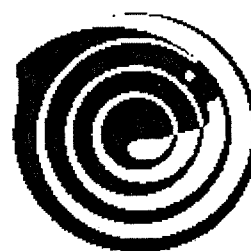


A Practical Guide to ITQs for Fishery Managers and the Fishing Industry

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OBJECTIVES:

1. Compilation of operational ITQ experiences in Australia and selected other countries.
2. Analysis of the practical difficulties faced in the implementation and operation of ITQs.
3. Develop guidelines to assist fishery managers and industry in the implementation of ITQ systems.

NON-TECHNICAL SUMMARY:**Background and Need**

Dissatisfaction with the results of input control based management has led to an increasing worldwide interest in the use of output controls, such as individual transferable quotas (ITQs). Individual transferable quotas involve setting a total allowable catch (TAC) for a given fish stock and allocating a share of the TAC to each of the various participants within the fishery. However, significant problems have emerged in the design and implementation of ITQ systems.

Given the strong and growing focus on ITQs as an alternative to effort controls, prevention of the ITQ implementation mistakes of the past is therefore extremely important. This project was designed to address this need by reviewing the practical experiences of ITQs, analysing the operational difficulties encountered when implementing ITQs and compiling a non-theoretical, easily understood operational guide to ITQs targeted at those directly involved in implementing ITQ regimes: fishery managers and the fishing industry.

Methods

The methods used to carry out the research included a review of Australian and international literature on ITQ implementation, semi-structured interviews with fishery managers in AFMA and state fisheries management agencies, discussions with industry on their experiences with ITQs, active participation in the process of introducing ITQs and information gathering from fisheries managers and economists working in Canada, Iceland, Norway, New Zealand and the United States.

Results/Discussion

The results of the project are detailed in a 240-page book entitled *Fish Futures: Individual Transferable Quotas in Fisheries*. The book is intended as a reference guide for planning and implementing an ITQ regime.

After presenting the main reasons as to why and how governments manage fisheries and an overview of ITQ fisheries in Australia and six other countries, *Fish Futures* discusses areas most important to ITQ design and implementation. The discussion includes the legal implications of ITQs, quota allocation, compliance and enforcement, discarding, management costs, TAC setting and social impact.

Analysis of both the legislation which created the ITQ right and the case law on fishing rights in Australia, New Zealand, Canada and the United States shows that ITQs are created by government legislation as a means of regulating an industry. Because they are created by statute, they are governed by statute. The legal implication of this is that most ITQ regimes are inherently open to modification such that compensation for modification or non-renewal of an ITQ is usually only payable if required explicitly by fisheries or other legislation.

The most contentious issue surrounding the implementation of ITQs is determining individual quota allocations as this has a major economic impact on pre-ITQ entitlement holders as well as other stakeholders such as crew members, processors and fishing communities in general. A review of the experiences in quota allocation highlights the need for a clear justification for the formula selected and the use of explicit principles in the allocation process. Experience has also shown that there are often advantages in removing the management agency and the fishers from direct involvement in developing and recommending an allocation formula. An alternative approach is to establish independent panels of experts in law, economics and fishing to advise on allocations.

A difficult task for a fisheries management authority proposing to introduce ITQs is to design a quota compliance program that will not only be effective but will instill confidence in all stakeholders without causing management costs to soar. Currently, compliance programs for ITQ fisheries are based either on paper trails (supported by random inspections of landings and product flow and by audits) or on large scale dockside monitoring of landings. After an analysis of both programs, dockside monitoring is thought to be the way forward as the emphasis of compliance activities shifts from prosecution to prevention of offences and thus is likely to engender greater cooperation from industry.

Unreported discarding of fish is sometimes seen as major impediment to the introduction of ITQs. Discarding may result in TACs being exceeded by an unknown quantity that would, in turn, result in increased uncertainty about the accuracy of stock assessments and the validity of TACs. A review of discarding practices in ITQ fisheries indicates that that fisheries management authorities will need to implement a combination of policies to adequately address the problems of discarding in multi-species fisheries. Although no particular policy is clearly superior to others, quota substitution, by using quota of target species to cover bycatch species, offers the advantage of smaller quota over-runs than do deemed value or surrender schemes.

