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TECHNICAL CONSULTATION ON THE USE OF SUBSIDIES IN THE FISHERIES SECTOR

Rome, Italy, 30 June – 2 July 2004

A GLOBAL PROJECT FOR THE STUDY OF IMPACTS OF FISHERIES SUBSIDIES

ABSTRACT

The central part of the proposed “Global Technical Initiative” is the FAO project “a global project for the study of impacts of fisheries subsidies”. The project is described in this document. It has two parts: fishery specific country case studies, and, a quantitative analysis of the effects of subsidies through econometric modelling. The document describes the activities and expected results for both parts.

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I. INTRODUCTION

1.1 BACKGROUND AND CONTEXT

The interest in fisheries subsidies in international fora continues to increase and there is a common understanding that at least some types of subsidies are harmful to the environment. Work on analysing the effects of subsidies is carried out by various organisations, e.g. OECD and UNEP, but still very little is known about exactly how these effects are created and what their magnitude is in relation to the amount of subsidies. The on-going WTO negotiations on improving the disciplines on fisheries subsidies have fuelled the debate and the future treatment of fisheries subsidies is a concern to many governments.

The FAO Fisheries Department started to take an interest in subsidies to the fisheries sector in 1992 when the organisation sounded the alarm that subsidies were having negative effects on capture fisheries. More intensive work begun in 1999 when an “Expert Consultation on Economic Incentives and Responsible Fisheries” was organised by the department with a view to find an operational definition of fisheries subsidies and to identify a strategy for learning more about their effects. As a follow-up to this meeting, a "Guide for identifying, assessing and reporting on subsidies in the fisheries sector"¹ was developed in 2002 as a first step towards improving our understanding of fisheries subsidies and of how to study them.

The 25th Session of the FAO Committee on Fisheries (COFI) in 2003 urged the Fisheries Department to accelerate its work regarding the impact of subsidies on fisheries resource sustainability and sustainable development. The Fisheries Department attempted to do this but few Governments were keen to participate. It is believed that this attitude may change if such studies are undertaken as part of an international programme to shed light on subsidised, in which confidentiality, high quality data and comparability is ensured.

This project has been developed with the collaboration of a number of experts and researchers with considerable experience from work on fisheries subsidies issues². The subject matter is

¹ Westlund, L., (in press). Guide for Identifying, Assessing and Reporting on Subsidies in the Fisheries Sector. *FAO Fisheries Technical Paper* No. 438, FAO, Rome.

² The case study sub-project (chapter 3) was reviewed in the Third *ad hoc* meeting of Intergovernmental Organizations on work programmes related to subsidies in fisheries (see FAO 2003. Report of the Third *ad hoc* meeting of Intergovernmental Organizations on work programmes related to subsidies in fisheries. Rome, 23-25 July 2003. FAO

complex and it is agreed that there has to be a concerted effort in the form of high quality studies in order to produce hard data and evidence to take the international debate forward. These studies need to be internationally compatible, i.e. taking the varying circumstances and situations in different parts of the world into account. Considering that the subject is also politically sensitive, the studies to be carried out have to be formulated in such a way that the confidentiality of participating governments and other stakeholders is assured. It is believed that the project proposed in this document meets these criteria.

1.2 STUDY COMPONENTS AND OUTLINE OF REPORT

The project consists of two main components:

- Descriptive and qualitative trend analysis of a number of selected subsidies and indicators by case studies of selected fisheries;
- Quantitative analysis of the effects of subsidies through econometric modelling.

The two sub-projects are independent complementary activities. The case studies represent a more exploratory approach focusing on obtaining empirical data on fisheries subsidies – the lack of which generally constitutes an obstacle to analysis – and on analysing these data using relatively simple methods. This approach is applicable in particular to countries and situations where data on the fisheries sector and subsidies are not readily available. The results of the sub-project will enhance the understanding of the effects of subsidies and of the mechanisms by which these effects are created, although not necessarily providing any quantitative measurements. The econometric modelling work, on the other hand, requires high quality data in long time series allowing for the development of a simulation model that explains the impact of subsidies in quantitative terms.

Chapter 2 discusses the overall objectives and the justification for the project. Chapter 3 gives the details of the case studies and chapter 4 discusses the model development work.

2. PROJECT JUSTIFICATION, OBJECTIVE AND INPUTS

2.1 PROJECT JUSTIFICATION

The subject of fishery subsidies is a difficult and complex one for policymakers. On the one hand, most fishery economists would argue that subsidies should not be introduced where they do not exist and should be removed where they do. On the other hand, subsidies have a long history and are introduced, not flippantly, but to accomplish socially useful objectives. Which side is right?

The argument against subsidies is based on a number of points. First, in the presence of fishery subsidies, firms (or fishermen) see their potential profits increasing, at least in the short term. The anticipation of increased profits leads to the acquisition of capital stock and an increase in fishing effort. If the fishery is fully developed, the increase in fishing capacity leads to overcapacity and most likely to overfishing, thus endangering the fish stock. Second, given the uncertainty inherent in fishery science, the existence of excess capacity in the fishery results in pressure being exerted

on fishery managers by the owners of capital, and fishermen, to set TACs sufficiently high that capital and labour can be fully employed, often without due regard for the scientists' opinions of the state of the fish stocks. Third, even if the fishery is much less than fully developed, there is a possibility, even a likelihood, that governments will find it difficult to withdraw the subsidies once they have served their purpose. In general, fishery subsidies tend to increase fishing effort and lead to the reduction of fish stocks.

The counter argument is based on the presumed social utility of subsidies. First, if the fishery is underdeveloped, the government may want to use subsidies to stimulate the growth of the domestic industry. This is a device used not only by developing countries, but, at the time of the extension of coastal state jurisdiction of marine fisheries a quarter century ago, was used extensively by developed nations to acquire the capacity to replace the displaced foreign distant water fleets. The developing countries could argue that the developed countries used subsidies when it served their purposes (as during the expansions of the 1970s) and now the developing countries should have their chance, since they face the same market imperfections: the same lack of private capital available for fisheries development. In addition, they, having observed the errors made by the developed countries, can avoid their mistakes. Second, governments may use subsidies to encourage firms to reduce the size of their fleets and to encourage fishermen to leave the industry. Third, governments may use subsidies to encourage firms to apply more environmentally friendly techniques, for instance, by adopting turtle excluder devices where appropriate.

