# Proceedings of the X Annual Conference of the European Association of Fisheries Economists
# The Hague 1998

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This publication contains the proceedings of the Xth Annual Conference of the European Association of Fisheries Economists (EAFE), held in The Hague, 1-4 April 1998.
The papers give a broad overview of the topics, which are being researched in Europe in the area of fisheries, economics and related fields. The conference had a multidisciplinary as well as inter-professional character. Special workshops were held on dialogue among various scientific fields as well as on communication with users of the research, industry and administration. Several articles have therefore a direct relevance to these topics.

Orders:
Phone: 31.70.3308330
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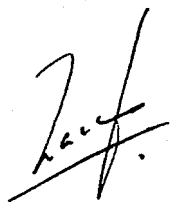
# Preface

The Proceedings of the X Annual Conference of the European Association of fisheries Economists reflect the progress, which has been achieved in this scientific field in Europe over the past 10-15 years. In the beginning of 1980's only a small group of individuals was doing research in this area, often on their own separated by language and institutional barriers.

The conference proceedings show that this situation has changed dramatically over the past decade. The availability of European research funds and the initiatives taken by the researches interested in fisheries economics have stimulated a growing amount of scientific literature in this field. The proceedings contain a broad scope of papers, theoretical as well as empirical, on policy, markets, vessel operations, technological innovation, bio-economic modelling, etc.

The introductions given by Dick Langstraat, Chairman of the Dutch Fish Board, and by John Farnell, Director of the Fisheries Directorate of the European Commission, are a stimulating contribution indicating topics and directions which fisheries economics research should take in the near future.

LEI Managing director,



Prof. Dr. Zachariasse

# Welcome speech

Drs. D.J. Langstraat, Produktschap Vis, The Netherlands

It was about 31 years ago that I took note of some fisheries economic reports for the first time. In order to get my university degree in social en cultural sciences I made a study on the social backgrounds for the economic progress of the fishing village Urk. I discovered already very soon that the most reliable source for fisheries economic data was the 'Agricultural Economics Research Institute' (LEI).

When I started my work in the fisheries organisations in 1969 one of the first introductory visits I paid, was a visit to the fisheries economic department of the LEI.

At that time the top professional administrators in my industry were already conscious of the necessity of economic research.

Personally I have learned a lot from my contacts with LEI. I have experienced how extremely useful their work is for the industry and its professional or public organisations.

The economists have organised a solid statistical documentation system. With the help of that documentation the economists could give an insight in the profitability of our fleet-segments and of the composition of the costs. Their work has made it possible to analyse the annual results of the enterprises. On basis of those analyses conclusions could be made on what development should be stimulated and what necessary measures should be taken in order to improve the fleet's structure.

Their data made it possible to get a better idea of the crew composition of the different vessels and of the productivity per capital.

The fishery economists' work made it possible to explain that the importance of our industry for employment is much greater than many people may think.

In reaction on a former top civil servants' remarks that to much work was done for only a few thousand fishermen, I used to ask our economists to give an indication of the multiplier effect of our fishing industry. And even in our high efficient country our seafishing industry proved to create four times more jobs ashore. You can imagine that such information was very important for the defence of the fishing industry.

The work of our fishery economists and the LEI made it possible to produce estimates on the consequences of government measures. Estimates of damage caused by the ban of specific fresh water fisheries were made. And what to think about the prognoses on the consequences of large infrastructural works like our famous delta works for instance.

Our fishery economists have not only paid attention to the catching sector but also to the fish trade and fish processing industry. Thanks to their research it became possible to get a better insight in the structure of our trade and processing industry. Marketing has got an increasing attention.

In our country the administrators have become more and more conscious of the necessity of a vertical approach all through the chain. Paying attention to the catching side only is

not enough. Creating good conditions for trade and processing industry are for the benefit of the whole chain.

Today I don't feel the need to pay attention to the economic contribution in the policy process. Tomorrow however it will be a pleasure to give my view on that issue.

When looking at the programme of the conference, it is indeed a pleasure for me to address you now during the opening and to participate in the discussion tomorrow.

Research into fleet performance is of major importance as we are continuously faced with the question of how large a sector may economically survive on the available stocks, given the market prices and production costs. Fishing is an economic activity and therefore we must know how well (or badly) it is doing.

Evidently, the fleet performance is determined by what happens in the market and the efficiency of the chains, to which I already referred. I am told that the real prices of fish remain at a constant level. Well, as you can imagine in our perception they should be going up, at least gradually, because fish is a valuable component of our nutrition. We need to know why the markets behave as they do, despite the fact that FAO forecasts increasing shortages.

When it comes to modelling, I am somewhat at a loss. We have mainly experience with biological models and as you are well aware those have come under some criticism recently. Economists still have to prove what they are capable of doing in this area and whether it will be any good. In this field it will be entirely up to you to be convincing. I understand that some of you are trying to model the behaviour of fishermen or fishing industry. Although you may be able to discover some regularities, it is my view that the essence and beauty of the fishing cannot be caught in a mathematical formula, but this we can of course discuss during the coming coffee break.

Economic research into fisheries management will be probably increasingly welcome. With the coming review of CFP in 2002 we need some fresh ideas about a management style which will be efficient and effective. It must well be understood and appreciated by the industry and therefore the economic component will have to prominent. In this connection I shall be looking forward to the results of the projects which will be presented on Saturday morning. I would like to stress, and I shall do it tomorrow again, communicate your work to us. Not only after you have finished but also feel free and discuss with the industry while you are working on your research. I can assure you that many of my colleagues throughout Europe are interested in what you are doing and can also provide you interesting input. Cooperation of the Dutch Fish Board with LEI has been fruitful for both sides over several decades now.

You can imagine that is was a pleasure for me to take note of your programme. A programme which is not focused on fisheries management only but also on the market. Moreover you pay attention to a multidisciplinary approach. I welcome that very much. Until now at a European level too much attention has been paid to the biological aspects. More multidisciplinary approach in which the economic aspects evidently included should be welcomed. I have the impression that you are going to have a busy conference, although you will see some tulips in between. I hope that you will enjoy the coming few days and leave inspired and motivated to carry on with your work.

# The economic contribution in policy process

D.J. Langstraat, Produktschap Vis, The Netherlands

The last few years I have had the pleasure to be invited for several annual meetings of European Scientists specialised in fisheries. It concerned meetings with fisheries biologists, social scientists and economists. There were two issues which got special interest of the participants of all those meetings:

1. communication with the industry linked with the question how to get support for a certain idea or for fisheries policy;
2. the increasing interests in a multi disciplinary approach.

Generally spoken the individual entrepreneurs don't demonstrate a high appreciation for scientific research. Nevertheless most of them are prepared to cooperate with scientists. But sometimes it happens that they refuse. It often happens that they do not recognise their specific situations in the results of scientific research. Such lack of recognition is often linked with the level of education of the entrepreneur. As the majority of the enterprises are small sized enterprises with an artisanal character there is almost a natural distance between their intellectual world and the world of the scientists. It has regularly happened for instance that beamtrawler owners who participate in the financial statistical documentation programme of the LEI don't recognise their enterprises in the economic analyses which they receive from this institute. Nevertheless most of them continue to cooperate because somewhere in their mind they realise that it is useful.

How different is the appreciation when it concerns the approach of a collectivity. The banks for instance highly appreciate the work of the fisheries economists. So insiders won't be astonished that the RABO-bank is one of the sponsors of this annual meeting.

Another group which appreciates this work are the public administrators.

But also the professional administrators when acting on behave of the collectivity know to appreciate the economic research activities. Although most of them started their career as active fishermen, they have discovered the necessity of economic research in the course of the years that they have been administrators. They have realised that without good economic data there is an insufficient basis to steer the industry and to defend it. In my openingspeech I referred already to some situations in which the results of the LEI were very important for the defence of the industry. The need for economic data in order to steer and defend the industry is a need which should not only exist in the Member States but also at the EU-level.

I have discovered that many questions, the economists are confronted with, are rather comprehensive. It is just that comprehensiveness that asks for a multi disciplinary approach. Next to economy there needs to be an expertise in marketing, biology, sociology and even technical expertise. Moreover I expect an increasing need for expertise on ecological aspects in the near future.

I will mention some of the subjects we expect that economists have more or less to deal with:

- assessment of profitability of segments in the catchingsector;
- research and advises on structure and fishstockmanagement in order to:
    - improve profitability;
    - maintain or increase employment;
- research and advises on the market structure and the effect of certain measures on the market;
- research and advises on (economic) incentives for the support for certain measures.

For the assessment of the profitability of the enterprises the economists need to collect data of the accountings of the enterprises. They are also a good basis for analysing enterprise problems and for analysing the structure of the fleet. In other words they are a good basis for discussions on structure policy. But structure policy goes further: It has to deal with technical aspects, social aspects and marketprospectives. So it has also to deal with the shoreside of the industry. In other words trade and processing.

The employment aspects of the structure policy and the quota policy are issues which need the high attention of the economists. The decisions concerning the actual multi annual guidance programmes are based on reports and advises to which the economists have only contributed marginally. Until now the economists' contribution to the discussions on the biological advises on TACs have also been marginal. In de Advisory Committee for Fisheries which I have been chairing since more than fourteen years we complained about that and I think with at least a partial success. The Commission decided to extend the amount of economists in the scientific, technical and economical committee for fisheries management. This committee should give an opinion on the fish stock management advises of the biologists (ACFM). When preparing this speech I assumed that anyway John Farnell would pay attention to this issue today.

I think that the MAGPs would have looked quite different from what they are now in case the economists' influence on them was greater. I would have expected them to base their advice on the objective: profitable industry in balance with sustainable fisheries. Now we risk a dogmatic approach in which it seems to be more important to meet the MAGP objectives then to realise a profitable industry in balance with sustainable fisheries. I think it remarkable that some Member States who were often blamed for overfishing criticised Member States like ours for not having fulfilled the MAGP, whereas thanks to our special co-managementsystem we have been fishing within our fishquota since five years. Now the MAGP straitjacket threatens to undermine the fishermen's support for our co-managementsystem. There still seems to be unclearity about the practical application of the Dutch days at sea limitation within the MAGP framework. Obviously discussions have not been closed yet. There is still some discussion on the question whether the imposed MAGP percentual reduction should be applied on the utilised days at sea in stead of the allocated days at sea. The fishermen experience that approach as a penalty for good behaviour. After all they utilised less days at sea because of quota reductions and thanks to their co-managementsystem they kept themselves to the catchquota. As said before, I think that the MAGP would have looked different in case the fisheries economists could have influenced it more. In that case interpretation problems like in our example might have been avoided. I also wonder whether the favoured position of the small coastal fisheries would be different,

in case decisions would have been based on the advises of the economists. Now I have the idea that in some regions of the EU the structure policy is used as an alibi for a failing social policy. With the help of the structural funds the fishing fleets of those regions are artificially maintained at a too high level without a perspective of structural profitability. In case my assumption is right economists and other scientists, amongst which biologists should warn against the long-term repercussions such a policy may have. One of the long-term repercussions may be a lack of credibility of those who have proposed such type of policy.
In relation to the economic performance of the catching sector in general and the MAGPs in particular, attention should be given to the question of productivity. What is the real trend in productivity of fishing vessels? The EC assumes as a standard an annual increase in productivity of 2% and MAGP objectives are defined accordingly. However, empirical research by LEI-DLO regarding the Dutch beam trawling indicates that the average productivity of larger vessels per unit of effort, which is horsepower days in our case, is in fact decreasing. This is not surprising because of the law of diminishing marginal returns. Evidently in case of other fleets and other technologies the situation may be different. But in any case we need conclusive research.

Furthermore, as you are well aware, increasing productivity is the only way to maintain the standard of living of the fishing communities in pace with the general development. What have been the historical developments and what is the outlook for the coming years? In view of the working conditions on board, fishing cannot be reduced to a low-income occupation.

There has been talked a lot about trade and the processing industry, but where are EU-reports from economists with proposals for improvement of the infrastructure, and of the structure of the industry in order to maintain or even increase employment? What views are there on the future structure? Increase of employment on the processing and trade side may be reached by finding or creating new markets; markettrends should be identified. Marketing research and marketing advises can all be considered to be part of the fishery economist's job. At the same time it indicates the need to include other specialisms. What to think about technicians and fish technologists. Technological knowledge may lead to the development of new fish products.

Coming back on the market issue: the European Commission has produced a communication which is called 'The future for the market in fisheryproducts in the EU'. It is a public document on which the Commission gets advises from the Europarlement, the Economic and Social Committee and the Advisory Committee for Fisheries. It is a very interesting document and contains some new ideas for which I have complimented the Commission. The comments on the document will help the Commission to formulate an official proposal on the revision of the marketregulation. I could imagine that a group of fishery economists in Europe would take the initiative to give also their critical observations on the document. Observations based on their experiences. Personally I will be interested in a comment from specialised economists on the carry-over premium which is part of the actual marketregulation and which the Commission considers to continue. My industry, producers as well as the traders think the premium does not have a stimulating market effect, but may even have a marketdisrupting effect. This opinion has been shared by many organisations in Europe. But there is no unanimity on it, so it might be interesting to get a further comment from the

economists on this point. The commission document contains also a paragraph about trade with third countries. On the one hand producers representatives are often complaining about cheap imports which influence their market prices. On the other hand the traders and processing industry need a continuous stream of raw material in order to supply the market and in order to safeguard their profitability. It is interesting to take note of the Commissions' wish that a debate takes place in order to see what possibilities there are to increase the European competitiveness within the framework of the trade policy. I think that such a debate should include a vision on a long-term perspective for the development of the fish processing industry. One of the connected questions must certainly be: what will be its future position in the light of competition from low wages countries?

The price mechanism is an issue which certainly deserves more attention. Does the auction system under the present circumstances still guarantee the optimal price for fishermen and traders? In which way will the prices be influenced by contract-sales? The theory has been described. Could field research result in new answers?

Another market influencing factor is the minimum size for the specific species. What for instance are the influences of the regional differences in commercial minimum size of the same species in the Union? And what is the marketinfluence of the decrease in minimum sizes of certain species as has been decided by the Council within the framework of the technical regulation. The decision concerned will be effective after about two years.

With this last issue I make a link with the fishstock management policy. Since many years I have been missing the influence of the economists on the Commissions' proposals for fishstock management. It does not only concern advises on the consequences of fluctuations in TACs etc., but also advises on the consequences of certain technical measures. When the Council decided on a Commissions proposal to decrease the minimum size for certain commercial species the proposal was based on the argument that with the existing mesh sizes one could not avoid bycatches of smaller sizes of certain commercial species which until now are considered to be below the official minimum size. What will be the market effect of the decrease of the minimum size of plaice form 25 centimetres to 17 centimetres for instance? The majority of the industry is afraid of negative marketconsequences of this decision. Moreover it is not convinced that the measure will contribute to a better fishstockmanagement. What is the fisheries economists opinion on this? Isn't there a task for the fisheries economists to make prognoses of the consequences of such measures; wouldn't it be good to communicate with the industry about the effects.

As said before until now the fisheries economists have only been marginally involved with the advises on the TACs and quotapolicy. I have welcomed very much a recent commissions message that the amount of economists in the STECF will be significantly enlarged. This is a great challenge for the economists. With their knowledge they can indicate the consequences of changes in TACs and national catchquota for the prices and the market and for the employment of the industry. In order to achieve well balanced proposals they can advise the commission and the industry. Advising the industry may also be important. Until now the majority of the fishermen is still too much kilograms minded instead of money minded. Presentation of well based prognoses about the price and marketconsequences of a decrease in catchquota for instance can contribute to more acceptance by the industry. On the other hand a presentation to the Commission of employment aspects for in-

stance, also for the processing industry, may help to find the right balance. The fisheries economists can also help to find incentives for support for special measures. They can help analysing strong and weak points of co-management options. In the Netherlands, thanks to a multidisciplinary approach (sociological included), they helped analysing the success of the co-managementsystem in our sea fisheries. Therewith they identified what exactly are, for the fishermen, the attractive incentives in the system.

At national as well as EU level an increasing attention is being given to long-term management. We must shift our attention from the annual discussion of TACs and quotas to fundamental principles on which an economically sound fishing sector should be based. I would expect that economics has something to say in this respect. And I would hope that your long-term analysis will go beyond the valuation of recovered fish stocks as forecasted by the biologists. Despite some special characteristics, fishing should be considered as an economic activity and management policy should be formulated accordingly.

The basic problem of fisheries management is what is called the 'tragedy of the commons'. This is not a technical, but a human issue. Therefore we would expect some operationally practical indications about how to deal with this problem, from social sciences in general and economics in particular.

It is evident that the economists cannot restrict themselves the deskwork. They must regularly communicate with all parties concerned. If they don't they will miss essential information. On their hand the other parties will also miss information which is important for their work.

This annual conference is an opportunity to improve the dialogue between scientists, but hopefully also between the scientists and the other parties involved.

# View of the European Commission on role of economics in CFP

J. Farnell, European Commission, Belgium

As the Director responsible for fisheries economics within the European Commission, I am grateful to have been asked to speak to you today. This is the first opportunity I have to meet so many fisheries economist. Frankly, I am relieved that there are so many of you.

Fisheries economics is now at the forefront of the debate about fisheries management, both internationally and within the EU. Your work is already important for us, and it will become even more so in the run-up to 2002 and the debate about the future of the Common Fisheries Policy. This debate will be (and should be) as much about the economics of European fisheries as about the legal framework in which it operates. And good economic advice has an essential part to play in that debate.