Regarding management costs, it is difficult to generalise about the net impact of ITQs as there has been little empirical analysis undertaken on this issue. To date evidence suggests that management costs under ITQs might be higher than for alternative input control options. However, the net impact on management costs will vary from fishery to fishery, depending on a number of factors such as the type of pre-ITQ management arrangements in place, the type of quota monitoring regime implemented, and whether existing effort controls are reduced or eliminated. The need to examine all of the costs and benefits of introducing both ITQs and the major effort control alternatives prior to embarking on a new management regime is recommended.

Management through individual quota regimes requires the setting of a TAC for species that are to be placed under quota management, although TAC setting is not unique to ITQ management. An analysis of experiences and research shows a lack of compelling evidence supporting the contention that ITQs require more timely or accurate stock assessments. Nor is there strong support for the position that uncertainty surrounding stock status requires lower harvest rates under ITQ management (relative to no TAC/effort management).

One concern frequently raised with respect to ITQs is the potential for negative social impacts. However, the research shows that there have been few in-depth studies on the social impacts of ITQs. It is concluded that social adjustment costs should be explicitly considered in the development of alternative fisheries management programs, and thought given to how such impacts can be ameliorated.

Benefits/Conclusions

Potential benefits from the adoption of some of the strategies described in the book, such as allocation advisory panels and dockside monitoring systems, include:

- A reduction in fishery management costs through improved design and implementation of ITQ systems.
- A decrease in litigation over quota allocation and a consequent reduction in litigation-related costs.
- An increase in compliance with management regulations through improved enforcement.

Fish Futures is the first book to address the practical issues of ITQ implementation and thoroughly review the state of the law on ITQs and property rights. The book should therefore contribute to a greater understanding amongst fisheries managers, the fishing industry and other stakeholders of the opportunities and constraints under ITQ systems.

A Practical Guide to ITQs for Fishery Managers and the Fishing Industry

1. Background

In recent times there has been an increasing focus on the failure of fisheries management to deliver resource sustainability and a profitable harvesting sector. The Food and Agriculture Organization of the United Nations estimated that in 1989, global fishing costs exceeded global fishing revenues by US\$ 54 billion (FAO, 1993). In Australia, the Australian Bureau of Resource Economics has estimated that the value of redundant inputs in Australian fisheries range from 25% to 60% of the value of landings (ABARE, 1990).

Until recently, the major tool used in fisheries management has been various forms of input controls. However, dissatisfaction with the results of input control based management has led to an increasing interest in the use of output controls, such as individual transferable quotas (ITQs). In 1989, the Commonwealth Government issued a Policy Statement on Fisheries that stated that ITQs were the preferred form of fisheries management instrument. In 1996, a review of the Commonwealth fisheries management by the Australian National Audit Office recommended that the Australian Fisheries Management Authority (AFMA) should 'formally identify the impediments to the introduction of output controls on Commonwealth fisheries and systematically develop strategies designed to overcome them'.

A number of ITQ systems have been implemented in state and Commonwealth managed fisheries in Australia since 1984 and in fisheries worldwide. The ITQ option is being currently considered for broader implementation in many jurisdictions within Australia.

2. Need

Significant problems have emerged in the design and implementation of ITQ systems both in Australia and worldwide. For example, the introduction of ITQs in the Australian Commonwealth south east trawl fishery (SET) was considered to be "appallingly handled" (South East Fishery Adjustment Working Group 1996). As a consequence, there has been at least eight internal reviews into various aspects of the SET as well as cases being heard by the Administrative Appeals Tribunal and taken to court. In Canada, the introduction of ITQs, in particular the allocation formula in the halibut fishery, was successfully challenged in court.

Similar difficulties with implementation of ITQs have been experienced in state managed fisheries. For example, in the Tasmanian rock lobster fishery, a proposal to introduce ITQs met with considerable industry resistance and a subsequent Tasmanian Legislative Council Select Committee review.

