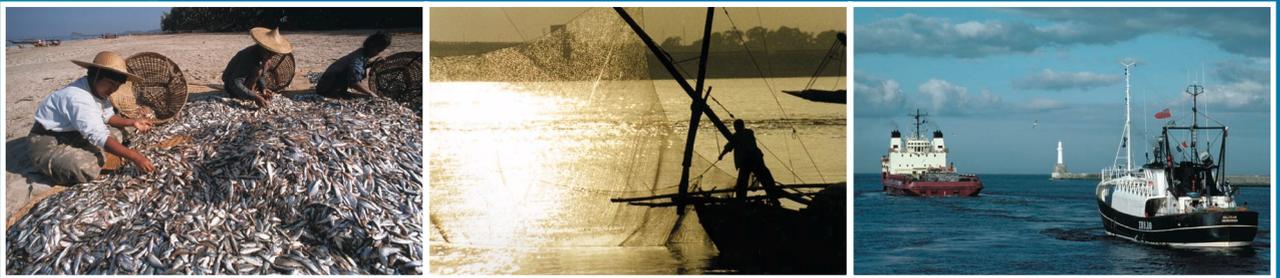




ANALYZING the RESOURCE IMPACT of FISHERIES SUBSIDIES: A Matrix Approach





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First edition 2004

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UNEP/ETB/2004/10

UNITED NATIONS PUBLICATION

ISBN: 92-807-2491-6

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Foreword



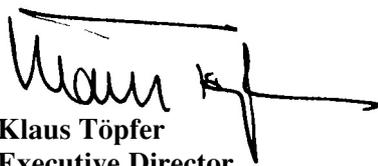
The majority of commercially valuable fish stocks is either overexploited or near its limits. This entails serious and sometimes irreparable damage to marine resources and threatens the livelihoods of many fishing communities. At the core of this crisis is a range of policies that have increased production and trade in fish, including direct and indirect subsidies to the fishery sector. Fisheries subsidies can potentially be harmful to fish stocks by contributing to increased fleet capacity and overfishing, particularly in the absence of effective management. However, fishing subsidies can also contribute to the achievement of sustainable fisheries if properly designed and effective safeguards are put in place.

The need to reform fisheries subsidies was one of the pressing issues highlighted at the World Summit on Sustainable Development, held in Johannesburg in September 2002. UNEP has been addressing fisheries subsidies since 1997 to actively promote integrated and well-informed responses to the need for fishing subsidies reform. UNEP currently attaches high priority to the work on fisheries subsidies, as it also feeds into the on-going WTO negotiations on potential new disciplines for fisheries subsidies.

Through a series of workshops, analytic papers, and country case studies, UNEP seeks to improve the understanding of the implications of fisheries subsidies, and to act as a forum for interaction among policymakers and stakeholders from a variety of institutional bases and perspectives to discuss fishery policies, the effects of fisheries subsidies, and innovative approaches to policy reform.

As a contribution to this process, UNEP commissioned a study to analyse the impacts of different types of fishery subsidies under various regulatory and environmental conditions. This study provides a classification of fisheries subsidies and offers a systematic assessment of impacts of the eight categories of subsidy types taking into account specific characteristics of a fishery's level of exploitation and its management regime. The study shows that most subsidies have the potential to be harmful to fish stocks under the conditions found in the vast majority of fisheries today.

I trust that this document will be successful in raising awareness of the actual and potential impacts of fisheries subsidies and that it will contribute to subsidies reforms at the national, regional and international level. I also hope that the analysis will be helpful for the design of new and improved WTO disciplines on fisheries subsidies that will halt the over-exploitation of the world's fishery resources.

A handwritten signature in black ink, appearing to read 'Klaus Töpfer', with a long horizontal line extending to the right.

Klaus Töpfer
Executive Director
United Nations Environment Programme

Acknowledgements

This project was initiated and managed by the Economics and Trade Branch (ETB), Division of Trade, Industry and Economics (DTIE) of the United Nations Environment Programme (UNEP). UNEP would like to thank Gareth Porter, the lead author, for his thorough research and analysis.

The study has benefited from comments and suggestions received through a number of review rounds.

Special thanks go to David Schorr, Sabrina Shaw, Ron Steenblik (OECD) and Markus Lehmann (CBD Secretariat) for their incisive input throughout the project. Other members of the group of experts that informally met in Geneva on 16 July 2003 and contributed greatly to the completion of the study included Hugo Cameron (ICTSD), Clare Coffey (IEEP), Anthony Cox (OECD), Karim Dahou (ENDA, Dipol), Ralf Döring (University of Greifswald), Maria Onestini (CEDEA, Argentina), Claudia Saladin (WWF), Christina Schroder (WTO) and Lena Westlund (FAO consultant).

After consideration and integration of the comments that were received at the expert meeting, the draft study was sent out for government review in December 2003. Comments were incorporated and the revision distributed to the UNEP Workshop on Fisheries Subsidies and Sustainable Fisheries Management held in Geneva on 26-27 April 2004. This workshop was attended by more than 100 participants from 37 governments (including officials from environment, trade and fisheries agencies), a broad range of intergovernmental and non-governmental organizations, academic institutions and regional fisheries management organizations. UNEP would like to express its gratitude to all participants for the comments and the lively discussion of this study at the workshop.

UNEP would also like to thank the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety for their financial support that made the realization of this project possible. Special thanks go to Cornelia Quennet-Thielen, Ulf Jaeckel and Volker Fuerst.

Anja von Moltke, Economics Affairs Officer at UNEP, was responsible for managing the project, coordinating the expert review, organizing the international workshop and editing the report. She was supported by Minna Epps. Administrative assistance was provided by Désirée Leon.

United Nations Environment Programme

The United Nations Environment Programme (UNEP) is the overall coordinating environmental organization of the United Nations system. Its mission is to provide leadership and encourage partnerships in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations. In accordance with its mandate, UNEP works to observe, monitor and assess the state of the global environment, improve the scientific understanding of how environmental change occurs, and in turn, how such change can be managed by action-oriented national policies and international agreements. UNEP's capacity building work thus centers on helping countries strengthen environmental management in diverse areas that include freshwater and land resource management, the conservation and sustainable use of biodiversity, marine and coastal ecosystem management, and cleaner industrial production and eco-efficiency, among many others.

UNEP, which is headquartered in Nairobi, Kenya, marked its first 30 years of service in 2002. During this time, in partnership with a global array of collaborating organizations, UNEP has achieved major advances in the development of international environmental policy and law, environmental monitoring and assessment, and the understanding of the science of global change. This work also supports the successful development and implementation of the world's major environmental conventions. In parallel, UNEP administers several multilateral environmental agreements (MEAs) including the Vienna Convention's Montreal Protocol on Substances that Deplete the Ozone Layer, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (SBC), the Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention, PIC) and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity as well as the Stockholm Convention on Persistent Organic Pollutants (POPs).

Division of Technology, Industry and Economics

The mission of the Division of Technology, Industry and Economics (DTIE) is to encourage decision makers in government, local authorities and industry to develop and adopt policies, strategies and practices that are cleaner and safer, make efficient use of natural resources, ensure environmentally sound management of chemicals, and reduce pollution and risks for humans and the environment. In addition, it seeks to enable implementation of conventions and international agreements and encourage the internalisation of environmental costs. UNEP DTIE's strategy in carrying out these objectives is to influence decision-making through partnerships with other international organizations, governmental authorities, business and industry, and non-governmental organizations; facilitate knowledge management through networks; support implementation of conventions; and work closely with UNEP regional offices. The Division, with its Director and Division Office in Paris, consists of one centre and five branches located in Paris, Geneva and Osaka.

Economics and Trade Branch

The Economics and Trade Branch (ETB) is one of the five branches of DTIE. Its mission is to enhance the capacities of countries, especially of developing countries and countries with economies in transition, to integrate environmental considerations into development planning and macroeconomic policies, including trade policies. ETB helps countries to develop and use integrated assessment and incentive tools for sustainable development and poverty reduction. The Branch further works to improve the understanding of environmental, social and economic impacts of trade liberalisation and the trade impacts of environmental policies, and to strengthen coherence between Multilateral Environmental Agreements and the World Trade Organization. Through its finance initiative, ETB helps enhance the role of the financial sector in moving towards sustainability.

In the field of environmental economics, ETB aims to promote the internalisation of environmental costs and enhance the use of economic instruments to contribute to sustainable development and poverty reduction, including in the specific context of Multilateral Environmental Agreements. The UNEP Working Group on Economic Instruments serves as an advisory body to UNEP-ETB's work programme on economics and has been instrumental in the preparation of UNEP publications on economic instruments.

For more information regarding UNEP's work on fisheries subsidies, please contact Anja von Moltke, Economic Affairs Officer, Economics and Trade Branch (ETB) at tel : 41-22-917 81 37 or email anja.moltke@unep.ch

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Executive Summary

Overfishing is widely recognized as a major threat to the world's fishery resources. This troubling state of affairs has serious environmental, social, and economic implications. Recently, a consensus has emerged that improperly designed government subsidies to the fisheries sector are among the direct causes of fisheries over-exploitation, in particular in the absence of effective management regimes. The widespread need to reform fisheries subsidies has been a matter of concern over the past years and has now been taken up as a high priority in such international fora as the FAO, WTO, OECD and UNEP.

The WTO Ministerial Declaration agreed at Doha in 2001 commits WTO members to negotiations to clarify and improve WTO disciplines on fisheries subsidies. Heads of state at the Johannesburg World Summit on Sustainable Development in 2002 subsequently reiterated a call for the elimination of harmful fisheries subsidies, and specifically noted the importance of completing the WTO negotiations towards that end.

Subsidies to fishing industries have both trade and environmental consequences. Reducing the costs of fishing or enhancing its profitability by increasing revenues will allow a subsidized producer to reduce prices, which may gain market share at the expense of unsubsidized competitors. Particularly likely to be trade-distorting are those that are contingent on increases in fishing capacity or effort such as subsidies to capital costs and price support. Less likely to distort production are those that involve lump-sum transfers unrelated to production, prices or input use. Whether and to what extent a particular category of subsidies is associated with certain impacts on fish resources depends on the circumstances in the fishery and the mechanism by which subsidies are provided. In each case, impacts will reflect both the different incentive effects of various subsidies and the different circumstances surrounding the fisheries affected by the subsidies.

In recent years, a great deal of effort in various fora has been put into defining subsidies and developing frameworks for categorizing subsidies, resulting in a wide variety of definitions and classification frameworks. In the present study, a pragmatic approach is taken to the definition and classification of subsidies. This paper does not attempt to propose either a new definition of fisheries subsidies or a classification system that should be used in international legal or negotiating processes. Rather, the focus of this study is on analyzing the effects of different types of subsidies, irrespective of how they might be viewed in the international legal context.

The fact that fisheries subsidies may increase fishing effort and thus have negative impacts on the level of fish stocks has been universally accepted in the fisheries subsidies literature. Simple economic models showing how a subsidy affects profits and therefore provides an incentive for increased fishing effort have accompanied a number of overviews of fisheries subsidies published by leading intergovernmental and research institutions. A number of case studies have also illustrated that fleet capacity has been the critical link between subsidies and that some categories of subsidies are more distorting than others.

Past analyses have suggested that the environmental and economic consequences of a fisheries subsidy will depend on the specific type of subsidy in question, as well as on the regulatory, biological and commercial context in which it is applied. However, the existing literature lacks a comprehensive analysis of the impacts of various fisheries subsidies types under the different circumstances in which they may be provided. Building on UNEP's earlier work, this paper seeks to fill that gap by presenting a matrix approach that ensures systematic

coverage of the relevant combinations of subsidy types and fisheries characteristics. It is designed to serve as an analytical basis for designing new or improved disciplines on fisheries subsidies with the goal of increasing the health and productivity of fishery resources.¹

Specifically, this paper analyzes fisheries subsidies of eight basic kinds:

- subsidies to fishing infrastructure (*e.g.*, construction of port facilities);
- management services (*e.g.*, monitoring and surveillance, management-related research);
- subsidies to securing fishing access (*e.g.*, government-to-government payments that cover significant portions of the cost of access to foreign fishing grounds);
- subsidies to decommissioning of vessels (*e.g.*, vessel or license retirement);
- subsidies to capital costs (*e.g.*, grants, loan guarantees, or tax incentives encouraging fleet renewal or modernization);
- subsidies to variable costs (*e.g.*, subsidies on fuel, bait, insurance, or other operating costs);
- income supports (*e.g.*, special unemployment insurance or “lay up” payments); and
- price supports (*e.g.*, government market interventions to guarantee a minimum price on fish products).

