Ocean fisheries management: recent international developments

Ragnar Arnason

This paper is concerned with ocean fisheries management with particular emphasis on the application of economic theory to fisheries management practice. The paper begins by briefly discussing the common property nature of ocean fisheries and explains how the common property problem gives rise to the need for a specific management of fisheries. It goes on to examine various proposed methods of fisheries management arguing that only property-rights-based fisheries management systems, such as individual transferable quotas (ITQs) or fisheries management based on the imposition of the appropriate tax on catch seem to be capable of delivering the full potential economic benefits of ocean fisheries. Finally, it reviews recent developments in the management of actual ocean fisheries with special reference to Australia, Iceland and New Zealand. The paper concludes that an economic rationalization of ocean fisheries is probably historically inevitable. Moreover, judging from historical trends in fisheries management, this rationalization will probably be accomplished by a property-rights-based management system such as the ITQ system.

Many of the world's marine resources are extremely rich. Prudently utilized they are capable of yielding very substantial economic benefits. In some regions, the potential value of the surrounding ocean resources is so great compared to the rest of the local economy that they can provide the means for shifting the economy onto a new and more favourable economic growth path.

However, there are formidable economic obstacles to actually realizing the potential benefits offered by ocean resources. It turns out that there is an incompatibility between the traditional free access, competitive fisheries and a sensible utilization of the fish stocks. Although free access and competition normally result in increased production and lower prices in manufacturing industry, they lead to reduced output and loss of economic benefits in ocean fisheries.

The particular aspect of fisheries that gives rise to these perverse results is that fish stocks constitute a natural resource. This resource is not unbounded. The annual catch is limited by the reproductive capacity of the fish stocks. This natural limitation cannot be expanded by the fishermen. On the contrary, attempts by individual fishermen to increase their catches will generally reduce the size of the fish stock, in particular the spawning stock, to the point where the sustainable yield of the fishery is greatly reduced. In fact, several previously large and valuable fish stocks have been depleted and the fishery destroyed by excessive fishing pressure due to fishermen competing for the catch.

The histories of most ocean fisheries have been distressingly similar. They usually run as follows. Initially, when the fishery is first being developed, the resource stock is high. Therefore catches are good and the fishermen earn a high return on their investment and effort. This encourages the more enterprising of the fishermen to expand the level of their fishing operations. It also attracts new fishermen to the fishery. Thus, an investment in fishing capacity takes place and fishing effort rises. This reduces the fish stocks and catch per unit of effort declines. Economic returns from the fishery are correspondingly reduced. This, however, does not put an end to the expansion of fishing capacity. This continues as long as the fishermen can reasonably hope to extract a positive rate of return from the fishery. Long before that happens, however, the fish stock has normally been reduced far below the level corresponding to a maximum sustainable yield, and total annual catches have been reduced in spite of greatly increased fishing effort.

The free access competitive fishery will reach an equilibrium only when the expansion in fishing effort has brought the stock size down to the point where total fishing costs equal the value of the harvest. As long as harvesting revenues exceed costs there will be an incentive to invest in new capacity. At the equilibrium point, however, net returns from the fishery are zero and, consequently, there is no incentive to invest in expanded capacity. These basic ideas are illustrated in Figure 1.

In Figure 1, aggregate fishing effort, denoted by E, is measured along the horizontal axis. Costs and revenues are measured along the vertical axis. It is important to realize that in this model these variables are supposed to reflect true social costs and revenues which may or may not coincide with market values. The curve labelled 'Total Revenues' represents total sustainable revenues or gains from the fishery at different effort levels. At low levels of fishing effort – as would be the case in the early development stages of a fishery – the shape of this curve indicates increasing revenues as higher effort levels yield more catches. This increase tapers off, however, and eventually revenues begin to fall as increased effort reduces the fish stock below the maximum sustainable yield (MSY). The curve labelled 'Total Costs' represents total costs of effort. This curve naturally rises as effort increases.

The author is Professor, Department of Economics, University of Iceland.