When subsidies are measured, what is computed are the amounts of money that the government transfers to the industry (firms and individuals), or the value of fees and taxes that the government waives, or the equivalent value to the firm and individuals of subsidies which cannot be so directly estimated. There have been a number of studies to measure fishery subsidies, of which the three most important are: a study by Milazzo, published by the World Bank³; an international study of government financial transfers to fisheries done by the Organization for Economic Cooperation and Development (OECD)⁴; and a study of the nature and extent of subsidies to the fishery sector done by PricewaterhouseCoopers for the Asia Pacific Economic Co-operation group of countries (APEC)⁵. The FAO Fisheries Department's Guide has been developed to help countries perform such studies.

However, the results of this empirical work indicate the amount of the subsidy but not their effects on the fishery. There is hence an urgent need to investigate the effects of fisheries subsidies to allow fishery managers to develop effective fishery policies concerning subsidies.

2.2 OBJECTIVE

The overall objective of the project is to improve the current knowledge of the impact of subsidies. More specifically, the intention is that the project will generate information on:

- The mechanisms by which impact is created.
- The particular circumstances that influence the impact of subsidies.
- How impact can be measured and what the magnitude of the effects is on the capacity of the fishing fleet, on fishing effort and on the size of the fish stock?

³ Milazzo, M., 1998. Subsidies in world fisheries - a re-examination. World Bank Technical Paper No. 406. The International Bank for Reconstruction and Development/World Bank, Washington.

⁴ OECD. 2000. Transition to responsible fisheries - Economic and policy implications. OECD, Paris.

⁵ PricewaterhouseCoopers LLP. 2000. Study into the nature and extent of subsidies in the fisheries sector of APEC Member Economies CTI 07/99T Draft Report - End module synthesis. Prepared for Fisheries Working Group, Asia Pacific Economic Co-operation (APEC).

It is expected that the results of the project will provide a good insight into the above listed issues. An additional objective of the project is to clearly identify further empirical and theoretical research needs for understanding the environmental, economic and social impact of fisheries subsidies.

2.3 PROJECT DURATION

The suggested duration of the project is 18 months.

3. SUB-PROJECT 1: CASE STUDIES

3.1 EXPECTED RESULTS AND SUMMARY OF ACTIVITIES

The intention is to carry out 6-8 case studies in different countries from different parts of the world with special consideration given to developing economies. Each case study is expected to provide information on existing subsidies relevant to a selected fishery and their likely impact on the target stocks and on the livelihoods of fishing communities. By synthesising the individual country case study results, conclusions will be drawn with regard to the mechanisms by which subsidies work, the effects that they create and the context in which they exist.

Historical data sets, ideally covering at least the last ten years, will be collected and collated. For the collection of base data, the "Guide for identifying, assessing and reporting on subsidies in the fisheries sector"⁶ will be used. Existing secondary data will be the main source of information, complemented by primary data collection through interviews with representatives of the fishing industry and government agencies. The analytical process will primarily include the identification of spatial and temporal patterns in data using time series analysis and other analytical techniques as appropriate. The results of these analyses will be also reviewed in the context of the analytical framework developed by Hannesson for the OECD⁷ and the matrix used by Porter in work for UNEP⁸ (see also section 3.3 below).

3.2 FOCUS AND LIMITATIONS

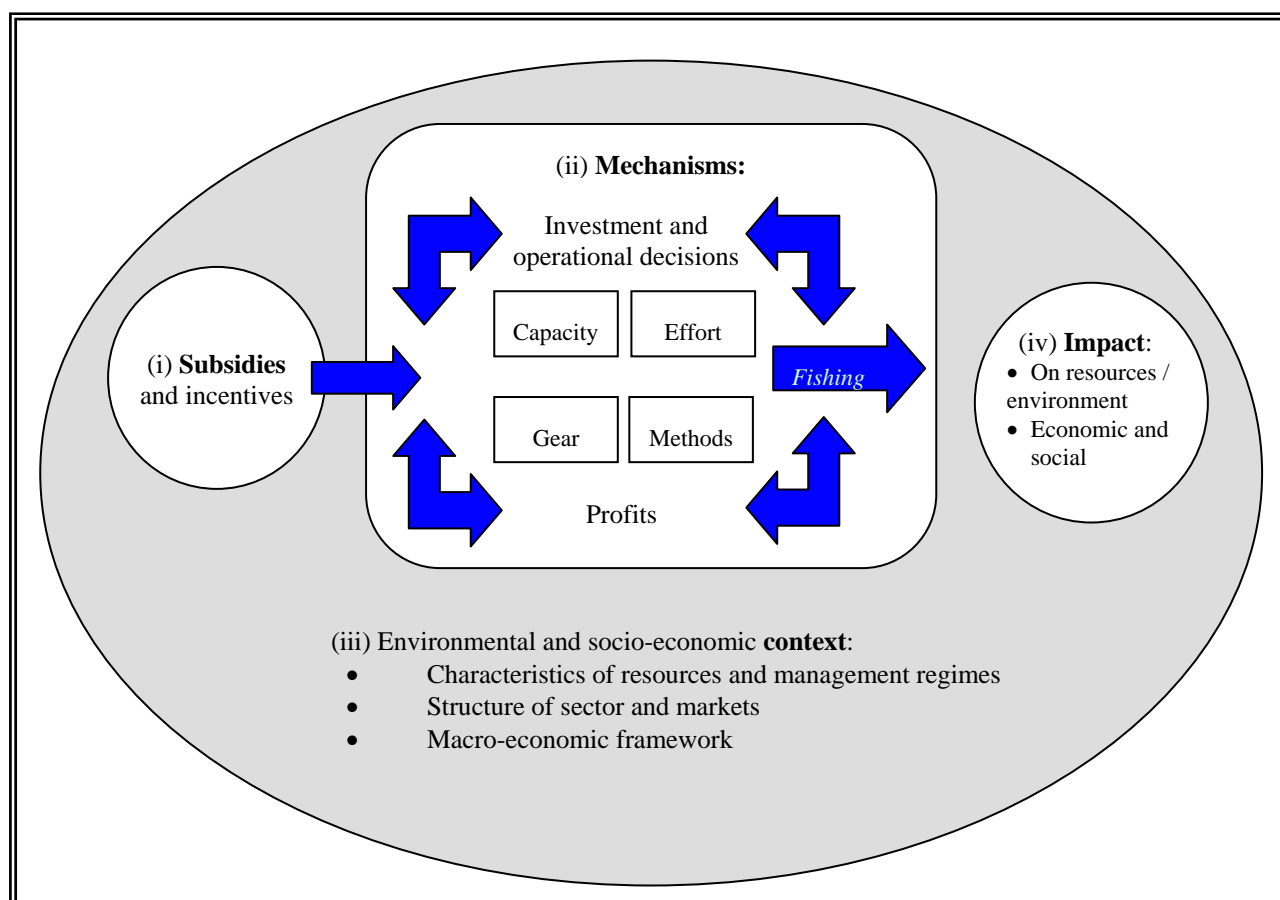
It is assumed that a subsidy leads to a change in industry profits and through the incentives it leads to the consequent change in behaviour, which in turn leads to the impact. This is of course a simplification and the real process would be iterative, especially in the longer term. (see figure 1).

