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PRIMARY SECTOR AND SUSTAINABILITY, ECONOMIC AND INSTITUTIONAL ASPECTS

(SECTOR PRIMARIO Y SOSTENIBILIDAD, ASPECTOS ECONÓMICOS E INSTITUCIONALES)

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A aita y ama,

a Iñigo e Idoia,

a Jens

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

GENERAL INTRODUCTION

1.1 Summary

The four central chapters presented in this thesis describe economic and institutional aspects of the relationship between fisheries and sustainability from the different perspectives of the overall EU fisheries policy, one of its management measures and the application of management measures to a three case studies.

The analysis of the Common Fisheries Policy from the point of view of its high level sustainability objectives resulted in the identification of a series of social and economic objectives and of synergistic proposals for management (to attain more than one objective simultaneously). The identified objectives and synergies came from both the literature and stakeholder consultations.

The social and economic objectives identified from the literature included "providing a fair standard of living for those who depend on fishing activities"(from the CFP reform of 2002), "contributing to the availability of food supplies" (from the current CFP), "satisfying the real needs of informed consumers" and also a mention to "thriving coastal communities" (both from the Commission communication on the CFP reform from 2011). The economic objectives identified through stakeholder consultation were the optimization of present value, gross value added or rent and the maximization of profits within ecological and social constraints. The social objectives delivered by the stakeholders were ensuring viable coastal communities, improving policy and decision-making through improved inclusive governance structures and ensuring fair living standards, including improved working and security conditions on board.

The analysis of the CFP from the overarching sustainability objectives perspective gave as a result the following synergistic effects extracted from the literature: the conservation of stocks, which enables economic and social sustainability (Green Paper), the reduction of catches in agreement with the industry to a minimum that allows the survival of the fishing fleet and also the reopening of stocks in recovery (STECF 2009), the introduction of individual daily catch limits that allow to stabilize prices (Aranda and Murillas, 2015) and the production of added value in the local community and the

fostering of social sustainability by keeping processing firms in the region (Strehlow 2010). More synergistic practices from the literature included the encouragement of responsible consumption patterns that reduce fish waste across the supply chain and thus reduce costs and pressure on the fish stocks (FAO 2011), the support to fishing techniques that have a sustainable catch composition reducing bycatch and optimizing the use of the unavoidable bycatch through marketing as standard or sub-standard products (FAO 2011) and the creation of realistic mid-term expectation of returning to the fishery and the investigation of alternative sources of income for the fishers while the stock is recovering (Pérez de Oliveira, 2013).

The analysis of the input from stakeholders brought about further synergistic effects in the management of fisheries, including the reduction of ghost nets (nets lost by fishing boats), which imply both costs and danger to sea fauna and the consideration of how much fuel is needed per unit of fish caught (relating ecological and economic sustainability). Synergies from a social and institutional perspective also from the stakeholders are the search for shared incentives instead of fines, making regulations compatible with other regulations (the latter two improving policy and governance without deteriorating ecological or economic sustainability), educating fish producers on sustainability and consumers on effects throughout the whole fish supply chain and making the policy more advantageous for fishers that work in an ecologically and socially sustainable way.

Further results of the chapter on the sustainability objectives of the CFP are that objectives have a hierarchy among them, and that the manageability and acceptability of objectives are key to their attainment. Objectives can be high level and have below them in the hierarchy other subordinate objectives, where the subordinate objectives would not be the aim but an intermediate step to achieve the high level ones. For example banning discards would be a subordinate objective for guaranteeing food security. Manageability is the capacity of an objective to be achievable by a management measure, that is, to be expressed in a management measure that can hit the target. For example keeping a healthy ecosystem is less manageable that keeping the current number of vessels. Acceptability by the fishers is key for a manageable objective to be achieved in practice.

The third chapter, on a particular fisheries management regime (ITQ), further concretises the interaction between fisheries and sustainability which was the topic of the second. The main result of the chapter is that the fairness framework of

Baumgärtner et al. (2012) is appropriate to assess fairness issues in ITQ regimes. A further result of the chapter is a first identification of the elements of the framework (including judicandum, claims, community of fairness and instruments) for a general ITQ regime. In that way, the judicandum would be the ITQ regime itself, as a bundle of rules and markets among others. The claims would be the efficient use of the resource with delivery of resource rents to the state, the equal access to the resource by fishers and the non-destruction of future resources and the ecosystem. The community of fairness would be composed by the state (as manager and owner of the resource), the present fishers, the conservationist organisations, the rest of the world and the future generations. Finally, identified instruments to apply distributive justice as a criterion for fairness would be the set up of the market mechanism, the initial quota allocation, the definition of the fishing right, the market monitoring and intervention, the target fishing mortality and the reserve quota. More generally, the perspectives of fairness suggested to be employed in the fairness framework were distributional fairness and fairness in exchange, the latter with its both approaches of outcome and process. Furthermore, though another key result of the third chapter is that evaluating the fairness of ITQ requires addressing each concrete regime on its own, two general issues for fairness are presented: the equal consideration in the initial distribution of quotas and the negotiation power in the access to quota once the ITQ system has been set up.

The fourth chapter revisits some of the instruments of fairness presented in the third chapter, as the initial allocation of quota and the reserve quota, and shows how they are applied in the quota management systems of two EU countries, Germany and Denmark. The identified instrument of initial allocation of quota is characterised in both countries by the “grandfathering” principle, which consists of awarding the quota for free to the fishers that were already active in the fishery for a defined period of years before the initial allocation took place. The instrument of reserve quota for newcomers has different forms in each of the two countries analysed. In Germany, this reserve quota was a one-off initiative that took place in 2011, and consisted of withdrawing part of the quota (5-10%) of scrapped vessels that, instead of going back to the owner of the scrapped vessel, would be returned to the state in order to allocate it to young fishers entering the fishery. In Denmark the reserve quota was established under the form of a “fisheries fund”, where the state reserved up to 20% of the total quota to distribute it to young fishers, among other criteria. Apart from the mentioned instruments of fairness, the fourth chapter deals with the general fairness issue of the negotiation power in the access to quota once the ITQ system has been set up. More concretely, the chapter analyses how the fleet structure has changed with the introduction of the ITQ, and especially whether there has been a concentration in vessel ownership.

A further result of the fourth chapter was the comparison of elements of intragenerational and intergenerational fairness for the quota regimes of Denmark and Germany. From the intragenerational perspective, the Danish regime established different fleet segments with rules governing who enters each of them and how the quota could be transferred among them. The Danish system has positive results on the stabilization of the fisheries labour force and the support for the small scale fisheries sector. On the other side the German system shows no indication of undesired quota concentration or unfairly concentrated pools of quota. From the perspective of intergenerational fairness, the Danish regime has established a support mechanism to provide quota for free to young fishers, while in the German system there was only one isolated scheme to this end and otherwise young fishers have to pay an extra price for vessels with quota, an extra cost that fishers active at the moment of the initial allocation did not have to pay.

The fifth chapter refers to a case study based on the European Union requirement that major legislative actions undergo an impact assessment (IA), and starts from the hypothesis that this methodology is often not adapted to policy measures in complex and data poor situations, as the coexistence of marine protected areas and small scale fisheries. The appropriateness of the IA methodology currently in use is then tested on the example of a small scale gillnet fishery in a protected area in the German coast in the Baltic Sea (Fehmarn island). In this protected area the regional government considered two sets of fisheries management measures: the first one was an eight months closure and the second one a combination of a reduction in net length and a closure of up to three and a half months. The impact of the fisheries management measures is first assessed using the available data and the results are then checked with the local fishers and a producer organization representative using a focus group. Given the discrepancies identified in the focus group, additional methodologies are explored. By performing a literature review and a workshop with scientists, fisher representatives, environmental organizations and managers, inputs from political science (the “wicked problem” approach) and philosophy of science (the NUSAP matrix) are applied to cope with the context of lack of knowledge driven by poor ecological, economic and social data. This case study brings the opportunity to identify challenges as the assessment of biodiversity and potentially conflictive differences in national policy objectives under different EU policies (including the Common Fisheries

Policy), in a way that goes beyond the contribution of other commonly used management tools as impact assessment. The usefulness of the approach resides both in a better identification of impacts on small scale fisheries and the unveiling of hidden governance conflicts that prevent the fulfilment of the objectives of policy measures.

1.2. Introduction

Primary sector and sustainability are both seen as conflicting concepts, where trade offs occur between the exploitation of a natural resource and nature conservation, and also as synergistic concepts, where primary sector can adopt sustainable practices that help preserve natural areas... In this thesis, a contribution is made to analyse those trade-offs and synergies, by addressing sustainability in its multifaceted version (ecological, economic and social) and considering the fisheries sector as an example of primary sector. The threefold nature of sustainability has been described) in the Johannesburg Declaration (WSSD 2002), in what has been called the three pillars of sustainability, beyond the original definition of sustainability in the Brundtland report (WCED 1997). From the side of the primary sector, fisheries is the economic sector most directly related to the environment and therefore sustainability is a key factor for its survival. Besides its direct dependence on the ecosystem, which makes ecological sustainability a priority, fishing as an activity in the EU presents enough complexity in terms of management due to the multiple combinations of gears and target species and different levels of governance to make it relevant to study economic and social sustainability.

There are several examples that show how the dependence between the different types of sustainability and the primary sector operates. In the secondary sector there are environmental quality assessments of some activities of the industry. In the primary sector assessing sustainability sometimes means measuring the effect of new herbicides on biodiversity. In fisheries sustainability is involved for example when considering how economic and social sustainability (e.g. represented by the profitability of the sector and the jobs involved) affect the biological sustainability of the exploited stocks of fish. More examples of this relationship in fisheries will be mentioned in the literature review in chapter five of this thesis, and would include the evaluation of the effect of a fishing fleet on the stock of cod or of the impact of bottom trawling on the seabed. More concretely, this thesis contributes to the approach that analyses how biological sustainability (e.g. biodiversity or fish stocks conservation) affect the economic (e.g. livelihoods) and social (e.g. continuity of a profession, of a cultural heritage) sustainability. Moreover, the thesis develops further the approach that considers how sustainability affects fisheries theoretically (e.g. through how fish quota allocation could be improved so that they present synergies with the economic and cultural survival of communities of fishers) and also in practice through a case study (e.g. through the effect of conservation measures on the continuity of the fishing sector).

To study the coexistence of fisheries and sustainability the thesis looks first at sustainability aspects of the fishing sector´s framework policy, the Common Fisheries Policy, then it analyses a concrete management tool for fisheries, the individual transferable quotas (ITQ) and finally focuses on a concrete application of another fisheries and biodiversity management tool to a case study.

The second chapter is about the objectives of the European Common Fisheries Policy (CFP), from the point of view of biological, economic and social sustainability. The CFP is one of the few areas were the EU has some exclusive competence to set law, and holds similarities with the Common Agricultural Policy (CAP), as subsidies and price support mechanisms.

The chapter first reviews the definition of objectives of the CFP historically, in its four versions up to now (1983, 1992, 2002 and 2013) and with relation to the priorities between the three pillars of sustainability (WSSD 2002). The CFP objectives have evolved, for instance on how they first looked at fisheries as a specific primary sector, gradually including needs for international fishing grounds, limits to fishing overcapacity of the fleets and different subsectors (as aquaculture, fish processing or EU vessels fishing beyond EU waters) and how they contemplated more social aspects, as employment and fair living standards. This evolution of the CFP objectives always included ecological sustainability, from conservation of fish stocks to that of the ecosystem, which are also reviewed in the chapter.

Secondly, the chapter discusses the issues of manageability and acceptability. Regarding manageability, the complexity of fisheries has originated a large number of management measures in the CFP, from limits to input (capacity of vessels to fish, normally in tons, or effort that they exert, e.g. duration in days and power in Kw put into fishing) to limits to output (quotas on how much fish can be caught) and other restrictions on areas that may be fished or technology used. These measures are difficult to design, implement, monitor and enforce because, among other factors, fisheries communities are scattered, fishing technology differs greatly and fishing vessels need to be controlled remotely. Designing objectives for the fishing sector is difficult per se, as for example an ecological objective is to preserve stocks of fish, but the evolution of these fish stocks in the wild has many aspects difficult to estimate and influence (as how fish reproduce, how fish of different species come together or how they feed on each other) and the objective is only manageable indirectly, limiting the fishing mortality caused by the fishing vessels. Related to the success of enforcement is the objectives´ acceptability, which has been reported to increase with the participation of fishers in setting objectives and management measures (EP 2012, Brooks, 2010).

Overall, the distinction between higher level objectives and subordinate objectives is also discussed in the second chapter. Finally, the chapter describes an articulation of high level objectives for the CFP which were derived from extensive stakeholder consultations at European and regional level performed inside two European research projects: SOCIOEC and MYFISH (Marchal et al., 2016 and Rindorf et al., 2017).

The third chapter is about a framework to analyze the fairness of a resource management system and the possibility to apply it to a fisheries management system, Individual Transferable Quotas (ITQ), to assess fairness related to its ecological, economic and social sustainability. An ITQ regime consists of the distribution of quotas of fish a coastal state is entitled to catch (according to the Law of the Seas, UNCLOS 1982) and the exchange of those quotas in a market established by the state. To distribute the quotas first the total which is allowed to be caught from a fish stock is decided (the Total Allowable Catch, or TAC), based on the principle of Maximum Sustainable Yield[1] (or MSY). The TAC changes each year depending on the state of the stock, which in the case of the EU is generally calculated by the International Council of the Exploration of the Sea (ICES), but TAC distribution across states is stable over time. To share the national part of a TAC under an ITQ regime, percentage values of this TAC (called access rights) are allocated on a permanent basis to fishers, normally based on their historical catches. The actual quantity of fish that is allowed to be caught by each fisher is calculated by the multiplication of the access rights by the TAC, and is called a permit. The permits can be traded by the fishers in an open market.

[1] The MSY principle consists in keeping the size of the population at the level where its growth is maximum. This is achieved by only harvesting the amount of fish that the population grows each year, and thus keeping the population size stable at the MSY level.

Assuming perfect information on the trading market leads to the premise in the classical literature of fisheries (e.g. Arnason 2002) that the process of trading generates an efficient outcome. The common explanation for this efficiency is that fishers with higher costs of catching fish will prefer to sell their permits, and fishers that have lower costs and therefore obtain more profit from the permits will be willing to buy them, with the outcome that the most efficient fishers will remain in the market. The ITQ regime would therefore foster economic sustainability, as it would avoid inefficiencies (e.g. waste of fuel by inefficient vessels or maintenance of unused vessel capacity) and ideally a part of the revenues (sometimes called "resource rent") would return to the state under the form of a tax, through the auctioning of fish quota or through a quota use fee. From an ecological perspective, the permanent character of the access rights would create the right incentives for the fishers to promote the long term sustainability of the stocks, to secure their own long term profits. Thus ecological and economic sustainability are normally considered natural consequences of ITQ regimes. From a social perspective, the access to quota and its trading present some issues, as difficulties to access quota for newcomers and concentration of quota in a small number of vessels when trading. Therefore, social aspects of sustainability are more unclear and the chapter shows how these aspects depend on the concrete design of each ITQ regime, which depends on the richness of data (e.g. fish stock assessment) but mostly on the definition of rules of access to quota and the transferability of quota shares.

The fourth chapter presents social aspects of sustainability of fisheries management systems in two case studies (Germany and Denmark), using the framework from the third chapter. As explained in the third chapter, social aspects of sustainability depend on the concrete rules for access to fish quota and the transferability of quota shares in each fisheries management system. More concretely, the case studies analyse rules for the initial allocation of quota (as access to quota), the impact of rules for the transferability of quota on the fleet structure and the access to quota of newcomers. In this chapter the social aspects of sustainability are considered in terms of intragenerational and intergenerational fairness. Intragenerational fairness refers to fairness among people in the same generation, and in the case of fish quota management it deals with how the quota is allocated at the moment of establishing the quota system. Intergenerational fairness refers to fairness among different generations, and in this case it involves the measures to provide quota to newcomers to the fishery, which are targeted at younger fishers.

To put it into context, Denmark and Germany have different systems of transferring fishing quotas In Denmark tradable quotas were gradually introduced to all fisheries while in Germany the quotas received by the fishers remain non-transferable. In that way Denmark has a formal system of dealing with quotas through a market, which gives its quota management system more specific market rules and exceptions than in the German system. Denmark has established its market for quotas by designing a system where vessels with higher income (over 35000€) receive an individual transferable quota, and vessels with a lower income take part in quota pools. The quota pools can be managed by a diversity of groups, as a municipality or a group of families that buy quota to set up a cooperative. In Germany there are also different types of quota. Individual quotas are managed by vessel owners, group quotas are managed by producer organizations and total quotas are set for part time fishers, sometimes in combination with daily limits.

The initial allocation of fish quotas, which entails fairness aspects inside the same generation of fishers (intragenerational fairness), has basically similar rules in both case studies, as quota is allocated on the principle of who was active in the fishery in the previous years. As to fairness between different generations of fishers (intergenerational fairness), the case studies present differences. In Denmark, there is a quantity of quota that is reserved by the state for young fishers (the fisheries fund), which allows them to have a starting quota without needing to buy it. In Germany, there was only one initiative in this direction in 2011, where the state allowed for a limited time to scrap vessels and held part of the quota tied to these scrapped vessels to allocate it to young fishers.

The exceptions to the tradeability of quotas include, in the case of Denmark, the prohibition to sell quota from the small scale section of the fleet to the large scale section, and the establishment of a maximum of four vessels for which rights may be owned. In addition to this, in Denmark fishers can only lease their quota inside their segment and to a limited amount, as they must earn a minimum of 60% of their income from active fishing in order to retain their licence. In Germany, however, quotas are tied to the vessels, and therefore in order to transfer the quota the vessel must be sold or inherited. The differences between both quota management systems could yield different results for their intra- and intergenerational fairness, and thus for their sustainability. The fifth chapter is a case study about the coexistence of fisheries and biodiversity conservation, and their economic and institutional aspects. The case study focuses on a particular type of measures: fisheries management measures that do not have as an objective to protect fish stocks or fishers, but to protect biodiversity. Therefore when referring to the case study we will call these measures indistinctively biodiversity management measures or fisheries management measures, as they are both, or simply “measures” for short. The focus of the case study will be on the effect these biodiversity management measures have on the fishing sector, which has been less studied than the opposite effect.

From the side of the fisheries, the case study refers to the German small scale fishing fleet around the island of Fehmarn, in the Baltic Sea coast, which use what is called “static fishing gear”, nets that are anchored to the seabed and then gathered after some hours. From the side of biodiversity management the case study includes protection measures for the harbour porpoise, a cetacean, and for diving seabirds, which both have the risk of getting entangled in the nets of the fishers. Regarding the institutions, the fishery takes place inside the 12 nautical miles from the coast, and is therefore the responsibility of the federal state of Schleswig-Holstein, and so is the introduction of the biodiversity protection measures under the Natura 2000 regulations. However the ministry in charge of fisheries and environment in Schleswig-Holstein allowed for a certain degree of participation from fishers and other stakeholders, and moved from compulsory measures to a voluntary agreement with them. Moreover, the measures in the voluntary agreement were partially designed with the fishers and consisted in reducing the amount of nets set in the summer time, to avoid trapping harbour porpoise (because they are more abundant in that season) and also in a real time closure scheme in winter, when fishers would avoid certain areas once they have seen that seabirds aggregate around them to feed.

The case study presents an attempt to measure the economic impact of the reduction in nets and the real time closures with the limited data available and explores the complexity of the coexistence of fisheries and biological sustainability measures with additional methodologies. These methodologies analyse the assumptions that need to be made to work in a data poor context and the necessity to reframe the problem to better capture its complexity.

The thesis includes four central chapters with the common denominator of ecological sustainability in fisheries, and how it affects economic and institutional aspects of sustainability. The second chapter of the thesis shows how the CFP contains at first an objective of sustainability of fish stocks (a biological sustainability objective) but it gradually incorporates other economic and social objectives. Chapter three analyses the allocation of quotas, which has among its objectives to keep the fishing capacity at a level compatible with the biological sustainability of the stock but also has economic and social sustainability implications. The fourth chapter illustrates the analysis in the third chapter by looking into a case study of vessel quota allocation regimes in Germany and Denmark. The case of Germany and Denmark is framed in the ecological sustainability of fish stocks, one of the main objectives of fish quota regimes, and also in economic and social aspects of these regimes.

The thesis includes therefore the sustainability of fish stocks (in chapter four) which is complemented and enlarged by the study of the ecological, social and economic sustainability aspects of the broader topic of biodiversity conservation (in the case study in chapter 5).The four central chapters follow a logical order based on the scale and scope of the fisheries management institutions analysed. In chapter two, the Common Fisheries Policy is the subject of analysis, which is an international fisheries policy. In the third and fourth chapter, the definition and distribution of fishing quotas also falls under the scope of fisheries policy, but it takes place at the national level. Finally, chapter five analyses the case of fisheries management measures that aim at protecting biodiversity in the area of territorial waters (12 nautical miles from the coastline) and corresponds to the regional level. The scope is enlarged in this last chapter to englobe not only fisheries policy, but also biodiversity conservation as part of a broader definition of ecological sustainability (including not only fish but also other species).

From the methodological point of view, the impact assessment (IA) methodology is taken as a starting point to consider the attainment of objectives of fisheries policy, with respect to biological, economic and social sustainability. The definition of the objectives of the policy is the topic of the second chapter. The third chapter goes beyond the usual definition of economic and social objectives and presents a framework to analyse the fairness of the policy. The fourth chapter uses the case study methodology to explore the framework in the third chapter for two contrasting regimes in two neighbouring countries. The fifth chapter, also a case study, presents a practical exercise of impact assessment, where the methodology to measure economic and social impact of concrete fisheries management measures is explored in a data poor context.

Participation is also a common thread through the thesis. The second chapter includes participation in the research, through a workshop and semi-structured interviews about the objectives of the CFP. The third and fourth chapters consider participation from the point of view of the inclusion of fishers (newcomers) in the quota allocation regime.

The case study in chapter five considers participation both in management, through a voluntary agreement, and in research, through a workshop and interviews.

Participation is an important aspect of the CFP, and it has been given different institutional forms during the evolution of the policy. Until the latest reform in 2013 the participation mechanism for stakeholders in the CFP took the form of Regional Advisory Councils (RACs). These councils were established based on the main fishing regions of the EU, including the North Sea, the Baltic Sea, the North Western Waters and the South Western Waters. The participants in the RAC came from different stakeholder groups, and there were for example fixed amounts of representatives from the fishing sectors and environmental NGOs. The RAC would be consulted when building up a fisheries management plan for species that are fished in the region, among other topics. In the latest reform of the CFP the name of the RACs was changed to simply Advisory Councils (AC), and their structure and functions remained basically the same. However, due to changes in the CFP as the introduction of a regionalisation approach, the weight of the ACs in the decision-making process has changed. New stakeholder groups have been set up for the purpose of dealing at a regional level with the landing obligation[2], for example. The new groups, as the Scheveningen group in the North Sea, have more representation from the regional managers of the fisheries, and the regional ACs only take part in them with one representative for the whole AC. This institutional change causes a smaller chance of participation of the fishing sector in the decision-making process.

Finally, the choice of Denmark and Germany for the case studies in this thesis responds to their interest for several overarching economic and social sustainability topics in the CFP. One of these topics is the difficulties for the economic sustainability of the fishing sector when there are fish stocks in a risk situation. This is currently the case for some important fish stocks in the Baltic which are both fished by Germany and Denmark, as the stocks of Baltic cod and Baltic herring. The economic difficulties derived from the scarcity of these stocks are especially important for some fleet segments, as the small scale sector, and are similar to those encountered by other European fleet segment in the same situation. Another topic that is relevant in the German case study is the aging of the fishers (with an average age of 55 years), which could also be a social sustainability issue in other European fishing communities.