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marine environmental conservation, with among other things world-famous seabird colonies. It is indeed an immeasurably valuable environment, both for the resources it provides and intrinsically in itself. Further, taking into account the relatively small island community dependent upon the sea, Shetland typifies many island and coastal communities the world over.

The Shetland Islands Council has a long tradition of taking the initiative in community affairs, including gaining a measure of local control over the developments associated with the advent of the offshore oil industry in the 1970s. This latest initiative is timely, not only in a Shetland context, but globally in showing the key importance which local initiatives must assume in environmental management, and the issues with which local communities are confronted in dealing with the sea. The Shetland example could well be followed around the world, in both raising awareness of marine environmental management issues and providing the all important guidelines for dealing with practical implementation measures.

In opening the conference, the Convenor of the Council, Edward Thomason, referred to the 19th century inspired motto of the Council, which harks back in Old Icelandic to the early medieval origins of the Norse settlement: 'Med logum skal land byggia' ('With laws shall the land be built'). This is not a narrow legalistic interpretation, but symbolizes the progressive building up of the community and its institutions in its island home over the generations, leading to the emergence of the 'Old Rock', which was the name given by 19th century – and later – Shetlanders to their islands, especially if they had emigrated from it.

In this, the sea has provided the essential inspiration, summed up at the closing of the conference by the doyen of Shetland life and literature, John Graham, reading from Rhoda Bulter's (Shetland's leading late 20th century poet) famous poem, 'The Sea':

'For nae man can tame dee and nae hadds keep,
Bit du's inspiration ta me'.

'*For no man can tame you and no walls confine,*
But you are inspiration to me'.

Note

The following papers delivered at the conference are unavailable for publication: Ragnar Arnason, 'The Icelandic individual transferable quota system' (to be published elsewhere); Captain Jean-Yves Alexandre, Chief Harbourmaster, Port Autonome de Marseille, 'The harbour authority approach to the environment: management and control of traffic within harbours and the role of the harbourmaster'; Ken Collins, MEP, 'The need for a consistent approach to pollution control: a coherent policy towards tanker safety and pollution control'; and Edwin Reavley, Head of Air and General Environmental Protection Division, Scottish Office, 'The role of an environmental protection agency in the UK'.

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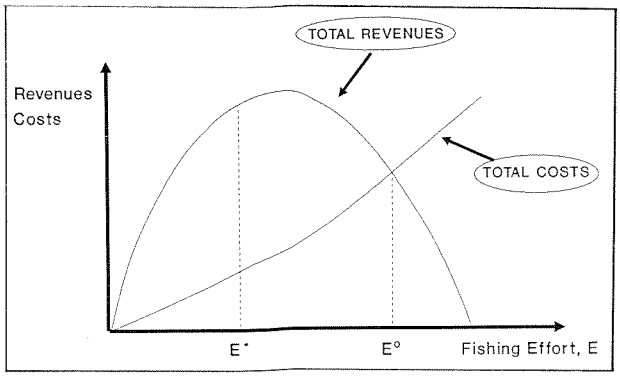

Figure 1. The sustainable fisheries model.

The equilibrium point for the free access, competitive fishery is at effort level E^O. At this level of fishing effort total costs equal total revenues. Profits are zero and there will be no further expansion nor contraction of fishing effort. The fishery has reached an equilibrium. Unfortunately, however, at this point there are no net economic returns from the fishery.

On the other hand it is clear from Figure 1 that significant net returns could be attained by reducing fishing effort. In fact, net returns are maximized at effort level E^*, where the difference between total revenues and total costs is greatest. The problem, however, is that a reduction in fishing effort to E^* will never be supported by free access, competitive fisheries. The reason is that the profits realized at such an effort level would encourage expansion of fishing capacity until the point E^O was reached again.

This simple analysis fits closely the observed pattern of free access, competitive ocean fisheries. All over the world such fisheries are characterized by excessive fishing capital and fishing effort, depressed fish stocks and little or no net economic returns.

The failure of free access, competitive fisheries was recognized only relatively recently. In the mid-1950s two Canadian economists, S.H. Gordon[1] and A.D. Scott,[2] published pioneering articles about the fisheries problem. These articles – which later proved to mark the beginning of the whole field of fisheries economics – put forward essentially the analysis that has been described above.

