

**FISHERY MODELS AND MANAGEMENT
SYSTEMS**

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INTRODUCTION

Insofar as human society has increased its capacity for exploiting renewable natural resources, and since these resources have started to become scarce goods, their exploitation can no longer be exercised in conditions of free access but is regulated through management systems¹. In fishing, and even though in some regions certain fisheries were already regulated almost a thousand years ago², marine resources in most parts of the world were exploited according to free access regimes until very recent times.

In recent decades, fishing activity in the oceans and seas of the whole world has seen remarkable growth, both in efficiency, due to improved technology, and in catch capacity, due to an enormous quantitative increase in the fishing effort. Today, the practical observation in the growth of the impact of fishing on the rate of reproduction of the resource and the study of bio-economic models as from the 50s, has led to the universal acceptance of the need to regulate fishing in order to optimize the production and economic yield of the fisheries.

The Gordon-Schaefer formulation³, developed in a great many subsequent studies, indicates that the activity of exploiting the renewable resource presents a maximum potential for sustainable biological production and a maximum economic yield (MEY). The model shows however that fishing activity does not necessarily tend to achieve these maxima. Theoretically, operations tend towards one of two possible equilibrium points, depending on whether they are exercised under a regime of free access or belong to one only owner, so to say under a controlled access.

According to the models under free access conditions it is not possible to attain neither the biological maximum, nor the maximum economic yield (MEY). It can be achieved only in the case where the resource is exploited by a single owner able to fix production at a level yielding a maximum profit with respect to the natural reproduction rate of the resource. In the free access regime, the fisherman cannot consider the future value of restricting his effort because he is not sure of receiving the future yield from a more moderate effort since a competitor could take advantage of any deferred catch.

From the theoretical standpoint, it is necessary to switch from a free access system to a managed system.

The MEY can be achieved only by setting up a management system to control access. The models consider that access may be regulated by assigning the resource to an owner (individual, enterprise, association, administration, etc.). The assignation of ownership is the simplest management method, but for technical causes in the majority of cases it cannot be directly applied to fisheries.

There are various reasons for this, in particular: the mobility of the resource, the lack of maritime jurisdiction establishing who may grant the right, the right of free circulation on the high

seas, the concept of resource ownership which confers the right to exercise the activity of fishing, etc. In the case of fisheries, the application of these theoretical principles has been complex and contested by the productive agents. Conversely, in the case of other renewable resources such as forests and pastures, it has been much easier to determine the ownership, it simply being a matter of delimiting the land on which these resources are situated.

As regards fisheries, it is not possible to resort to a simple assignation of ownership. It is necessary to set up a whole system to control access and regulate management, which is why we talk of management systems.

In view of the objective difficulty of establishing management systems and the need to control access to the fisheries, we need to focus on determining the **type** of control (**management systems**) and the conditions (fishery models) which make it possible to obtain the social and economic optima.

The present study is made up of three parts. We present our point of view regarding the efficiency, effects, conditions, validity and possible criteria for the administrator when it comes to determining priorities among fishery management systems. The three parts are as follows. First, we argue for the existence in the fishing activity of fishery structures, which we attempt to characterise and classify typologically according to fishery models. Second, we note the existence of several management systems, which we also try to typify. Third, and last, we consider that while there is no optimum management system for every fishery structure the different fishery models have different optimum management systems.

FISHERY MODELS

Every fishery is an economic enterprise which presents a set of particular and specific characteristics. These characteristics concern a number of phenomena which explain its operating mechanism. In order to define a fishery it is necessary to consider all the data which explain how and why a stable socio-economic structure comes about.

Without pretending to be very exhaustive, we shall consider the following characteristics as the most important for the definition of a fishery model: the type of resource (degree of concentration, mobility, reproduction rate, etc.), the geographical milieu (type fishing areas, distance to landing areas, concentration of the fishing areas, facility to control activities, etc.), means of production and the fishing technology (effectivity, selectivity, regularity, cost structure, etc.), economic structure of the fishermen and into which the fishing sector fits, marketing and the market, etc.

