Towards a Model of Property Rights-Based Fisheries Co-Management

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I. Introduction

Fisheries, as an important human activity, have suffered from a variety of problems worldwide, in developed and developing countries alike. With a hope to eliminate fisheries problems and achieve a sustained fisheries development, scholars in different disciplines from different parts of the world have proposed a lot of solutions, ranging from biologists conservation-minded techniques through economists market-based instruments to sociologists community-centred approaches. Among these approaches, property rights-based management, such as the cap-and-trade approach to which ITQ and its variants belong, and co-management have gained a wide popularity and, depending on specific situations, they do each create some successful stories of fisheries governance.

The philosophical and institutional advantages of ITQs and co-management are obvious for scholars in the Western sphere. Philosophically, individualism could not live without clearly defined private property rights while democracy would become a hollow promise if the affected individuals were not meaningfully involved in the process of rules making and implementation. As one may note, it is individualism and democracy that have been, and remain, the fundamental view of value in the Western society. Fisheries management is no exception. Institutionally, the privatisation of a free-entry resource does have the effect of externalities internalisation by eliminating rational individuals incentive to race for a greater share of the resource. Co-management, on the other hand, is expected to enhance the legitimacy of fisheries management and, hence, increase the level of users compliance with regulations through improving users perception on the rightness of rules contents and the rightness of procedure in rules making and implementation.

For a finfish stock, however, there can be no any real sense of privatisation due to its

migratory nature. Even if it could be perfectly privatised by using, for example, the ITQ regime, the individual share of an available TAC were likely too small to be workable in terms of economies of scope and scale, especially in countries with a huge fishing population but relatively limited resources.

It follows then logically to ask how to use the institutional advantages and, in the same time, overcome the constraints of ITQs regime. Obviously, this issue has not only theoretical significance but practical utility as well. The primary objective of this study is to provide an answer to this issue. The main theme of this paper is that privately owned ITQs do not necessarily superior to collectively owned ones. Instead, the collective ownership of fishing quotas, together with a co-management mechanism, can not only take advantages, and overcome deficiencies, of the ITQ regime but also realize multiple objectives of fisheries management. We term this model as property rights-based fisheries co-management.

In the remaining parts of this paper, we will first examine what a fishery is defined and how fisheries problems are perceived. Following on from this, we will investigate the rationales behind various approaches that are devised to tackle fisheries problems. Based on this investigation, we argue that property rights-based management and co-management can be combined together to better sever the management of finfish stocks. Finally, we conclude with findings identified in the paper.

II. Fisheries and Fisheries Problems

How we view fisheries problems depends on how we define fisheries. Our understanding and perspectives in respect to fisheries problems, in turn, determine critically what solutions to them we may propose. In what follows, we will discuss these issues in some degree of detail.

1. What is a Fishery?

Fishing, with farming and wild animal hunting, are perhaps one of the most ancient human activities. With an ancient origin, however, fisheries have not gained a universal definition among scholars of fisheries science. A brief review of fisheries literature may easily identify many definitions associated with the label fishery, as listed in Table 1. Most definitions in Table 1, however, provide only a single-faced description, paying no attention to the fundamental aspect of a fishery. The diversity in defining a fishery may be interpreted as a reflection of researchers' special interest in a particular fishery. This

simplified conceptualization of a fishery, however, may give researchers a false picture about the underlying nature of fisheries problems, as will be discussed later.

Table 1. A List of Definitions on the Term Fishery

Definitional Attribute(s)	Illustrations
By geographic locations	The coastal fishery and the inshore fishery as opposed to the offshore fishery, high sea fishery and distant water fishery, the domestic fishery as opposed to the international fishery.
By fishing methods	The trawling fishery, the purse-seining fishery, the gillnetting fishery, the hook and line fishery.
By fishing species	The pelagic fishery such as the anchovy fishery, the demersal fishery such as the cod fishery.
By fishing purposes	The subsistence (artisanal) fishery, the commercial (industrial) fishery, and the recreational (sports) fishery, the ceremonial fishery.
By scales of fishing operation	The small-scale fishery, the large-scale fishery.
By the salinity of fishing waters	The freshwater fishery, the brackish water fishery, the seawater fishery.
By the intensity of human manipulation	The capture fishery, the ranching fishery, the aquaculture.
By with or without regulations	The unregulated (open access/free entry) fishery, the regulated (restricted/limited access) fishery.
By the level of exploitation	The overexploited (overfished) fishery, the underexploited (underfished) fishery.
By the degree of development	The developing fishery, the developed fishery.
By combining some attributes as listed above	The Pacific pelagic herring fishery, the large-scale commercial capture fishery

Increasingly, a fishery is viewed as a human activity embedded in broad human and natural settings (e.g., FAO 1999; Lackey et al. 1980:3; NRC 1999:18-19: Ross 1997:2-3). In defining a fishery, for example, A. Spoehr (1980:196) shares Andersons (1986:19) view but emphasizes the interaction of social, economic and technological systems (as quoted in McGoodwin 1990:65). With a reflection on the complexity of fisheries problems, the U.S. Magnuson-Steven Act (Sec. 3[13]) broadens the concept, defining a fishery to be one or more fish stocks that are taken as a unit of conservation and management and that have distinctive geographic, scientific, technical, recreational, and economic characteristics, as well as any fleets targeting such stocks.