A number of the problems experienced with ITQs, such as ineffective and costly monitoring, discarding and dissatisfaction with allocations can be related to improper design and implementation of ITQ systems as opposed to the difficulties intrinsic to ITQs. As there is a strong and growing focus on ITQs as an alternative to effort controls, there is a need to prevent the ITQ implementation mistakes of the past. A compilation of the practical experiences of ITQs and an analysis of the operational difficulties encountered when implementing ITQs would address this need. Such a compilation should be a non-theoretical, easily understood operational guide to ITQs. It should be targeted at those directly involved in implementing ITQ regimes: fishery managers and the fishing industry. Such a need was identified by AFMA and supported by the Commonwealth Fisheries Research Advisory Body.

3. Objectives

1. Compilation of operational ITQ experiences in Australia and selected other countries.
2. Analysis of the practical difficulties faced in the implementation and operation of ITQs.
3. Develop guidelines to assist fishery managers and industry in the implementation of ITQ systems.

4. Methods

There were five methods used for the research:

1. A review of Australian and international literature on ITQ implementation.
2. Semi-structured interviews with fishery managers in AFMA and state fisheries management agencies.
3. Discussions with industry on their experiences with ITQs. This was carried out in association with the researchers' participation in Commonwealth Management Advisory Committees and Fisheries Assessment Groups and during the course of other consultancy work carried out by FERM. This included consultancies on the introduction of ITQs in the Queensland spanner crab fishery (FERM,1997), the Bass Strait scallop fishery (FERM,1998a) and a study on the use of integrated electronic data management systems for AFMA (FERM,1998b).
4. Active participation in the process of introducing ITQs to the south east non-trawl fishery and the southern shark fishery as chairs of Commonwealth Management Advisory Committees for these fisheries.
5. Information gathered from fisheries managers and economists working in Canada, Norway, Iceland, New Zealand and the United States.

In the project application, one proposed method was the use of a standard questionnaire to assist in the discussions with fishery managers and the fishing industry. However, following the literature review and preliminary discussions, this method was changed in favour of informal semi-structured interviews which covered the main research areas but

enabled a more flexible approach to information gathering and allowed the interviewer and interviewee to explore issues in more depth, where necessary.

5. Results/Discussion

The results of the project are detailed in a 240-page book entitled *Fish Futures: Individual Transferable Quotas in Fisheries*. Once the research was completed, it was decided that the book should take the form of a reference guide to implementation of ITQs rather than the development of guidelines, as originally proposed. The main reason for this change in format was that the research team considered there was a danger in offering prescriptions to ITQ implementation for diverse and complex fisheries. The preferred approach was to thoroughly review experiences in the key areas of ITQ implementation and highlight possible approaches and solutions. In other words, the book did not become a "how to" book but a reference text for planning the implementation of an ITQ regime and problem solving, should difficulties arise.

There are twelve chapters in the book:

1. Introduction
2. Why and how do Governments manage fisheries?
3. A brief overview of ITQ fisheries
4. Fishing entitlements and property law
5. Quota allocation
6. Principles and processes of quota allocation
7. Compliance and enforcement
8. Discarding
9. Management Costs
10. TAC setting
11. Social Considerations
12. Other issues

A summary of the ten main chapters, excluding the two introductory chapters, is given below.

Overview of ITQ fisheries

A review of ITQ fisheries in Australia, New Zealand USA Canada, Iceland, the United Kingdom and the Netherlands shows that most ITQ fisheries comprise either one or two normally high value species. An exception is the south east trawl fishery in Australia which has a total of sixteen low value species under ITQs. The nature of the ITQ regime varies from fishery to fishery, in some cases such as New Zealand, ITQs are issued in perpetuity, whilst in other fisheries, such as some Australian Commonwealth and state fisheries, ITQs are valid for the duration of the management plan. In other fisheries, ITQs are issued as a condition on an annual fishing licence.

Fishing entitlements and property law

There is a great deal of confusion amongst fishers, fisheries managers and others concerning the legal status of statutory fishing entitlements in general, and ITQ rights in particular. The analysis of both the legislation which created the ITQ right and the case law on fishing rights in Australia, New Zealand, Canada and the United States shows that ITQs are created by legislation as a means of regulating an industry. The practical implication of this is that ITQs are created by statute and can be taken away if the legislation is changed or modified if the legislation allows this to occur. It is clear that ITQ rights do not have the same degree of permanency or confer a legal status similar to the ownership of a house or a piece of land.