Each of these subsidy types is investigated within a matrix that reflects two major variables: level of fleet capacity (expressed as “overcapacity”, “full capacity”, or “less than full capacity”) and type of management regime (categorized broadly as “open access”, “catch control” and “effective management” regimes). For purposes of analysis, the management regime categories are necessarily presented as stylized ideal types. “Open access” regimes are defined as lacking any legal or regulatory framework - a condition that has been considered a root-cause of fisheries over-exploitation. “Catch control” regimes are those that use a variety of controls over catch levels, fishing effort and input, such as “total allowable catch” quotas, catch limits per day or trip, area and seasonal closures, restrictions on certain vessel types or fishing gear, and limitations on fishing licenses. Finally, “effective management” regimes are considered those that combine scientifically-based catch and effort controls, adequate monitoring and surveillance measures and effective socio-economic incentives for sustainable fishing, such as property rights. This combination is very rare in the real world.

The analysis in this paper also relies heavily on existing case studies of specific subsidy programmes. Some of these studies examine the effects of fishing subsidies on investment or other behaviours of vessel owners, rather than directly examining impacts on fish stocks. Accordingly, this paper has adopted certain simplified assumptions about the relationship between changes in the level of fishing effort or capacity and changes in the condition of fish stocks. For example, it is assumed that in a fishery already suffering from overcapacity, any increase in fishing effort induced by a subsidy will have some negative impact on fish stocks - an assumption widely confirmed by real-world experiences.

Based on the analytic approach described above, this paper draws the following conclusions about the likely fisheries resource impacts of the major categories of fishing subsidies, which are summarized in Table 11 (page 48):

¹ Note that the focus of this paper is on commercial fish stocks. Other impacts of fisheries subsidies - including broader ecological impacts and non-resource impacts of fisheries subsidies, such as effects on trade or on social welfare - are not investigated in this analysis.

- **Subsidies for fisheries infrastructure** are expected to be harmful to fisheries resources except where incentives ending the race for fish are provided by an effective management system or where the fishery is clearly less than fully exploited. While subsidies to infrastructure might not cause actual increases in fishing effort within “catch control” regimes, they would provide disincentives to reduce capacity, even in an overexploited fishery. As in the case of all fisheries subsidies other than management services, subsidies to infrastructure will always be harmful in an open access regime that is fully exploited, over-exploited, or capitalized to or beyond full capacity.
- **Subsidies to management services and research** have not proved harmful to fishery resources. Subsidies to research that clearly benefits only the fishing industry and is not in the general public interest are an exception, although these are likely to be marginal in their impact.
- **Subsidies for access to foreign countries’ waters** could theoretically be beneficial in the presence of effective management. However, such subsidies are expected to be harmful to fisheries resources, unless the fisheries covered by the agreement are clearly undercapitalized. Unfortunately, bilateral access agreements in the real world have almost universally involved host country fisheries in which capacity or exploitation levels are already high, and/or in which management controls are absent or weak.
- **Subsidies to decommissioning of vessels and license retirement** are provided only in fisheries that are already overcapitalized and usually are also overexploited. In the presence of effective management controls, including property rights, a vessel decommissioning or license withdrawal programme can often be successful in substantially reducing capacity and effort in the fishery. However, effective property rights regimes should be able to reduce or prevent overcapacity without resort to decommissioning subsidies. Historically, in fisheries with systems of catch control but no property rights or community management, catch quotas and enforcement systems have not prevented stocks from being overfished. In some such cases, decommissioning subsidies have increased rather than reduced capacity. In an open access fishery, the likelihood of actually reducing either capacity or effort through a decommissioning scheme is low, and the danger of worsening the state of the stock is significantly greater.
- **Subsidies to capital costs** are expected to be harmful in all circumstances unless the fisheries management system provides for property rights, community-based management, or other means for eliminating economic incentives to overfish. They can be harmful even in fisheries that are less than fully exploited, where subsidies to capital costs encourage the adoption of much more powerful fishing technologies, potentially causing an overshoot in fleet capacity well beyond a biologically sustainable level. Only under the extremely rare ideal circumstances of an effective management regime, could such subsidies be benign.
- **Subsidies to variable costs** provide an incentive for vessel owners to use more powerful and fuel-consuming engines and are expected to be harmful unless “effective management” exists or the fishery is less than fully exploited. These subsidies are similar to subsidies to capital in their potential for harm, although in “catch control” fisheries that do not suffer from overcapacity or overexploitation, the likelihood of harm is considered “probable”.

- **Subsidies to income**, particularly for vessel owners, could be harmful if the fishery is fully or overexploited and lacks economic incentives to eliminate the “race for fish”, or when open access prevails. Income subsidies in the form of “laying up” subsidies are likely to have the effect of discouraging reductions in capacity that would otherwise be financially more attractive. Where catch control fisheries are at or beyond full capacity, the impacts of unemployment insurance schemes are likely to be less harmful than “laying up” subsidies.
- **Price support subsidies** are expected to be harmful in all circumstances unless the fishery has appropriate economic incentives to eliminate incentives for overfishing, such as property rights or community-based management. Price supports have had a clear impact on levels of fishing effort, and can speed up the transition from a condition of less than full exploitation to overexploitation.

Viewed synoptically, the analysis shows that most subsidies have the potential to be harmful to fish stocks under the management and bio-economic conditions found in the vast majority of fisheries today. While all fisheries subsidies would theoretically be “not harmful” in the presence of truly effective management, very few if any fisheries today are subject to management systems that are sufficiently “effective” to ensure that fisheries subsidies will not harm fisheries resources.

More specifically, five categories of fisheries subsidies (subsidies to fisheries infrastructure, subsidies for access to foreign waters, subsidies to capital costs, subsidies to variable costs, and price support subsidies) can generally be considered harmful to fisheries resources under most real-world conditions. Subsidies that contribute directly to increased fishing capacity or effort, such as subsidies to capital or operating costs are among the most harmful. Of the remaining three categories, two (decommissioning and income supports) are considered “possibly or probably” harmful. Only management services can generally be considered “not harmful”.

Subsidies for decommissioning deserve particular attention. They are likely to be harmful to fisheries resources under the conditions found in the fisheries where they have been and are most likely to be used. Stringent policy conditions are necessary to accompany such a subsidy programme in order to avoid altered incentives to enter or exit the industry or to invest in modernization or purchase of new vessels. These safeguards could include mandatory physical scrapping of vessels, prohibition of introducing new vessels, and commitment to time limits of decommissioning programmes.

Properly designed fisheries subsidies, including government programmes for the reduction of fishing capacity and the improvement of fishing techniques, can contribute to the achievement of sustainable fisheries, provided that effective safeguards are put in place. It is also generally acknowledged that access agreements have the potential to provide benefits. Inappropriately designed agreements, however, can contribute to overexploitation and to inequities in the distribution of rents from fisheries resources. To date, access agreements have not returned the benefits hoped for in many developing countries, and have often been associated with stock depletion and with negative developmental results.

The impacts of subsidies in small-scale, and particularly artisanal fisheries, deserves more detailed analysis as a contribution to the international discussions and negotiations on fisheries subsidies in a variety of fora, including the WTO. In addition, analysis of other ecological, social and economic impacts of fisheries subsidies, as well as subsidies to the aquaculture and the fish processing sectors, is desirable.

1. Introduction

The issue of subsidies to the fisheries sector has been the subject of national and international debate for some years now. However, a number of recent events have propelled it to the forefront of the international agenda. At the World Trade Organization's (WTO) Fourth Ministerial Conference in Doha, Qatar, in November 2001, Ministers committed in paragraph 28 of the Declaration to "clarify and improve WTO disciplines on fisheries subsidies, taking into account the importance of this sector to developing countries" (WTO, 2001). This was followed at the World Summit on Sustainable Development in Johannesburg by a call, in paragraph 30(f) of the *Plan of Implementation* to "eliminate subsidies that contribute to illegal, unreported and unregulated fishing and to over-capacity, while completing the efforts undertaken at the WTO to clarify and improve its disciplines on fisheries subsidies..." (United Nations, 2002).

Subsidies to fishing industries have both trade and environmental consequences. Reducing the costs of fishing or enhancing its profitability by increasing revenues will allow a subsidized producer to reduce prices, which may gain market share at the expense of unsubsidized competitors. Particularly likely to be trade-distorting are subsidies to capital costs and price supports, which can have major impacts on the relative prices in international trade. Subsidies to variable costs and access to foreign fishing waters are also likely to distort trade. Nevertheless, it has proven extremely difficult to document the trade effects of fisheries subsidies because of the heterogeneous nature of fisheries products and the consequent absence of unsubsidised reference prices (WTO, 2002b). Beyond the normal distortion of competitive relationships in the international market for fish products, moreover, subsidies also distort access to shared fish stocks and contribute to the depletion of the stocks.

The difficulty of using the existing WTO Subsidies and Countervailing Measures (SCM) Agreement to discipline subsidies to the fisheries sector, as well as growing awareness of the issue of impacts of such subsidies on fish stocks, has increased the interest of a number of countries in developing new disciplines on such subsidies. The purpose of this report is to analyse more systematically than has been done heretofore the impacts of the major categories of fisheries subsidies on fisheries resources in order to help inform the debate surrounding the disciplining of fisheries subsidies.

Given the range of interests at stake in the international dialogue over fishing subsidies, the limited scope of this study should be clearly understood. Although the focus of this report is on the impacts of subsidies on commercial stocks targeted in a given fishery, it should be borne in mind that other environmental impacts of fisheries subsidies – increased by-catch, marine pollution, and damage to habitats from certain fishing gear – also occur as a result of increased fishing effort.

This paper also does not investigate other non-resource effects of fishing subsidies, such as impacts on trade or on social welfare. Note, however, that impacts of these various kinds are very often interdependent, and the analysis of this paper can thus be considered relevant to the broader discussions. Moreover, the approach adopted here might be usefully applied to analyses focused specifically on these other impacts. It is worth noting, for instance, that the overexploitation of resources encouraged by some fisheries subsidies is relevant to the analysis of those same subsidies on social equity and poverty. The assumption often voiced

in international discussions of fisheries subsidies that fisheries subsidies may be used for poverty reduction, even if they have environmental impacts, must therefore be carefully analysed in terms of the specific subsidy in question.

UNEP's work on fisheries subsidies is based on a UNEP Governing Council mandate to enhance capacities of countries, especially developing countries and countries with economies in transition, to integrate environmental considerations into development planning and macroeconomic policies, including trade policies. UNEP's Economics and Trade Branch (ETB) has also been requested by the Governing Council to promote the internalization of environmental costs and to enhance the use of economic instruments for environmental policy. ETB's work programme includes the provision of technical assistance to governments in the development of policy reform packages and measures for sustainable fisheries management, including by addressing subsidies that contribute to overcapacity and overfishing.

UNEP has carried out numerous country studies to assess the impacts of fisheries subsidies, which have highlighted the high risk of resource depletion from subsidies to the fishing sector. It has also addressed the impacts of fisheries subsidies on overfishing through several international workshops. UNEP published an analysis of the linkages between fisheries subsidies, overfishing and trade for a workshop in 1997 on "The Role of Trade Policies in the Fishing Sector" as part of its Trade and Environment Series in 1998 (Porter, 1998a). In 2001 and 2002, UNEP sponsored conferences in which it sought to enhance international dialogue on international policy regarding fisheries subsidies and fisheries management. Background papers commissioned by UNEP for these conferences proposed an approach aimed at moving the international discussion to a new level of concreteness (Porter, 2002).

The fact that fisheries subsidies can have the effect of increasing fishing effort and thus have negative impacts on the level of fish stocks has been universally accepted in the fisheries subsidies literature. Simple economic models showing how a subsidy affects profits and therefore provides an incentive for increased fishing effort have accompanied a number of overviews of fisheries subsidies published by leading intergovernmental and research institutions (Stone, 1997; OCED, 2000; FAO, 2000; Arnason, 1998; Munro, 1999; Munro and Sumaila, 1999; Nordstrom and Vaughan, 1999; WTO CTE, 2000; OECD, 2003). Apart from this insight from economic theory, a number of case studies on Canada's Northwest Atlantic offshore fleet, the U.S. Alaska Pollock fishery, the EU's fleet modernization programme, and studies in Spain, Norway, and Chinese Taipei have illustrated the general analytical point that fishing fleet capacity has been a critical link between subsidies and overfishing (Porter, 1998a; Holden, 1994; Chuang and Zhang, 1999; Milazzo, 1998; OECD, 2000a).

Some of the country position papers on fisheries subsidies that have been tabled in the Negotiating Group on Rules in the WTO over the last couple of years have made the point that the environmental effects of subsidies depend on the management regimes in the fisheries in question (WTO, 2000; WTO, 2002a; WTO, 2003a; WTO, 2003b; WTO, 2003c). Different categories of subsidies, moreover, have different implications for fishing effort. The existing fisheries subsidies literature points to the need for a systematic, case-by-case analysis of the impacts of fisheries subsidies on fishery resources, which will reflect both the different incentive effects of various subsidies and the different circumstances in which subsidies may be provided.