⁶ See footnote 1.

⁷ Hannesson, R. 2003, The economic aspects of subsidies, document presented to the 92nd Session of the Committee of Fisheries, Paris 6-8 October 2003, AGR/FI(2003)11.

⁸ Porter, G., 2002, Fisheries subsidies and overfishing: Towards a structured discussion. UNEP Fisheries Subsidies Workshop, Geneva, 12 February 2001. Economics and Trade Unit (ETU).

Figure 1 : Analytical levels: fisheries subsidies, mechanisms, context and impact



In order to achieve the objective of understanding the impact and mechanisms of subsidies, all these components need to be investigated. However, in order to keep the study within a manageable and workable format, it is necessary to define a limited number of key issues and indicators. These issues and related indicators have to be clearly defined and should be based on existing economic theory and the current understanding of the mechanisms of fisheries subsidies. Naturally, they should be relevant for the overall objectives of the work. Expected problems with data availability should be taken into account when deciding the level of detail of the analysis and there may be a need to use slightly different approaches in different case study countries.

While it will be important to understand the overall situation of the fisheries sector in the various case study countries, the focus of each country case study should be on one particular fishery (ideally with a dedicated fleet that only operates in this particular fishery) in the marine capture fisheries subsector in order to allow for an in-depth analysis.

Moreover, the focus should be on the more explicit subsidies, i.e. direct and indirect transfers and services. These are defined as categories 1 and 2 in the Guide⁹. Within these categories, focus should be on subsidies that are policy relevant and hypothetically linked, whether overtly or less obviously, to overcapacity¹⁰. These types of subsidies are likely to include:

⁹ Category 1: Direct financial transfers; category 2: Services and indirect financial transfers.

¹⁰ In the COFI recommendations, IUU fishing was mentioned – together with overcapacity – as a special priority area to study. However, it would appear that the problem of IUU fishing arises as a result of poor enforcement and inadequate

- Infrastructure (in particular port and landing facilities)
- Boat building schemes and vessel modernisation programmes
- Buy-back/decommissioning programmes (for vessels and gear)
- Income support (including price support) and compensations for temporary cessation of fishing

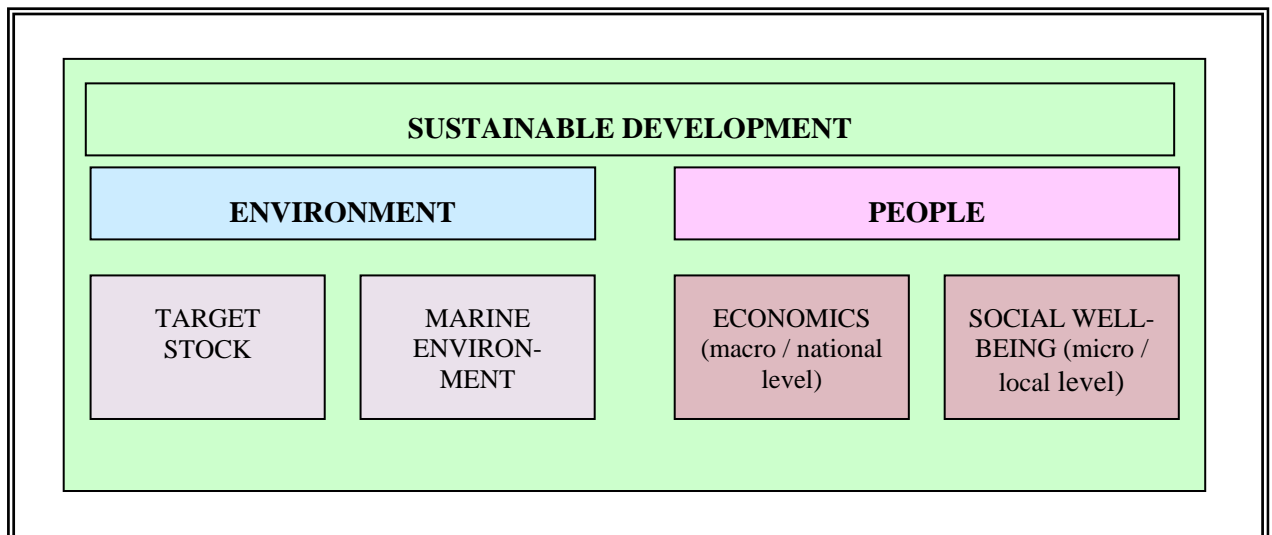
The environmental and socio-economic context consists, naturally, of a myriad of aspects. Some of the ones considered more important for the analysis include:

- The characteristics of the resources and the fisheries management regime
- The structure of the sector, including market structures (up- and downstream)
- The overall macro-economic framework

Within these categories, specific indicators will need to be selected for each country case study. As a minimum requirement, the management regime in place and the status of the stocks will have to be included. When time series data collected exhibit unexplainable trends, surrounding circumstances would need to be explored further, e.g. whether there are macro-economic policies outside the sector that may have had an influence.