In my presentation this morning I would like to set the scene for developments which are likely to occur in this field over the next 3 to 4 years. I will focus on three main areas:

- first, I will look at the growing political interest in fisheries economics, internationally and in the EU;
- then I will describe the Community's present sources of economic advice and how these may develop;
  and, finally, outline economic questions for which we are looking for answers as far as the future of the CFP is concerned.

We will. I hope, have an opportunity in the Panel Discussion to discuss in more details how fisheries economics can help the Commission and also, perhaps, how the Commission can help fisheries economics.

## 1. The growing interest in fisheries economics.

As far as the European Union is concerned, improving the economics of fishing has traditionally come well behind other priorities in the CFP**,** such as the conservation of resources, the adjustment of fishing capacity and the safeguarding of Community fishing interest in non-EU countries.

Fisheries policy over the past 20 years has above all been driven by concern for the biological resource. It has been directed towards bringing the total level of exploitation of fish stocks under physical control, on the one hand, and encouraging adjustment of fishing capacity and effort, on the other hand. This internal agenda has been accompanied by considerable efforts to negotiate and maintain fisheries Agreements with third countries.

As far as conservation of fisheries resources are concerned, we may at last have reached a situation of 'relative stability', where limits on catches and technical regulations on genuine fishing activity are now regularly agreed adjustment without major political difficulties.

In the area of structural adjustment, too, we have had in place for some time a system which imposes a multi-annual programme for fleet adjustment and legal framework for financial support to three industry. Whatever its shortcomings, this system has delivered results in recent years (a 15% reduction in tonnage for the fleet between 1991 and 1996, and a 9,5% reduction in engine power). It is expected to deliver more positive results between now and the years 2001.

In this situation of 'stable regulation', the Common and the Member States are beginning to take a greater interest in the economic dimension of the CFP. We are interested for three reasons.

The first is the realisation that better economic management may also help to achieve the other objectives of the CFP, in terms of achieving greater efficiency in matching effort to resources, for example.

There is a second broader, economic or 'industrial policy' motive: to ensure greater international competitiveness and to maintain long-term (as opposed to short-term) employment in the fisheries sector.

The third motive is perhaps more pragmatic - the prospect of growing budgetary constraints in the context of EMU and further enlargement of the Union. Frankly speaking, it is becoming more and more difficult to justify long-term subsidisation of any economic sector within the Union, and fisheries are no exception.

Other motives for this interest in fisheries economics, however, come from outside the EU, in particular, from the growing activity in international organisations focused on the economic dimension of fisheries management and, in particular, the suggested link between unsound economics in the fisheries sector and the global over-exploitation of fisheries resources.

Some of this international discussion may be to you, but let me just give you a quick overview:

- The OECD Fisheries Committee, after completing a first 3-years study entitled 'Towards sustainable fisheries', has recently launched a second cycle of studies looking at the economic costs benefits of 'responsible fishing' including a review of public financial transfers (i.e. subsidies) tot the fisheries sector;
- The FAO Fisheries Committee also has set up a working group on over-capacity, whose second meeting will take place this summer (15/28 April 1998); the relation between subsidies and the fleet capacity will be an important item to be discussed in this working group;
- The Environment Committee of the World Organisation is looking at the impact if subsidies in the fisheries sector on resource depletion;
- In the past few months, various non-government organisations have presented critical studies of the EUs structural policy for fisheries and the EUs fisheries agreements with certain development countries.

In many, if not all, of these discussions, two economic themes consistently emerge. The first is that the fisheries sector is particularly dependent on public subsidies when in many other sectors the trend is towards privatisation and the elimination of subsidies; the second is that new forms of quota management, based on individual property rights, may be more effective in terms of achieving conservation and economic goals than more traditional forms of quota distribution by public authorities.

All of this discussion and debate is giving a more political dimension to economic considerations in fisheries management. The integration of environmental protection, developing policy and trade policy within international economic policy will probably lead, for example, to the fisheries sector assuming a high profile in any future multilateral negotiations within the WTO.

The conclusion for the Commission is obvious - the EU must 'get its act together' in terms of fisheries economics. It must develop a coherent strategy and be prepared to defend that strategy robustly in the international context.

## 2. Sources of economic advice to the Commission

In these changing circumstances, what is the Commission doing in order to obtain better advice in the area of fisheries economics?

The first thing it has done is to identify fisheries economics as a distinct management task within DG XIV. Since last year e new Unit within my Directorate has come into existence, responsible of co-ordination of our activity in this area (We don't have enough resources yet - but we are building them up).

A second element has been to ensure that the Scientific, Technical and Economic Committee on Fisheries (STECF) lives up to its name by containing at least a few economists! Today we have (7) economists on the Committee out of a total of (20) members; what is more, the acting STECF Chairman, Joergen Loerkegaard, who is here today, is an economist.

The role of the STECF is to offer the Commission advice on all of its work, although, in the past, its role has been focused almost exclusively on the biological advice provided annually by ICES prior to the annual fixing of TACs and quotas. The Commission is trying to strengthen the economic role of the Committee on two respects. First, we want to ensure that the advice about annual decisions about the exploitation rate of stocks is accompanied by advice about the economic effects of these decisions. And second, we would like the STECF to give the Commission guidance about how to develop a longer-term economic view of the development of European fisheries. What is equally important is that economists and biologists become more familiar with each others' objectives and methods.

The STECF has, however, only limited resources for the moment. It cannot carry out independent research. For that, we have to turn to the third element in the picture, the Concerted Actions currently funded under the FAIR programme. One of the most important of these actions, currently led by our hosts, the LEI-DLO, is focused on the promotion of common methods for economic assessment of EU Fisheries. This project brings together

research institutes from all EU Member States with an interest in sea fisheries, together with participants from Norway and Iceland. For the next 3 years it has a two-fold task:

- to develop an annual report on the performance and prospects of a number of specific fisheries segments within the EU (about (30) fisheries will be covered in the 1998 Report);
- to offer advice on the short-term economic impact of the annual ACFM advice on biological management of EU fish stocks.

This is an ambitious project which is facing many challenges: the differences in methodology or in the definitions of key parameters from country to country, the absence of economic data from fishing fleets in some countries, the time constraints for analysis which result the need to deliver reports in time for them to be taken into account. But it is clearly at the cutting edge of thinking about fisheries economics in Europe today and we are encouraged by the results of its early work.

The last source of advice available to the Commission today is through individual *ad hoc* studies financed under DG XIV's own budget. Although our investment in economic studies has always been considerably less than in biological research, the budget devoted to non-biological studies is still important - about 13 million ECU over the past 3 years, for example. The problem has been that this work has been largely unfocused, initiated by individual departments within DG XIV (responsible for structural policy, conservation, markets or international affairs) without any particular to set priorities or ensure overall coherence. We are hoping to move to a more coherent approach from now on.

## 3. The priority questions to which we need answers

This brings me to my last point; namely, priorities for future work in fisheries economics in Europe.

As I have already said, the Commission has begun to set its own priorities, which are based on the information needed for the debate about the future development of the Common Fisheries Policy after 2002 and the preparation of international discussions on subsidies and other subjects. This debate provides the opportunity to take a fresh look at where the EU fisheries sector is going in economic terms and what public authorities should do (or not do) in order to improve its economic performance.

The Commission is interested in looking more closely at three different sets of questions.

The first set concerns analysis of the economic impact of CFP to date - a retrospective look at what Community level regulation and Community-authorised public financial support have changed, for better or worse, in the fisheries sector. This will involve looking at the effects of technical measures, structural policy aids, the MAGPs and market support mechanisms. It should also include national measures in the area of taxation or social security rules (A major set of studies, for example, is about to start on the dependence of individual EU regions on the fisheries sector).

A second area of work will try to analyse trends in various important economic variables for the fisheries sector (capital investment, employment, market prices, the cost of inputs as labour and fuel) in order to assess whether and to what extent the European fisheries is becoming more or less profitable and why.

The third area will be more prospective in nature, looking at the possible effects of future changes in the way the CFP might be managed. This could include changes in technical rules for fishing, for example (if we were to decide, for example, that all by-catches should be landed) or in management of national quotas (ITQs in certain fisheries).

Much of this work will be difficult, as the data necessary for a complete analysis may not exist. Some of it will inevitably be speculative. This should not discourage us. For even approximate economic analyse or forecasting could greatly improve the quality of political decision-making about the fisheries sector. It is clear that these decisions will never be based purely on economic criteria. Nevertheless we must ensure that whatever economics can tell us about the fisheries sector is presented to the politicians in the clearest possible way.

## Conclusion

To sum up, European fisheries economics has a secure future! Your services will be called upon even more in the future than they are today.

The major problem that we face is not shortage of work in this field or lack of interest in it. It is rather one of making sure that we use limited resources to best effect and that the analysis is clear enough to get the political attention it deserves. I am convinced that the next five years will bring profound changes in the way we think about the fishing industry in Europe. Fisheries economists can help to clarify the choices that politicians must make, by making clear what the real cost of each option is. I am looking forward to working with you towards that goal.

# Social science and fisheries management: The social impacts of co-management in the Dutch Wadden Sea

Nathalie A. Steins, University of Portsmouth, United Kingdom

**Abstract**

In 1993, the Dutch Sea and Coastal Fisheries Policy (SCFP) came into effect. The SCFP aims at the integration of fisheries and nature and the division of management responsibilities between the Government and the fishing industry. The first phase of the SCFP is currently being evaluated; in this evaluation, the impact of the co-management measures on nature conservation, economic impacts and fishermen's compliance, are key issues.

This paper discusses the social impacts of the co-management strategy. It discusses (i) how the cockle, mussel and shrimp fishermen in the Wadden Sea perceive the co-management measures and their effects; and (ii) how the multiple actors' different images of nature and fishing influence co-management strategies at both the operational and organisational level. The paper is based on sociological field research carried out over a three months' period in 1997.

The case study forms the basis for a discussion on how social science can contribute to fisheries management and policies as part of a multi-disciplinary approach.

## Introduction

In recent years, 'multi-disciplinary research' and 'integrated management' have become a 'hot issue' in natural resource management policy and research. Traditionally, fisheries management was heavily dominated by biological research, followed by economics in the past decade. Increasingly, however, policy-makers, researchers and the industry realise that fisheries cannot be managed in a sustainable fashion if different management aspects, such as biological, environmental, economic and social factors, are studied and managed in isolation. Integrated management is of particular importance for inshore fisheries, which tend to be located in coastal areas where multiple economic uses take place and where nature conservation is often a policy priority (Steins, 1997a).

Integrated management demands a multi-disciplinary approach to research and policy-making. In reality, however, multi-disciplinarity is often difficult to achieve due to (i) lack of funds; (ii) lack of mutual appreciation; (iii) reluctance to adopt new approaches at political and policy levels; (iv) threats to vested interests; and (v) lack of experience.

This paper presents a case study of the co-management strategy for fisheries in the Dutch Wadden Sea, which aims at the integration of fisheries and nature and the division of management responsibilities between the Government and the fishing industry. The

evaluation of the first phase of the co-management policy (1993-97) is currently being finalised. The evaluation process is characterised by multi-disciplinary research (biological, environmental, economic and social) and by extensive participation of the industry and nature conservation interests. The paper examines the co-management strategy from a sociological perspective and discusses how social science can contribute to fisheries management and policy as part of a multi-disciplinary approach.

## Co-management in the Dutch Wadden Sea

The Wadden Sea is a tidal area extending from the northwest corner of The Netherlands along the coast and islands of the German Bight to Esbjerg in Denmark. It is a network of tidal channels, sandbars, mudflats, salt marshes and islands covering about 900,000ha. The Wadden Sea is one of Europe's most important nature conservation areas and is the main staging area for migrating birds. About 30% of the Wadden Sea falls within the jurisdiction of The Netherlands. This part is a designated Ramsar site, Special Protection Area (SPA) and Man and Biosphere Area (MBA) (NFNA et al., 1991).

The protection and conservation of the Dutch Wadden Sea is based on a combination of planning instruments: (i) the Nature Conservation Act 1981, which designates the area as a State Nature Monument; and (ii) the Wadden Sea Memorandum (1981, amended in 1994), which is the basis for all further planning, conservation and management for the area for all state, regional and local authorities. The protection of the Dutch Wadden Sea did not become an issue until the late 1960s when the government launched a plan to reclaim the Dutch part, which met a lot of opposition. By that time, the area had become subject to extensive human exploitation such as commercial shipping, fishing, recreation, and extraction of minerals and military exercises.

The Wadden Sea has been an important fishing ground for centuries. Nowadays, fishing for cockles *(Cerastoderma edule)*, blue mussel seed *(Mytilus edulis)* for cultivation on parcels, and shrimp *(Crangon crangon)* are the dominant activities. Currently, there are 36 licences for cockle fishing with hydraulic suction dredges concentrated on 22 large vessels, the so-called 'mechanical sector'. In addition, 75 fishermen are licensed to use the *wonderklauw*, a hand dredge, and the 'non-mechanical sector'. In 1990, total landings of Wadden Sea cockles were 5,112t (fresh meat); in 1994, these landings were reduced to 2,382t (PO Kokkels, pers.comm.). In 1996 the Wadden Sea was closed for cockle fishing with suction dredges. The mussel industry in the Wadden Sea is a semi-culture, concentrating on the (bottom) cultivation of wild mussel seed on parcels, which are rented from the state by 82 lessees. In 1996, the total mussel seed catch was 52,500t; the total landings of mussels for consumption were 94,500t (fresh meat) (PVV, 1996). Maximums of 97 shrimp licences are issued for the Wadden Sea. In 1996, shrimp landings were 2,400t, accounting for 30% of the total national landings (Directie Visserij, pers.comm.).

In 1993, the national Sea and Coastal Fisheries Policy *(Structuurnota Zee- en Kustvisserij)* came into effect. Its starting point is nature conservation and protection of natural processes, which is stipulated in the Wadden Sea Memorandum. The policy is aimed at 'achieving a harmonisation between fishing effort and nature where possible, and a separa-

tion of the two where necessary' (Keus, 1994:6). The policy is built around two central themes:

1. the division of responsibilities between the fishing industry and the government; and
2. the integration of fisheries and nature (Min. LNV, 1993).

The implementation of the Sea and Coastal Fisheries Policy must be seen in the context of two developments in the fisheries for quota and non-quota species. First, the management of the quota fisheries was characterised by a number of serious problems, the most important being: (i) overfishing of Individual Transferable Quotas (ITQs); (ii) non-compliance with additional control and enforcement measures due to lack of fishermen's support; and (iii) a severe crisis between the industry and the Government (Langstraat, 1997). To address these problems, the so-called Biesheuvel Groups for quota self-management were established. The Groups operate through the Producers' Organisations (POs). Group members are obliged to transfer the right to manage their ITQs to the board of the Group and have the right to use their ITQs under the conditions which have been agreed upon in a 'fishing plan' made by the group. Through the administration of the Group, they are allowed to rent or hire (part of) their quota to or from other members[1]. A total of 97% of all cutter owners has voluntarily joined a Group. The system has led to a drastic reduction of offences and no quotas have been exceeded over the last four years (*ibid*.).

Second, in the early 1990s, the (non-quota) shellfish industry was heavily criticised by environmental groups. Due to continuous fishing pressure in the 1980s, followed by a series of mild winters which caused low spatfall, the Wadden Sea mussels stocks were very low in the early 1990s. The lack of sufficient mussel seed led to intensive fishing of the remaining wild beds. The combination of human and natural factors resulted in the total disappearance of intertidal mussel beds (Smit, 1995). In the same period, cockles also showed reduced spatfall. A considerable share of the low stocks were fished (Dankers, 1993). All these factors contributed to a food shortage for, most notably, the oystercatcher and the eider, resulting in high mortality rates. The fishermen were blamed by the environmental groups, the national media, some researchers and the public. The shellfish industry could do nothing but react at the increasing pressure from the public and voluntarily imposed a number of restrictions on the fishermen.

In 1991, the mussel industry and the government agreed on a division of available mussel seed between fishermen and the birds. In addition, a fishing plan was made which stipulated a Total Allowable Catch (TAC) for mussel seed and individual mussel seed quota. In 1992, the mussel industry voluntarily agreed on the closure of tidal mudflats for seed fishing in the eastern Wadden Sea. By restricting the adverse influences on the environment, the mussel sector hoped to prevent strict government measures (Keus, 1994). In 1992, the mechanical cockle sector followed the mussel industry and implemented a fishing plan. Measures included *inter alia*: (i) reduction of the fleet from 36 to 22 vessels by concentrating two licences on one vessel; (ii) quota for the Eastern Scheldt estuary; (iii) an agreement not to fish near eelgrass *(Zostera marina)* beds; and (iv) the requirement to have a 'black box' on board, a computer which registers all fishing positions and activity. In 1993, a similar fishing

[1] See Langstraat (1997) for a detailed discussion of the operation of the Biesheuvel Groups.

plan came into effect for the Wadden Sea (PVV, n.d.). The non-mechanical sector made its own fishing plan.

After a period of consultation and heated discussions involving the industry, environmental groups and government authorities, the Biesheuvel Groups and the system of self-management through the implementation of yearly fishing plans by the shellfish industry was formalised in the Sea and Coastal Fisheries Policy (SCFP).

Under the SCFP, the shellfisheries in the Wadden Sea have become subject to restrictions. A total area of 26% has been closed for all forms of shellfishing (and beam trawling with thickler chains) to protect the development of mussel and cockle banks and eelgrass. This closure is based on an agreement at the 6th Trilateral Wadden Sea Conference in 1991. Management policies for the shellfisheries are based on a differentiated approach in which a distinction is made between 'normal years' and 'years of food shortage'.