[2] The landing obligation is the prohibition to discard (through over board) any fish of commercial species that has been caught by the vessel, and must therefore be obligatory landed at the port.

1.3 Objectives

The objective of this thesis is to study the interactions, both positive and negative, between the primary sector (in this case fisheries) and sustainability. To analyse these interactions an identification of ecological or biological restrictions to the development of the activity of the fisheries sector is performed. Furthermore, institutional bottlenecks to the sustainable development of the fisheries sector are analysed. Finally, an attempt is made to study the economic and social impact of different management measures for the fisheries sector.

More in detail, the second chapter aims at showing how establishing high level objectives for fisheries policy with the help of stakeholders can lead to a more effective and efficient integration of different sustainability criteria in the management of fisheries. The objective of the third chapter is to assess if the fairness framework from Baumgärtner et al. (2012) provides practical guidance for evaluating whether a given ITQ fisheries management system operates under a fair framework programme, including fairness to future generation as in the definition of sustainability (WCED 1997). The assessment of the fairness framework also aims at looking into examples of some instruments inside ITQ systems where there might be institutional bottlenecks to achieve fairness, and hence some components of economic and social sustainability.

The objective of the fourth chapter is to show a concrete example of national institutional arrangements, referring among others to the fairness to future generations as mentioned above for the definition of sustainability. The two case studies of Germany and Denmark fisheries management systems aim at showing how intergenerational fairness objectives can be introduced in practice in quota allocation rules for newcomers. The case studies in the fourth chapter also aim at showing instruments of intragenerational fairness, in that concrete regulations are targeted at the sustainability of several social groups, as active fishers (as opposed to quota leasers), small scale fishers (as opposed to large scale) and both long time fishers and newcomers.

The aim of the fifth chapter is to look into ecological restrictions for the development of the fishing activity given by biodiversity protection measures, to study institutional bottlenecks for the sustainable development of the fisheries sector present in those measures and to explore methods to study their economic and social impact on a concrete fishery.

1.4 Hypothesis

The main hypothesis considered in this thesis is that the positive role of the primary sector with respect to sustainability depends on economic and institutional aspects. It is assumed that there would be both bottlenecks and synergies already existing in different subsectors and institutional systems. In addition to this there would exist in practice many other ways of interaction between the different selected aspects, that can be identified through field work with stakeholders involved in different ways in the fisheries sector and the protection of the ecosystem. Finally, it would be possible to analyse these fields of study in economic and institutional terms, and suggest management measures that can help promote the wellbeing of the involved population.

The second chapter presents the hypothesis that there is a lack of clarity in the objectives of the CFP, that clarifying them could achieve sustainability with more balance between ecological, economic and social criteria and that this clarification can be done with help from stakeholders.

The main hypothesis of the third chapter is that not all ITQ fisheries management systems are equally fair, that their fairness depends on their concrete rules and that the fairness framework from Baumgärtner et al. 2012 can help identify how those rules of ITQ systems affect the fairness of the system, and thus some bottlenecks and synergies with respect to its sustainability.

The fourth chapter deals further with the hypothesis that the framework from Baumgärtner et al. 2012 can help identify how quota management instruments affect the fairness of the system, and may create synergies with the social sustainability of the fisheries where the instruments are applied (in this case for two concrete countries, Denmark and Germany).

The fifth chapter presents the hypothesis that fisheries measures for biodiversity protection have not only effects on the ecological sustainability of the species to be protected, but also on the economic and social sustainability of the fishers´ communities, and that the measuring of the effects on the fishers suffer from a situation of data poorness.

1.5 Methodology

From a methodological point of view, the thesis includes different literature reviews on fisheries policy objectives, fishing quotas distribution and biodiversity management for fisheries, accompanied by stakeholder participation exercises in the second and fifth chapters and by a brief quantitative exercise of assessment of impact of fisheries measures in the fifth chapter.

Regarding the methodology of the second chapter, the compatibility of fisheries management measures with their sustainability objectives was analysed using the framework of the SOCIOEC project (EU grant agreement No. 289192), more concretely the first element of the framework where objectives were defined to allow a later comparison with the results of implementing the management measures[3]. Stakeholders were consulted on high level objectives and their implications at regional level. The work on high level objectives was based on group consultation and the implications at regional level were studied through additional individual consultation. 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 (EU grant agreement No. 289257, Kempf et al. 2016). The workshop gathered representatives from different stakeholder groups, geographic regions and potential objective sets. These inputs from stakeholders were analysed to produce a narrower set of objectives in the ecological, economic and social categories. The results from the workshop at the European level to identify objectives were then further examined at regional level for the Baltic and North Seas in additional individual consultations. To do this, the case of Germany was used, as it addressed two seas (Baltic and North Seas), had a complex governance structure (due to federalism) and presented significant roles for the three types of actors (industry, government and environmental NGOs). Five semi-structured interviews were performed, with two fishing sector representatives, two environmental NGOs and one fisheries manager.

The methodology of the third chapter follows the framework presented in Baumgärtner et al. (2012) for the analysis of fairness and applies it to the ITQ system (which in the framework would be named the "judicandum"). The first elements of the framework is

[3] Further elements of the SOCIOEC project framework for the impact assessment of fisheries management measures were the analysis of the incentives created by the management measures, the governance under which they were implemented and the assessment of their impact using indicators. The governance and impact of some fisheries management measures will be dealt with in the fifth chapter of this thesis.

the “claim”, which is defined as a legitimate basis for demanding something, for example claiming efficiency in the use of the resource, access to fishing quota or a sustainable use of the resource. The concept of claim helps categorise stakeholders as claim holders (the ones demanding the fulfilment of the claim) and claim addressees (the ones which are being held responsible for fulfiling it). Then according to a series of criteria the framework analyses the detailed measures (or “instruments”) that an ITQ system contains to allow the fulfilment of the claims, for example a well-functioning price mechanism in the quota market to fulfil the claim for efficiency or a TAC established under MSY criteria to fulfil the claim for sustainability. The criteria used for judging the claims vary from equality of treatment or proportionality of instruments to intergenerational or intragenerational aspect. The framework further categorises the instruments of fairness based on whether they refer to the distribution of rights (e.g. initial allocation of access rights) or their exchange (e.g. capacity to buy and sell access rights), and even further, if the elements related to the exchange of rights respect fairness in their outcome (e.g. how many rights a particular fisher receives) or the process itself (e.g. who is allowed to buy rights and how many).

Regarding the methodology of the fifth chapter, it was very much influenced by the data available, both quantitative and qualitative. Quantitative data available lacked some data items important for a sustainability impact assessment, such as some prices, the number of days worked (to estimate costs or employment) and the exact areas that were being fished. Therefore the impact of the biodiversity protection measures was calculated through comparing “what if” scenarios: revenue was chosen as an indicator and to estimate the impact of the measures the revenue of the last available year (2012, the year before the introduction of the measures) was reduced by detracting the revenue of the months in which the areas were closed in winter and the revenue corresponding to the removed amount of nets in the summer.

The fourth chapter took over the methodology from the third chapter (the framework from Baumgärtner et al. 2012) and applied it to two case studies. For the case studies of Germany and Denmark the focus was on intergenerational and intragenerational justice. The topic of intergenerational justice was addressed by looking into the instruments for newcomers in the quota allocation systems while the topic of intragenerational justice was tackled by analysing the initial allocation of rights and the changes in the fleet structure due to the transfer of rights.

The methodology in the fourth chapter was comparative in different ways. For the initial allocation of fish quota a description of both the allocation rules and the exceptions for both Germany and Denmark was performed. For the influence of the different rules for the transfer of rights, a “what if” exercise was undertaken, due to the more limited availability of data on the Danish case study. The exercise consisted in evaluating what would have happened in the German fleet structure if the Danish rules and exceptions for the transfer of rights would have been applied. More concretely, the distribution of the number of vessels owned by German companies/ fishers was plotted and then the Danish rule of owning quota for a maximum of four vessels was applied to the German data. In addition to the “what if” exercise the distribution of the ownership of vessels in Germany was compared to a hypothetical perfectly egalitarian distribution of ownership by using the Lorenz curve. The Lorenz curve presents on its vertical axis the cumulative number of owners and in the horizontal axis the cumulative number of vessels owned. Finally, for the comparison of the instruments for allocating fish quota to newcomers, the data on German inactive and active vessels before and after the newcomers´ scheme of 2011 was tabulated and compared.

The impact assessment methodology employed in the fifth chapter implies comparing estimated results under the measures (indicators) with the ecological, economic and social objectives of the measures (reference points), but as no reference points were defined in the text of the measures from the case study the results could only be discussed with the fishers. Qualitative data was thus available from a focus group with fishers from the area where the results of the impact assessment and the quality of price data were discussed. Then, to assess the deficiencies in the price data the NUSAP pedigree matrix was used (van der Sluijs et al. 2005). The matrix helped identify the gaps of knowledge (in its columns), compare them with different data situations (in its rows) and assess them using knowledge from both scientists and stakeholders (in its cells).

In the case analyzed, some of the gaps of knowledge identified were the lack of plausibility of some price assumptions and the broad choice of alternative assumptions for the missing price data. The data situations compared were the actual data poor situation (with some price information missing), the same data poor situation corrected through an estimation of the missing price information and the data rich situation that is considered normal in large scale fisheries. More qualitative data was available from a stakeholder workshop which included a SWOT analysis and a critical discussion, and which provided indications of many implicit assumptions about the sustainability of the biodiversity conservation measures in the impact assessment process. This qualitative evidence from the workshop was thus used to check the existence of a “wicked problem” (Rittel and Webber, 1973), a type of policy problem that escapes the usual cycle of problem analysis used by the impact assessment, that is to set the objectives, analyse alternative paths to achieve them and evaluate the results (as explained for fisheries by Jentoft and Chuenpagdee (2009)).

CHAPTER 2

OVERARCHING SUSTAINABILITY OBJECTIVES OVERCOME INCOMPATIBLE DIRECTIONS IN THE COMMON FISHERIES POLICY

2.1 Introduction

Article 2 of the Common Fisheries Policy (CFP) (European Parliament and European Council 2013) 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 (European Commission 2009a.).

Clear objectives are critically important for the evaluation of the impact and success of any proposed management measure (Cardinale et al. 2013, Khalilian et al. 2010). 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 (European Parliament and European Council 2008), 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 (Stephenson et al. 2017) 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. (2016) and Rindorf et al. (2017).

2.1 The problem of defining objectives

2.2.1 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 (WCED 1987), 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(UNGA 2015), 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 (Khalilian et al. 2010). Again, all three pillars of sustainability are represented, but without detail.

Further at the European level, the Marine Strategy Framework Directive MSFD (European Parliament and European Council 2008, European Commission 2017) 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 environment[4], most pertinently, the CFP, whose first objective is specified in the current regulation Article 2.1 (European Parliament and European Council 2013) 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*

[4] 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.

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 (European Council 1983) 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.

In the second framework regulation in 1992 (European Council 1992a), 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 (European Council 2002) introduced the integrative concept of ecosystem management. An analysis of the implementation of ecosystem based management in the CFP can be found in (Prellezo Curtin 2015).

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 (European Commission 2009a) 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 Parliament[5]. The communication from the European Commission on the reform of the CFP from 2011 (European Commission 2011a) 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

[5] 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).

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 2.1 below.

Table 2.1. Sustainability objectives in the CFP across time.

Definition of ecological, economic and social sustainability objectives	Additional objectives	CFP version reference
"conservation of the biological resources (...)in appropriate economic and social conditions"	*"the protection of fishing grounds"*	(EEC) No 170/83 of 25 January 1983, Art.1
"protect (...) living marine aquatic resources (...) in appropriate economic and social conditions for the sector"	*"implications for the marine ecosystem"* *"the needs of both producers and consumers"*	(EEC) No 3760/92 of 20 December 1992, Art.2
"ensure exploitation of living aquatic resources that provides sustainable economic, environmental and social conditions"	*"providing a fair standard of living for those who depend on fishing activities and taking into account the interests of consumers."*	(EC) No 2371/2002 of 20 December 2002, Art.2
"environmentally sustainable in the long-term and (...) consistent with the objectives of achieving economic, social and employment benefits"	*" and of contributing to the availability of food supplies"*	(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*"(European Council 2007), thus allowing industry to adapt and plan in the longer term.

2.2.2 Priorities between the three pillars of sustainability

The three pillars of sustainability were introduced in the 2002 Johannesburg Declaration (World Summit on Sustainable Development 2002) "*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 (Ott Döring 2008). However, some approaches to objective prioritization have been carried out (Stephenson et al. 2017, Mardle et al. 2002, Hilborn 2007). 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 (European Commission 2009a), 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 (Kelly et al. 2006), 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 (European Commission 2008)).

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. Suuronen Sarda 2007). 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 (STECF 2009). 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 (STECF 2009).They may also introduce individual daily limits to influence prices (Aranda Murillas 2015). 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 (Strehlow 2010). 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 (Strehlow 2010). 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 fishers (Burke 2013). 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 (Symes Phillipson 2009) and yet, understanding of social and economic dimensions can impact on the success or failure of a simple conservation policy (Loring 2017).

2.3 Managing fisheries to meet the overarching principles of the CFP

2.3.1 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 (Drucker 1954, Rice Rochet 2005). 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 (Dickey-Collas 2010). 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 (European Commission 2009a, Khalilian et al. 2010, European Court of Auditors 2007).

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 (European Parliament and European Council 2008). 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 (Calderwood et al. 2016, Villasante et al. 2016).

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 (King Sutinen 2009, Boonstra et al. 2017, Fitzpatrick et al. 2017). 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 (European Parliament 2012, Brooks 2010). 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 (Davies Ruddle 2012).

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.

2.3.2 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 (European Commission 2009a, Cochrane 2000) 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 (Voyer et al. 2017) 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 (European Commission 2011a) 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 2.3.1 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 (Rosckström et al. 2009), 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 (Dickey-Collas et al. 2003). 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. Boyes Elliott 2016). 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 (Ostrom 2007). 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 (Davies Ruddle 2012) 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 (Ulrich et al. 2012) are being incorporated into management, the target for management may need to be more adaptive. Following Lind (1995) 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 (FAO 2011). 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, Walpole et al. 2012) and for a balance in the diet (as has been done with meat, see Rohrmann 2013). 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 Little et al. 2015. 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 (Greenpeace and NUFTA 2012)and to relate fishing rights concessions to compliance (Bromley 2009). 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.

2.4 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.

2.4.1 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 2.4.2 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 (Kempf et al. 2016). 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 (Kempf et al. 2016). The results from this process of identification of objectives are shown in Table 2.2.

As with any objective in fisheries, the chosen examples (see Table 2.2 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 2.2 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

More relevant with respect to the management of fisheries policy objectives is the study of how objectives influence each other, in order to avoid unintended effects due to policy Ostrom (2007). A practical way to do this is to identify management measures for each objective that are compatible (at least partially) with the other objectives. There might be a negative effect from some measures on some objectives and this should be clearly shown (Rindorf 2017). Ideally the partial or complete fulfillment of other objectives would be reinforced, or the effect should be neutral. Examples of how objectives are compatible within various management measures are given below.

A first example would be to move towards MSY in a socially proactive way by promoting (through quota or marketing incentives) the fishing gears that have a catch composition appropriate to a relevant multispecies MSY. This may imply social decisions, like deciding on trade-offs between species: consume more cod or more pelagic species (Gislason 1999, European Parliament and European Council 2016). Another socially and economically compatible measure to implement this objective would be to promote responsible consumption patterns, regarding for example the minimization of fish waste across the supply chain (FAO, 2011) to raise awareness on excess catch. The elimination of discards can also be promoted by fostering fishing techniques that have sustainable catch composition, to then promote the marketing of those less valued discard species (FAO, 2011) either as standard or sub-standard products.

The reduction of bycatch is compatible with using socially acceptable management measures specific to each case, as short temporary closures that enable the fishers to have other sources of rent and therefore allow for viable coastal communities (Burke 2013). Another way to improve management measures to reach the bycatch objective is to benchmark different management measures employed in nearby areas, and reach an agreement to implement similar measures regionally. This can prevent potential problems of social acceptance due to a perception of unfairness when implementing different measures in close by areas that share a bycatch problem. . An example of this is the different measures to protect seabirds and harbour porpoises across the Danish-German border. In the German Baltic coast gillnets are seen as harmful for harbour porpoises and seabirds and therefore suffer restrictions, whereas in the close by Danish coast gillnets are seen as sustainable and harmless and they are not restricted due to bycatch of those species. This is also influenced by the different objectives of environmental NGOs in both countries (Bates 2013). An economically efficient way to achieve this objective would be to promote sustainable seasonal consumption of regional fish to foster 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 Schmücker Schmüdderich (2010)), 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 2.4.2 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 (Khalilian et al. 2010)) 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 CO_2 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 (European Commission 2009a). 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 (Schmücker Schmüdderich 2010). Monitoring potential problems with succession of fishers (Burke 2013), building realistic mid-term expectations for the return to fishing activity and investigating of alternative sources of income (Strehlow 2010, Perez de Oliveira 2013) 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 (Österblom et al. 2011, Jones et al. 2013). 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 (Kempf 2016) 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 (Hilborn 2016). 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 Brooks (2010). Kempf et al (2016) 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.

2.4.2 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 2.4.1 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 (Gilman 2015) 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 2.4.1, but note the fact that, as many objective 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.

2.5 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 (Hilborn 2016, Mayer et al. 2005), ecosystems (Ramírez-Monsalve, 2016) 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. (2016), *"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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CHAPTER 3

EQUITY AND ITQS: ABOUT FAIR DISTRIBUTION IN QUOTA MANAGEMENT SYSTEMS IN FISHERIES

3.1 Introduction

The use of natural resources such as fish stocks raises issues of intra- and intergenerational fairness. The intensity of fishing and its effects on the ecosystem directly influence humanity's short- and long-term prospects on the availability of the stocks.

In more and more countries governments introduce Individual Transferable Quotas (ITQs) to distribute access rights for fish stocks to fishers. New Zealand was the first country to do so in 1986 (O'Connor, 1994). ITQs as a system to distribute access rights in fisheries are primarily introduced to improve efficiency, reduce overcapacity or setting the right incentives for fishers (more interest in longer term sustainable exploitation of stocks). There is a long list of literature on the introduction of ITQs which includes discussions of social and ecological aspects (e.g. Olson, 2011; Branch, 2009; Copes and Charles, 2004; McCay, 1995). However, there is only very limited analysis about how to assess equity and fair distribution aspects when introducing ITQs (see Parslow, 2010 for an example). This is surprising as there is a lively debate around the positive and negative effects of ITQ systems, including issues which can be interpreted as equity or fairness questions (distribution of rights at the start, price of the rights, market power problems, etc., see Soliman, 2014; Bromley, 2009; Copes, 1986). In this paper we apply a framework developed by Baumgärtner et al. (2012) for assessing justice in resource use systems. This we see as a step to close parts of these gaps.

The basic idea of their framework is to understand the abstract issue of fairness (justice)[6] by specifying several elements of fairness considerations. The authors distinguish between the community of justice (or 'stakeholders') i.e. claim holders and claim addressees, positive and negative claims[7], the judicandum, instruments of justice (or fairness) and the chosen metric to evaluate the instruments. We will introduce these concepts in the respective sections and relate them to the ITQ setting. This systemized approach facilitates the assessment of fairness and distribution issues, as Stumpf (2014) shows in her analysis of the biopiracy debate.

Fishery management systems in general and ITQs in particular are characterized by several stakeholders with often conflicting interests. From a fairness perspective, these systems are particularly interesting as they comprise issues of both inter- and intragenerational fairness. The aim of the present study is to assess some problems related to fairness in ITQ systems using Baumgärtner et al. (2012)'s systematic approach. We describe the status of fish stocks as common pool resources, discuss the importance of distribution and fairness issues in exchanges when introducing ITQs, and then go into detail on aspects of distributional fairness and mechanisms to address fairness-related claims.

3.2 Conceptual background – fish stocks as common pool resources and tradable quota shares

Fish stocks are classified as a common good or common pool resource. They belong to no-one in particular and every human being has, in principle, the same access rights.[8] This includes not only the current generation but also future generations. We are

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[6] With fair we mean basically free from injustice, a proper outcome under the rules or a legitimate request. We don't use justice (as Baumgärtner et al. 2012) as the question of actual distribution of fishing rights is an issue between a rather small number of individuals in a society compared to issues which are relevant to large parts of the whole society (intra- and intergenerational justice in resource use systems, income distribution, etc.). Therefore, we apply the framework of Baumgärtner et al. (2012) but speak of equity and fairness in ITQ systems instead of overall justice.

[7] With claims we mean a legitimate basis to demanding something.

[8] Ostrom explains the problem of common pool resources as follows: "In contrast, common-pool resources are sufficiently large that it is difficult, but not impossible, to define recognized users and exclude other users altogether. Further, each person's use of such resources subtracts benefits that others might enjoy. Fisheries and forests are two common-pool resources that are of great concern in this era of major ecological challenges" (Ostrom, 2008).

obliged to use natural resources such that their use potentials are not diminished in the future. Overfishing of a fish stock means that we abuse the resource with the effect that catches are reduced in the present and future (Willmann et al., 2009).

In the history of fishing, the idea of fish stocks as common pool resources has often led to overfishing as more and more fishers, often with the help of governmental subsidies, entered certain fisheries (Khan et al., 2006). The resources were first treated in many cases as 'open access' with no regulation on fishing effort.

The first major development in fisheries management was the legal framework provided by the United Nations Convention on the Law of the Sea (UNCLOS, 1982), which changed most fisheries from open access to being owned by states within 200 nautical miles of the coast, called the Economic Exclusive Zone (EEZ). The UNCLOS defines a coastal state as the sovereign over its territorial sea (UNCLOS, 1982, §2) and "*has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resource*" (UNCLOS, 1982, §56) and "*shall ensure through proper conservation and management measures that the maintenance of the living resources* […] *is not endangered by over-exploitation*" (UNCLOS, 1982, §61) in its EEZ.[9]

With the restriction of the access to fisheries resources by legal institutions the question emerges who may claim the benefits of the use of these resources? Governments manage the access to resources mainly by giving access rights for certain stocks to national fishers.[10] One option is the introduction of tradable fishing rights (or ITQs).

The basic theoretical idea behind ITQs is the economically efficient observance of a target reference point (like Maximum Sustainable Yield (Johannesburg Declaration 2002)), in this case, the allowed catch from a certain fish stock (see Ellerman, 2005; Spash, 2010 for a general introduction). The coastal states as owners of the resource

[9] A few stocks are outside of country ownership, especially deep sea stocks, and international agreements between interested nations can avoid overuse of these resources. These additional legal institutions under the UN roof are less strict (only restricting the countries which adopted a given regulation), therefore these resources are often under more pressure as they are still technically within an open access regime.

[10] Within the European Union the member states adopted a Common Fisheries Policy to regulate the fishing effort but still countries receive a certain share of the allowed catch as national quota to allocate it to the fishermen.

decide how they want to define the catch limit. An annual Total Allowable Catch (TAC) for a specific stock is set from an assessment of the stock status by fisheries biologists.[11]

The resource owner(s) then decide how to distribute the TAC to the fishers. In an ITQ system, the coastal state partitions the TAC and distributes them to the fishers on a percentual basis. In practice, this percentage of the TAC depends mostly on historical landings over a multi-year period before the introduction of ITQ's. Applying a percentage means that quotas can vary every year following the changes in the overall TAC. The fishers can then trade the access rights (percentages) to the overall quota ('permits'). An ITQ holder is typically an owner of a vessel or a group of vessels which is, in theory, easily controlled at a known cost. Trading is often limited by specific rules against concentration of rights but, usually, fishers can trade permits on an open market. Therefore, the permit/individual quota market is a key institution of any ITQ system.

