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„Overarching sustainability objectives overcome incompatible directions in the Common Fisheries Policy“

Leyre Goti^{1*}, Mike Fitzpatrick², Ralf Döring¹, David Reid³, John Mumford⁴, Anna Rindorf⁵

¹Thünen Institute of Sea Fisheries, Hamburg, Germany, ²Irish Observer Network Ltd., Cork, Ireland

³Marine Institute, Galway, Ireland, ⁴Imperial College London, United Kingdom, ⁵DTU Aqua, Technical University of Denmark. *correspondence: leyre.goti@thuenen.de.

Abstract

The lack of clarity in the objectives of the Common Fisheries Policy (CFP) must be addressed to create a more efficient balance across diverse ecological, economic and social dimensions. Particularly economic and social objectives present at an overarching level must be made explicit and addressed in lower level management measures, in order to link them to biological objectives and allow policy to build a balance across types of objectives. Selecting clear objectives is essential, particularly for policy impact assessment. The aim of this paper is to demonstrate how more specific high level objectives to managing fisheries can be derived from stakeholders. The paper first reviews the definition of objectives, from a historical and conceptual perspective. Secondly, it discusses the issues of manageability and acceptability, and finally describes an articulation of the high level objectives derived from extensive stakeholder consultations at European and regional level. The results from workshops at the European level to identify objectives were further examined at regional level for the Baltic and North Seas in additional individual consultations. The German case addresses two seas (Baltic and North Seas), has a complex governance structure (due to federalism) and significant roles for the three types of actors (industry, government and environmental NGOs). The analysis suggests that establishing higher level sustainability objectives within the CFP can help diverse interest groups to develop a consensus on management actions to meet complex social goals.

Keywords: Common Fisheries Policy; high level objective; sustainability goal; participatory method; EU fisheries management; impact assessment

Highlights

- High level policy objectives allow for synergies that are lost at lower level
- Manageability and acceptability of objective is key for implementation and compliance
- Limit values of some objectives can restrict the speed at which others are achieved
- Participation of stakeholder in drafting objectives can lead to innovative approaches

1 Introduction

Article 2 of the Common Fisheries Policy (CFP) [1] contains a series of overarching objectives. These tend to focus on core fisheries management issues, such as Maximum Sustainable Yield (MSY) and the Landing Obligation (LO), but also include very high level objectives for sustainability in an ecological, economic and social context – the three pillars of sustainability. Across the different framework regulations for fisheries issued in Europe since 1983 the description of objectives has changed from the conservation of fishing grounds to the restructuring of the sector or the conservation of the resource, and in the same way the scope of the policy has been modified to include fisheries, aquaculture and EU registered vessels fishing abroad.

Little prioritization between objectives can be discerned in the latest policy, which includes all three aspects of sustainability. It ranges from high level, and quite vague, objectives covering all three aspects, to specific objectives, such as for coastal activities (Article 2.5i). Prioritization has been demanded at the higher level, for example setting conservation over other goals and also creating a distinction between principles and technical implementation to avoid micro-management and a short term focus[2].

Clear objectives are critically important for the evaluation of the impact and success of any proposed management measure[3,4]. This includes the outcomes in terms of changes in the fishery and incentives for that, changes in the ecosystem (for example, progress towards Good Environmental Status (GES) under the MSFD[5]), and changes in the social and economic indicators chosen to represent those two pillars.

The aim of this paper is to demonstrate how clear high level objectives [6] can be derived with stakeholders to effectively and efficiently manage fisheries across a range of sustainability criteria. The paper addresses this first by reviewing the definition of sustainability objectives, from a historical and conceptual perspective. Secondly, we discuss the issues of manageability and uncertainty and finally describe an articulation of the high level objectives derived from extensive stakeholder consultations at European, regional and local levels from two research projects, as described in Marchal et al [7] and Rindorf et al. [8].

2 The problem of defining objectives

2.1 Sustainability objectives in context

The sustainability objectives of the Common Fisheries Policy cannot be considered in isolation, as they exist under a wider suite of global and European objectives. The most widely used definition of a sustainability objective promoted by the United Nations at a global level was developed by the Brundtland Commission in 1987[9], stating that “*sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*” This statement is completed by an emphasis on its two main elements. The “needs”, with priority given to the needs of the poor, representing a social objective, and the “limitations” imposed by the need to maintain a healthy environment, representing an ecosystem objective. With respect to fisheries, the United Nations Convention for the Law of the Sea in its Article 61 states that conservation measures should be designed to “*maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield, as qualified by relevant environmental*

and economic factors, including the economic needs of coastal fishing communities and the special requirements of developing States". This qualifies a primarily technical indicator (maximum sustainable yield, MSY) to include social, economic and ecological factors, in a very similar fashion to Article 2.1 of the CFP. This demonstrates how the objectives of conservation and social and economic development are tightly connected in international policies. Finally, Sustainable Development Goals (SDG) were also defined by the UN[10], and in particular SDG 14 - Conserve and sustainably use the oceans, seas and marine resources for sustainable development. In terms of fisheries SDG 14 states: *"By 2020, effectively regulate harvesting and end overfishing, IUU 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 as determined by their biological characteristics"*, again focusing on MSY, but with a wider scope. SDG 14 further states: *"By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing"* which can be seen as a specific governance measure. SDG 14 also emphasizes social and economic sustainability, especially for developing countries, but in very general terms. The UN Conference to Support the Implementation of Sustainable Development Goal 14 in New York, 2017, set out a "Draft call for action" but without stating any specific objectives beyond those from 2015.