In years with a food shortage, 60% of the mean food requirement (cockles and mussels) for birds will be reserved [1], if less than this percentage is available, the shellfishery will be closed. In addition, fishing quota are set in such years. To ensure that the non-mechanical cockle sector receives part of the share in poor years, a 1:16 (non-mechanical:mechanical) distribution code for the available cockles has been set. In addition to the above measures, the shellfishing industry, in collaboration with environmental groups, has to implement yearly fishing plans in which the principle of integration of fisheries and the natural environment in the coastal waters has to be shaped through tangible agreements [2] (Min. LNV, 1993).

For the shrimp fishery no restrictive measures have been taken, since the negative environmental impacts of shrimping are considered to be minimal. However, Wadden Sea shrimp fishermen are affected by the SCFP through the measures taken to optimise mussel parcels and, if they own ITQs, though the operation of the Biesheuvel Groups.

The evaluation of the measures taken for the management of shellfisheries during the first phase of the SCFP (1993-1997) started in September 1997. Its prime objective is to assess the effectiveness of the differentiated approach of 'normal years' and 'years of food shortage' (Directie Visserij, 1997). Through scientific research the *ecological* and *economic* impacts of the measures have to be identified. The results of the scientific research are presented to and 'cross-checked' by a working group comprising the different authorities and user groups with an interest in the shellfisheries (including nature conservation interests). The second objective is to examine the extent to which the shellfish industry has succeeded in realising the self-management rules aimed at reducing adverse impacts on the natural environment (*ibid*). The Commodity Board for Fish and Fishery Products was asked to report on the industry's feelings and experiences regarding the policy, thereby partly focusing on *social* factors.

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[1] In the Sea and Coastal Fisheries Policy, a 70% food reservation in years with a food shortage is stipulated. However, the government decided that this measure was not sufficiently scientifically proven. In the Policy alternative food sources for birds had not been taken into account, although research by the National Fisheries Research Institute (RIVO) and the Agricultural Economics Research Institute (LEI) indicated that such alternatives did exist. It was decided that further research was necessary, and that a reservation of 60% was set until the evaluation of the first phase of the Policy in the autumn of 1997 (PVV, n.d.).

[2] See Steins (1997b) for a detailed discussion of the operation of the fishing plans.

As a completely separate project from the formal evaluation, a sociological study was carried out by the author (Steins, 1997b). Its objectives were (i) to describe the evolution of the SCFP and (ii) to analyse its effects on the operational (fishermen's) level. The study was based on a three months' field research and 37 open-ended, unstructured interviews with fishermen, their representatives, nature conservation groups, researchers and authorities. The results of this study are briefly discussed hereafter.

**Social impacts of Wadden Sea fisheries co-management**

On the basis of the interview data, two categories of impacts of the SCFP can be distinguished. The first group relates to direct impacts felt and identified by the industry. The second category refers to the discourse (or language) different stakeholders use to talk about each others' activities which influences the process of co-management indirectly. The direct impacts are summarised below.

The *mechanical cockle sector* identified the following advantages of the co-management measures:

1. *the shift from a 'wild west' fishery to a regulated fishery*: prior to the voluntary regulation of the mechanical cockle fishery by the industry, the fishery was not subjected to any other restrictions but licence requirements. Fishermen feel that the regulations have brought peace in a fishery that was previously governed under wild west' rules;
2. *the obligation to have a 'black box' on board of each* vessel: after initial mixed feelings, the fishermen are now raving about the computer since it covers them from false accusations from nature conservation groups (e.g. fishing in the closed areas). The black box is also useful in keeping records of fishing areas and catches;
3. *economic benefits*: the concentration of 36 licences on 22 vessels has resulted in a better spread of the fleet over fishing grounds and reduced the running costs. In addition, restrictions on engine capacity and adjustment of suction dredges has led to quality improvements.

Disadvantages are:

1. *financial setbacks*: a number of subsequent years of food shortage resulting in low quota allocations and the closure of the fishery in 1996, led to a lack of returns, putting the sector in a difficult financial position. The sector also fears the loss of the important Spanish market;
2. *constraints on exercising the profession of fisherman*: fishermen mentioned that it has become more difficult to use their skills as cockle fishermen. For example, prior to the SCFP individual each fishermen would make an inventory of available stocks on the tidal flats; 'good fishermen' would be rewarded by a bigger catch. Nowadays the inventory is carried out collectively to minimise disturbance the birds and seals. In addition, the measures have a social impact on the daily lives of fishermen and their families. A number of subsequent years with a food shortage has resulted in short fishing seasons (or none at all in 1996), which is perceived to be very depress-

ing after spending six months on preparing the vessel for the new season and one month on the stock inventory.

The *non-mechanical cockle sector* identified three effects:

1. *quota allocation in years with a food shortage*: in years of food shortage the non-mechanical sector is allocated 1/17 of the TAC for cockles. Fishermen feel badly done by this allocation;
2. *practical problems in the designated fishing areas for the non-mechanical sector*: when the cockle season opens for the mechanical sector in years with a food shortage, the non-mechanical sector is obliged to fish in designated areas ('squares'). In practice, the criteria a square has to meet before it can be designated are difficult to meet. Furthermore, the limited number of squares results in 'congestion problems' if many fishermen are fishing at the same time;
3. *impacts on output*: subsequent years with a food shortage has resulted in low outputs.

*The mussel sector* identified the following benefits:

1. *the shift from 'tramp fishing' to a regulated fishery*: prior to the voluntary regulation of the mussel seed fishery by the industry, the fishery was not subjected to any other restrictions but licence requirements. This resulted in a 'race' for available mussel seed during the season;
2. *more efficient use of mussel seed*: due to the regulation of the seed fishery through quota and fishing days, cultivation parcels are sown more efficiently using less seed. This has resulted in an increase of the total output;
3. *the obligation to have a black box on board*: like the mechanical cockle fishermen, the mussel sector feels that the black box protects them from accusations on illegal fishing;
4. *the optimisation of parcels*: the SCFP explicitly aims at optimising the mussel cultivation parcels through relocation resulting in higher outputs.

The disadvantage of the present policy is the absence of a so-called *extension de régime*. At present the co-management measures in the sector's fishing plans are not binding to non-members; this undermines the co-management system since non-members can rely on 'alternative' management regulations offered by the Government.

Although the SCFP does not include any direct measures for the shrimp fishery, the *shrimp fishermen* perceive a number of indirect effects of the policy, including, *inter alia*:

1. *greater flexibility for shrimpers with ITQs for finfish through the Biesheuvel Groups*: when the market price for shrimp is low, fishermen can rent additional flatfish quota from the Group. When the price is high, fishermen can rent additional days at sea from the Group;
2. *competition over fishing grounds due to the mussel parcel optimisation*: good cultivation parcels tend to be located near and on shrimping grounds. Although shrimp fishermen are consulted about proposed optimisations, they feel that they often loose important shrimping grounds to the powerful mussel sector. The mussel sector has bought out a number of shrimp fishermen; it is hoped that a reduced number of

shrimp fishermen will facilitate the cumbersome process of negotiating over relocation of parcels. Many shrimp fishermen find this strategy hard to take;

3. *increased competition with the Eurocutter fleet*: the shrimp fishermen perceive that the shrimping activities by the Eurocutter fleet (300HP) negatively influences their fishing activities, including a decrease in market price because of increasing supply and overfishing of the 12 mile zone;
4. *limited powers of the POs*: market regulatory agreements made by the POs are not binding to non-members, causing uncertainty amongst members. An urgent need for an *extension de régime* is therefore felt. In the sea fisheries sector, PO membership offers clear advantages over non-membership; this is not the case in the shrimp sector, which is seen as an additional reason for advocating an *extension de régime*.

In addition to the aforementioned impacts, an analysis of the interview data revealed that the process of co-management, i.e. deciding on the division of responsibilities between the Government and the industry, design and implementation of the fishing plans, and evaluating the outcomes of co-management on nature conservation, is heavily influenced by the stakeholders' different images of fisheries and nature. The common interest of the industry and the nature conservation groups is overshadowed by the different language the groups use when discussing the integration of nature and fishery. The nature conservation groups tend to use (i) subjective language (e.g. hydraulic suction dredges for cockles are referred to as 'vacuum cleaners' that 'plough the entire Wadden Sea'); (ii) invalid information (e.g. the blade attached to the suction dredge is said to be 10cm rather than 2.5cm); and (iii) create a negative image of fishermen and their activities in the media (e.g. shellfishermen are accused of 'robbing' food from birds). The shellfishermen, on their turn, find it hard to empathise with the nature conservation objectives of the SCFP, which, *inter alia*, aim at the re-development of wild mussel and cockle banks. Particularly the mussel fishermen, who are used to demarcated, structured cultivation parcels perceive such banks to be 'untidy' [1]. Although the relationship between the industry and the nature conservation groups has improved significantly from being 'enemies' to being 'negotiators', the nature conservationists' activities have resulted in an extremely fragile relation between, particularly, the mechanical sector and the nature conservation groups.

While the nature conservation groups' actions mainly focus on the mechanical cockle sector and, to a lesser degree, on the mussel fishery, they do not object against the traditional activities of the shrimp and non-mechanical cockle sector. By being 'traditional', these fishermen have obtained two powerful tools. First, unlike the mechanical cockle sector and mussel sector, they are considered to have historical rights to fish a nature conservation area. Second, they are considered to be 'harmless' from a nature conservation perspective. Future research will have to prove if this last assumption is true. However, their historical rights will continue to be a strong symbol in the debate about integrating fisheries and nature.

The sociological study concluded that co-management is the way forward for fisheries management in the Wadden Sea. The industry has succeeded in implementing the co-

[1] See Steins (1997b) for a detailed discussion of the creation of different images of fisheries and nature.

management measures, the relationship between the industry, Government and nature conservation interests has improved significantly and, for the first time, there is a policy that actively promotes the integration of fisheries and nature. However, the discussion on the 'effectiveness' of the differentiated approach with respect to nature conservation can only lead to tangible results if:

1. a political decision is made on quantifiable objectives with respect to the long-term carrying capacity of the Wadden Sea and;
2. the discussion on cockle, mussel and shrimp fisheries is led by scientific and rational arguments, which also take into account the socio-economic importance of these fisheries, rather than on the basis of prevailing images of different types of fisheries.

To guarantee the long-term success of the co-management strategy, two further conditions are necessary:

3. an *extension de régime* which extends the enforcement powers of the producers' organisations to non-members; and
4. further strengthening of the feeling of trust and partnership between nature conservation organisations and the fishing industry.

The next section discusses how social science can contribute to fisheries management and policy as part of a multi-disciplinary approach, using the above case study as an example.

## The contribution of social science to fisheries management and policy

The design, implementation, evaluation and amendment of policies for fisheries management tends to rely heavily on biological, environmental and economic considerations. As a consequence, multi-disciplinarity in fisheries management is often synonymous to 'bi-disciplinarity', i.e. marine biology and economics. Social scientific research, such as sociological, anthropological, psychological and policy research, is often carried out by individual researchers as part of their own research agenda and does not necessarily have the explicit objective to contribute to policy processes. There are numerous reasons for this *status quo* in social science, the most important being: (i) lack of appreciation by researchers, policy-makers and funding organisations of the contribution of social science to fisheries management; (ii) the prevailing belief that policy can only be made or evaluated on the basis of hard, quantifiable data; (iii) lack of communication between the different disciplines; and (iv) the historical lack of organisation of social scientists involved in fisheries management [1].

The contribution of social science to fisheries management and policy should, however, not be underestimated. Increasingly it is recognised that policies and plans are more

[1] The European Social Science Fisheries Network (ESSFiN) was only established in 1995 and has since been joined by a large (and growing) number of social scientists. Improving communication between researchers and the dissemination of research are among its objectives (http://www.hull.ac.uk/geog/essfin.htm).

likely to succeed if user groups participate in the development, implementation and evaluation of plans. In the case of fisheries co-management in the Wadden Sea, for example, fishermen's compliance with the (initially voluntary) restrictive regulations can largely be explained by the fact that regulations were not imposed upon them, but were developed by the industry itself, and were feasible at the operational level. Other examples where user participation is considered to be the key to success, are integrated estuary management plans, where different users, including fishermen, come together to agree on management strategies (Robinson, 1997; Steins, 1997a). Furthermore, fishermen tend to have extensive local knowledge of fishing grounds and often have their own local management regimes for fisheries (Olomola, 1993; Steins & Edwards, 1997; Taylor, 1987), which can be incorporated in policy processes initiated at higher levels of decision-making, thereby respecting local culture and practice and enhancing the chances for successful management. In the social sciences, numerous methods and techniques aimed at user participation in natural resource management have successfully been developed.

Second, social science can assist in the evaluation of outcomes of management regulations and policy at the operational level, focusing on, *inter alia*, reasons why fishermen comply (or do not comply) with regulations, and social and cultural effects of policies on fishermen, their families and fishing communities. An important aspect of the Wadden Sea case study, for example, was to identify fishermen's perceptions on the co-management strategy. This was done on the basis of extensive open-ended, unstructured questionnaires. For larger research projects, involving more stakeholders, or in projects were time is a constraint, more quantitatively social scientific research may be a viable alternative (e.g. structured questionnaires, statistical analysis of data).

Finally, the analysis of policy processes is an important aspect of fisheries management to which social science can make a valuable contribution. By explaining how policy processes evolve, identifying who is involved in policy-making (and why); analysing how different stakeholders can influence policy processes; and explaining the relationships between different stakeholders, social scientists can further our understanding why certain management policies and strategies work in certain situations and not in others. For example, during the field research for the Wadden Sea case study, it became clear that the creation of images of fishermen and their activities by the nature conservation groups obstructs the envisaged partnership between these two interest groups and therefore the co-management strategy as a whole. The industry feels that they are being criminalised by the image the nature conservation groups create in the media. This seriously affects their trust in the nature conservationists with whom they have to negotiate under the provisions of the SCFP and has resulted in strained relationships, making negotiation a cumbersome process and limiting negotiations to periods when policy 'demands' a partnership. Once problems have been identified, social scientists can play a further role in facilitating discussions between the stakeholders who are 'responsible' for the problem in an attempt to create mutual understanding and to arrive at action strategies. For example, Wadden Sea fishermen found it difficult to understand why biotopes such as wild mussel banks are so important for nature conservation. Informative meetings organised by the POs, in which marine biologists explained the need to protect and develop such biotopes, were an important tool in gaining fishermen's support for the restrictive measures.

## Discussion

In view of the increasing emphasis on 'integrated policy approaches' and 'integrated management strategies', fisheries research and management cannot lag behind. Sustainability in fisheries can only be achieved if fisheries management goes beyond the biological objective of stock conservation to include economic considerations (maximum use), social considerations (who is involved and how are they affected) and environmental considerations (resource conservation). Therefore, multi-disciplinary research is advocated. In fisheries research, however, multi-disciplinarity often embraces marine biology and economics only. Social aspects are often considered in terms of 'socio-economic factors', thereby ignoring that fishermen's perceptions on management regulations and policies are important factors determining the success (or failure) of fisheries management. Furthermore, in the analysis of socio-economic factors, the 'socio-' aspect is often underappreciated, thereby overvaluing the 'economic' aspect. However, fisheries that may not generate high economic returns may be locally important to fishing communities, even if fishing has become more of a hobby to keep the family tradition going, as is the case for many coastal fishermen in remote areas in Ireland (Steins, 1998).

This paper presented an empirical example of a sociological study into the implementation and outcomes of a co-management strategy for the Dutch Wadden Sea fisheries. The case study indicated that social science can contribute to multi-disciplinary fisheries research in three important ways:

1. facilitating participatory research and participatory development of fisheries management policies and plans;
2. analysing the outcomes of fisheries management and policies at the operational level;
3. analysing policy processes for fisheries management.

Truly multi-disciplinary fisheries research is still in its infancy; where there is willingness to co-operate between different research disciplines, such co-operation is often frustrated by funding organisations. More multi-disciplinary research is, however, urgently needed to obtain experience and knowledge and to work collectively rather than sectorally towards sustainable fisheries management. To achieve this objective, it is first recommended that communication links between different disciplines should be encouraged and further improved. Second, much multi-disciplinary research is disseminated in the 'grey area' of government reports and reports to funding organisations or EU research programmes. Through networking or publication in refereed journals, experiences can be shared with other researchers. Furthermore, experiences with multi-disciplinary in coastal zone and estuary management can be of use to fisheries managers and researchers. Third, funding organisations must be encouraged to promote multi-disciplinary research. Finally, social scientists themselves should try to play a more active role in promoting their activities.

In the 'quest' on how to realise multi-disciplinary fisheries management, care should be taken not to focus on the management of fisheries explicitly, i.e. without taking into account the wider environment in which fisheries are embedded and which influences and is influenced by fishing activities. This is particularly the case for fisheries in the 12 mile

zone, where other interests, such as aquaculture, aquatourism, mineral extraction, coastal defence works and nature conservation, are of importance. This *multiple use* characteristic of the marine environment has to be taken into account in fisheries management. Besides multi-disciplinary management, fisheries management has to be *integrated* management.