A fishery model can be defined as the abstraction of a specific table set of characteristics present in a fishery structure having a certain degree of association, linked between them and mutually affecting one another. A model is precisely a simplification of reality. Thus defined fishery models are abstract generalisations making it possible to establish topological classifications of fisheries. Obviously, reality does not completely correspond to the patterns of the models. It is nevertheless very useful to define these models in their most simplified and theoretically pure form

in order to be able to formulate a certain theoretical association between these models and fishery management systems.

For the purposes of this study, we consider it useful to define two fishery models, with which we can associate a good proportion of the fishery structures in the developed countries. Thus, regardless of the fact that other models could be constructed or that those considered could be subdivided into others, we shall limit ourselves here to studying two of them, which we shall arbitrarily refer to as the single species fishery model and the complex fishery model.

The single species fishery model is that which has all the following characteristics:

- i) The resource tends to comprise large quantities of a single species.
- ii) There is a single type of fishing technology, aiming at a single species and using highly selective fishing gear.
- iii) Production in weight tends to be quantitatively substantial, for the target species.
- iv) Production is organised in fairly long fishing seasons. The fishing units can change the target species up to a certain point, but this change requires a certain time. It is often necessary to start a new season.
- v) The production units tend to be capital-intensive.
- vi) The production relationships tend to be of an enterprise nature. A significant percentage of the incomes tend to be fixed so that the boat owner has to pay wages regardless of the actual catch.
- vii) Production tends to be more constant and regular than in the case of less developed fisheries because of the fishing technology, knowledge of the reproduction possibilities of the resource and the existence of effective measures to control competition (through access).
- viii) The enterprise structures are of large dimension and tend towards concentration. There is a certain control at enterprise level over the degree of reproduction of the resource. The fishing effort is not determined completely independently of the will of each individual enterprise.
- ix) The price structure of the product is relatively stable and known, tending to fluctuate but slightly. Production is linked to the world market.
- x) Because of conditions vii), viii) et ix), the income structure is relatively regular and can be more or less foreseen by the fishing enterprises.
- xi) In view of the concentration of the productive fabric in these fisheries, control of production is relatively simple both for administrations and for enterprises or groups of enterprises.

By contrast, the complex fishery model presents all the following characteristics:

- i) The target species are multiple and may change in the very short term (in a few hours) as a function of prices. The possibilities of catching each of these species are relatively reduced. The resource tends not to be concentrated.
- ii) The fishing technology is used for several species and has low selectivity. The target species is caught at the same time as other species which also have an economic value.
- iii) Production tends to be quantitatively small with respect to the effort and occupation.
- iv) Cruises generally last one or several days. The fishermen tend to live in the landing areas. There is great social cohesion and immediate dependency since the resource is found in the vicinity of the landing port.
- v) The production units tend to be labour-intensive and are of a family nature
- vi) The production units are based on the system of payment according to the share of the catch. Owners and workers bear the risks stemming from irregular catches. Payment is immediate (daily or weekly) and there are substantial variations in income because of conditions vii) and ix) below.
- vii) Catches tend to be more irregular than in the more developed fisheries and the possibilities for moving to other fishing areas are limited.
- viii) The enterprise structures are of a family dimension and there is a high degree of dispersion. The individual fisherman has no power of control over the resource other than through fishermen's associations. Only local associations can exercise a certain control over the fishing effort.
- ix) There are significant variations in the cost structure. Production is linked to local markets and is subject to variations over which the fisherman has little control.
- x) Because of conditions vii), viii) and ix) above, the income structure is irregular and generally speaking unpredictable for the fishermen in the short term.
- xi) *In the geographical area of the fishing activity, various types of activity appear in association and different types of fishing gear coexist. This space is likely to produce other uses such as aquaculture and sport-fishing which may have a certain local economic importance.*
- xii) Control of the effort and of production is very complex and costly for the administrations in view of the diversity of the fishing gear, the large number of small fishing areas and landing points and the reduced size of the enterprises.

