Economic Analyses of User Interactions in the Coastal Zone

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Preface

This thesis is for the degree Philosophiae Doctor in Social Science, at the Norwegian College of Fishery Science, University of Tromsø. Although I have written everything here, I could not have done it without the help and support of many people and institutions.

The most important institutions:
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I thank you all, and look forward to work and play more with you!

Summing up, I guess this thesis marks the high point (or largest depth?) of my interest in natural resource management and environmental issues. I have really enjoyed making it. I hope to learn more, but mostly I hope to contribute to better protection and management of natural resources, through my work at Norut, and through cooperation with people at the University of Tromsø and elsewhere.

Eirik Mikkelsen, Tromsø, 7. November 2007

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Economic Analyses of User Interactions in the Coastal Zone

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Summary

Marine and coastal areas contain many resource types, with many uses and user groups. Conflicts are common, both over access to the same resource, and to avoid negative effects of others' use. Such conflicts are expected to increase in extent and severity. Being able to analyze and understand the nature and consequences of the interactions between different user groups, how it affects their behaviour in planning and other processes where resource allocation and rules of use are decided, as well as finding management schemes and instruments that can replace or complement the existing ones, to better deal with these conflicts, are important. This thesis contains attempts to do all of this, for specific situations. It includes a bioeconomic model to analyse three types of possible externalities of aquaculture on fisheries. We consider how asymmetric externalities of resource use can affect the behaviour of users in contests or bargaining over resource access, and how a regulator's set-up of these can affect outcomes. Schemes for tradable rights to coastal resources between user-groups, particularly their design and how to account for external effects on third-parties, are considered. This includes how power relations can be affected by the introduction of such schemes, and the further effect on institutional efficiency, influenced by the possibilities for power abuse and level of resources wasted on rent-seeking and lobbying.

Introduction

Marine and coastal areas contain a vast array of resource types, with many different uses, and many user groups (Cicin-Sain et al. 1998). Conflicts over resource access are common, partly because several want access to the same resource, and partly to avoid external effects of others' use. Conflicts will increase in the future, as human populations grow, and new stakeholders continue to enter (Hassan et al. 2005).

There are several major types of interactions between actors investigated in economics. These are i.a. those through markets (for goods, services and rights), external effects, how regulators try to affect actors' economic activities, and how actors try to influence the decisions of authorities or other types of decision makers. When authorities regulate economic activities it is by command-and-control measures, taxes or subsidies of some sort, or by creating markets for use rights.[1] Regulations are often to correct for market failure, of which the presence of externalities is a common cause. Trying to influence decision makers is done by participation in formal policy formation processes (public hearings, committee membership, etc), but also lobbying and bribing. Using resources to influence such decisions for personal gain is in economics called rent-seeking (Tullock 1993). Social scientists are (naturally) also concerned with how actors can influence decisions and behaviour, and the *power* of individuals and organisations is a crucial concept. Russell (1938) writes that it is as fundamental in the social sciences as energy is in physics. Mainstream (neo-classical) economists have only been

[1] In a broader sense of regulation authorities try to govern using also information and education to affect behaviour.

concerned with power to a limited degree (Bartlett 1989; Schutz 2005), usually restricted to market power (e.g. Tirole 1988) and bargaining power (e.g. Muthoo 1999).

The economics approaches above focus largely on conflict-ridden interactions, but interactions can also enable positive developments and finding solutions. Power encompasses both the conflictive and enabling dimensions. Power relations are affected by legal structures, management systems' design, as well as development in technology, culture and markets and more (French and Raven 1959). Economists' analysis and advice on management system design rarely include the "other" dimensions of power, even though it is very important for the implementation and functioning of management systems (Jentoft 2007).

The overarching theme of the thesis is the interaction between user-groups in the coastal zone, considering both marine and coastal resources. I look at three major topics:

1. How to represent and analyse externalities relevant for coastal zone management, particularly considering biological and ecological aspects?
2. How does such interactions affect users' behaviour in processes where allocation of resources or use rights is determined;
3. The possible use of tradable use rights for coastal resources between user groups, particularly when interactions are present; how could and should tradable rights schemes be designed, and how might they affect power relations and thus institutional efficiency?

Together these give a broad perspective on user interactions in the coastal zone. Naturally, I only look at some specific questions or examples of questions related to (1-3) in this thesis. The three papers (I-III) deal each with at least one of the three issues above; Paper (I) deals

with all three of them, but focuses on (1); Paper (II) deals with (2); Paper (III) deals with (2) and (3), but focuses on (3).