Scott, moreover, managed to throw a slightly different light on the problem. He noted that a single informed owner of a fishery would not fall into the trap of excessive exploitation of the resource. Thus, from this point of view, the fisheries problem is caused by the lack of private ownership over ocean resources or, in other words, the common property nature of ocean resources.

It is this common property nature of ocean resources that basically forces fishermen to overexploit the fish stocks, even against their own better judgment. When many fishermen have access to the same fish stock, each has every reason to grasp as large a share of the potential yield as possible lest the other fishermen reap all the benefits the resource can offer. Prudent harvesting exhibited by one fisherman in order to maintain the stocks will, for the most part, benefit only other, more aggressive, fishermen without preventing the ultimate decline of the stocks. Thus, each individual fisherman, acting in isolation, is powerless to alter the course of the fishery. His best strategy is to try to grasp his share as quickly as possible while the resource is still large enough to yield some profits.

This in a nutshell is what has been called the 'tragedy' of common property resources.[3] Their potential benefits, no matter how great, tend to become dissipated under the onslaught of a multitude of users.

The common property problem is by no means confined to fish resources. The same problem is encountered in the use of common land, wildlife and many water and air resources. This, of course, includes the use of the ocean and waterways for the transport of hazardous materials. In all these cases the commonly owned resources tend to become overused, sometimes with disastrous consequences.

Thus, both empirical evidence and economic analysis go hand in hand. Both clearly demonstrate the need for special management of fisheries if the potential benefits of ocean fisheries are to be realized. For coastal States with rich fish resources in their waters the potential economic benefits of well informed fisheries management are very great indeed.

Fisheries management methods

This simple analysis of the fisheries problem demonstrates the need for specific fisheries management. For this purpose a great number of different fisheries management measures have been suggested and tried. Most of these, however, may be conveniently grouped into two broad classes: (1) biological fisheries management, and (2) economic fisheries management (Figure 2). Economic fisheries management measures may be further divided into (a) direct restrictions and (b) indirect economic management.

Biological fisheries management

The most common fisheries management method is undoubtedly to impose an upper limit on total allowable catch (TAC). This is a typically biological management

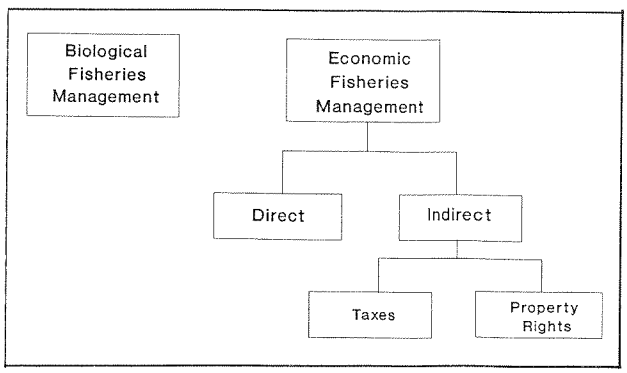

Figure 2. Fisheries management methods: classifications.

measure designed to protect the fish stock. If adhered to – which is not always the case – total allowable catch restrictions are indeed well suited to conserve the fish stocks. This kind of fisheries management does not, however, alter the underlying economic forces operating in the fishery. Therefore, if the total allowable catch approach manages to enhance the fish stocks, competition between fishermen for shares in the total allowable catch will result in correspondingly increased fishing effort and overcapitalization in the fishing fleet. More vessels will be brought into the fishery and fishing effort expanded until all economic benefits have disappeared again.

The same holds for all other management measures designed to improve the state of the fish stocks. These include fishing stoppages during spawning seasons; closures of nursery grounds; measures for protection of juvenile fish, fishing gear restrictions, etc. To the extent that such measures are actually successful in enhancing the fish stocks, the potential economic benefits will be dissipated by increased fishing effort and renewed investment in fishing equipment by competing fishermen striving to grasp a greater share in the fishery.