From a comprehensive systems, perspective, we consider a fishery as a complex, adaptive, and dynamic system. This system consists of human, support and natural subsystems, each of which may be further divided into some subsystems or components

(Fig. 1). The ecosystem includes fishery resources that are one of the basic inputs of fishery process and other components that affect fishery resources productivity. The economy is the reflection of costs and benefits with the fishery. The technology is one of the main determinants of fishing capacity and fishing effects on environment. The society component consists of non-monetary costs and benefits that, nonetheless, constitute inseparable parts of human welfare, such as scientific, aesthetic, religious, recreational, and non-use (inherent) value. Governance includes the norm, institutional arrangements, and substantive policies that govern the system.[1] All the subsystems or components co-evolve constantly in a way of mutual interaction. Moreover, the ability to change and evolve must be maintained if the systems of fisheries are to remain viable and sustainable. It is on the basis of this holistic view that we will turn to examine fisheries problems in the next section.

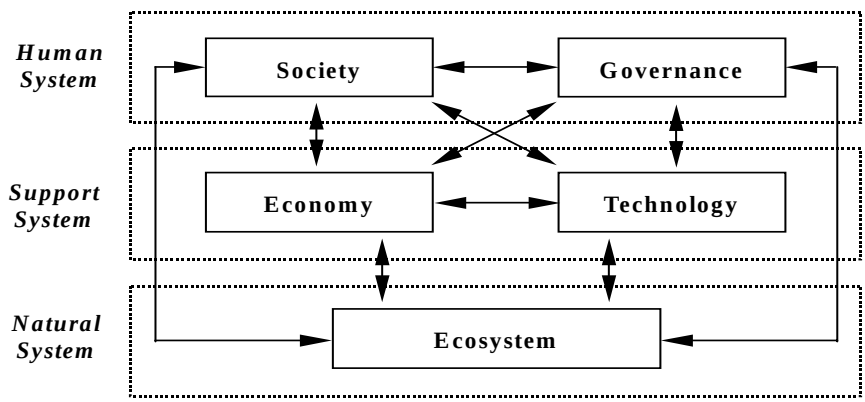

Figure 1. A Systems View on Fisheries (adopted from Mu et al. 2000)

2. The Typology of Fisheries Problems

Moving toward optimal fisheries governance requires a better understanding of the fundamental nature of fisheries problems. In the absence of a correct diagnosis, management efforts are usually wrongly targeted and, in some circumstances, may compound issues at hand. For example, fisheries professionals are frequently preoccupied by issues such as overcapitalization and overfishing. The failure in identifying the

1) For a detailed definition of the term *governance*, one may go to FAO Fisheries, website at <http://www.fao.org/fi/glossary/default.asp>. In our view, the two terms of institutions and governance are similar while institutional arrangements may be viewed as equal to the phrase governance system/structure.

incentive behind fishermens behaviors explains partially why the traditional regulatory mechanism has last so long in the history of fisheries management. In a sense, underlying the pervasive fisheries crisis worldwide is the lack of a precise diagnosis of fisheries problems and, as a result, the incorrect prescription to address them. The primary concern of this section is to identify the underlying cause of fisheries problems.

What are likely to be perceived as a fisheries problem? Generally speaking, the performance of fisheries systems as a whole or their individual components that are in short of, rather than meet, or come in contract, rather than harmonization, with the public expectations (or objectives) can all be defined as a fisheries problem. This is, indeed, a definition of fisheries problems that is frequently used in daily life. For example, just by a casual glance of fisheries literature and press reports, one may quickly identify a lot of terms frequently used by biologists, ecologists, economists, or journalists to describe problems facing the real-world fisheries. Here is a list of examples (e.g., FAO 1996, 1998, 2000):

- Bycatch, highgrading and discarding, illegal fishing, and misreport of the catches;
- The overfishing of resources, the "capital stuffing"[2] of fishing fleet, intensified race-to-fish among fishermen;
- The decreased catch per unit of effort (CPUE) and shortened fishing days;
- The modification of ecosystems or the losing of fishing habitats;
- Intensified conflicts among fishermen and between fishermen and other users of resources, fishing disorder, and fishermens marginalization in society, and the like.

Although they are frequently exposed to the audience, however, these terms do not reveal the root clause underlying fisheries problems. In a sense, they are simply phenomena arising from the interconnection, interdependency and interaction among fisheries participants, between fishermen and other users of the resources, and between human system, support system and natural system. From this perspective, they are of no fundamental nature and, borrowing on from the language of institutional economics, they may belong to issues that have to be coped with by the operational level of institutions.[3]

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2) One may refer to a website at <http://www.fao.org/fi/glossary/default.asp>. for a definition of this term.

3) A framework of the institutional analysis and development (IAD) developed by Ostrom (1986, 1990) and her colleagues (e.g., Blomquist 1992; Kiser & Ostrom 1982) suggests that institutional levels may be categorized into three hierarchical types: 1) operational choice rule; 2) collective choice rule; and the constitutional choice level (in that order) with operational choice rule located in the lowest decision-making level (see, for example, Ciricy-Wantrup *et al.* 1975; Kenney *et al.* 1999:12-14; and Reddy 2000).