Topic 1 - Economic analysis of externalities between coastal user groups

Like much use of the coastal zone, aquaculture and fisheries rely on biological and ecological processes occurring there, either for extraction of "biological surplus" or for the services they provide. Externalities from economic activities (production or consumption), may affect the capacity or rate of reproduction of natural stocks and systems. Basic models of externalities, found in environmental economics textbooks like for example Baumol and Oates (1988), can be applied to a multitude of real world cases, but only to a limited extent explicitly consider such effects. Textbooks on the economics of natural resources do more often consider externalities that "work through" the biology/ecology (e.g. Neher (1990), Clark (1992)), albeit in a rather abstract way. Examples include ecosystem abatement of air pollution (Neher; Ch. 12), nature's reproduction of amenity values (Neher; Ch. 13), external benefits of forestry (ecosystem services and recreational values) (Clark; p.275), and the so-called stock externality in fisheries, affecting harvesting costs when harvest rates depend on stock size (Clark; p.27). The volume of articles in economics journals that consider this type of interactions is, however, fairly large and rapidly growing.[2] A growing general recognition of

[2] Some consider interactions based on interactions between biological species (May et al. 1979; Flaaten 1988; Flaaten 1991), some effects on habitats from economic activities (Barbier 2003; Armstrong 2007), or the value of ecosystem services in relation to destructive industries (Barbier 2007). Partly these consider competing interests, and partly they consider feedback

the impact of human activity on ecosystems and stocks of individual species, and also the importance they in turn have for human welfare[3], will lead to increased growth of economics papers on externalities based on biological/ecological linkages.

Paper I models how external effects from aquaculture on fisheries can affect fishing effort, fisheries yield and fish stock in equilibrium. The externalities considered are that aquaculture may affect wild fish habitat, the growth rate of the wild fish stock, or the efficiency with which fishing effort is turned into harvest. It also considers three basic management regimes, and whether they can achieve the optimal balance between the two industries, given such externalities. The regimes are (1) that aquaculture has a right to use the coast, (2) that a social planner decides how much farming and how much fishing shall take place, and (3) that fishermen have a right of use of the marine areas, but may allow marine farming, possibly against compensation.

I consider aquaculture and fisheries since they are major industries in the coastal zone of many countries, including Norway, and conflicts between them are not uncommon. Interactions between them have been studied previously, but not much analysis exists on the effects that I study, considering both industries simultaneously (see Paper (I) for references).

The Verhulst-Schaefer model is the classic fisheries economics model of Scott and Gordon (Gordon 1954; Scott 1955). It is one of the most influential fisheries economics models, as

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of an industry's activities on themselves, through the effect on the biological and ecological system.

[3] See for example the "Millennium Ecosystem Assessment" (www.millenniumassessment.org).

Wilen (2000) notes in his review of fisheries economics. He thinks the later extensions, in which the model has been technically refined, has not nearly shaped policies to the same degree as the original simple model. With the rationale that it is the most fundamental relations that fundamentally shape policies, it would make sense to analyse the possible interactions between aquaculture and fisheries using the same simple model as a basis.

The major conclusion in paper (I) is that the different aquaculture externalities can give totally opposite effects on fisheries yield, effort and equilibrium stock levels, even if we only consider "negative" externalities.[4] If aquaculture leads to a reduction in the habitat's carrying capacity, or the fish stock's growth, it gives opposite effects than when it reduces fishing efficiency (given that the characteristics of the fishery is so that open access would lead to an equilibrium stock level below the maximum sustainable yield (MSY) level).

The findings from paper (I) underline the importance of knowing what kind of externalities there are between user groups. In reality, there could well be a mix of externalities, and then knowing the relative strength of them matters. The policy advice is not to ban activities with negative externalities, but rather to invest in knowledge about the nature and likely magnitude of the externalities in the actual context.

If one of the industries has a primary right to the coastal resources this will not give the optimal allocation of resource access between the industries, unless some sort of side payment can be paid for access. The advantage of such a tradable rights regime, compared to a "social planner" regime, is that firms are probably better informed on externalities and cost- and benefit-functions.

[4] I.e. aquaculture reduces carrying capacity, growth rate or fishing efficiency.

The model in paper (I) is simple, but simple models may catch the essence of real world situations, making them applicable to many different settings, even though their results must be interpreted with care, taking heed of the context . Still, considering effects of aquaculture on fisheries using more realistic fish stock models, like Beverton and Holt (1957) year-class models, should be done. Empirical work, trying to assess these links in reality, should also be done. The amount of nutrients/energy added to marine ecosystems through feeds in finfish aquaculture can for example be substantial (Ackefors and Enell 1994).

The tradable rights scheme sketched in paper (I) assumes that the spatial scale of management, fish stock habitat and aquaculture externalities all match. If this is not the case, other regulating mechanisms are necessary. Such tradable rights schemes are considered in paper (III).