At the European level, the fundamental aim of the European Union is asserted in the Treaty of Lisbon where, in Article 2, it is formulated as *"to promote peace, its values and the well-being of its peoples"*. The same Article states sustainability as an aim of the internal market, detailing aspects of economic growth, employment and social progress and, finally, protection and even improvement of the environment. Within the European legislative framework fisheries are included under the same section as agriculture, both using similar economic measures such as subsidies and price support mechanisms, despite having objectives that differ substantially [9]. Again, all three pillars of sustainability are represented, but without detail.

Further at the European level, the Marine Strategy Framework Directive MSFD [5,11] refers to *"enabling the sustainable use of marine goods and services by present and future generations"* (Article 1.3). Regarding social and economic aspects, Article 1.2 refers to human health and *"legitimate uses of the sea"*. Another aim of the MSFD is to coherently integrate environmental aspects into other policies affecting the marine environment¹, most pertinently, the CFP, whose first objective is specified in the current regulation Article 2.1 [1] as *"The CFP shall ensure that fishing and aquaculture activities are environmentally sustainable in the long-term and are managed in a way that is consistent with the objectives of achieving economic, social and employment benefits, and of contributing to the availability of food supplies"*. Therefore, the objective includes sustainability and the three pillars concept (environmental, economic and social) in an explicit way.

The history of the CFP provides an alternative way to understand how objectives have evolved. A framework regulation on the European fisheries sector dates back to 1983, with successive reforms in 1992 and 2002. In the first framework regulation for fisheries [12] the first element of the statement of objectives was *"the protection of fishing grounds"*, mirroring the discussion at the time over the sovereignty of territorial waters.

¹ This is a slightly different approach than fulfilling the three pillars of sustainability equally in every sector or activity. It hopefully gives clearer priorities as the MSFD defines ecosystems with good environmental status as a necessary basis for every activity.

In the second framework regulation in 1992 [13], the scope was increased to include aquaculture, processing and marketing, as well as to EU vessels operating beyond EU waters. The preamble of the regulation mentions the existence of new fishing opportunities and a need to restructure the sector, increasing the complexity as new issues shift the focus beyond the original objectives. The third framework regulation from 2002 [14] introduced the integrative concept of ecosystem management. An analysis of the implementation of ecosystem based management in the CFP can be found in [15].

The most recent reform process (completed in 2013) has also gone through several stages of development, with a corresponding evolution of objectives. The Green Paper on the reform of the CFP [2] mentions the lack of prioritization of objectives in the previous regulations, considering that the three types of objectives are compatible in the long term, but not in the short term. At the same time, and in more practical terms, the document highlights the fact that in the CFP both principles and instruments to achieve them are decided at the same level (the Council of Ministers), promoting inappropriate high level micro-management as issues that could be managed at a lower level need to go through the Council of Ministers and in many cases also the European Parliament². The communication from the European Commission on the reform of the CFP from 2011 [16] includes a broad section on objectives, many of which can be categorized as social. In addition to a first objective on improved status of the stocks, the other proposed objectives include “a future for fisheries and aquaculture industry and jobs”, “thriving coastal communities”, “satisfying the real needs of informed consumers” and “better governance through regionalization”. A summary of the evolution of the objectives in the different versions of the CFP is given in Table 1 below.

Table 1. Sustainability objectives in the CFP across time.

Definition of ecological, economic and social sustainability objectives	Additional objectives	CFP version reference
<i>“conservation of the biological resources [...] in appropriate economic and social conditions”</i>	<i>“the protection of fishing grounds”</i>	(EEC) No 170/83 of 25 January 1983, Art.1
<i>“protect [...] living marine aquatic resources [...] in appropriate economic and social conditions for the sector”</i>	<i>“implications for the marine ecosystem”</i> <i>“the needs of both producers and consumers”</i>	(EEC) No 3760/92 of 20 December 1992, Art.2
<i>“ensure exploitation of living aquatic resources that provides sustainable economic,</i>	<i>“providing a fair standard of living for those who depend on fishing activities and taking into account the interests of</i>	(EC) No 2371/2002 of 20 December 2002, Art.2

² In the new CFP a co-decision process was introduced for certain decisions while in some other cases regionalization is a priority. For some issues, like discard plans, Member States in a certain region can agree on measures, which after approval by the EC clarifying whether the proposals fulfill the requirements, go into force without a decision in Council or Parliament (delegated acts).