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# Investment behaviour and path-dependancy in the fishing industry - an evolutionary perspective

Pascal Le Floc'h and Jean-Pierre Boude, ENSAR, France

**Abstract**

This article deals with a methodology to study investment behaviour in the fishing industry. Distinctions are made according to the main technologies with respect to a fishing boat. A historical examination is necessary and applied to the case of fishing fleets in French Basque Country. This methodology offers the opportunity to identify several path dependencies for the two fleets in French Basque Country, pelagic trawlers and seiners, from 1986-1995. Technological competition exists between these fishing fleets exploiting tuna and anchovy in the same fishing grounds. Lastly, various scenarios are proposed. Investment behaviour is detailed according to the nature of investment, routine, imitation or innovation. Theoretical background is taken from evolutionary economics (Nelson & Winter, 1982). Decision-making in the investment process depends on the one side with needs of the firm and financing capabilities, and on the other side with technological opportunities on the market. These implications rely on the debate between *technology-push* and *market-pull theories*.

Key words*:* Innovation - Imitation - Routine - Path dependency - Fishing

## 1. Introduction

This paper presents a methodology focused on investment behaviour and path-dependency in the fishing industry. Objectives concern a quantitative and qualitative analysis of innovation. Theoretical approach is founded on evolutionary economics (Nelson & Winter, 1982; Dosi, 1982; David, 1985). In the field of fisheries, Allen and McGlade proposed a similar approach in 1986 with two groups of fishermen, cartesians and stochastics. This dual behaviour reveals two strategies for fishing companies in the economics of innovation, innovation and imitation.

Empirical context is elaborated from two fisheries exploited by French fleets. These two cases are defined as technological competition. The first case is the technological competition in Basque Country between pelagic trawlers, a recent technique, and traditional seiners, the old technique. Common target species for these two fleets are anchovy and red tuna. Pelagic trawling and seining are rivals (or exclusive) and non-complementary.

The second case concerns technological competition between side trawlers and stern trawlers from Concarneau harbour. Fisheries are located to the west of Ireland and Scotland. The main species are saithe, cod, megrim, and anglerfish. Side and stern trawling are neither rivals nor complementary.

Methodological tools explore two fields of research that are central for evolutionary economics. These deal with, on the one hand, the process of diffusion combined with the concept of path dependency, and on the other hand, the impact of investment on firms' performance (productivity or profitability). This second programme requiring scenario and objective is not optimisation but simulation.

## 2. Nature of Investments in the fishing industry and technological opportunities

Decision-making in investments depends on the one side with needs of firm and financing capabilities, and on the other side with technological opportunities on the market. These implications rely on the debate between the technology-push and the market-pull theories (Schmookler, 1966).

### 2.1 Transition matrix and investment decision in the fishing industry

The Markovian matrix enables the definition of the sample structure according to four states of behaviour. Each period, skip-owners can adopt the behaviour state number one, a no investment statement. The second state is a routinized investment. The third behaviour state reveals an imitation investment. And the fourth is an innovation investment. An historical approach is necessary (David, 1985) to estimate transition probabilities between two steps of behaviour.

These probabilities of transition are founded on micro-data nij.

*Matrix with transition probabilities*

$$p_{ij} = \frac{n_{ij}}{\sum_{j=1}^{n} n_{ij}} \geq 0$$

$n_{ij}$ : number of firms going from i to j.
$p_{ij}$ : transition probability from i to j.

This work is based on a hierarchy at three levels. In the first, the matrix defines the four states of behaviour.

*Four behaviour states*

$$\begin{array}{c} S1 \\ S2 \\ S3 \\ S4 \end{array} \begin{pmatrix} + & + & + & + & + & + & + \\ + & + & + & + & + & + & \\ + & + & + & + & & & \\ + & + & + & & & & \end{pmatrix}$$

No investment
Routine investment
Imitation investment
Innovation investment

Assumptions are made between state three and state four, between state four and state three and between state four and state four. Imitation and innovation entail a higher risk than routinized investment and generally, corporations in the fishing industry cannot support two new projects in succession. Stronger probabilities should be stated between S1, S2, S3 or S4 in the previous step and S1 in the next step. This is represented with three crosses in the matrix.

The second hierarchical level describes the three technological trajectories in which skip-owners can invest. This taxonomy refers to any articles in bio-economics (Wilen, 1985; Squires, 1988; Sampson, 1992; Bjormdal and Gordon, 1992).

$$\begin{array}{c} d1 \\ d2 \\ d2 \end{array}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

d1 : Direct and indirect fishing equipment
d2 : Electronic equipment
d3 : Handling and conditioning equipment

Last level defines the technical aspect of equipments.

Fixed capital includes all equipment liable to the depreciation rule. Depreciation allowances are derived from technical obsolescence on the one hand, and from conditions of use on the other hand. Usually, materials linked to the technological trajectory of direct and indirect equipment (hull, engine, fishing gear) are subject to harsher conditions of use whereas electronic material (the second technological trajectory) requires a replacement rate according to the obsolescence factor.

Technical obsolescence reveals the occurrence of minor and major innovations. This first source of diffusion explains the phenomenon of substitution for the actual physical capital. A celebrated case study in the fishing industry concerns the substitution between side trawling and stern trawling (Whitmarsh, 1978). In France, the first stern trawler was conceived in 1962. The technological competition began in the mid sixties. Progressively, the new process (stern trawling) recorded better results in terms of productivity and profitability than the old technique. In another field, new positioning equipment, the GPS (Global Positioning System), has replaced older materials since the end eighties.

The second source of diffusion in economics of technical change is the wear factor for material. The activity of fishing boats and skipper behaviour influence this wear rate. Activity can be fixed or mobile fishing methods. We use the concept of « métier » to describe the fishing activity. Strictly speaking, the 'métier' associates three elements, fishing grounds, main fished species and fishing gear. Skipper behaviour depends on the nature of risk and degree of uncertainty [1].

[1] A main distinction appears between risk and uncertainty. According to Knight (1921), objective probabilities linked with the risk concept give the opportunity to forecasting.

## 2.2 Nature of equipment and technological field

The third level describes the technical investment:

If d1,

$$\begin{matrix} m11 \\ m12 \\ m13 \end{matrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

m11 : Engine
m12 : Hull design
m13 : Fishing gear

If d2,

$$\begin{matrix} m21 \\ m22 \\ m23 \\ m24 \\ m25 \end{matrix}\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

m21 : Acoustic Detection
m22 : Transmission
m23 : Navigation
m24 : Control of fishing gear
m25 : Data processing

If d3,

$$\begin{matrix} m31 \\ m32 \\ m33 \end{matrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

m31 : Handling
m32 : Conditioning
m33 : Refrigeration

In Markovian language, identity matrixes (second and third levels) are defined as absorbing states.

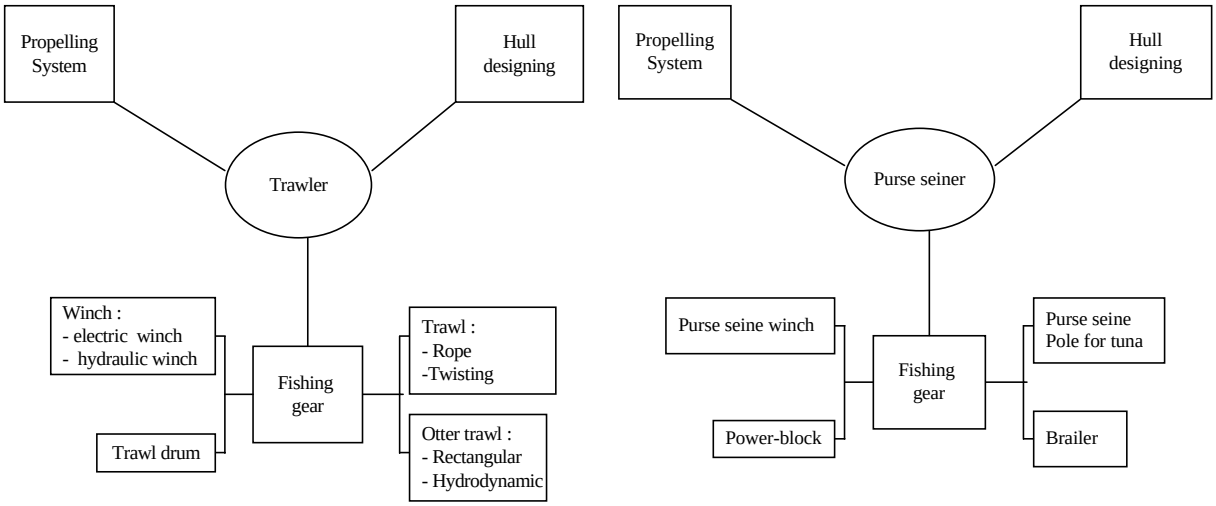



*Figure 1 Technological trajectory of direct and indirect techniques of exploitation*

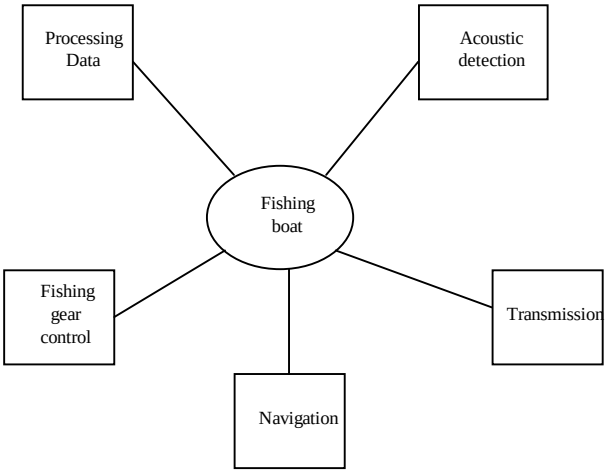



*Figure 2 Technological trajectory of electronic equipment*

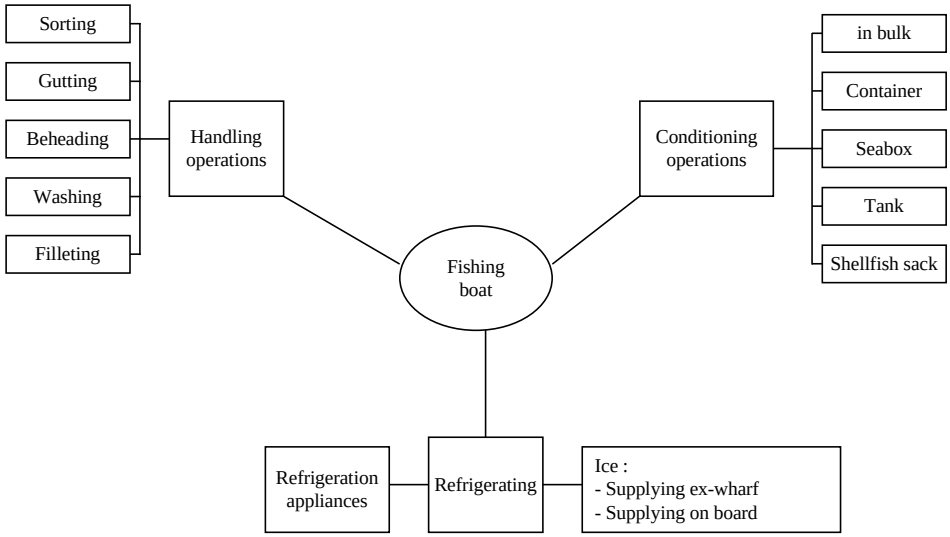



*Figure 3 Technological trajectory of handling and conditioning*

To sum up, methodology comprises three main assumptions. Firstly, a historical approach is necessary to study the diffusion process in fishing industry. Secondly, the innovation process is followed by the next step, an imitation process. This mechanism appears as the diffusion process (Arthur, 1989; Metcalfe, 1988). Thirdly, in technological competition with two techniques, the former technique must be considered as a routine investment and recent technique must be considered as an imitation investment.

Three others assumptions must be added concerning the model of the Markovian matrix. We suppose that 25% of the sample renew routinely fishing gear each period. This concerns a scrapping capital (Silverberg, 1988). Sample is fixed but there is a possibility of

entry and exit into or out of the fleet. An entry must be compensated with an exit. Finally, a single investment is taken account each period for one fishing boat (company).

## 3. Investment behaviour and path dependency in fishing industry

Identification of investment behaviour requires a historical approach (Wright, 1997) to define technological opportunities for a limited period. Fishing companies, suppliers and producer organisations were interviewed and collected data was used to classify different materials according to nature of investment (routine, imitative or innovative investment).

*The case of pelagic trawlers*

In French Basque country, technological competition includes the technique of purse seining (the old process) and the technique of pelagic trawling (the recent process). The fleet of pelagic trawlers included about thirty boats. Most of them use the technique of midwater pair trawling. Landings are made in two sites, Saint-Jean de Luz and Hendaye.

Routine investment concerns engine, fishing gear and electronic material. We retain two assumptions. Firstly, the duration of the propelling system is ten years. Every decade, ship-owner changes engine. Secondly, fishing gear must be renewed every four years. During the study period, four engines were changed.

*Table 1* *Routine investment for pelagic trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m12 | Engine | | | | | | | | | |
| m13 | Fishing gear (trawl warp, hydrodynamic otter board) | | | | | | | | | |
| m21 | Acoustic detection (sonar) | | | | | | | | | |
| m22 | Transmission (VHF) | | | | | | | | | |
| m23 | Navigation | | | | | | | | | |
| m24 | Fishing gear control (netsonde) | | | | | | | | | |

The imitative process (table 4b) represents the second step of diffusion process in economics of technological change (first step is the innovation behaviour). Pelagic trawlers in Basque Country have invested in three techniques according to an imitation process. Hull designing for a future pelagic trawler must be considered as an imitative investment during the technological competition between an old and a recent technique of exploitation. In the field of electronic equipment, two techniques have been increasingly employed since 1988 in the fishing industry in France. These are GPS (Global positioning system) and data processing. The diffusion process according to an imitative behaviour began in 1989 and ended in 1992.

*Table 2 Imitation investment for pelagic trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m11 | | | | | Hull designing | | | | | |
| m23 | | | | | GPS (Global position system) | | | | | |
| m25 | | | | | Data processing | | | | | |

Evolutionary economics in field of technological change is based on innovation and imitation behaviour. But in fishing industry, most innovative techniques come from other industries. However, an innovation has been introduced aboard pelagic trawlers. In 1988, three fishing boats were chosen to test a computer. This equipment was conceived in order to make a connection with other electronic material (acoustic detection, navigation, and transmission, fishing gear control). This project was a successful affair and the diffusion process started in 1989. That's why the duration of imitation process for this equipment was four years, from 1989 to 1992.

*Table 3 Innovation investment for pelagic trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m33 | | | Data* | | | | | | | |

* Data processing.

Sample includes 20 pelagic trawlers, that is to say a representative rate of 50%,

*Table 4 Investment behaviour for pelagic trawlers*

| | 85-86 | 86-87 | 87-88 | 88-89 | 89-90 |
|---|---|---|---|---|---|
| S1 | 14 | 14 | 10 | 10 | 9 |
| S2 | 5 fishing gear | 5 fishing gear | 5 fishing gear | 5 fishing gear | 1 engine<br>5 fishing gear |
| S3 | 1 pelagic trawler | 1 pelagic trawler | 2 pelagic trawlers | 4 computers<br>1 pelagic trawler | 4 computers<br>1 pelagic trawler |
| S4 | 0 | 0 | 3 computers | 0 | 0 |
| | 90-91 | 91-92 | 92-93 | 93-94 | 94-95 |
| S1 | 5 | 5 | 4 | 13 | 13 |
| S2 | 5 fishing gear | 5 fishing gear | 1 engine<br>5 fishing gear | 5 fishing gear | 2 engines<br>5 fishing gear |
| S3 | 4 computers<br>1 pelagic trawler<br>5 GPS | 4 computers<br>1 pelagic trawler<br>5 GPS | 1 computers<br>1 pelagic trawler<br>8 GPS | 2 GPS | 0 |
| S4 | 0 | 0 | 0 | 0 | 0 |

According to the assumption of routine investment in fishing gear, 25% of the sample changes trawl gear each year. This assumption squares with the scrapping capital. Therefore, five individuals are represented in this category.

A path-dependency for a sample of 20 individuals:

1985-1986

$$\begin{bmatrix}14 & 5 & 1 & 0\end{bmatrix} X \begin{bmatrix}0{,}8 & 0{,}2 & 0 & 0\\ 0{,}56 & 0{,}44 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\end{bmatrix}$$

1986-1987

$$\begin{bmatrix}14 & 5 & 1 & 0\end{bmatrix} X \begin{bmatrix}0{,}51 & 0{,}2 & 0{,}08 & 0{,}21\\ 0{,}56 & 0{,}44 & 0 & 0\\ 0{,}06 & 0 & 0{,}94 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\end{bmatrix}$$

1987-1988

$$\begin{bmatrix}10 & 5 & 2 & 3\end{bmatrix} X \begin{bmatrix}0{,}42 & 0{,}28 & 0{,}3 & 0\\ 0{,}56 & 0{,}44 & 0 & 0\\ 0 & 0 & 1 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1988-1989

$$\begin{bmatrix}10 & 5 & 5 & 0\end{bmatrix} X \begin{bmatrix}0{,}42 & 0{,}28 & 0{,}3 & 0\\ 0{,}56 & 0{,}44 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\end{bmatrix}$$

1989-1990

$$\begin{bmatrix}9 & 6 & 5 & 0\end{bmatrix} X \begin{bmatrix}0{,}2 & 0{,}2 & 0{,}6 & 0\\ 0{,}5 & 0{,}5 & 0 & 0\\ 0{,}04 & 0{,}04 & 0{,}92 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1990-1991

$$\begin{bmatrix}5 & 5 & 10 & 0\end{bmatrix} X \begin{bmatrix}0{,}44 & 0{,}56 & 0 & 0\\ 0{,}56 & 0{,}44 & 0 & 0\\ 0 & 0 & 1 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\end{bmatrix}$$

1991-1992

$$\begin{bmatrix}5 & 5 & 10 & 0\end{bmatrix} X \begin{bmatrix}0{,}4 & 0{,}2 & 0{,}4 & 0\\ 0{,}4 & 0{,}2 & 0{,}4 & 0\\ 0 & 0{,}4 & 0{,}6 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1992-1993

$$\begin{bmatrix}4 & 6 & 10 & 0\end{bmatrix} X \begin{bmatrix}0{,}3 & 0{,}5 & 0{,}2 & 0\\ 0{,}3 & 0{,}5 & 0{,}2 & 0\\ 1 & 0 & 0 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1993-1994

$$\begin{bmatrix}13 & 5 & 2 & 0\end{bmatrix} X \begin{bmatrix}1 & 0 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0 & 1 & 0 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\end{bmatrix}$$

1994-1995

$$\begin{bmatrix}13 & 7 & 0 & 0\end{bmatrix}$$

Technological competition in the Basque Country concerns mainly two fleets, pelagic trawlers and purse seiners. Matrix reading must be made in rows. For example, 50% of pelagic trawlers, 10 boats, have adopted identical behaviour (S1, no investment) throughout the period. Twenty-seven per cent invested in a routine technique after a period without investment, 21% in an imitation and only 2% in an innovation. Of course, transition probabilities are equal to zero at the end of the two last rows. The sum of the row must be equal to one.