The conclusion thus appears to be that biological fisheries management measures, while well suited to preserving fish stocks, are useless from an economic point of view. In fact, the outcome is typically even worse.

Setting and enforcing biological fisheries restrictions is invariably costly. Usually, these costs are quite substantial. Since, as we have already seen, biological fisheries management generates no economic benefits to speak of, these costs represent a net loss. Hence, we must conclude that fisheries management based exclusively on biological conservation measures will generate a negative economic return. Such measures are therefore not to be recommended unless the only alternative is the biological destruction of the fish stocks.

Economic fisheries management: direct restrictions

The most frequently employed direct fisheries management methods are restrictions on fishing effort and restrictions on investment in fishing capital. These methods are basically designed to bring fishing effort and capital down to optimal levels and thus realize the potential economic benefits of the fisheries. These direct methods do not, however, eliminate the basic common property nature of the fisheries and thus encounter severe problems in achieving this objective.

Restrictions on fishing effort have been tried in many fisheries.[4] Such restrictions take various forms; there are limitations on days at sea, fishing time, engine size, holding capacity of the vessels, etc. However, irrespective of the precise nature of the effort constraints, the outcome is generally the same. Fishing effort is a composite of many variables. In their attempts to maximize their returns from the fishery, competing fishermen always expand fishing effort variables that are not subject to restrictions. If the number of fishing days is limited, investment in larger and more powerful vessels is usually observed. If there is a restriction on the holding capacity of the vessels, fishermen will counteract by adding vessels and employing speedier ones. If there are simultaneous restrictions on the number of vessels, fishing days, holding capacity and engine capacity, there will simply be investment in fish-finding equipment, fishing gear and similar variables. The end result is always the same. Competing fishermen will find ways to invest in uncontrolled effort variables. This investment, moreover, does not come to an halt until all potential economic rents from the fishery have been dissipated. As long as there are economic rents in fishery, there will be an incentive to find ways to by-pass the restrictions. Experience shows that it would be unwise to underestimate the ingenuity of fishermen in finding such ways.

The conclusion therefore must be that direct fisheries management methods are unlikely to generate significant economic benefits. Moreover, since the maintenance and enforcement of such measures is usually quite costly, the net benefits generated may easily turn out to be negative.

Economic fisheries management: indirect measures

The most prominent indirect economic fisheries management methods are (1) corrective taxes and (2) property-rights-based instruments such as access licences and individual transferable quotas. Both taxes and individual transferable quotas are theoretically capable of achieving economic efficiency in the fisheries. There are, however, substantial socio-political problems as well as some practical ones with taxes as fisheries management tool. In any case, taxes have not to my knowledge been used as the main fisheries management measure in any significant ocean fishery. Individual transferable quotas, on the other hand, have been employed in several fisheries with a fair degree of success and are rapidly spreading.

Corrective taxes. The idea of taxes as a fisheries management tool is to alter the economic conditions of the fishing firms so as to induce them to behave in socially optimal fashion. Many different types of corrective taxes are conceivable for this purpose. They can, however, be broadly classified as either taxes on fisheries inputs or taxes on catch.

Taxes on fisheries inputs do not appear very promising. Such taxes will generally lead to substitution away from taxed inputs to those not taxed. However, to the extent that technical input substitution possibilities are not perfect, this method will generally manage to generate some economic rents in the form of collected taxes.

Tax on catch is a much more effective way to realize the potential economic benefits of a fishery. After all, apart from straightforward cheating, there is no way for the fishermen to avoid this kind of a tax. The immediate effect of a tax on catch is to make the fishery less profitable. Hence, by squeezing out least efficient fishermen, tax on catch forces a reduction in aggregate fishing effort. Thus, depending on the tax rate, the effort level in the fishery can in principle be brought down to the economically most rewarding one.

Property-rights-based approaches. Property-rights-based approaches to fisheries management attempt to eliminate the common property problem by establishing private property rights over the fish stocks. Since the source of the economic problems in fisheries is the absence of property rights, this approach should in principle be successful in securing full economic benefits from the fishery.

