjusting the consumer campaigns (RQiii). As a consequence, a positive impact in profitability might be expected, not only directly concerning the purchasing of seafood, but also in other types of products.

Lastly, we contend that the objectives of this research were fully achieved, since the current corporate sustainable practices have been understood and explained (i), the topic was addressed following a triple bottom line approach, (ii) there was a relevant contribution to practice, which enabled the fine tuning of business practice, and (iii) during this exercise, sustainability in fisheries was promoted through discussing the implementation of visibility in the supply chain.

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