In addition to the user interactions between aquaculture and fisheries that I consider, other user interactions exist that have only to a limited degree been the subject of economic analysis (to the best of my knowledge): For example oil production and fisheries (Exxon Valdez oil spill and fisheries (Cohen 1995)), tourism and reduction of natural amenities (scuba diving destroying coral reefs (Davis and Tisdell 1996)), marine reserves creation and effects on fisheries and tourism (Boncoeur et al. 2002)[5], wind power production and fisheries and

[5] The literature on marine protected areas and marine reserves is rapidly expanding now. The work has so far concentrated on the effect of creating marine reserves on fisheries and the targeted fish stocks (Sanchirico and Wilen 2001; Flaaten and Mjolhus 2005; Armstrong 2007), in some cases on the bycatch species (Reithe 2007). Not much work has been explicitly on the economic value of reserve creation for other users or stakeholders.

tourism. No doubt this type of study will be performed to a larger degree in the future, both on the theoretical and the empirical level, as coastal development pressures grow.

Topic 2 - Economics of allocation mechanisms

Management of the resources in the coastal zone typically combines spatial planning with more traditional resource management. It includes top-down management, "negotiated economy" (Christensen et al. 2007), co-management (Jentoft 1989), integrated coastal zone management (ICZM) (Cicin-Sain et al. 1998) and local management (Ostrom 1990). In all of these management regimes the resource users, and other stakeholders, try to influence the decision makers. Partly they try to get larger shares of resources, and partly they try to avoid negative effects from other's use.

But how should one understand these planning processes, including the role and actions of stakeholders? Resource users and stakeholders either have formal roles in these management systems, or they might be able to influence decisions by lobbying, buying influence (bribery or political campaign contributions), or as strategic voters (Grossman and Helpman 2002), or using their power in other ways (Jentoft 2007). Focusing on interactions between user groups it is natural to ask, how is lobbying or planning effort affected by external effects between stakeholders? How does this affect the outcome of allocation processes?

Epstein and Nitzan (2006) argue that contest-models can be used to study lobbying in a large variety of democratic political environments, capturing the basic relationship between government objectives, public policy, and interest groups' characteristics. Paper (II) considers first a contest for resource access or allocation between two players, when there is an asymmetric externality. This means there is an externality from player 2 on player 1, but not

the other way. In contests players spend costly effort in order to increase their chances of winning a prize, or of winning shares of a prize. Chances or shares increase in own effort, but fall in opponent's effort.

The idea is that in an allocation process, actors spend effort, be it man hours or other resources, to influence the outcome in their interest. That higher effort leads to higher chances of getting one's wishes fulfilled seems reasonable, at least for some levels of effort; if it is overdone it may antagonize the decision maker(s). It can also be interpreted as a simple view on lobbying: The one who spends the most on lobbying stands the biggest chance of winning the prize. The same goes for bribing and political campaign contributions.

Paper (II) also considers a bargaining game between the actors over the same resource, where the contest is one possible threat point for the game. When an externality is present, but the regulator is uncertain about the nature of it, he may suggest that the stakeholders try to agree on the sharing of resource access. If they cannot reach agreement, the regulator will decide the sharing rule, in practice returning to the contest as an allocation mechanism, unless he specifically chooses some other allocation.

I find in paper (II) that if the regulator can set up the contest so that the player with the lower valuation of resource use spends his effort first, society gets the largest net benefit (given that a contest is used for allocation). The net benefit is the users' benefits from use of the allocated resources less the effort they spent in the contest to influence that allocation. With such a sequential game, also both the users' net benefits are maximised. The interests of the regulator and both the contestants are thus aligned, assuming that what is best for society is the regulator's objective. Despite this, if the regulator does not know which player has the lower

valuation of resource use, he can not expect an honest answer if he asks the contestants who should be allowed to move first in a contest. The regulator would really like to give the player with the highest effective valuation all of the resources, without a contest, since a contest implies wasting resources. If the underdog (the lower-valuation player) fears the regulator will allocate resources directly based on his answer, he will not tell the truth. Hence, the regulator must bind himself to arrange a contest for resource allocation, with the order of play decided by the players.

If the regulator suggests the two contestants bargain over the sharing of the resource, the threat point of bargaining is important for the outcome. The threat point is what the contestants get if they do not reach agreement. A threat point of "no allocation" gives the outcome with the largest benefit to society. A sharing of the resource is then agreed where the recipient of the externality get the same benefit independent of the size and magnitude of the externality. The source of the externality, on the other hand, takes the full impact of a negative externality, or receives the full benefit of a positive externality. No allocation as threat point may not be very credible, though. An obvious alternative is that the regulator says the threat point for the bargaining is a contest. When the contest where the higher valuation player spends his effort first is threat point, the outcome gives the largest benefits to society. That contest is, however, not the contest that maximises societal benefits, as we remember from above. Hence it is not credible either, unless the regulator can bind himself somehow. Unlike for the contests, the regulator's interests are not aligned with both players' in bargaining. While the favourite and the regulator share interest over which contest should be used as threat point, the underdog gets the highest payoff if a different contest is used as threat point. The extra benefits accruing to the favourite when his preferred contest is threat point, rather than the contest the underdog prefers, is more than enough to be able to compensate the

underdog for a change of threat point. The favourite should thus be able to make the underdog accepts as threat point in bargaining the contest the favourite prefer. This means a regulator with limited information on the players' valuation could still achieve the best outcome for society through a bargaining game, provided he binds himself to using as threat point the contest the players jointly recommend.