By creating a market for permits the assumption is that the less efficient companies, in terms of costs of catching a certain amount of fish, will sell their permit to the more efficient companies (Arnason, 2002)[12]. In the fisheries economic literature ITQ holders are generally assumed to have perfect information about all aspects of trading, transaction or information costs in finding and trading with other permit holders are low, there is a well-functioning capital market, and there are no income or wealth effects from the initial allocation of permits/quotas. Under these assumptions the outcome of permit trade is efficient. However, it is clear that these conditions rarely exist in practice (e.g. due to uncertainty about future TAC or fishing costs) and to assess fairness issues needs a closer look at the existing systems instead of relying solely on the literature (see i.e. Pinkerton and Edwards, 2009).

Recently, ITQs are being implemented or are being contemplated in more and more countries around the world. In 2008, approximately 10% of the global harvest was retrieved in ITQ systems (Chu, 2008). As a result more information has become available on the success and failures of these systems (e.g. Sumaila, 2010; Hilborn et al., 2005). Many ITQ systems worldwide do not simply provide fisher a share of the overall TAC but also include regulations to anticipate expected problems resulting from

[11] The International Council for the Exploration of the Sea (ICES) developed for the EU a practical framework how MSY can be interpreted (from a stock status perspective) and how the stock status information can be transferred into an annual TAC (ICES, 2013).

[12] There is empirical evidence in Denmark that the number of fishing companies decreased after the introduction of ITQs (Andersen, 2012).

implementation of the ITQ. Some of these expected problems have normative implications, including the method of the initial distribution of quota shares, the disappearance of small coastal fisheries, the treatment of newcomers to the fishery, and the use of fishing methods which cause external effects (e.g. bycatch of non-target species or destruction of bottom habitats). ITQs are an instrument to distribute access rights by the resource owner but in only a few cases do fishers pay fees for access or for services related to the fishery.[13]

We will now, applying Baumgärtner et al. (2012), define the stakeholders (see footnote 2) bound by fair practice rules (in short later 'stakeholders') as possible claim addressees and claim holders in a fisheries setting. Afterwards, we develop the corresponding legitimate claims, and discuss the judicandum, the ITQ system (section 3.5). The judicandum is evaluated according to the approach (outcome/process), metrics and principles (i.e. equity, proportionality). We then discuss which instruments in applied ITQ systems can be used to satisfy possible claims.

3.3 Claims and community of fair practice in a fishery setting

The 'stakeholders' in fairness considerations consist of claim holder and claim addressee (Risse, 2012: 4; Page 2007: 1; Caney, 2005: 103). The former is holding (legitimate) claims against the latter. We restrict the 'stakeholders' here to members of the human race.[14] We identify the following claim holders in a fishery setting.[15]

(1) **Coastal States:** Following the UN legal framework (UNCLOS, 1982), the coastal state, and the citizens of that state, are the owners of the resource in their EEZ. The state acts as both owner of the resource and fishery manager, as it assigns the use rights of the resource to the fishers.

(2) **Fishing sector:** Fishers, producer's organisations or fish processing companies of the present generation act as the users of the resource and so are part of the

[13] For example in New Zealand (Mace et al., 2014), and Nova Scotia (FAO, 2008) where the fishing sector pays for assessment of fish stocks.

[14] It could be argued that nature itself is a possible claim holder when discussing fairness in fisheries management. However, this is beyond the scope of this study.

[15] We are not addressing the question of whether a claim is legitimate or not, which would require a deeper analysis of the legal framework and is outside the scope of this study.

’stakeholders’. Fishers (similar to processors) qualify as a special group of claimholders since usually not every citizen is allowed to fish (or process) commercially. In Europe commercial fishing usually requires an appropriate qualification and a licence. Similarly commercial fish processing is usually restricted via training or licensing.[16] Recreational fishing is more open but often some kind of license is necessary.

(3) **Future generations:** Future generations belong to the community of fair practice as future owners and users of the resource. The justification for considering future generations is grounded on the principle of sustainability as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland, 1987) that has been acknowledged by the UN (e.g. UNCED, 2012).

(4) **Conservationists:** Conservationists can include members of animal rights groups, environmental advocacy groups, conservation and preservation groups, even conservation minded recreational fishery groups. They represent portions of a state or states with interest in the fishery as advocates on behalf of the environment or species.

(5) **Rest of the world:** In many cases the intensity of fishing and the negative effects of fishing may affect an ecosystem or stocks in a way that harms the rest of the world outside the coastal state and, therefore, other people have also legitimate claims on the management of the resource.

The ’stakeholders’ can act, depending on the claim, either as claim holders or as claim addressees. We furthermore identify the following legitimate claims:

(1) **Efficiency:** Efficiency is a target to a non-wasteful use of the resource and following that, the creation and delivery of the maximal possible outcome from the use of the fishery. This we see as the claim of the state as resource owner (claim holder) to the fishing sector (claim addressee). This claim is

[16] Fishing licences are required amongst others in Canada, Australia, the US, and the EU. Fish processing licenses and/or specific training are required for example in Canada, Australia. Alaska the US, and several EU member states. Information on licenses can be reviewed on the respective states websites for fishery management and/or food safety regulations.

derived from the fact that the state is the owner of the resources within its exclusive economic zone (UNCLOS, 1982, §61). [17]

(2) **Access:** As the state is normally not able to use the resource itself, the rights are granted to a group of citizens by certain rules and it is the state's responsibility to make the resource available for users. The state may restrict the access to the resource by issuing licenses, or may restrict the use of the resource by setting a total allowable catch (TAC) level that could be divided in ITQs. Members of the fishing sector (fishers, producers organisations or fish processing companies) thus claim the use of the fishing resources from the state.

(3) **Sustainability:** The non-destruction of their future share of the resource is a claim from future generations and conservationists, to both the current state as the resource manager and the fishers as the resource users. Additionally, the supporting ecosystems are not allowed to be destroyed as it harms the claim of conservationists, future generations and the rest of the world (see principle of sustainability (Brundtland, 1987)). This claim is significant since there is a danger that today's fishing activities may have a negative effect on the reproduction capacity of fish stocks and impair sustainable fishing in the future.

A systemized view of possible stakeholders and their claims is central to the concept of fairness (Ott and Döring, 2008: 47). In that respect, employing Baumgärtner et al. (2012)'s syntax helps identifying stakeholders concerned with issues of inter- and intragenerational fairness arising in ITQ systems. In the following we distinguish between different fields of fairness considerations, in which the just developed claims may be classified.

[17] Baumgärtner et al. (2012) consider efficiency a "secondary normative objective" to attain primary normative objectives. In the fishery management setting, we do however consider efficiency as a legitimate claim.

3.4 Distributive fairness and fairness in exchange as perspectives of fairness regarding ITQs

After describing claims and distinguishing claim holders and addresses we will analyse how we can assess a ‘fair’ distribution between claim holders from the perspective of intra- and intergenerational justice. From our experience and analyzing literature on distributional justice we may easily say that “every generation is equally entitled to a fair share of the bounty” (intergenerational justice, Habib 2013: 752) and that every actual member of a society shall have the same entitlement (intragenerational justice).

For the analysis of access rights in fisheries we will focus on the perspectives (as classified by Koller (2007)) of distributive fairness and fairness in exchange, as ITQs are mainly an instrument to distribute fishing rights to the fishing sector. Different principles of distribution can apply in the perspective of **distributive fairness**. In modern conceptions of distributive fairness, it requires equal consideration and treatment, unless there are reasons for unequal consideration which are acceptable for all (Koller 2007: 9).

In an ITQ system, setting the claim for access as mentioned in the previous section corresponds to the initial phase of granting fishing rights. The claim holder may be a single fisher while the claim addressee is a central authority like the state (Petersen 2009: 25) representing the community as a whole. How the fishing rights are granted and distributed is an issue in the perspective of distributive fairness. Citizens are usually not treated equally as not everybody is allowed to go fishing. One generally accepted criterion for unequal consideration is merit. In Germany, for example, fishers have to obtain certain training to be able to receive a fishing license. Other examples of merit guiding unequal access to quota include performance on environmental and social indicators (NUTFA, 2012) and compliance with fisheries regulation for the renewal of quota (Bromley, 2009). Expectation that could be considered legitimate include for example the access to a fishery for a new generation, for which a special regulations to facilitate access for newcomers to the fishery may be created.[18] Furthermore there is a long discussion that the permanence of traditional small scale fisheries should be ensured (Bonzon et al, 2010). This could be covered for example, by facilitating that

[18] Denmark, for example, has the *Fishfund*, a proportion of quota set aside for newcomers (Bonzon et al., 2010).

one generation of a family of fishers may be able to transfer their rights to the next generation.

In most applied ITQ systems allocation is proportional only with respect to historical catches during a defined reference period. This “grandfathering” leads to a distribution of quota shares among fishers who have already participated in the fishery. It is controversial whether the concept of grandfathering corresponds to any of the criteria of proportionality with respect to merit, basic needs or legitimate expectations (Koller, 2007). Allocation being proportional to previous catches does not imply that it is proportional to the merit of the fisher; e.g. higher depending on how sustainable is his/her fishing practice, that a group of fishers which normally fish on the stock do not have fished in the reference year(s) or the dependency on a certain species. It is also not proportional to the fisher´s basic needs; e.g. reaching a minimum salary or being higher for more employees. Finally, a grandfathering type of allocation is not proportional to the expectations of the fishers to continue the activity for those that foster the livelihood of the community just as the previous generation has.

The principle of proportionality regarding grandfathering is an issue when we look at fishing outcome for the rest of the world: Fishers that received more fishing rights given their historical catches now also receive more benefits when they fish more, as their main criteria is profit, irrespectively of the damages they inflict on the ecosystem. This leads to a misalignment of incentives between claim holder and claim addressee and a possible conflict with the claim for sustainability.

Fairness-in-exchange is the perspective of fairness that applies to exchange relationships, i.e. the cases where two or more persons interact voluntarily to mutually confer certain goods and services on each other (Stumpf, 2014; Koller, 2007). The fairness of exchange can be judged according to the *outcome* approach, i.e. who benefits and how much, or the *process* approach, i.e. how goods and services are conferred.[19] The outcome of an ITQ system can be seen as outcome for the fishing sector (both in matters of the distribution of the rights, and of their materialisation, as stated above), but also in terms of the outcome for society. In this respect, ITQ systems are a policy option that is meant to be more efficient at capturing the resource rent (Nostbakken, 2013), and also able to do it with a smaller cost to society in terms of administration, which would

[19] The process approach has been used especially to describe fairness aspects in sport competitions (rules shall guarantee equal chances) or on e.g. financial markets (Angel and McCabe, 2010).

correspond to the claim for efficiency. The fairness principle applying to the outcome approach is equivalence (Petersen, 2009: 26). Following this reasoning the state as the resource owner is in an exchange relationship with the fishers and would have to benefit from the resource as much as the fishers (as actual resource users) do. For example, it has been suggested that the payments from ITQ concessions could be reinvested in the fishery so that the cost for the fishers also reverts to the fishing communities (Bromley, 2009). Similarly, future citizens (as claim holders) would claim to benefit from the resource as much as the present society do, corresponding to a non-destruction of the resource. In this example, the claim addressees are the fishing sector and the exchange an intertemporal one.

However, the main discussion has been focused solely on fishers, i.e. on the distribution of quota shares, especially the concentration of rights or the initial distribution of rights (e.g. Olson 2011; Sumaila, 2010). In several ITQ systems, especially in Europe, regulations were introduced to avoid unfair outcomes such as the concentration of rights in a few hands (Andersen 2012).

The principle for the *process* approach on fairness-in-exchange implies that an exchange is fair if there is a fair negotiation position for all partners (Koller, 2007: 9). In the case of ITQs received quota shares are secure (quota holdings last for a long enough period of time) and exclusive (there are clearly assigned to an entity and can be defended legally, which are characteristics of successful catch share programs (Bonzon et al., 2010). This equality of the negotiation position addresses the legitimate claim of fishers to use the resource. However, in applied ITQ regimes there are additional issues. When the rights are initially given away for free, then the fishers that enter the fishery after the initial distribution are in a worse negotiation position as they have to pay for their rights (Bromley, 2009), extending the issue of fairness in negotiation position to future generations. The negotiation position of the state must also be considered, as once the rights have been granted by the state they might be consolidated and might then be very difficult or costly to recover. Another aspect of the negotiation position is the relative stability criterion, by which differences among the amounts of quota given to the countries are historical and/or political, which could be considered an un-level playing field.[20] Finally, an important case of unequal negotiation positions arises with multinational fishing companies, as independent fishers need to remain inside the

[20] In the EU Common Fisheries Policy the TAC is distributed between member states following a fixed percentage for each country, which is called the principle of 'relative stability'.

quotas allocated to their state and region (including some where quotas are not fully tradable) while companies can adjust their quotas more easily when they have vessels registered in different states.[21]

Up to now we developed ideas about the ’stakeholders’, legitimate claims that arise in fishery management systems, and the domains of fairness they concern. In the following we discuss the judicandum (the ‘instrument of fairness’) of this study: the ITQ management system.

3.5 Judicandum: ITQs as a management system

The judicandum is the “domain of application “ of the claims, the aspects (in our case, elements of an ITQ management system) to which claims can be applied (Pogge 2006: 863). In our study we need to ask ourselves the question “What are the concrete features of an ITQ management system that we need to detail in order to apply the framework?” The judicandum is to be assessed using different metrics, i.e. the information base and the corresponding principles. According to Baumgärtner et al. (2012, p. 5) “In sum, judging a certain judicandum as inter -or intragenerationally just according to some metric requires first to specify the positive and negative claims of claim holders in present and future generations against claim addressees in the present generation which are to be satisfied by certain instruments of justice”.

The information base to assess the elements of an ITQ system can consist of ecological, economic and social indicators. There are great differences between these three groups of indicators. Especially measurable social indicators are rare as there is no sufficient data collection on them (mostly there is only data on overall employment). Some examples of indicators that can be used to assess the application of claims to the judicandum are detailed below.

Ecological indicators include resource status (Precautionary approach or MSY framework), bycatch rates (impact on non-target species) and areas of impacted habitats (impact on catch possibilities now and in the future). The MSY framework allows fisheries biologists, with sufficient data, to assess how far the stock is away from the

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[21] This issue came up during personal communication with a member of a producer organization.

desired maximum sustainable yield target.[22] Given the structure of ITQ systems, ecological factors play a role in locating the appropriate TAC level that is then portioned into quota shares, and thus contributes to fulfil the claim of sustainability under the domain of fairness in exchange (fishery sector and future society both benefit from the resource).

ITQs itself are basically an instrument to introduce economic incentives and efficiency. Fishers are more interested in future catches if they have a security to be the beneficiaries of a sustainable exploitation (of the given quota) today. This may give economic indicators a more important role in the future. Economic indicators include, resource rent, income/profits of the fishers and gross value added among others. This corresponds to the claim of efficiency (not to waste the resource) from the state as claim holder to the fishing sector as claim addressee.

Another element of ITQ systems as judicandum is the allocation of resource rent, which is the payment to the resource owner for (allowing) the harvest of the resource. In theory this would be the returns that the states achieves when selling the quotas to fishers. However, this is hardly done in practice. Additionally, as Grafton (1996) already points out, the estimation of resource rents in practice is a non-trivial problem. Income, profits and Gross Value Added (GVA) may be other useful indicators. GVA is the contribution of the fishing sector to the national economy. Profit measures the financial position of individual companies, and income the consumption and savings opportunities of fishers and other workers in the fishery sector. These indicators would also help measure the fulfilment of the efficiency claim, and how equivalent are the outcomes for the fishing sector and for the state (fairness in exchange)

Among possible social indicators, we can think of the persistence of communities (population level, social infrastructure), food security as well as employment, working conditions, employment level.[23] All these indicators may be severely affected by an introduction of ITQ systems (Copes, 1986).

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[22] MSY is a target reference point. If we reach that target we can claim that we are fair towards future generations as we keep the resource base intact. However, there are great uncertainties about exact biomass levels and, therefore, in praxis managers will apply a cautious setting of catch limits to avoid decreasing stocks again.

[23] Although employment may fall under economic indicators as well, we list it under social indicators since evaluation principles are similar for those indicators. See next paragraph.

In terms of evaluating social indicators it makes sense to think of lower limits that one would not want to fall below. As an evaluation principle a decision rule like Rawls (1971: 152) "Maximin" or a threshold on what may be enough might apply here.

Once the element of the judicandum have been established, for the above mentioned economic (monetary) indicators, several distributional principles could serve to measure whether an ITQ affects the claim holder in an acceptable or even desirable way. Distribution indicators could include, for example, the Lorenz curve (a graphical representation that illustrates wealth distribution in a population, Lorenz 1905), people's perception on fairness or social indicators, such as employment before and after the introduction of the ITQ. It is, however, unclear in many cases if an ITQ system itself or other regulations are responsible for certain developments, such as an increase in the profitability of a fleet when e.g. fish prices increase.

3.6 Instruments of distribution in ITQ systems

Instruments of fairness are the claim addressee's tools to balance the mutual claims of different claim holders (Anand and Sen, 2000; Dobson, 1998). The claim addressee is in most cases the state, although in some ITQ regimes a certain degree of use of these instruments is granted to producer organizations (as for example allocation of rights or use of the reserve quota). We identify six main instruments in applied ITQ regimes:

(1) **Set up of market mechanism:** We earlier developed one possible claim for efficiency of the fishing industry, i.e. the delivery of the maximal resource rent to the resource owner. The price mechanism of the quota market is the appropriate instrument for achieving the delivery of maximal rent to the resource owner (if delivered to the state). If the right information mechanisms (for example, an electronic trading facility) are provided, then fishers will have the required information to sell their quota share as long as their marginal benefit is lower than the quota price. Fishers whose marginal benefits are too low will leave the fishery, leading to an overall increase in efficiency in the fishery. The problems of excess individual effort and overcapitalization are reduced by introducing a well-functioning market for quota but this only addresses efficient exploitation and is not dealing with fairness. The resource rents, however, accrue to the original owners of the quota, which is, per se, the state even if in practice many quotas are allocated

for free. Thus the societal claim to the maximum possible resource depends very much on another instrument – the initial quota allocation.

(2) **Initial quota allocation:** There are three ways to initially allocate quota shares (Copes, 1986): (1) Giving quotas away free, (2) selling quotas at a fixed price, and (3) auctioning quotas off. The latter two are consistent with the state´s (representing society) claim to efficiency as the coastal state receives a payment and the resource will be harvested with the lowest costs. Both imply that fish stocks are a property of the state, since collected rents might be used to pay for fisheries management and/or distributed to the people of the relevant jurisdiction. However, as developed in Section 3.4, fishers have a legitimate claim to access to the resource. An optimally set fixed price fulfils the claim of equality, while auctioning off quota shares implies a sense of proportionality, given that fishers pay according to their bidding price.[24] However, by setting an initial price established fishers with claims due to their history in fishing that cannot afford the additional costs could lose their access to the resource. This creates a conflict with the claim for access and the principle of legitimacy as the notion of distributive fairness. Giving away quota for free violates not only the state's claim of receiving the resource rent, today´s fishers obtain the resource rents as windfall gains, but also invokes problems with intergenerational fairness. It only addresses the claim of access to the resource of the present generation of fishers. Future newcomers have to pay for their right to fish while fishers present for the Initial ITQ allocation gain the access right for free therefore fishers across generations are treated unequally.

The question of eligibility to receive (or buy) an initial quota share is another concern of intra-generational fairness. In applied ITQ management regimes, the quota is initially allocated for free among vessel owners, which violates the principle of equality as not all fishers are vessel owners. We conclude that the initial allocation of quota as an instrument of fairness can lead to different degrees of fulfilment of two claims: the state's claim to the maximization of its resource rents and the fisher's claim to access to the resource. In applied ITQ systems, however, we observe that both claims are principally disregarded. This raises issues of intra-generational fairness, since a person who was present at the initial allocation has more rights than a person who was not there.

[24] Considered is, however, only proportionality in terms of economic performance, other merits, for example cultural, social, or ecological advantages are not included.

(3) **Definition of the fishing right**: there are different way to define the share of the stock that a fisher is allowed to fish, for example privileges are given and can be withdrawn, while rights are something that, being innate and fundamental to the person, deserves protection from the state (Lam and Pauly 2010). A more ambiguous term to “quota” or “right” would be “concession”, whose strength depends on the duration (one year concession, permanent concession, etc.). The duration of the privilege or right is also an important issue, as it sets different incentives for profit seeking or sustainable fishing among others, as for example a fisher would have little incentive to fish sustainably if he or she knows that he or she will not benefit from the stock the next year. These two decisions, privilege/right and duration, are taken into account at the initial allocation stage and may be difficult to modify afterwards and are therefore critical considerations when analysing fairness in ITQ systems. Another aspect relevant to the definition of the fishing right would be its conditionality on the fulfilment of a criterion, e.g. ecological performance. A fishing concession could be of short duration but with automatic extension if the fisher behaves sustainably, making the duration proportional to merit (Bromley, 2009). In this way a concession would be similar to a privilege, as it can be removed, but also to a right, as it can be permanent if minimal conditions are met.

(4) **Market monitoring and intervention:** Concerning the outcome approach, ITQs are designed to increase efficiency by decreasing over-capitalization of fishing fleets. One major concern is that by reducing the number of active vessels an ITQ regime may lead to oligopolistic or monopolistic market forms, where only few large firms remain and the small scale fishery is wiped out or becomes increasingly dependent on larger firms for leased quotas.[25] The market power of large firms may lead to non-competitiveness, another type of inefficiency.[26] Obviously this is an issue concerning the state’s claim to an efficient use of its resource. Concerning the

[25] There are empirical studies about the effect of ITQs on the market structure. Adelaja et al. (1998) investigate the mid-Atlantic surf clam and quahog fisheries for signs of monopoly power after implementation of an ITQ regime. They found a strong reduction in the number of fishing vessels but did not find evidence for monopoly power in the industry. Brandt (2005) showed that, for the mid-Atlantic clam fishery, small scale fishermen were adversely affected by the introduction of ITQs. See also Olson (2011) for an overview.

[26] In the presence of economies of scale, however, these market forms may even be efficient. Analysis, therefore, requires knowledge about scale effects in the industry. There is evidence for economies of scale for Norwegian cod and pelagic fisheries (Nostbakken, 2006, Sandberg, 2006).

process approach, fair negotiation conditions are granted as long as everyone eligible may buy or lease quota shares at the same conditions. This corresponds to the fishers's claim on using the resource (claim of access above). Unfair negotiation conditions might arise, as we have seen in the explanation of the process perspective of fairness in exchange, as there is market intervention at the national level as fishers need to remain inside the quotas allocated to their state and region, while there is no authority to intervene at the level of multinationals, and therefore companies can adjust their quotas among vessels registered in different states.[27] There is some evidence that these companies typically have a strong lobby, are often vertically integrated in the fishing industry, and thus have a stronger economic position to acquire quota. Small-scale fishers have a more fragile economic condition and may more easily give up their quota shares. Restrictions on quota trade have been introduced in several ITQ programs in order to address the issue of quota concentrations. These restrictions vary among jurisdictions but fit five broad classifications: (1) limits on the quota share that can be owned by any one individual or company with the special case of limits on quota concentration and quota holding from nationals of foreign countries (e.g. Denmark), (2) restrictions on the spatial tradability of quota shares to avoid quota concentration in particular regions (e.g. Iceland, Denmark), (3) restrictions on tradability beyond one specific fish stock (e.g. New Zealand), (4) prohibition to trade quota shares intertemporal (e.g. New Zealand), only accepted under some limit and with the year immediately after and (5) the acceptance of cooperatives as quota holders that facilitate quota trade for small-scale and local fishers (e.g. German Producers Organisations).