These two models being defined, we can find many examples of fisheries in the developed countries more or less corresponding to one of the two. The fisheries of the Grande Sole, NAFO (Northwest Atlantic Fisheries Organisation), CECAF (Fishery Committee for the Eastern Central Atlantic), etc. may be assimilated to the single species fishery model. The coastal fishing exercised in the waters off Brittany, in the rias of Galicia and in the Mediterranean correspond to the complex fishery model.

FISHERY MANAGEMENT SYSTEMS

We have already pointed out how economic theory, through bio-economic models, shows that the assignation of ownership of renewable natural resources is the way to achieve the maximum economic yield. We have also pointed out that the difficulty of granting this ownership right has made it necessary to establish more complex solutions, i.e. the introduction of management systems.

By management systems, we mean an articulated set of control instruments and institutions the aim of which is to regulate fishing activity.

We can classify the control instruments into two broad types. The first comprises those based on the control of the catch and the other on control of the effort.

The first type of instrument includes total allowable catch (TAC) and individual transferable quotas (ITQ). Both systems raise the problem of the precise determination of the total maximum catch to be distributed and its control. The switch from TAC to ITQ means the simplification of the problem of the distribution of quotas and avoids the consolidation of excessively large structures, but on the other hand brings problems of the concentration of enterprises and reduction of employment. There is an abundant literature on the still continuing debate on the advantages and disadvantages of the two systems and more particularly the passage from the TAC system to the ITQ system⁴.

We should like to point out however, from the standpoint of our study, certain important limitations concerning both types of catch control instruments.

First of all, there are great difficulties with respect to the application of these systems to multi-species fisheries, because the fishing activity employs a technology which does not differentiate between species or because the resource presents a high level of association with other species. It is therefore necessary to determine, and this is a problem, the species subject to the quota and what rate of by-catches is authorised as regards this species when the fishermen argue that the target species is another.

Second, there is a technical problem of control if there is a large number of vessels and/or if there are many potential landing points (coastal fishing). Landing points increase with geographical proximity to the final markets, which has an impact on the establishment of more direct sales systems. In this latter case it is possible that the cost of efficient control will be very much higher than the potential benefits of management⁵.

The second type of control is that of instruments to control effort. This is exercised through a great number of mechanisms: fishing permits and licenses, control over fishing hours, regulation of fishing cruises, limits on engine power or the dimension of vessels, establishment of minimum mesh sizes, etc.

As in the case of the TAC or ITQ, it is difficult to establish the basis for tolerable levels of effort. It is frequently difficult to justify these bases scientifically with the precision⁶ required for the drafting of legal regulations which in addition will have broad territorial application.

As regards the control institutions, we may distinguish between the market, the administration and the systems of territorial self-regulation.

The market is an institution permitting anonymous and automatic regulation, which therefore reduces the potential for arbitrariness on the part of institutions run by individuals. However, it is also necessary to be aware of the limitations of the market, for it may favour situations which are not optimal from the social standpoint (concentration of enterprises, reduction of employment, etc.) and in certain periods may be socially unacceptable. The market may also have a non-neutral (arbitrary) type of functioning, for in the final analysis it is also regulated by other institutions. Lastly, the market is an institution which has virtually no operating costs, but it is also necessary to consider the solutions it brings, for these may give rise to economic and social costs.

The administration is the regulating institution with final political responsibility⁷ for its decisions affect the efficiency and results of the management systems applied.

The exclusive use of administrative mechanisms may imply serious obstacles to the functioning of competition mechanisms. An undesirable effect of administrative regulations is the possibility of producing or maintaining situations of over-investment or inefficiency.

In the absence of more automatic mechanisms, the administration has to exercise regulatory action to avoid serious biological and socio-economic distortions. Resorting to the administration is based on the fact that it is this authority which has political responsibility in the last resort and regulation by it can be decided and applied more rapidly. In addition, its measures may produce much more immediate effects than the market or self-regulation. In general, however, these mechanisms raise a problem: this is an administrative decision, which means that the administration is going to be subjected to all types of pressures on the parts of individuals and interest groups.