Broadly speaking, two quite different rights-based approaches have been employed in actual fisheries. They are (1) access licences and (2) individual catch quotas.

(1) Access licences give the holder the right to participate in the fishery. Access licences thus constitute a property right and, to the extent that they are transferable, will comand a market price. Access licences do not, however, eliminate the common property problem. The fishery is still the common property of all holders of access licences. This group, therefore, tends to act in the way already described. In order to improve or even maintain their share in the fishery they are forced to invest in fishing capital and expand fishing effort. This process continues until all attainable rents have been dissipated at which point the fishery finds an equilibrium.

Under a system of access licences, however, the common property problem may be somewhat alleviated. This holds, for instance, if the number of access licence holders is low and, more importantly, if there are restrictions on capacity expansion amongst the holders of licences.

Access licences have been employed in many important fisheries in recent years. In the very valuable British Columbia salmon fishery, for instance, access licences have been in effect for a number of years with some, albeit limited, economic success.

(2) Individual vessel quotas constitute a much more promising approach to the fisheries problem. By being allocated catch quotas individual fishermen are in effect given property rights in the fish stocks. Since each fisherman's catch is secured by his quota holdings, the common property nature of the fishery is eliminated. Thus, instead of competing with his fellow fishermen for catch from a limited resource, under an individual quota system the fisherman can concentrate on minimizing the cost of harvesting his catch quota and maximizing its value by improving its quality.

Transferable and perfectly divisible catch quotas are usually referred to as individual transferable quotas (ITQs). If the ITQs are also permanent they constitute a complete property right just like a building or a piece of land. In that case, standard economic theory should apply and, barring market imperfections, the fishery should automatically reach full efficiency.

This important point may be explained in a little more detail: First, if catch quotas are transferable, a market for the quotas will emerge. With the help of this market the quotas will tend to revert to the most efficient fishing firms. The more efficient the quota market the more pronounced will this tendency be. In this manner, an ITQ fisheries management system will tend to guarantee that the TAC is always caught by the most efficient fishing firms.

Second, if the catch quotas are also permanent, fishing firms will find it to their advantage to adjust the capacity of the fishing fleet to the socially optimal level. After all, due to the transferability of the quotas, only the most efficient firms will do the harvesting. These firms will not hold excessive fishing capital. If they did they would not be fully efficient and would lose out in the market for quotas. For the other firms, not holding any catch quotas, there is of course no point in maintaining unused fishing capital. Therefore, aggregate fishing capital will tend towards the socially optimal level.

Most promising fisheries management systems

Of all the fisheries management systems considered, only the individual transferable quota system (ITQ) and tax on catch seem to be capable of delivering the full potential economic benefits of fisheries. Since the ITQ system essentially eliminates the basic common property problem of fisheries, there has now emerged a consensus among fisheries economists that this management system offers the most promising general approach to managing ocean fisheries. This does not mean, however, that ITQs are necessarily the best management in all fisheries. For instance, a prerequisite for this method to work is that the individual quota constraints should be enforceable. If that is not the case some other management method may be preferable.

Recent development in fisheries management

Following the general extension of national exclusive economic zones to 200 miles in the 1970s there has been a rapid development in fisheries management methods worldwide. Many coastal States, enjoying for the first time sovereignty over important fish stocks, have adopted new management regimes. Most of these methods, however, are of the biological type and are not likely to yield significant economic benefits.

In recent years, however, a few prominent fishing nations have instituted fisheries management systems that hold promise of success. The most interesting of these new management systems are found in New Zealand, Iceland and Australia. These three countries have all adopted advanced versions of the individual transferable quota system in their fisheries. Generally speaking, their experience of this fisheries management system has been favourable.

As a great deal may be learned from the experience of these countries, it may be useful to review briefly their management systems.

New Zealand

Until the late 1970s New Zealand fisheries were for the most part free access although some inshore fisheries were subject to limited entry. In the late 1970s and early 1980s, however, it became clear to the fishing authorities that the fisheries had become overcapitalized with corresponding adverse consequences for their economic profitability and the biological state of the fish stocks. Consequently,

various measures to restrict new entry to the fisheries were introduced. However, these proved rather ineffective. In 1983 a system of company catch quotas was introduced in the deep water fishery and a separate system of individual catch quotas in the inshore fisheries soon thereafter. In 1986 these systems were consolidated in one uniform individual transferable quota system (ITQ) in all major fisheries.