Often ITQs may be a condition on an annual licence which means that the quota together with the licence must be reapplied for every year. In other fisheries, such as in New Zealand, quota is granted "in perpetuity" which means, in practical terms, for the duration of the legislation.

A review and analysis of the case law in Australia, New Zealand, the USA and Canada shows that, whilst there is only a very small number of court cases on whether ITQs are property rights, there are a number of cases concerning the proprietary nature of fishing licenses and fishing entitlements. This provides useful guidance as to how courts may consider ITQs. The case law analysis shows that for a particular purpose, such as the payment of stamp duty, fishing entitlements are considered proprietary in nature. However, for the purposes of compensation if the entitlement is taken away, the courts are more cautious about how they view the right. Whilst accepting that a fishing entitlement is proprietary in nature, they have rejected the idea that any modification of that right (such as reducing the TAC) or extinguishment of the right (such as cancellation of a licence) is "acquisition" of property for the purposes of payment of compensation, unless specifically provided for in legislation. The reason for this conclusion is that fishing rights are created by statute, and can therefore be limited by statute. If the statute no longer exists, the right also no longer exists. These rights are therefore not common law rights (i.e. judge-made law) such as *profit à prendre*. This means that most ITQ regimes are inherently open to modification, and compensation for modification or non-renewal of an ITQ is usually only payable if required explicitly by fisheries or other legislation.

Quota allocation

The most contentious issue surrounding the implementation of ITQs is the determination of quota allocations to individual fishers. Quota allocation has a major economic impact on pre-ITQ entitlement holders as well as other stakeholders such as crew members, processors and fishing communities in general. A review of the experiences in quota allocations highlights the need for a clear justification for the formula selected. A quota formula can be codified in primary or secondary legislation (e.g. an act, a regulation or a management plan), or the legislation may simply enable the Minister to determine the

formula guided by policies or guidelines. As allocation is one of the most contentious issues, fishers often want to challenge their allocation either by challenging the validity of the law which allocated the quota or by challenging their own individual allocation.

A review of the experiences in quota allocations highlights the need for a clear justification for the formula selected. The analysis shows that, in general, it is very difficult to overturn an allocation where the formula is outlined in an act of Parliament. This is because the person would have to show that that part of the legislation was in some ways unconstitutional. With regard to allocations made under delegated legislation such as a management plan, the fisher wanting to challenge the formula would have to show that the formula was in some way outside the powers of the decision-maker. Such a challenge has been successful in the Australian Commonwealth south east trawl fishery, where the courts found that the formula was void because it had produced an irrational result. This can be contrasted to a challenge to the allocation formula in the South Australian southern zone rock lobster fishery. This challenge was unsuccessful, because the court found a rational explanation for the formula claiming that the formula had the support of industry, preserved the economic unit in the industry and conserved the resource.

Appeals against individual quota allocations occur in situations where the formula is not contained in any statute but is determined at the Ministers discretion in the form of a policy or guidelines, taking into account any special circumstances of an individual fisher. In this situation, the fisher challenges the application of the policy claiming that the policy was applied too rigidly and did not take into account their particular circumstances. Such cases usually do not get to court but are decided by an administrative tribunal.

The heated debate over who is the most deserving, combined with the usually long, tangled and vitriolic history of previous management arrangements, has placed fisheries managers in a no-win decision-making position when it comes to quota allocation.

Principles and processes of quota allocation

From the analysis of the experiences of quota allocation in ITQ fisheries, there appears a clear need for explicit principles in the allocation process. These principles are likely to be either based on, or consistent with, fishery management objectives. An analysis of fishery management objectives in Australian Commonwealth and state fisheries show that there are four main categories of objectives: economic efficiency, ecological sustainability, community and social benefits and fairness and equity in determining access. Experience has shown that economic efficiency objectives are interpreted by the courts to be related to the efficiency of the fishery as a whole rather than to the efficiency of individual operators. With regard to ecological sustainability, it is debatable whether this objective should play a role in quota allocation especially as there may be insufficient evidence in favour of one sector over another. Consideration of community and social objectives or fairness and equity objectives suggests that the pursuance of such objectives in the initial allocation should be clearly stated at the start of the allocation process.