This analysis takes an approach that ensures systematic coverage of the relevant combinations of subsidy types and relevant characteristics of the fishery and its management regime. It is designed to serve as an analytical basis for designing new or improved disciplines on fisheries subsidies that will help protect fishery resources.

2. Categories of Fisheries Subsidies

In recent years, a great deal of effort in various forums has been put into defining subsidies and developing frameworks for categorizing subsidies, resulting in a wide variety of definitions and classification frameworks. This variety is primarily a response to the various objectives pursued in the studies as well as the different perspectives taken by the studies' authors. In the present study, a pragmatic approach is taken to the definition and classification of subsidies. This paper does not attempt to propose either a new definition of fisheries subsidies or a classification system that should be used in international legal or negotiating processes. Rather, the focus in this study is on analysing the effects of different types of subsidies, irrespective of how they might be viewed in the international legal context.

The definition of a "subsidy" can be the subject of extensive technical and political debate. From an economist's perspective, a subsidy may be any net economic benefit given by a government to a private enterprise. Not all government interventions that provide such a benefit are clearly covered in the WTO Subsidies and Countervailing Measures (SCM) Agreement, however. This study does not limit the analysis to those subsidies that would clearly qualify under the SCM. It analyzes the forms of government support that have been most widely used and which have been most prominently discussed in the discourse on reforming fisheries subsidies.

The study does not, therefore, analyze the full range of "implicit" subsidies that occur as a result of government inaction (such as non-collection of resource rents). While it may be argued that these are indeed subsidies, most of them are peripheral to the main focus of policy discussion at this stage. Moreover, they are perhaps better examined in the context of the overall management of fisheries rather than under the more specific topic of fisheries subsidies.

A study commissioned by UNEP (Porter, 2002), provides a review of the various classification schemes that have been employed by the Organization for Economic Cooperation and Development (OECD), the Asia Pacific Economic Cooperation (APEC), and the United States. The Food and Agriculture Organization of the United Nations (FAO, 2000) provides a less detailed scheme that employs broader categories. Categories of subsidies in one categorization scheme often overlap with those used in other schemes. Overlaps occur because some categories are defined by the intended effect of the subsidy, whereas others are based on the form of the subsidy.

This study employs a composite list of subsidy categories that encompasses the categories used in previous schemes. It groups subsidies by their objective, rather than by the form of the subsidy. Thus all subsidies that have the same economic effect (i.e., direct funds towards the same objective) are grouped together under one heading, regardless of the form of the subsidy. For example, soft loans, tax preferences, insurance and other risk-reducing programmes, as well as grants for vessel modernization or new vessels, are grouped together as subsidies that channel resources into capital investment in the fishing industry. Price supports and other programmes that contribute to the income of both vessel owners and fishermen, but do not channel the money into any particular kind of investment, are also grouped together, as well as all social or income assistance to fishermen.

The subsidy categories employed in this analysis are:

- Fisheries infrastructure;
- Management services and research;
- Subsidies for access to foreign countries' waters;
- Decommissioning of vessels and license retirement;
- Subsidies to capital costs;
- Subsidies to variable costs;
- Income support and unemployment insurance; and
- Price support subsidies.

Some governments and non-governmental actors consider that properly designed subsidies can in some cases have positive impacts on the conservation of fish stocks or other aspects of marine ecosystems. Two of the foregoing categories—"management services" and "decommissioning of vessels and license retirement"—are often justified in these terms. In addition, similar claims are made about some subsidies to capital costs, such as for the acquisition of selective fishing gear. Significant debate surrounds the question whether, or under what circumstances, subsidies of these kinds can have positive impacts on fisheries resources. With the exception of a detailed discussion of the effectiveness of decommissioning and license retirement subsidies, this study does not go deeply into this debate.

Furthermore, as international discussion of fishing subsidies has matured, attention has been increasingly drawn to the differences between large-scale industrialized fisheries and small-scale or artisanal fisheries. This study does not address scale or technological level as significant variables. More empirical work to illuminate the issues surrounding subsidies to small scale or artisanal fisheries is clearly warranted.

2.1 Subsidies to fisheries infrastructure

General infrastructure programmes, such as highways and ports, which benefit the general public as well as all industries involved in trade, are excluded from the definition of subsidy under the SCM Agreement. But a fishing port, which provides benefits to the general public, benefits the fishing industry even more. WTO dispute settlement panels have not yet clarified precisely what standard is to be used to determine whether assistance in building fishing ports is a subsidy (Milazzo, 1998).

Some trade lawyers have suggested that the criterion for identifying infrastructure subsidies to the fishing industry should be whether the industry pays for fishing infrastructure projects in most countries. By this criterion, fishing port construction would not be considered a subsidy, since financing the construction or modernization of fishing ports have been treated by national and local governments as well as bilateral and multilateral funding agencies as general development projects rather than as a subsidy to the fishing industry. In practice,

fishing ports are almost always paid for by the state or by external financing institutions (Milazzo, 1998). Applying this criterion would therefore simply legitimize the status quo that results in general subsidization of fishing industries.

A more rigorous set of criteria, in line with the economic definition of infrastructure subsidy, would be whether the fishing industry is clearly the primary beneficiary of the project and whether it pays a reasonable user fee for the services provided by the infrastructure. By this measure, government provision of fishing ports for its fishing industry is always a subsidy, unless the users do in fact pay user fees, because the intention is in every case to benefit local or regional fishing fleets.

Included under this classification are payments for the provision of land-based resources encouraged by government budgetary transfers. Expenditures on fisheries infrastructure include the construction of harbours, the dredging of ports and the improvement of landing installations and equipment. In this classification, financial assistance to institutional infrastructure for fisheries is also included (i.e. government transfers to support the activities of producer organizations).

Under this classification the entire amount of payments to infrastructure for a specific fishery that is not offset by user fees may be considered as the subsidy rather than an estimate of the “economic benefit” to fishers of total infrastructure spending.

Programmes included in fisheries infrastructure are:

- Harbour facilities and moorage – provided free or at low rates of moorage for fishing fleets
- Fishing port infrastructure enhancement, such as dredging
- Support to producer organizations – institution infrastructure (except where in the details of the policy the payments are for price support).

2.2 Management services and research

Management services usually comprise three functions: administering the existing management system, adjusting management settings within an existing management system and recommending amendments or additions to the existing system. Research is often used as the basis for management decisions and the creation of new management systems. Common examples of research activities include data collection, survey data analysis, stock assessment and risk assessment. Enforcement services typically involve surveillance of compliance with fisheries laws and a role in the prosecution of fishers who do not comply with those laws. Also included in this category is research to develop the fisheries industry and programmes encouraging fish re-stocking and protection of marine areas.

Although management services, including monitoring and surveillance, stock assessments, and research on sustainable fishing gear generally benefit both the industry and the general public, they can be considered a subsidy in economic terms to the extent that a reasonable proportion of the costs of those services are not recovered from industry. A number of countries, including New Zealand, Iceland and Australia, have adopted programmes of cost recovery for fisheries management services.

Programmes included in management services and research are:

- Stock enhancement programmes, including fish habitat improvements, release of juveniles
- Fisheries Management Programmes, including monitoring and surveillance
- Fisheries Enforcement Programmes, including prosecuting of offences
- Programmes to assess fish stocks
- Programmes to identify and develop new fisheries
- R&D to develop new fisheries technologies
- Protection of Marine areas
- Aid for fish re-stocking
- Artificial reefs.

2.3 Payments for access to other countries' waters

Some distant water fishing states negotiate fisheries agreements with coastal states that involve the granting of fishing rights conditional on financial payments. Such payments to foreign countries, which may cover a significant part of the effective costs of a distant water fleet's access to a foreign fishery, have the effect of subsidising the foreign fleet in question.

One mechanism by which the distant water fishing fleet is subsidized is a provision that guarantees access to the fleet up to a given level of catch or for an unlimited level of catch, in return for a specified payment of part or all of the fleet's cost of access and further compensation. In cases where such provisions are included in the access agreement, the proportion of access costs subsidized through such agreements can be calculated by comparing actual payments by the subsidized distant water fleet per vessel with the payments made by unsubsidized fleets for access to the same waters. In the case of European bilateral agreements with West African coastal states, the EU used official compensation under bilateral fishing agreements to pay for roughly 85 to 90 per cent of the normal cost of access of the EU tuna seiner fleet operating in African waters in the 1994 - 1996 period. Official compensation also paid for 68 to 75 per cent of the costs of access of the EU shrimp trawl fleet in African waters during the same period (Porter, 1997).

However, distant water fishing states may subsidize the costs of fishing access even without such an explicit provision in the access agreement. During the early 1990s, the U.S. tuna seiner fleet was paying on average only about US\$ 72,000 per vessel for access to the tuna fisheries of the Pacific Island states – a little more than one-fourth of the US\$ 250,000 average access fee per vessel being paid by other distant water fishing fleets operating in those waters (Gillett *et al.*, 2002; Herrick *et al.*, 1997). The rest of the cost of access to the tuna was being paid for by the U.S. Government through a US\$ 15 million grant to the Pacific Island countries.

Programmes included in access to other countries' waters are:

- Payments of part of the costs of access to foreign fishing waters in conjunction with international fishing access agreements.

2.4 Subsidies for decommissioning of vessels and licence retirement

Because of massive overcapitalization of fishing fleets, states have used the provision of grants for decommissioning of fishing vessels or license retirement as a means of reducing the level of fishing capacity in their fisheries. These schemes involve payments for the *permanent* removal of fishing vessels or fishing licenses from the fishery or fisheries involved.

Some states have insisted that decommissioning subsidies should be considered as “good subsidies”, because of their objective of reducing fishing capacity. Although this categorization scheme uses the explicit objective of decommissioning in defining this category, it is, however, not meant to imply that its actual *effect* is necessarily to reduce capacity in the fishery. As discussed in the following section, whether a subsidy in this category has a positive or negative impact on fisheries resources depends on the circumstances in which it is provided and the policy conditions attached to it.

It should be noted that, in this classification scheme, this category does not include payments for *temporary* cessations of fishing. Such payments are included under subsidies to income.

Programmes included under decommissioning of vessels and license retirement are:

- Payments for the permanent withdrawal of fishing vessels
- Payments for the permanent withdrawal of fishing permits or licenses.

2.5 Subsidies to capital costs

Grants or below-market loans to purchase new fishing vessels or to modernize existing vessels reduces a major capital cost. In some countries and at certain times, subsidies to capital costs have represented a large proportion of total new capital investment in the industry, magnifying the impact of such subsidies on both capacity and ultimately fishing effort.

This category includes all government-funded grants for fleet renewal and modernization, loans, loan guarantees, and loan restructuring at below commercial lending rates to the fisheries sector. Also included are tax preferences, which reduce the costs of the purchase of capital goods, and risk reduction mechanisms such as loan guarantees. Loan guarantees do not necessarily cost the government anything, and the loans might be made at conventional interest rates, but they still affect investment decisions by reducing the risk of investment.

Programmes included in subsidies to capital costs are:

- Grants and below-market loans for fleet renewal and modernization
- Accelerated depreciation that reduces taxation of vessels and fishing gear
- Development grants for fisheries enterprises
- Aid to shipyards which supports fishing boat construction
- Reduction of the financial burden of equipment needed for deep-sea fishing
- Loan guarantees
- Loan restructuring.

2.6 Subsidies to variable costs

This category includes policies which reduce fisheries operating costs, including tax concessions – e.g. tax rebates on purchases of fuel, vessel insurance programs provided by government, payment for damages, bait services, extension services, training and transport subsidies.

Government provision of insurance programmes reduces the rates of insurance paid by the fishing industry thus increasing the numbers involved in the fishery. In such a case, the government, which has a broader ability to bear risk to do so, will provide insurance where private insurers refused to operate because of the high costs of doing business (Schrank, 1998).

Programmes included under subsidies to variable costs are:

- Fuel tax exemption or rebates for vessels
- Income tax deferral for fishers
- Vessel insurance and reinsurance programmes
- Subsidies to reduce bait prices
- Support of baiting stations
- Extension services consultant advice for fishers
- Compensation for damaged gear
- Transport subsidies
- Interest deduction for liquidity loans
- Support to energy saving devices onboard fishing vessels.

2.7 Subsidies to income

Subsidies included in this classification are income support and unemployment insurance (although, as noted above, some analysts may consider such supports subsidies only if they go beyond the normal unemployment insurance for other economic sectors). Also included are payments to vessel owners for temporary stoppages of fishing, or “laying up” of vessels.

Programmes included in subsidies to income are:

- Payments beyond the norm for other sectors to supplement the incomes of fishers and fisheries workers
- Payments targeted specifically for unemployed fisheries workers and going beyond social insurance in other sectors
- Payments for independent fishermen who are idled by restrictions on fishing
- Payments to vessel owners for temporary cessation of fishing.