The initial allocation of catch quotas to individuals and firms was based on catches prior to the institution of the quota system. The quotas stipulated the right to harvest a certain quantity every year. This particular aspect of the quota system proved problematic for the management of the resources due to the annual variability in total allowable catches (TACs). Therefore, in 1989, the catch quotas were changed into rights to harvest a certain fraction of the TAC annually.

The essentials of the current individual transferable quota system in New Zealand are as follows:

(1) The quotas constitute a right to catch a fixed proportion of the TAC every year in perpetuity.
(2) The quotas are perfectly divisible and transferable to all New Zealand nationals.
(3) All important commercial fisheries are subject to these quotas.
(4) The quotas were initially allocated on the basis of catches prior to the institution of the quota system.
(5) The government has announced its intention to extract the resource rents by means of taxing quota values.

The New Zealand quota system has now been in effect for a number of years. Although few hard data are available on its results, it seems to have been quite successful. Some reduction in fishing capacity has taken place. There has been a degree of consolidation of quotas in the hands of the more efficient companies. The profitability of the fishing industry seems to have improved and the market value of quotas, which is usually considered a good indicator of economic rents, has increased substantially. Finally, the system continues to enjoy the support of the fishing industry.

Iceland

Until the mid-1970s most Icelandic fisheries were, for all intents and purposes, international free access, competitive fisheries. With the extension of the Exclusive Economic Zone (EEZ) to 200 miles in 1976 this was drastically changed. Since then practically all Icelandic fisheries have come under extensive management restrictions.

Since 1976 a variety of fisheries management measures has been tried in Iceland including (1) overall catch quotas, (2) fisheries access licences, (3) fishing effort restrictions and (4) individual vessel catch quotas.

With increased experience, however, there has been a clear trend towards ITQs in the management of all fisheries. An ITQ system was adopted in the herring fishery in 1979. This, incidentally, seems to be one of the first ITQ systems adopted in a major ocean fishery. An ITQ system was introduced in the Icelandic capelin fishery in 1981 and in the important demersal fisheries in 1984. Since 1990, all Icelandic fisheries have been managed on the basis of a uniform system of individual transferable vessel quotas. The essentials of this system are as follows:

(1) The quotas constitute a permanent right to catch a given proportion of the TAC every year.
(2) The quotas are perfectly divisible and transferable with some minor restrictions on trans-regional transfers.
(3) All important commercial fisheries are subject to these quotas.
(4) The quotas were initially allocated on the basis of catches prior to the institution of the quota system.

The individual vessel quota system in Iceland seems have yielded considerable economic benefits. New investment in fishing capital has been reduced. In some fisheries the number of operating vessels has dropped significantly. Fishing effort has also been significantly reduced. Finally, estimates of the actual economic rents generated by the system as well as analysis of quota values strongly indicate that very substantial economic benefits are already being generated by this management system.[5]

Australia

The Australian fisheries jurisdiction is one of the largest in the world and comprises many fisheries. Most of these fisheries, however, are relatively small and Australia is not among the world's major fishing nations.

In a Policy Statement issued in 1989, the Australian government announced its intention to manage Australian fisheries so as to (1) preserve fisheries resources, (2) maximize the economic efficiency of the fisheries and (3) collect the appropriate share of the economic gains generated by the fisheries.[6] The Australian government went on to state that an ITQ fisheries mangement system is its preferred method to achieve these objectives.

The three most important Australian fisheries are (1) the northern shrimp fishery, (2) the bluefin tuna fishery and (3) the South-east trawl fishery. Of these, the bluefin tuna fishery and the South-east trawl fishery have already been subjected to an ITQ fisheries management system.

The Australian bluefin tuna fishery was experiencing an alarming drop in stocks and was subjected to an ITQ system in 1984. At the same time the total allowable catch was reduced and a corresponding cut in fishing capital encouraged.