(5) **Target fishing mortality:** The target fishing mortality determines the level of the total allowable catch (TAC) the state sets every year. This directly influences the size of the fish stocks. By setting the target fishing mortality the fishery manager implicitly balances the positive claim of today's fishers to the right to fish and the negative claim of future generations to a non-destruction of their future resources. The European Union recently decreased the reference point of fishing mortality from Flim to Fmsy.[28] This indicates a tendency to attach a greater importance to the future generation's claim.

[27] Source: Personal communication with a member of a producer organization.

[28] *Flim* and *Fmsy* are reference points for fishing mortality. *Flim* shall avoid that the stocks falls under the limit biomass reference point *Blim* while *Fmsy* corresponds to the maximum

(6) **Reserve Quota:** Not all of the announced TAC is necessarily provided to today's fishers, and by extension to the quota market in the case of ITQ's, at the beginning of the year. Fishery managers often keep a reserve for several causes (e.g. in Germany (BLE, 2012)). Some quota reserves are particularly put aside for newcomers to the fishery (e.g. in Denmark (Andersen, 2012)), or as precautionary measures.

(7) **Ban on highgrading and harmful harvest techniques:** Wasteful and destructive fishing practices such as highgrading (exchange of smaller sellable catch for larger specimen for higher revenues), employing harmful harvesting techniques (like bottom trawls who can destruct bottom habitats), and discarding (bycatch which fishers throw overboard) can in practice hardly be prevented by introducing quota markets (or any other management regime) – even if ITQs are theoretically creating incentives for sustainable harvest practices and conservation. Banning such techniques is thus a necessary instrument to fulfil the future generation's claim to maintain their resources.

3.7 Discussion

In this paper we assess if the existing framework for the assessment of fairness issues from Baumgärtner et al. (2012) can be applied to fisheries management, particularly to the case of ITQ management systems. The paper is, therefore, part of a broader discussion in environmental ethics/ecological economics on questions of intra- and intergenerational justice or fairness (e.g. Habib 2013, Glotzbach & Baumgärtner 2012, Kvendokk 1995). Other applications of the framework inside fisheries could be different management measures such as multiannual management plans and closures.

We come to the conclusion, that the framework is a useful tool to assess fairness issues in ITQ systems. It allows us to distinguish claims, claim addresses and the community of justice. The judicandum can be clarified and we can identify applicable instruments

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sustainable yield biomass *Bmsy*. In case a stock falls under *Blim* reproductive capacity is at risk and automatic reduction in fishing pressure have to put in place (limiting fishing mortality), *Bmsy* is the biomass level at which reproduction plus biomass growth is at its maximum. Thus, it is true that *Blim*<*Bmsy* always. *Blim* is part of the precautionary approach concept in fisheries management trying to avoid a loss of reproductive capacity, *Bmsy* is part of the MSY concept trying to maximize the catch over time and this means normally much higher stock levels.

of distributive justice. The concepts are broad enough to provide a good fit also for fisheries management.

To discuss if the distribution of access rights can be judged as ‘fair’ or ‘unfair’ for society as a whole (ITQ as the Judicandum) and the users (fishers) we introduced possible metrics from the domains of:

(1) ecology: e.g. stock status, bycatch of non-target species or impacts on habitats,
(2) economics: GVA, profits and income,
(3) society: employment, persistence of communities.

As Habib (2013: 751) points out environmental sustainability is often described as duty of distributive justice to future generations. Managing fish stocks sustainably within a MSY framework guarantees the fulfilment of this duty to a certain extent: it provides us with an existing reference point in the ecological domain. However, for economic and social indicators/issues assessing fairness becomes more difficult. Discussions in the economic domain are often focused on a theoretical level, interpreting sustainability in terms of the economic concepts of efficiency and intergenerational equity (e.g. Stavins et al., 2003). Analysing the social domain in ITQ regimes often tends to be tangled with political issues (Jakobsen and Delaney, 2014).

In practice, as extensively discussed in the previous section, there is no “one” ITQ management regime but a continuum of regimes that employ different instruments and regulations. Thus, judging fairness in ITQ systems requires the discussion of each system on its own. This goes far beyond the scope of this study. However, we will discuss first general indicators of fairness in practical ITQ systems.

One important aspect in virtually all existing ITQ regimes is that - although born from the idea of an efficient resource management that maximizes resource rents - the generated rents are in practice rarely given to the owner of the resource (the state). This is because most of the existing ITQ systems give initially quotas away for free. Another impact of this policy is that while existing fishers benefit hugely from that, newcomers have to pay for their quota to get access. Already these two points raise significant doubts about one major aspect of distributive fairness in quota management regimes, the aspect of equal consideration, meaning that if existing fishers profit from the resource, so should the state as well as future generations of fishers.

Another important issue is that negotiation powers (or bidding power when trading quotas) are unevenly distributed as larger companies have much higher negotiation power than small vessel owners. Although, in ITQ regimes, as that of New Zealand, some instruments have been implemented to set limits on quota concentration, as limits on the number of quota shares that can be owned, and foreign quota holding, we see fewer and fewer companies own the quota shares (Stewart and Callagher 2011). Denmark is more cautious and implemented limits on the quota shares that can be owned by a single entity, restricted the spatial tradability, accepted cooperatives as quota holders (called *Fishpool*), and set aside a proportion of quota for newcomers (called *Fishfund).* Denmark tries to combine several objectives apart from being efficient in its ITQ system. It remains to be seen if they will succeed at fulfilling the claims of the fishing sector and future generations in terms of distributional fairness. [29]

Another important aspect is that although ITQs are born from the idea of an efficient resource management that maximizes resource rents, the generated rents are in practice rarely given to the owner of the resource (the state). This, as we have shown, may raise doubts about one major aspect of distributive fairness in quota management regimes, the aspect of equal consideration, meaning that if the fishers profit from the resource, so should the state. Still, we interpret the many instruments used in applied ITQ schemes as recognition of normative problems, many of which have not been concretely analysed in practice.

3.8. Conclusion

The main purpose of the paper is to apply the framework of Baumgärtner et al. (2012) to ITQs in fisheries management. For that we distinguish between five (human) members of the stakeholders bound by fair practice rules: the state (manager and owner of the stock), present fishers, conservationists, the rest of the world, and future generations. Three main claims are identified: the non-wasteful use of the resource and delivery of the resource rents to the state, the equal access to the resource by fishers, and the non-destruction of future resources and the ecosystem. We relate these claims to the perspectives of distributive fairness and fairness in exchange.

[29] Along with an efficient fishery, Denmark aims at preserving the small scale sector and keep alive commerical fishing in remote areas.

Finally we discuss instruments that may satisfy the claims in relation to the perspective of distributive fairness and fairness in exchange. Several instruments in applied ITQ schemes are identified which can be used to bring about fairness. It is clear that societal goals, such as fairness, lead to specific regulations in ITQ systems in order to avoid some problems with ITQs (concentration of rights in few hands, difficulty of access to newcomers, etc.).

Identifying different domains of fairness helps structuring one's view of fairness issues in ITQ systems. We argue that the initial granting of access to the resource falls into the domain of distributional fairness. We also make clear that fairness for in exchange - which addresses the trade of quotas - the main characteristic of an ITQ management, must be viewed not only from an outcome but also from a process perspective. Shortfalls of applied ITQ systems (such as the above mentioned ones) can be categorised using the applied framework, evaluated, and then targeted with appropriate 'instruments of fairness'.

It was not our aim to show if an ITQ system is fair or unfair. Such an evaluation must be done separately using all information on at least the instruments in a particular ITQ regime. In future research it would be interesting to provide detailed examples of regulations for particular countries.

CHAPTER 4

INDIVIDUAL VESSEL QUOTAS IN GERMANY AND DENMARK: A FAIR DISTRIBUTION PROCESS?

4.1 Introduction

In this chapter, we investigate fairness aspects in allocation of tradable vessel quota fisheries exemplified by assessing the access rights systems in Germany and Denmark. In Denmark, tradable vessel quota rights were introduced in some fisheries while in Germany fishers still receive only non-transferable vessel quota. Tradable quotas, whether tied to vessels or traded separately as quota in an ITQ, are introduced in more and more countries as a management approach designed to make a more efficient use of resources (catch the quota with least costs) and to help to guarantee a sustainable exploitation over the long run. They are thought to be effective measures to counteract the problems facing many European fisheries: too many overharvested and biologically at risk fish stocks, and overcapacity in the fishing fleets.[30]

Drawing on Baumgärtner and Quaas (2010: 3) “sustainability aims at fairness in the domain of human-nature-relationships and in view of the long-term and inherently uncertain future”. Baumgärtner and Quaas write of ‘justice’ and not ‘fairness’. However, we see the distribution of access rights in fisheries not as an overall justice but as an economic fairness issue and analyze aspects regarding a fair distribution of access rights. Investigating the sustainability in terms of the fairness of tradable quota systems thus calls for consideration of the impact of the access rights system on the present generation (intra-generational aspects), between humans of different generations (intergenerational aspects) and between humans and nature (Becker 2009; Baumgärtner and Quaas 2010). We will focus on the notion of fairness as economic-oriented distributive fairness among humans, considering the initial allocation and future distribution of quota shares, and the associated distribution of wealth and labour.

[30] In the meantime, however, the number of stocks at risk decreased substantially and also the number of vessels decreased. The main reason for that was the introduction of long-term management plans and not so much the changes in access rights systems (Cardinale et al. 2013).

Particularly we investigate the German and Danish handling of initial allocations of quota shares, the development of the fleet structure with its linked effects on market power and employment, and criteria that are widely used to determine social and economic effects of fishery management regimes. Additionally, we study the prospects for newcomers to enter the fishing industry.

This chapter is organized as follows. The methodology of investigating intra- and intergenerational fairness aspects is explained at first before this approach is applied to the German and Danish fisheries quota management systems. The last section discusses the results and examines whether, on the basis of these findings, ITQs can be classified as a sustainable and thus inter- and intra-generational fair management tool.[31]

4.2 Criteria for fairness in tradable quota systems

Tradable quota schemes are widely discussed management systems that allow for economic rationalization and are expected to contribute to increased efficiency in a fishery. Resistance to such schemes originates mostly in distributional conflicts that arise from implementing the regimes as an existing group of fishers receive the access rights at a certain point of time. The distributional effects are often not considered by economists at the time of introduction as pure ITQ allocation regimes are, indeed, solely concerned with efficiency, and even tradable quota systems that tie quota to vessels are implemented to effect a rationalization of the fleet.

Tradable quota systems are being implemented or are being contemplated in more and more countries around the world. In 2008, approximately ten per cent of the global harvest was retrieved in ITQ systems (Chu 2008). As a result, more information has become available on the success and failures of these systems (e.g. Sumaila 2010; Hilborn et al. 2005). Many quota management systems worldwide do not simply provide fishers a share of the overall TAC but also include regulations to anticipate expected problems resulting from implementation of the system. Some of these expected problems have normative implications, including the method of the initial distribution of quota shares, the disappearance of small coastal fisheries, the treatment

31 The theoretical framework of justice and its application to the ITQ system is further explained in the paper on 'Equity and ITQs' (Döring et al. 2015) In this paper we refer to the instruments of fairness, concentrating on the initial allocation of quota shares, market interferences, and newcomers to a fishery.

of newcomers to the fishery, and the use of fishing methods which cause external effects (for example bycatch of non-target species or destruction of bottom habitats). Tradable quota are instruments by which the resource owner distributes access rights to fishers/fishing companies but in only a few cases do the recipients pay fees for access or for services related to the fishery.[32]

The tradable quota systems enlist the assistance of the market to reduce fleet capacity. The quota right owner is expected to be aware of the risk of quota fluctuations and to behave accordingly (Hatcher et al. 2002). Further, because quota can be traded, fishing capacity can be adjusted by the industry. A quota rights owner will increase or decrease his quota holdings depending on the revenue/cost structure of the vessels at his disposal, thus more appropriately aligning fleet capacity to the available resources.[33] This behaviour will produce a general tendency in the fishing fleet, where owners of vessels with high capacity will seek to increase the amount of quota in their hands and thus the efficiency of their vessels, while owners of inefficient vessels will tend to exit the fishery and to compensate losses by selling their quota (Hatcher et al. 2002).

Economic Efficiency and Fleet Capacity

Defining and measuring fleet and vessel efficiency are not simple tasks. The two should not be confused and it is generally assumed for the purposes of economic analysis of fleet efficiency that vessels are perfect substitutes for one another: regardless of equipment, gear, size, crew, or age, a vessel is a vessel, regardless of its operating environment, whether conceived of in institutional, social, geographic or biological terms. With this assumption in hand, it is logical to declare that the fewer the number of vessels employed in catching the (set quantity of) fish the more efficient the fleet is. Subsequent attention, as is given here, to the distribution of vessels over size or gear classes to some extent compensates for the potential issues arising from this necessary assumption. Attention to fleet composition under conditions of declining or increasing TAC are also helpful.

[32] For example in New Zealand (Mace et al. 2014), and Nova Scotia (Townsend et al. 2008) where the fishing sector pays for assessment of fish stocks.

[33] See for example Copes and Charles (2004) for an overview over criticism of ITQs. Other concerns regarding quota regimes are the incentives for highgrading, discarding and quota busting (Copes 1986).

However, an approach based on vessel numbers, however straightforward and appropriate given the patchy data available on the fishing fleets, does not in itself provide a comprehensive assessment of fleet efficiency. Many other characteristics of the fleet besides the number of vessels in relation to the TAC are potentially relevant to understanding the changing efficiency of the fleet (e.g. gear technology, type and state of stocks, distribution of the stock in the sea). This multitude of other considerations challenge any assumption that fewer vessels, or a shift from small to larger boats are positive signs of fleet efficiency, even in terms of reduced overcapacity.

In order to elaborate the intra- and intergenerational fair distribution of individual transferable quotas, we analyse the Danish and German quota system with the following criteria: the initial allocation of quota shares, the beneficiaries of 'windfall' gains, and on changes in the market structure, focusing on changes in the labour market. We ask: (A) How is the initial allocation of quota shares made? Who earns the 'windfall' gains? (B) What are the consequences of quota trade on the fleet structure? It is our intention to examine the effect in the fleet structure as small scale fishers tend more readily to sell their quota share than fishers with larger vessels.[34] (C) How does the management regime deal with newcomers to the fishery?

(A) The initial allocation of quota shares: Copes (1986) summarizes market principles of initial allocation of quota shares: (i) giving away freely, (ii) selling at a fixed price, (iii) auctioning off. The first two possibilities require the decision about how much of a quota each entity may receive. Principles for that decision could be (a) grandfathering, (b) distribution based on vessel characteristics, (c) equal distribution. If quota is given away for free one would additionally have to decide who is eligible to receive quota shares: vessel owners, crew members, people employed in the fishery, or all citizens of the relevant jurisdiction.

Auctioning of quotas by the government would be the market-efficient tool (Mattíasson 1992). It not only implies that fish stocks are a property of the people as with the other two market principles, but might actually raise revenues from auctioning that could be used to pay for fishery management and/or distributed to the people of the relevant jurisdiction. The socially unwanted, but possibly economically efficient, result of an

[34] Basically due to a more vulnerable economic position (low profits and low possibilities for renewal of the capital stock, see Lucchetti et al. 2014).

auction is that established fishers may lose their access to the fishery, with potentially negative effects to the economy and increased demands for public welfare provision.

Selling quota at a fixed price again yields returns that may be redistributed to the people. By initially imposing a maximum acquisition quantity, one could oppose initial dropping out of some established fishers. However, in presence of economies of scale, large firms may be advantaged by buying at a relatively lower price than small scale firms due to their otherwise lower unit costs. Of course, this will not be the case in the absence of economies of scale in such enterprises, or in the case of the presence of economies of scope in small enterprises.

Giving away quotas for free imposes an intergenerational as well as intra-generational conflict since particular present entities receive by chance the 'windfall gains' of their quota share, while future generations and present disregarded fishers will have to pay for their access to the quota.

The question about who is eligible to receive an initial quota share is a concern of intra-generational justice. The resource manager would have to decide if the resource is solely property of the fisher/vessel owners, all people employed in a fishery, or all people in the relevant jurisdiction. Again, it is a question of equity who among the present generation receives the economic windfall gains of a quota share.

However, in practice auctioning off quotas is politically hardly accomplishable since current licensed vessel owners would hardly accept paying for something they got for free for decades. The same holds for selling quota at a fixed price. In most applied ITQ management regimes, the quota is initially allocated for free among vessel owners, which poses the above mentioned serious conflicts with inter- and intra-generational justice.[35]

(B) Effects on the fleet structure: tradable fisheries quota systems are economic management tools, designed to increase efficiency of the fleet by decreasing over-capacity of fishing fleets, and, more precisely, by removing vessels which do not have sufficient quota to allow them to operate efficiently, profitably or optimally. Concerns are that, by reducing the number of active vessels, a tradable quota regime may lead to oligopolistic or monopolistic market forms, where only few large firms remain and the

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[35] Denmark distributed the majority of quota shares for free (see section 8.3 b.). See Shotton (2001) for an overview over initial distributions of tradable quota shares in fisheries.

small scale fishery is wiped out[36] or becomes increasingly dependent on larger firms for leased quotas[37]. This market power of the largest firms might then lead to lack of competition and following lack of socially desirable outcomes. In the presence of economies of scale, however, these market forms may even be efficient despite the associated regional economic impacts[38]. The corporate concentration of ownership might lead to a spatial concentration of the fishing fleet in large or specialized ports where quota owners have their main facilities and enjoy economies of scale (Copes and Charles 2004), while at the same time stripping the fleet and related employment from other ports where the effect is to produce social and economic problems.

Naturally, monopolistic or oligopolistic market structures resulting from implementing a tradable quota regime are not only a concern of efficiency considerations but also are socially and politically unwanted. If important objectives of fishery policy are the maintenance of owner operated fisheries and fishery-dependent communities, measures such as setting upper limits on accumulation of quota shares (as in New Zealand) and/or compensation of disadvantaged communities may be necessary[39] (National Research Council 1999). Indeed, such measures feature in the regimes developed in Norway, Iceland, Sweden and Denmark.

The reduction of capacity by implementing ITQ schemes would also naturally reduce employment in the fishery[40]. A decreasing number of vessels goes along not only with a diminishing demand for employment in the harvesting sector but also affects demand for maintenance, baiting and other fishery related activities (Copes and Charles 2004). Where there are sufficient alternative earning opportunities, this is not an issue, per se,

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[36] There are empirical studies about the effect of ITQs on the market structure. Adelaja et al. (1998) investigate the mid-Atlantic surf clam and quahog fisheries for signs of monopoly power after implementation of an ITQ regime. They find a strong reduction in fishing vessels but do not find evidence for monopoly power in the industry. Brandt (2005) showed for the mid-Atlantic clam fishery that small scale fishers were not disproportionately affected by the introduction of ITQs.

[37] See Olson (2011) for an overview.

[38] There is evidence for economies of scale for Norwegian cod and pelagic fisheries (Nostbakken 2006; Sandberg 2006).

[39] Many applied ITQ regimes use such measures to address equity concerns and prevent the development of excessive market power of large firms. (See for example Asche et al. 2008).

[40] There is evidence for a short term sharp reduction of employment from various fisheries (Geen and Nayar 1989; Casey et al. 1995; Wang 1995). See Olson (2011) for an overview over empirical evidence of employment reduction in fisheries as a result of the adoption of ITQ regimes.

but for fishery dependent communities, where employment alternatives are rare, the employment effect of ITQ schemes becomes an important issue of equity concerned policy.

While the total number of people working in the fishery might be reduced, the amount of hours worked per crew member who remain in the industry may rise. This is because "a decrease in the race for fish can mean vessel owners are able to substitute labour for extra time spent at sea" (Grafton 1996: 14). Grafton (1996) also points out that employment in the fish processing sector might actually increase since fishing activity and likewise landings may spread over a longer period. Note that these outcomes are, in each case, tied to the special situation in which the TAC has been dramatically reduced due to overfishing to a mere fraction of the available fleet capacity, with harvest closure as soon as the TAC is caught inducing a frenetic 'race to fish'.

(C) Newcomers to the fishery: The implication for newcomers is an important issue of intergenerational justice. "In practice, therefore, for any given area and for one or more particular species, the number of entitled fishers is both limited and known. In effect, the appropriation of fish from these areas and the species fished are especially reserved for designated fishers" (Morin 1999: 174). This is important for two reasons: At first access to fisheries has been tightly controlled through licenses, fishing permits or in community based management systems access was limited by social rules. Secondly, whereas it is difficult to enter an existing fishery whether one controlled by quota management (QMS) and/or other fisheries management practices, established fishers in Europe are usually allowed to stay in a fishery, getting annual quotas according to the principle of relative stability. When a fisher leaves, he or she is allowed to sell the quotas even though he or she did not have to pay for them. On the other hand, younger fishers have to buy quotas on a market if they want to enter the fishery. These aspects have to be analysed in the context of fairness.

In the next section we will briefly describe the German and Danish quota allocation regimes, and discuss how these applied regimes deal with the concerns identified above.

4.3 Case studies

Both, Germany and Denmark, as EU member countries, fall under the framework of the Common Fisheries Policy (CFP). The responsibility for decisions on the allocation of fishing rights, such as individual transferable quotas, lies with the member states. The EU uses a Maximum Sustainable Yield (MSY) management framework. The International Commission for the Exploitation of the Sea (ICES) is responsible for assessing the stocks' status and for giving scientific advice on management and the level of the TAC. ICES developed an assessment framework to translate MSY into a certain TAC for a given fish stock. With the scientific advice the EU Commission prepares a regulation for the Council of Ministers and the Council then adopts the actual TAC levels for the upcoming year. This is an international best practice but, as Jennifer Hubbard documents in chapter two of this volume, the history of this set of practices is by no means uncontroversial, unproblematic or without intended and unintended effects.

The allocation of the TAC is stated in Article 4 (1) of the Council Regulation (EEC) No 170/83: 1: "The volume of the catches available to the community referred to in Article 3 shall be distributed between the member states in a manner which assures each member state relative stability of fishing activities for each of the stocks considered". The principle of relative stability means that each member state's share of each Community quota should remain constant over time. This country shares are based on historic catches of the respective member state for a certain species, the Resolutions of The Hague which set out to consider nations whose economy is dependent on fisheries while implementing the CFP, and the compensation for jurisdictional losses when non-member states extended their exclusive economic zones (EEZs) into areas already fished by the fleets of EU member states.

Most important are the basic elements for the utilisation of the allocated quotas as regulated in Article 5 (1, 2) of the Council Regulation: "1. Member states may exchange all or part of the quotas in respect of a species or group of species allocated to them under Article 4 provided that prior notice is given to the Commission. 2. Member States shall determine, in accordance with the applicable community provisions, the detailed rules for the utilisation of the quotas allocated to them. […]". The responsibility for the quota utilisation lies with the respective member state. In general, the member states are allowed to swap quotas. However, quotas are not tradable within the EU between countries. The proposal of the European Commission for EU-wide tradable quotas was not adopted in the new basic regulation from January 1st 2014 (EU Regulation 1380/2013).

a. The German quota system[41]

The German system is an Individual Quota (IQ) system where the quotas are attached to the vessels and thus their respective owners. This system was implemented after the Common Fisheries Policy (CFP) had been introduced (beginning January 1st 1983). The vessel owners received quotas following records for landings of a certain reference period (end of 1970s). The basic elements of this system have also been introduced in the Mecklenburg-Western Pomerania area (former East Germany) after 1990. There has been no basic change in the quota allocation since its introduction but many vessels were scrapped or bought by other fishers who sought to be able to fish on additional quota.