2.8 Price support subsidies

Price support provided to the fisheries sector is to ensure a minimum price level. Within this category are the budgetary transfers used for maintaining the price for fish products including export subsidies and market intervention programmes, as well as border measures (tariffs and tariff quotas) used to maintain the prices of domestic fish above world levels.

Programmes included in marketing and price support:

- Government support to ensure minimum prices or to keep domestic prices above world prices
- Withdrawal of fish from the market to maintain minimum prices.

3. Analytical Framework

Whether and how much impacts on fish resources are associated with a particular category of subsidies depends on both the circumstances in the fishery and the way in which subsidies are provided. It is widely recognized that some categories of subsidies are more distorting than others. The subsidies that are most distorting are those that are contingent on increases in fishing capacity or effort. Least likely to distort production are those that involve lump-sum transfers unrelated to production, prices or input use.

The extent to which a given subsidy results in increasing fishing capacity or effort in a fishery will be determined in part by the management system governing the fishery in which they operate. A detailed assessment of a particular category of fishing subsidies requires the identification of key characteristics of the regulatory situations. Among the broad variables or parameters that distinguish different management regimes are: (i) whether the fishery is managed with effective catch and effort controls (see Box 1); (ii) the presence or absence of incentives for sustainable fishing; and (iii) whether the fishery is experiencing overcapitalization and excess capacity.

Box 1: Catch and Effort Controls

Fisheries managers in many countries have been using a variety of controls over catch levels, fishing effort and inputs in the hope of reducing, if not eliminating, overexploitation of the fishery. The management tools used for this purpose, as catalogued and analysed by OECD (2000b), are total allowable catch (TACs) quotas for the entire fleet in the fishery and/or vessel; catch limits per trip; restrictions on fishing effort (seasonal and spatial closures, limits on the number of fishing trips or days spent fishing per vessel per year); restrictions on the number of fishers allowed access to the fishery through limited licensing; and limitations on the number or types of vessels and types of fishing gear.

Often restrictions on catch, effort and inputs are used in combination with one another. However, they have been consistently ineffective in preventing or reducing overfishing where the economic incentive for a “race for fish” has not been eliminated from the fishery. The incentive to catch as much fish in the shortest time possible exists in any fishery that has not allocated individual fishing rights to fishers or managed fisheries through community-based institutions. Under these circumstances, fishermen inevitably exceed catch limits while underreporting catches. That distorts the statistical basis of decisions on catch quotas and leads fisheries managers to set those quotas at levels above the carrying capacity of the resource (Beddington and Rettig, 1984). Effort restrictions, of which limiting the duration of fishing seasons is the most prominent, simply result in more “capital stuffing” – heavy investment in capital equipment aimed at attaining higher catch rates earlier in the season (Beddington and Rettig, 1964; Corten, 1996; OECD, 1997). Restrictions on total number of vessels or certain types of gear usually stimulates growth in other factors that are less well regulated (Townsend, 1985; Townsend, 1992; Smith and Hanna, 1990).

The incentives for sustainable management may be either economic or a combination of economic and social. Purely economic incentives are provided by the allocation of “property rights” -- tradable rights to a share of fishing quotas, often called individual transferable quotas (ITQs). Properly designed and enforced ITQs can provide an economic incentive or fishermen to want quotas to be set at levels that are consistent with the sustainability of stocks and to want the quotas to be fully enforced (see Box 2). Territorial Use Rights or community management schemes that involve face-to-face relations among fishers may have a parallel effect, by combining the allocation of fishing rights with social pressures to motivate fishermen to limit fishing effort to agreed biologically sustainable levels (see Box 3).

Box 2: Property Rights in Fisheries

Experiences in many OECD fisheries have shown that a particularly effective approach to altering the economic incentive for a “race for fish” can be the allocation of “property rights”, in the form of individual transferable fishing quotas (ITQs), to fishers. Such tradable individual quotas represent shares of the total allowable catch and are a longer-term economic asset which gives the fisher an incentive to harvest his individual share at the lowest cost possible and to contribute to conservation of the fish stocks.

By the late 1990s, the OECD (2000b) had identified 49 fisheries in ten OECD countries that had been managed by the use of ITQs, of which more than a third were in New Zealand. Although it does not eliminate the danger of TACs being set too high, and still requires high levels of monitoring and enforcement, the use of ITQs does appear to reduce cheating on quotas and to reduce substantially the incidence of competitive behaviour among fishers (Green and Nayar, 1988; Clark, 1993; Grafton *et al.*, 1996).

It should be noted, however, that property rights approaches to management have not yet been universally accepted. The effectiveness of property rights regimes may depend on specific cultural, commercial, and economic conditions. Moreover, the means by which property rights regimes are implemented can have significant implications for the social organization of a fishery, including by encouraging concentration of vessel or license ownership.

Box 3: Territorial Use Rights and Community-based Management

In relatively small-scale fisheries, rights to fish can be allocated by local communities or cooperatives through systems of Territorial Use Rights in Fisheries (TURFs) or community-based management, rather than by central or state governments. In these alternative forms of management, fishing communities and cooperatives can effectively manage capacity and effort when all the fishermen in the fishery have face-to-face interactions and can bring effective sanctions to bear against violations of locally agreed rules. In such community-based and TURF systems, fishing rights are normally not transferable, so that holders are always subject to community pressures.

Once a fishing community or cooperative realizes that overfishing in a well-defined area endangers its livelihood, community-based systems of rights can make necessary adjustments in capacity and effort. Instead of competing for very limited resources, communities can limit access by defining qualifications for membership in the cooperative, reduce and control fishing effort so that it is sustainable by pooling fishing opportunities. Japan has a number of successful examples of TURFs and community-based systems for managing fisheries that have been fully integrated into commercial fish markets, in part because of a cultural heritage of strong community institutions. All fishermen in Japanese coastal communities belong to fishing cooperatives with an average of about 250 members, which are able to make authoritative decisions on fishing that local officials cannot change (FAO, 1993).

The other broad variable affecting the impact of a given subsidy is whether the fishing fleet is over-capitalized or not – i.e., whether the level of fishing capacity in the fishery exceeds what is required for the desired level of catch (See Box 4). The experiences of fisheries management in OECD countries shows that overcapitalized fisheries tend to create powerful pressures on fisheries managers to set catch quotas too high and to impose effort limits that are not strict enough and too late to prevent serious resource depletion (OECD, 2000). The persistence of overcapitalization in many of the world's fisheries remains a cause of concern and is one of the key motivating factors behind the inclusion of fisheries in the Doha Declaration and the WSSD Plan of Implementation. Even if subsidies do not increase capacity or effort in a given fishery, because of severe restrictions on fishing opportunities, they are likely to delay or prevent the decrease in capacity and effort required to achieve sustainability. The present analytical framework therefore includes as a major parameter the level of fishing fleet capacity in relation to fish stocks, which is also referred to as the “bio-economic conditions” of the fishery.

Box 4: Defining and Measuring Overcapacity

In the fisheries literature, fishing capacity is generally defined as the maximum available capital stock in a fishery – vessels, engines, gear and equipment – that is fully utilized at the maximum technical efficiency in a given period. In order to measure that capacity against the desirable level of capacity, however, that capital stock must be translated into its potential output – the tonnage of fish that it would catch, assuming constant returns to scale (Kirkley and Squires, 1999). This is a theoretical level of catch achieved by multiplying the potential catch of the average vessel at maximum efficiency and multiplying it by the total number of vessels. In the real world, of course, if there is too much capacity in the fishery, each boat catches far less than its maximum potential. But establishing this theoretical level of total catching power is necessary to compare actual fishing capacity with the desired level. In almost all cases, the former is much greater than the latter, and that difference is overcapacity.

The ideal level of capacity is that which, when fully utilized, would yield a level of catch that maximizes the difference between fleet costs and revenues over time. This level of output is called maximum economic yield (MEY). One measure of overcapacity, therefore, is the ratio of actual capacity to the level of capacity needed to produce MEY. A somewhat higher but still desirable level of output would be the highest level of catch that can be replaced through compensatory changes in the fish population, which is called maximum sustainable yield (MSY). Thus, a second measure of overcapacity is the ratio between the actual level of capacity and the level required for MSY.

Calculating precisely either the theoretical capacity of the fleet or the desirable level of capacity involves a number of technical issues, the most difficult of which is determining what constitutes a biologically sustainable level of catch. Indeed, catch quotas have been more often than not set at levels that turned out to be too high to permit the necessary compensatory changes in fish population, and thus contributed to the depletion of fish stocks. For the purpose of determining the general impact of subsidies on fish stocks, however, a number of gross indicators of the existence of some overcapacity in and overexploitation of a fishery are available that do not require such calculations. Examples of such gross indicators of overcapacity and overexploitation in a given fishery include any evidence of declining biomass, seasonal limits on fishing, decommissioning schemes, laying up subsidies and social schemes for fishermen to compensate for loss of fishing opportunities. Where any one of these indicators is present, it may be reasonably assumed that the fishery has already experienced overcapacity. Very few fishing states in the world have not already reached the point of overcapacity in the exploitation of their commercial fish stocks.

The combinations of these two broad variables must be considered in order to understand the implications of each category of subsidies for the health of the fishery resources. The analytical framework used in this paper is based on the matrix approach proposed by OECD (1993) and by a study commissioned by UNEP (Porter, 2002) to take into account these different combinations of management and bio-conditions of the fishery in analysing the impacts of fishing subsidies on fishery resources. The matrix approach has been further refined by adapting a framework developed for the OECD's study on the liberalization of fisheries markets (OECD, 2003b). That study postulated three stylized management regimes—"open access", "catch control" and "effective management" as the basis for evaluating the impacts of fisheries subsidies in general.

In the OECD study, these three ideal types of regimes are assumed to represent management regimes that are effectively enforced. In the analytical framework used for this study, however, this assumption has been relaxed to reflect the fact that in the real world, management systems are not perfectly implemented. Indeed, experiences in a number of OECD countries have shown that in those fisheries which have not allocated property rights and in which fleet capacity already exceeds a level required for a sustainable level of catch, the countries have been unable to prevent widespread cheating on catch quotas and serious overexploitation of fisheries (Commission of the European Communities, 1991; Sutinen *et al.*, 1990; Karagiannakos, 1996; Nielsen and Joker, 1995; Jensen and Vestergaard, 2000).

In this analytical scheme, therefore, the category of “effective management” assumes that adequate systems of catch and effort controls as well as monitoring and enforcement systems are supplemented by incentives for compliance with fishing regulations. Thus an effective management system in a particular fishery is one in which legal and regulatory systems operate in such a way as to eliminate or radically reduce the “race for fish” incentives and in which cheating on quotas is practically eliminated. Additionally, “effective management” assumes that data constraints and scientific uncertainties have been sufficiently overcome or met through application of a precautionary approach.

This paper assumes that such “effective management” can only be accomplished in the presence of some kind of property rights regime (see Box 2). The definition of “effective management” used here is based on the reduction or elimination of economic incentives to overfish, regardless of the means by which that result is achieved. The analysis here thus does not go into the details regarding the merits or draw-backs of specific property rights regimes.

In today’s world, “effective management” regimes remain an ideal objective rather than a common reality. Thus, in reviewing the matrices developed throughout this study it is important to recall that the third of each matrix devoted to “effective management” conditions represents only a tiny fraction of real world circumstances.

Thus the three management regimes types in the OECD study have been translated into three real-world management regimes. The “open access” regime is one which combines the absence of catch and effort controls and the absence of an effective incentive scheme; the “catch control” regime combines (imperfect) catch and effort controls and the absence of incentives for sustainable fishing; and the “effective management” regime combines effective incentives and is relatively more effective (because of the effects of the incentives) catch and effort controls. On this scale of possible management regimes, a few OECD countries have fisheries that approach the “effective management” regime, but most OECD countries are clustered around the “catch control” model. Most, but not all, developing country fisheries management systems have few catch and effort controls and little monitoring and surveillance systems or enforcement and are closer to the open access model.

It is generally accepted in the fisheries economics literature that the existence of well-defined and enforced property rights provides a strong incentive for fishers to exploit fisheries resources in an efficient and sustainable manner (OECD, 1997). Fisheries managed by well-designed and fully enforced Individual Transferable Quotas (ITQs) should not experience higher levels of fishing effort and catch as a result of a subsidy unless the subsidy is accompanied by an increase in the Total Allowable Catch (TAC). Without an increase in

the TAC, the subsidy would be a straight transfer to the industry (Arnason 1999; Hannesson, 2001). If a set of instruments other than ITQs could effectively control the level of effort at the profit maximizing level, they would also negate the effect of a subsidy in expanding effort and capacity. However, few management systems have demonstrated the ability to do this.