Lastly, territorial self-regulation institutions bring together the individual fishermen and reduce their margin of freedom with the aim of maximising collective incomes. In the limit case, they make a group of fishermen equivalent to a single owner. This institution makes certain decisions automatic and exercises more direct control at a very low cost. The problem to which it gives rise is that it tends to hide the fact that it is managing a public resource (it has to act like an owner without really being one*) and it encourages the consolidation of a pressure group which privatises public incomes (it resists, for example, having to pay taxes for the right of access to the exploitation of a resource belonging to society as a whole). This type of management is based on the restriction of access to the profession of fisherman and hence the preservation of a certain monopoly. There are thus problems with respect to establishing mechanisms for the admission of new members. Its field of action is of a local nature. Its success is based on control of the territory by the association members (both as regards the fishing areas and the primary markets).

Globally, we are going to consider the existence of six types of management system, which we shall call **A**, **B**, **C**, **D**, **E** and **F**. These imply the predominance of the presence of a control objective and a control institution. The content of all the management systems considered is contained in Table 1.

Table 1. TYPES OF MANAGEMENT SYSTEM, INCLUDING THE DEFINITION OF THE INTERRELATIONSHIP BETWEEN THE INSTRUMENTS AND THE INSTITUTIONS

OBJECTIVE INSTRUMENTS:	CATCH	EFFORT
<p><i>INSTITUTIONS:</i></p> <p>MARKET</p>	<p>Management sys. A * ITQ</p>	<p>Management sys. D</p> <ul style="list-style-type: none"> * Licence market * Transferable units of effort <ul style="list-style-type: none"> - days fished (DF) - DF per GRT - DF per HP
<p>ADMINISTRATION</p>	<p>Management sys. B * TAC</p>	<p>Management sys. E</p> <ul style="list-style-type: none"> * Licence or permit * Hours * Mesh * Maximum power * Maximum GRT * Ban on certain gear * Halt on fleet activity * Minimum sizes * Prohibited species
<p>SELF-REGULATION</p>	<p>Management sys. C</p> <ul style="list-style-type: none"> * Maximum landings 	<p>Management sys. F</p> <ul style="list-style-type: none"> * Hours * Mesh * No fishing period * Ban on certain gear * Halt on fleet activity * Minimum sizes * Prohibited species

CRITERIA FOR THE ADOPTION OF A MANAGEMENT SYSTEM

Good management does not depend on its homogeneity but on its effectiveness in resolving conflicts. More concretely, a fishery structure will have an optimum management system if this system helps the operation to achieve its maximum economic yield (MEY) with a minimum cost of control. If a management system creates more conflicts than it resolves in a fishery structure we have clear empirical evidence that this system is inappropriate. It may correspond to a theoretical optimum, but in this case our theory does not correctly reflect reality.

Before discussing the optimum forms of management we have differentiated the characteristics of fisheries and tried to classify them according to fishery models. If these fisheries

have significant differences then we shall probably not be able to find any single optimum management system.

A first factor making it possible to evaluate the excellence of a management system is to consider to what extent it contributes to the fishery reaching a level of effort such that the operation approaches the MEY.

A second factor is the cost of control. This cost is not solely of a budgetary nature, but has a broader sense. It includes, for example, the social cost of any conflicts which may arise when the system is applied.

From the formal standpoint, the optimum management system would be that which, in each situation, would obtain the maximum incomes produced by the fishery after deducting the direct and indirect costs of the system.

$$\text{Max.} \rightarrow TI_i - (TC_i + CC_i)$$

In this formula representing management system *i*, *TI* represents the total incomes of the operation, *TC* the total costs of the operation and *CC* the costs of control to society⁹. We know that the difference between *TI* and *TC* corresponds to *MEY*, which is to be understood as an income of the fishing units. Now we can also say that a management system *i* is better than another when the following minimum is obtained:

$$\text{Min.} \rightarrow MEY - [TI_i - (TC_i + CC_i)]$$

In this formula, *MEY* represents the maximum economic yield which can be obtained by the fishery. With this formulation we want to point out that, in reality, an *i* management system which attains the theoretical *MEY* does not necessarily exist.