Markovian matrix for a sample of 20 pelagic trawlers (1986-1995)

$$P = \begin{bmatrix}0{,}5 & 0{,}27 & 0{,}21 & 0{,}02\\ 0{,}44 & 0{,}49 & 0{,}07 & 0\\ 0{,}12 & 0{,}16 & 0{,}72 & 0\\ 0{,}88 & 0{,}12 & 0 & 0\end{bmatrix}$$

*The case of stern trawlers*

In the beginning of the eighties, the old technique of side trawling disappeared and technological competition came to an end, since the technological trajectory represented with the technique of stern trawling describes a lock-in phenomenon. In evolutionary economics, this situation verifies the no-ergodicity hypothesis (Arthur, 1988).

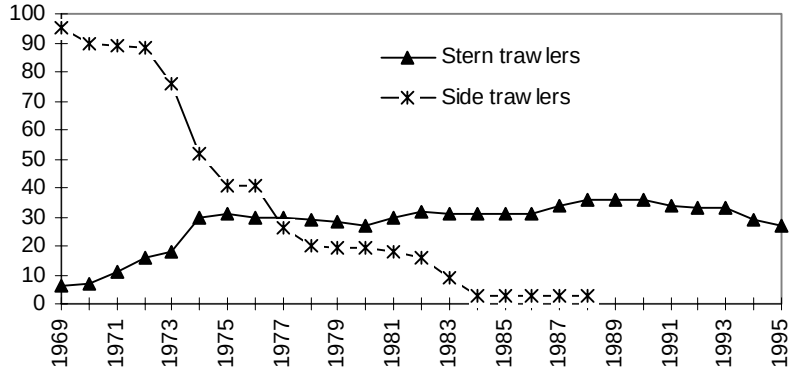



*Figure 1 Side trawlers and stern trawlers in Concarneau harbour*
Source: UAPF - Etat des flottilles.

Routine investments (table 16a) take account of a new stern trawler. Since the old technique has disappeared, potential users invest automatically in the process of trawling only. Other routine equipment is engine, fishing gear and standard electronic material.

*Table 5 Routine investment for bottom stern trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m11 | Hull designing | | | | | | | | | |
| m12 | Engine | | | | | | | | | |
| m13 | Fishing gear (trawl warp, rectangular otter board) | | | | | | | | | |
| m21 | Accoustic detection | | | | | | | | | |
| m22 | Transmission | | | | | | | | | |
| m23 | Navigation | | | | | | | | | |

As in the case of pelagic trawlers in the Basque country, diffusion of GPS and data processing followed an imitation process between 1989 and 1992. Period of diffusion according to an imitation process for containerisation goes from 1992 to 1994. The last imitative investment concerned a control system for fishing gear in 1994.

*Table 6 Imitation investment for bottom stern trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m23 | | | | GPS (Global positioning system) | | | | | | |
| m25 | | | | Data processing | | | | | | |
| m24 | | | | | | | | | Fishing gear control | |
| m32 | | | | | | | Containerisation | | | |

The containerisation project was implemented in 1991. Two stern trawlers from Concarneau have tested this innovation process. This technique has been imported from Iceland and minor improvements have been included. On the one hand, fishing boats can use landing sites in Scotland, Ireland, Wales, near their fishing grounds. On the other hand, conditioning in containers improves the state freshness of species.

*Table 7 Innovation investment for bottom stern trawlers*

| | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| m23 | | | | | | Containerisation | | | | |

The exhaustion of usual stocks exploited by stern trawlers in fisheries of West-Scotland and West-Ireland (cod, anglerfish, saithe, megrim, hake) seems an irreversible position. Ship-owners are increasingly interested in equipment linked with the third technological trajectory in order to increase added value. At the end of the eighties, diffusion process concerns increasingly handling and conditioning techniques. Therefore, all individuals included in the sample have invested in the containerisation project and eleven acquired handling material in 1993 and 1995 (table 18).

*Table 8 Investment behaviour for bottom stern trawlers*

| | 85-86 | 86-87 | 87-88 | 88-89 | 89-90 |
|---|---|---|---|---|---|
| S1 | 13 | 4 | 13 | 0 | 1 |
| S2 | 5 fishing gear<br>2 stern trawlers | 5 fishing gear<br>4 stern trawlers<br>7 engines | 5 fishing gear<br>2 stern trawlers | 5 fishing gear<br>3 stern trawlers<br>2 engines | 5 fishing gear<br>1 stern trawler<br>3 engines |
| S3 | 0 | 0 | 0 | 10* electronic | 10* electronic |
| S4 | 0 | 0 | 0 | 0 | 0 |
| | 90-91 | 91-92 | 92-93 | 93-94 | 94-95 |
| S1 | 12 | 6 | 4 | 9 | 2 |
| S2 | 5 fishing gear<br>1 stern trawler | 5 fishing gear<br>1 stern trawler | 5 fishing gear | 5 fishing gear | 5 fishing gear |
| S3 | 0 | 8 containerisa-tion | 4 containerisation<br>7*** handling | 6 containerisation | 9** Control<br>4*** handling |
| S4 | 2 containerisation | 0 | 0 | 0 | 0 |

* These investments concern a GPS and a computer; ** This equipment is known under its brand name, Scanmar. It consists of an acoustic system to control the fishing gear; *** This material serves to handle catches. The exhaustion of commercial stocks constrains skip-owners to invest in handling and conditioning techniques linked with the third technological trajectory to improve quality.

A path-dependency for a sample of 20 individuals:

1985-1986

$$\begin{bmatrix}13 & 7 & 0 & 0\end{bmatrix} X \begin{bmatrix}0{,}3 & 0{,}7 & 0 & 0\\ 0{,}01 & 0{,}99 & 0 & 0\\ 1 & 0 & 0 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1986-1987

$$\begin{bmatrix}4 & 16 & 0 & 0\end{bmatrix} X \begin{bmatrix}0{,}05 & 0{,}95 & 0 & 0\\ 0{,}8 & 0{,}2 & 0 & 0\\ 1 & 0 & 0 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1987-1988

$$\begin{bmatrix}13 & 7 & 0 & 0\end{bmatrix} X \begin{bmatrix}0 & 0{,}5 & 0{,}5 & 0\\ 0 & 0{,}5 & 0{,}5 & 0\\ 1 & 0 & 0 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1988-1989

$$\begin{bmatrix}0 & 10 & 10 & 0\end{bmatrix} X \begin{bmatrix}1 & 0 & 0 & 0\\ 0{,}1 & 0{,}9 & 0 & 0\\ 0 & 0 & 1 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1989-1990

$$\begin{bmatrix}1 & 9 & 10 & 0\end{bmatrix} X \begin{bmatrix}0{,}8 & 0 & 0 & 0{,}2\\ 0{,}8 & 0 & 0 & 0{,}2\\ 0{,}4 & 0{,}6 & 0 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1990-1991

$$\begin{bmatrix}12 & 6 & 0 & 2\end{bmatrix} X \begin{bmatrix}0{,}25 & 0{,}25 & 0{,}5 & 0\\ 0{,}33 & 0{,}33 & 0{,}34 & 0\\ 1 & 0 & 0 & 0\\ 0{,}5 & 0{,}5 & 0 & 0\end{bmatrix}$$

1991-1992

$$\begin{bmatrix}6 & 6 & 8 & 0\end{bmatrix} X \begin{bmatrix}0 & 0{,}5 & 0{,}5 & 0\\ 0 & 0 & 1 & 0\\ 0{,}5 & 0{,}25 & 0{,}25 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1992-1993

$$\begin{bmatrix}4 & 5 & 11 & 0\end{bmatrix} X \begin{bmatrix}0{,}05 & 0 & 0{,}95 & 0\\ 0 & 1 & 0 & 0\\ 0{,}8 & 0 & 0{,}2 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1993-1994

$$\begin{bmatrix}9 & 5 & 6 & 0\end{bmatrix} X \begin{bmatrix}0{,}2 & 0 & 0{,}8 & 0\\ 0{,}04 & 0{,}4 & 0{,}56 & 0\\ 0 & 0{,}5 & 0{,}5 & 0\\ 1 & 0 & 0 & 0\end{bmatrix}$$

1994-1995

$$\begin{bmatrix}2 & 5 & 13 & 0\end{bmatrix}$$

The post competitive period, from 1986 to 1995, depicts an active process in decision-making concerning different states of investment behaviour. The case of innovation was a new form of conditioning tested in 1991. Two fishing boats participated in this program. It dealt with 2% of the sample in the first row of the matrix.

Markovian matrix for a sample of 20 stern trawlers (1986-1995):

$$P = \begin{bmatrix}0{,}3 & 0{,}32 & 0{,}36 & 0{,}02\\ 0{,}23 & 0{,}48 & 0{,}27 & 0{,}02\\ 0{,}63 & 0{,}15 & 0{,}22 & 0\\ 0{,}94 & 0{,}06 & 0 & 0\end{bmatrix}$$

The third row contains high probabilities and expresses numerous imitative investments during the observed period.

Steps of diffusion process imply innovation behaviour, an imitation behaviour and finally, when alternative techniques disappear, routine behaviour. The containerisation program necessitated the two first steps (innovation and imitation). Electronic equipment (GPS, Data processing, and fishing gear control) diffused directly in the second step (imitation). Sixti-three per cent of the sample was located in S1 after an imitative investment. 15% invest according to a routine process and 22% reinvest in a new technique diffused with imitation.

Final objective considers a set of scenarios for each fleet.

**Assumptions of the model of investment behaviour**

- Three main assumptions on the methodology

P1 : A historical approach is necessary to study the diffusion process in the fishing industry
P2 : Innovation process is followed by the next step, an imitation process
P3 : In technological competition with two techniques, the former must be considered as a routine investment and the recent technique must be considered as an imitation investment

-

H1 : 25% of sample invest each period with a routine process. This includes a scrapping capital
H2 : Fixed sample but possibility of entry and exit in fleet. An entry must be compensated with an exit
H3 : A single investment is authorised each period for one single fishing firm

## 4. Investment behaviour: a set of scenarios

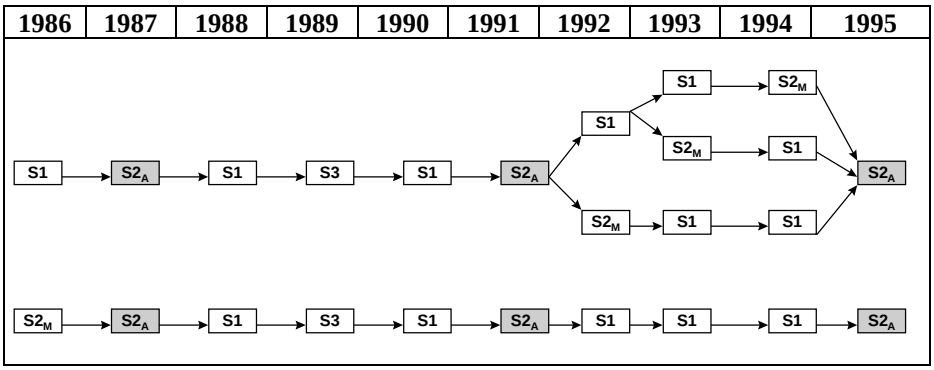
*The case of pelagic trawlers*
The number of scenarios is limited to the diffusion process of innovation (S4) and imitation (S3) investments. The assumption concerning replacement of fishing gear every four years is added. We identify five scenarios in the case of pelagic trawlers.
This first scenario represents a fishing boat using an innovative manner technique of catch processing in 1988. From 1987 to 1988, it went from S1 (no investment) to S4 (innovation investment) with a transition probability of 2%. Replacement of fishing gear occurred in 1986, 1990 and 1994. S3 behaviour in 1992 depicts a purchase of GPS. Engine changing occurred in 1995 ($S2_M$).

*First scenario*

| 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|
| $S2_A$ | S1 | S4 | S1 | $S2_A$ | S1 | S3 | S1 | $S2_A$ | $S2_M$ |

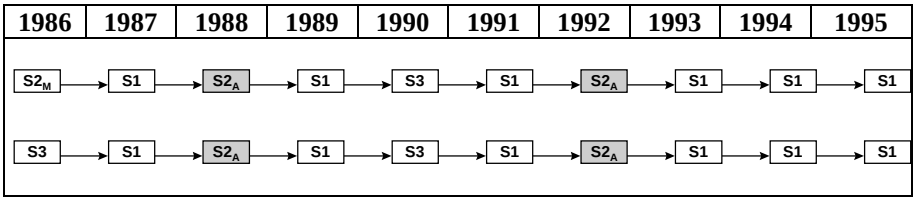
Data processing is purchased in 1989, with an imitation behaviour, the first step of the diffusion process. In the first figure, engine replacement occurs between 1992 and 1994, whereas this investment is made in 1986 in the second figure.

*Second scenario*

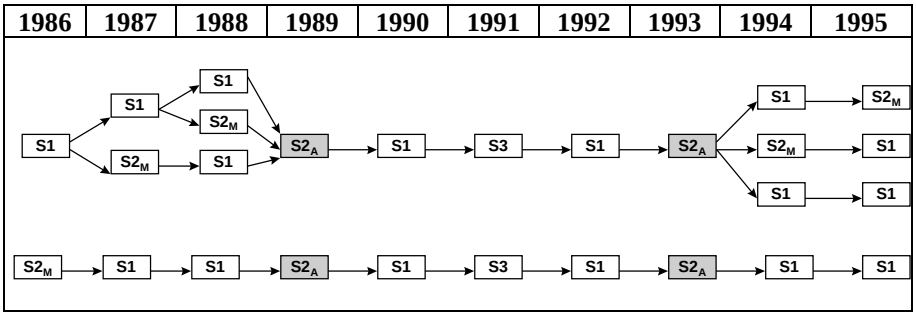



The three following scenarios show the last steps of the diffusion process.

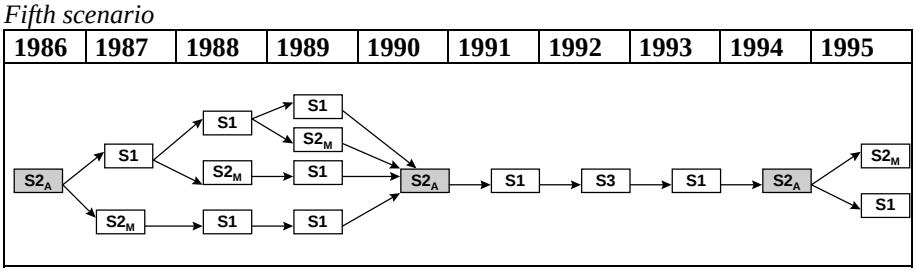
*Third scenario*




*Fourth scenario*




*Fifth scenario*

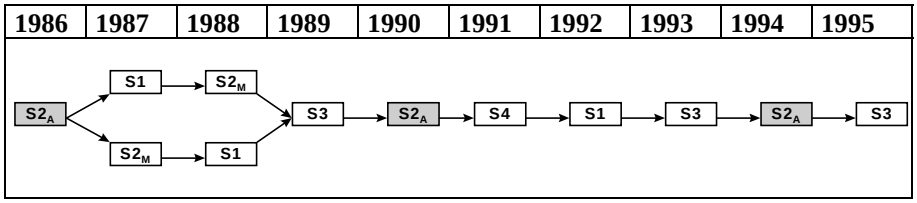


*The case of stern trawlers*

The number of scenarios is limited to four according to the span of diffusion for containerisation. In addition, other imitative investments must be taken in account as electronic equipment (data processing, GPS, fishing gear control), and handling equipment.

When a firm is located in S4, the next step is generally S1, with a 94% probability. But, 6% of individuals have adopted an S2 behaviour (routine investment). This situation is not realistic in the fishing industry because innovation behaviour implies taking a financial and technical risk.