The overriding concept with regard to impact is sustainable development; what we would like to know is how subsidies affect sustainable development. Sustainable development consists of several, interrelated, elements that are schematically illustrated in Figure below.

Figure 2: The concept of sustainable development



While all of these elements are important, the sub-project will focus on the impact on the target stock and on the social well-being – the livelihoods – of fishers and fishing communities, in

management and legal frameworks. From an analytical point of view, the underlying economic framework for analysing IUU fishing is similar to that used for analysing non-IUU fishing. Therefore, IUU fishing could be analysed after the economic/operational links between subsidies and overcapacity have been established and, would need be, explicitly emphasised at this stage.

particular income and employment. The effects on the marine environment and macro-level effects will be considered when feasible. Trade-offs between the impacts of subsidies on the different elements will be explored.

3.3 ACTIVITIES AND METHODOLOGIES

3.3.1 *Components*

The case study project will consist of the following main components:

- Selection of and agreement with case study countries and implementation partners
- Collection of base data
- Review of the base data and further development of methodologies
- Collection of detailed data and analysis
- Preparation of case study reports
- Exploration of case study results and preparation of a synthesis report

Below the data collection and analytical components of the country case studies are described. Details with regard to the implementation procedure and a tentative work programme are included in section 3.4.

3.3.2 *Collection of base data*

As a starting point for each case study, it will be important to have a good overview of existing subsidies and of the fisheries sector. Accordingly, an inventory of existing direct transfer and indirect transfers and services subsidies should be made and basic information on the sector collected. For this data collection, the methodologies of the FAO Guide should be followed:

- Subsidies of Categories 1 and 2 (see sample summary table in the Guide's Figure 9)
- Structure of the fisheries sector (see sample table in the Guide's Box 22)

3.3.3 *Review of the base data and further development of methodologies*

Based on the base line information, the continuation of the work can be planned, i.e.:

- Assessment of the data collected and more generally of data availability and quality.
- Selection of the particular segment of the sector, i.e. the fishery, that should be studied in detail.
- Identification of indicators and data collection needs
- Establishment of work and survey methodologies for the continuation of the data collection (e.g. data sources – primary and secondary, sample population, questionnaires, etc).

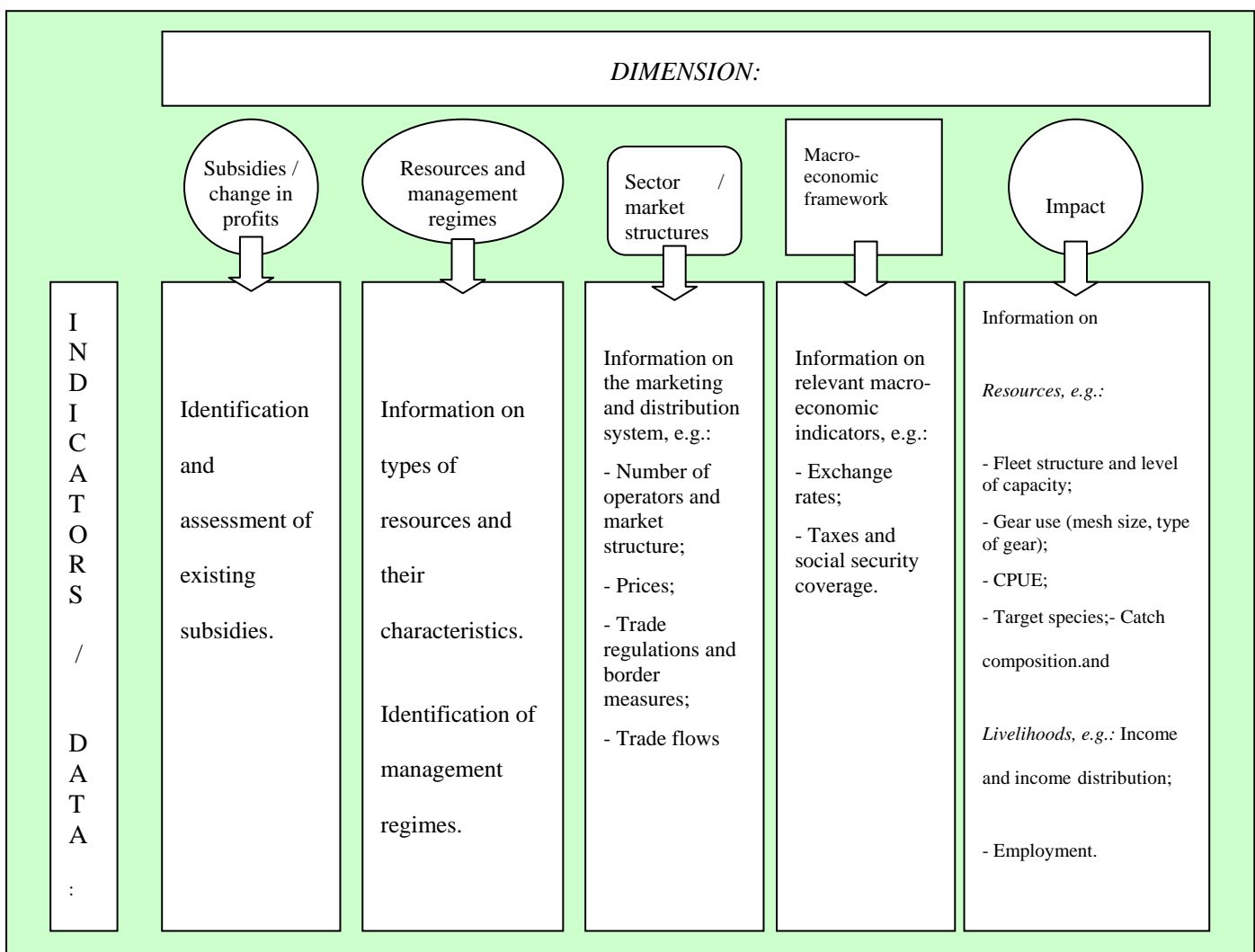
3.3.4 *Analysis*

(i) Identification of spatial and temporal patterns in data

Figure gives a schematic overview of the components, or dimensions, of the subsidies system. The first column represents the subsidies and the last their impact. The three dimensions in-between correspond to the three aspects of the context that were identified in section 3.2 above: resources and management regimes, structure of sector and markets, and macro-economic framework. For each dimension, a number of indicators are suggested, representing the historical data to be collected.