The solution concept used for the bargaining in my paper is due to Nash (1953). This solution concept is probably the most commonly used for bargaining models, but it is not the only one.[6] The Nash solution concept maximises the product of the gains from the agreement (difference between outcome and threat point levels for each player are multiplied). The focus is on the efficiency of the allocation, in the sense that the player with largest marginal benefit of resource use gets the larger share of the resource. The "fairness" of the initial state does not matter in the allocation of additional resources. The Kalai-Smorodinsky (1975) solution concept allocates resources according to the additional benefit each player could get from resource allocation, if each got all of the resource. The solution is thus according to the *constrained utopia point*, where both get the best they can get, independent of the other. In the Kalai-Smorodinsky solution, the ratio of increases in benefits for each player is equal to the ratio of total potential increases in benefits. The Nash solution allows the paradoxical result that increased marginal benefit of resource use, for example from improved technology, for player A, can lead to lower benefits for him in the "new" bargaining solution. The Kalai-Smorodinksy concept rules out this possibility. However, with the Kalai-Smorodinsky concept, the other player could end up with a lower benefit in the "new" bargaining solution,

[6] The following presentation of different solution concepts owes a lot to (Clark 1995). See Armstrong (1994) for different bargaining theoretic solution concepts compared to real allocations in a fishery.

compared to the solution where the technology for player A had not improved. For the bargaining game Clark (1995) uses, he writes that the Kalai-Smorodinsky concept may be said to include both considerations of equity and efficiency. Other solution concepts are the utilitarian and the egalitarian. In the former, allocation is so as to maximise total benefits, in the latter, either the increase in benefit can be the same ("equal gains") or the final benefit level can be the same ("equal outcome"). The solution concept chosen for the bargaining game clearly affects the outcomes of the game. Which concept is more appropriate depends on the setting of the game. Sometimes fairness will have the larger weight (whatever is the criteria for fairness), and other times efficiency. If side payments are possible in the bargaining game, it opens up for a resource allocation focused on efficiency, in terms of total increase in benefits, rather than fairness, as fairness is dealt with through the side payment. This is comparable to the general idea in economics, that the issues of efficiency and equity can be dealt with separately.

The contest literature includes many models that analyse externalities of effort, but not many with asymmetric externalities (see paper (II) for references). Applications to natural resources are also rather limited. Using the contest as threat point in a bargaining game over natural resource allocation seems (in retrospect!) a rather obvious thing to do. Yet, we only know of one other paper where this is done (Grepperud and Pedersen 2003).

Having only two actors is obviously a limitation for the interest of the results. Sometimes there are only two stakeholders, but as the interest for coastal and marine resources is growing, such situations are more and more unlikely. On the other hand, sometimes the actors competing for rights are not individuals, but groups of stakeholders. My model may be relevant also for such cases, being similar to other economic analyses of special interest

groups' attempts at influencing policy outcomes (Grossman and Helpman 2002). The internal free-riding opportunities, and other possible internal conflicts of interests groups, important for their formation and functioning (Olson 1965), would have to be assumed away for this interpretation of my model.

Substantial resources are wasted in contests for shares or access to natural resources, as well as other places where someone has the power to hand out privileges at their discretion (Tullock 1993; Congleton et al. 2007). This is sometimes called rent-seeking. It represents a major cost to society, without being productive, and is thus coined *directly unproductive profit-seeking activities* (DUP) (Bhagwati 1982). How the design of the management system may affect individual's power, and thus opportunities for and levels of rent-seeking, is one of two major themes in paper (III).

Topic 3 - Tradable rights between user groups

Natural resource management has to a large degree relied on direct regulation only (Heal 2007), but market-based instruments, like tradable rights of use, are becoming more and more common (Tietenberg 2002). Example are in fisheries (Hannesson 2005; OECD 2006), air emissions (Tietenberg 1999), water use (Thobanl 1997), land use and land conservation (Machemer and Kaplowitz 2002), and nature conservation (e.g. endangered species) related to land use (Heal 2007).

Tradable rights can limit the overall pressure on a resource, given that the total number of rights is limited, and each right is limited as well. Tradability opens up for voluntarily transfer from the relatively inefficient users of natural resources to the more efficient ones. A relatively long duration of the right opens up for making investments for long term efficient

use of the resource, be they in capital, knowledge or the resource itself (see references in paper (III)).