Unfortunately, fisheries professionals have historically been, and some of them remain, preoccupied by these phenomena of fisheries activities. This preoccupation may be viewed as a result of the historical dominance of fisheries biologists in fisheries management. Due to the lack of the economic knowledge, biologists on the whole, tend to treat the fisherman as an exogenous element in their analytical model, and the behavior of fishermen is not made into an integrated element of a general and systematic bionomic theory (Gordon 1954).

Then, what should be considered as the real problem of a fishery? To answer this question, it is useful to examine the fisheries bioeconomic theory as developed since the 1950s. Underlying fisheries bioeconomics is the Gordon-Schafer model.[4] It is this model that marks the beginning of the whole field of fisheries economics and that helps fisheries professionals understand fisheries problems in the last few decades.

An important insight provided by the Gordon-Schafer model is that an open-access fishery will inevitably end up at an equilibrium where total fishing costs equal total revenues, with no economic surplus being produced by the fishery. Underlying the dissipation of economic rents is the open-access nature of the fishery and fishermens race-to-fish behavior motivated by a rent-seeking incentive.[5]

This is a typical case of social dilemmas in which each rational actor has an incentive to behave in ways that are suboptimal or even tragic for the resource, the actor himself in the long-run horizon, and ultimately the society as a whole.

Surveying the literature on managing natural resources, Ostrom (1990) found that researchers use three major models to explain why natural resources are often exploited to the point of endangering the long-term viability of economic activities depending on them. They are 1) Hardins tragedy of the commons ; 2) the prisoners dilemma game; and 3) the collective action theory. According to the prisoners dilemma game, each player in the exploitation of a natural resource will take a dominant strategy that will always

4) The Gordon-Schafer model is a classical paradigm of the marriage of biology and economics, with the American fisheries biologists M.B. Schafers (1954, 1957) *logistic model* (developed from the English biologist E.W. Holts [1895] *propagation theory* and his fellow biologist C. Petersens [1894] *growth theory*) on one hand, and the economic model identified by two Canadian economists H.S. Gordon (1953, 1954) and A.D. Scott (1955) on the other (McGoodwin 1990:68-73). For a detailed introduction to this model, see, for example, Anderson 1986:19-55; Cunningham *et al.* 1985:27-61; Hannesson 1993:47-75).

5) Note the difference in competitive effects between marine fisheries and manufacturing industry. In normal industries, advantage is gained by producers who adopt cost-minimizing technological changes because total production can be increased. In natural systems, total production is exogenously fixed and technological changes simply serve to redistribute catch shares among participants, increasing costs and decreasing profits (e.g., Cunningham *et al.* 1985:161-65).

make him better off when choosing the strategy to defect no matter what the other player chooses a situation similar to those involved in a non-cooperative game (see also Badhan 1999; Heltberg 1999; Mankiw 2001:358-66; OECD 1997:161-62). When all players choose the same strategy, they will inevitably end up at a non-Pareto optimal equilibrium, a paradox that individually rational action leads to collectively irrational outcomes.

The third model is based on the outcome provided by Olson in her eminent book, The Logic of Collective Action, in which she challenged the optimism expressed in group theory that individuals with common interests would voluntarily act for purpose of furthering their interests.[6)]

She basically uses the free rider problem as a basis for explaining why individuals have little incentive to contribute voluntarily to the provision of a good that benefits the group. The free rider problems are indeed pervasive among users of common-pool resources and pubic goods.

Among the three models explaining why problems arise in certain fisheries, the best known is Hardins (1968) tragedy of the commons . Inspired by insights provided by many precedents,[7)]

Hardin argues that [f]reedom in a common brings ruin to all . He ascribes the root clause of problems in natural resources to their status as common property, maintaining that when tenure to resources is unspecified, a tragic situation will almost inevitably ensue as more and more entrants compete for a profitable process of exploitation.

We conclude that: It is the failure of human-made governance structure, or alternatively termed as the institutional arrangement, that transforms a resource from a de jure non-open access to a de facto open access that induces fisheries problems. In other words, the tragedy of the commons would be bound to happen when institution arrangements fail to match the nature of the resource ownership and the incentive created by such

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6) Oslon argues that unless the number of individuals is quite small, or unless there is coercion or some other special device to make individuals act in their common interests, rational self-interested individual will not act to achieve their common or group interest .

7) Scholars have long recognized that the nature, extent, and allocation of property rights can significantly affect the rate of resource depletion and degradation. In the 4th century B.C. (some 2,300 years ago), Aristotle had asserted [t]hat which is common to the greatest number has the least care bestowed upon it (quoted in Cole 1999). Hardins argument was also articulated in the 18th century by Adam Smith (1957[1772]) and less well known people such as William F. Llord (1968[1837]) (NRC 1999:26). In a similar vein, Gordon (1954) concludes his paper by saying that everybodys property is nobodys property. · the fish in the sea are valueless to the fishermen, because there is no assurance that they will be there for him tomorrow if they are left behind today .