<i>environmental and social conditions”</i>	<i>consumers.”</i>	
<i>“environmentally sustainable in the long-term and [...] consistent with the objectives of achieving economic, social and employment benefits”</i>	<i>“and of contributing to the availability of food supplies”</i>	(EU) No 1380/2013 of 11 December 2013, Art. 2

The objectives of the CFP and MSFD cover most Member States and regional differences, for example between the Baltic and Mediterranean areas, are critically important for the discussion of objectives. The context here includes the different economic, social and cultural importance of fishing for areas that are considered “most fishery dependent regions”. There are also regional objectives outside of EU regulations that affect fisheries, such as the environmental objectives in regional organizations (such as the Helsinki Commission or the Barcelona Convention) or economic and social objectives (such as in the Bergen Statement of the OSPAR Commission). At a more local level there will be regional and sub-regional differences in the importance of small scale coastal fisheries, in attitudes of those fishing, and in Member State choices of GES indicators and targets. More specifically, some multiannual management plans include similar, but not identical, objectives to the high level aims in the CFP. For example, the management plan for Baltic cod mentions social and economic incentives only implicitly by stating that sustainability will be attained by “*gradually reducing and maintaining fishing mortality rates*” [16], thus allowing industry to adapt and plan in the longer term.

2.2 Priorities between the three pillars of sustainability

The three pillars of sustainability were introduced in the 2002 Johannesburg Declaration [18] “*the interdependent and mutually reinforcing pillars of sustainable development - economic development, social development and environmental protection - at the local, national, regional and global levels*”. The interdependence of those pillars is clear, but with regard to fisheries objectives, it is less clear that these have equal priority or importance.

The assumption of three equal pillars is that no priority exists between them and the text avoids explicit statements about that balance[19]. However, some approaches to objective prioritization have been carried out [[6, 20, 21]]. In the case of fisheries objectives, there can be different levels of importance attached to each of the pillars, either due to specific social values or due to practical constraints. We detail examples of this below.

The pillar of ecological sustainability in some cases constitute a clear priority in fisheries management. In the Green Paper on the CFP Reform[2], it states “*Ecological sustainability is therefore a basic premise for the economic and social future of European fisheries*”, which implies a long time horizon, long enough for ecological feedback processes. Conservation of stocks, while a clear ecological objective, is also important for a sustainable industry, and hence has both economic and indeed social connotations, suggesting a sequential priority between pillars. The stock conservation advice is provided by the International Council for the Exploration of the Sea (ICES), dating from 1902. This advice is further refined by the EC Scientific, Technical and Economic

Committee for Fisheries (STECF), which may add an economic context. STECF was not founded until 2002, again suggesting the evolving importance of the economic pillar catching up with the ecological pillar. Further, there are particular situations where there is a clear asymmetry towards conservation objectives, such as where stocks are managed under an explicit recovery plan. An example of a recovery plan is that for the stock of Irish Sea cod [22], among many other European stocks. In these cases, the ecological pillar is given priority, but again, with expected benefits under the other two pillars. The Green Paper formulates it as “*the economic and social viability of fisheries can only result from restoring the productivity of fish stocks*”. . Sometimes this asymmetry is incorporated into harvest control rules, as for example in the Baltic Sea long term management plan for cod, where higher restrictions in fishing mortality are foreseen in cases of particular danger for the stock (when stock spawning biomass is below the stock specific reference point[23]).

The pillar of economic sustainability is often not a high priority in conventional fisheries management. But economic factors can still act as a clear limit or constraint that needs to be given some consideration even in what appears, at first glance, to be a simple conservation issue (e.g.[24]). Fisheries are an economic activity and there may be market constraints that make fishing economically difficult or impossible under some conservation measures. The price and availability of fish, together with the dependence on the processing industry as the main market, are issues that may bring economic sustainability to the forefront. This was the case for the closure of the anchovy fishery in the Bay of Biscay in 2005. Most of the catch was used in the processing industry and the closure of the fishery created the risk that the processing industry would look for another source of supply [25]. Fishers may thus prefer to reduce their catches to a minimum TAC for a faster re-opening of the fishery so that they can more effectively serve the needs of the processing industry [25]. They may also introduce individual daily limits to influence prices [26]. In this way the market (the processing industry in this case) may set the speed of the stock recovery. Therefore, a temporal and a sectoral scale are used to emphasize the economic pillar.

Finally, social objectives could also alter the equilibrium of the three pillars model. A possible social objective might be ensuring the survival of local fish processing firms. A good, if negative, example of this was the gradual disappearance of the filleting industry on the German Baltic Sea coast since the 1990's[27]. Only one firm now remains, and the catches of herring are generally trucked to other countries due to the lack of processing capacity. Fishing cooperatives in such areas can employ in fishing and processing in a ratio of 4:3. This added social value to the local community is lost when most of the catch is exported [27]. Demographic factors may be a clear limiting factor in certain fisheries, especially where fishing is a part-time occupation. In these cases, a closure in certain fisheries breaks the income stability of a community, causing emigration of the young and loss of training of local fishermen [28]. The breakdown of social sustainability can thus have irreversible consequences, which may make it worthwhile to reconsider alternative management targets when dealing with the biological pillar. In general, however, social objectives are not strongly emphasized in fisheries management [29] and yet, understanding of social and economic dimensions can impact on the success or failure of a simple conservation policy [30].