According to a recent study,[7] this system appears to have been a success. The transferability of the quotas has enabled less efficient fishing firms to sell their quotas to the more efficient firms and leave the fishery. Thus, the fishing capital levels have been significantly reduced and this fishery is now generating substantial economic rents compared to none before.

Recently, an ITQ system has been imposed on the Southern trawl fisheries. Thus, two of Australia's three most important fisheries are currently subject to an ITQ fisheries management system.

Other nations

The relatively positive outcome of the ITQ systems in New Zealand, Iceland and Australia has encouraged several other prominent fishing nations to consider seriously the adoption of similar property-based management systems in their fisheries. Thus, Canada has already adopted or is in the process of adopting an ITQ system in several of its most important fisheries. These include *inter alia* the deep-sea cod fishery off the east coast and, interestingly, the Pacific halibut fishery which until now has been the textbook example of a biological successful but economically mismanaged fishery. The USA appears to be moving gradually in the same direction. A number of other fishing nations, including Norway and several EC countries have installed individual quota management systems without transferability, ie the so-called IQ system, in some of their fisheries. Finally, the large fishing nations of South America (Chile and Peru) have already taken steps toward the eventual adoption of an ITQ system into their fisheries.

Conclusion

Since the general extension of the Exclusive Economic Zones to 200 miles in the 1970s there has been a clear trend toward the adoption of property-rights-based fisheries managment systems worldwide. This trend has been encouraged by the relatively positive outcome of experiments with such systems by such prominent fishing nations as Iceland and New Zealand.

This trend toward property rights in fisheries replicates to a certain extent a corresponding development in the organization of economic activity on land in earlier times. In fact, the spreading of ITQ fisheries management systems may be regarded as yet another stage in the historical expansion of private property rights as a method of economic organization. Just as with property rights on land, the ITQ system at sea may be confidently expected to yield substantial economic benefits. This prediction is, in fact, supported by the experience of the fishing nations that have already adopted the system.

These historical and economic arguments should not, however, close our eyes to certain problems associated with the ITQ system.

First, the ITQ system is not suitable for all fisheries. For the ITQ system to work, it has to be possible to enforce the quota restrictions. This, of course, applies also to property rights systems on land.

Second, the introduction of an ITQ system often represents a radical restructuring of traditional fishing activities. This generally requires socio-economic adjustments that are often resisted and may therefore make the introduction of the ITQ system difficult to achieve.

Third, although the introduction of an ITQ system may be expected to yield social benefits far exceeding the costs in most fisheries, the actual distribution of the costs and benefits may easily turn out to be socially undesirable. Fortunately, however, distribution objectives of this nature can generally be achieved through the design of the ITQ system, especially the initial allocation of quotas. This suggests the importance of taking full notice of distributional considerations in the design of an ITQ system.

The crucial point, however, is that economic rationalization of ocean fisheries is probably inevitable. A property-rights-based system, such as the ITQ system, appears to be the most effective way of accomplishing this. Therefore, it is advisable to begin preparations for the eventual implementation of such a system in an orderly fashion. The alternative is to risk being rushed, a late stage, into a fisheries management system that may not be suitable.

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[1]H.S. Gordon, 'Economic theory of a common property resource: the fishery', *Journal of Political Economy*, Vol 62, 1954.

[2]A.D. Scott, 'The fishery: the objectives of sole ownership', *Journal of Political Economy*, Vol 63, 1955.

[3]G. Hardin, 'The tragedy of the commons', *Science*, Vol 162, 1968.

[4]Notable cases are the Pacific halibut fishery and the Icelandic demersal fisheries in the 1970s.

[5]For more details on this see R. Arnason, *The Icelandic Fishing Industry: Changing Structure and Performance*, Department of Economics, University of Iceland, 1991; and R. Arnason, *Fisheries Management: Catch Quotas or Effort Restrictions* (in Icelandic), Department of Economics, University of Iceland, 1992.

[6]For more details see *New Directions for Commonwealth Fisheries Management in the 1990s: A Government Policy Statement*, Australian Government Publishing Service, 1989.