ownership as well as the cultural, economic, environmental, and political settings where the commons harbor. Hardins model provides a particularly useful framework for explaining overexploitation and overcapitalization of natural resources and for understanding roles played by property rights in natural resource management. However, as criticized by many scholars, especially those in social and political sciences, Hardins model is a prime example of a theoretical misstep in environmental and natural resource sciences. The model errs mainly in its conceptual confusion of the common property with open access, failing to distinguish the communal (common-pool) property and no property, as the two concepts generally agreed upon among the majority of economists and sociologists (e.g., Ciriacy-Wantrup et al. 1975; Ostrom 2000). Hardins argument has provoked some economists interest in such question as why is the pig not an endangered species? (Hannesson in Pitcher et al. (eds.) 1998:251-60) or why the cow is not extinct (Mankiw 2001:238-39). The comparison of the fish with the pig and cow has misled some economists who conclude that privately owned resources are institutionally superior to common-pool resources.[8] In view of the established fact that few resources are open access de jure,[9]

In the case of managed fisheries, problems are of course a result of management failure. It then follows logically to ask why fisheries management often fails. Hart et al. (in Pitcher et al. [eds.] 1998) argues that the collective interest expressed by government or state and the interests of individual fishermen rarely match. Table 2 illustrates some other hypotheses to explain the issue.

8) It should be noted that Hardins (1968) analysis provides no clue for preferring private ownership to common or state ownership, as those regimes are conventionally defined. In other words, his analysis appeals for the creation of property rights where none previous existed, but does not suggest any concrete property rights regimes of private, collective, or state ownership. In a subsequent writing, however, Hardin (1978) does list private and state ownership (or private enterprise and socialism) as the only two viable solutions to the tragedy of the commons, implying that communal ownership would not suffice. It is this argument that is under attack of numerous empirical and theoretical studies (e.g., Apostle. *et al*., 1998; Christy *et al.* 1998; Cole 1999; McKean 2000; Ostrom 1990, 2000; Sjaastad *et al*. 2000).

9) Indeed, even the high sea fisheries are still subject to international regulations, such as the UN Convention on the Law of the Sea (UNCLOS 1982), the 1995 United Nations Implementing Agreement on Straddling Stocks and Highly Migratory Stocks (UNIA), and the FAO Code of Conduct for Responsible Fisheries (1995), and therefore should be viewed as an international commons, instead of an open-access resource *de jure*.

Table 2. Hypotheses for the Failure of Fisheries Management

Hypothesis	Example
Folly	Tuchman 1984, *"... perverse persistence in a policy demonstrably unworkable."*
Data uncertainty	Graham 1956, *"inherent limitations of ... fishery statistics..."*
Simple models	Walford 1961, *Fishing "cannot be understood out of context from the intricate system of their biological environment."*
Lack of ownership	Beverton and Holt 1957, *Perfection of regulation will require "some modification of ... individualistic and competitive approach."*
Complexity	Wilson *et al.* 1994, *The "complexity and perhaps chaotic nature of the biological environment" makes management intractable.*
Institutional failure	Holt and Talbot 1978, *"Institutions are imperfect."*
Greed	Ludwig *et al.* 1993, *"Short-sightedness and greed of humans underlie difficulties in management."*

Source: modified from Williams *et al.* 1999.

To sum up, perceptions on fisheries problems may be grouped into three broad categories: 1) the symptoms of fisheries problems; 2) the common-pool nature of fisheries which tend to induce rational users rent-seeking and free-riding behavior; and 3) the mismatch of institutional arrangements or governance structure with the common-pool nature of fisheries resources and rational actors incentive. For regulated fisheries, we argue that it is the institutional mismatch that induces the first two kinds of problems. In short, when a valuable natural resource is depleted, it is either because it has never before been incorporated into an institutional framework (the nonexistence of institutions), or because it has become a de facto open-access resource due to institutional failures of one kind or another.

III. Alternative Approaches to Fisheries Problems

Concern for fisheries problems is not new; it dates at least back to the Spring and Autumn period of ancient China (770-476 BC).[10)]

In the Western sphere, the issue has attracted an increasing attention since the 1890s, especially after World War II (OECD 1997:27-8). To eliminate fisheries problems and to achieve a sustained fisheries development, scholars in different disciplines from different

10) *Guanzi*, a well-known ancient Chinese scholar, notes that fisheries resources are not limitedness. He emphasizes the need for restriction on the size of fishing nets and suggests that different fishing boats and nets must be designed for targeting different fish species for the long-term livelihood of future generations (cited in Zhang *et al.* 1983:29). However, this warning does not reach an international audience because *Guanzi*s article is written in Chinese.

parts of the world have proposed a lot of solutions, ranging from biologists conservation-minded techniques through economists market-centered instruments to sociologists community-based approaches. In this section, we will provide a summary of these alternatives.

1. Traditional Solutions to Fisheries Problems

The historical review of fisheries management indicates that three schools of fisheries theorists have led the evolution of fisheries management over the past two centuries. They are the school of governmental interventionists, the school of free marketists (or the school of private property rights), and the school of communitists.

Following Hardin's (1968) propositions, traditional fisheries theorists have taken two different approaches to fisheries problems. They are market-oriented instruments and the command-and-control regime led by the government. According to free marketists, market fails in natural resource management only because property rights are incompletely specified. For the invisible hand to have a role to play in natural resource management, a clearly defined property rights is a "must" precondition. As the Coase Theorem suggests, where transaction costs are low, all that the state needs to do is to define and enforce property rights, and private negotiation will allocate resource efficiently (Coase 1960).[11)]

While theoretically attractive, however, markets in the real world cannot solve all fisheries problems due to various reasons, including externalities, incomplete information, bounded rationality of agents or behavioral opportunism, imperfect competition, poorly defined and/or unenforceable property rights regime. Where private costs, which are the basis for market decision, deviate from social ones, market failure occurs, resulting in allocative inefficiency in general and anti-Pareto optimality of resource consumption in particular.