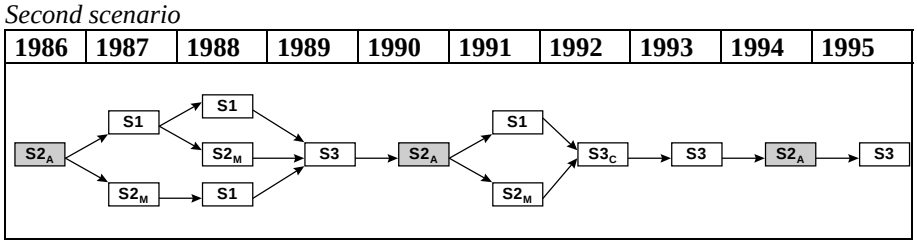
*First scenario*




In the first scenario, the fishing corporation acquired GPS equipment and data processing material in 1989 in an imitative manner (S3). Replacement of fishing gear occurred in 1986, 1990 and 1994. The innovation process appeared in 1994 (S4) with the implementation of the containerisation program. Another stage in the imitation process takes place in 1993 with a handling technique. The system of fishing gear control is equally obtained according to an imitative behaviour in 1995.

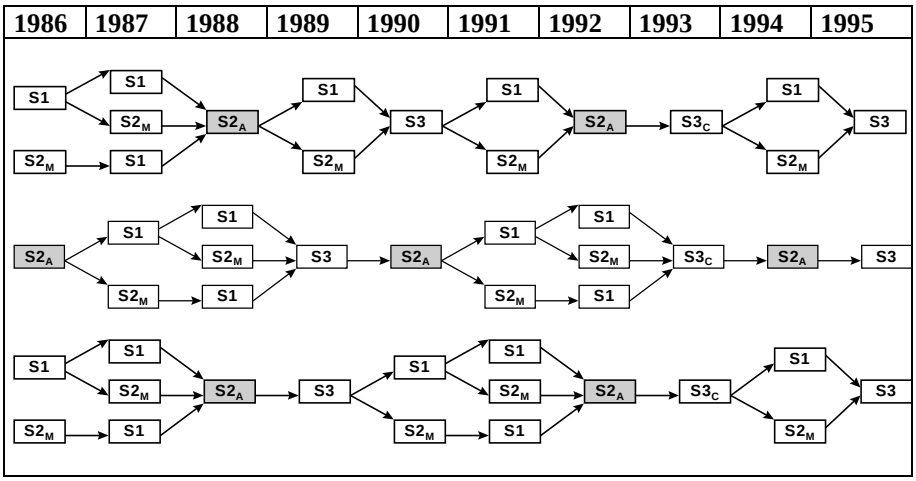
The second scenario represents the first step of the diffusion process concerning the containerisation program. The ship-owner invested in this new technique in 1992 (S3).

*Second scenario*



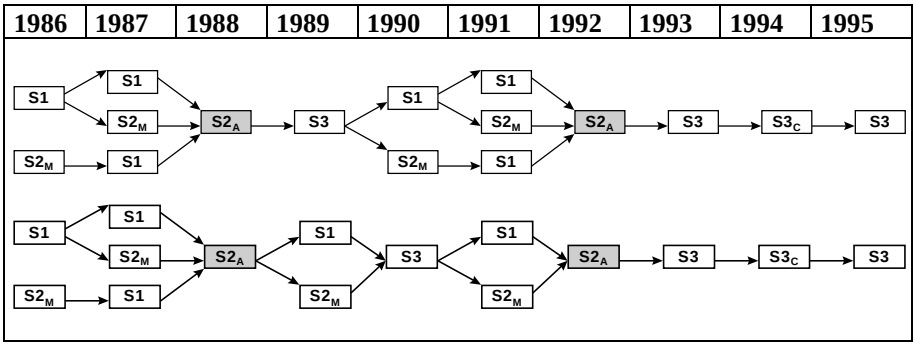

In the third scenario, structure of the figure depends on the period of use of electronic equipment (GPS and data processing). If the fishing corporation had invested in electronic material in 1990, the replacement of fishing gear was engaged in 1988 and 1992. If it acquires this equipment in 1989, changing of fishing gear occurred either in 1986, 1990 and 1994 (second figure), or in 1988 and 1992 (third figure). Whatever the figure, the common point is an imitation investment in containerisation in 1993.

*Third scenario*




This fourth scenario indicates the last step in diffusion of the containerisation technique. This operation was implemented in 1994. Differences between the two figures come from the period of investment in electronic equipment (in 1989 for the former figure and in 1990 for the latter).

*Fourth scenario*




## 5. Conclusion

In this work, scenarios of investment are derived from a path-dependency. Evolutionary economics has been a successful theoretical background to develop a specific methodology in the fishing industry. But assumptions in the model limit the number of conceivable scenarios for each fleet. A special feature has been a clear distinction between investments. A new technique is characterised with incremental improvements and the adoption of this material needs innovative behaviour from fishing corporations. In the following steps, the diffusion process takes place and investment assumes an imitation behaviour. As the old

techniques disappear completely, investment is routine. Future research should be founded on the simulation of scenarios.

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# Segmentation in the Spanish Fleets of the Mediterranean and Analysis of Profitability: One Application to the Barcelona Case

Ramon Franquesa and Laura Romeu, Gabinete de Economía del Mar, Universidad de Barcelona, Spain

**Abstract**

As well as in the whole Mediterranean, the Spanish fisheries suffer a lack of information about profitability. In this context the basis for establishing managing recommendations is missing. In the paper we present segmentation on two relevant gears of the Spanish Mediterranean Fleets (purse seine and trawler), and from this distribution we present some outcomes of the evaluation of their accounts in the case of Barcelona harbour. A data basis of the landings has been built with the bills collected by the *Cofradías* (guilds), and the estimations of the costs have been established by using enquiries in several interviews with the owners of the vessels.

The team participates in the project FAIR CT96-1454 *Measurement of Economic Impacts of Fishery Management Decisions* directed by Rolf Lasch, where the operational data of different fisheries are analysed in order to see the effects of management decisions on the profitability of these fisheries. This paper is a preliminary advancement of the final outcomes attended in this project.

## 1. The objectives of the developed work

In the context of the European fisheries management day by day is being more evident the necessity of having a larger vision that encloses more than exclusively the biological point of view but also the economic one. Formally the Scientific, Technical and Economic Committee for Fisheries (STECF) suffered a change in that direction. However, in practice, their decisions are supported only on the biological perspective. The reason is not the absence of specialised economists but that the fieldwork that acts as the base to their decisions has their origin in the ICES, with an exclusively biological character. While that problem is not solved by a structural solution, the economic point of view will be the great absent of the STECF.

Enlarging the tasks of the STECF towards a solid following, within the economic area, means to develop an analytic and methodological work that allows knowing the economic results of each fleet that has a hand in the common waters.

There is an agreement about the importance of promoting common methods of data analysis in order to evaluate the actual situation of the sector and also to establish a proper economic assessment.

The GEM has spread several researches in that direction with the support of the *Ministerio de Agricultura, Pesca y Alimentación* [1], (Agriculture, Fishing and Food Ministry), the *Generalitat the Catalunya* [2] and the European Commission and is advancing towards the development of a systematic economic analysis of the Spanish fleet.

At the moment there are two projects that are being developed with the Community financial support and which are related to the Mediterranean area:
By a hand the project FAIR CT96-1454 *Measurement of Economic Impacts of Fishery Management Decisions*, directed by Rolf Lasch. In this project the operational data of different fisheries of two harbours of the Mediterranean (Barcelona and Castelló) are analysed in order to see the effects of management decisions in the profitability of these fisheries.
By another hand the concerted Action Promotion of Common Methods for Economic Assessment of EU Fisheries, directed by Pavel Salz. This Action is directed to promote and strengthen research into fishery economics in the EU and to provide economic information required for an effective fisheries management.

In both projects, the GEM team, of the University of Barcelona tries to develop the economic knowledge on fishing activities in the Spanish Mediterranean.

Making deep into the economic analysis must generate results both on the community countries and on the perspective of a global management of the Mediterranean having the starting point from de CGPM of FAO. In the present deep renewal of the CGPM, the economic point of view has to be very relevant in the design of a new global methodology of managing [3].

## 2. The segmentation of the Spanish Mediterranean Fleets

One of the most important aspects in the economic perspective is to establish an adequate segmentation of the fleets. If in the biologic perspective, the subject of analysis is the 'specie', in the economic analysis the subject is the 'segment of fleet'. But unfortunately, the definition of 'segment' is not precisely as the concept of 'specie' is.

From the data of the Spanish *Ministerio de Agricultura, Pesca y Alimentación*, we try to establish a segmentation of more 6000 fishing boats registered in the Mediterranean harbours.

In table 1, we present the distribution of the number of boats by gears, the capacity (measured in GRT) and the potency (measured in horsepower). In table 2, this information is presented as a percentage of the total Spanish Mediterranean fleet.
In this table, there appear all the boats that are registered in the Mediterranean harbours although part of them does not fish in this sea. The south of Spain (*Andalucia* Region) has harbours Atlantic and Mediterranean waters, but the Mediterranean is better communicated

[1] The GEM has a collaboration agreement with the MAPA to support them in economic fields from 1992.
[2] The GEM supported the scientific evaluation of the effects of the application of an Experimental Fishing Plan (reduction effort in the area of Tarragona, 1997-99), established by the regional government of Catalonia.
[3] Ramon Franquesa & Denis Bailly, Les indicatuers de tendance socio-économique dans le precessus d'amanegement des pêches en Mediterranée, FAO-CGPM, 1998.

in terms of trade and transport (highroads, train, etc.). Because of that, part of the fleets that work in Atlantic ocean, in practice make their landings and are registered in some Mediterranean harbours as Algeciras or Adra.

Near of the 300 boats registered in the Mediterranean does not fish in this sea. These boats are parting from fleet that works under the agreement with Morocco and the rest from other Occidental Africa countries. The gears of these boats are trawlers, purse seines, freezer trawlers, freezer tuna factory and long line. Their analyses are not relevant for managing the Mediterranean area.

The type of gear can divide the boats that fish in the Mediterranean Sea. The gears registered by the Administration are Trawlers, purse seiners, long line, dredges, and other artisanal boats. In the census of the administration are listed other boats, that are not directly fishing vessels. This vessels are auxiliary unties of aquaculture activities, little boats used by the purse seiners to attract the fish by using a light, and boats used in the tramps allocated in the coast to catch tunas (*Almadraba*). That official list also contains the institutional boats used by researching institutes and by the Administration inspection services.

Within the group of the fishing boats in the Mediterranean the most important by catch are trawlers and purse seiners. These boats represent only the 30 per cent of the number of vessels, but more of the 65 per cent of the capacity (GRT) and potency (HP) of the fleet.

The trawl and in minor degree the purse seine, are the dorsal column of the fishing activity, in the Spanish Mediterranean. Because of that, we give the priority to establish criteria of segmentation to both groups.

These vessels present a great diversity among them. A very different dimension, capacity and potency is noticed on the Mediterranean seaboard.

*Table 1 Total vessels registered in the Spanish Mediterranean harbours, by fleet classification*

| Gear | Number of vessels | GRT | GT | HP |
|---|---|---|---|---|
| **Working out Mediterranean sea** | **282** | **20832,13** | **18441** | **97680** |
| Trawlers under the agreement with Morocco. | 168 | 12560,70 | 11616 | 61367 |
| Trawlers not under the agreement with Morocco | 96 | 4805,29 | 4691 | 24231 |
| Freezer Trawlers (West Africa & Atlantic) | 4 | 461,25 | 447 | 1425 |
| Freezer Tuna Factory (No Mediterranean) | 4 | 1805,09 | 591 | 6602 |
| Long line | 10 | 1199,80 | 1096 | 4055 |
| **Working in Mediterranean sea** | **6085** | **95630,41** | **107396** | **646112** |
| Trawlers | 1443 | 63749,62 | 75180 | 371592 |
| Purse seiners | 519 | 13976,59 | 17640 | 113748 |
| Long line | 197 | 2978,74 | 2506 | 18775 |
| Dredges | 309 | 922,67 | 702 | 10198 |
| Other Artisanal gears | 3512 | 12813,71 | 10057 | 125108 |
| Non fishing vessels (aquaculture, auxiliary, etc) | 90 | 926,98 | 1026 | 3695 |
| Institutional (Research & inspection) | 15 | 262,1 | 285 | 2996 |
| **Total** | **6367** | **116462,54** | **125837** | **743792** |

*Table 2* *Percentage of importance on different concepts of the fleets registered in the Spanish Mediterranean harbours*

| Gear | Number of vessels | GRT | GT | HP |
|---|---|---|---|---|
| **Working out Mediterranean sea** | **4,34%** | **17,89%** | **14,54%** | **13,14%** |
| Trawlers under the agreement with Morocco. | 2.60% | 10.79% | 9.16% | 8.25% |
| Trawlers not under the agreement with Morocco | 1.50% | 4.13% | 3.70% | 3.26% |
| Freezer Trawlers (West Africa & Atlantic) | 0.05% | 0.31% | 0.35% | 0.19% |
| Freezer Tuna Factory (No Mediterranean) | 0.05% | 1.64% | 0.47% | 0.89% |
| Long line | 0.14% | 1.02% | 0.86% | 0.55% |
| **Working in Mediterranean sea** | **96,16%** | **82,11%** | **85,46%** | **86,86%** |
| Trawlers | 22,60% | 54,74% | 60,06% | 49,95% |
| Purse seiners | 8,21% | 12.00% | 13.91% | 15.32% |
| Long line | 3,05% | 2,56% | 1,97% | 2,53% |
| Dredges | 4,64% | 0.79% | 0.55% | 1.37% |
| Other Artisanal gears | 55,05% | 11,01% | 7,92% | 16,81% |
| Non fishing vessels (aquaculture, auxiliary, etc) | 1,40% | 0.80% | 0.81% | 0.49% |
| Institutional (Research & inspection) | 0,23% | 0.23% | 0.22% | 0.40% |
| **Total** | **100,00%** | **100,00%** | **100,00%** | **100,00%** |

We have designed a graphic containing the distribution of the different qualities registered of the vessels. We consider length, GRT and HP. Unfortunately the potency registered presents some difficulties. It does not exist an exact correlation between the dimension and the real potency of the boats. For different reasons the fishermen try to reduce the real potency in official registers (but not always). Moreover, it does exist some technical problems. Fishermen can effect some modifications in engines that increase the real potency at sea without changing the cylinders. As there is a large number of vessels in fleet, the registered HP are in some cases real and in others notably underestimated.

Is because of this reason that we prefer to establish the segmentation basing on criterions of length and capacity. This is an indirect system to evaluate the real potency of the boats: A longer boat is supposed to have more Capacity (GRT) and necessity of a more potent engine.

The final outcomes in the relation between length and capacity are presented in the graphics 1 and 2. This distribution shows a large diversity, produced by the evolution and adaptation of fleets to the market, competence, administrative regulations and resource distributions. In our analysis we divide these fleets in segments. These segments are fixed depending on their relation between length and tonnage.

The trawlers can be divided in three groups taking into account the GRT:

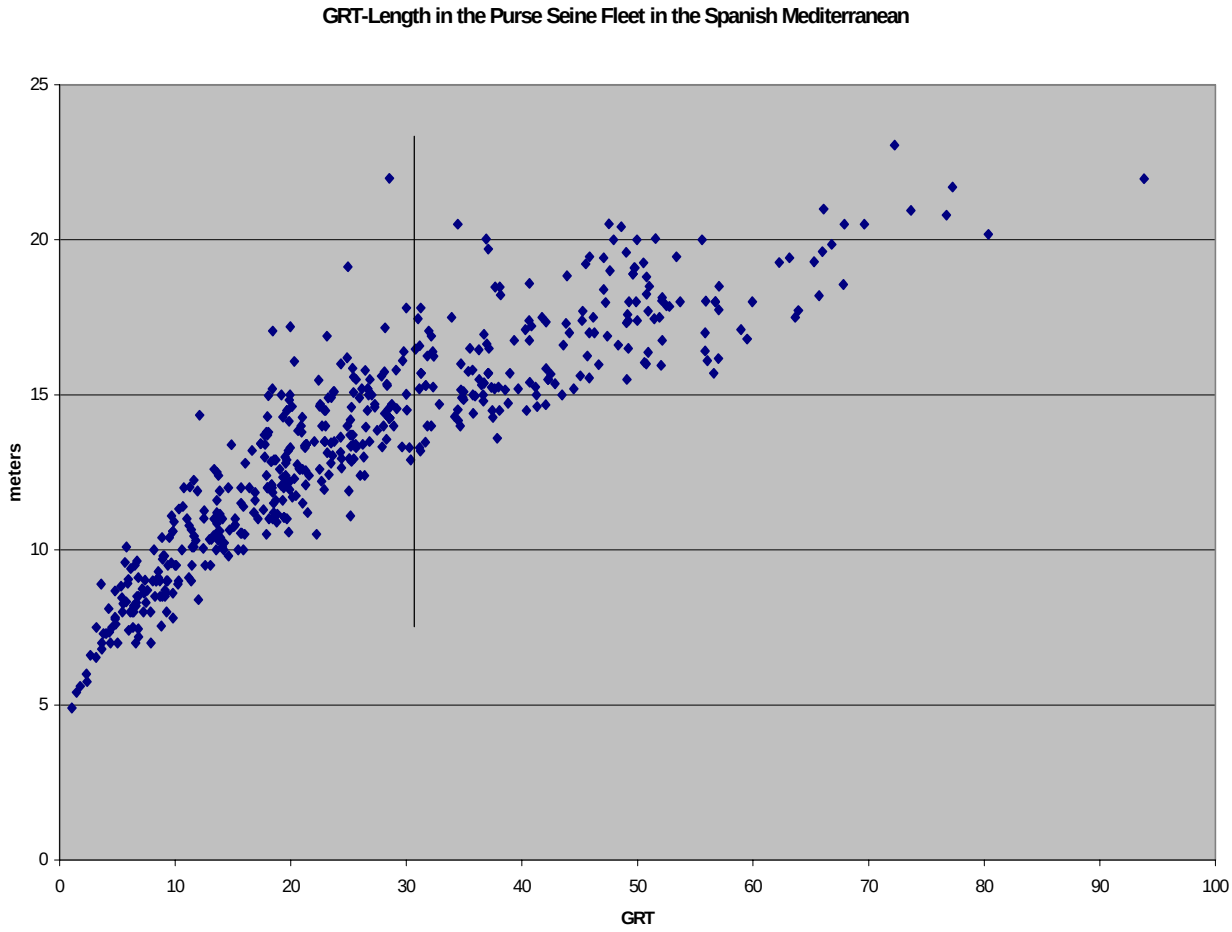
- (A1) vessels with less than 30 of GRT (this suppose in general trends from 5 to 16 meters of EPP);
- (A2) vessels with a GRT between 30 and 70 (from 14 to 22 meters of EPP);
- (A3) vessels with a GRT of more than 70 (from 17 to 22 meters of EPP);
- in the case of the purse seines we have taken the following two groups;
- (C1) vessels with less than 30 of GRT (this suppose in general trends less than 17 meters of EPP);
- (C2) vessels with a GRT of more than 30 (in general more than 14 meters of EPP);

In table 3, we present the distribution of the fleets of Trawl (A1, A2, A3) and Purse Seine (C1, C2) for the total Spanish Mediterranean Fleet. This distribution can shows us, which is the most proper dimension to Mediterranean conditions, watching it from the economic perspective.