Each major category of subsidy is assessed in the context of each combination of management regime and levels of exploitation, and the results for each of the nine combinations associated with each category are summarized in a matrix. The template for this matrix is shown in Figure 1. Across the top of the matrix are the three different management parameters, reflecting the presence or absence of property rights and whether catch and effort controls have been imposed. The left hand side of the matrix refers to the bio-economic parameters, indicating whether the fishery is overcapitalized or not fully utilized. Within each cell of the matrix, the effect on fisheries resources of the provision of the particular category of subsidy is assessed as either “harmful”; “possibly harmful” or “not harmful”. These assessments reflect the degree of certainty that can be assigned to the subsidy category under that combination of parameters.

In the case of certain combinations of subsidy type and management and bio-economic parameters, the theoretical case does not arise in the real world, for reasons that can be easily explained. In these cases, the cell in the matrix is labelled “not applicable”.

In order to translate the effects of a particular category of subsidy on the behaviour of a vessel owner into an impact on fish stocks, this analysis has had to make certain simplified assumptions about the relationship between changes in the level of fishing effort and changes in the biomass of fish stocks. Fish stocks, defined as total fish biomass, fluctuates considerably over time, and fluctuations are determined by changes in water temperature and other variables exogenous to the management regime and the level of fleet capacity. There are also cases in which a fishery that has been overexploited and has suffered a collapse of fish stocks is subject to a moratorium on fishing in order to allow for recovery. However, in this simplified scheme, the assumption is made that in a fishery that already has overcapacity, any increase in fishing effort induced by the addition of a fishing subsidy will have some negative impact on fish stocks. It is believed that this assumption reflects the reality for most fisheries most of the time.

Table 1: Matrix Template

	Effective Management	Catch Controls	Open Access
Overcapacity			
Full capacity			
Less than full capacity			

4. Analysis of Impacts by Category

4.1 Subsidies to fisheries infrastructure

The construction and maintenance of fishing ports provides a service to the fishing industry for which it would have to pay in the absence of government funding of the costs. Because the fishing industry has seldom had to spend any money on fishing ports, infrastructure subsidies represent a large hidden cost of fishing that has been avoided. That means that the cost curve for each level of fishing effort is shifted upward, so a higher level of fishing is profitable in most cases.

It can be argued that fishing ports have some public goods elements, particularly because they are more likely to protect public health and landings than in the absence of fishing ports where landings can be checked by authorities. Government administration of such facilities, therefore, is better for the public than private industry administration. The issue is not whether governments build and run the ports, but whether industry pays its fair share - presumably the largest share - of the costs of construction and maintenance, as is already being done in some countries.

To analyze the effects of infrastructure subsidies to the fisheries sector in the context of different management and bio-economic parameters, an assumption must be made about how much the fishing industry would have spent on fishing infrastructure in the absence of the state subsidy. It need not be assumed that the industry would have spent the full amount. Some fraction of the infrastructure spending may exceed what the industry would need to be profitable. In the Philippines, an analysis of fishing ports (Israel and Roque, 2000) concluded that most of them represented “excess capacity” for fish landing and processing, partly because such projects are funded on a political basis, and partly because of unanticipated declines in fish catch. The following analysis assumes, therefore, that the industry would have had to spend most, but not all, of the amount spent by the state on fishing ports and related infrastructure.

Perhaps the most ambitious such programme has been financed by Japan’s Ministry of Agriculture, Forestry and Fisheries (MAFF). The MAFF announced in 1994 that its Long-Term Plan for Fishing Ports, running from financial year (FY) 1994 through FY 1999, would require US\$ 5 billion annually (Japan MAFF, 1994). The total commercial value of Japan’s fisheries production in 1996 was approximately US\$ 18 billion (OECD, 2001). Assuming that the allocation of fishing ports reflects political influence as well as the needs of the fishing industry, however, this figure inflates the actual cost savings to industry.

Many other countries have relatively ambitious programmes of building fishing ports for their fishing industries, although the costs would not represent such a high proportion of total fishing costs or of the commercial value of the catch. Indonesia is in the process of expanding two existing ports, with funding from Japan, at a cost of US\$ 45 million (Australian Trade Commission, 2003). The Philippines is still constructing regional fishing ports in new areas (Israel and Roque, 2000).

A distant water fleet vessel owner may find deep sea fishing in a given pelagic fishery more attractive because of access to a fishing port. It is also possible that the same vessel owner would not enter into the pelagic fishery if access to the port were to cost. This effect of infrastructure subsidies on fishing decisions would affect only those with a particular cost structure, rather than all those interested in deep sea fishing.

The effect of infrastructure subsidies on fishing capacity and effort in a given fishery depends on the management and bio-economic conditions in which the fishery operates. It is also affected by the type of fishery (in-shore, coastal zone or deep sea). The differences in effect given different combinations of these conditions are examined below.

Effective Management

Fisheries that are managed with individual tradable fishing quotas have no economic reason to subsidize the fishing industry by providing fishing ports to them free of charge. However, a state may be motivated to provide fishing ports or other infrastructure projects to a fishing industry as an inducement to accept a new management system that includes individual transferable quotas.

As long as the fishermen are assured of a total catch level, they will have no incentive to increase fishing effort. Instead, they will take advantage of the subsidy to fishing infrastructure to minimize their costs and increase their profit at the existing level of effort (Arnason, 1999; Munro and Sumaila, 1999; Hannesson, 2001). The same is true of a fishery that is under community-based management.

Catch Controls

Reducing the cost of infrastructure to the fishing industry would not alter the producer's plans for fishing capacity and effort. The incentive for increasing capacity or effort would remain the same, because the profitability of a given resource allocation decision would not be different from that of the same decision without the subsidy. Therefore subsidies to fishing infrastructure do not have any impact on fishing effort or capacity for vessel owners already in the fishery.

However, subsidies to infrastructure projects make fishing more profitable regardless of the existing level of effort, and therefore provide an incentive for vessel owners to remain in the fishing industry, if they would have been below the level at which continued fishing is financially viable in the absence of the subsidy. If the fishery is already at full exploitation or overexploitation, the incentive effect of the subsidy will be to discourage disinvestment that otherwise would have reduced overexploitation. For a fishery that is still underexploited but has catch and effort controls, the impact of the subsidy would not be harmful to fish stocks.

Open Access

In the vast majority of fisheries in which the catch is not controlled, fishing capacity is already well above the level needed for a biologically sustainable catch. In an open-access fishery that is already fully exploited, and which is likely to experience continued growth in capacity in the future, infrastructure subsidies would not have an immediate impact on stocks but be a future liability in regard to efforts to reduce capacity. Therefore, it can be considered harmful to fish stocks in the longer term. If the fishery is not fully exploited, the eventual impact would depend on whether the dynamic in the fishery is undergoing relatively rapid increases in capacity or not. If the fishery is clearly moving toward full exploitation and beyond, it could be considered as potentially harmful. If not, the risk to fish stocks would be small.

Table 2: Expected Impact of Subsidies to Fisheries Infrastructure on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Harmful	Harmful
Full capacity	Not harmful	Harmful	Harmful
Less than full capacity	Not harmful	Not harmful	Not harmful

4.2 Management services and research

Management services to the fisheries sector include setting fishing regulations, surveillance and enforcement of those regulations, stock assessments, and a wide range of research on fish habitats, fishing technology, market issues and other topics. Together, these services constitute an estimated 36 per cent of the total financial transfers from OECD governments to the fisheries sector (Wallis and Flaaten, 2000). Whether the costs of these services should be borne by the fishing industry and uncompensated provision of the services considered as a subsidy has been the subject of vigorous debate. To the extent that these services provide conditions under which output can be increased over time, costs per unit of effort reduced and return per unit of output maximized, they benefit the fishing industry, but they also benefit consumers more generally from the sustainability of fish supplies over time (Hayes et al., 1986).

Under these circumstances, it is argued that the public interest requires government intervention, thus distinguishing the issue from one of discretionary service to the industry (Hannesson, 1991). Based on this view, most countries have not demanded that commercial fishing interests pay any of the costs of management services. It can also be legitimately argued, however, that the fishing industry is the main beneficiary of management services. Australia, New Zealand and Canada, have already adopted for a cost recovery policy in regard to management services in the fisheries sector based on that rationale, and in Canada user fees collected from license holders pay for part of the costs of those management services (Hatcher and Pascoe, 1998; Pascoe, Tingley and Mardle, 2002). A potential danger of the cost recovery approach, however, is that the industry may seek greater influence over the management regime if it is paying its full costs and may obtain increased opportunities for rent-seeking (Hatcher and Pascoe, 1998).

Failing to recover the costs of management services that are in the public interest is not a direct subsidy to industry. Failure of producers or consumers to internalize the externalities of the production of a particular product, however, has been considered by some economists to be an “implicit subsidy” (OECD, 1996; Reijnders, 1990). Thus, it may be argued that failure of producers to pay the full social costs of sustainable fisheries management is an implicit subsidy.

Some fisheries research programmes are clearly for the benefit of the industry. Such programmes include programmes aimed at improving the marketing of fish products and identifying new and unexploited fisheries. Norway conducts research on fishery technology

and on market issues that are of particular interest to the fishing industry (Myrstad, 1996). Similarly, the United States funds some research and feasibility studies that would otherwise have been paid for by the industry (OECD, 2000a). Even research on new, more selective fishing technologies that are clearly in the public interest, could also be viewed as directly affecting the fishery resources on which the future of the industry depends. Canada has set aside up to five per cent of the coast-wide total allowable catch on its Pacific coast to pay for selective fisheries projects (Fisheries and Oceans Canada, 2001). However, it is difficult to distinguish in principle between such research programmes and stock assessments, because both are also clearly in the public interest.

It is not always easy to determine whether fisheries research programmes are subsidies to the industry or whether the industry would have borne the costs in the absence of government payment for them, and the answer might change over time. Until very recently, the fishing industry in OECD countries probably would not have been willing to finance research on selective gear, but that may be changing.

Most fisheries management services are considered, for the purpose of this analysis, to have no negative impacts on fisheries resources, on the ground that government-funded services have, on balance, at least the potential for greater restraint on exploitation of fisheries than the financing of those same services by the industry. This generalization applies across all bio-economic parameters and all management parameters. Research programmes that are not necessary for the regulation of fishing and directly benefit the industry, however, are considered to be similar in impact to government financing of fisheries infrastructure, albeit on a smaller scale. The matrix that follows, therefore, should be understood to refer to dominant components of fisheries management services.

Table 3: Expected Impact of Provision of Management Services on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Not harmful	Not harmful
Full capacity	Not harmful	Not harmful	Not harmful
Less than full capacity	Not harmful	Not harmful	Not harmful

4.3 Subsidies for access to foreign countries' waters

A subsidy provided to a fishing fleet through an international fishing access agreement operates in the same manner as a subsidy to any other variable cost, reducing the costs of fishing per unit of effort for the distant water fishing fleet being subsidized. Unless other factors prevent it, such a subsidy will provide an incentive for the distant water fleet to invest in greater fishing effort in that country's waters. Beyond the incentive to the distant fleet of reduced fishing costs, the subsidy may cause increased fishing in those waters by giving the coastal state government an incentive to allow more distant water fishing capacity than would have been the case in the absence of the subsidy. The actual impact of the subsidy on fish stocks will depend on the management and bio-economic conditions in the country that has given access to the foreign fleet.

Effective Management

International fishing access agreements normally cover relatively short time periods (usually four or five years). At present, no state allows foreign fleets to obtain domestic fishing quotas. It is theoretically possible, however, for coastal states entering into such agreements with distant water states to offer property rights, such as tradable individual catch quotas or other effective means of eliminating economic incentives to overfish, to distant water fleets. Under such ideal circumstances, subsidizing the costs of access for distant water fleets would not provide an incentive for increased fishing effort. It would not have any impact on fish stocks, regardless of the previous level of exploitation of stocks. In reality, no such case of a coastal state with effective management of a fishery signing a fishing agreement with subsidies to access for a foreign fleet is likely to arise.

Catch Controls

In the ideal situation of a completely effective system of catch controls, in which biologically safe catch quotas are imposed on the fishery and are effectively enforced on all fishers, the incentive effects of the subsidy to fishing access would not result in any increase in catch beyond a sustainable level. In the real world, however, no states signing bilateral or multilateral fishing agreements in which subsidies are embedded have had management systems with effective catch controls, even though catch quotas are sometimes imposed on the distant water fleet. Even if catch controls were as effective as they are in OECD countries, however, the risk that subsidies to distant water fleets would cause additional harm to fishery resources would be very high. And in the real world, catch controls suggest that the fishery is already at or above full exploitation.

Open Access

Without a system of catch and effort controls, backed by adequate monitoring, surveillance and enforcement capabilities, to ensure that the catch by distant water fishing fleets remains within biologically sustainable limits, subsidies to access foreign countries' fishing waters will induce a higher level of catch than would have been the case in the absence of the subsidy. This might take the form of increased effort by subsidized vessels that were already in the fishery, a larger number of vessels from the subsidizing distant water state's fleet entering the coastal state's waters, or both. If the level of total capacity in the fishery is still well below the level sufficient for the maximum sustainable yield, the increased fishing effort caused by the subsidy will not have any short-run impact on the health of stocks. However, if the fishery is already fully exploited or overexploited, the subsidy will result in some harm to fish stocks.