To overcome the limits of market to realize Pareto-efficiency, some sort of governmental intervention to promote collective action and to overcome the prisoner's dilemma is needed. Governmental interventionalists argue that whenever property rights are incompletely defined or enforced, externalities arise and resources cannot efficiently be allocated without intervention. Two categories of governmental action are suggested: 1)

11) It is important to note free marketists do not necessarily support individual ownership over group or communal ownership. The important distinction for them is between public property (*res publicae*) and private property, where private is defined to include both individual property (*res individuales*) and common property (*res communes*).

direct intervention through closed areas/seasons, restrictions on fishing gear, size/sex limits, TAC, etc., as proposed by biologists; and 2) indirect intervention through taxation to check negative externalities/overinvestment or by subsidies to encourage positive externalities/under-investment and/or through a clear definition of property rights as proposed by economists.

Government intervention to fix market failures may enhance social welfare, but these efforts may also end up in Pareto-inefficiency. This is because the government may not have the information necessary to intervene appropriately. Regulatory efforts may also be distorted by public choice failures. Sometimes the outright corruption of the decision makers (the agent-principal problem) may lead to interventional failure. More often, special interested groups may manipulate the decision-making process and causes policy choices not to reflect the true will of stakeholders. These issues, among others, put forward the legitimacy issue of governmental intervention as frequently argued by the community school.[12)]

Scholars from the communitists school prefer co-management, arguing that it can enhance the legitimacy of fisheries management and, hence, increase the level of users' compliance because of the improvement in users' perception on the "rightness" of rules contents and the "rightness" of procedure in rules making and implementation (e.g., Jentoft 1985, 1989; Jentoft et al. 1995; 1998; Nielson 1996; Nielsen et al. 2000; Pomeroy 1995, 2000; Pomeroy et al. 1997). Table 3 lists main instruments that have been proposed by the mainstream schools of fisheries theorists to govern fisheries in the past two centuries, and most of them remain in use.

2. New Paradigms in Fisheries Management

Throughout the 1980s and the early 1990s, there was growing concern globally about resource overexploitation and environmental degradation, threats to biodiversity, and a call for sustainable development. As a result, several international initiatives were put into action in the 1990s, including the UN Conference on Environment and Development (UNED), the International Convention of Biological Diversity, and the Code of Conduct for Responsible Fisheries.

12) Indeed, in most countries, the fishery sector is regulated by a great number of laws, rules and norms, many of which are quite specific and well intentioned. However, routine policy solutions of government intervention and privatization have not yet overcome the problems of resource overexploitation and rent dissipation; instead, in many instances, they have deprived large portions of the population of their livelihood.

Table 3. Instruments Available for Governing Fisheries

Instrument	Function	Applicability to Fishing
1. Regulatory Tools		
No take zones	Protect juveniles, spawning areas, etc.	No fishing in specified zones means externalities not created.
Marine Reserves	Protect juveniles, spawning areas, etc., protect habitat.	Area set aside for preservation of marine species.
Closed seasons/areas	Protect juveniles, spawning areas, etc.	No fishing during designated times and/or in prescribed areas.
Size or sex selectivity	Direct effort away from individual fish of specified ages, sex.	Requirement for fishers to return to sea all prohibited catch.
Bycatch Reduction Devices (BRDs)	Reduce rate of bycatch of fish and other species.	Vary technology used while fishing to reduce bycatch of fish or other species.
Technology ban	Prevent externalities created by specific fishing technologies.	Reduce bycatch by only allowing techniques with the least externalities.
Input limitations	Reduce externalities associated with certain inputs.	Reduce volume of fishing activity and associated externalities.
Catch limitations	Reduce externalities with fishing effort.	Limit total harvesting and associated externalities.
Retention and utilization requirements	Reduce dumping of target and non-target species	Allow non-target catch to be landed, not dumped.
2. Financial Measures		
Taxes	Provide incentive to reduce, e.g., pollution.	Apply tax to variable inputs, boats, outputs, to reduce profits and externalities.
Subsidies	Reduce costs of inputs.	Reduce costs of developing BRDs.
Environmental performance bonds	Provide financial incentive to avoid creating externalities.	Provide disincentive to damage habitat or marine ecosystem.
3. Rights-Based Methods		
IQ, ITQ, IVQ, CDQ, etc.	Reduce race to fish through changing participants incentives	Creation of rights reduces need to race, provides incentive to maintain asset, so less externalities created.
4. Voluntary Approaches		
Co-management	Right holders draw up operating systems.	Peer agreements reduce externalities.
Codes of practice	Agreed behavior which limits externalities.	Industry develops, adopts, codes which limit or preclude externalities.
Accredited environmental management systems	Industry develops externally audited prior to accreditation.	Industry develops, adopts, systems with environmental policy which aims to limit or preclude externalities.
Conservation easement	Negotiated agreements restricting a partys behavior.	Negotiated agreement not to take certain actions which may create externalities.
5. Legal Remedies		
Civil law	Liability for pollution damages.	Potential damages claims provide incentive to avoid creating externalities.
6. Education and Public Awareness		
Publications, guides, kits, etc.	Numerous.	Informe people change behavior, not create externalities.
Informal regulations, e.g., environmental reporting	Toxics Release Inventory and corporate environment reporting.	Information release plus community pressure, modifies firm behavior.