It turns out to be enormously complex to carry out an empirical calculation using the above equations to determine the degree of excellence of a management system in each fishery model. In fact, empirical evaluation could not be made on the basis of a model but for concrete fisheries.

Probably, the results would be insignificant in view of the fact that we can deduce analytically a good number of things concerning the efficiency of a management system in a given type of fishery, but we would not reject the possibility of making a more formal calculation using quantitative data. We have established a hierarchy of management systems for the single species fishery model and for the complex fishery model. This hierarchy is based on the description of a set of structural characteristics of the management systems (A to F) for each model, as set out in Tables 2 and 3.

Table 2: HIERARCHY OF MANAGEMENT SYSTEMS IN THE SINGLE-SPECIES FISHERY MODEL

MANAGEMENT SYSTEM:	POSITIVE AND NEGATIVE ASPECTS
TYPE A:	<ul style="list-style-type: none"> + Automatic assignation mechanism. + Favourable to the most efficient units. + Reduces the costs of the catch. + Reduces the role of the administration. + Low cost of the system. - May be problems in the control of effective catches. - May lead to excessive monopoly, which could manage to control sales prices. <p>In the short term:</p> <ul style="list-style-type: none"> - Concentration leads to unemployment. - The process of concentration may be very rapid and difficult to assimilate socially. - The price of the ITQ may be excessively high because fishermen might be buying not this ITQ but positions on the market.
TYPE B:	<ul style="list-style-type: none"> + In the framework of international agreements in which TAC are established for all the countries concerned, multilateral administrative regulation may avoid over-fishing. The TAC system tends to freeze the situation and maintain historic structures, which means that the competition mechanisms stop functioning. This results in inefficiency. Prolonged utilisation of TAC will lead to the appearance of obsolete fleets and capacity utilisation rates very much below the optimum: many boats will remain a long time in port. It results in over-investment. The distribution of TAC between countries and between enterprises within each country will always be arbitrary. There may be problems with the control of effective catches.
TYPE E:	<ul style="list-style-type: none"> + In the context of international agreements in which parallel restriction measures are introduced simultaneously in all the countries concerned, administrative regulation can help avoid aggravating over-fishing and facilitate redeployment for the future. This avoids aggravating the problem and may even help improve the situation, but not to resolve it (i.e. bring international exploitation to the MEY in a stable way). - The objective of these fisheries is a resource and not an area where there are resource. The operating area can easily be changed; if only the effort is controlled there will be no relationship between the effort and the reproduction of a stock. - The presence of fleets from several countries in a single area makes it difficult to ensure the limitation of the effective effort in the areas of origin. - The presence of non-homogenous fleets makes it difficult to draw up homogenous scales concerning the effort. - With the establishment of maximum limits for effort, this system bars entry to new competitors and tends to maintain historic structures, which means that the competition mechanisms cease to function. This results in inefficiency. - With the establishment of maximum effort limits, national administrations limit the growth of their fleets without being able to know whether they will be competitive in the world market. Administrations will be very little inclined to introduce these measures because they then make themselves responsible for limiting the expansion of a national sector which could be competitive.
TYPE D:	<ul style="list-style-type: none"> - Negotiating effort units in the world market is more complex than that of ITQ. - The objective of these fisheries is the resource and not the exploitation of an area where there are resources. Vessels can easily change their area of operation. If effort only is controlled there will be no relationship between effort and the reproduction of a stock.