Basic principles of the German fisheries management in marine waters are regulated in the *Seefischereigesetz* (Anonymus 1984). In §1 SeeFischG we read that the aim of fishery regulations are the protection of fish stocks and biodiversity as well as the implementation of the European structural and regional policy. §3 SeeFischG states that fishing licenses are bound to fishers, which can have one or more fishing vessels[42]. It also states that the allocation of fishing rights should be based on economic factors, such as efficiency and sufficient market supply, as well as social factors such as previous employment in the fishery. §3 SeeFishG also determines the responsibility of the *Federal Office for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung (BLE))* for the management of the national quota, set by the European Council. Quota may be allocated individually to fishers/vessels or collectively to so-called producer organizations (POs) that may distribute the quota among their members autonomously. Among POs quota may be exchanged internally but not traded.

Basic distribution principles of the national quota are not stated in the SeeFischG but can be identified from the BLE's yearly *Announcements about the German Fishery (Bekanntmachung über den Fischfang durch deutsche Fischereibetriebe, e.g. BLE 2012).* Generally, the German share of the EU-TAC is distributed more or less by the same principles as under the CFP, with relative stability based on historical catch shares. The basic management systems employed are individual quotas (IQs), group

[41] Information for this part is also taken from an interview with Marina Lapetina and Sybille Möller (Federal Office for Agriculture and Food, BLE, Department for Fisheries, Hamburg) which took place in January 2012. We would like to thank both experts for the kind support.

[42] Generally, this was a fishing vessel that was employed in the fishery by someone in 1986/1987. If such a vessel suffered a total loss, it may be replaced by a 'smaller' vessel. Also, a new vessel may be licensed if it replaces one or more licensed vessels.

quotas (GQs) and total quotas (TQs), and, for some fisheries, effort regulations. Individual full-time fishers usually receive IQs for their vessels, while POs receive a collective quota that they distribute among their members autonomously. These quota pools can be a very good instrument for an efficient allocation of fishing opportunities between the members as they can be distributed taking account of e.g. vessel characteristics. Part-time fishers usually receive a TQ or a GQ that is a total quota with individual maximum landing levels[43].

(A) The initial allocation of quota shares: When the member states of the EU decided to implement the CFP, Germany decided to implement the IQ system by allocating individual quota to vessel owners or POs. The government followed the same rule as within the EU and allocated the quota shares following a reference period at the end of the 1970s. That means that in Germany a 'grandfathering' system was chosen. Owners of fishing vessels employed to fish on a certain stock during the reference period received a quota share comparable to their part in the fishery at that time. The quota shares were given away for free but were bound to the vessel. Therefore, this group of owners of vessels received windfall gains. Note that no payments were introduced afterwards. However, the relationship between 'owners' and 'vessels' has not remained constant since this allocation – some owners have left and others joined the system, while some vessels have been traded among owners, and others have been scrapped or replaced.

(B) Effects on the fleet structure:

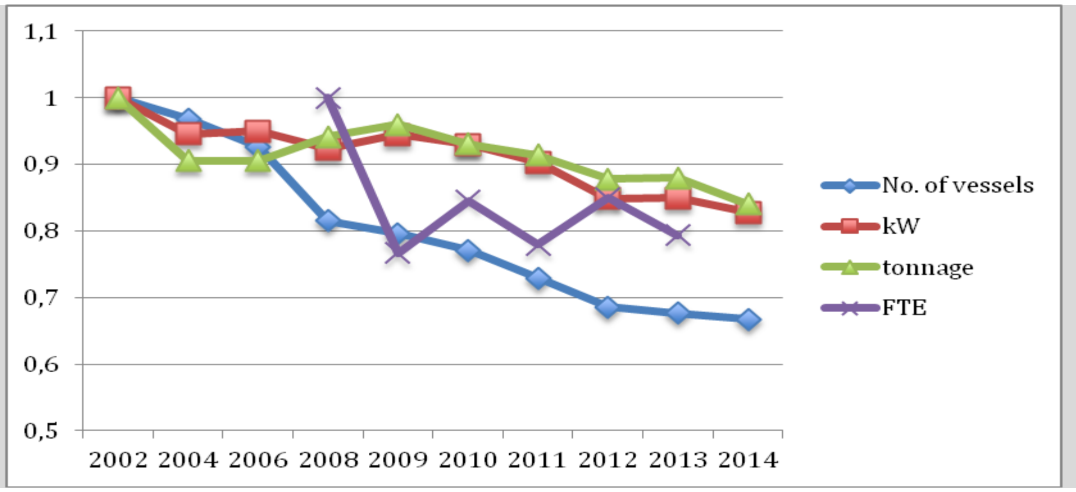

Fig. 4.1: Development of the German fishing fleet (STECF 2014)

[43] This is true for Baltic cod, North Sea cod, Saithe, plaice and Baltic herring. For Baltic sprat, individual full-time and part-time fishers receive each a total quota.

Fig. 1 depicts the development of the German fishing fleet in the period 2002-2014. As mentioned above, quotas are attached to the vessels and their respective owners. The binding of quotas to vessels, in theory, should stabilize employment in the fishery. In practice, many old vessels remain inactive, while other vessels fish their quota share. In fig. 1 we see that while employment in the fishery sank about 20% since 2002, the total number of vessels decreased about 30%, and the total machine capacity and tonnage of the German fleet also shows this decreasing trend.

The German quota system does not allow for quota trade. Increasing one's quota, beyond the exchange possibilities among POs, is solely possible by buying fishing vessels bound to a quota share. Quotas from scrapped vessels are reallocated to fishers remaining in the respective fisheries. Fishers who have bought the vessels get the quota of the vessel for themselves. These fishers are then able to use the quota with their former vessels albeit the bought vessel must stay active. It was not until 2011 that this regulation was changed and then for only one single year these inactive vessels (because the attached quota to these vessels was fished by another vessel of the owner) could be scrapped. Since then this has not been allowed again.

(C) Specialties for newcomers: Newcomers to the German fishery need to inherit or receive a vessel from an outgoing fisher, and in many cases they have to buy a vessel with the attached quota on it. As the vessels are often quite old it is clear that the attached quota basically determines the value of the vessel. In 2011 the government decided to allow scrapping of inactive vessels that fishers had bought before in order to use the quota on another vessel. This reduced costs for companies. Because of that the government requested that 5% of the quota should be put into a fund. The government then distributed these quotas to young fishers who were able to get quota without actually buying an old vessel. However, the amount of quota an individual fisher was able to receive under this reallocation was not very high.

b. The Danish system[44]

In 1976 Denmark introduced an access system to the fisheries by issuing fishing licenses to fishers. Before that the number of vessels or employed people had not changed much but due to technical improvements and state support to construct new

[44] This chapter is based in part on information from Mogens Schou (at that time in the Danish Ministry for Fisheries) given in an interview in January 2012. We thank Mogens for the possibility to talk with him.

vessels the overall landings increased substantially (Host 2015: 30). There were no other restrictions at least for the larger vessels and fishers were able to fish as much as possible everywhere outside the national waters. Inside national waters there were some restrictions but not many. Newcomers had to earn 60% of their income from fishing in a given year to be allowed to buy a vessel and receive a license. As a consequence of entering of new fishers with their modernized vessels the landings grew further. The government had to intervene in order to reduce overcapacities and introduced a more restricted system for licenses. But still, owners of licenses were able to fish as much as they wanted.

With the first basic regulation for a Common Fisheries Policy (CFP) in 1982, Denmark had to stay within its share of the Total Allowable Catch (TAC) of a given species. The government decided to limit the landings per vessel for species with a landings quota in a monthly or 14-day rhythm. As the quotas decreased it was harder and harder for some segments of the fleet to stay profitable and fishers protested against the restrictions. The government then issued scrapping programs (Host 2015: 35). Nevertheless, the overall Danish fleet was still too big and the system was very inflexible as quotas were not exchangeable or tradable. Overall, as the fleet was far away from gaining profits fishers were very much against the system.

This system lasted until 2003. As more and more stocks were regulated under the framework of the CFP, the number of species that were within the 14-day system increased substantially. In 2000 a discussion started about changing the existing system into an ITQ system. The main criticism to that was that rights would now be capitalized and that the small-scale sector would suffer.

Beginning with the herring fishery in the North Sea, which served as a test case, Denmark introduced ITQs in 2003. Based on a historical reference period of a vessel, fishing rights were given as private property to the owners with allowance to sell and buy (Host 2015 37). After its introduction, the number of vessels decreased and the economic situation of the fleet improved a lot. In November 2005 the political decision was finally made to introduce ITQs for all fisheries. The official starting date for all commercially valuable species was then January 1st 2007 (Andersen et al. 2010).

In summary, the Danish government first introduced a license system with some restrictions on the amount of overall catch in 14-Day periods. Subsequently, to limit capacity the overall number of licenses was limited to those working at the start of the

CFP and newcomers had to buy a vessel to get a permit. This meant an ‘entry fee’ for fishing access rights, and this was reflected in very high costs for vessels as in the German case. The later introduction of ITQs was specifically designed to reduce fleet capacity but was, as we will see, a quota attached to at least two separate groups (large and smaller vessels) and the tradability, therefore, a bit more restricted compared to for example in New Zealand.

(A) The initial allocation of quota shares: The Danish system is based on five criteria: The allocation of fishing rights, the definition of who is embedded in the system, and additional regulations aiming at avoiding undesirable effects.

Criteria 1: The initial allocation of rights was based on historical landings per vessel between 2003 and 2005. The average of reported landings over a time frame of three years set the share of the overall quota a vessel got under the new system (to obtain additional quota the fisher had to buy the vessel to allocate the quota to the original vessel (Host 2015: 61)). As small vessels had often unclear catch records (there was no obligation for a logbook with landings data at that time) they were combined and summarized in an own group to avoid the allocation of individual rights following from those unclear catch records. A part of the overall quota was then set-aside for this group following the previously set overall share. This quota is not allocated to individual vessels.

Criteria 2: The separation of two groups of fishing vessels was not only applied by taking catch records into account. All vessels with a gross income below €35,000 were able to opt for the group of ‘small scale vessels’ with, more or less, the old system and an overall quota for that group. Vessels with incomes over € 35,000 had to be in the group with vessel quotas. Quota holders (owners of boats which have more than € 35,000 income and are part of the tradable quota system) are able to lease or sell quotas to vessel owners of the same segment but not to owners of larger vessels of another segment. On the other side, the purchase of quotas from larger vessels is possible.

Criteria 3: Due to this regulation there are now three segments: large vessels with a length over 17m, vessels under 17m which belong to the coastal small scale fleet and even smaller vessels that are not part of the coastal small scale fleet. In order to avoid the concentration of fishing rights in the hands of a few owners, it is only allowed to own the rights for up to four vessels.

Criteria 4: Fishers are allowed to lease 25% of their rights without being considered inactive. It is also possible to create a pool within which more rights can be swapped. However, still 60% of the income must come from fishing and not from leasing quotas (Andersen 2012).
Criteria 5: Fishing rights can be called back within a time frame of 8 years. Additionally, the government keeps a part of the total quota in a fisheries fund.

(B) Effects on the fleet structure: The main effect was the reduction of vessels, after the ITQ system had been introduced. In 2010, 716 vessels were in the Danish fleet compared to 1,097 vessels in 2005. In the segment 24-40 m the register shows in 2010 44 vessels less than 2006 (Andersen 2012: 3).

Especially in the pelagic fleet vessels were scrapped and the quota was transferred to the remaining vessels/owners. Also the demersal fleet showed a reduction of 20-30%. This effect was also detectable in the coastal fleet. It has to be noted that this part of the fleet appears to lease most of the rights but still, the fisher needs to have a minimum of 60% gross income from fishing otherwise losing their status as active fishers.

It may be the case that more fishers created pools and thus it could be stated that municipalities have bought rights in order to keep the fleet. There is one example for community-based-management for fishing (with approximately 35 vessels[45]) and one where 20 fishing families founded a cooperative who owns the rights (Andersen & Højrup 2008). A community purchased a vessel and its associated quotas and thus created a common pool. Members of this pool were given the rights to fish. In this case the pool manager does not have that much influence on the quota allocation. In other pools the pool manager decides on the quota allocation and, therefore, these pools are normally not named community-based-management. There is a substantial change in the number of harbours which lost vessels between 2005 and 2012 (Host 2015: 74). However, for the coastal fleet overall, counting about 1,000 vessels, there have only been a few changes made concerning the allocation of fishing rights.

In general, the introduction of the Danish quota system appears to have improved the sector. All vessels seem to be competitive, either vessels over 17 m length or for smaller vessels (Andersen 2012). But it has to be mentioned that fishers running the latter vessel types will probably be more and more dependent on additional income in the future as costs increase (e.g. fuel costs, limits to fish in certain areas due to closed seasons or

[45] Personal interview Mogens Schou.

areas) while revenues may not be increasing. It must be additionally mentioned that many owners sold their quota and fishers who do not own a vessel or a share of a vessel are left without any compensation although their status as full-time fishers lead to part of the historical fishing rights of the vessel (Andersen & Højrup 2008: 33).

(C) Specialties for newcomers: For newcomers, in principle, there is no change in the rules (they still need a license and a vessel). There is some kind of apprenticeship for fishers but this is not a requirement for the participation in a fishery. Naturally young fishers must get quotas now. The government is supporting this approach by holding back a part of the quotas for a fishery fund. Young fishers get their quotas from this fund to be able to start fishing without the necessity to buy the quota in the first place.

The Danish specialty: the fisheries fund

The Danish Government keeps a part of the Danish total allowable quota in order to allocate it according to its own criteria. This fund is up to 20% of the total quota. There are different options for fishers to participate in this system. Fishers can support the collection of biological data on stock compositions or purchase fishing rights by auction. After the introduction of the system in 2007, fishers had to pay a lot for the vessels and fishing rights. Therefore, it is planned that only a very limited part of the rights will be auctioned to not further increase costs. The auctioning is done in order to at least be able to cover some of the management costs. One part of this fund is also used to issue rights to young fishers.

4.4 The German and Danish quota management systems: A comparative analysis

The analysis that follows compares the Danish and German quota management systems in terms of the aspects of fairness referred to above. While the Danish system has a ‘formal’ market system and therefore a more complete specification of market rules and exceptions than the German quota system, the comparative effects on fairness of both types of management can be studied by looking at fleet data from the German fisheries on a ‘what if’ basis. This can be done by comparing, when possible, the status quo of the German fleets and an estimation of the hypothetical effect that equivalent measures to those in the Danish system could have had if applied to the German fleets.

The equivalent Danish measures to which we will attempt to examine a hypothetical effect in the German fisheries are, with respect to intergenerational justice, the measures to facilitate entrance of newcomers and, regarding intra-generational justice, a series of measures such as limits to quota exchange among vessels of different sizes, upper bounds to the ownership of vessels by the same company and incentives to vessels participating in programs to improve the state of the fishery.

The data employed has been obtained mainly from the German data collection program under the Data Collection Framework (DCF) and the Annual Economic Report (STECF 2014) as well as additional data from the German Ministry among other institutions. Different data categories are used in the German and Danish fisheries and this restricts the potential for comparison.

Comparison of the initial allocation of quota shares

The initial allocation of quota shares in Germany was based on previous participation in the fishery, as in the Danish system. The granted exceptions in the German system were given for extraordinary happenings to the vessels. The Danish system also granted exceptions for temporary absence from the fishery during the reference period, this time of a personal character, such as illness of the owner. The Danish system has brought about more opportunities to grant access to quota besides buying it through programs for newcomers or participation in pilot studies.

Comparison of effects on the fleet structure

Concentration of ownership in German fleets has not been regulated, as in the Danish system, by a ‘maximum 4 vessels per owner’ rule. If this Danish regulation were implemented in Germany, less than 2% of ship owners, as shown in fig.2 (19 out of 1136, with most of them having 5 or 6 vessels and, with only a very few owning more, and in the extreme cases, owning up to a maximum of 24), would be affected.

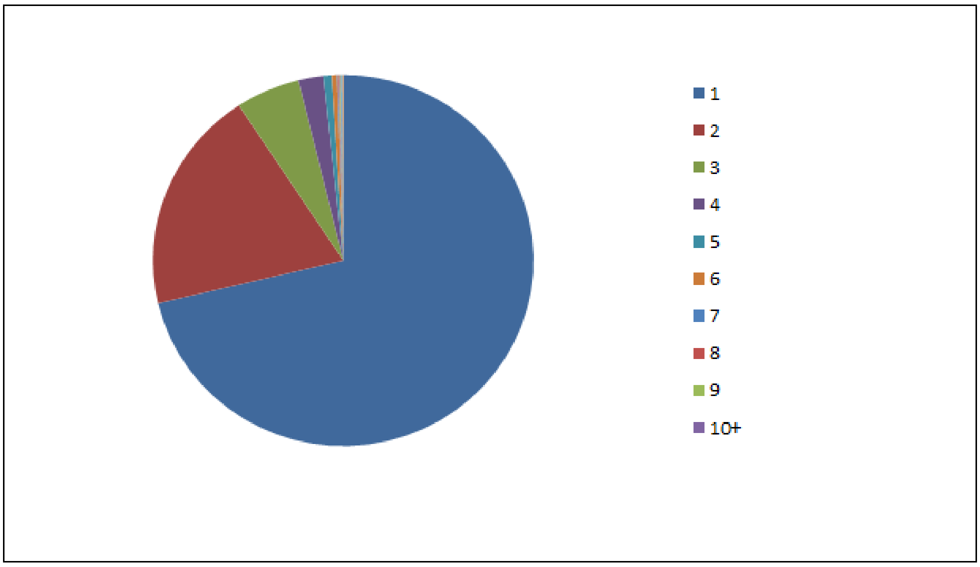

Fig. 4.2: Proportion of shipowners of the German fleets by number of vessels owned (DCF Database 2012)

Therefore we can say that the system in Germany has not lead to undesired concentration of property in the sense that it has not promoted excessive (or unjust) market power. This can be interpreted from both the fishing vessels market and the goods market. In the fishing vessels market, the ownership and use of the vessels and their corresponding allocated quotas are not unjustly concentrated in the sense that owners with more investing capability (indicated by ownership of more vessels) do not seem to be hindering other fishers from acquiring vessels. From the consumer's point of view there does not seem to be a clear monopolistic power withdrawing consumers' surplus. There seem to be plenty of firms competing in the market to guarantee that consumers have a choice of suppliers and can take advantage of it to obtain a good price.

In terms of standard equity measures, a Lorenz curve for the ownership concentration of the German fishing vessels can be observed in fig. 3 below, where, as conventionally represented, the diagonal would show perfectly equal distribution of ownership.

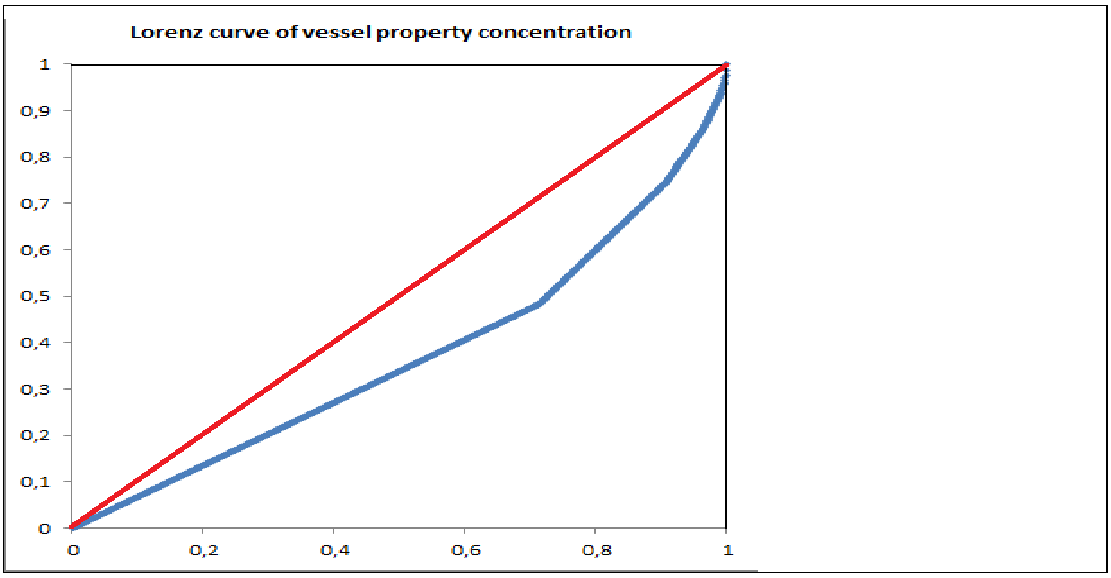

Fig. 4.3: Diagram of concentration in ownership of German fishing vessels (DCF Database 2012)

There was no access to Danish primary data so as to perform a similar analysis for the Danish fleet. The effect on the market structure of the system in Denmark can be approximated by the distribution of quota shares.

In the Danish fisheries on demersal species the evolution since the introduction of the system in 2007 shows a decrease in the amount of quota owned by the smaller vessels (<15m) and an increase in the ownership of quota by the larger vessels (see fig. 4 below).

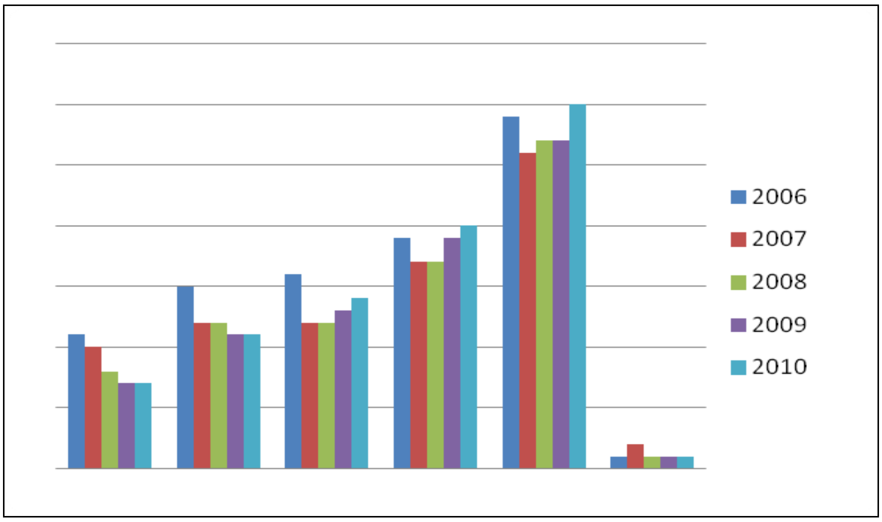

Fig. 4.4: Evolution of the distribution of quota rights for demersal species (Andersen 2012 (quota ownership at 31st December except for 2006, which corresponds to 1.1.2007))

The pelagic sector shows a much higher concentration of rights, with the largest vessels owning just under half of the rights in 2006. By 2010 they had increased their share by 43%, while some of the smaller vessel segments, and notably the 15-18m class, decreased their shares of rights in the same proportion between 2007 and 2008. Although there are restrictions on selling quota from the segment of smaller vessels to the larger one, owners/fishers found a way to get around this regulation a bit (Host 2015: 60ff.). Therefore, quota moved from smaller (<12 m) to larger vessels. The evolution of the concentration of rights can be seen in fig. 5 below.