Source: modified from Hughey *et al.* (2000).

Following these initiatives, there have been changes in the objectives of fishery management. The objectives have shifted from maximizing annual catches and employment, sustaining stocks and short-term interests, to maximizing long-term welfare, sustaining ecosystems and addressing both short- and long-term interests. Policy changes have shifted from traditional production- and stock/species-based management toward conservation- and ecosystem-based management, from sectoral fishery policy to macro economic instruments, and from top-down and risk-prone approaches to wide stakeholder participation, risk-aversive precautionary and adaptive (learning-by-doing) approaches. These changes, together with a surging concern for sustainable development, has led to the introduction of what we term as new paradigms of fisheries management.[13] These new paradigms may broadly be grouped into three categories in terms of issues they are to address (Table 4).

Table 4. New Paradigms in Fisheries Management

Issues to Be Addressed	Management Strategies
The integrity of ecosystem, the interdependency and interaction of ecosystems components	Multispecies management, ecosystem-based management and its variants, including ICAM, LME management, marine protected area (MPA), and bio-region management
Complexity, uncertainty, incomplete information and fisheries dynamics facing management	Precautionary approach and adaptive management
The need of a more wider inclusion of stakeholders into management process	Eco-labeling
To achieve a balance of benefits and costs at the margin in the use of natural resources	*The principle of user pays and user says and the cost-sharing mechanism*

3. The Institutional Nature of Fisheries Management

We have noted the development in contemporary fisheries management that is characterized by the following characteristics:

- A trend from the traditional focus on single species management to a more emphasis on the importance of multi-species management and ecosystem-based management, including its variants such as integrated coastal area management (ICAM), large marine ecosystem (LME) management, marine protected area (MPA), and bio-region management;

13) See, for example, Arrow *et al.* 1999; Bormann *et al.* 1995; Davidson-Hut *et al.* 2000; De Leo *et al.* 1997; Imperial 1999; Lancia *et al.* 1998; Larkin 1996; Lee 1993; Walters *et al.* 1998; and William *et al.* 1996.

- A preference for the precautionary approach and adaptive management to address uncertainty and incomplete information with fisheries;
- A popularity regained by the traditional community-based management and co-management; and especially
- A tendency to adopt cap-and-trade approach based on market mechanism, to which ITQs and their variants (EAs, IFQs, IVQs, CDQs, and the like) belong.

We do not suspect the theoretical rationality of these approaches and success stories they have created under specific circumstances. However, we argue that, when applied to the real-world situation, any of these approaches must be embedded in, and supported by, certain kind of institutional arrangements. For this reason, all these approaches are simply a tool (or institutional arrangement at lower level) that may be accepted or rejected by specific institutional arrangements (at higher level). Therefore, the success or failure of fisheries management is not determined by a specific management skill but by comprehensive institutional arrangements that are employed. Then, what kind of institutional arrangements is likely to ensure the success of fisheries management?

IV. The Integration of Property Rights-Based Management and Co-Management

As already made clear, the key to the effective governance of a fishery is to eliminate fishermens incentives to race for fish. Therefore, the institutional arrangement adopted by the management must be able to transform the fishery from an open-access resource to a closed one. To be success, on the other hand, fisheries management activities have to be conducted in an equitable way and they have to be perceived by fishermen as legitimate. For migratory finfish stocks, we argue that the integration of property rights-based management and co-management can better achieve the dual purposes, as will be explained in this section.

1. The Common-Pool Nature of Finfish Resources

As a common pool resource, finfish stocks have two important characteristics, i.e. non-excludability and subtractability or rivalry in consumption (Mankiw 2001:226-27). As a result, it is difficult and costly to exclude potential users of the resource because of its physical properties (non-excludability). In marine fisheries, for example, it is usually difficult to identify and monitor boundaries of the fish species that often migrate across

multiple political/administrative jurisdictions. In addition, when the resource is finite, the extraction by one user diminishes the amount available for other potential users. This is known as subtractability or rivalry in consumption. Due to the two characteristics, the law of capture prevails in most fisheries. That is, an individual can own a fish only after capturing it; once he owns it, the fish has no opportunity for others to capture, nor to contribute to growth and perpetuation of the stock. In a game like this, every rational actor is likely to take the strategy of "catch all you can, and catch it right now".

2. Institutional Advantages and Deficiencies of ITQs

By attempting to transform the common resources of the ocean to privately owned ones, the institution of ITQs has been highly praised as "one of the great institutional changes of our times" (Neher et al. 1989:3). With a history of no more than two decades, however, the idea embedded in ITQs has a deep root in the Western society, where the invisible hand of market is thought of as the most efficient in organizing economic activities; exclusive, transferable, and well-defined property rights are essential precondition for market to function (Arnason 1999).