The quota allocation formula has often been developed by fisheries management agencies in consultation with user groups. Experience has shown that there are often advantages in removing the management agency and the fishers from direct involvement in developing and recommending an allocation formula. These advantages include a reduction in the potential for conflict between fishers and fishery managers after the allocation and the removal of vested interest bias. It is also unlikely that fishery managers possess the necessary skills in law and economics that are relevant for identifying the legal and economic effects of alternative allocation options.

An alternative approach is to establish independent panels of experts in law, economics and fishing to advise on allocations. This approach has been used in Canada and is increasingly being used in Australia. Such panels have made recommendations to the management agency on allocation formulae and have been used on a number of occasions in Commonwealth, Queensland and South Australian fisheries.

Compliance and enforcement

A difficult task for a fisheries management authority proposing to introduce ITQs is to design a quota compliance program that will not only be effective but will instill confidence in fishers, scientists and the general public, without causing management costs to soar. An analysis of the main approaches used in Australia and to a lesser extent in other countries show that compliance programs for ITQ fisheries are based either on paper trails supported by random inspections of landings and product flow and by audits, or on large scale dockside monitoring of landings.

Traditionally, reliance has been placed on paper trail systems. Over time these systems have been enhanced by the use of pager reporting by fishers to forewarn compliance officers of their arrival in ports, and by the use of various electronic communications systems through which fishers input their landings data and receive updates on their quota balances. In some cases pager reporting has been extended to processors who have to report receivals and dispatches of products.

A key criticism of this paper trail approach is that it is complex and expensive. It requires specialised and additional investigative audit resources and sophisticated computer systems to keep track of product flow and detect irregularities. The level of conventional compliance resources also usually has to be maintained to carry out inspections at docks and at the premises of processors, as well as other activities.

Dockside monitoring of landings is an alternative path. It simplifies the compliance regime by focusing compliance on inspection of landings before they leave the wharf. The success of a Canadian system of dockside monitoring has encouraged the Alaskan authorities to propose a similar system. A modified system is under development for Australian Commonwealth-managed fisheries. Enhancements to the system include the use at the dock of electronic scales and communication technology to capture and transfer landings data directly to the management authority concerned, and the use of a vessel

monitoring system (VMS) to discourage fishers from attempting unreported landings. Compliance officers suggest that expenditures on upgrading existing paper trail systems would need to double to achieve the same degree of tightening of that compliance regime as expected under the dockside monitoring program.

The expected costs of such an electronic quota monitoring system (EQMS), including the costs of dockside observers and the vessel monitoring system, are similar to those of a paper trail system. The costs are likely to be substantially lower than those of an extended paper trail system. Perhaps the greatest benefit of a dockside monitoring system is that the emphasis of compliance activities is shifted, from prosecution to prevention of offences – one that is likely to engender greater cooperation from industry and result in fewer management resources being tied up in costly investigations

The implementation of a VMS also provides an opportunity for fisheries agencies to overcome some of the mis-reporting problems encountered with fishers' catch and effort logbooks. An electronic logbook can be developed using the communications capability of the VMS combined with an onboard personal computer or data terminal to give near real time catch and effort information. This would require fishers to commit to the size of their catch following each haul and provide an accurate location of fishing effort. The combination of dockside monitoring and a vessel monitoring system could provide scientists with data less prone to the hazards of data fouling, although onboard observers would still be needed to monitor discarding practices.

Discarding

Discarding occurs in many fisheries under a wide variety of management arrangements. A need to adhere to minimum size limits, market or processor demands or stay within bycatch limits often leads fishers to discard their catches. Under ITQs, fishers may have an incentive to highgrade the marketable portion of their catches or discard catches for which they have no quota.

Unreported discarding of fish is sometimes seen as major impediment to the introduction of ITQs. Discarding may result in TACs being exceeded by an unknown quantity that would, in turn, result in increased uncertainty about the accuracy of stock assessments and the validity of TACs. If thought to be a substantial and widespread practice, discarding may seriously undermine public and industry confidence in the ITQ management system. It is therefore important to estimate the extent of discarding under an ITQ system and to identify any specific management regulations that may be necessary to minimise the problem. However in considering these issues it is important not to lose sight of the fact that discarding in fisheries is a widespread practice – irrespective of the form of management applied to the fishery (Alverson *et al.*, 1994).