The collected historical data sets – which should preferably cover a continuous time series of at least the last ten years – will be used to explore the relationships and linkages between the different dimensions, i.e. subsidies, their impact, and the context in which exist. The impact (on resources and livelihoods – last column in Figure) may be explained by a subsidy or/and by other “happenings” in any of the other dimensions¹¹. It may also be that a subsidy only has a certain effect under specific circumstances.

Figure 3: Elements of a study of the impact of subsidies



¹¹ Questions to be asked could include, for example: Is there a correlation between an increase in fishing effort and the value of fleet modernisation subsidies? What combination of variables best explain an increase in fishers' income, e.g. fluctuations in the value of the local currency, price support, a change in the market structure?

Data analyses may be either more qualitative (descriptive) or more quantitative, according to the nature and reliability of the data. Time series analysis and other econometric estimation and modelling techniques will be used and existing academic work will be explored in this context.

As a complement to the mainly secondary data collection of historical data sets, information may also be collected directly from fishers and other representatives of the industry with regard to how they perceive that their behaviour has changed due to existing subsidies. This qualitative information may help explain trends that are otherwise difficult to understand and also give insights into aspects that are not easily covered by quantitative data.

(ii) Hannesson/Porter framework

Hannesson developed an analytical framework for OECD. Table 1 shows an example of the conclusions from this analysis.

Porter has used a similar matrix in his work for UNEP¹². For the case studies, it is suggested that the results be reviewed within the context of the findings of the OECD and UNEP studies using the Hannesson and Porter framework/matrix.

Table 1: Environmental effects of subsidies to decommissioning and licence retirement

Subsidy category	State of fish stock	Management regime				
		Property rights		No property rights		
		Catch controls	Effort controls	Catch controls	Effort controls	No catch or effort controls
Subsidies to decommissioning and licence retirement	Over-fished	No effect on stocks	If total effort reduced, stocks recover	No effect on stocks	If total effort reduced, stocks recover	No effect on stocks Reduced stocks if new vessels more efficient
	Under-fished	No effect on stocks	No effect on stocks	No effect on stocks	No effect on stocks	No effect on stocks Reduced stocks if new vessels more efficient

Source: Page 20, A. Cox, *OECD Technical Expert meeting on environmentally harmful subsidies – Environmental aspects of fisheries subsidies, Paris 3-4 November 2004, SG/SD(2003)12*.

3.4 IMPLEMENTATION PROCEDURE AND TENTATIVE WORK PROGRAMME

The country case studies will be discussed with and approved by the relevant authorities of the host government. The actual work will be carried out by a qualified institution/individual under contractual arrangements with the FAO Fisheries Department (Fishery Development Planning

¹² See footnote 8.

Service, FIPP) and in cooperation with the competent bodies of the host government. FAO will provide technical backstopping during the course of the study in the form of visits by a consultant/staff member.

Each case study will produce a report covering the results of the data collection, the elements of the analysis and its conclusions as well as a description of the methodologies used and possible problems encountered. Part of the report can be kept confidential if this is requirement of the host government.

The results of the individual studies will be explored and synthesised into a final report to be prepared by FAO.

A tentative outline of the work programme is given in Table 2.

Table 2: Tentative work programme for case studies

<i>Step</i>	<i>Tasks</i>	<i>Time frame</i>
1	Selection of case study countries, agreement with host government and contract established with implementing partner.	3 months
2	Data collection – phase 1 – in accordance with methodologies outlined in the Guide: <ul style="list-style-type: none"> • Subsidies of categories 1 and 2; • Overview of the structure of the fisheries sector. 	2 months
3	Planning of data collection – phase 2: <ul style="list-style-type: none"> • Review of the data collected and the general data availability and quality. • Selection of the particular segment of the sector that should be studied in detail. • Identification of suitable indicators and data collection needs • Establishment of work and survey methodologies for the continuation of the data collection (e.g. data sources – primary and secondary, sample population, questionnaires, etc). 	1 month

	This planning exercise should preferably take place in cooperation with the FIP consultant/staff member during a backstopping visit.	
4	Data collection – phase 2: according to plan under 3.	3 months
5	Analysis	3 months
6	Preparation of country case study reports	3 months
7	Preparation of synthesis report	3 months

4. SUB-PROJECT 2: A SIMULATION MODEL¹³

4.1 EXPECTED RESULTS AND SUMMARY OF ACTIVITIES

Despite the comprehensive and at times heated discussions that have taken place regarding the harmful effects of subsidies, there have been few, if any, studies that attempt to quantify the effects of subsidies. The question, “if such and such a subsidy with a certain value is implemented, the incentives will be such that the effect on the capacity of the fishing fleet, on fishing effort and on the size of the fish stock will be how much” is rarely asked, much less answered. The objective of the proposed research is to develop prototype models that can help answer these questions. The argument against certain subsidies is clear. Whether or not, in fact, the effects demonstrated in the relevant theoretical literature are of quantitative significance is quite another matter.

¹³ This sub-project has been developed in collaboration with Prof. W.E. Schrank of the Memorial University, Newfoundland, Canada; Prof. R. Hannesson of the Norwegian School of Economics and Business Administration, Bergen, Norway; and, Prof. B. Sharp, University of Auckland, New Zealand

4.2 ACTIVITIES AND METHODOLOGIES¹⁴

4.2.1 *Components*

This sub-project consists of four main components, i.e.:

- Development of a generic model.
- A case study on fisheries subsidies in Norway.
- A case study on fisheries subsidies in Newfoundland, Canada.
- A case study on fisheries subsidies in New Zealand.