Table 2: HIERARCHY OF MANAGEMENT SYSTEMS IN THE SINGLE-SPECIES FISHERY MODEL (cont.)	
MANAGEMENT SYSTEM:	POSITIVE AND NEGATIVE ASPECTS
TYPE C:	<ul style="list-style-type: none"> - The presence of fleets from several countries means that it is difficult to ensure the effective limitation of the effort in the areas of origin. - The presence of non-homogeneous fleets makes it difficult to establish homogeneous scales for the effort. <p>+</p> <ul style="list-style-type: none"> + This type of management is effective only for the control of sales prices. - There are no conditions for the operation of an association at this level: lack of socio-economic fabric, diversity of countries, of markets, of employment structures and of capital; fishing areas are far away from the centres of social life of the communities, etc. - It cannot contribute to the optimum exploitation of the resource.
TYPE F:	<ul style="list-style-type: none"> - There are no conditions for the operation of an association at this level: lack of socio-economic fabric, diversity of countries, of markets, of employment structures and of capital; fishing areas are far away from the centres of social life of the communities, etc. - It cannot contribute to the optimum exploitation of the resource.

Table 3. HIERARCHY OF MANAGEMENT SYSTEMS IN THE COMPLEX FISHERY MODEL	
MANAGEMENT SYSTEM:	POSITIVE AND NEGATIVE ASPECTS
TYPE F:	<ul style="list-style-type: none"> + The community of fishermen incorporates within its activity the greater part of the control, the cost of which becomes virtually nil. + The community of fishermen forms part of the local community and is a significant element within it. The fishing activity is connected with other economic activities and it is the community which decides, according to a system of local self-management, the alternative uses of the marine environment: fishing, aquaculture, leisure activities, etc. The local community bears the costs and enjoys the benefits of the choice made between the alternative possibilities. Within the community the families and individuals are redeployed and redistributed without any need to resort to administrative measures or external aid. + The optimum use of capital between various types of fishing gear and different activities is determined automatically and the intensity of the effort for the resource reaches an equilibrium. + The community of fishermen lives in the fishing region and hence has an interest in continuing to live from the resource and hence to exploit it only to the extent that its reproduction is sustainable. + The degree of control over the members of the fishing community is high: the fishermen work in the region where they live, there are close social links between them (which means that respect of the regulations is imposed not only by means of coercive action), the community of fishermen controls the local market (sales), etc. - Difficulties tend to arise as regards the admission of new members. (+) Within the limits imposed by the family nature of the enterprises, there is always a certain pressure tending to increase the number of members, which avoids the stagnation of the association if there are possibilities of work for the children of its members. - The community of fishermen is opposed to paying society for the use of the fishery resource because it considers that this resource belongs to it. If the monopolistic income is not significant, this is not a real problem.

Table 3. HIERARCHY OF MANAGEMENT SYSTEMS IN THE COMPLEX FISHERY MODEL (cont.)