3 Managing fisheries to meet the overarching principles of the CFP

3.1 The problem: manageable and acceptable objectives

A common description for a good objective in management is expressed by the acronym SMART: Specific, Measurable, Achievable, Relevant and Time-bound [[31,32]]. However, in the case of fisheries this may not be so simple to achieve. Fisheries management is largely based on objectives for stock biomass (B) achieved by controlling fishing mortality (F). So, while an objective can be specific, for example, to recover a stock to a given biomass, a measure to achieve the objective may not be. This would be most obvious in mixed fisheries where a measure specific to one species, say reduce F, could also impact on many other species via food web interactions, but also fishing opportunities where fish are caught together. Equally, while we can *estimate* fish stocks, monitoring them is more difficult, and often lags by one or more years behind the current situation in the ocean. Whether an objective is achievable depends on many factors in addition to fisheries management, most obviously those factors that affect recruitment. Even the best management is ineffective in the face of a persistent stock recruitment failure, such as that of North Sea herring in the early 2000s [33]. F and biomass (B) objectives can probably always be seen as relevant. as B is the ecologically relevant objective and F is relevant for economic and social dimensions. F may also affect other species through ecological interaction with the target species. Finally, it is very difficult to have time bound objectives in a complex ecosystem where many factors interact to drive fish abundance over different time scales. As an example, the target of the Johannesburg Summit, which set 2015 as a time limit for reaching MSY, was already postponed by the Green Paper of the CFP to 2020 to allow more time to develop management. While recognizing the value of SMART objectives, we would suggest evaluating the objectives for the Common Fisheries Policy in terms of two key characteristics: manageability and acceptability. Policy objectives clearly need to be manageable. However, there will be complex environmental, ecosystem, technical, geographical and cultural factors that make manageability in fisheries a complex issue. An additional difficulty is the existence of elements outside human control, illustrated by the use of biomass as an objective. Biomass is something that cannot be tightly controlled by management due to the diverse array of uncontrolled natural environmental and ecosystem factors that interact, so management needs to be adaptable and resilient. Objectives of fisheries management regulations have consequently moved from highly dynamic and hard to measure biomass objectives (e.g. the Bay of Biscay plaice long term management plan) to fishing mortality targets (e.g. the Baltic Sea cod long term management plan), a variable that can be directly influenced by management. This is not the only source of complexity of fisheries that makes manageability a key issue. Fisheries regulations need to devise mechanisms to manage a wide array of fishing techniques, from artisanal gillnets to the latest satellite technology used by high sea trawlers. Geography is an issue when we consider the different areas where European fisheries occur, and the implications of spatial issues and climate, for example for seasonal or area closures. Finally, setting up the needed governance mechanisms is a challenge when we consider the cultural diversity of the EU, which also faces different time horizons from international framework policies, the activity of a commercial sector or the life of a fishing community. A set of objectives needs to consider these factors, at least at a later stage of development, if it is to be manageable.

Management of fisheries comprises four basic stages; policy design, implementation, monitoring and enforcement. All of these phases present challenges that should be foreseen when drafting the objective of the policy. First, in the design phase, information is needed, in at least the three basic aspects of biologic, economic and social data. None of these data will be simple to obtain. As an

example, economic data for fishing firms or individual fishers is not readily available, as there are confidentiality issues in many fleets, an informal economy in subsistence sectors with low data availability and in general a fear of control that often creates an incentive to misreport. Second, in the implementation phase there are elements that create costs both to the management and to the fishers, and this can create negative incentives towards these objectives. Examples include changes in mesh size, which for the fishers means buying new nets, or the setup of a license system, which entails administrative costs for the management authority involved. Thirdly, monitoring progress towards the objectives is costly, from creating and using Vessel Monitoring Systems VMS (both for the vessel owners and for the management authority) to analyzing the vast recordings from onboard cameras. Finally, while the enforcement of the management system is already very expensive, it is still considered insufficient [[2], [4], [34]].

The Marine Strategy Framework Directive is an example of a related policy that is more recent than the original CFP and is more management-oriented. It incorporates many of the elements described above. The directive uses the DPSIR (Driver, Pressure, State, Impact, Response) framework and sets a series of descriptors with associated indicators, where particular values can be considered as objectives [5]. In this way the objectives are intrinsically linked to the management measures, as they have been designed based on those criteria. The CFP on the other hand tends to describe objectives that lack manageability. For example, the CFP suggests that *“Measures are needed to reduce the current high levels of unwanted catches and to gradually eliminate discards”*. But it does so without specifying the type of discard (landable target species, small individuals of target species or non-commercial species, etc...) or the way in which their reduction or elimination is to be achieved. Such an objective is likely to be very difficult to manage, or needs very careful specification in order to be manageable [35,36].

In addition to being manageable, the objectives of the CFP need to be acceptable to fishers simply because the cost in terms of compliance of not being so is too high. If an objective, and the measures adopted to achieve it, lack acceptability, legitimacy and credibility, it is highly unlikely there will be full compliance. Lack of compliance will lead to conflict between fishers and managers and indeed between different groups of fishers who view the measures as more or less acceptable ([37,38,39]). On one side, there is the cost of conflict, with cases such as the strikes in the brown shrimp fishery in Germany due to low product prices in 2011 or the blocking of the port of La Rochelle in France in 2008 due to high fuel costs. On the other, there are the particularly high costs of enforcement, due to the complexity of surveillance of many vessels, across wide areas and throughout the year. Participation (in the objective setting and measures process) has been reported to improve compliance [40, 41]. Nevertheless, there are critics of the value of participation in improving social outcomes of fisheries management, based on its potential to allow powerful vested interest to further entrench inequality in management regimes [42].