The four components are interrelated. The proposed generic model will be modified through the work on the three case studies. The four components are described below.

4.2.2 *The generic model*

Each nation's fishery is unique. We propose in this section a generic model whose structure would be modified, and whose parameters would be estimated, for each fishery under study. The generic model is based on published work by the distinguished Icelandic economist, Dr. Ragnar Arnason. Dr. Arnason obtained numerical results by applying imaginary, but "reasonable" numbers to a mathematical construct. The generic model proposed here differs from Arnason's in that the formulation is somewhat changed and, to as great a degree as possible, the model parameters will be statistically estimated. Even were the same basic model used to estimate the effects of fishery subsidies in a number of different countries or different fisheries within a country, the results will differ because the data will differ from country to country and from fishery to fishery.

The model is designed to determine the effects of cost reducing and price enhancing subsidies. Other subsidies, with more complicated structures, are beyond the compass of the proposed model, although extensions to the model are always possible. The results generated by the model show the quantitative effects of subsidies on industry profits (thus quantifying the incentive effects generated by the subsidies to expand the fishery), and on fishing effort and fish populations (thus showing the effects of the subsidies on sustainability). Once the change in fishing effort motivated by the subsidy is known, if the structure of the fishery is also known (number and types of vessels and gear, the number of fishermen per vessel), the effect of the subsidy on effort can be converted to the effect of the subsidy on the number of vessels and fishermen. If utilization rate data are available, the effect of the subsidy on utilization rates can be determined. If not, utilization rates will simply be assumed constant.

The basic generic model consists of four equations, one each representing fish population dynamics, fishing effort, fish catches and profits. Fish population at the start of a period (say, a year) is determined by the fish population at the start of the previous year, increased by the natural growth of the stock through births and aging throughout the previous year, minus the catch during the previous year. The Pearl-Verhulst logistic model is the standard starting point for this analysis.

¹⁴ Sub-project two can be implemented independently of Sub-project one.

Fishing effort during the year is determined from the previous year's effort and the expected level of profits. When expected profits increase, effort will increase. Expected profits are taken as the profits in the previous year.

The catch in a year is determined by the application of fishing effort during the year to the population at the start of the year. The starting point for this analysis is the standard Schaefer production function. When effort or catch are limited by fishery management regulations, the appropriate constraints must be built into the model.

Profit in any year is the difference between the revenues in that year (price per unit of catch multiplied by catch) and the cost of fishing effort, where price and cost are taken as given.

In its simplest form, the model is strictly recursive, which means that the equations can be solved one at a time in a specific order and that no computing more complicated than the elementary use of a spreadsheet is necessary to solve the model. As bits and pieces are added to the model to represent peculiarities of the specific fishery under study, this strict recursivity may break down and more complicated computing techniques may need to be applied.

Resulting from the solution of the model are values for profit, fishing effort, fish population, and catch. As was stated previously, once the change in effort is known, the structure of the fishery can be used to determine changes in the numbers of vessels and fishermen. Since revenues and costs can be adjusted to reflect the role of subsidies, solutions to the model can be made to reflect the effect of the subsidies on each of the four solution variables: profit, fishing effort, fish populations and catch.

4.2.3 Fisheries subsidies in Norway

(i) Case study fishery and data

In Norway fisheries subsidies were initiated in the mid-1950s. While varying in response to resource availability and market conditions they trended upwards, reaching a high point in the early 1980s when they amounted to at least 70 percent of the value added in the industry. From the late 1980s this trend was reversed, and fisheries subsidies have now been virtually abolished in Norway.

Norway's case therefore seems an excellent one for an empirical study of the effects of subsidies. This study is expected to answer questions such as the following: To what extent did subsidies encourage the overexploitation of fish stocks? To what extent did they lead to overinvestment in fishing boats and excessive use of labor and other factors of production? What was the adjustment process after the subsidy regime was abolished? Did the industry go through a period of hardship because of overexpansion encouraged by subsidies, or was profitability quickly restored without a wave of losses and bankruptcies?

The Norwegian case study will put some empirical blood into the generic model set out elsewhere in this proposal. The results of the generic model depend critically on the value of the parameters of the model, but the value of these parameters must necessarily reflect the economic reality of each country or fishery if they are to be policy relevant. While the parameters estimated from a case study of Norway are relevant primarily for that particular country, or even for a particular fishery being studied, this study would still be of a more general interest, for three reasons. First,

it would demonstrate the practical applicability, or the lack of it, of the approach being proposed. Second, it would demonstrate how one would go about applying the model in an empirical setting; what data need to be gathered and what problems could be encountered along the way. Third, the result of this study would provide some idea about the seriousness of the subsidy problem.

Even if the data on fish stocks, subsidies, and costs and earnings of the fishing fleet, are probably more extensive in Norway than one finds in most other countries, this does not mean that the empirical study proposed here is straightforward. There are three main reasons for this. First, the Norwegian fishing fleet exploits many different fish stocks, and it is not straightforward to attribute the subsidies to individual stocks or fleet segments. Second, there is no reliable data on the effort of the Norwegian fleet and still less on how it has been distributed among the different fish stocks. Third, most stocks exploited by the Norwegian fleet are also exploited by fleets from other countries, so what happens to the stocks depends also on what other countries do, as well as on environmentally driven fluctuations in ocean currents and temperature.

To address these problems, we propose the following approach. First, as far as the effect on fish stocks is concerned, the study would be limited to the Northeast Arctic cod. For this stock there exists a time series of stock abundance going back to 1946. The Norwegian landings of cod are overwhelmingly taken from this stock, and there also exists a time series of landings from this particular stock.