MANAGEMENT SYSTEM:	POSITIVE AND NEGATIVE ASPECTS
TYPE E:	<p>+ Rapid results are achieved, which gives this type of management great short-term effectiveness in situations which call for an urgent solution and in those where the internal procedure for adopting the decisions of the associations could be excessively slow or difficult.</p> <p>- Regulation of the effort may produce distortions in investment: the limitation of gross registered tonnage leads to many boats with low tonnage and high power; limitation of the number of boats may lead to an artificial increase in power; limitation of the number of boats able to use a given type of fishing gear may lead to an increase in the number of boats using a replacement type of gear even though this is less efficient, etc.</p> <p>- There are difficulties in ensuring compliance with the administrative regulations.</p> <p>- The cost of control may be very high.</p>
TYPE D:	<p>+ The effort being more permanent than the catch, it is easier for it to be controlled by the administration, but even here the cost of control is high.</p> <p>- The structure of the fishermen's community is broken. At present only the buyer of effort rights is interested in maintaining control. He who has no rights (or who has acquired only few) but has fishing gear may try to exercise "sport-fishing", etc. If there is no fishermen's community it is more difficult to ensure control of the effort because the fishing areas are easily accessible from the coast.</p> <p>- It does not permit an immediate reduction because effort rights are first granted to the existing fleet. Subsequently, these rights are sold when boats are withdrawn, which permits a certain concentration in the medium and longer term.</p> <p>- As there are several concepts of effort it is not very effective to put one of them up for sale. If GRT is put up for sale, it is the HP which will increase, etc.</p>
TYPE C:	<p>+ This type of management is effective only as regards control of the sales price.</p> <p>- Control is difficult because of by-catches.</p> <p>- Control is difficult in view of the fact that it is easy to find alternative landing points (hidden from the direct sale).</p>
TYPE B:	<p>- Establishment and control are difficult because of the by-catches. This reason alone makes it virtually impossible to use this management system.</p> <p>- The TAC system tends to freeze the situation and maintain historic structures, which means that the competition mechanisms cease to operate. This results in inefficiency.</p> <p>- Prolonged utilisation of the TAC will mean that there are obsolete fleets and capacity utilisation very much below the optimum: many boats will remain in port for a very long time. There will be over-investment.</p> <p>- The distribution of TAC between the fishermen will always be arbitrary.</p> <p>- There may be problems with regard to the control of effective catches. The markets are very decentralised at the origin (and may be decentralised and more hidden) since they are close to the consumer.</p>
TYPE A:	<p>- Establishment and control are difficult because of the by-catches. This reason alone makes it virtually impossible to use this management system.</p> <p>- The structure of the fishermen's community is broken. At present only the buyer of effort rights is interested in maintaining control. He who has no rights (or who has acquired only few) but has fishing gear may try to exercise "sport fishing", etc. If there is no fishermen's community it is more difficult to ensure control of the effort because the fishing areas are easily accessible from the coast.</p>

We can now draw up a synthesis of the tables presented above, presenting the following hierarchy of management systems by decreasing order of effectiveness:

	SINGLE SPECIES MODEL	COMPLEX MODEL
Most efficient	A	F
Efficient	B	E
Inefficient	E	D,C
Totally unsuitable	D,C,F	B,A

According to this hierarchical list of the value of the management systems we can see that certain management systems may be extremely efficient in one context and extremely inefficient in another. This means that the good results given by a management system in a given model or a given fishery does not mean it is universally valid.

More precisely, as regards the fishery models studied we can state that they have various optimum management systems. Despite the schematic and synthetic presentation of the characteristics of each system in the preceding tables, it can be seen that the ITQ management system (type A) has a high degree of efficiency in the single-species model but is totally unsuited to the management of a complex model fishery. The situation is exactly the reverse with the self-management system applied to effort (type F).

The purpose of the present document is to reflect on the fact that the empirical observation of the value of the excellence of a fishery management system does not make this conclusion universal for all types of fishery. The conclusion concerns the fishery model studied, which it is essential to characterise through its principle features.

We can see today that different management systems predominate in different fisheries. This situation is not simply due to historical reasons, but sometimes has structural causes. When attempts are made to renew management systems, an effort must be made not to ignore these causes, but on the contrary to situate them at the very centre of any attempt to change or modernise management systems and postulate the existence of different fishery management optima.

The discussion the OECD's Fisheries Committee is interested in is the reduction of the distortions on the efficient allocation of resources. From that point of view, the management system based on ITQ (type A) appears to solve satisfactorily the problem of the market liberalisation of the fishing services, as a very important factor which helps to reduce the distortions on the resource allocation in the fishing sector considered as a whole (product and fishing services' markets).

However, large distortions could arise in some fisheries if this system should be adopted. Considering the creation of Value Added, these fisheries (mainly run by the fishermen communities in coastal waters) could become marginal in relation to the most industrialized. These coastal fisheries are significantly relevant in their local economies in terms of employment so an irreflexive application of new management systems could generate great socio-economic disequilibrium in their local structures deeply dependant on the fishing activity.

Consequently, the best way to prevent the social rejection towards the changes needed to internationally improve the fisheries' management and raise the incomes, could be to take into account these exceptions to the liberalisation and commercialisation of the fishing services process, defining them both theoretically and in practice.

NOTES

- 1 Thus nowadays pastures are no longer free, forests have ceased to be a communal good and fish is no longer a resource that can be accessed by anyone wishing to catch it.