Overall, manageability and acceptability are two clear requisites for objectives when dealing specifically with fisheries management. Manageability is necessary, given the perspective of fishing as an economic activity dealing with a highly variable resource and with an already over-complex fisheries management system. Acceptability is also a requirement, as this should lead to better compliance and a reduced control and enforcement burden. Manageability should thus be taken into account when designing management actions to meet objectives and acceptability, to have those management actions successfully implemented.

3.2 Management under lack of clear objectives

The above discussion illustrates the need for careful consideration in the setting of objectives, and in the measures taken to achieve them. One further critical factor that should be considered is the lack of clarity in the objectives themselves, and hence in the information needed to evaluate them.

The problem of the definition of objectives in an uncertain world has been identified in the literature [[2], [43]] and defining management objectives is one of the key challenges. To improve the clarity on what constitutes an objective we approach the definition by considering the social objective that we want to achieve (such as in the social utility function) as conceptually separated from restrictions (the “resource constraint”). Objective definitions of the social utility function that fall into this conceptual characterization are sustainable development as in the Brundtland Report (meet the needs of the people) and the overarching objective in the Lisbon Treaty (promote peace and well-being). The study of well-being (for instance [44]) has recently been developed in economics and other social sciences, where it is well known that money has a decreasing influence on feelings of “well-being” above a certain level of income. So the capacity of individuals to work to achieve their goals by their own effort is key to well-being. This provides a guide to why the Brundtland wording of “*without compromising the ability of future generations to meet their own needs*” is quite appropriate. This type of objective was also found in the documents of the CFP reform [16] as “*take into account the interests of both consumers and producers*” or “*projecting the principles of the CFP internationally*”. As to the restrictions, those suggested in section 3.1 above, present circumstances under which social, economic and biological factors can be limiting. Higher level restrictions are not normally considered in fisheries, but an example of such conceptual restrictions can be found in the idea of planet boundaries[45], which are a minimum threshold to keep the biophysical characteristics of the planet, such as marine biodiversity or the nitrogen and phosphorus cycles.

There is also a confusion between intermediate and final objectives making it unclear what needs to be achieved within particular time frames. In the general hierarchy of objectives of society there is welfare as a very high goal, and the objective of fisheries policy is not to fish, to keep the ecosystem healthy or to provide employment, these become all subordinate objectives or tools to achieve the higher objective of welfare. The difference can be seen, for example, inside the hierarchy of objectives of fisheries policy, when a technical innovation is used to catch more fish in an overfished stock or to improve the working conditions of fishers using a sustainable gear. This distinction is also important because in the last CFP reform discussion there was a tendency to define objectives as the avoidance of a problem, for example to decrease impact on the ecosystem or to reduce overcapacity. These are not objectives per se, but results, either of fishing or of the management process itself, which we then seek to restore by setting these objectives. Effort and resources may also be wasted due to an inappropriate conceptualization of an objective. Overall, the building of a structure composed of clear objectives, from higher goals to management strategy and control measures and further to their incorporation to regulations is key to success [33]. Therefore, once objectives are clear, we need to look at other knowledge limitations, mainly those related to lack of knowledge about the future and the ecosystem and future socioeconomic mechanisms, as for example economic crises (e.g.[46]). From there, it should be possible to try to derive the complementarities between objectives that could be useful for assessing hypotheses, as will be shown in sections 4.1 and 4.2 below.

For the lack of clarity in the time horizon of objectives, there are two main issues, one internal and one external. For internal issues the need to consider time comes from the manageability of objectives: the inherent complexity of resource management systems that, in order to avoid harmful generalizations in management design need a longer period of time for an analysis and learning process [47]. Another cause of this internal need to consider time comes from management implementation. Co-management, defined from a scientific point of view, is a process that requires knowledge acquisition and, as such, is progressive [42] and requires a longer time horizon than other ways of meeting objectives. For external issues the need to consider time comes from the longer time horizons of stock and ecosystem functions themselves, and in a similar way to addressing the likely impacts of climate change, it requires a sequential planning of objectives. As new aspects like ecosystem interactions and new modeling capabilities [48] are being incorporated into management, the target for management may need to be more adaptive. Following Lind [49] the question might be *“what should we be doing over the next ten years to position ourselves to act on new information and new technological developments?”*.