The extent of discarding under ITQs, particularly in multi-species fisheries, will be heavily influenced by the ability of fishers to target individual species, the size of TACs in relation to fish availability, the functioning of the quota market and the price differentials between fish grades. In the Australian southern shark fishery in which school and gummy shark are often caught together, research suggests that despite a halving of

the school shark TAC, fishers if willing, should be able to largely avoid catching and discarding school shark. However, highgrading of damaged sharks is probable, as there is a sizeable price discount on these carcasses.

Discarding for market-related reasons has a long history in the Australian south east trawl fishery. The introduction of ITQs in 1992 provided fishers with additional incentives for discarding. Mistrust of government by fishers, following the initial quota allocation did little to encourage changes in fishing practices to avoid discarding. Despite the acrimony, fishers agreed to a voluntary onboard observer program to monitor for scientific purposes the size and composition of retained and discarded catches. In the late 1990s fishers are increasingly adapting their behaviour to make the most of their quotas and avoid the need to discard. Most discarding is now market rather than quota-driven, and would occur under any management regime, not just ITQs. Fishing practices are being modified to increase the species diversity in each haul, and new trawl designs and technology are being used to help avoid unwanted catches. A similar response by industry has been observed in New Zealand fisheries where the discarding of bycatch species has been substantially reduced through adherence to voluntary codes of fishing conduct.

Although important, gaining the good will of fishers is not usually enough to eliminate discarding in multi-species fisheries. Targeted policies that introduce flexibility into the quota balancing process are needed to help fishers deal with unintended over-quota catches. Fisheries management authorities have introduced policies that range from simply giving fishers a period of time to lease quota to cover their over-catch or allowing a certain amount of over-catch to be deducted from the following year's quota, to more complex deemed value and quota substitution schemes. Although potentially useful in helping to avoid discarding, all these measures also have the potential to stimulate additional targeting of fish when no quotas are held. The more complex the system, the more likely it is that fishers will take advantage of administrative blunders to intentionally over-catch their quotas.

It is likely that fisheries management authorities will need to implement a combination of policies to adequately address the problems of discarding in multi-species fisheries. Although no particular policy is clearly superior to others, quota substitution, by using quota of target species to cover bycatch species, does offer the advantage of smaller quota over-runs than do deemed value or surrender schemes.

Bycatch management systems can be complex and costly. If administered poorly, they can aggravate the problems they are intended to cure. Based on case studies, the ability of fishers to avoid over-quota catches is a matter that demands careful consideration by fisheries management authorities as a foundation for the development of appropriate bycatch management policies.

Management costs

The costs of management in ITQ fisheries are often claimed to be higher than for other management regimes. In a number of countries, fisheries management activities are funded by taxpayers and supplied by government management and research agencies. These agency budgets are usually limited, and therefore the impact of ITQs on management costs is an important operational issue. In a few countries, a significant portion of management costs is recovered from the commercial harvesting sector, and a proposed move to ITQs can generate industry concerns about increased cost-recovery payments

It is difficult to generalise about the net impact of ITQs on management costs. Little empirical analysis has been undertaken on this issue. Fortunately, analysis of management costs under various management regimes is a research programme that is receiving increasing attention. Evidence to date suggests that management costs under ITQs might be higher than for alternative input control options. The net impact on management costs will vary from fishery to fishery, depending on a number of factors such as the type of pre-ITQ management arrangements in place, the type of quota monitoring regime implemented, and whether existing effort controls are reduced or eliminated.

In light of uncertainties surrounding the management cost implications of ITQs, it is important to undertake a pre-ITQ implementation analysis on this issue. However, this analysis should not be restricted to ITQs. Specifically, managers would be well advised to examine all of the costs and benefits of introducing both ITQs and the major effort control alternatives prior to embarking on a new management regime. Simply looking at estimated ITQ management costs or undertaking cost benefit analysis on the ITQ option is not sufficient. There is a tendency for ITQs to be compared to some ideal management regime, as opposed to being compared to existing effort control management alternatives.