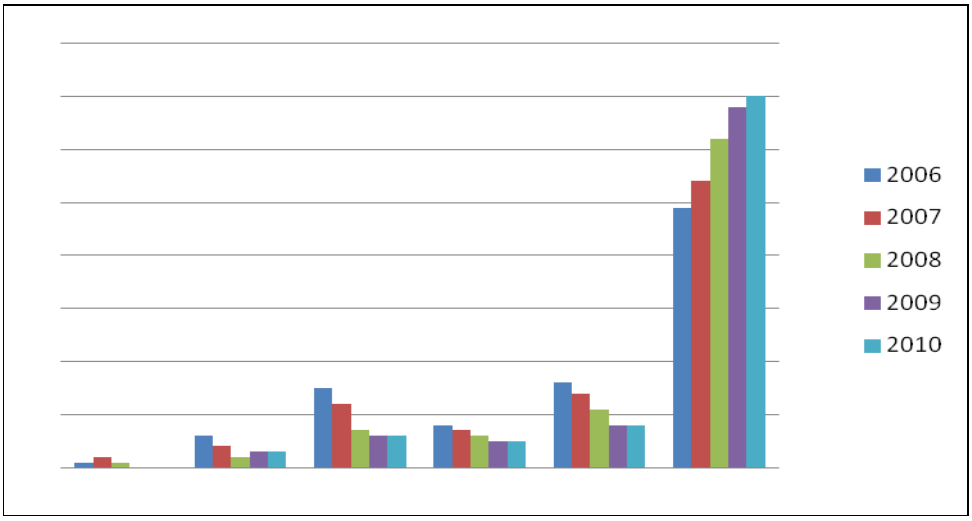

Fig. 4.5: Evolution of the distribution of quota rights for pelagic species (Andersen 2012 (quota ownership at 31st December except for 2006, which corresponds to 1.1.2007))

As mentioned above (see fig. 1) the labour intensity (employment compared with available quotas) of German vessels has decreased continuously as employment has decreased and quotas have remained fairly constant. Reasons for this include technical efficiency improvements among others. Nevertheless, the importance of the small-scale sector remains as can be seen in the great size of the segment. Further, the estimation of the employment in larger vessels has to be taken with caution as current estimation methods used under the Data Collection Framework do not accurately reflect the phenomenon of vessels switching from the North Sea to the Baltic Sea and that may lead to double counting.

This contrasts with the increased attractiveness of joining the group of small-scale fisheries in Denmark (joining the quota pool instead of getting an individual quota) thanks to the measures that make it easier for newcomers to enter the fishery and to measures designed to protect ownership of quota associated with small vessels. The measures that aim at protecting the small-scale fisheries include both limitations on trading and on the initial allocation of (and capacity to hold) the fishing rights. Trading of rights is limited by prohibiting the sale of quota from firms in the small-scale sector to those in the industrial fisheries sector and also by limiting the amount of individual quota that can be traded (even if it did not always function). Measures affecting the allocation of rights include limiting the capacity to own quota to people obtaining more than 60% of their income from fisheries (Andersen 2012) and thus benefitting the dedicated fishers over the speculators.

Other more recent measures such as the promotion of training in fisheries for unemployed people undertaken in Denmark have been reported to have had a certain degree of success in bringing in and creating incentives for employment in fisheries (see www.fishermannow.com), especially since currently employment in other sectors on proximate geographical areas is declining.

Comparison of specialties for newcomers

In 2011 a scheme to promote the entrance of newcomers in the fisheries was issued in Germany for 2012. The scheme amounted to removing the requirement to keep vessels in active conditions in order to be able to use their quotas and to grant a temporary (only in 2012) allowance to scrap inactive vessels, thus removing the maintenance burden. The aim of this scrapping scheme was mainly to derive a small percentage of the quota (around 5-10%) to newcomers. Therefore, vessels inactive in 2011 could be scrapped in 2012.

In order to study the effect of this measure in practice the evolution of data regarding the German fleet segments previous to the new comers´ scheme has been tabulated (see figures of active and inactive vessels in table 1 below). In contrast to the reported success of the Danish measures to promote the entrance of newcomers (see section on labour market) it is difficult to observe any such development in the German data. The main phenomenon that can be noticed is the decrease in the number of inactive demersal trawlers that under this scheme would correspond to a scrapping of those vessels. However, it could be expected from the aims of the policy measure that a percentage of this quota would end in some new active vessels, for which there is no evidence in 2012. Therefore, quota was already allocated to existing vessels and no new vessels built. There were no payments for scrapping vessels, as it was already a huge incentive to scrap the vessel, which had to be kept in good condition before without any activity. In addition to this data, the impact of the scheme has also been very low, because a substantial number of vessels were only scrapped in the demersal trawl segment (DTS) (12, but also 8 in 2011).

Active vessels	2008	2009	2010	2011	2012
Drift and/or fixed netters	23	23	19	16	14
Dredgers	7	5	9	12	12
Demersal trawlers and/or demersal seiners	108	106	107	99	87
Vessels using pots and/or traps	2	3	2	3	3
Vessels using passive gears <12m	960	937	902	883	875
Beam Trawlers	245	232	221	216	215
Pelagic Trawlers	12	6	9	10	9
Sum Active	1357	1312	1269	1239	1215
Inactive vessels	2008	2009	2010	2011	2012
DFN	2	2	5	6	1
DRB	5	9	5	2	2
DTS	4	8	13	22	4
PG	479	462	451	386	35
TBB	23	24	23	22	13
Total Inactive	513	505	497	438	370

Table. 4.1: Evolution of active and inactive vessels in the German fleet before and at the time of the newcomers´ scheme (end of 2011 scrapping allowed under certain conditions as a unique exception) (STECF 2014)

The Danish data shows an increase in the number of inactive vessels and no increase in active vessels occurs that might point towards newcomers being incorporated into the fleet. The only exception would be an increase in the active vessels in the smallest length category, belonging to the coastal vessels segment, in 2006, prior to the introduction of individual quotas for that segment in 2007 (Andersen 2012). The evolution of the net entry/exit of the different length categories can be seen in fig. 6.

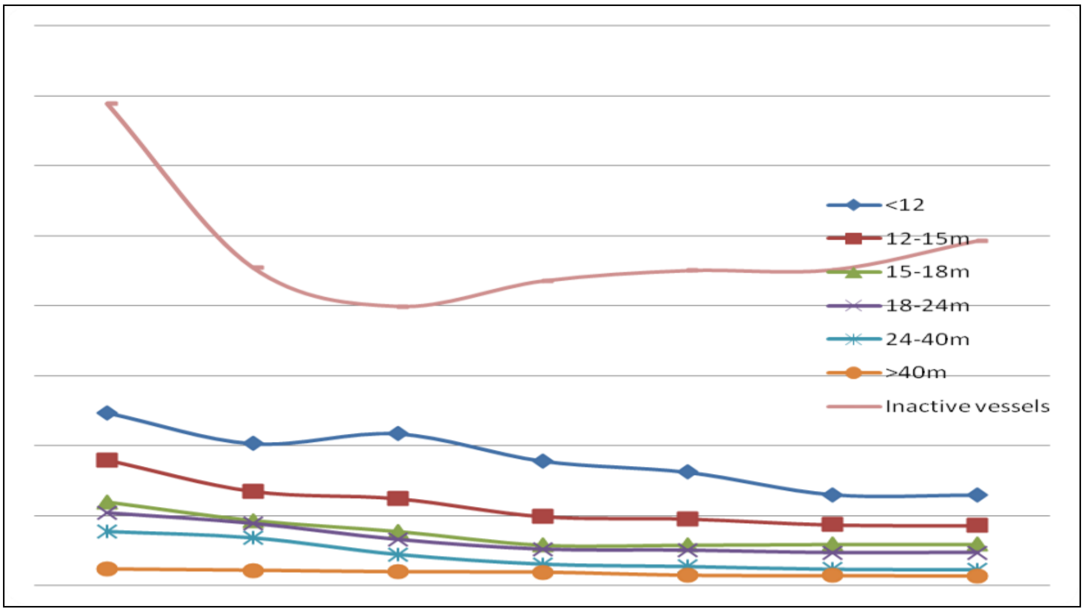

Fig. 4.6: Number of vessels by length category 2000-2006 (Andersen 2012)

4.5 Concluding remarks

There are many studies on the implementation and potential outcome of ITQ systems. ITQs are expected to be one of the most efficient regulatory systems concerning sustainable fisheries management. A few parameters that were revealed in this study may indicate that the German and Danish systems follow this approach. What made this study different from others was the investigation of the impact of ITQs on inter- and intra-generational fairness.

From the intra-generational point of view, in Denmark, the initial allocation of quota shares was designed to establish separate fleet segments each of which would be managed separately, with incentives given to fishers to self-regulate within limits. The

ITQ system has had positive effects on stabilizing the fisheries labour force and supporting the small scale fisheries sector. From the intergenerational point of view, the Danish system has included special mechanisms to recruit young fishers and to prevent the potential overallocation of quota shares.

Thus, based on the examination of the instruments of justice, it can be concluded that the Danish quota management system can be characterised as including some restrictions and tools, which we may call elements for a just and economic efficient regulatory system for sustainable fisheries. Fishers moved from open access and licenses with no catch limitations to a system with quota limitations and individual quotas (Andersen et al. 2010).

Nevertheless, there are no indications that the German system shows undesired quota concentration or unjustly concentrated quota pools. From the perspective of intra-generational justice, the German vessel quota management system also appears to show elements of a just allocation system. Concerning the criteria of intergenerational justice, identified through the instrument of specialties for newcomers into a fishery, this system does not seem to have the same level of just elements as the Danish one. Each newcomer has to buy a vessel and is not allowed to trade the quota share. Newcomers have to take into account that they may bear a high level of investment risk.

Finally, it can be stated that, under the analyzed criteria for fairness, the analysed ITQ, IQ or vessel quota systems are considered to be a management tool with a basically fair distribution process. However, this is probably only the case for these two examples and may not be stated in general.

For future research two other aspects have to be taken into consideration which might bring into question whether the distribution of ITQs as such is a fair process. In some of the ITQ systems quota holders are allowed to lease their quotas to other fishers for a given year (e.g. British Columbia Halibut fishery; Pinkerton and Edwards 2009). This would mean that fishers who may have received the initial quota for free could lease out the quota to other fishers. Analysis of existing systems shows that this may lead to high lease prices and that there is not an automatic buy out of the least efficient vessels (Pinkerton and Edwards 2009: 712).

Secondly, a general criticism of ITQ systems with the rationalization of quotas to the most efficient vessels is that small scale fishers sell their quota to the larger ones which have a better capital basis and can fish with lower costs. Therefore, in order for the small scale fishing sector to be preserved, countries need to take action to avoid their disappearance. Whether these criteria are applied to other ITQ systems needs to be investigated in further studies.

CHAPTER 5

ASSESSING THE SOCIAL AND ECONOMIC IMPACT OF SMALL SCALE FISHERIES MANAGEMENT MEASURES IN A MARINE PROTECTED AREA WITH LIMITED DATA

5.1 Introduction

The European Union requires that major legislative actions undergo an impact assessment, (IA, European Commission 2015) and this requirement is of special relevance for fisheries measures related to conservation of biodiversity under the Common Fisheries Policy (CFP, European Parliament and European Council 2013). However, the assessment of the effects of fisheries measures for conservation of biodiversity is different to measures aiming at the conservation of fish stocks (e.g. Agardy 2000, STECF 2012a). Many times biodiversity conservation is managed through protected areas (European Council 1992b) while management of fisheries is based on input (fishing effort), output (catches) or technical measures (Penas-Lado 2016). The matching of fisheries and biodiversity conservation measures also needs to consider that, while the effect of fishing on targeted stocks can normally be well identified, (with some exceptions, Eero et al. 2015, ICES 2016) fishing is often just one of the sectors exerting pressure on biodiversity (Agardy T. 2000). In addition to the need for an IA, these policies have in common that they are implemented under a complex governance scenario, including EU, federal states and unitary states legislation among others. Finally, as there is normally less information on small scale fisheries (SSF) as compared to large scale fisheries, the assessment of how biodiversity conservation measures affect SSF remains a challenge.

A helpful case study to illustrate the effect of fisheries measures for SSF with the aim of biodiversity conservation (from now on fisheries measures for short) is the gillnet fishery around the German island of Fehmarn. The area is an important habitat for the Western Baltic Sea harbour porpoise (*phocoena phocoena*, Viquerat et al. 2014, Siebert et al. 2006) as well as a feeding area for piscivorous and molluscivorous seabird species (Zydelis et al. 2009, Sonntag et al. 2012) and these species can be trapped in static gillnets. These species are included in the Natura 2000 Habitat (European Council 1992b) and Birds (European Council 1979) directives and, in the case of the harbour porpoise also in the EU fisheries regulation on deterrent devices (European Council 2004). As of governance, given the narrowness of the belt between Germany and Denmark in the area, fisheries measures are set at unitary state (see Sørensen Kindt-Larsen 2016 for Denmark,) and federal state levels (see Sell et al. 2011 for Germany). There is a further level of governance for both fisheries and conservation in the German coastal waters, the government of the coastal federal state, Schleswig Holstein. The Schleswig Holstein ministry of environment and fisheries proposed in 2013 two sets of fisheries measures. The first one was a closure of the fishery for eight months per year, mid-June to mid-September and mid-November to mid-April (MELUR 1996, MELUR 2013a).

The second, consisted of a voluntary agreement, reducing the length of the gillnets in July and August (to decrease the possibility of porpoises being trapped), and closing the fishery in some periods from mid-November to the end of February depending on the abundance of diving seabirds in the area (MELUR 2013b). The first set of measures was opposed by the stakeholders, which led to the second set of measures being proposed. Partners to the agreement on the second set of measures were the Ministry, fishers and a local scientific museum as scientific partner, the OIC (Baltic Info-center) in Eckernförde. The OIC would monitor the abundance of seabirds using a system based on information provided per mobile phone by fishers. Through this system the personnel of the OIC would collect information from the fishers and process them with the help of an ornithologist (OIC 2015). Depending on the abundance of birds, a website was created, for fishers to consult, which showed, through a traffic light system which areas they should preferably avoid (yellow) or which areas were closed (red). In addition to these fisheries measures, small scale fishers in the area also have to comply with other EU fisheries management regulations, such as the cod management plan (Strehlow 2010). No IA was foreseen in the agreement, either for the fisheries measures or for the overlap of these measures with other EU regulation, so an IA from a research project would contribute to fill in this gap.

The Fehmarn island case study illustrates a situation where the species to be protected are migratory and need protection at a wide spatial scale, but the fisheries measures are established at a different territorial governance level. In the EU there is a lack of data concerning the assessment of the impact of these measures on the SSF activity (Guyader et al. 2013), especially the social and economic aspects (STECF 2012b, Jentoft 2006). The deficiency of data and of public attention to the SSF sector also evolves more slowly than for large scale fisheries (Papaioannou et al. 2012, Jacquet Pauly 2008).

Despite some efforts (European Commission 2009b, 2015) the mandate to assess fisheries measures in the EU has not been developed as far as in other countries, such as the US (NOAA 2005) or Australia (where the "social license" approach is used for IA of measures on fisheries and other sectors related to natural resources (Voyer et al. 2015).The assessment of the social and economic effects of fisheries measures in the EU is also less developed than the biological one, but some partial approximations exist. From the methodological point of view of IA, the EU guidelines present some general guidance for EU policies (European Commission 2009b, 2015). Regarding fisheries, specifically methodological studies for economic and social IA on fisheries include for example FAO (De Young et al. 2008) and Wildlife Conservation Society (Adams et al. 2010).

These methodological documents are focused on a developing world context, were social and economic aspects are of a more urgent nature. Examples of IA performed on EU fisheries most often refer to impact of fisheries on the conservation of depleted fish stocks, sometimes overlapping other fishing restrictions inside protected areas (e.g. STECF 2010, 2012b). Also for EU fisheries some less specific studies are included in the IA of larger policies, as the IA of the CFP (European Commission 2011b). As for biodiversity conservation measures in the EU examples of assessments include the EU biodiversity action plan (European Commission 2006), and some more specific documents as the guidelines on fisheries measures in Natura 2000 protected areas (European Commission 2007a). However, assessments of biodiversity measures refer to the opposite effect to that considered in this article, that is: how fisheries affect biodiversity conservation. In this direction, empirical assessments of impacts in the academic literature in the EU sometimes focus on the lower impact of smaller scale fisheries on biodiversity (Walmsley et al. 2015), or even their lack of impact (Cadiou et al. 2009).

In the opposite direction, assessment of social and economic effects of fisheries measures on the fishing sector often focus on conservation measures targeting fish stocks, and in the context of protected areas they are based on a governance approach (Pérez de Oliveira 2013, Pascual-Fernandez et al. 2014). In the cases when the conservation measures do not target fish stocks, they refer to impact of active gear on the habitat (Mangi et al. 2011) or to a general spatial target of conservation of a percentage of an area (e.g. Richardson et al.(2006)).

Outside the EU there are also some studies of social and economic impacts of habitats change in Australia referring to coral (Mascia 2003) but not so many on biodiversity of animal species as porpoises and seabirds. To find references on the social and economic effects of fisheries measures on coastal fishing communities there is a need to look at conservation of turtles outside the EU, as for example in the US under the requirements of the Endangered Species Act (Santora 2003). The study by Santora analyses the social effects, of fisheries measures with a clear mandate from the Endangered Species act and specific research questions on social impact.

In addition to assessing social and economic effects (European Commission 2009c), other aspects of IA as participation and dealing with uncertainty need to be considered (European Commission 2009b, 2015). A participatory setting has already been explored in a fisheries context, first in the EU research project EFIMAS (Motos Wilson 2006). More recently in JAKFISH (Hauge et al. 2011) the measurement of uncertainty with a pedigree matrix was used in a fisheries context (Röckmann et al. 2012, Dankel et al. 2012), but not in a context of biodiversity conservation. Therefore a combined analysis paying attention to social and economic effects with participation and considering uncertainty fills a gap in the study of the effects of fisheries measures on SSF.

The aim of this article is a better identification of impacts of fisheries measures on SSF and the unveiling of hidden governance conflicts that prevent the fulfillment of the objectives of policy measures. The testing of the IA methodology for a data poor context was a key part of the aims of the European research project SOCIOEC (www.socioec.eu), which had as one of its objectives the improvement of the EU IA methodology. The objective of the Fehmarn case study exercise was therefore to assess the applicability of the EU IA methodology to fisheries measures in a data poor case study. The study aims at showing what can be assessed with the existing data, what the assessment tells us about the effects of fisheries measures and most importantly how the assessment could be improved. This is done by applying a combination of theoretical approaches that are not generally used together. By proposing an innovative analysis tailored to the context a more focused framing of the problem is achieved which could empower the stakeholders to better target their capacities to build a participatory, adaptive and robust management of fisheries and biodiversity.

The article starts with a description of the methods as applied chronologically to the analysis of the case study, that is, the EU standard IA methodology, the NUSAP method and the wicked game approach,. This is followed by the presentation of the results of the application of the methods in the same order. The article finishes with a discussion of the advantages and disadvantages of the application of the methods to the case study, and some conclusions on the usefulness of the approach for the tailoring of policy measure design and implementation.

5.2. Methods

5.2.1 Data

The fleet segments selected to test the IA approach were the gillnet vessels fishing around the island of Fehmarn, based at the ports of Heiligenhafen, at the mainland coast, and Burgstaaken, on the island itself. The individual vessels were selected from the European common fleet register among those under 12m registered in any of the two ports. The quantitative data was obtained from primary sources and then, as part of the IA methodology (European Commission 2009b, 2015), a focus group was used to check data assumptions and discuss the first results at an early stage. The focus group included three fishers with vessels of different sizes and a PO representative. In addition to this a total of sixteen interviews were performed: seven more in depth individual interviews with a fisher, a PO representative, a data scientist, two marine biologists, a manager and an NGO representative; an interview with two gear technology scientists and eight shorter individual interviews with other members of the same mentioned stakeholder groups. Finally, a SWOT workshop (European Commission 2015) took place towards the end of the analysis. In the workshop there was participation from the industry, conservation movements, scientists and managers (two of each). Qualitative information obtained from the workshop and also the focus group and interviews was used for the NUSAP and wicked problem approaches (see Methods sections 4.2.3 and 4.2.4 respectively).

The main primary quantitative data sources were the sales notes and logbooks, which included quantity and value of catches, except for the value of catches sold directly by the fishers which was implicitly assumed to be zero. As is common in SSF (Papaioannou et al. 2012), the two sources of economic data, the European Data collection Framework, DCF, under regulation EC 949 (2008) and the German national survey of small and coastal fisheries (BMEL 2012), did not have the right disaggregation level, as they mixed both Baltic and North Sea fleets. The survey included cost data but referred to different length classes (0-9m and 9-14m). Normally costs could be estimated using effort data from logbooks, as for example the number of days at sea (see JRC (2015)). However over 85% of vessels in the case study are under 10m and they were not legally obliged to hold logbooks[46] (European Council 2007b, 2009, European Parliament and European Council 2016), so in Germany they only provided reduced information once a month from the sale notes, including value, weight and ICES rectangle. Larger vessels up to 12m are not required to record VMS data (European Council 2009)and provide only ICES rectangle of catches, therefore the fishing area relevant for the study was approximated by the four ICES rectangles[47] (37G0, 37G1, 38G0 and 38G1) surrounding the island, which yielded at least 98% of the revenues of the fishers in the studied ports. According to interviews with local fishers, the maximum range of the small vessels is of about 11 nm, which is not only determined by their technical capacity but also by costs and safety regulation restrictions. This range matches the results by Hattam et al. (2014) for SSF in the UK.

5.2.2 Impact assessment EU policy standard methodology

The method first employed was the standard IA methodology for EU policies (European Commission 2009b, 2015, OECD 2010). The methodology includes the statement of objectives, the description of policy options (including management options and risk factors, see Table 5.1), the measurement of impacts and the comparison of the options in terms of costs and benefits.

Following the IA methodology, in the first phase a literature review and analysis of legal texts were performed to find out the objectives aimed by the policy (MELUR 1996, 2013a, 2013b). In the second phase the three different proposals of fisheries measures (status quo, eight months closure and effort reduction with shorter closure) together with two possible risk factors derived from interviews with PO representatives and the literature were analysed, forming nine different scenarios (see table 1). Risk factor 1 describes a situation where the producer organisation (PO) would set the conditions for all members to market the landings exclusively through the auction, as

[46] The most recent multiannual plan for the stocks of cod, herring and sprat in the Baltic Sea (EU 2016) requires logbooks for all vessels of 8 metres or more holding cod, so effort data will be available to improve future IA.

[47] In this latitude, the area of an ICES rectangle is of approximately 3x3 nm (Marine Scotland 2016 http://marine.gov.scot/information/ices-statistical-rectangles-and-areas Last retrieved 8.10.2016).

the PO customarily charge a fee for landings. This condition would make fishers wanting to remain in the PO sell the part of their catches that they were marketing directly at the lower price reached at the auction. A side effect of this option would be that the value of those catches would now appear in the statistics (see Table 5.3 in Results section). Risk factor 2 refers to the possibility of a decrease in the price of cod due to e.g. lower quality of catches (as has happened with Eastern Baltic cod (Eero et al. 2015, MSC 2015) and though the evolution of prices is more uncertain, it helps illustrate the use of the IA methodology.

Table 5.1: Scenarios for impact assessment of two alternative management options of the fisheries around Fehmarn

Management option / Risk factor	***Status quo***	***Alternative 1***	***Alternative 2***
Risk factor 0	No regional closed areas or changes in current quota regulation, effort regulations or EU and local technical regulations.	MPA measures 1: regional closed areas 8 months.	MPA measures 2: regional closed areas up to 3.5 months and effort
Risk factor 1	S*tatus quo* scenario with change in fish prices due to stop in direct marketing.	*MPA measures 1* scenario with change in fish prices due to stop in direct marketing	*MPA measures 2* scenario with change in fish prices due to stop in direct marketing
Risk factor 2	*Status quo* scenario with change in fish prices due to lower quality of cod restrictions.	*MPA measures 1* scenario with change in fish prices due to lower quality of cod	*MPA measures 2* scenario with change in fish prices due to lower quality of cod.