- 2 In Spain there have been fishermen's guilds regulating the activity of coastal fishing since the early Middle Ages. The guild located in the Ebro delta, for example, was created by royal concession in 1232, in the middle of the struggle to repopulate the peninsula following the Arab occupation. This institution, in exchange for the payment of royalties to the king, had the monopoly of fishery exploitation. Thus new families could not join the guild unless they were accepted by those who held the concession. Once they entered the association however, they became full members on an equal footing with the others.

- 3 See H. Scott Gordon (1953): *An economic approach to the optimum utilisation of fisheries resources*, Journal of Fisheries Research Board of Canada, vol.10 no.7, p.442-457. H. Scott Gordon (1954): *The economic theory of a common property resource: the fishery*, Journal of Political Economics, vol.62, no.2, p.124-142. M. Schaefer (1957): *Some considerations of Population Dynamics and Economics in Relation to Management of Marine Fisheries*, Journal of the Fisheries Research Board of Canada 14:669-681.

- 4 Among the more recent studies we would mention the following: the advantages of management through the ITQ system have been dealt with by Clark P. et al. (1988): *Development and implementation of New Zealand's ITQ Management System*, in: Marine Resource Economics, vol.5, no.4, p.325-350. The problems of introducing the ITQ system have been studied by Lee G. Anderson: *Fundamental issues in the design of ITQ programs*, Papers session 8, IIFET Conference 1992; Parzival Copes: *Individual Fishing Rights: some implications of transferability*, Papers session 8, IIFET Conference 1992. The problem of determining the price of the ITQ and a study concerning the application of the ITQ in the Netherlands appear in: Herman Harmsma & Wim Davidse: *Effects of property rights on structure of fishing industry*, EAFE Conference Papers 1992. The problems of the regional impact of the ITQ system and a study of its application in Norway have been dealt with by Torbjorn Trondsen & Jostein Angell: *Regional Enterprise Share Quota (RESQ) management system*, EAFE Conference Papers 1992. A comparative study of the efficiency of licensing systems and ITQ in the United States has been made by James D. Hastie: *The role of economics in the development of limited entry programs: two examples from ground fisheries in the western United States*, Papers session 8, ~~IIFET~~ Conference 1992.

- 5 Thus, for example, the cost of operating a small control launch with a three-man crew is 25 million pesetas in Spain. To control a possible quota system with acceptable effectiveness over an area such as Catalonia for example, which has 2 000 fishing boats and 25 legal auctions, 10 launches would be necessary. With an annual income of 15 000 million pesetas from sales, which represents a net yield of 2 000 million pesetas, the minimum cost of control at sea would be 14 per cent of this net yield, not counting the cost of the necessary control on land.
- 6 The problem here is of the same type as the dilemma a teacher has to resolve when he is faced with a large number of examination papers. He knows more or less what constitutes the pass level but it is difficult to justify the precise limits of this level: if the pupil fails because he obtains 4.9 (out of 10) or 4.5, is it possible to maintain that the difference between a paper obtaining 4.9 and another obtaining 5 justifies the first pupil having to repeat the year? While the pupil having obtained 4.9 will probably have enormous difficulty in accepting this decision, a fisherman will have even greater difficulty when he has to remain below an arbitrary line obliging him in fact to abandon operations.
- 7 This responsibility may be exercised through its actions (regulation) and by inaction when the administration decides not to regulate or to delegate this regulation.
- 8 Renewable marine resources are the public property of the States where they are found and hence it is the society of the State which should in the final analysis be the beneficiary of their exploitation. Governments, as representatives of the State, manage these resources for the benefit of the society as a whole. Although the State may delegate this management to a fishermen's association, the aim is always to obtain maximum benefits for society as a whole and not simply for the association exploiting the resources.
9. From the theoretical standpoint, the CC should be incorporated in the TC, but insofar as they are not generally considered in view of the fact that the CC is generally an external cost as far as the fisherman is concerned, we prefer to indicate its presence by differentiating it from TC.