Setting the Total Allowable Catch

Management through individual quota regimes requires the setting of a total allowable catch (TAC) for species that are to be placed under quota management. However TAC setting is not unique to ITQ management. A number of non-ITQ fisheries around the world are managed through TACs, usually in combination with various effort controls.

There are three major issues related to TAC-setting. The first concerns stock assessment requirements under ITQs. The second issue is the impact of ITQs on catch and effort data – often referred to as ‘data fouling’. Third, an overview of various TAC-setting techniques is provided.

An analysis of experiences and research shows a lack of compelling evidence supporting the contention that ITQs require more timely or accurate stock assessments. Nor is there strong support for the position that uncertainty surrounding stock status requires lower harvest rates under ITQ management (relative to no TAC/effort management).

The move from effort controls to ITQs will probably affect the usefulness of catch and effort data for stock assessment, and this possibility should be addressed explicitly before ITQs are introduced. However any major change in management arrangements is likely to affect the utility of catch and effort data.

Three alternative conceptual frameworks for setting TACs are analysed: a biological perspective, a bio-economic perspective, and a market-based approach. TAC setting from a biological perspective relies on the use of harvesting strategies. One of the most frequently used harvesting strategies involves setting the TAC by multiplying an estimate of the stock size by some predetermined constant harvesting rate. A great deal of effort has gone into determining what the appropriate harvest rate should be – specifically the percentage of the fishable stock which should be harvested. Another approach has been to specify limits or thresholds that the harvest rate should not be allowed to exceed or below which the stock should not be permitted to fall. Many ‘optimal’ harvest strategies developed around these fixed-harvest-rate biological reference points are implicitly based on ad hoc economic objectives such as maximising catch and/or minimising inter-annual variation in catch. Research shows that it is important that fisheries managers and others user groups fully appreciate that a number of biological reference points are not just about ‘conservation’, but rather, have at their foundation implicit and poorly defined economic objectives.

Although infrequently employed in practice, there have been attempts to explicitly incorporate economic information in the TAC-setting process. Economic models for TAC setting suffer the same failure as strictly biological models. In response, a number of bioeconomic models have been developed to overcome these problems. Bioeconomic models attempt to integrate population dynamic models with economic considerations such as price determination and harvesting and processing costs. Although they show potential to examine the impact of alternative harvesting strategies on economic efficiency and current and future stock status, they have played little part on TAC setting. The main drawback of these models is that there is a tendency to regard them as naïve simplifications often based on faulty data. Furthermore, it is difficult for these models to produce reasonable forecasts if markets or fish populations have undergone recent changes that are not reflected in the historical data with which the models were constructed. One way to overcome these constraints is to involve user groups in model development. Experience of the southern shark fishery in Australia has shown the value of such involvement which allows concerns to be aired and tested and additional information incorporated into the harvesting strategy evaluation process.

The final model is a market-based approach to TAC-setting which is centred around the idea that prices in the quota market reflect all relevant information about current and future conditions in the fishery so that the management authority need only monitor quota market prices to become privy to the same information. Such a model has never been used and it seems to have little operational value as it assumes that the quota market is efficient and that fishers have long term harvesting incentives which may not be the case if quota is not be issued in perpetuity.

Social Considerations

One concern frequently raised with respect to ITQs is the potential for negative social impacts. The literature review shows that there are few in-depth empirical studies on the social impact of ITQs and on monitoring and evaluating performance of ITQs once they have been implemented. Furthermore, there is some uncertainty as to the baseline to be used as even under effort controls, the socio-economic situation in the fishery may be changing. The main areas of potential negative social impact from ITQs are through quota allocation, loss of employment and negative flow-on impacts on fishing communities, particularly isolated ones.

The allocation of quota only to owners rather than crew members or processors is not a problem inherent to ITQs, and could be addressed by including other stakeholders in the allocation process. The impact of ITQs on employment in the harvesting and processing sectors may be negative if rationalisation of the fishery takes place. Reduction in vessel numbers, harvesting and processing employment may be unavoidable consequences of introducing more effective management regimes. ITQs may also change the structure of harvesting and processing which may impose negative social adjustment costs on communities dependent on these sectors (although often providing new opportunities in others). Another concern about ITQs is that quota may become concentrated in the hands of a few people or a few large corporations. A number of policies have been introduced to ameliorate this problem by establishing minimum and maximum holdings and other restrictions of transferability. Another way to address negative community impacts in isolated fishing communities is to introduce community quotas, as has been done in Alaska.