This combination of parameters describes the management system in the countries that have actually entered into international fishery agreements that provided subsidized access to their fishing zones. The African states that have allowed EU vessels access to their fishing zones under EU-African fishing agreements have not set catch quotas based on the known state of the fish stocks (Porter, 1997). Systems of monitoring and enforcement, moreover, have been virtually nonexistent, and African coastal states have obtained little data on the level of catches and even of fishing effort of distant water fleets (Sub-Regional Fisheries Commission, 1997; Acheapong, 1997).

In most of the fishing zones covered by EU bilateral fishing agreements with West African coastal states, total fishing fleet capacity was already excessive in the 1980s (Fishery Committee for the Eastern Central Atlantic, 1992). Studies of exploitable biomass of demersal fish off the coast of Mauritania and Senegal indicate severe and continuous reductions between the early 1970s, the early 1980s and the early 1990s (Johnstone, 1996; Bonfil *et al.*, 1998; Dahou and Deme, 2002). The fisheries affected by these agreements have been overexploited, therefore, for many years. Distant water fleet fishing that has been permitted under those agreements has continued to deplete the fishery resources of African coastal countries. Nevertheless, because of reduced fishing costs, distant water fleets can continue to fish profitably for a longer period, in spite of the depletion of the resources, than would have been the case in the absence of the access subsidies (Porter, 1997).

The Pacific Island states that signed a fishing access agreement with the United States in 1987 have not imposed either catch or effort limits on its distant water fleets (Aqorau and Bergin, 1997; Hunt, 1997; Aqorau and Bergin, 1998; Petersen, 2001). The subsidy to the U.S. tuna seiner fleet’s access presumably caused an increase in the fleet’s capacity and effort in the fishery relative to an unsubsidized scenario, by increasing its attractiveness in relation to the other option available to the fleet, the Eastern Tropical Pacific tuna fishery. By reducing costs at each level of effort, it also provides an incentive for more trips and therefore higher catch levels than would have been the case in an unsubsidized scenario.

However, the U.S. and other distant water tuna seiner fleets in the Pacific Island region are targeted on skipjack and yellowfin tuna. Thus far, no evidence of generalized overexploitation of those species has come to light, but serious over-capitalization had already been reported in Fiji’s fishing zone, and improvements in statistical coverage in some critical regions are needed (Anon., 2001b, Silbert, 1999; Coan *et al.*, 2000). It can no longer be assumed automatically that subsidies to Pacific Island States’ tuna fisheries are not harmful.

Table 4: Expected Impact of Subsidies for Access to Foreign Countries’ Waters on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Harmful	Harmful
Full capacity	Not harmful	Harmful	Harmful
Less than full capacity	Not harmful	Not harmful	Not harmful

4.4 Subsidies to decommissioning of vessels and license retirement

Decommissioning schemes have represented a significant share of government transfers to the fishing industry for many years, as nearly every fishing state has financed programmes to buy back vessels, and sometimes licenses, in order to reduce overcapacity in their commercial fishing fleets, increase the efficiency of their fisheries and transfer income to the fishing industry. Vessel and license buy-back programmes represented the second largest category of subsidies in the OECD countries in 1996-97, after fisheries infrastructure (OECD, 2000b).

Decommissioning and license withdrawal programmes influence the economic behaviour of the fishing industry on multiple levels. Although their objective is to reduce the level of fishing capacity in a fishery, decommissioning schemes also have unintended impacts on industry behaviour that undermine that objective. The mechanism on which the programmes rely is a cash transfer to vessel and/or license owners for withdrawing either a vessel or license or both. This in turn creates quasi-rents in the fishery by increasing catch per vessel and per unit of effort. Given the “race for fish” in any but an ideally managed fishery, however, this rent in fishery will spur efforts to capture more of the rent through “capital stuffing” by the vessel owners remaining in the fishery (Townsend, 1985).

The removal of some active capacity from the fishery also increases demand for idle vessels in the fishery (Gates *et al.*, 1997; Holland and Sutinen, 1998). The vessel owner who receives the decommissioning premium has an economic incentive to use the additional capital to reinvest in the same fishery or another that is well regulated. If the decommissioning scheme gives vessel owners the discretion to resell the vessels to be withdrawn, rather than scrapping them, it further increases the incentive to invest in more additional fishing capacity.

The differences in technological capabilities between newer and older vessels of the same tonnage and engine power is so great that decommissioning programmes are virtually certain to increase the level of fleet capacity if they target the oldest or least productive vessels in the fishery, and then allow a lesser number of new vessels to enter the fishery based on a formula using similar physical characteristics (De Wilde, 1999; Cogan *et al.*, 2000; Eggert, 2001; Pascoe *et al.*, 2002).

Beyond these direct effects of the availability of additional capital and the temporary increase in rents, moreover, it has been widely observed that the existence of vessel buy-back programs encourages vessel owners and potential investors to believe that the risk of additional capital investments in fishing is significantly reduced, even if stocks have been or are being depleted. This belief would tend to increase investment in the fishery or to discourage disinvestment from it (Gates *et al.*, 1997a; Arnason, 1999; Munro, 1999; Jorgensen and Jensen, 1999; Munro and Sumaila, 1999; OECD, 2000b). However, no statistical methodology exists to estimate such an indirect effect. Unless the management regime discourages additional capacity through ITQs or community-based management, or by tight controls over technological improvement and increased effort, over time decommissioning subsidies will not prevent and will even contribute to the replacement of all the withdrawn capacity and the addition of more capacity. Even a programme that ostensibly purchases destructive fishing technologies, such as the Indonesian buy-back of trawlers, would pose the problem of decommissioning premiums being used for reinvestment in another overexploited fishery.

It cannot be safely assumed, therefore, that the net impact of decommissioning subsidies on a fishery will be positive. Case study data are available on 11 different decommissioning schemes in nine different countries. Table 5 summarizes the data on these 11 case studies.¹ Some of these case studies do not provide quantitative estimates of net results of the programme in terms of changes in capacity or effort in the fishery, much less the impact on the health of commercial fish stocks. But for each case study at least some data are available on the major policy conditions associated with the programme and on the general situation

¹ Not included in this table

regarding capacity and effort in the fishery or fisheries affected. The discussion of the implications of different management systems for the effects of decommissioning subsidies on economic behaviour and on fish stocks draws on this body of case study evidence.

The analysis of impacts under different bio-economic and management parameters below does not consider the possibility of anything other than overcapacity in the fishery. Vessel and license buy-backs are invariably a sign of overcapacity in the fishery, because the incentive for decommissioning schemes would not exist in the absence of such severe overcapacity in the fishery. Therefore it is assumed that all fisheries in which decommissioning schemes are implemented have already experienced significant overcapacity. The economic dynamics of decommissioning subsidies depend on whether the economic incentive to “race for fish” remains imbedded in the management system of the fishery, whether effective control over catch levels are exercised, and on the degree of overcapacity in the fishery.

Table 5: 11 Decommissioning Schemes: Policy Conditions and Results

Decommissioning Programme	Payment based on vessel catch or revenues	Retirement of vessel from fishing required	Reduction of total capacity achieved	Reduction in total effort achieved	Increased capacity/effort in specific fisheries encouraged
Denmark	No	Yes	Yes	No	No
Norwegian Purse Seine	No	Incentives provided	Yes	No	No
United Kingdom	No	No	No	No	Yes
Chinese Taipei	No	Yes	No	No	Yes
Netherlands	No	No	No	No	Yes
U.S. NE Multi-Species Groundfish	Yes	Yes	No	No	Yes
Canada Atl. Groundfish	Yes	No	No	No	Unclear
Canada Inshore Lobster	Yes	No	No	No	Probably
France Scallop	No	No	Yes	No	Unclear
Japan Akita	No	Yes	Yes	Yes	No
Japan Shimane	No	Yes	Probably not	Probably not	Probably

Sources:

Denmark: Lindebo, 2000; Danish Directorate of Fisheries, 2001; Gates et al., 1997b; Salz, 1991.

Norwegian Purse Seine: OECD, 2000a; Trondsen, 1999; Asche et al., 1998; Hannesson, 1992.

United Kingdom: Nautilus, 1997; Banks, 1999; Gates et al., 1997b; Geboval and Munro, 1999

Chinese Taipei: Chuang and Zhang, 1999; Porter, 1998b.

Netherlands: Court of Auditors, 1993; De Wilde and van Beek, 1996; Frost et al., 1996; De Wilde, 1999; Gates et al., 1997b

United States NE Multispecies Groundfish: Thunberg, 2000; Kitts et al., 1999; Walden and Kirkley, 2000; Gates et al., 1997b

Canada Atlantic Groundfish: Auditor General of Canada, 1997; Gates et al., 1997b

Canada Inshore Lobster: OECD, 2000a; Gates et al., 1997b

France Scallop: Guyader et al., 2000; Daures and Guyader, 2000

Japan: OECD, 2000b

Effective Management

If the management system for a fishery includes both effective overall controls on catch and effective incentive systems, a vessel decommissioning or license withdrawal programme should be successful in substantially reducing capacity and effort in the fishery. In this case, neither the additional capital obtained by the industry nor the creation of rent in the fishery by removing excessive capacity would cause vessel owners to make additional investment or to increase effort in the fishery.

Owners who are assured of a definite share of a specified catch level and who know all other owners are similarly allocated a definite share, would be able to allocate fishing effort more evenly through the entire fishing season. Less capacity would be required, therefore, to catch a given level of fish. Costs per unit of effort would thus be reduced, and overall profit would increase. Without a “race for fish”, vessel owners would have no incentive for “input-stuffing”. Thus, the capacity withdrawn from the fishery by a decommissioning programme would not be replaced by idle capacity or by new capacity financed by the decommissioning premiums.

If property rights or other economic disincentives to overfish have been established in a fishery management system, however, it would not be necessary to use decommissioning payments to reduce fleet capacity in the fishery to the level required to catch the quota at the least cost. Under an Individual Transferable Quota (ITQ) system, the adjustment in capacity level would take place even without a vessel-buy back programme. Because the incentive is to catch the quota level at the least cost, excess capacity would be withdrawn voluntarily, as has been shown in a number of fisheries that have adopted ITQs (Geen and Nayar, 1988; Gauvin *et al.*, 1994; Grafton, 1996; Wang and Tang, 1996; OECD, 1997; Trondsen, 1999; Runolfsson and Arnason, 2001).

Although ITQ-based fisheries have made major adjustments in capacity in as little as a year or two in several cases, it could take several years to remove excess capital from a fishery under certain circumstances (Squires and Kirkley, 1991). A decommissioning scheme may help to speed up the process of capacity adjustment in a rights-based fishery, but it is not necessary for such adjustment.

The only two documented examples of a decommissioning subsidy programme implemented in a rights-based fishery are the Norwegian Purse Seine decommissioning scheme and the U.S. vessel buy-back programme for the Bering Sea Pollock Fishery. In both cases the decommissioning scheme was either completed or mostly completed when the rights-based system of quotas became fully effective.

In the case of the Norwegian Purse Seine Fleet, the first step toward property rights, taken in 1973, was to require licenses that entitled the owner to a certain level of catch depending on the cargo capacity of the vessel. Initially, however, the licenses were not transferable. By the mid-1980s, there was a de facto market in such licenses, providing an incentive for vessel owners to further reduce the number of vessels in the system (Flaaten *et al.*, 1995). In 1990, the transfer of such licenses was legally accepted for the first time (Asche *et al.*, 1998).

The decommissioning programme, which began in 1979, reduced the number of purse seine vessels from 202 to 90 and the licensed catch capacity of the purse seine fleet from 1.3 hectolitres of fish in 1973 to 0.8 hectolitres from 1978 to 1990 (Asche *et al.*, 1998; Hannesson,

1992). From 1990 to 1992, the number of purse seine vessels fell still further from 90 to 63 (Asche *et al.*, 1998). The effectiveness of the decommissioning programme was undoubtedly increased by the existence of a license transfer system that allowed owners to buy up catch rights and achieve more catch with less capacity and cost. The number of vessels withdrawn was also boosted by export subsidies for vessels (Flaaten *et al.*, 1995).

The U.S. Bering Sea Pollock Fishery was among the most over-capitalized fisheries in the United States in 1998, with more than five times the fishing capacity needed to catch the allowable quota for the fishery in 1998 (Porter, 1998b). The U.S. buyback programme for the fishery purchased 9 of the 29 factory trawlers operating in the fishery in 1998, but they accounted for only 10 per cent of the fleet's catch capacity (U.S. GAO, 2000), which would have left the fishery still vastly over-capitalized and would not have reduced effort. This programme is distinguished by the fact that most of the costs of the buy-out were borne by the companies themselves through a fee on the inshore Pollock sector (U.S. GAO, 2000; APA, 1999).