[7]For example, see G. Geen, and M. Nayar, 'Individual transferable quotas in the Southern Bluefin Tuna Fishery: an economic appraisal', in Neher et al, *eds*, *Rights Based Fishing*, Kluwer, 1989.

Individual transferable quotas: the New Zealand experience

Ian Clark

This article describes the New Zealand experience of individual transferable quotas (ITQs) since 1986. Documentation is detailed and the benefits of the ITQ system are listed. The report concludes that the ITQ system has been more successful than traditional fisheries management methods.

When we talk of protecting the environment, conserving resources, ensuring the eco-system is not damaged, we are only acting in our own self-interest. We are making certain that we survive. Regardless of what we do, the planet, nature, the environment will continue to exist. It might be slightly, or even vastly, different from what we know and it may well be in a form that will not support our continued existence.

It can be argued that we have a moral, ethical or even intellectual responsibility to ensure that we care for the environment and its contents; that we have a stewardship to exercise; that we are merely tenants or even mere passersby and must always be conscious of our duties and responsibilities. Just so: but if we fail in this we fail only ourselves. We are the ones who will suffer.

With fisheries we speak of the management and conservation of the resource and the protection of the environment and eco-systems. If a species is fished out it would be replaced by something in the system or the system would change in response to that species' demise.

If we look at the experience of the past 50 years of fisheries management, we can be nothing but appalled at the failure to manage fisheries sustainably. And yet in many, if not most, places we are still trying the failed old ways. There are successful ways to manage fisheries for their conservation and economic and social contribution. Even more importantly there are now increasing numbers of examples around the world where successful management regimes exist.

Ian Clark is an Economic and Fisheries Management Consultant based in New Zealand.

Development of New Zealand fisheries

For the period up to the declaration of the 200-mile EEZ in 1978, New Zealand's fisheries were small and largely confined to an inshore domestic industry.

Management of fisheries during this time was confused and characterized by fundamental changes. From 1938 to 1963 the fishery was managed under a restrictive licensing system with very tight controls. In 1963 the fishery was completely deregulated and remained that way, by and large, until 1980, when a moratorium on the issuing of further wet fish permits was introduced.

With the introduction of the EEZ in 1978 a major expansion of the industry took place through the development of joint venture arrangements with foreign fishers to exploit the new and unfamiliar resources of the EEZ. By 1980 it was realized that economic as well as biological objectives were necessary for effective management and to this end a fisheries management regime was needed that concentrated on improving the economic performance of the industry within the overall constraint of the sustainability of the resource. It had also become clear that the traditional fisheries management approaches had and were continuing to fail. It was realized that a new and different approach was needed based on controlling output rather than relying on old-fashioned input controls.

In 1983 the quota-based deepwater trawl policy was introduced. Under this system total allowable catches (TACs) were established, quotas were allocated to major participants in the industry based on specific determined criteria, and monitoring and reporting systems introduced.

At the same time the inshore fishery was facing severe biological and economic problems of its own. These problems (primarily overfishing and the danger of biological collapses) focused attention on the inability of traditional management methods to deal effectively with sustainable management. They certainly highlighted the failure of these methods to deal with economic performance issues.

Individual transferable quotas

The result of these developments was the integration of economic objectives and strategies into the overall management programmes and in 1986 the individual-transferable-quota-based management system for both the inshore and deepwater fisheries (the QMS) was introduced. The fundamental constituent of the QMS is the individual transferable quota (ITQ) which is a transferable property right allocated to fishers as a right to harvest surplus production from stocks.

Currently some 32 species are included in the system and the government has made it clear that the ITQ-based QMS is the fundamental mechanism by which fisheries in New Zealand will be managed. At present the system is being expanded and extended to incorporate the remaining commercial fish species. The incorporation of recreational, environmental and conservation objectives into the QMS is also under consideration.

The system covers single-species fisheries, multi-species trawl fisheries, and multi-method fisheries. It is also to be used to manage highly migratory species. Quotas are managed through a computer-based recording system using information provided by quota

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