Another source of confusion when setting the objectives for fisheries management, would be limited knowledge about the real needs of consumers and citizens. On a lower level in the hierarchy of objectives, the available options for management would also be a source of confusion. Meeting the needs of consumers is limited in fisheries policy to one part of the supply chain of fish as a product. For example, the idea that discards need to be minimized or eliminated to achieve stock conservation ignores the fact that more is lost in the distribution and processing of the fish than is discarded; approximately 9% of catch is discarded compared to approximately 13% wasted in distribution and processing [50]. To be consistent with an aim to protect the stock, a proportionate emphasis should be given to avoiding the removal of wasted fish from the sea. Another issue arises with consumption, where increasing consumption of fish is not differentiated from social well-being, considering both real needs for overall food consumption (see for example, [51]) and for a balance in the diet (as has been done with meat, see [52]). Therefore, setting the objective at the level of satisfying human needs fosters a more global view that can reduce fish demand in a greater proportion, by considering the whole food supply and consumption cycle. When considering this, avoiding discards is no longer a high level objective but just a part of a larger objective. In addition to this, limitations of knowledge often constrain management actions where the different levels of targets are more aligned. An example of this would be management measures that foster synergies between objectives, for example practices that improve both production and good environmental effects. Examples for fisheries would include some forms of results based management [53]. In a field where so many external uncertainties exist, aligning economic and conservation outcomes is a way to work towards higher level objectives. Hence, a proposal could be to assign fishing rights to fleets that are more sustainable (as suggested by environmental NGOs and small scale fisheries associations [54] and to relate fishing rights concessions to compliance [55]. The gradual and adaptive learning process that occurs during participatory management and research allows time to tackle questions as the in depth definition of objectives, the time horizons required for their achievement and at the same time opens a wider array of management options.

4 Lessons from participatory research

It is the role of scientists to evaluate how well management measures meet objectives with the best scientific and social knowledge available. For this there is a need to design an effective analytical framework, which includes not only appropriate models but also consideration of wider hypotheses about the relevant scenarios, states of the world and management options.

4.1 Participatory definition of management objectives in research projects

Investigating the socioeconomic effects of the current Common Fisheries Policy requires targets against which the effects of the policy can be assessed, including the identification of high level policy objectives. The focus in the SOCIOEC project was on objectives that can be dealt with through the use of management measures and which are relevant to stakeholders.

To derive the high level objectives the project team used the results of a combined workshop with the MYFISH EU research project held at Vigo, Spain, in 2012 and several interviews (see section 4.2 below) to test the applicability of the objectives in a regional context. The workshop gathered representatives from different stakeholder groups, geographic regions and potential objective sets [56]. These inputs from stakeholders were analysed to produce a narrower set of objectives that could be used in the SOCIOEC project to study the impact of fisheries management measures under the CFP [56]. The results from this process of identification of objectives are shown in Table 2.

As with any objective in fisheries, the chosen examples (see Table 2 below) present challenges when defining associated indicators. To achieve MSY it is judged more convenient to set fishing mortality as a management target instead of stock biomass, as, in contrast to fishing mortality, the stock level is driven by many factors outside the control of management. Target species discard as well as bycatch still present challenges with respect to reliable data collection, while the impact on bottom habitat requires a combined indicator that maps fishing effort (including gear and size) to habitat types through empirical and modelled relationships. The economic objectives also present challenges, such as showing the difference between societal and company interests, or including externalized costs in the net present value to be optimized for the whole society. Finally, the social objectives require the collection of composite indicators (employment and opportunities, hours at work and number of accidents, etc) and an evaluation of not only the presence or absence of co-management processes, but also their inclusiveness.

Table 2. High level objectives for fisheries management developed from the combined SOCIOEC-MYFISH workshop.

Sustainability pillar	Population level	Short/ long term	High level objective
Ecological	Society	Long term	Maximize yield in tonnes of commercial species
Ecological	Society	Long term	Gradually eliminate discards on a case-by-case basis
Ecological	Society	Long term	Minimizing bycatch of vulnerable and

			protected species
Ecological	Society	Long term	Minimizing negative impact on seabed habitats
Economic	Society	Long term	Maximization/optimization of present value
Economic	Society	Short term	Maximization/optimization of gross value added (or rent)
Economic	Firm/Individual	Short term	Maximization of profits (within ecological and social constraints)
Social	Society	Long term	Ensure viable coastal communities
Social	Society	Long term	Improve policy and decision making through improved inclusive governance structures
Social	Individual	Long term	Ensure fair living standard, improved working and security conditions on board of fishing vessels

429

430 More relevant with respect to the management of fisheries policy objectives is the study of how
 431 objectives influence each other, in order to avoid unintended effects due to policy [47]. A practical
 432 way to do this is to identify management measures for each objective that are compatible (at least
 433 partially) with the other objectives. There might be a negative effect from some measures on some
 434 objectives and this should be clearly shown [57]. Ideally the partial or complete fulfillment of other
 435 objectives would be reinforced, or the effect should be neutral. Examples of how objectives are
 436 compatible within various management measures are given below.

437 A first example would be to move towards MSY in a socially proactive way by promoting (through
 438 quota or marketing incentives) the fishing gears that have a catch composition appropriate to a
 439 relevant multispecies MSY. This may imply social decisions, like deciding on trade-offs between
 440 species: consume more cod or more pelagic species [[58, 59]]. Another socially and economically
 441 compatible measure to implement this objective would be to promote responsible consumption
 442 patterns, regarding for example the minimization of fish waste across the supply chain [50] to raise
 443 awareness on excess catch. The elimination of discards can also be promoted by fostering fishing
 444 techniques that have sustainable catch composition, to then promote the marketing of those less
 445 valued discard species [50] either as standard or sub-standard products.