Given the data available, revenue from fishing was selected as the indicator of economic impact. A basic social indicator (impact on employment) could not be obtained, given the lack of effort data to calculate a full time equivalent indicator. The lack of effort and spatial data reduced the modelling possibilities, and thus the impact assessment exercise took the form of a comparison of "what if" scenarios (Miethe et al. 2014) based on the most recent available revenue data (2012). To measure the impact on revenue of each of the nine policy scenarios, the revenues in the status quo scenario were thus reduced according to the number of months closed in each management option, and a linear reduction of catches was used for the effort restrictions (reduction of net length), based on an interview with two researchers in gear technology. This linear assumption is specific to the bottom gillnet, where mostly bottom species are caught and therefore the length of the net is the determining factor for the catches. The impact of risk factor 1 (decrease in direct marketing) was calculated by applying auction prices to the catches that were sold directly. The impact of risk factor 2, implied that the catches of western cod (fished around Fehmarn) could suffer from similar price decreases of those of eastern Baltic cod, and thus the average price of eastern Baltic cod in the same year was used as a proxy for a lower price of western cod to calculate potential losses in revenue. Finally, the obtained impact indicators (revenues before and after each measure) were compared using double entry tables, and this information together with input from the stakeholder in the focus group were used to rate the management options.

5.2.3 The NUSAP pedigree matrix: making uncertainty explicit

Given the deficiencies of the data available for the IA methodology, the lack of knowledge was analysed using the NUSAP[48] method to better understand its origin and develop an alternative if possible. The NUSAP method was first introduced by Funtowicz and Ravetz (1993) and later adapted by van der Sluijs et al. (2005). The method is used to characterize assumptions on scientific models and data, involving an "extended peer community" (Funtowicz Ravetz 1993). Its main element is the pedigree matrix, a table format where the column headings display different categories of lack of knowledge (and magnitude of its influence in the outcome) while the row headings present brief qualitative descriptions of suggested levels. The cells of the table are thus to be filled with the level selected by the persons doing the assessment as best fitting the assumption (see e.g. Table 5.2).

A first step, following the example of Kloprogge et al. (2011), would be to list the assumptions that came across during the process of the impact assessment. In the context of limited resources allocated to the case study, the SWOT workshop, together with the previous input from interviews and the focus group (see section Methods 4.2.1) were used to collect the explicit and implicit assumptions. The focus group dealt mostly with economic assumptions, while the SWOT workshop focused on the voluntary

[48] NUSAP stands for Number, Unit, Spread, Assessment and Pedigree, the latter two corresponding to the construction and evaluation of the pedigree categories.

agreement in general, including governance aspects and allowing for some synthesis (European Commission 2015).

Adapting the second step according to Kloprogge et al. (2011) and using the output from a critical discussion with the stakeholders at the workshop, the collected assumptions were classified as described in van der Sluijs (2005). Due to the lack of resources to organize a specific workshop to assess the value-ladenness of the assumptions under an extended peer community most of the assumptions did not feed into a pedigree matrix (step 3 and 4 of Kloprogge et al.), but were analysed in a different way (see the wicked problem approach in Methods section 4.2.4). The assumptions for the price for directly marketed species, on the contrary, were specifically discussed in the focus group. Given the use of revenue as an indicator and the higher reliability of the weight data (all data on catch weights was collected, as opposed to prices, see Methods section 4.2.1) the assumptions on price had a fundamental influence on the indicator and were prioritized and tested afterwards using the pedigree matrix.

Building a pedigree matrix is a further step in the methodology by Kloprogge et al (2011). In the case study the matrix was adapted from (Funtowicz Ravetz 1993, van der Sluijs et al. 2005). The different categories underpinning the assumptions presented in the column headings of van der Sluijs et al (2005) were kept, but their negative character was reversed so that the assessment scale increases with the pedigree to improve the clarity. The slight renaming of the criteria does not imply that assumptions reaching the highest level show a guarantee of quality of the knowledge nor are intended to present the pedigree matrix as a warrant of that quality: the matrix can be best used to help identify caveats (Funtowicz Ravetz 1993). This said, the assessment values do not represent an ordinal value, but are set up in a way descriptive enough to help the assessment (Funtowicz Ravetz 1993, van der Sluijs et al. 2005).

Table 5.2: Pedigree table for the assumptions of price of the landings marketed directly by the fishers.

Criteria / Assesst.	Lack of influence of situational limitations	Plausibility	Focused choice space	Agreement among peers	Agreement among stakeholders	Independence from views and interest of the researcher	Robustness of results
2	Choice assumption hardly influenced	Assumption plausible	Hardly any alternative assumption available	Many would have made the same assumtpion	Many would have made the same assumtpion	Choice assumption hardly sensitive	Assumption has only local influence
1	Choice assumption moderately influenced	Assumption acceptable	Limited choice from alternative assumtpions	Several would have made the same assumption	Several would have made the same assumption	Choice assumption moderately sensitive	Assumption greatly determines the results of the parameter
0	Totally different assumption had there not been limitations	Assumtpion fictive or speculative	Ample choice from alternative assumptions	Few would have made the same assumption	Few would have made the same assumption	Choice assumption sensitive	Assumption greatly determines the results of the indicator

The assumptions of price the landings marketed directly by the fishers are needed because these prices are not collected by data officers under the DCF or any other scheme. The assumptions are based on data on landings marketed through the auction and consultation with stakeholders.

Following loosely the example of the Jakfish project (Hauge et al. 2011) the pedigree table was used to compare three different assumptions for the same parameter (price of directly marketed fish). Two of the assumptions correspond to the data poor case: the current implicit assumption of price zero and the alternative, the maximum price attained on the same year by each species in the auction. The third assumption corresponds to a data rich case: perfect price information for a large scale fleet segment. The assessments that populated the table were derived from–interviews with data collection officials for the data rich and current implicit assumptions, and discussed with fishers in a focus group for both the data poor assumptions.

Finally, after further analyzing the results of the pedigree matrix, a sensitivity analysis of the assumptions was performed when possible. The sensitivity analysis in the case study consisted in the proposed alternative value for the price of the directly marketed catches: the maximum price in the auction. Other sensitivity analysis performed contrasted the revenues obtained under the implicit assumption in the sale notes database (that only professional fishers were included) with the alternative of including all fishers (both professional and part time). Due to the lack of further data for the segment and resources to implement a modeling approach, it was not possible to further diversify the assumptions or choose other modelling paths. As a last step the results were further synthesized (see Results section 4.3.2).

5.2.4 The "Wicked problem" approach: embracing complexity in governance also in small scale fisheries

The preliminary description of the complexity of the case study as reflected in the list of assumptions was further analysed under the lens of the wicked problem approach. The wicked problem approach describes problems that are not conventional or "tame", in that, among other things, they do not have a clear start and end, and escape the usual cycle of setting objectives, choosing alternative paths to solution and evaluating them (Jentoft Chuenpagdee 2009). The approach was first presented by Rittel and Webber (1973) who proposed ten elements to characterize wicked problems. The approach has since then been used in planning (Muller 2016) and policy (Patterson 2016). More recently specialized applications have originated in environmental problems (Levin et al 2012) and fisheries governance (Jentoft Chuenpagdee 2009). Jentoft and Chuenpagdee (2009) went further to identify "concentric" wicked problems that could occur inside the wicked problem of fisheries governance itself, and used the framework of interactive governance analysis (Kooiman et al. 2005, Jentoft Chuenpagdee 2015) to clarify further this intricateness. Based on the examples from Jentoft and Chuenpagdee(2009) the wicked problem approach was tested for the Fehmarn case study by assessing the presence of the ten elements proposed by Rittel and Webber using literature research (including peer review, grey literature and local and specialized media) and the direct input from stakeholders at the interviews, focus group and workshop.

5.3 Results

5.3.1 Impact assessment

One of the initial steps of the IA methodology could not be performed because the objectives of the management measures were not specified beyond a statement of the will to protect the harbour porpoises and diving seabirds and maintain the fishing activity, and therefore no target reference points were available for the study.

The results of the next step in the IA methodology, the estimation of the impacts of the fisheries measures using the available quantitative data, are shown in Table 5.3 below. Considering that the revenues calculated using the data in the sale notes database refer to a fleet segment of 21 vessels, the baseline situation (without considering any risk scenario) presents a yearly revenue of over 450,000 €, which would imply a revenue per boat of just over 20,000 € (see Table 5.3). When including in the IA scenarios considering different risks as described in the methods section 4.2.2 the negative impact of each fisheries measure would range from 71% to 73% of the baseline revenue for the eight months closure and from 37% to 57% for the three and a half months closure with effort reduction during summer (see Table 5.3).

Table 5.3 Estimation of revenue (€) of the SSF fleets fishing around Fehmarm (2012) under different scenarios according to sale notes database (no direct marketing included)

Management option / Risk factor	*Baseline (€)*	Revenue with 8 months closure	Revenue with 3,5m closure + effort reduction	Loss of revenue with 8 months closure (%)	Loss of revenues with 3,5m closure + effort reduction (%)
No risk considered (Risk factor 0)	*452,381*	*118,250*	*227,875*	*-74%*	*-50%*
All catches compulsorily sold through auction (stop of direct marketing, Risk factor 1)	*516,398*	*149,762*	*256,910*	*-71%*	*-57%*
Lower cod price (Risk factor2)	*318,161*	*85,591*	*148,718*	*-73%*	*-37%*

When trying to establish a ranking of management options as required in the last step of the IA methodology, the lack of clear target reference points from the regulation made it impossible to quantify the degree of attainment of the objectives and therefore only a qualitative assessment was possible based on the preferences stated by the stakeholders at the focus group and workshop. The focus group revealed a clear preference of fishers for the shorter closure and the assessment of the longer closure as more acceptable only under financial support. The workshop showed the strong preference of the environmental NGO representatives for the longer closure, as presenting a larger reduction of effort which was seen as granting less risk for porpoises. NGO representatives also preferred the stronger reduction of effort because it would take place under a modification of the law, seen as giving more guarantee of success in implementation than the voluntary agreement reached for the shorter closure. The strong losses and large variability between the scenarios could be due to deficiencies in the data (as hinted by many stakeholders across the implementation of the IA), which brings the necessity for an uncertainty analysis.

5.3.2 NUSAP method

As a first step in making explicit the uncertainty with the data, all the uncertainties and related assumptions were systematically identified by examining the literature, the interviews, the focus group and the workshop during the process of the impact assessment. The complete list of assumptions that arose throughout the different phases of the impact assessment process can be seen in Table 5.4 below. The identification process included both explicit and implicit assumptions, including some derived assumptions, and it yielded a total of 32 assumptions. The assumptions did not only referto economic and effort data (items 1-15), as expected, but also to technical, ecological and governance aspects among others (items 16-32).

Table 5.4: List of uncertain claims identified during the IA for the NUSAP method

List of uncertain claims/ assumptions collected during the IA	Sources
1. The sale notes database is complete, with all professional fishers delivering sale notes.	Data Collection Framework – DCF (Commission Decision 949-2008).
2. The price of directly marketed fish is equal to zero.	Implicit in the sale note database.
3. The price of directly marketed fish is (approximately) equal to the highest price paid that year at the auction for the same species.	Interviews and focus groups.
4. The information on active/inactive vessels in the register for 2012 is complete and up to date.	Community fleet register, CFR.
5. There is economic information (costs etc.) on the fishery.	Implicit in DCF and report on economic information of the German SSF [48].
6. In the EU vessels under 10m do not hold logbooks.	[50]
7. Vessels shorter than ten metres only fish one day a month.	Implicit in the sale note database.
8. Fishing activity of vessels from Heiligenhafen and Burgstaaken takes place in ICES rectangles 37G0&1 and 38G0&1.	From logbook data.
9. Inside those rectangles, fishing activity concentrates in areas closest to the coast, coinciding with the closed areas.	Interviews and focus group.
10. Small vessels cannot normally reach a distance larger than approximately 20km.	Focus group, [53].
11. Once the closures are enforced, gillnet fishers will have to restrain from fishing during the closure period, as they will not be able to reach other areas due to technical/ cost reasons.	Focus group.
12. As the type of gillnets employed are bottom set gillnets, only the length of the net (and not its breadth) are important for the fishing effort. Reducing the length of the nets will reduce the effort (and with it the catches) in a linear way.	Interviews, focus group.
13. Fishers in the area incur losses in the year of analysis.	Information from sale notes and DCF economic data.
14. If fishers would incur losses as shown by the data, they would have quitted long ago.	Focus group.
15. Fishers do not want the closures/effort restrictions because they are mostly profit driven and what disturbs them from the measures is the economic loss.	Environmentalist website.
16. The achievement of the objectives can be evaluated on a yearly basis.	Text of the voluntary agreement, [19].
17. A voluntary agreement is not as effective as a regulation.	Environmentalist websites, workshop.

18.	The fact that in this case a voluntary agreement has been put in place means that the conservation issue is not as important to the authorities, otherwise they would have legislated it.	Derived from 17, workshop.
19.	Fishers avoid the feeding areas of ducks anyway, because they cannot set the nets on that type of seabed and because ducks entangled in the nets only cause them losses of time, effort and money.	Interviews, focus group, workshop.
20.	The amount of harbor porpoises caught in the gillnets is minimal.	[67], workshop.
21.	Gillnets are environmentally friendly gears, and as such regulation should give them a bonus compared to other, less environmentally friendly ones, as is done in other areas.	Fisher organization website, workshop.
22.	Fishers are happy to help with the research on harbor porpoises because they also want to protect them, but it is difficult for them to bring a dead one to port because it causes bad press.	[67], workshop.
23.	Pingers are an effective way of dissuading the harbor porpoises from entering a gillnet .	Implicit in [14].
24.	The Fehmarn Belt is a key area for the circulation of harbor porpoises, and therefore the conservation measures are very important.	[10]
25.	The stock of harbor porpoises in the Western Baltic needs special protection.	Derived from [5, 19].
26.	The diving seabirds in the area need special protection.	Implicit from [19, 11].
27.	Reducing the fishing activity of the German gillnet fleet around Fehmarn (and the surrounding coast of the state of Schleswig-Holstein) will increase the population of harbor porpoises and diving seabirds.	[68, 11]
28.	If the voluntary agreement is not accepted, harder measures will come into force under the form of a new regulation.	Fisher organization website.
29.	The undesired effects of deterrent devices e.g. habituation by porpoises or excess reduction of their accessible habitat are not well known.	Focus group, workshop.
30.	The social resilience of the fishing communities has not been explored.	Workshop, specialized press.
31.	More resources are needed to enforce the compliance with the voluntary agreement.	Voluntary agreement evaluation report [69].
32.	Data collection on harbour porpoises and diving seabirds would be more useful for the assessment of their populations if performed under the assistance of scientists already involved in that assessment and using their standard protocol.	Workshop, [70].

List of uncertainties which arose during the literature reviews, interviews, focus groups etc. The drafting of this list is a step in the NUSAP method, the uncertainties in the list are further classified in Table 5.5.

Some of the assumptions identified were contradictory, depending on the stakeholder delivering them. These contradictions were especially clear at the workshop where, according to the participants themselves, the relaxed atmosphere, lack of high stakes and neutral setting contributed to the freer disclosure of information. Some assumptions delivered at the stakeholder contacts, as the price of directly marketed fish, presented alternative assumptions, often depended on the role of the stakeholder (for example data collector, data user and fishers). Seeing the heterogeneity of the assumptions and the difficulty to prioritise them because of the lack of resources for a specific workshop, an intermediate classification was performed into quantifiable and non-quantifiable assumptions (see Table 5.5 below) following the method referred to in Methods section 4.2.3.

Table 5.5. Classification of uncertainties from Table 5.4 in *quantifiable* and *non quantifiable* (after van der Sluijs et al. 2005 "Key dimensions of uncertainty in the knowledge base of complex environmental problems").

Unquantifiable uncertainties	Quantifiable uncertainties
Those associated with: **Problem framing,** The problem is harbour porpoises and diving ducks drown when trapped in the nets. The problem is mostly seen as an incompatibility problem (fisheries vs conservation) instead of, for instance, a knowledge problem or a timing problem. **Model structures,** Status quo and two alternative management measures (with two additional risk factors) reflect what would have happened to the fishers. **Assumptions,** Closures and net reductions at the agreed times will improve wildlife protection, their impact can be measured without knowing the initial situation. The measures will have no impact on the fishers, who will be able to maintain their activity without further compensation. The economic impact of the measures can be calculated with acceptable quality with the current data. **System boundaries,** The measures will take effect independently of what happens in other areas (e.g. Denmark or Mecklenburg Western Pomerania EEC and beyond). The (economic) impact to the fishery is independent to other impacts. The duration of the voluntary agreement goes beyond the political mandate of the current minister. **Indeterminacies** Economic "before and after" exercise cannot be done yet because of lack of more recent (and accurate, see technical below) economic data. Biological "before and after" exercise cannot be done because of lack of data on initial catches of porpoises and ducks by the fleet segment.	

Value-ladenness A voluntary agreement is not as effective as a regulation. The fact that in this case a voluntary agreement has been put in place means that the conservation issue in not as important to the authorities (otherwise they would have legislated it). If the proposed voluntary agreement is not accepted by the fishers, stricter measures will come. Direct marketing is not important and information on it does not need to be collected	
Methodological(unreliability) The impact calculations are a simple "what if " exercise, not a forecast. **Epistemological (ignorance)** The behavior of harbour porpoises and diving ducks is not well known. The resilience of the fishing communities to regulatory shocks as the introduction of the closures is not known. *Societal (social robustness)* **Controversy** Fishers do not agree with environmentalists and government on the gravity of the wildlife problem. Government and environmentalists do not agree with fishers on the gravity of the fisheries problem. Environmentalists do not agree with government that the agreement is the best that can be done at the time**.** **Institutional dimensions** Around 20% of the gillnet fishers do not belong to any of the PO. Fishers have established support links with other fishers and hunters. There is legal pluralism including local federal state, federal government, Baltic Sea regional body (HELCOM) and European Union. There is a lack of coordination between administrations of Schleswig Holstein and the neighbouring federal state, German government and Danish government agencies, and scientific institutions (ITAW, OIC etc…), **Stakeholders´view** Fishers would be happy to cooperate in data collection and also find positive and would be ready to regulate themselves in a RBM framework. Scientist would prefer to do data collection themselves (for which they would need more resources) and when done by the fishers they thing fishers would need more assistance. Management body (OIC) thinks more resources are needed to implement and control the measures. (see also controversy section above)	**Technical(inexactness)** Collecting price data of direct sales of fish Improving the segmentation of data collection between professional and part-time fishers. Collecting effort data. Collecting spatial data of fishing activity. Exact cause of dead of harbour porpoises needs data according to cetaceans accidental catch protocol. Counting of diving ducks by fishers is inexact due to lack of training and a scientific sighting protocol.

The classification of the assumptions after the criteria mentioned in the Methods section 4.2.3 helped separate the assumptions into quantitative ones (those can be more easily analysed through the NUSAP method's pedigree matrix) and those that have a “broader” character. The “broader” assumptions (column on the left in Table 5.5) refer among others to problem framing issues, governance and values, which match the characteristics of a different kind of pedigree matrix that could not be implemented because of the lack of resources. The identified missing resources were availability of researchers with expertise in social sciences to create a discussion protocol and facilitate specifically designed discussions and background documents accessible to the stakeholders as a basis for the discussion. The minimum document would be a dossier explaining the situation with the harbour porpoises and diving seabirds for fishers and managers and a document explaining the social and economic effects of the measure on the fishery, for environmentalists and managers.

From the more concrete assumptions the feasibility of using a pedigree matrix method was evaluated considering minimum requirements for an extended peer community as explained in the methods 4.2.3 section. The price assumption was selected to test this method because of the availability of economic data collection expertise at the research institute, further contacts with other national data collection officers and assessments on the price assumptions from the focus group. The focus group was required for the IA process and therefore designed explicitly to check quantitative information. In order to be able to use the pedigree matrix for the other more concrete assumptions, on cost data, effort or spatial data it was found that additional data collection would be required. Additional data collection would imply more expertise, time and resources for travelling to obtain data through interviews or be granted access to existing accounting and insurance data.

Following the pedigree matrix method for the assumptions on the price of the directly marketed fish as described in the methods section 4.2.3 gave very different results depending on the assumptions (see Table 5.6 below). The influence of situational limitations, as the impossibility to obtain the exact data on price of direct sales, made a strong influence on the value of the revenue indicator in the current data poor assumption (see sensitivity analysis on next paragraph), while the proposed data poor assumption gave a result closer to the value communicated by the fishers. The plausibility of the current “zero price” assumption was very quickly discarded by the fishers and other experts, while the proposed assumption was judged by them closer to the real value. The choice space became more focused with the proposed assumption because this assumption allowed the discarding of unrealistic prices below the auction price level, while the current assumption broadens the choice space to include those unrealistic zero values. When looking at the agreement among peers, all scientists judged the proposed assumption to be closer to the truth than the current one. There was also agreement among fishers and other stakeholders that the proposed assumption was better than the current, zero price assumption. Regarding the independence from the views and interests of the researcher, the data collector proposing the current assumption does not have an incentive to deepen into the origin of the uncertainty about the price, and is thus conditioned by the fact that the assumption is enough for its purpose (as it meets the requirements of the statistical office).

On the other hand, the researcher considering the proposed assumption is not targeting the data per se, but building an indicator for a further purpose (IA) where reducing uncertainty is beneficial to the result. The NUSAP robustness of the results is in both cases fairly strong, as under both assumptions the measures have a strong impact on the revenue of the fishers (even stronger in the case of the proposed assumption). The third assumption, considering for example that the large scale fisheries do have a price zero for direct marketing, is generally accepted as having a low value-ladenness, as large scale vessels because of their volume of landings and business model market all their landings through the auction. There is therefore no (or insignificant) direct marketing for large scale vessels, their revenues are unaffected by it and consequently a price for directly marketed fish is not relevant, and can be assumed to be zero.

Table 5.6: Pedigree matrix for the assessment of the assumptions on prices for direct marketing of fish in contexts of data poor (current and suggested) and data rich situations based on van der Sluijs 2005 and Kloprogge et al. 2011.

Assumption	Lack of Influence of situational limitations	Plausibility	Focused choice space	Agreement among peers	Agreement among stakeholders	Independence from views and interest of the researcher	Robustness of results
Current data poor	0	0	0	0	0	0	1
Data poor proposed	1	1	1	2	2	2	1
Data rich in general	2	2	2	2	2	2	2

Once the pedigree matrix showed the lower value-ladenness of the proposed data poor assumption for price, it was decided to perform a sensitivity analysis for this parameter, following the sequence of steps described in Methods section 4.2.3. The test of the sensitivity of revenue to the alternative assumption on the price showed a strong variation in the results. The use of zero price for all landings marketed directly instead of the highest price attained by each species in the auction yielded a variation of 48% in the annual revenues of the fleet segment. An additional sensitivity analysis exploring the sensitivity of the revenue to alternative definitions of the population (either all fishers or only full-time) yielded a decrease in revenue of 42% when only full-time fishers were taken into account.

However, as said above, the discussion at the workshop highlighted that many assumptions other than the impact assessment parameters were relevant to the attainment of the objectives of the fisheries measures. Given that the results of the classification exercise from Table 5.5 pointed at possible framing issues, the existence of a wicked problem (which has as an important element a framing problem) was tested using the evidence from the workshop and the broader assumptions on the left column of Table 5.5.