*Table 3 Total boats by segments for the Spanish Mediterranean Fleet*

| | Number of Vessels | GRT | HP |
|---|---|---|---|
| **C1** | 335 | 5.567,43 | 52.426 |
| **C2** | 172 | 7.937,91 | 57.912 |
| **A1** | 425 | 6.379,19 | 36.195 |
| **A2** | 731 | 33.870,01 | 200.370 |
| **A3** | 201 | 18.606,41 | 110.089 |

We are in the way of establishing a profitability evaluation of the outcomes of these segments in some Spanish harbours. At this moment we are in conditions to present the preliminary information obtained from Barcelona harbour, one of the most relevant in the Spanish Mediterranean.


GRT-Length in the Purse Seine Fleet in the Spanish Mediterranean
meters
GRT
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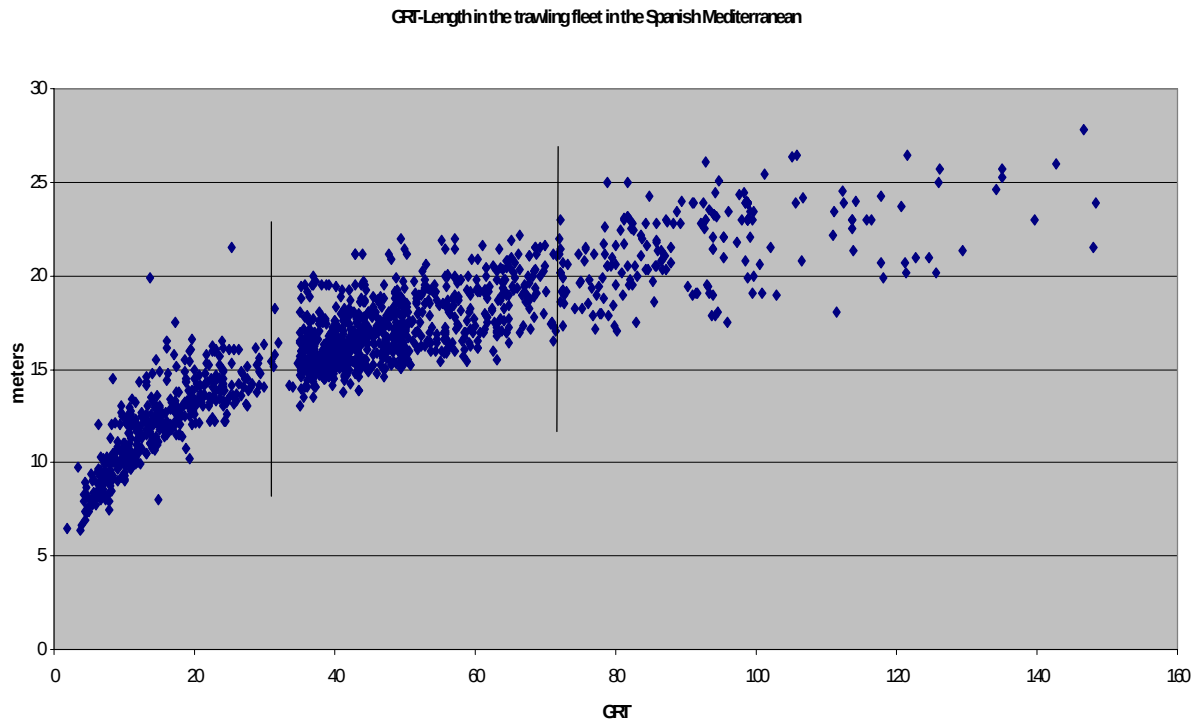
GRT-Length in the trawling fleet in the Spanish Mediterranean
meters
GRT
0
5
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25
30
0
20
40
60
80
100
120
140
160

## 3. A profitability evaluation of the segments from a sampling of Barcelona fleet.

Here we present an analysis on the profitability of the different chosen segments in the case of Barcelona. This is an example of the kind of data we are working with, and the kind of information that can be obtained from this concrete case is the one that we want to get for the major part of the harbours.

Barcelona is an important harbour in the Spanish Mediterranean area. The fleet is mainly dedicated to purse seine and trawl, as is shown in table 4.

*Table 4 Fleet structure in Barcelona by segments, in relation to the Spanish Mediterranean Fleet.*

| | Number of vessels | GRT | HP | % Over the total Number of Vessels of the Spanish Mediter. | % Over the total GRT of the Spanish Mediter. | % Over the total HP of the Spanish Mediterr |
|---|---|---|---|---|---|---|
| **C1** | 23 | 454,80 | 4.863 | 6,86% | 8,16% | 9,27% |
| **C2** | 16 | 684,42 | 5.232 | 9,30% | 8,62% | 9,03% |
| **A1** | 9 | 125,63 | 702 | 2,11% | 1,96% | 1,90% |
| **A2** | 13 | 607,88 | 4.187 | 1,77% | 1,79% | 2,08% |
| **A3** | 3 | 256,70 | 1.520 | 1,49% | 1,37% | 1,30% |

The segmentation of the fleet has been made following the same criteria as with the total fleet in the Spanish Mediterranean. Therefore, we have an example of each group of the general segmentation: for the three groups of the trawling fleet, and for the two groups of the purse seine fleet.

The production analysis has been made for the year 1995 due to reasons of availability of data. The relative importance in production of each gear is shown in table 5.

*Table 5 Landings in Tones and Value for each gear in 1995*

| | Trawling Fleet | Purse Seiner | Artisanal | Total |
|---|---|---|---|---|
| Total Tones | 941,5 | 8.073,6 | 195,5 | 9.210,6 |
| Total Value (millions Pts) | 745 | 1.041 | 64 | 1.850 |
| Total fishing days | 6.142 | 5.319 | 2.569 | 14.030 |
| Total vessels | 28 | 39 | 19 | 86 |
| Average fishing days per vessel | 219 | 136 | 135 | 490 |
| Average Kg per vessel | 33.626 | 207.016 | 10.288 | 250.930 |
| Average Kg per vessel per day | 154 | 1.522 | 76 | 1.752 |
| Average value per vessel (Pts) | 26.608.605 | 26.717.657 | 3.377.497 | 56.703.759 |
| Average value per vessel per day (Pts) | 121.500 | 196.453 | 25.019 | 342.972 |
| Average price (Pts) | 791 | 130 | 328 | 1249 |

The gear with the highest value in 1995, in the Barcelona harbour is the purse seine with 1.041 millions Pesetas (Pts.), followed by trawling gear with a landing value of 745 millions Pts. The trawler fleet has gone to fish more days than the purse seiner fleet (6.142 and 5.302 fishing days respectively).

If we analyse the data per day and per vessel we can see some differences in the every day landings for every gear. The purse seiner vessels catch much more Kg. per day than the trawler fleet (1.522 vs. 153 Kg). But talking in value terms there is not an important difference between both gears (196.453 Pts. for purse seiner and 121.500 for trawling). This is because the average price of the species caught by trawling fleet is much higher than the price of the species caught by the purse seine one (791 vs. 130 Pts.).

The artisanal vessels do not proportionate high values in the Barcelona harbour (3,4% approximately). Each vessel has a low value per day, basically due to the few kilograms they catch, although the average price of landings is not as low as the one of the purse seiner (328 Pts.).

In the harbour of Barcelona the fleets catch about 100 different species. Each gear is specialised in different species: pelagic species for the purse seiner and demersal for the trawler one.

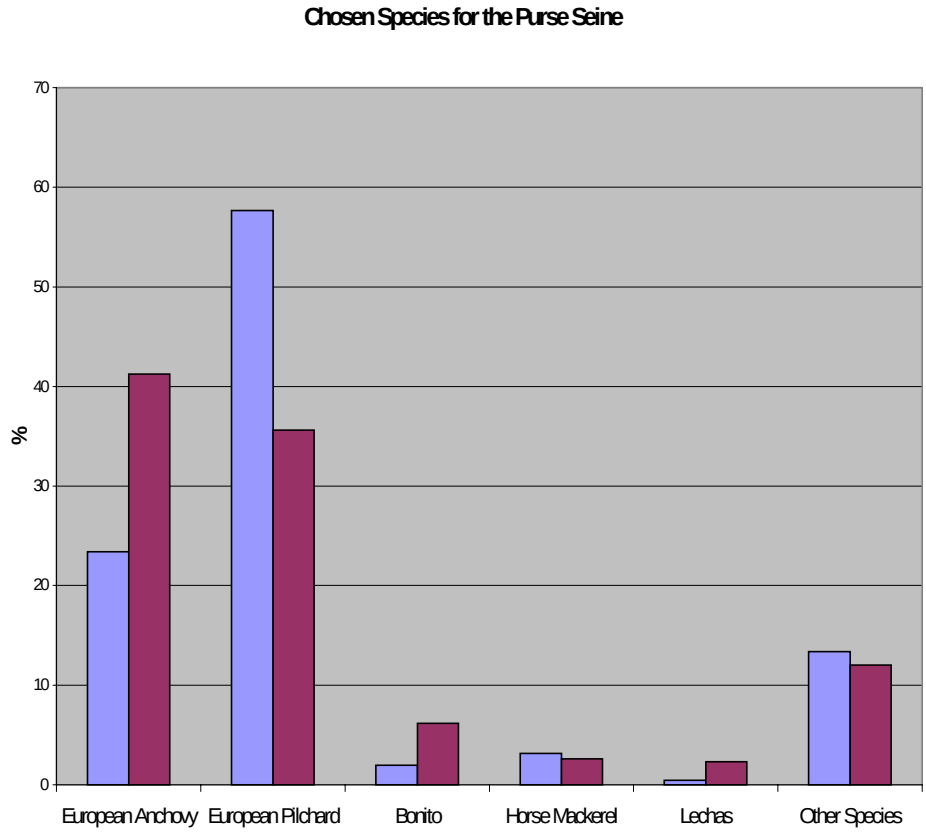
In table 6 is presented the most important species caught by purse seiner and trawl. In the case of purse seiner the number of species is reduced and a part of them have a significative weight and value. Only sardine and anchovy represent the 80% of the weight and the 77% of the value.

In the case of the trawler the big diversity of species is evident, the caught more abundant is in weight the 'Other species' where the individual catches is less of the 1% over total. The second in importance is the Blue Whiting and the 'several species' (classification that is the boxes sold with different species). In the economic value the most importance species are the red shrimp, hake and lobster.

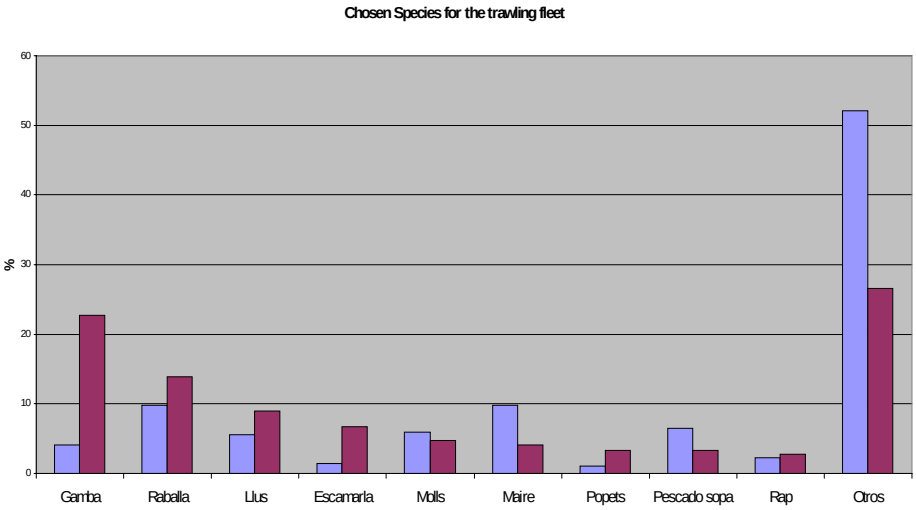
As we can see in graphics 3 and 4, there are big differences if we take into account the value or the volume. Especially in the trawling species where the most important ones in value only represent the 4% in landings. With the trawling gear there are more different species caught. With the purse seine gear there is also a big quantity of species caught but there is a higher concentration in terms of value and volume in few species.

*Table 6 Relevant species for Trawling and Purse Seiner, Barcelona in 1995*

| Trawler Species | % in Kg | % in Pts | Purse Seiner Species | % in Kg | % in Pts |
|---|---|---|---|---|---|
| Red Shrimp | 4,1 | 22,7 | European Anchovy | 23,4 | 41,3 |
| Several Species | 9,8 | 14,9 | European Pilchard | 57,7 | 35,6 |
| European Hake | 5,5 | 8,9 | Bonito | 2,0 | 6,2 |
| Norway Lobster | 1,4 | 6,7 | Horse Mackerel | 3,1 | 2,6 |
| Mullet | 5,9 | 4,7 | Lechas | 0,5 | 2,3 |
| Blue Whiting | 9,8 | 4,2 | Other Species | 13,3 | 12,0 |
| Small Octopus | 1,0 | 3,3 | | | |
| Soup Fish | 6,5 | 3,3 | | | |
| Angler Fish | 2,3 | 2,8 | | | |
| Other Species | 53,7 | 28,5 | | | |




*Graphic 3*




*Graphic 4*

Once we have seen the main important characteristics, we must analyse the Barcelona fleet by segments in each gear.

## 3.1 The Purse Seine Fleet

Within this gear, there are not only operational differences, but also differentiated sociological pacts that give a special status to the purse seine in Barcelona harbour. We are not dealing with the sociological problems in general but we are taking into account some pacts just to better understand the characteristics of the fleet.

In this gear, most part of workers is from the south of Spain and they have not completely reached the social integration, even with workers from other gears. It is really a problematic sector that makes most of the times impossible to reach consensual decisions. The crew has a low salary and usually economic problems, so difficulties for the social integration are aggravated. From this description we can see how difficult is to impose restrictions in this fleet. They do not trust in Administration either in the *Cofradía*. It also happens that when the vessel owner decides to follow a biological restriction, the crew disagree with him because their incomes are submitted on what they catch.

As a result of all those aspects, each vessel tries to catch as much as possible in order to survive in this deteriorated frame.

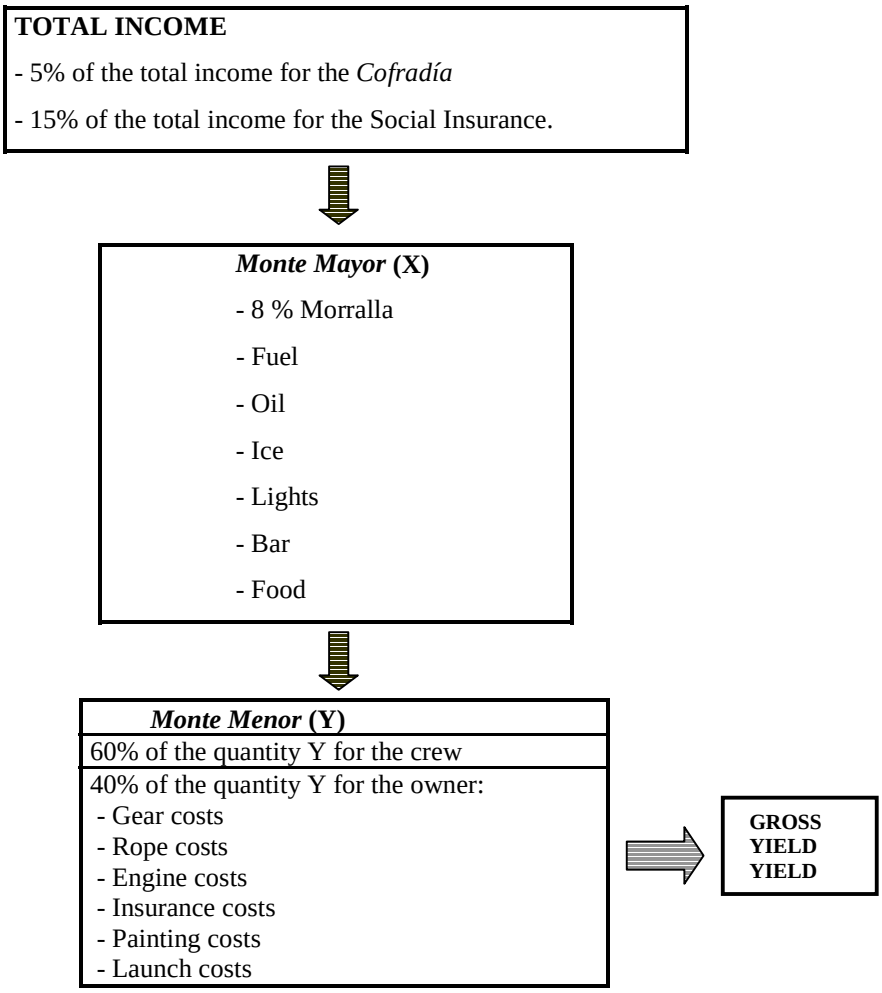
Every week the earnings are divided between the owner and the crew. It is said that this way of payment is the preferred by the crew because they can keep one part in the pocket and so on, their wives will not be able to control what they spend.
To obtain the parts the way to calculate them shown in graphic 5, where it is explained the distribution process of the income in the purse seiner.