(ii) Price subsidies

In their heyday, a large part of the Norwegian fisheries subsidies were price subsidies. Information is available on how much was given to the groundfish fisheries and how much to the pelagic fisheries. The cod fishery is, in terms of value, the most important part of the groundfish fisheries. By relating the price subsidies to the gross value of the groundfish fisheries it is possible to get an estimate of the magnitude of the price subsidy as a percentage of price. In the absence of data on the effort of the fishing fleet, it is proposed to investigate whether the Norwegian share of cod caught from the Northeast Arctic cod has been sensitive to the real price of cod (price deflated by the consumer price index). If such dependence is found, it would be possible to run two different scenarios for the cod stock, one with and the other without subsidies. The difference would then indicate the degree of stock depletion encouraged by price subsidies. For this purpose a logistic model similar to the one proposed elsewhere in this study would be utilized.

At this point, two further comments are in order. First, this procedure presupposes that the overall catch is not regulated. This is no longer true; since the late 1970s there has been in place a TAC regime for the Northeast Arctic cod. However, until the early 1980s this regime was not fully effective, as the Norwegian coastal fleet could continue to fish even if the Norwegian share of the TAC had been exceeded. It would thus be meaningful to carry out the said analysis from the mid-1950s when the subsidy regime began until the early 1980s. Second, the proposed approach assumes that any variability in the Norwegian real price of cod implied variability in relation to the price of other countries. This is indeed not unlikely. The prices in the Soviet Union, the other main exploiter of the Northeast Arctic cod, had no relation to the prices in the rest of the world. While Norway sold its fish in part to the same markets as other western European nations fishing this stock, the Norwegian subsidy regime was unique, thus weakening the link between the price the fishermen got and the price prevailing in the markets for finished products.

As to the effects on investment and the use of labour, we are at this stage uncertain as to whether or not to limit the analysis to the groundfish fisheries. Data on investment and capital stock in the fishery concern the fleet as a whole. A further examination of the available data will have to be carried out in order to ascertain whether this can be meaningfully split between different fisheries. The same applies to the use of labour. It may be necessary, therefore, to look at the effect of subsidies on investment and use of labour in the fishery as a whole.

(iii) Buy-backs and decommissioning grants

Some subsidies are explicitly intended to reduce overcapacity of fishing fleets and ultimately reduce the pressure on the fish resources. To what extent such subsidies accomplish this depends critically on how tightly the capacity of the fleet is controlled and to what extent the money is prevented from flowing back into the industry. A part of the Norwegian fisheries subsidies were of this kind, being used for buying redundant fishing boats and for grants for selling boats out of a particular fishery or out of the country. There are indications that these subsidies were successful for some fleet segments (the purse seine fishery), resulting in a reduction in fleet capacity in terms of volume and a structural adjustment towards larger and more profitable vessels.

A further study of these buy-back and decommissioning grants would be of interest in a broader framework in order to identify critical factors of success for such grants. How can buybacks and decommissioning grants be prevented from flowing back into the industry, neutralizing any effect they might initially have on fleet capacity or perhaps augmenting it? What are the adequate controls on capacity, or the system of incentives, which prevent this from happening? An empirically oriented research into these questions is timely because overcapacity of fishing fleets is apparently widespread and so are proposals to ameliorate this through buybacks and decommissioning grants.

4.2.4 Fisheries subsidies in Newfoundland, Canada

(i) Case study fishery

The situation in Newfoundland is different from that in Norway. As in Norway, there were a host of subsidy programs of all kinds for decades starting in the 1950s. At that time, the foundation of the Newfoundland fishery, as in Norway, was codfish. During that period, the range of species caught expanded, but continued to be dominated by cod and other groundfish. Then in the early 1990s the groundfishery collapsed. While groundfish are still caught, the quantities for most groundfish species are far lower than earlier. The fishery is now dominated by snow crab and northern shrimp, species which played only very minor roles in the Newfoundland fishery before the groundfish collapse. The only important subsidy remaining in the 2000s is unemployment insurance (known in Canada as “employment insurance”) which constitutes, on average, about 40% of a fisherman’s total earnings. The transformation of the Newfoundland fishery during the 1990s was so complete that it is best to view the Newfoundland situation as consisting of two totally separate fisheries, each to be modeled in isolation from the other. First, there is the current situation where the fishery’s important components are snow crab and northern shrimp and the only significant subsidy is unemployment insurance. Second, there is the pre-1990 fishery which was dominated by groundfish and was subject to a variety of subsidies.

In dollar terms, the most important fishery sectors today are the inshore snow crab fishery, with a landed value in 2002 of \$226M (Canadian), inshore northern shrimp at \$55M and offshore northern shrimp at \$94M. The inshore crab fishery consists of two types of vessels, truly inshore vessels of less than 35 feet in length, and “nearshore” vessels of 35-64 feet. For the shrimp

fishery, the “inshore” vessels are those of 35-64 feet and the offshore vessels are those greater than 100 feet in length. Each of these fleet segments must be treated separately.

Offshore and inshore groundfish had landed values of \$20M and \$42M, respectively, of which a little more than half was cod. Although of some importance, these groundfish catches are divided among a number of species and even more stocks, and their fisheries have been characterized by repeated openings and closures. The groundfishery at this time (2004) is too diverse and too erratic to be modeled. That leaves us with only three harvesting sectors: inshore crab and inshore and offshore shrimp.

The offshore vessels are owned by large processing companies subject to enterprise allocations. The inshore vessels are individually owned and each receives its own individual quota (IQ). The structure of the fleet (vessels by type and gear and crew size) are known. The catches and gross revenues are also known. Costs are more difficult but surveys can be run. Costs usually run between 25% and 40% of gross revenues. It may be adequate merely to select cost values in this range. The unemployment insurance regulations are also known.

(ii) Data and econometric modeling

For each class of vessel, the catch, gross revenues, costs and crew member and skipper shares are known or can be determined. Unemployment insurance benefit payments (subsidies) can be estimated on the basis of these data.

Individual fisherman’s incomes with and without the subsidy can be calculated. Were the subsidy to be withdrawn, estimates can be made of how the fishery would be restructured, since sufficient fishermen would leave the industry until those remaining earned a “reasonable” income.

The choice of what is a “reasonable” income will, of necessity, be rather arbitrary since it is impossible to know at what point individual fishermen will see their income as being so small that they must leave the industry.