446 The reduction of bycatch is compatible with using socially acceptable management measures specific
 447 to each case, as short temporary closures that enable the fishers to have other sources of rent and
 448 therefore allow for viable coastal communities [28]. Another way to improve management measures
 449 to reach the bycatch objective is to benchmark different management measures employed in nearby
 450 areas, and reach an agreement to implement similar measures regionally. This can prevent potential
 451 problems of social acceptance due to a perception of unfairness when implementing different
 452 measures in close by areas that share a bycatch problem. . An example of this is the different
 453 measures to protect seabirds and harbour porpoises across the Danish-German border. In the
 454 German Baltic coast gillnets are seen as harmful for harbour porpoises and seabirds and therefore
 455 suffer restrictions, whereas in the close by Danish coast gillnets are seen as sustainable and harmless
 456 and they are not restricted due to bycatch of those species. This is also influenced by the different
 457 objectives of environmental NGOs in both countries [60]. An economically efficient way to achieve
 458 this objective would be to promote sustainable seasonal consumption of regional fish to foster
 459 ecological values, such as avoiding certain fish consumption in some periods to allow for undisturbed

seasonal presence of seabirds. Finally, the fishing activities that have low seabed impact could be encouraged through targeted management measures based on detailed knowledge of fishing operations, including high definition spatial and temporal data on gear operation, as well as through support for operational (like real-time feedback mechanisms) and technical innovation (which also supports the auxiliary industries through the development of new types of more sustainable gear).

There are also management measures that meet economic objectives as well as ecological and social sustainability objectives. To increase the net present value of fisheries aspects such as food quality, leisure value (fisheries attractive to tourism [61]), and environmental values (programmes such as “fish for litter” or scientific cooperation) should be promoted. This can be done by identifying the fleet segments that have significant contributions to these values and taking them into account when proposing closures or quota or effort restrictions. Profits can be enhanced through the promotion of higher value through certification, regional product status, higher quality fish through optimized operations and technological improvements. Ecological sustainability is therefore indirectly improved by measures that avoid higher catches, with an objective that lies at a higher level than, for example, overcapacity reduction.

In a shorter term perspective, maximization of gross value added (GVA) could be pursued through cost reduction, as well as through policies that optimize employment according to fair living standards and improved working and security conditions on board. This has special importance when referring to international fisheries (see section 4.2 below). At the firm level, improvement of profits subject to ecological and social constraints is encouraged through the reduction of inefficiency costs (as fuel costs of gear operation, vessel steaming to and from fishing areas and final product transportation). A cost benefit approach that reduces negative externalities by minimizing fuel use could reduce societal expenditure in the current implicit subsidy (as tax exemption [4]) for fuel. To maximize long term net present value in a cost benefit approach the reduction of fuel use would not only reduce subsidies, but also minimize the environmental cost in CO₂ from the catch sector and from the transport sector from imported fish.

Some management measures may meet both the high level social sustainability objectives and ecological sustainability goals, despite often being blamed for not meeting one of them. For example, measures to soften TAC reductions to keep local employment have been blamed for jeopardizing stock recovery [2]. To contribute to the viability of coastal communities there should be an evaluation prior to any management measure of the total economic value of sustainable fisheries, to avoid spatial developments that reduce the net value creation in a community [61]. Monitoring potential problems with succession of fishers [28], building realistic mid-term expectations for the return to fishing activity and investigating of alternative sources of income [27,62] through longer term policy coordination should also be incorporated into policy design, especially during fishery closures and adaptation periods.

To improve policy and decision making processes it is important to identify the governance level at which the objectives above can be more effectively implemented, referring to location of resources, including knowledge, and incentives for action [63,64]. To promote fair living standards and improved working and safety conditions on board it is necessary to study the social impact of combined management measures at the stage of design, for example in cases where combined effort and quota limits drive fishers in small-scale fisheries to fish in bad weather conditions. Social objectives are also important, for example during fishery closures or gear bans, where policy

coordination with other non-fishery policies becomes especially relevant. Finally, a current issue is to monitor living conditions of non-EU workers in EU vessels, especially outside EU waters through international agreements. Ecological and economic sustainability goals could also be met in accordance with social objectives if special attention would be paid to the whole fish supply chain. This would include living standards related to the provision of imported fish products as in life cycle analysis for the full environmental and economic impacts of manufacturing processes.

Relating to the lack of clarity in models brought about by the existence of intermediate (even implicit) and final objectives, further workshops and modelling exercises in the MYFISH project show a clear example. The decision support tables resulting from the project within the example of the North Sea [56] maximized the fleet catches or their revenue from fishing. Referring to the catch maximization, a step following the approach described in our study would entail the analysis of food security objectives in the area of origin and of consumption of the catches [65]. Beyond enhancement of revenues, the overarching objectives approach would imply considering the fair conditions of work in the area of origin of the catches including outside the EU as a minimum constraint (as in the social utility function objective of “projecting the principles of the CFP internationally”) or tackling the distributional aspects of optimized revenue from catches beyond distribution between fleet segments (e.g. inside the affected fishing community, through social capital that allows for participation and succession in the industry for future generations, see[41]). Kempf et al [56] also show the distinction between objectives (e.g. promoting inclusive governance) and restrictions (e.g. respecting good environmental status according to the MSFD) as already assumed in our study. These perspectives on the definition of objectives open new options for the design of indicators and modelling approaches, and would make the management conceptually more coherent.