Going through the theory and experiences from using tradable rights in many different fields, it became clear to me that there might be a potential for wider use of tradable rights to natural resources in the oceans and on the coast. While tradable rights are used for some marine and coastal resources, they are mainly used for transferability within the same user group, like only among fishermen (maybe only among vessels of a certain size range and gear type), or only among marine farmers.

In paper (III) I first consider the design of tradable rights schemes for marine and coastal natural resources, allowing for trade between different user groups. A major issue is what the traded right can be. Is it to a very specific natural resource like a quota for fish of a certain species, or can it be an area-based right, basically giving the right to use all resources within the area? If and when these different types of rights can give efficient allocation and resource use is considered. Based on previous theoretic work, as well as experiences from existing tradable rights schemes, ways of dealing with externalities at different spatial scales in the coastal zone is proposed.

Secondly, I consider possible effects on power relations of introducing such tradable rights schemes. The power relations considered are both between users and managers, as well as among users. Power has sometimes been abused in management systems for coastal and marine resources, leading to unfair and inefficient resource allocation and use, and there are examples where some groups' short term interests have been met at the expense of the long term sustainability of natural resources (see the paper for references).

In paper (III) I explain how tradability of use rights between user groups is possible, and that it can increase the efficiency of resource use, both for very specific use rights and for area-based rights. However, I also show that even for the same resource used in a rather similar manner, like fish caught in commercial fisheries and marine fishing tourism, the tradability poses challenges for the setting of management objectives, like fish stock size and composition. Spatial and temporal differences in use by different user groups also represent a challenge, but zoning may solve this.

Local external effects can be internalised through tradable area-rights (where local mean they are confined to the area defined by the right). External effects outside the area of the right can be dealt with through other mechanisms, like regulatory tiering and zoning. With regulatory tiering trade in user rights is not restricted, but the actual use of rights must be in compliance with local and other regulations.

There will always be a need for regulatory oversight when using tradable rights schemes, to protect public goods and services. A task for regulators is to ensure that groups of stakeholders with individually small benefits from resource use, but collectively substantial benefits, either are protected by direct regulation (like zoning), or are aided in organizing themselves as a market actor. Another point is that for market efficiency it should be possible to buy a use right and leave it unused, in order to avoid negative external effects that else could be generated from its use (Colby 2000).

Some management systems consciously and explicitly leave out tradability of rights, trying to safeguard other interests, and to avoid market power determining resource use. Tradability

nevertheless often evolves. If limited licenses or quotas cannot be lawfully traded, the entities with such associated rights (like e.g. vessels or companies) are traded at prices that clearly indicate a high value on the right itself (Flaaten et al. 1995; Hersoug et al. 2000; Hannesson 2005). When a grey market like that evolves, allocation and use is likely not as beneficial to society as if trade and use was consciously regulated. If tradability is the de-facto situation, it might be better to consciously set up a system of tradable rights, with appropriate limitations on transferability, ownership and use of the right, to avoid negative external and distributional effects and achieve or approach sustainability and economic efficiency.

Power can stem from several different bases, as French & Raven (1959) points out: (1) Legitimate power (due to formal position in an organisation); (2) Referent power (due to persuasive abilities); (3) Expert power (due to skill and expertise that others need); (4) Reward power (due to ability to decide who gets rewards); (5) Coercive power (due to actual or potential use of physical force). When rights that previously were handed out at someone's discretion become tradable, those that used to decide allocation lose some of their reward and legitimate powers. How weakened their power becomes depends on how he initial allocation of the (then) tradable rights is done, and if they have power from other bases.

An obvious fear with tradable rights schemes is that market powers in rights will emerge. Economists know about measures to reduce market powers, but the smaller the market, the more difficult it is, also due to possible non-market (power) relations between actors affecting trade.

When the powers of individual actors in a management system are reduced, these individuals become less interesting as targets for lobbying and rent-seeking. The time, money and

resources spent on these unproductive activities should then go down. If a reform introducing tradable rights only shifts lobbying and rent-seeking to a higher management level, the total amount of effort spent on rent-seeking could go up or down. This is since the scale where decisions are made affects both level of lobbying, the number of participates, and how often lobbying processes will occur, but the changes in these dimensions can go in opposite directions as one moves up or down on scale.

Changes in power relations may thus increase efficiency of resource use, but not necessarily so. Context matters, as power can be used both destructively and constructively, making it a question of who gains and who loses power and how do they use their power. Whether lobbying and rent seeking will be reduced also depends on context. The strongest, or at least most common, advocates of more rights based approaches in natural resource management seem to be economists (Grafton et al. 2006; Wilen 2006; Heal 2007). Economists have traditionally not paid much attention to the implementation process related to management reforms. However, the performance of management schemes often depends crucially on this. We should take into careful consideration how power relations affect implementation of management reforms, as well as how they are affected by it. Particularly the initial allocation of rights matter, and that invidious market power in rights are not allowed to develop. Even though power is difficult to study (Jentoft 2007), more work should be done to try to uncover how power has affected management reforms, both the forming and implementation, and also how management reforms have affected power relations.