The analysis would demonstrate how a commercially viable fishery would look: how many vessels of each type, quota per vessel, income per vessel, skipper and crew member. Thus the empirical effects of the subsidy can be estimated. To determine the potential pressure on the stocks, the hypothetical catch (and associated incomes) can be estimated assuming that the vessels caught their capacity and were not restricted by quotas. It should not be necessary to estimate the population dynamics equations for crab and shrimp. There does appear to be excess pressure on the crab stocks, so that reducing the number of fishermen and vessels in the fishery would probably serve both to help the fish stock and render the industry economically self-sufficient without the necessity of unemployment insurance. This analysis should not be too difficult to perform.

For the earlier period, when groundfish dominated the industry and the structure of the fishery and the variety of subsidies were much more diverse than now, an econometric simulation model already exists. A research group at Memorial University in Newfoundland in 1984 built a 1,000 equation model of the groundfishery, a model that incorporated details on 96 vessel-gear-species-stock combinations. Included were stock dynamics equations for nine separate groundfish stocks. The model has four modules: marketing, processing, relative productivity of harvesting

technologies, and harvesting production, costs and revenues. Only the last listed of the four modules would be required for the work suggested in this proposal.

The model has not been maintained for a number of years and computer technology has changed dramatically so the model would have to be reconstructed. However, the equations, parameters, and data are all known. In addition, the same research team published not only the model and model simulations, but studies showing government expenditures (including subsidies) existing at the time. Costs, revenues, and profits in the model can be modified to accommodate the role of subsidies and simulations can be run to determine the effects of the subsidies on the fishery (capacity, effort, and fish stocks).

4.2.5 Fisheries subsidies in New Zealand

(i) Case study fishery

The rock lobster fishery was New Zealand's most important domestic fishery from the 1950s through the late 1980s. In the mid-1970s full time rock lobster fishers accounted for about 50% of full time commercial fishers; rock lobster accounted for about 25% of total export earnings. In 1963, a restrictive licensing system was removed, resulting in an increase in vessel numbers by almost 50%; landings almost doubled over this period. Beginning in 1965, the government embarked on a program of industry assistance. Over the 1963-83 period, government provided assistance to the fishing industry in the form of loans and export incentives. Concern over the biological state of the rock lobster fishery and its commercial viability resulted in a moratorium on entry. The rock lobster fishery was brought into the quota management system (ITQs) in 1990.

(ii) Data

The following data are available now:

1. Dates of changes to fisheries management regulations and conditions of entry.
2. Independent estimates of the vulnerable biomass from 1945 through to 2001. Early estimates have a relatively high degree of uncertainty
3. Dates of government initiatives to provide assistance (loans and export incentives) to the fishing industry.
4. Landings, number of vessels, export value, from 1945.
5. Survey results of rock lobster industry for three years (1976-78). The survey provides gross revenue, fixed and variable costs, across vessel class size. Data on employment are also available.
6. Catch per unit effort (kg/pot-lift) from 1979.
7. Unit record data; for example, revenue, tonnes landed, employment, operating costs, and capital. The unit record data set covers the period 1992 through 2002.

(iii) Econometric modeling

The above data set provides an opportunity to study evolution of the rock lobster industry within the context of government policy regarding access and development incentives. The outcomes of policy can be quantified in terms of profitability and state of the biomass. If need be, we can also study the phase when rock lobster was brought into the quota management system. The period 1992-2002 for which the detailed firm-level data set exists is characterized by no subsidy and a regulated harvest limit.

Single equation model

The following simple single equation time series model is first estimated:

$$\pi_t = \alpha + \beta X_t + \gamma Z_t + \varepsilon_t \quad (1)$$

where

π_t = profit – revenue (where possible net of export incentives) less cost (where possible net of subsidies);

X_t = vector of regressors, including: number of vessels, labor, vulnerable biomass;

Z_t = vector of binary variables controlling for management;

ε_t = error term which we assume to be normally distributed.

Equation (1) will be estimated with and without lags. Standard tests – for example, causality and stationarity – will be applied. Thus we will examine the possibility of using auto distributed lag (ADL) models. As noted above we have landings, vessels, tonnes harvested per vessel, average export price, and vulnerable biomass, data for years 1945 through 1981; and, cost and revenue data for 1976-1978. In order to complete the data set we will have to extrapolate (based on vessel numbers and industry cost indices) the cost and revenue data from 1976-78 out to the other years. The above model has two or more endogenous variables and we will test for simultaneity; if present the least-squares estimators to be inconsistent.

Multiple equation model

The following equations proposed at an earlier meeting at FAO (Rome) provide the basis for simultaneous-equation modeling:

$$\begin{aligned} \pi_t &= \mathbf{p} \mathbf{a} e_t \mathbf{x}_t - \mathbf{c} e_t \\ \mathbf{x}_t &= \mathbf{f}(\mathbf{x}_{t-1}) \\ e_t &= e_{t-1} + \mathbf{b} \pi_{t-1} \end{aligned} \quad (2)$$

where;

π_t = profit, e_t = effort, \mathbf{x}_t = biomass, \mathbf{c} = cost, \mathbf{p} = price, \mathbf{a} = catchability coefficient, \mathbf{b} = coefficient attached to lagged profit.

Econometric specifications capturing the above system of equations (2) will be also estimated.

(iv) Outputs

The above econometric analysis should demonstrate the impact of subsidies – as defined by Shrank – on profit and the biomass. Thus we should be able to isolate the separate effects of

relatively open access to the fishery and the effect of subsidies (input and output), on the biomass and rent in the fishery.

(v) Further work

The unit record data set covering the period 1992-2002 provides a basis for further work. For example, we have an independent estimate of vulnerable biomass and income-expenditure data that will enable additional econometric work for a fishery managed under ITQs. While this may not be directly relevant to the study it should be possible to estimate productivity growth resulting from technological change and improvements in the biomass.

4.3 IMPLEMENTATION PROCEDURE

Once detailed work plans have been developed for the project components, their implementation will be carried out through consultant contracts.