ITQs are a rights-based management approach which aim to reshape fishermen's psychology from a hunter to a farmer, assuming that fishermen, if allowed exclusive use rights, will clearly see the benefits of managing for the long-term health and productivity of fisheries. In contrast to most traditional management arrangements which usually directly regulate where, when and how participants are allowed to operate, ITQs-based management is to regulate the amount each participant can take but allow holders to catch where, when and how as they want. Related to this institutional advantage, ITQs are expected to 1) improving economic efficiency by providing incentives to reduce any excess harvesting and processing capacity; 2) improving conservation by creating incentives to reduce bycatch and lost gear and engaging in other activities that conserve the resource; and 3) improving safety at sea by reducing incentives to fish in dangerous conditions (NRC 1999:33-37).

Nonetheless, ITQs are not free from shortcomings, especially when used for managing finfish fisheries. Unlike shellfish resources which may easily be allocated to individual users, finfish stocks can hardly be privatized in any real sense, providing the biophysical properties of these resources and the status quo of technology.[14] Moreover, even if

14) Christy (1999) has proposed to privatize fish stocks by using fixed gear approach. This approach may be applicable for coastal small-scale fisheries. Its applicability to offshore and high-sea fisheries is no doubt unrealistic, given, for example, the current status of fishing technology.

privatization is possible, it is still a problem in view of economies of scale and scope when fishing population is huge in comparison with the available resources. In addition, fisheries management is increasingly understood as a pursuit of multiple objectives. Rarely are MSY (i.e. the conservation objective) or MEY (the objective of capturing economic rent) pursued singly by fisheries management agencies. Instead, in most countries, social issues (e.g., distributive equity and employment) are also important decision variables. Then, a question follows immediately: Is it possible to take the institutional advantages of ITQs and, at the same, avoid their constraints?

3. Property Rights-Based Co-Management as a Solution

As mentioned previously, Hardins argument is primarily based on his analytic problems arising from the confusion of common property with open access This has led to the consequent rejection of Hardins conclusion that common property resources are inherently problematic. What is important is not the type of resource but the property rights regimes in combination with the resource it is subject to, namely open access, private property, communal property and state property. This separation between the nature of resource and the property regime it falls under shows that Hardins theory holds only for a situation of a common property resource under an open access regime (without institution governing access to and use of the resource). However, other property regimes can, and indeed have also, led to overexploitation, indicating that the provision of property rights alone is not enough. The reappraisal of Hardins pessimistic view on common property resources, together with the recognition of the limits of government intervention, has driven researchers paying more attention on co-management[15] e.g., Pomeroy 2000).

Indeed, a fishery cannot be effectively managed without the cooperation of fishermen and other stakeholders to make laws and regulations work. Fishermen do not easily accept the rule of game imposed top-down by the centralized command-and-control regime.[16]

This lack of acceptance is exacerbated when what they are being told does not make

15) Co-management is not a new idea in social governance. Theoretical bases for co-management originate from Tonniess (1887) concept of *gemeinschaft* (socially constructed order) (Larmour 1997:386-87, as quoted in Haward *et al*. 1999).

16) Nielson (1996), for example, points out that advantages of approaching fisheries management as a bottom-up process, as opposed to the traditional centralized top-down system, may be a high degree of acceptability and compliance with regulation measures, due to the participation of user-groups in the decision-making and implementation process.

sense in terms of their understanding. It most cases, fishermen, scientists, and fisheries managers rarely disagree with each other upon concerns for the long-term objectives of resource sustainability and industrys prosperity. What they do disagree with each other are, in general, the short-term action that should be taken to achieve these objectives. This disagreement reflects their difference in social position, education and enculturation, and specific day-to-day concerns (e.g., McGoodwin 1990:77-86).

Moreover, fisheries problems are often related to distributional conflicts. Equity and legitimacy are critical variables that influence users compliance with rules and the effectiveness of management. Any institutional arrangements, and the change in them alike, will inevitably carry with distributional effects. In a market, redistribution will happen in accordance with principles of efficiency. Actors able to exploit the most efficient strategies will gain control over resources. Access to capital and information is generally skewed in favor of the rich; it seems unlikely that the market principle will work in favor of the disadvantaged groups. In contrast, co-management takes social equity as a primary concern. Taking the sustainability of marine resources and the feasibility of administration as a precondition, however, fisheries management has to attain a balance between the economic efficiency of industry and the social equity of resource allocation. Obviously, if property rights-based management and co-management could be integrated into a unified institutional framework, the dual objective would be achieved.

The complementarity of property rights-based management and co-management is obvious. A question follows: Are they compatible? Literature shows that co-management encompasses different degrees of power sharing between stakeholders and government, from formal power sharing to active consultation (e.g., Choe 1999). It is characterized by two important properties: the sharing of decision-making power and a focus on the management process. The co-management process defines stakeholders and incorporates them, through various forms of representation, into the fishery management process. Therefore, what distinguishes co-management from the biologists and economists approaches to fisheries problems is that it focuses on management process. It is a process, rather than a tool, of management and, thus, can be used with a variety of management tools. This characteristic makes co-management possible to combine with actually all approaches including, of course, the property rights-based management. This is an important rationale underlying our proposition to integrated property rights-based management and co-management.