However, the legislation mandating the programme also established a fishing cooperative by the remaining 20 factory trawler owners, which allocated individual catch quotas to its members and thus ended the race for fish.² In the following season, without the pressure of competition for the catch, only 16 of the 20 remaining factory trawlers in the fishery fished during the winter/spring season and only 14 fished in the summer/fall season. More importantly, the average daily catch rates for the fleet during the winter/spring season were only one-third of the catch rate of the fleet during the same season during the previous year (APA, 1999). The combination of decommissioning and property rights thus achieved a major reform of fishing effort that should have been beneficial to Pollock stocks. Without the creation of individual catch quotas, the short-run capacity reduction achieved by the decommissioning subsidy would have been much smaller and would have had little or no impact on fish stocks.

Catch controls

In a perfect system of catch controls, with biologically safe catch quotas and completely effective enforcement, a decommissioning programme would not contribute to additional pressure on the stocks, even without effective management to curb the race to fish. It could not guarantee that the programme would actually reduce the level of capacity in the fishery, however, unless it included an effective system to prohibit additional capacity being introduced into the fishery through improvements in vessels and gear.

In the real world, in fisheries with systems of catch control but no property rights or community management, catch quotas and enforcement systems have not prevented stocks from being overfished. Under these circumstances, the race for fish has continued, as vessel owners seek to maximize their share of the catch. Limited access in the form of caps on licenses and controls on effort through limits on days at sea and seasonal closures have come only after excessive capacity and overfishing has caused stock collapses. In this combination of bio-economic and management conditions, decommissioning schemes are unlikely to help solve the overcapacity problem and could make it worse. If the fishery is fully exploited but

² In fact, these individual quotas were not yet fully protected use rights, since the system was to expire in 2004 unless renewed. (Testimony of Mike Hyde, President, American Seafoods, Senate Commerce Committee, Magnuson-Stevens Hearings, January 18, 2000. See <http://www.commerce.senate.gov/hearings/0118hyd.pdf>.)

not clearly overexploited, there is normally little reason for a decommissioning scheme, but the result is likely to be increased rather than reduced capacity, since the incentive for new investment in the fishery would be even greater under such a combination of management and bio-economic conditions.

When rent is created in a fishery without property rights by withdrawal of some capital, extremely tight controls over increased effort and technological improvements are required to prevent the temporary gain from being nullified by the race for fish. That task becomes virtually impossible if there is a very large overhang of idle capacity licensed for the fishery or fisheries, or if the programme is geared towards the withdrawal of older and less efficient vessels. When large overcapacity exists, most vessels in the fishery are operating at low levels of efficiency, and increased effort can easily swallow up any short-term effort reduction achieved by the programme (Lindebo, 1999; Eggert, 2001; Pascoe *et al.*, 2002).

The danger of a programme that permits some replacement of capacity is even greater when subsidies for capital cost are allocated across an entire national fleet without regard to the impact on fleet capacity in each specific fishery. In that case, the replacement capacity is most likely to flow into those fisheries that are already most highly exploited and where the danger of accelerated depletion of fish stocks is greatest (Nielsen, 1992; Banks, 1999).

When a new vessel, or an older vessel with modern gear, replaces an older vessel withdrawn under a buy-back programme, it always represents an increase in capacity. A study of the English Channel beam and otter trawl fisheries found that the capacity of newer vessels was 1.6 per cent greater for every additional year of difference in vessel age (Pascoe and Cogan, 2002). Thus a new vessel would have 40 per cent more fishing capacity on average than a 25-year old vessel with the same tonnage and engine power.

Table 5 shows that only a few of the 11 decommissioning programmes in fisheries without property rights (or other means for eliminating economic incentives to overfish) achieved any net reduction in capacity in the fishery, and that only one (Japan Akita Province) achieved any reduction in the level of fishing effort. These programmes failed to prevent the erosion of the initial capacity reduction achieved through vessel and license buy-backs, because of the combination of incentive effects, additional capital introduced into the fisheries by the decommissioning premiums, and the insufficiency of controls over increased capacity or effort.

Of these 11 programmes, only three were based the purchase of licenses or vessels on actual catch history or historical revenues in order to ensure the removal of the greatest capacity for the money spent. The others were biased in favour of withdrawal of older vessels that had been less active or less efficient, and would have been most likely to exit from the industry within a relatively short time even without a decommissioning programme.

Except for the programmes in Chinese Taipei and Japan, these programmes all allowed the vessel owner to resell the vessel outside the fishery or nearby fisheries, thus adding to the effective premium obtained for withdrawal. In many cases, the decommissioning scheme led to the transfer of capacity into fisheries that were less regulated, often on the high seas (OECD, 2000b; Gates *et al.*, 1997a). The likelihood that a decommissioning scheme will not succeed in achieving any net reduction in active capacity, or even a reduction in total capacity licensed for the fishery, increases if the programme purchases only the withdrawal of the least

active and productive vessels (Pascoe *et al.*, 2002). Vessel buy-backs that are biased towards retiring the oldest and least efficient vessels provide a windfall profit to those owners who might otherwise be considering withdrawing from the fishing industry, so they are particularly prone to slowing the normal rate of disinvestment from the fishery, as illustrated in studies of a range of fisheries in Japan and France (OECD, 2000b; Guyader *et al.*, 2000; Daures and Gayuder, 2000; Giguelay and Piot-Lepetit, 2000).

Unless it is otherwise forbidden, vessel owners who divest themselves of old and inefficient vessels may then use their decommissioning premiums to buy a new vessel, invest in more modern gear or even reconfigure another existing vessel to increase its catch capability. Meanwhile, any temporary reduction in total capacity creates an incentive for others to upgrade existing vessels and increase their effort in the fishery. The net result may be even more capacity than at the time the programme was introduced.

Three basic factors cause levels of capacity and effort in the industry to be higher than would be the case without the decommissioning subsidies: the introduction into the fishing industry of additional capital that can be used for capital investment; the incentive for investors to take more risks investing in the fishery; and the incentive for vessel owners to stay in the industry longer than would otherwise be the case. The first effect can be limited or even blocked through the most stringent capacity and effort controls. The latter two effects cannot be reduced through management measures except for adopting a strong prohibition against vessel decommissioning subsidies.

The UK decommissioning programme provides an example of a programme that purchased the withdrawal of the least productive vessels in the fishery. Most of the vessels leaving the fisheries under that scheme had about half the catch rates and days at sea of the average vessels in the fisheries targeted. Furthermore, the programme included a major loophole that allowed vessel owners to use their decommissioning premium to buy a new vessel (Nautilus Consultants, 1997). The result was a failure to achieve a net capacity reduction. Of the three biggest segments of the UK fleet (beam trawl/seiners, demersal trawl/seiners, and nephrops trawl), representing 76 per cent of the total decommissioning premiums and 65 per cent of total capacity, only the nephrops trawl segment did not actually increase its catching power during the 1992-1996 period, despite the decommissioning programme (Banks, 1999).

The U.S. decommissioning programme for its Northeast Multi-species Groundfish Fishery was unusual in basing its bidding system on actual catch history, so it avoided one weakness of most such programmes. However, it also illustrates the problem of huge latent capacity waiting to take advantage of any rents created by a decommissioning or license retirement programme. Latent capacity consists of both vessels that are completely idle and vessels that are actively fishing but using only a part of the days at sea allocated to them. One indication of the latent capacity in the fishery is that, of the 832 otter trawl vessels licensed to operate in the fishery, only 128 or 15 per cent of the total would have been required to take the entire cod quota for 1998 (Walden and Kirkley, 2000).

Another estimate of the overall level of unused capacity in the fishery is the gap between the number of fishing days of effort in the fishery estimated to be required to catch the quota, on one hand, and the number of fishing days allocated to those with licenses, on the other. The estimate of fishing days needed to catch the quota for all commercial species in 1989 was 49,000 days. The number of fishing days of effort actually used was 75,000 days, meaning that only one third of the vessels actually fishing were needed to catch the quota. At the time

the decommissioning programme was launched, the groundfish fleet as a whole was allocated a total of 249,000 days-at-sea. Thus, less than one-fifth of the capacity in the licensed fleet was needed to catch the quota, since groundfish quotas in 1996 were lower than they had been in 1989 (Kitts *et al.*, 1999).

The Northeast Multi-species Groundfish Fishery vessel buy-out that began in 1996 removed the equivalent of roughly 16.8 per cent of fishing days actually used during the 1996 fishing year, but only 4.9 per cent of the total allocated fishing days (Kitts *et al.*, 1999). In terms of reducing total capacity, including latent capacity that could become active if controls over effort are relaxed, therefore, the decommissioning programme was meaningless. In the absence of unusually stringent effort and capacity controls in the fishery, moreover, it could have worsened the overexploitation of stocks.

The New England Fisheries Management Council has imposed deep reductions in days at sea and even a ban on the use of pair trawlers on the fishery to limit further overexploitation of groundfish resources (Porter, 1998). Little or none of the previously idle capacity in the fleet, therefore, could be introduced into the fishery in response to the capacity reduction. However, some of that idle capacity has been diverted to *other* fisheries where effort restrictions were less stringent (Thunberg, 2000). Increased capital available for investment in those other fisheries because of the buy-back programme has contributed to some of the increase in exploitation experienced in those other fisheries.

Meanwhile, cod stocks in the Northwest Groundfish Fishery are still being overexploited, despite warnings that fishing mortality must be “substantially reduced” (Mayo and O’Brien, 2000). Even if the programme has not contributed directly to a worsening of stock depletion in the fishery by encouraging vessel owners to remain in the fishery and wait for stocks to recover, it has slowed the rate of exit from the fishery and reduced pressures for a more fundamental solution to the problem of the race for fish.

In the absence of property rights (or other means for eliminating economic incentives to overfish), therefore, a vessel or license retirement subsidy is bound to fail to reduce both capacity and effort significantly, and is likely to make the overcapacity situation worse unless very stringent and well-enforced regulations are in place to prevent increased capacity and effort. Unless very strong efforts are made to control effort, the perverse incentive built into the fishery management system for a race for fish will cause additional increments of capital from the programme to be used to increase pressure on fish stocks. Even with such stringent controls, moreover, such decommissioning programmes are likely to discourage normal exits from the fishery.

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If the fishery into which a decommissioning scheme is introduced lacks either a system of control over catch levels or individual quota rights for fishers, the likelihood of actually reducing either capacity or fishing effort through such a programme is very low, and the danger of worsening the state of the stocks is correspondingly greater. Since the race for fish is not blocked by meaningful limits on catch, a decommissioning premium would both provide an inducement to capacity increases by creating rent in the fishery and would also serve, in effect, as a fund for modernizing the fleet.

Assuming that the fishery is already seriously over-capitalized, or even fully capitalized, the result of a decommissioning programme would almost certainly be further depletion of fish stocks. Even prohibiting the entry of new vessels would not prevent the improvement of existing vessels that had been idle or that were already active in the fishery. Efforts to limit new capacity by restricting gear types would not be ineffective, given the limited resources for regulating the fishery implied in the lack of catch controls. The kind of strict controls over capacity and effort required to prevent further damage to stocks would not be a realistic possibility.

Table 6: Expected Impact of Subsidies to Decommissioning of Vessels and License Retirement on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Probably harmful	Harmful
Full capacity	Not harmful	Probably harmful	Probably harmful
Less than full capacity	NA	NA	NA

NA=Not Applicable

4.5 Subsidies to capital costs

Subsidies to capital costs, whether by grants, loans at below-market rates, loan guarantees or tax benefits, have a direct impact on the economic behaviour of fishers. By definition, these subsidies are used only for the purchase of fishing vessels, new fishing gear, motors or engines or other fixed cost investments. Unlike other categories of subsidies which have an indirect effect on fishing capacity or effort, subsidies to capital costs cause increases in fishing capacity. How significant that contribution to total fleet capacity is and how it affects fish stocks, however, depends on the size of the subsidy and how much of the total costs it covers.

In the worst case, these subsidies are directly responsible for leaps in fishing fleet capacity that lead quickly to overexploitation and fisheries depletion. Even in the best combination of management and bio-economic conditions, however, large-scale capital subsidies can have serious economic and biological consequences.

In theory, capital subsidies could be given solely for the purchase of selective fishing gear, although no state has used subsidies for that objective thus far. If the subsidy were limited to gear that had been proven to reduce buy-catch or capture of juvenile fish, it would not be harmful, regardless of the management and bio-economic conditions of the fishery.