Concluding comments

This thesis considers interactions between users and user-groups in the coastal zone from several different angles. There are, however, a number of current topics in marine and coastal

management that I do not explicitly discuss. They include uncertainty (Pindyck 2007), ecosystem based management (Pew Oceans Commission 2003; Pikitch et al. 2004), and governance (Hilborn et al. 2005). Some of these are nevertheless implicitly considered, e.g. the use of zoning, a crucial element in ecosystem based management (Pikitch et al. 2004), is an important element in paper (III). When trade of use rights occurs it makes information on private benefits and costs of resource use public. This is an additional positive benefit of tradable rights schemes (Tietenberg 2002). For ecosystem-based management the need for system level indicators, reference points and control rules to be derived and developed has been pointed out (Pikitch et al. 2004). An interesting issue is if the information from trade of use rights can be utilised there. Hilborn *et al.* (2005) discuss what they see as important dimensions of fisheries governance: 1) The way in which individuals are allowed access to the resource; 2) The decision-making structure of the institutions; 3) The spatial scale of management; 4) Biological and economic factors of the fishery. All of these are important themes in this thesis, and I even consider interactions between them and effects on the institutional efficiency of management systems.

Another major issue I do not explicitly consider is the differences between industrial and artisanal uses of marine and coastal resources (like in fisheries). Clearly the management capacities and infrastructure necessary to make different regulatory instruments work can be very different, and hence, different management options are appropriate for different settings (Castilla and Defeo 2005). Ostrom (1995) argues that to manage a complex system, you need a complex management system, of nested hierarchical levels. The management instruments I suggest in paper (II), with tradable rights between user groups, are not in opposition to her suggestions. The schemes I suggest can be part of large nested complex management systems, as well as local co-management systems, typically advocated for artisanal fisheries.

Beddington et al. (2007) show how fisheries with ITQs have both been successful and disastrous, and the same goes for top-down management. They argue that the most successful fisheries management systems are likely to be rights-based to create incentives for efficiency and long-term sustainability, to have pre-agreed rules about what to do if critical reference points are reached, and also adequate monitoring and enforcement. The second element points to the need to avoid that scientific uncertainty leads to delays in management action. It can be due to real scientific uncertainty, but also if someone uses the uncertainty to avoid action, furthering their own short term interests against the long term sustainability of the resource (Pikitch 2001). Pre-agreed rules reduce the possibility for those that normally have power and influence to affect short term management decisions. In fact, it reduces their power and influence for the short term. I believe these observations are equally valid for the general management of marine and coastal resources, as it is for fisheries in particular.

Power abuse in management systems for marine and coastal resources can be a problem, both generally and when there are attempts to reform them. Which elements should be added, and which removed during a reform, depends on context. The proposals that go against the interest of the current dominant powers will meet the toughest opposition. Our study suggests that introducing tradable rights *can* help shift powers in a favourable manner, but it depends crucially on how it is implemented.

This thesis has certainly increased my understanding of interactions between stakeholders of marine and coastal resources, what their implications may be for resource use, in management procedures, and how management systems can be designed and implemented to accommodate them. Hopefully, it will also contribute to better use of marine and coastal resources, through

better management, to the benefit of current users and stakeholders, as well as those that will follow in the future.

References

Ackefors, H. and M. Enell (1994). "The release of nutrients and organic matter from aquaculture systems in Nordic countries." Journal of applied ichthyology **10**(4): 225-241.

Armstrong, C. W. (1994). "Cooperative Solutions in a Transboundary Fishery: The Russian-Norwegian Co-management of the Arcto-Norwegian Cod Stock." Marine Resource Economics **9**(4): 329-51.

Armstrong, C. W. (2007). "A note on the ecological-economic modelling of marine reserves in fisheries." Ecological Economics **62**(2): 242-250.

Barbier, E. B. (2003). "Habitat-Fishery Linkages and Mangrove Loss in Thailand." Contemporary Economic Policy **21**(1): 59-77.

Barbier, E. B. (2007). "Valuing Ecosystem Services as Productive Inputs." Economic Policy(49): 177-213, 217-29.

Bartlett, R. (1989). Economics and Power - An Inquiry into Human Relations and Markets, Cambridge University Press.

Baumol, W. J. and W. Oates (1988). The theory of environmental policy, Second edition., Cambridge University Press.

Beddington, J. R., D. J. Agnew and C. W. Clark (2007). "Current Problems in the Management of Marine Fisheries." Science **316**(5832): 1713-1716.