Further, both the NIE and practical experience have shown that private property is not necessarily superior to common property as long as the institutions that govern the use of

the commons are properly designed. That is, the performance of a rights structure depends not on whether rights are individual or communal, but on how individual rights are partitioned. Delvin & Crafton (1998:113), for example, argues that [t]he key to success is to set up an incentive structure for individuals that is compatible with both the characteristics of the resource and institutions (cited in Ingrid et al. 2000). Thus, there is no sense that introducing private fishing rights into a fishery is necessarily superior to a collectively-owned property rights. The conclusion is that given the impossibility of devising a perfect regime of property rights to migratory fish stocks, together with an individual share of available TAC that is likely too small to realize fishing economies of scale and scope for heavily populated countries, the collective ownership of ITQs become an option.[17)]

The combination of a property rights-based management and co-management can at least serve as the second best strategy for transforming finfish stocks to de facto to "closed resources". Under such a regime, property rights define the required mechanisms and structures to optimize resource use and conservation while co-management, on the hand, attempts to increase the degree of compliance by users with regulations through incorporating them into the process of rules making and enforcement.[18)] The integration of property rights-based management and co-management can therefore makes use of the institutional advantages embedded in the two management strategies while avoiding their constraints when used separately.

V. Conclusions

The extensive review of literature has led us to the following conclusions.

First, in an interconnected, interdependent, and interacted word, a fishery can no longer be viewed as only consisting an isolated fish stock and those who harvest it. Instead, a fishery has to be taken as a systems embedded in its surrounding human and natural settings.

Second, when a valuable natural resource is depleted, it is either because it has never

17) The term *individual* among the concept of ITQ should not be considered as only representing a fisherman or boat. Rather, it may refer to a group of individuals such as a firm or a fishing village. Here, by the collective ownership of ITQs, we mean that transferable quotas are collectively owned by a group of people rather than an individual person or boat (see also McCay 1999).

18) In fact, Australia, Canada, and New Zealand are all making an effort towards the integration of ITQs and co-management (see, for example, Robichaud 1999; Campbell *et al*. 1999; Harte 2000).

before been incorporated into an institutional framework (the nonexistence of institutions), or because it has become a de facto open-access resource due to institutional failures of one kind or another. For a regulated resource, the tragedy of the commons would be bound to happen when institutional arrangements fail to match the nature of the resource ownership and the incentive created by such ownership as well as the cultural, economic, environmental, and political settings where the commons harbor

Third, the essence of fisheries management is the management of human being, not fish per se. Therefore, the central task of fisheries management has to be the instituting of an enabling governance system. To be effective, such governance system must be able to bring the biophysical and ownership attributes of resources into the greatest harmonization with human incentive structures.

Finally, the property rights-based management and co-management are not only complementary but also compatible. Therefore, they can be integrated into a unified institutional framework. The combination of the two regimes would be able to make full use of the institutional advantages of property rights-based management and co-management when they are used in separation. We believe that this institutional arrangement may be a unique option for countries with a huge fishing population but relatively limited resources to take the institutional advantages of ITQs in managing their finfish stocks.

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재산권에 기초한 협동어업관리에 관한 이론적 연구

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[요 약]

인간의 주요한 경제행위로서의 어업은 현재 전세계에 걸쳐 여러 가지 문제들로 많은 어려움을 겪고 있는데, 그 가운데서 주된 내용이 자원유지와 어업행위와의 조절이다. 이에 따라 어업문제에 대한 해결과 지속적인 어업 발전의 실현에 대한 열망으로 세계 각지에서는 각기 다른 학문영역, 예를 들면 생물학, 경제학, 사회학 등 각 분야의 전문가들이 모여 생태보호주의적 접근법(Conservation-minded techniques)이나 시장 기구에 의한 방법(Market-based instruments), 그리고 공동체에 기초한 관리(Community-centered approaches) 등과 같은 여러 가지 어업관리정책을 제시하고 있다. 이러한 여러 접근 방법 중에서 현재 세계적으로 폭넓은 지지를 받고 있는 것이 재산권에 기초한 ITQs과 협동어업관리제도(Co-management)이다.

ITQ제도는 어업행위에 대한 사적 재산권의 설정을 근간으로 한다. 그러나 어업자원은 회유성이라는 자원의 본질적 성질에 의해 진정한 의미의 사유화는 어렵다. 따라서 어업자원은 완벽한 사유화가 이루어진다 하더라도 특히 어업 인구가 거대한 지역 또는 자원이 한정된 국가에 있어서는 충허용어획량의 개별 할당량이 어업에 있어서 규모의 경제와 같은 경제적 운영을 도모해 나가기에는 너무 적을 수도 있다.

그렇다면 여기에서 어떻게 어업관리를 합리적으로 운영하면 ITQ의 제도적인 이점을 이용하고, 동시에 ITQ제도의 경제적 제약을 극복할 수 있는지에 대해서 묻게 된다. 본 연구의 주목적은 이러한 의문으로부터 출발한 것으로, 협동어업관리제도에 의한 어업 할당량의 공동소유는 ITQ제도의 경제적 약점을 제거하는 동시에 그 이점을 누리는 최고의 해결책이 될 수 있다고 보고, 다음과 같은 내용에 대해 고찰하였다.

어업 문제의 본질은 어떻게 인식되는가, 어업문제 해결의 전통적 방식과 새로운 패러다임은 무엇인가, 그리하여 본 논문에서는 결론적으로 어업문제 해결의 새로운 패러다임으로서 협동어업관리 제도의 본질을 이해함과 아울러 재산권에 기반을 둔 협동업관리 제도의 통합모형을 제시하였다.