5.3.3 “Wicked problem” approach

The results of critically applying the definition of wicked problem to the evidence from the case study delivered at the workshop are presented in Table 5.7 below. From the elements in the list in Table 5.7, evidence from the case study corresponding to numbers 3, 5, 8 and 10 point strongly at governance aspects influencing the effects of the measures. Element number 2 is at the crossroads between governance and science, as objectives are set up by the management but are also needed as reference points for the analysis of impact. One by one there is evidence from the case study to cover all ten items in the wicked problem definition.

Table 5.7: Elements of wicked problems applied to the Fehmarn case study

Elements of wicked problem definition	Corresponding issues in the case study
1. has no definitive formulation	Coexistence of conservation and fisheries is not well defined, to assess how the fisheries measures will affect fishing itself there is a need, among others, to know how fishing affects the porpoises and birds, how other fishers (and other sectors) affect those species and how other policy measures affect fishers. Many questions arise trying to solve the problem that cannot be foreseen at the start
2. has no stopping rule	No target reference points have been set up, only a generic limit reference point exists for the harbour porpoise population
3. is not true-or-false, but good or bad	Optimal conservation or, for fishers, "basis for their existence" depend on judgement
4. has no immediate, ultimate test of a solution	There is large uncertainty in the assessing of both conservation achievements and livelihoods maintenance.
5. is a "one-shot operation"; there is no opportunity to learn by trial and error, every attempt counts significantly.	Harbour porpoises are menaced, the economic damage to fishing community is certain, the loss of livelihoods as they are now, social and cultural capital from the local fisheries sector, and other risks (loss of trust, loss of opportunities for adequate monitoring) exist and could be irreversible.
6. does not have an enumerable (or an exhaustively describable) set of potential solutions, nor a well-described set of permissible operations that may be incorporated	Inside the range of both harbour porpoises and diving seabirds each geographic area sets different strategies in place and all stressors on porpoises and seabirds, and impacts on fishers are not exhaustively described, neither the applicable solutions
7. is essentially unique	Combination of geographic area, institutional jurisdictions, group of species to be protected, fish stocks and fishing communities is essentially unique
8. can be considered to be a symptom of another problem	Uncoordinated conservation and fisheries governance and a narrow view of larger ecosystem issues are some of the overarching problems
9. has discrepancies that can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution	Harbour porpoises behaviour is not yet clear, which could, for example, turn the resolution in any direction from more exhaustive/targeted use of pinger devices to complete closures; neither is gathering and feeding behavior of seabirds nor the adequateness of soft or hard law for the management of the situation
10. is in a context where social planner has no right to be wrong (i.e., planners are liable for the consequences of the actions they generate)	The social impact of the measures has repercussions on the credibility of the management authorities towards fishers, environmentalists and the general population

The existence of a wicked problem is also confirmed by the fact that there are further, "concentric" wicked problems comprised in the case study. Examples of these "concentric" wicked problems are the governance of the different sectors and conservation in the area (issues under element no. 8), the definition of the problem itself (under elements 1 and 9) and the enforcement of the governance (including control of the reduction of effort by fishers). Finally the attendants at the workshop themselves considered the complexity of the case study to be well beyond the uncertainty in the parameters of the impact assessment (as presented briefly for price in results section 4.3.2) and of fundamental relevance to the achievement of both the ecological and social-economic objectives. The case study therefore fulfils the criteria for being considered a wicked problem. This characterization shows that, before a methodology as the IA can be of use, a thorough rethinking of solution proposals and options for framing the problem of the case study need to be considered.

The identification of the case study as a wicked problem lead to a further examination of the literature analysed for the impact assessment and an additional literature research for alternative solution proposals and problem framings. Collected solution proposals include considering direct payment to fishers for closure; promoting catches with alternative gears by directly linking them to their benefits for conservation and promoting other values of local fishing that are compatible with conservation (social values as the capacity of fisheries to give local employment, preserve culture and provide gastronomic pleasure). Alternative problem framings found included considering the issue as a learning process, where fishers are seen as mutually supporting conservation as qualified data providers and disseminators partners (Bavinck Gupta 2014); framing as an extinction problem, where additional resources are drawn to preserve the harbour porpoises and diving ducks by using them to fund science and total fishery closures (Jefferson Curry 1994); reframing the problem to shift the position of environmental NGOs to campaign for promoting sustainable fishing techniques, instead of prohibiting unsustainable ones (Jacquet Pauly 2008); indirectly promoting other less sustainable sources of protein (Hilborn 2016) or framing the issue as a payment for ecosystem services scheme, where alternative fishing techniques and fishers´ stewardship activities would be rewarded.

5.4 Discussion

As stated in the introduction, the main objective of the analysis was to test the IA methodology and improve it, which nevertheless has its limits. As to the IA approach, the Fehmarn case study shows how the possibility of analysing the impact of SSF fisheries measures in Germany at a smaller spatial scale with the current data would only be possible for larger vessels, as in Miethe et al. (2014) or would require further resources, as available in (Strehlow 2007, Mangi et al. 2011). Comparing with the literature, the limitations of economic and spatial data found for the German SSF in Fehmarn correspond to those encountered in Papaioannou et al. (2012) .

One objective of the study was nevertheless to present a better identification of impacts and point at solutions for a data poor situation. Information on costs and revenue delivered at the focus group might be biased, because fishers might not want to disclose their true values in front of (at least) partial competitors. Costs might be overestimated in an attempt to stress current bad economic results and ask for subsidies or for the reduction of conservation-based limits on fishing effort.

On the other hand Chuenpagdee and Kungwan (2011) show that small scale fishers have other motivations than “playing the poor card”. In any case, this problem could have been avoided by using individual interviews and establishing trust through longer term repeated interaction with stakeholders (De Vos van Tatenhove 2011, Ostrom 2003). This would open the path for using existing insurance data, as revealed by a PO representative. The opposite possibility, that revenues might be overestimated to try to make the point that the fleet segment is profitable enough to guarantee that it is viable by itself (and therefore deserves being taken into account with relation to the regional economy), is discarded in different ways. These include the analysis of the price assumption in the results section 4.3.2, the results of interviews with fishers and PO representatives and direct observation at restaurants, which show that prices of direct sale from fishers are in fact much higher that the assumptions used in this study. In addition to this the revenue results are even very low compared to the lowest revenue needed for break-even declared to be around 60,000 € (by fishers in the focus group) and also lower than the threshold set up by the local authorities to consider a fishing vessel apt for regional support, which was set at 30,000 € (as communicated by a PO representative in an interview).

Another issue is that the impact of the fisheries measures according to the IA method could arguably be lower if the possibility that fishers move to alternative fishing grounds is considered, as in Mangi et al. (2011). However, this is limited by the fact that, except for a few of the larger vessels, most vessels have both cost and technical limitations to move further ashore (as revealed by fishers and scientists in interviews). The study showed that the coastal areas around Fehmarn not covered by the measures are not accessible to gillnet fishing either. This is because they correspond to an area under spatial management where either fishing is only allowed for traps, or the characteristics of the seabed prevent the anchoring of the gillnets.

In the first improvement proposed to the IA methodology, through the NUSAP approach, this article shows explicitly and comprehensively the assumptions that are made during a standard IA process, through an analysis similar to van der Sluijs et al. (2005). This is not the case for other similar fisheries management measures IA published to date (e.g. STECF 2012b). The NUSAP sensitivity analysis performed in the Results section 4.3.2 shows the limitations of a sale note based sampling programme that complies with the EU regulation (European Council 2007b), and that the part time fishing segment competes with full timers, which confirms the findings by Strehlow (2010). Given that 42% of the German SSF fleet is considered part time fishing (BLE 2016), the better understanding of the part time sector in the Fehmarn case study introduces new questions to the analysis of fisheries measures impact. These include the competition in prices with professional fishers (Strehlow 2010) and the potentially overseen economic incentive for additional fishing pressure (and bycatch of porpoises, (Rubsch Kock 2004). Competition may influence legitimacy (Jentoft 2000), participation and compliance. An alternative interpretation of the role of the part time fisheries as providing a source of knowledge transmission, training and motivation for future fishers (as in Brooks (2010)) remains to be explored.

Finally, the wicked problem approach proposed as a further improvement to the IA methodology benefitted from making assumptions explicit through the NUSAP approach. The approach by Santora (2003) also showed the importance of the use of an applied qualitative approach to improve management legitimacy and elicit ideas from the fishers that can contribute to protect biodiversity. Making assumptions explicit opens space for unveiling governance issues, as presented in Rittel Webber (1973) and, more recently for fisheries, in Jentoft Chuenpagdee (2009). The unveiling of hidden governance conflicts through the identification of assumptions as part of the NUSAP method was also an objective of the article. Hidden conflicts unveiled through the

NUSAP and wicked problem approaches include the disappointment of the environmental organizations with the use of voluntary agreements as giving less importance to conservation in a SSF setting (as highlighted by Jacquet and Pauly (2008)). Possible conflicts with neighboring spatial areas due to the lack of coordination that were unveiled during the study include the rest of the German EEZ (Sell et al. 2011)and Danish EEZ (Sørensen Kindt-Larsen 2016), where fisheries measures are also required. Another hidden governance conflict unveiled is the dichotomy between urgency of conservation action (as in Thompson Warburton (1985) and necessity of further knowledge development (as clarifying the NGO confusion between western and eastern Baltic stocks of harbour porpoises (Viquerat et al. 2014, ASCOBANS 2012)).

The approach used for this case study has thus shown how impacts and governance conflicts can be better identified by applying additional qualitative methodologies while making use of existing evidence from an IA. What is also new is that at the same time these qualitative methodologies bring about improvements to the use of the IA methodology. The analysis of the Fehmarn case study presents a better identification of impacts of fisheries measures on SSF through the IA approach in at least three different ways. First it complements the identification of economic data sources with stakeholder contacts, and shows deficiencies and possible ways forward in data collection, as the estimation of direct sales prices. Second it uses stakeholder contacts for the testing of assumptions and shows tentative values for the impact of fisheries measures and alternative solution paths. Third, the existence of an impact of the part time fishery on the full-time fishery through competition for customers is further confirmed, and opens this line of inquiry for the assessment of economic impact. Finally, the impact of the measures on the participation of the fisheries stakeholders is also better identified, as the results of the workshop showed the motivation of fishers to engage in a different manner in the management (De Vos et al. 2016).

5.5 Conclusions

IA, at least in the context of wicked problems (and most fisheries policies are) needs to be considered inside the broader frame of the relationship between policy and knowledge. Failure to do so could not only create further, undesired impacts, but, in a very pragmatic view, prevent the attainment of the objective of assessment and waste valuable resources in the exercise. This paper presents an alternative, which shows that methods different from IA can under some circumstances (as data poorness and wickedness) guide decision makers towards a better problem framing and concept of solution. Defining the problem of impact in an open and participatory way is therefore neither a waste of resources nor a hindrance to the achievement of policy objectives, but an improvement in both the governability and the much needed knowledge base of fisheries and conservation. This supports policy drafting in a more useful way than the IA alone.

The usefulness of moving from an initially (and exclusively) quantitative approach into a more qualitative approach and from a risk (and risk quantification) perspective into a problem definition approach that allows the identification of a wider set of effects resides in a sharper focus on solution proposals centered on adaptive policies. This is made possible by wider knowledge and better coordination through a tailored participation of all stakeholders (Pascual-Fernández 2005).

Looking ahead the prospects of the gillnet fishery in Fehmarn are not very promising considering the heavy reductions of quota of western Baltic cod for 2017, which makes assessment of impact yet more relevant. The German Government is already considering an SSF action plan that could benefit from the approach presented here and the data collecting authorities have been consulted on the possibility to gather data more than once a month. A SSF action plan and the collection of fisheries effort data more often constitute a portfolio of tools to better tailor policy measures design and implementation. Market mechanisms are not always effective to promote sustainability, and to this respect the suspension of the MSC certification of Eastern Baltic cod due to problems with the stock (MSC 2015) is a warning of smaller chances of certifying the western German catches. In this context of reduction of key catches the value added of demonstrating an attitude of cooperation and adaptability in the management of the small scale fisheries of Fehmarn is even more important for its subsistence. Improving the data collected on harbour porpoises together with scientists and giving visibility in the market to the efforts of fishers collecting these data are also useful ways to tailor policy implementation. In summary, the paper aims at showing how standard methods complemented by other methodologies can be used to integrate this human dimension in two so strongly biologically driven marine policies as Natura 2000 and the Common Fisheries Policy. The case study reinforces the view that there are no panaceas for complex problems of natural resources and conservation (Ostrom 2007), but that carefully tailored cooperative solutions can be developed over time and they do work in practice (Ostrom 2015).

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CHAPTER 6

GENERAL CONCLUSIONS

The thesis achieves its objective of studying the economic and institutional aspects of the relationship between the primary sector and sustainability by gradually zooming in through different geographic areas and institutional scales, from an EU-wide perspective to a national perspective and then to a regional case study.

The second chapter fulfils the objective of the thesis to identify ecological, economic and social objectives for the development of the fisheries sector by looking at the overarching level of the Common Fisheries Policy. Objectives are identified from the text of different versions of the CFP and other overarching policies, as the SDG defined by the UN, as well as from a group consultation of stakeholders at EU level. The article goes further in fulfilling the objectives of the thesis in that it analyses the interaction of fisheries with sustainability by presenting synergistic effects of management measures derived from the literature and from interviews with stakeholders in an EU country (Germany). When presented with the objectives derived at the EU level stakeholder group consultation and asked about management measures to apply them, the stakeholders from the German case study delivered synergies and bottlenecks between the objectives, as well as further objectives at a high level (such as ecosystem effects or supply chain aspects). This unexpected result suggests that the high level objectives are very interdependent. Furthermore, it shows that presenting stakeholders first with high level objectives and then asking them for management measures, instead of discussing concrete management measures from the beginning, may result in proposals for management measures that fulfil the three sustainability objectives in a more balanced way.

The chapter on the objectives of the CFP can be seen in the context of articles in the literature that take an overarching perspective on the objectives and restrictions of human activities affecting the ecosystem. Two of those articles are Rockström et al. (2009) and Ye and Gutierrez (2017), which take a planetary perspective as compared to the EU perspective in the chapter of the thesis. However a perspective beyond the EU is also considered in the thesis, for instance by talking about international agreements with third countries. Comparing to Rockström et al., the second chapter in the thesis focuses on objectives instead of restrictions or boundaries, that is, it states positive directions instead of directions to be avoided. Nevertheless the article in the thesis also considers restrictions conceptually when it addresses the lack of clarity of objectives. Comparing to Ye and Gutierrez they focus more on the ecological sustainability of fisheries, while the thesis focuses on all three sustainability dimensions, and especially on the economic and social ones. Thus Ye and Gutierrez focus on one SDG, number 14 on ending overfishing, while the article in the thesis considers a broader palette of objectives, including for instance reducing food waste (which would correspond to SDG target 12.3). The approach of the second chapter in the thesis is new in that it starts from the high level objectives and then moves on to apply them at a smaller scale instead of starting from particular experiences and trying to transpose them to a larger scale, as Ye and Gutierrez do for developed and developing countries or Ostrom does for experiences with the commons (Ostrom, 2015).

The main conclusion of the second chapter is that looking at the objectives of a primary sector policy as the CFP from a high level perspective allows the identification of synergistic effects that are not seen when focusing at the lower level of management measures. Thus the high level perspective could also help develop consensus on management actions that aim at complex social goals, those where more than one dimension of sustainability is present. The synergies in the attainment of objectives could give new impulse to fisheries policy, which is especially important when stocks and fishing communities are at risk and there is urgency for action. The attainment of broader ecological objectives as good ecosystem health and more social sustainability objectives as food security and community livelihoods would need more international and regional coordination, and would benefit from bottom up participatory processes, as gathering inputs from fishing communities.

The third chapter of the thesis zooms in from the perspective of the CFP to a type of management measure, the individual transferable quotas. The analysis underlines that there is no such thing as an ITQ regime per se, but a continuum of regimes depending on the regulations and instruments they include. Nevertheless the text highlights an important aspect of fairness which is equal consideration. Despite the multiplicity of ITQ regimes, the aspect of equal consideration allows a first approximation to a general issue of fairness in ITQ regimes: the initial distribution of rights. It is discussed that the rule most often used for the initial distribution, which is giving away the quota for free, does not respect equal consideration. This rule favours the fishers against the state (the owner of the resource) and furthermore favours the fishers active at the time of the distribution against those who come afterwards, who do have to pay to buy quota. Another general issue that can be discussed using the fairness framework is the uneven distribution of negotiation power to bid for quota, which is stronger for large companies as compared to smallholders. The chapter presents different instruments to level this power difference, from pools of quota for cooperatives of small scale fishers to limits on quota concentration for the larger quota holders. The study of both issues, the initial distribution of rights for free and the unequal negotiation power describes institutional bottlenecks to achieve social, economic and ecological sustainability in fisheries, one of the aims of the thesis. Additionally, the issues presented, among others, set the chapter in the context of the literature about intragenerational and intergenerational justice (or fairness) in disciplines as environmental ethics or ecological economics (see for example Glotzbach and Baumgärtner, 2012).

In a more general way, fairness in the third chapter of the thesis relates to the interaction between fisheries and sustainability through both economic and social sustainability. The economic sustainability of the fisheries management system is related to the economic distributions of the gains from the fishery. For example, economic sustainability would be fostered through a fair recovery of the rents of the resource by the state. These rents could then finance (at least partially) the management of the fishery and contribute to its continuity. Furthermore, the economic sustainability of fishing firms would be supported by a fair ITQ regime in that all firms could access quota under fair conditions to pursue their activity, irrespective of their negotiation power. Regarding social sustainability, a fair ITQ regime would enable the continuity in the activity of different social groups, as the small scale fishers through succession in the family (e.g. by rules that allow for fair conditions for inheritance of quota) or newcomers to the fishery (e.g. by fair rules to access quota or through specific institutions). The article thus fulfils the objective of the thesis of identifying interactions between the fishing sector and sustainability, especially social and economic sustainability in relation to fairness.

The third chapter makes clear that aiming at fairness (and its implications for social and economic sustainability) implies specific regulations in ITQ regimes to avoid some problems as concentration of rights or difficulty of access for newcomers. The chapter also shows how identifying different perspectives of fairness, as distributive fairness or fairness in exchange, helps structure the view on the fairness of ITQ systems. Finally, the utility of the chapter resides in showing how the fairness framework can be used to categorise shortfalls of applied ITQ systems, and then evaluate them and target them with the appropriate instruments of justice, one of the elements of the framework. Further applications of the framework could include other fisheries management measures as multiannual management plans and area closures, or a detailed analysis of the ITQ regulations of different countries.

The fourth chapter fulfils the objective of showing a concrete example of national institutional arrangements in relation to the framework in chapter three, and refers to the fairness to future generations as mentioned in the definition of sustainability. The two case studies of Germany´s and Denmark´s fisheries management systems have also shown how intergenerational fairness objectives can be introduced in practice in quota allocation rules for newcomers. The case studies in the fourth chapter also show instruments of intragenerational fairness, in that concrete regulations are targeted at the sustainability of several social groups, as small scale fishers.

The fifth chapter of the thesis fulfils the objective of describing the interactions of the fisheries sector and sustainability in several ways. First, the most straightforward way, and the one that is the starting point of the need for regulation, is a negative interaction: fishing nets trap cetaceans and diving seabirds, thus reducing the ecological sustainability of their populations. But there are other positive interactions that are not so well known and are described in the chapter. The role of the gillnet fishery to support the economic sustainability in the coastal area is highlighted in the study through the attempt to make explicit the contribution of catches marketed through the auction and also those through direct sales. Finally, there is a positive social interaction in that the fishers, through the voluntary agreement, provide information to scientists on the populations of porpoises and seabirds, contributing to their conservation. At the same, the increased social interaction among the different stakeholders involved in the agreement contributes to the creation of social capital (Brooks, 2010), which could improve the social sustainability of the fishing community.

More in detail, the fifth chapter also contributes to the thesis objectives of identifying ecological restrictions, institutional bottlenecks and economic and social impacts on the activity of the fisheries sector. The chapter describes ecological restrictions (competition for space between fishers, cetaceans and diving seabirds) that affect the fishers through biodiversity conservation measures. It is important to identify the type of measures described because they take place in a region (the federal state of Schleswig-Holstein, in Germany) and their existence is not perceived when looking only at EU-wide fisheries policy level. Ecological restrictions are present in the EU fisheries policy under what is called the ecosystem approach (Prellezo, Curtin 2015), but the approach is still at an early stage: it contains the restriction that fishing one species of fish exerts on other species of fish, as for example in the multispecies management plan for cod, herring and sprat in the Baltic Sea (EC 2016). The Fehmarn case study also identifies institutional bottlenecks as the lack of coordination between different levels of policy. The case study includes a bottleneck in coordination among geographical levels of policy, on how the region of one EU member state may have one type of measures (the voluntary agreement in Schleswig Holstein) while the member state at national level may have other measures (acoustic deterrent devices in Germany, see Sell et al. 2011) and other neighbouring member states still other measures (experimental video monitoring in Denmark, Sorensen Kindt-Larsen 2016). In addition to the geographical levels mentioned in the case study, the EU level has a cetaceans protection regulation regarding fisheries (EC 2004). Furthermore, the case study shows the institutional bottleneck of coordinating two sectoral levels of EU policy, as conservation policy (Natura 2000) and fisheries policy (CFP). Finally, the inclusion of a data poor case study in the thesis allows to fulfil the objective of better identifying social and economic impacts. The case study presents an attempt to estimate the impact of two kinds of management measures, one top down measure (an eight months closure of the fishery) and one with a certain degree of participation by the stakeholders (shorter closures and partial net length reductions).

In the fifth chapter, the preliminary calculations done in the case study highlight the limitations of the data currently in standard use for impact assessment (that is, the data from the CFP data collection programme). More important, and what is more innovative and relevant to the data poor context of small scale fisheries, is a description of the lack of knowledge in the assessment of economic impact by using the NUSAP and wicked game approaches. These methodologies allow the shift from an approach of quantification of risk (the impact assessment methodology) to an uncertainty identification, learning approach (the NUSAP methodology) and then to a solutions proposal approach (the wicked game methodology).

At the EU level, the thesis shows how, despite the changes in participation described in the introduction, sustainability is not necessarily at odds with the primary sector if a broad spectrum of stakeholders are consulted. A condition for the coexistence of sustainability and the primary sector would be that those stakeholders are left the possibility to give their opinion openly starting from scratch with the highest level of policy objectives. The institutional setting is thus a key factor to allow participatory processes to yield management measures that make the objectives of the fisheries sector and sustainability compatible.

The thesis also shows how economic aspects are key to this compatibility, in two directions. First, the economic consequences of measures to foster ecological sustainability need to be taken into account. Ecological sustainability can have an economic cost for fishers in terms of lost catches and a social cost when affecting fishing communities already touched by restrictions to access fish stocks. That fishers bear the costs of a concrete ecological sustainability measures (for biodiversity conservation) is shown in the fifth chapter. In a second direction, economic causes could also contribute to make fisheries and sustainability compatible. This would be possible if there were economic incentives to the fishers to be sustainable. Or, as formulated in the consultations with stakeholders in the second chapter by an environmental NGO representative, 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"*. Surprisingly, that fishers can ripe the benefits of sustainability was not suggested by a fisher, but by a conservationist organization. That incentives are set up in the form of more quota for fishers that operate sustainably was already proposed by fisher organizations (Greenpeace 2012) and is included in the most recent CFP in its article 17, which mentions that *"[...]Member States shall endeavour to provide incentives to fishing vessels deploying selective fishing gear or using fishing techniques with reduced environmental impact [...]"*. The third and fourth chapters of the thesis show the example of a framework that could be used to analyse such a sustainable quota allocation mechanism, considering sustainability in relation to intergenerational fairness.

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