Other considerations

There are a number of other implementation issues concerning ITQ implementation, only three of which are singled out for brief consideration: the operation of quota registries; tax considerations; and, management of non-quota species in multi-species fisheries.

The operation of quota registries varies from fishery to fishery but in general is computerised and registers third party interests, much like a land title registry. The treatment of permanent and seasonal sales of quota for tax purpose is important both from the perspective of a quota buyer or seller but also in the broader context of fisheries management. If taxes on transfer or ownership or on the realisation of capital gains discourage quota trading, this might have implications on the realisation of efficiency gains in the fishery. Experience suggests that seasonal transfers of quota are not subject to capital gains tax as these transfers are assessable as ordinary income or business expenses. However, permanent sales of a single species quota are likely to be treated as assessable for capital gains tax. The difficulty arises in multispecies fisheries, such as the Australian south east trawl fishery, where a quota holder may want to adjust the species composition of their holdings by buying and selling quota. If each sale of quota is traded as assessable for capital gains tax, then this may act as a disincentive to quota trading. In Australia, the problem has been overcome for businesses with assets of less than \$5 million by allowing them to sell assets provided the sales are reinvested in the business, by for example, purchasing quota.

As relatively few fisheries are based on single species with no bycatches, when ITQs are first introduced they tend to cover only the main target species. If bycatches are relatively small, this omission may be of no consequence. However, if catches of non-quota species are significant, or the species lend themselves to target fishing, new incentives may be created for a competitive expansion of fishing capacity that may erode the economic gains from the introduction of the ITQ system and lead to depletion of these species.

A number of management approaches may be used to attempt to address these concerns. These include using input controls or competitive TACs to manage this sector of the fishery, or introducing "basket quotas" that combine a number of species within a single TAC. Alternatively, all commercial species could be progressively brought under the ITQ system. This approach is used in New Zealand.

6. Benefits

The project has the potential to generate tangible and intangible benefits to fisheries managers and the fishing industry. These benefits are expected to be realised once the book has been disseminated to, and used by, fisheries management agencies, the fishing industry and other stakeholders involved in fisheries management. Potential benefits from the adoption of some of the strategies described in the book, such as allocation advisory panels and dockside monitoring systems, include:

- A reduction in fishery management costs through improved design and implementation of ITQ systems.
- A decrease in litigation over quota allocation and a consequent reduction in litigation-related costs.
- An increase in compliance with management regulations through improved enforcement.

Fish Futures is the first book to address the practical issues of ITQ implementation and thoroughly review the state of the law on ITQs and property rights. The book should therefore contribute to a greater understanding amongst fisheries managers, the fishing industry and other stakeholders of the opportunities and constraints under ITQ systems.

7. Further development

Apart from on-going dissemination of the book by FERM and FRDC, the results of the project could be further developed by examining two areas where the research has shown a lack of empirical data on management costs of ITQ systems and the socio-economic impact of these systems.

8. Conclusion

The outcomes of the project are in the form of three publications:

1. A 240-page book, entitled *Fish Futures: Individual Transferable Quotas in Fisheries*, published in November 1999.
2. A 16-page summary of *Fish Futures: Individual Transferable Quotas in Fisheries*. The summary is intended to be quickly and easily digested description of the key issues discussed in the book. It is anticipated that the summary will accompany final reports (to all fisheries agencies and peak industry bodies) for inclusion in their magazines. This was completed in November 1999.
3. An article in the international journal, *Marine Resource Economics*, titled 'Quota allocation and litigation: an economic perspective'. This was published in 1998.

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Appendix 1: Intellectual property

The aim of the project was to undertake research to generate benefits for all stakeholders in Australian and international fisheries where ITQ systems are being contemplated. Thus the focus is to conduct public domain research and it is not anticipated that any commercial intellectual property will arise from the project.

Copyright of the book is held 50% with FRDC and 50% with FERM.

Appendix 2: Staff

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