From what is weekly sold, the *Cofradía* takes the 5% as fee for the administrative tasks, the 15% of the Total Income is for the Social Insurance. Nowadays, due to the bad situation of the sector instead of the 15% is the 20% for the Social Insurance.

The left quantity is called *Monte Mayor* (X in the schedule). This quantity covers the costs of fuel, oil, ice, lights, and other costs that need to be described. The 8% of the *Monte Mayor* (X) is given to the crew as *Morralla*; this is because of traditional reasons. In former times, the crew took a part of the catches for eating at home, nowadays in stead of taking fish they take the 8% of the *Monte Mayor*. In fact they take also fish to home, but the *Morralla* has become a right for the crew.

Traditionally the owner has also paid the bill of the bar for all the crew. Nowadays the owner does not pay everyday the bar bill but he keeps paying the bill with the earnings of the week the day when they are distributing the money.

After paying these costs with the *Monte Mayor* (X), we obtain the amount of money that should be shared between the owner and the crew *Monte Menor* (Y). The 60% of the *Monte Mayor* (Y) is for the salaries of the crew. The amount each member receives depends on the task he carries out in the vessel. The wages are quite low, even sometimes not enough for the maintenance of a family.




*Graphic 5 Income Distribution Process in the Purse Seine*

The other 40% of the *Monte Mayor* is for the owner who must face the following costs: the maintenance of the gears, the ropes, the maintenance of the engine, the insurance, the painting costs and the launch costs. There is a discount in the launching costs for the fleet of Barcelona if they repair the vessels in the port of Barcelona, but the owners say that there is no effect of discount because then they have to pay high prices for the painting.

The benefits that the owner gets after facing all these costs and after paying taxes and credits have been decreasing the last years. They say that is not easy to survive. That is the reason why there are no more owners who are not working in the vessel. Nowadays the owners must invest as much time as possible and try to get help of the family, in order to save money from labour force. They are also investing in mechanic improvements in order to reduce the number of members of the crew, which is quite high at the moment.

The timetable of the purse seine fleet is different during summer and winter. During summer the vessel leaves at eleven o'clock in the night, and in the winter at ten o'clock in the night. The crew arrives half an hour before to the vessel. The travelling time till the fishing ground is about one hour, and the effort time depends on the day, but as maximum a vessel fishes for six hours. The time to come back to the landing port depends also on how the catches are going, but the vessels arrive usually at seven or at eight o'clock in the morning, and half an hour later the crew usually goes home. The time for repairing and painting is approximately three weeks per year.

Once we have described the costs of this fleet, we will give an approximation of each one of these costs for a standard vessel of each segment established in the purse seine fleet. In table 7, we show the synthetic information recompiled from enquiries to the owners of the boats. The table presents the average income structure for each segment of the fleet: the segment C1 (less of 30GRT) and the segment C2 (more of 30 GRT).

The outcomes of this evaluation show as that the Gross Yield of the owner (before tax and amortisation) are similar in the segment C1 and C2. In the case of the bigger boats only have an income of 3% up of the other segment.

The estimation of amortisation is difficult, because there is not information available about the real value of boats. We only dispose of indirect information on this (from the second hand market). What we can assume is that the minimum value of the boat is related to GRT, because the EU programs pay 700.000 Pts. by GRT definitively destroyed.

Moreover, another important thing is that if difference in amortisation terms is higher that a 3% between the C1 And the C2 categories, we deduce that, in real terms, the segment C1 has better outcomes that the C2 one. Our provisional estimations indicate that is what happens in our case. *In the purse seine the relative smaller vessels (less that 30 GRT) have more profitability that the bigger ones.*

*Table 7 Average Estimation on the Incomes Distribution in Purse Seine Segment*

| **Segment C1** | | **Segment C2** | |
|---|---|---|---|
| **TOTAL INCOME:** | **22.898.766 Pts** | **TOTAL INCOME:** | **30.040.920 Pts** |
| **(170.255 Kg)** | | **(240.129 Kg)** | |
| - 5% for the *Cofradía*: | 1.144.938 Pts | - 5% for the *Cofradía*: | 1.502.046 Pts |
| - 15% for the Social Insurance: | 3.434.814 Pts | - 15% for the Social Insurance: | 4.506.138 Pts |
| **Monte Mayor X: 18.319.012 PTAs** | | **Monte Mayor X: 24.032.736 PTAs** | |
| - 8 % Morralla: | 1.465.521 Pts | - 8 % Morralla: | 1.922.619 Pts |
| - Fuel: | 745.500 Pts | - Fuel: | 1.207.500 Pts |
| - Oil: | 227.000 Pts | - Oil: | 148.925 Pts |
| - Ice: | 908.000 Pts | - Ice: | 920.000 Pts |
| - Lights: | 340.800 Pts | - Lights: | 303.600 Pts |
| - Bar: | 98.000 Pts | - Bar: | 230.000 Pts |
| - Food: | 60.000 Pts | - Food: | 120.000 Pts |
| **Monte Menor Y:** | **14.474.191 PTAs** | **Monte Menor Y:** | **19.180.092 PTAs** |
| ***60% for the crew:*** | ***8.684.515 Pts*** | ***60% for the crew:*** | ***11.508.055 Pts*** |
| ***40% for the owner:*** | ***5.789.676 Pts*** | ***40% for the owner:*** | ***7.672.037 Pts*** |
| - gear costs: | 600.000 Pts | - gear costs: | 1.100.000 Pts |
| - rope costs: | 300.000 Pts | - rope costs: | 350.000 Pts |
| - engine costs: | 200.000 Pts | - engine costs: | 500.000 Pts |
| - insurance: | 452.000 Pts | - insurance: | 656.000 Pts |
| - launch and painting: | 300.000 Pts | - launch and painting : | 1.000.000 Pts |
| **Gross Owner Yield (Before tax & amortisation)** | **3.937.676 Pts** | **Gross Owner Yield (Before tax & amortisation)** | **4.066.037 Pts** |

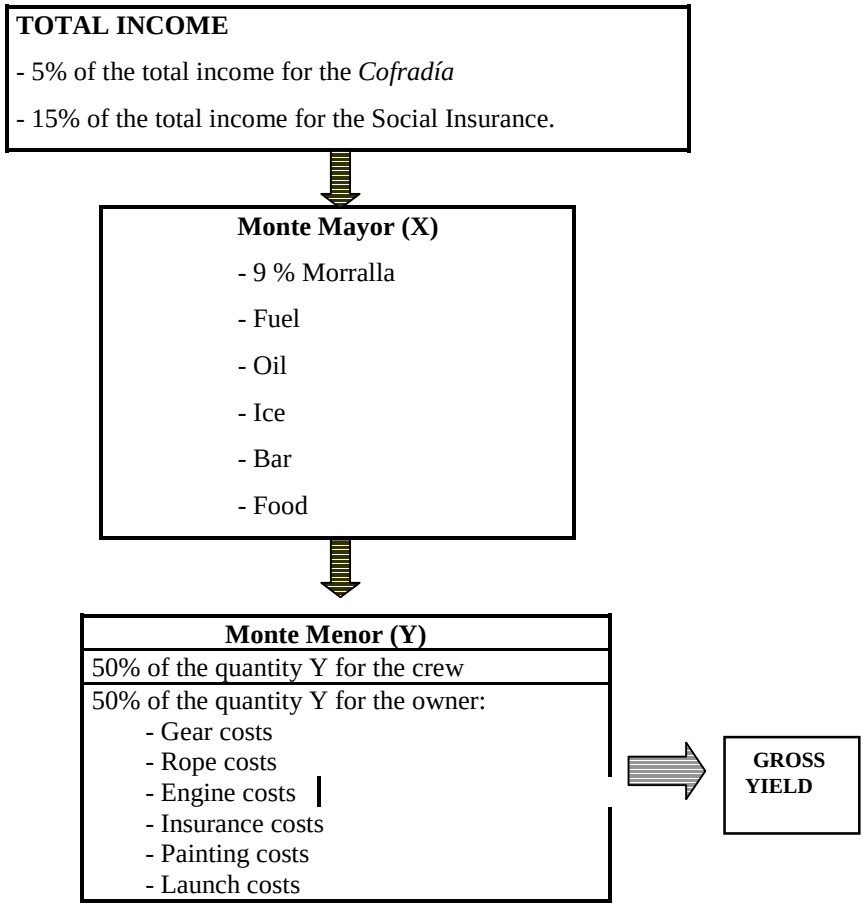
## 3.2 The Trawling Fleet

As the fishermen say, trawling and purse seine are two different worlds. There are sociological and operational differences, which make both gears completely unlike.

In the trawling vessels there are few members in the crew, and usually all of them are from the same family, included the owner. It also happens that different vessels of the fleet belong to the same family. So the different families are like clans and most of the times there are problems between the families. In this context is also quite difficult to achieve consensual decisions, what brings the same result as in the purse seine fleet: each vessel looks for its own interest.

These families have a long tradition in fishing in Catalonia, so they don't have the same social problems as the purse seine fleet.

The payment method is basically the same as in the purse seine with some little differences. The case of trawler is showed in the Graphic 6. There are no differences in the first part of the schedule: the fees for the *Cofradia* and the percentage for the Social Insurance are the same.




*Graphic 6 Income Distribution Process in the Trawler*

But there are some little differences in the costs before the distribution of the *Monte menor* (Y). The percentage of the *Morralla* (additional income for crew, proportional in this gear to *Monte mayor*) is for this gear the 9% instead of the 8%. There are also differences in the food costs, because in the trawling fleet the crew eats in the vessel every day, so there is a fixed cost of food each fishing day.

The percentage of distribution of the *Monte menor* (Y) is also different in this case: the 50% is for the owner and the 50% for the crew (instead of purse seine where the relation is 40% and 60%).

Once we have described the costs of this fleet, we will give an approximation of each one of these costs for a standard vessel of each segment established in the trawler fleet. The distribution of costs and earnings for each of the three segments of the trawlers is shown in table 8. In this table is presented the synthetic information recompiled from enquiries to the owners of the boats of Barcelona harbour. The table presents the average income structure for each segment of the fleet: the segment A1 (less of 30GRT), the segment A2 (GRT between 30 to 70) and the segment A3 (more of 70 GRT).

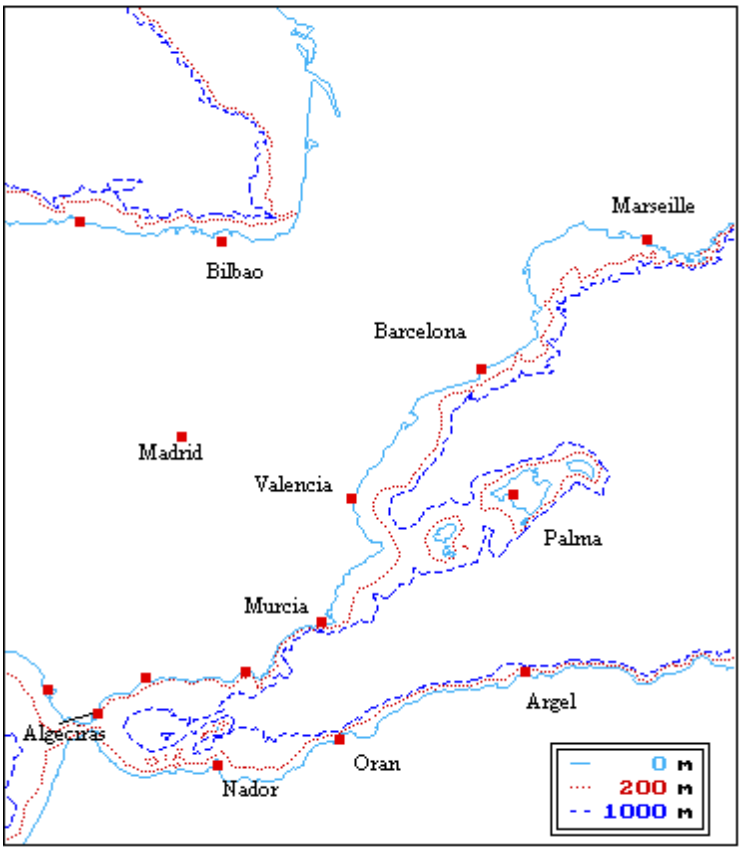
The outcomes of this evaluation show that the Gross Yield of the owners (before tax and amortisation) is significative. The segment A2 produces the biggest Gross Yield. It is 31% highest than the segment A1, and 97% (near the double) of the segment A3.

As the case of Purse Seine, estimating amortisation is difficult in trawlers. From the information that we have at this moment on the amortisation cost, it is a real higher profitability in the case of the A2 than in A1 one, but without a very important difference.

In any case, it is clear that the segment A3 is not proper to the Mediterranean conditions. The vessels are too big, have an excessive engine, excessive fuel consumption, and are too expensive. This is our provisional estimation for the studied case. *In the trawler the intermediate vessels (30 GRT to 70) have a higher profitability that the others. The segment with little vessels has economic viability but not the highest (more of 70 GRT).*

*Table 8 Average Estimation of the Incomes Distribution in Trawler Segments*

| **Segment A1** | | **Segment A2** | | **Segment A3** | |
|---|---|---|---|---|---|
| **TOTAL INCOME: (23.920 Kg)** | **15.168.262 Pts** | **TOTAL INCOME: (39.032 Kg)** | **35.001964 Pts** | **TOTAL INCOME: (54.162 Kg)** | **35.411.409 Pts** |
| - 5% for the *Cofradía*: | 758.413 Pts | - 5% for the *Cofradía*: | 1.750.098 Pts | - 5% for the *Cofradía*: | 1.770.570 Pts |
| - 15% for the Social Insurance: | 2.275.239 Pts | - 15% for the Social Insurance: | 5.250.294 Pts | - 15% Social Insurance: | 5.311.711 Pts |
| **Monte Mayor X:** | **12.134.609 Pts** | **Monte Mayor X:** | **28.001.571 Pts** | **Monte Mayor X:** | **28.329.127 Pts** |
| - 9 % Morralla: | 1.092.114 Pts | - 9 % Morralla: | 2.520.141 Pts | - 9 % Morralla: | 2.549.621 Pts |
| - Fuel: | 1.126.125 Pts | - Fuel: | 3.733.800 Pts | - Fuel: | 5.846.400 Pts |
| - Oil: | 43.875 Pts | - Oil: | 152.400 Pts | - Oil: | 185.600 Pts |
| - Ice, bar, food: | 780.000 Pts | - Ice, bar, food: | 5.257.800 Pts | - Ice, bar, food: . | 712.000 Pts |
| **Monte Menor Y:** | **9.092.494 Pts** | **Monte Menor Y:** | **16.337.430 Pts** | **Monte Menor Y:** | **16.035.505 Pts** |
| ***50% for the crew:*** | ***4.546.247 Pts.*** | ***50% for the crew:*** | ***8.168.715 Pts*** | ***50% for the crew:*** | ***8.017.752 Pts*** |
| ***50% for the owner:*** | ***4.546.247 Pts*** | ***50% for the owner:*** | ***8.168.715 Pts*** | ***50% for the owner:*** | ***8.017.752 Pts*** |
| - gear costs: | 400.000 Pts | - gear costs: | 1.500.000 Pts | - gear costs: | 2 .000.000 Pts |
| - rope costs: | 345.000 Pts | - rope costs: | 2.000.000 Pts | - rope costs: | 2.500.000 Pts |
| - engine costs: | 1.000.000 Pts | - engine costs: | 1.000.000 Pts | - engine costs: | 1.000.000 Pts |
| - insurance costs: | 396.000 Pts | - insurance costs: | 480.000 Pts | - insurance costs: | 480.000 Pts |
| - painting costs: | 200.000 Pts | - painting costs: | 300.000 Pts | - painting costs: | 400.000 Pts |
| - launch costs: | 200.000 Pts | - launch costs: | 250.000 Pts | - launch costs: | 300.000 Pts |
| **Gross Owner Yield (Before tax & amortisation)** | **2.005.247 Pts** | **Gross Owner Yield (Before tax & amortisation)** | **2.638.715 Pts** | **Gross Owner Yield (Before tax & amortisation)** | **1.337.752 Pts** |




*Graphic 7 Spanish Mediterranean Fishing Area*