4.2 Adapting overarching objectives to regional context: a case study

The SOCIOEC project involved stakeholders in several different ways, from analyzing incentives in management measures to feedback on impact of measures to the participants who suggested them. Stakeholders were consulted on both high level objectives and their implications at regional level, giving them a unique opportunity to participate in a research exercise. This work on high level objectives includes both group consultation (as presented in section 4.1 above) and also additional individual consultation by means of semi-structured interviews. Five semi-structured interviews were performed, with two fishing sector representatives, two environmental NGOs and one fisheries manager. The case of Germany was found to be useful because it includes two seas (Baltic and North Seas), it has a complex governance structure (due to federalism) and has a significant roles of three types of actors (industry, governments and environmental NGOs).

For the ecological sustainability objectives there was agreement on MSY as a high level objective, with the exception of an environmental organization representative that expressed the need to consider a higher biomass value to provide an additional buffer for ecosystem and climate change effects. The issue of manageability came across in a very clear manner in a statement by a producer representative who said: *“I want the objective, but I think it is not achievable”*. An environmental representative also related objectives to the means to achieve them by saying *“When this is the objective, but the capacity to reach it is not given, then it is a political error”*. Additionally, other high

level objectives in relation to ecological sustainability included the reduction of ghost nets (nets lost by fishing boats [66]) and the consideration of fuel consumption per unit of fish, which bring a wider perspective (ecosystems and economic efficiency) that can be better grasped by many actors. These measures could make different objectives compatible, as seen in the previous section 4.1, but note the fact that, as many objectives delivered by policy makers and stakeholders, they imply defining a “consequence” of the fishing activity (losing nets or consuming fuel) as an “objective”.

Economic sustainability was judged by at least one representative of each group to be closely connected to the other types of objectives. A fisheries manager related it to regional development and jobs (objective of viable coastal communities) and with the carbon footprint of the fishing industry (ecological sustainability). The importance of fishing as an activity despite its environmental effects was also highlighted by an NGO representative: *“The question is where they fish, how and how much. This must be regulated, but it does not mean to say that there should not be any fisheries”*. A fisheries manager suggested that a more targeted approach through the European Maritime and Fisheries Fund (EMFF, an EU structural fund promoting sustainability and employment in fisheries) would strengthen both economic and social sustainability of the CFP.

Finally, the discussion on social sustainability objectives of fisheries also produced some ideas that simultaneously support (or do not hinder) other sustainability objectives. A producer representative proposed that management use cooperation and search for shared incentives instead of fines, while a fisheries manager suggested making regulations compatible with other regulations. These approaches could improve policy making and governance structures without necessarily reducing profitability or stocks, by incorporating more than one pillar in a single objective and through gains in efficiency of implementation. Education of both fish producers (on sustainability) and consumers (on effects of the whole fish supply chain) were also suggested by a representative of an environmental NGO to achieve high level objectives such as reducing discards.

A summary of useful inputs to the manageability of the objectives and the synergy between objectives can be found in the following quote from an environmental NGO representative, who pleaded to ensure that *“the fisher that goes fishing every day, is sustainable and works for the region, is the one that receives most advantage from the CFP”*. Without specifically asking for it, all stakeholders came up with relationships between the objectives presented, as well as other objectives at a higher conceptual level (such as ecosystem effects or supply chain aspects). This shows how clear it is that objectives of fisheries management should not be considered in isolation, and that high level perspectives can help to bring both consensus and practical inputs for policy.

5 Conclusion

Working on policy objectives at a high level and observing the hierarchy among objectives both from a research perspective allows the perception of synergistic effects that may get lost when looking only at subordinate objectives. These effects are fundamental, given the ineffectiveness of the existing complex regulatory and micro-management approach, especially when facing the current poor state of some fishing communities and stocks.

Nevertheless, manageability and acceptability must be kept in mind when considering high level objectives in fisheries. Manageability is a prerequisite if the objectives are to be met, given the

complexity of fisheries in the EU. Otherwise they will only be a paragraph in a regulation. On the other hand acceptability is a key factor for compliance, if the management actions are to be successfully implemented.

The approach presented here is useful because it allows the analysis of objectives in relative terms with respect to the time perspective over which risks occur. Issues such as the scale at which an objective is to be reached or the relative risk of disappearance (in terms of urgency of action) of a particular species, specific fishing community, ecosystem or industry, should be incorporated into the policy design discussion. The extension of the objectives to food security [65,67], ecosystems [68] and community livelihoods would imply more coordination between policies outside the fisheries area (including international relations and regional development in the EU) and a more adaptive approach to take advantage of bottom up participatory arrangements, e.g. those started from fishing communities. As discussed by Kempf et al. [8], *“inclusive governance can be seen as an essential part of fisheries management because of the need for a balanced and stable outcome on all three dimensions of sustainability – ecological, economic and social”*. The policy design process would benefit from a deeper conceptual analysis of objectives, and this study shows not only how this conceptual analysis is useful for the design of management measures, but also how certain processes of participation from stakeholders can contribute to deliver more coherent, manageable and acceptable fisheries management.

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