Beverton, R. J. H. and S. J. Holt (1957). "On the dynamics of exploited fish populations. Ministry of Agriculture." Fisheries and Food, London, UK.

Bhagwati, J. N. (1982). "Directly Unproductive, Profit-Seeking (DUP) Activities." The journal of political economy **90**(5): 988.

Boncoeur, J., F. Alban, O. Guyader and O. Thebaud (2002). "Fish, fishers, seals and tourists: Economic consequences of creating a marine reserve in a multi-species, multi-activity context." Natural Resource Modeling **15**(4): 387-411.

Castilla, J. C. and O. Defeo (2005). "Paradigm Shifts Needed for World Fisheries." Science **309**(5739): 1324c-1325.

Christensen, A.-S., J. Raakjaer and T. Olesen (2007). "The voices of Danish fishermen in resource management -- An examination of the system of negotiated economy." Ocean & Coastal Management **50**(7): 551-563.

Cicin-Sain, B., D. Jang, G. W. Fisk and R. W. Knecht (1998). Integrated coastal and ocean management : concepts and practices. Washington, D.C., Island Press.

Clark, C. W. (1992). Mathematical bioeconomics. The optimal management of renewable resources, 2. ed., John Wiley.

Clark, D. (1995). "Priority setting in health care: An axiomatic bargaining approach." Journal of Health Economics **14**(3): 345-360.

Cohen, M. J. (1995). "Technological Disasters and Natural Resource Damage Assessment: An Evaluation of the Exxon Valdez Oil Spill." Land Economics **71**(1): 65-82.

Colby, B. (2000). "Cap-and-Trade Policy Challenges: A Tale of Three Markets." Land Economics **76**(4): 638-58.

Congleton, R. D., A. L. Hillman and K. Konrad, Eds. (2007). 40 years of Rent Seeking Research, Springer Verlag.

Davis, D. and C. Tisdell (1996). "Economic Management of Recreational Scuba Diving and the Environment." Journal of Environmental Management **48**(3): 229-48.

Epstein, G. and S. Nitzan (2006). "The Politics of Randomness." Social Choice and Welfare(3): 317-330.

Flaaten, O. (1988). The economics of multispecies harvesting: Theory and application to the Barents Sea fisheries.

Flaaten, O. (1991). "Bioeconomics of Sustainable Harvest of Competing Species." Journal of Environmental Economics and Management **20**(2): 163-80.

Flaaten, O., K. Heen and K. G. Salvanes (1995). "The Invisible Resource Rent in Limited Entry and Quota Managed Fisheries: The Case of Norwegian Purse Seine Fisheries." Marine Resource Economics **10**(4): 341-56.

Flaaten, O. and E. Mjolhus (2005). "Using Reserves to Protect Fish and Wildlife--Simplified Modeling Approaches." Natural Resource Modeling **18**(2): 157-82.

French, J. R. P. and B. Raven (1959). "The bases of power." Studies in Social Power, Institute for Social Research, Ann Arbor.

Gordon, H. S. (1954). "The Economic Theory of a Common Property Resource." Journal of Political Economy **62**(2): 124-142.

Grafton, R. Q., R. Arnason, T. Bjorndal, D. Campbell, H. F. Campbell, C. W. Clark, R. Connor, D. P. Dupont, R. Hannesson, R. Hilborn, J. E. Kirkley, T. Kompas, D. E. Lane, G. R. Munro, S. Pascoe, D. Squires, S. I. Steinshamn, B. R. Turris and Q. Weninger (2006). "Incentive-based approaches to sustainable fisheries." Canadian Journal of Fisheries and Aquatic Sciences **63**(3): 699-710.

Grepperud, S. and P. A. Pedersen (2003). "Voluntary Environmental Agreements: Taking Up Positions and Meeting Pressure." Economics and Politics **15**(3): 303-21.

Grossman, G. M. and E. Helpman (2002). "Special Interest Politics." Journal of institutional and theoretical economics **158**(4): 731.

Hannesson, R. (2005). "Rights Based Fishing: Use Rights versus Property Rights to Fish." Reviews in Fish Biology and Fisheries **15**(3): 231-241.

Hassan, R., R. Scholes and N. Ash, Eds. (2005). Millennium Ecosystems Assessment: Ecosystems and human well-being : current state and trends. Washington, DC, USA, Island Press.

Heal, G. (2007). "A Celebration of Environmental and Resource Economics." Rev Environ Econ Policy **1**(1): 7-25.

Hersoug, B., P. Holm and S. A. Ranes (2000). "The missing T. Path dependency within an individual vessel quota system -- the case of Norwegian cod fisheries." Marine Policy **24**(4): 319-330.

Hilborn, R., J. M. L. Orensanz and A. M. Parma (2005). "Institutions, incentives and the future of fisheries." Philosophical transactions of the Royal Society B: Biological Sciences **360**(1453): 1471.

Jentoft, S. (1989). "Fisheries co-management , : Delegating government responsibility to fishermen's organizations." Marine Policy **13**(2): 137-154.

Jentoft, S. (2007). "In the Power of Power - The Understated Aspect of Fisheries and Coastal Management." Human Organization **forthcoming**.

Kalai, E. and M. Smorodinsky (1975). "Other Solutions to Nash's Bargaining Problem." Econometrica **43**(3): 513-18.

Machemer, P. L. and M. D. Kaplowitz (2002). "A Framework for Evaluating Transferable Development Rights Programmes." Journal of Environmental Planning and Management **45**(6): 773-95.

May, R. M., J. R. Beddington, C. W. Clark, S. J. Holt and R. M. Laws (1979). "Management of Multispecies Fisheries." Science **205**(4403): 267-277.

Muthoo, A. (1999). Bargaining theory with applications, Cambridge University Press.

Nash, J. (1953). "Two-Person Cooperative Games." Econometrica **21**(1): 128.

Neher, P. A. (1990). Natural resource economics. Conservation and exploitation, Cambridge university press.

OECD (2006). Using Market Mechanisms to Manage Fisheries: Smooting the Path. Paris, France.

Olson, M. (1965). The logic of collective action, Harvard Univ. Press.

Ostrom, E. (1990). Governing the commons : the evolution of institutions for collective action. Cambridge, Cambridge University Press.

Ostrom, E. (1995). "Designing complexity to govern complexity." Property rights and the environment: social and ecological issues. The Beijer International Institute of Ecological Economics and the World Bank, Washington, DC, USA: 33-45.

Pew Oceans Commission (2003). America's living oceans: Charting a course for sea change. A report to the nation, Pew Oceans Commission.

Pikitch, E. K. (2001). The Scientific case for precautionary management: Current fishery problems traced to improper use of science. Pew Oceans Commission Workshop on Marine Fishery Management, Seattle, Washington, USA, Pew Oceans Commission.

Pikitch, E. K., C. Santora, E. A. Babcock, A. Bakun, R. Bonfil, D. O. Conover, P. Dayton, P. Doukakis, D. Fluharty, B. Heneman, E. D. Houde, J. Link, P. A. Livingston, M. Mangel, M. K. McAllister, J. Pope and K. J. Sainsbury (2004). "Ecosystem-based fishery management." Science **305**(5682): 346-347.

Pindyck, R. S. (2007). "Uncertainty in Environmental Economics." Rev Environ Econ Policy **1**(1): 45-65.

Reithe, S. (2007). Essays on the bioeconomics of marine reserves. Department of Economics and Management. Tromsø, University of Tromsø.

Russell, B. (1938). Power. London, Unwin.

Sanchirico, J. N. and J. E. Wilen (2001). "A Bioeconomic Model of Marine Reserve Creation." Journal of Environmental Economics and Management **42**(3): 257-276.

Schutz, E. (2005). What has Neoclassical Economics contributed to the Understanding of Social Power? Accociation for Heterodox Economics Annnual Conference. London.

Scott, A. (1955). "The Fishery: The Objectives of Sole Ownership." The Journal of Political Economy **63**(2): 116-124.

Thobanl, M. (1997). "Formal Water Markets: Why, When, and How to Introduce Tradable Water Rights." World Bank Res Obs **12**(2): 161-179.

Tietenberg, T. (1999). Lessons from using transferable permits to control air pollution in the United States. Handbook of Environmental and Resource Economics. J. van den Bergh, Edward Elgar Publishing.

Tietenberg, T. (2002). The tradable permits approach to protecting the commons: What have we learned? The Drama of the Commons. E. Ostrom, National Academies Press.

Tirole, J. (1988). The theory of industrial organization. Cambridge, Mass., MIT Press.

Tullock, G. (1993). The Welfare Costs of Tariffs, Monopolies, and Theft. Public choice theory. C.-K. Rowley. Volume 2, The characteristics of political equilibrium.. Elgar Reference Collection series. International Library of Critical Writings in Economics vol. 24. Aldershot**:** distributed in the U S by Ashgate, Brookfield, Vt , 1993; 3-11 Previously published 1967.

Wilen, J. E. (2000). "Renewable Resource Economists and Policy: What Differences Have We Made?" Journal of Environmental Economics and Management **39**(3): 306-327.

Wilen, J. E. (2006). "Why fisheries management fails: treating symptoms rather than the cause." Bulletin of Marine Science **78**: 529-546.

Paper I: Aquaculture-Fisheries Interactions

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Paper II: Resource Allocation by Contest or Bargaining

Paper III: Tradable Rights between Coastal User Groups