Effective Management

Because this combination of management parameters is always associated with fisheries that are already fully capitalized or over-capitalized, a fishery that is not already at least fully exploited can be dismissed as irrelevant to this exercise. Similarly, a fishery with both effective catch controls and property rights, community-based management or some other

means for eliminating economic incentives to overfish would not remain seriously over-capitalized, because the fishers would have a strong incentive to reduce overall capacity. Therefore, this combination would exist for a relatively short time. The strong tendency in the fishery would be towards a reduction in capacity to a level compatible with maximum profitability.

That leaves the case of a fishery that does have full capacity and the combination of effective controls and property rights or community-based management. In that case, a subsidy to capital costs would not have any impact on the level of capacity or effort, according to economic theory (Arnason, 1999). If overall quotas are set at a level of maximum economic yield (MEY), and each vessel has an individual quota assured, the fishing industry would be motivated to replace existing capacity, making the fleet more efficient but not increasing total effort. As profit-maximizing producers, vessel owners would not want to add to total capacity, because it would reduce the catch per unit of effort. Hence, the subsidy to capital costs would increase profits but not output. This combination would also imply that fisheries managers would apply very stringent controls to prevent an increase in overall capacity.

In the real world, however, no fisheries managers who have already assigned property rights to fishers would be motivated to seek or to continue subsidies to capital costs. As Arnason (1999) notes, it would not be “deemed politically appropriate for a well managed ITQ fishery.” There are no cases of fisheries with this combination of management conditions that have provided subsidies to capital costs. Therefore, this case is of theoretical rather than actual policy significance.

Catch Controls

If the management system of a fishery includes catch controls but no assignment of individual catch quotas to fishers or community-based management, subsidies to capital costs would have a very strong tendency to increase capacity as well as fishing effort. A system of catch controls implies that full exploitation of fishery resources has already been reached or surpassed. Although an ideal catch control system would prevent increased fishing effort induced by subsidies to capital investment, in practice the effectiveness of the system of catch controls would be affected by the level of capacity in the fishery

Because an incentive for a race for fish would strongly influence fishing industry behaviour, vessel owners would take advantage of the subsidies to increase their own fishing capacity and effort, because they could do so at reduced cost. This motivation would prevail regardless of the level of capacity in the fishery in relation to resources. Even in a grossly over-capitalized and overexploited fishery, where additional capital investment by the industry and additional effort would reduce overall profitability in the fishery, the individual owner would have to focus on relative gains to be obtained from acquiring increased capacity at a reduced cost.

The motivation for governments to provide subsidies to capital costs is either to increase capacity in particular fleets, to make the fishing industry more profitable by modernizing it, or both. Subsidies for the purpose of expanding fleet capacity are often extended to the industry when fishing fleets are believed to be at less than full capacity. Under these circumstances, the risk that the subsidies will lead to excessive fleet capacity is particularly great. Estimates of the biomass and spawning stocks of the fish resources in question may

be significantly overstated, making any increase in capacity dangerous to fish stocks. But even assuming that the estimates are accurate, subsidies for vessel construction or vessel modification almost inevitably lead to capacity overshoot in the relevant fisheries (de Wilde, 1999). These subsidies not only increase the number of vessels in the fleets but speed up the introduction of new fishing vessel technologies and gear. When one group of owners decides to invest in the new technology because of the reduced costs, it induces others in the industry to do the same in order to remain competitive. The likely result is that the catching power of the fleet will quickly grow far beyond a level needed for sustainable catch.

Since the premise of the policy was that fleet capacity could be safely increased without damage to the health of fish stocks, such leaps in capacity inevitably translate into substantially increased fish mortality and will very likely result in serious depletion of resources. The Netherlands case illustrates the subsidizing of vessel construction and modernization in circumstances where increases in both fleet capacity and modernization were objectives.

When fishing fleets already have significant overcapacity in relation to the fishery resources they target, the motivation for subsidies to capital costs is normally to make the fleet more efficient and more profitable without increasing capacity. Subsidies to capital costs only for the purpose of modernization are usually combined with decommissioning schemes in order to maintain or reduce the net level of fleet capacity. Such schemes for subsidized replacement of older vessels with more modern vessels are almost certain to fail to prevent overall increases in capacity.

Capital investment subsidies combined with a system that allows the replacement of vessels on the basis of formulae involving tonnage or engine power have two major weaknesses that make them very unlikely to achieve their goal. First, they fail to take into account the fact that newer vessels replacing older ones have much higher catching capability than is indicated by similar tonnage and engine power. Thus, they hide actual substantial increases in capacity and risk undermining the controls over even nominal additions to capacity (de Wilde, 1999).

Second, such programmes are likely to allocate subsidies to capital costs to entire national fleets without regard to the impact on fleet capacity in each specific fishery. The result of such a loosely drawn “fleet adjustment” programme is that the reductions in capacity will be concentrated in fisheries that are less profitable, allowing those fisheries that are more profitable to remain highly over-capitalized and worsening the effect on stocks in these fisheries (Banks, 1999; Nielsen, 1992).

The likely impact of subsidies on capital costs of fishing effort in a “catch control” management system varies according to the bio-economic conditions of the fishery. A fishery with stocks that have already been severely depleted and that has stringent limits on days-at-sea and seasonal closures is likely to experience less net increase in fishing effort because of capital subsidies than a fishery that already has full capacity but has not yet imposed such severe effort restrictions. On the other hand, the greater the level of over-capitalization, the more difficult it is to avoid the setting of overall quotas at levels well above biologically sustainable levels, and to prevent cheating on quotas. These increased pressures on the management system in a highly over-capitalized system limit the effectiveness of effort restrictions in protecting against even higher levels of fish mortality in already overexploited stocks.

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If neither effective catch and effort controls nor appropriate incentives exist in a fishery, the purpose of subsidies to capital costs must be to increase the level of fleet capacity. In the absence of catch controls, even if the fishery is less than fully exploited, such subsidies are likely to cause an overshoot in fleet capacity well beyond a biologically sustainable level. Subsidies to capital costs are likely to encourage the adoption of much more powerful fishing technologies, causing the capacity level to grow so much that the fishery shifts from less than fully exploited to seriously overexploited. Thus, subsidies to capital costs can cause unintended damage to fish stocks in either or both of these two situations.

If a foreign fleet is also operating in the same fishery, the difference between the under-capitalization and over-capitalization of a national fleet obviously will be much smaller than would otherwise be the case. The Canadian subsidies for capital construction of its northwest Atlantic Fleet from 1954 to 1968 illustrate the dynamics of such subsidies under this combination of management and bio-economic conditions. Canada wanted to increase its fleet in order to compete for the catch more effectively with European fleets operating in the same waters off its coast. Over this 14-year period, Canada provided grants and low interest loans to its northwest Atlantic Fleet that increased its catching capacity by as much as 18 times, according to one estimate. This enormous leap in fishing capacity was spurred mainly by encouraging the general adoption by the fleet of not one, but two successive generations of fishing vessel technology: the side trawler and then the much more powerful stern trawler. By 1970, the Canadian government estimated that the fleet already had twice as much capacity as needed for a sustainable level of catch, taking into account the increased capacity of the European fleet also fishing in the same waters (Porter, 1998).

Senegal's programme of subsidizing the purchase of engines for fishing vessels in the small-scale fishing sector illustrates the use of subsidies to capital costs in a developing country's fishery under these conditions. Beginning in the 1960s, the state sold engines to the owners of pirogues tax-free and perhaps at below-market prices as well. This programme continued on a much larger scale in the 1970s and 1980s, and is still apparently in operation today (Dahou and Deme, 2002).

The effect of this subsidy has been to touch off and accelerate a technological revolution in the Senegalese small-scale fishing fleet. The number of fleets that were motorized increased from none in the 1960s to nearly 2000 in 1970, and doubled to 4,000 by 1974. This engine subsidy also made possible the introduction and generalized use of purse seine nets in the 1970s and 1980s (Dahou and Deme, 2002). The Senegalese domestic fleet increased its share of the catch in the national economic zone (as against the share of distant water fishing fleets) from a very small fraction in the 1960s to one-third by 1970 and to three-fourths by 1975 (Bonfil *et al.*, 1998). Although most of this development probably would have occurred even in the absence of the engine subsidy, it certainly increased the speed and total impact of motorization (Dahou and Deme, 2002).

In the absence of any limitations on access or catch, the engine subsidy has exacerbated the depletion of fishery resources that followed the modernization of the Senegalese fleet. The sharp reductions in stocks of most major commercial species, indicated by data on catch per unit of effort, quickly followed the trajectory of modernization. The decline in biomass has brought, in turn, a rise in destructive non-selective fishing methods (Dahou and Deme, 2002).

Table 7: Expected Impact of Subsidies to Capital Costs on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Harmful	Harmful
Full capacity	Not harmful	Harmful	Harmful
Less than full capacity	Not harmful	Harmful	Harmful

4.6 Subsidies to variable costs

As noted above, subsidies to variable costs include all those that reduce actual operating costs of fishing vessel owners. Those that have been provided in the past have reduced the costs of a wide range of items, including income taxes, vessel insurance and re-insurance, bait services, damaged gear, and energy-saving devices onboard. The most popular subsidies to variable costs, however, have been tax rebates or other special arrangements to reduce the costs of fuel. As fisheries have become increasingly overexploited, the costs of fuel per unit of catch have continued to increase, so fuel costs have become a large proportion of total operating costs.

In general, reducing these costs through a subsidy makes each fishing trip less expensive and tends to increase fishing effort. Although subsidies to variable costs generally have less impact on fish resources than subsidies to capital costs, subsidies to fuel use may actually affect the level of fishing capacity indirectly through their technology effects. They provide an incentive for vessel owners to use more powerful and fuel-consuming engines (Beddington and Rettig, 1984; McGoodwin, 1990). They also induce more use of refrigeration on vessels by making it more profitable. Both effects of fuel subsidies give vessel owners greater incentives to extend fishing trips in time and space, implying large increases in catch. The seriousness of the impact of subsidies to variable costs on fish resources thus depends on the size of the subsidy, the degree to which it has a technology effect, and the combination of management and bio-economic parameters in the fishery.

Effective Management

Assuming effective catch controls as well as the existence of individual fishing quotas, subsidies to variable costs should not increase fishing effort or capacity. As discussed in relation to subsidies to infrastructure, which would otherwise be a variable cost, the assurance of a proportion of the total allowable catch will take away the incentive to use a subsidy to fuel costs or other variable costs to increase capacity, even if it can be done at less cost per unit of additional capacity. Rather, the recipients of such subsidies would choose to simply minimize costs and increase their profit, while maintaining the existing level of effort (Arnason, 1999; Munro and Sumaila, 1999; Hannesson, 2001). As noted in the discussion of other categories of subsidies, however, the assumption of property rights makes the choice of subsidies to variable costs by fisheries managers most unlikely.

Catch Controls

As previously discussed, in the absence of property rights, community-based management, or other means for eliminating economic incentives to overfish, catch control systems involving catch quotas, monitoring and surveillance, and time and geographical restrictions on fishing effort, have not been able to prevent significant quota violations in fisheries which are overexploited. The failure of such control systems is likely to be greater as fleet overcapacity in the fishery increases.

Therefore, the effect of subsidies to variable costs, which is to induce marginally higher fishing effort, and in the case of fuel subsidies, to encourage greater use of more fuel-intensive fishing vessels, is only partially mitigated by the existence of catch control systems. If fleet capacity is already greater than required to exploit the resources at a sustainable level, a subsidy to variable costs will carry a high risk of degrading fish stocks.

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In fisheries with no effective controls over catch and no means for eliminating economic incentives to overfish, subsidies to variable costs, and particularly to fuel, will certainly increase capacity and effort. Although few empirical studies of this case are available, they show that the result of such subsidies is to promote technological change towards the use of more powerful engines that consume more fuel. The case study of Senegal's fuel subsidies shows that it provided an incentive for boat owners to acquire engines that consumed more fuel and which could take fishermen further out to sea, as well sustain longer trips. Thus it contributed to opening up new fishing areas and to the development of a purse seine industry. The result was significantly increased catches (Dahou and Deme, 2002).

Under the bio-economic conditions of fleet overcapacity in either commercial or inshore small-scale fisheries, such capacity and effort increases induced by subsidies to fuel use cause further depletion of the fish resources. Thus the impact of subsidies to variable costs is particularly damaging to resources when they have indirect impacts on technology choices and occur in fisheries that are already fully or nearly fully exploited.

In a clearly underexploited fishery, this category of subsidy would not necessarily harm the resources. Many developing countries have deep-sea fisheries that are not fully exploited, for example, and the fish stocks would not be damaged in the short-run. The potential for a "technology effect" of such a subsidy, however, raises the possibility that it could induce a rapid increase in capacity and cause an overshoot of the sustainable level of capacity and effort. In an open access fishery, such an overshoot can occur within a very short time span, as was the case in Senegal. The capacity of the inshore, small-scale fleet was clearly below the level required for full exploitation when the motorization of the fleet began in 1970, but by the early 1980s, stock biomass for demersal fish had already been reduced by half, and it was halved again by the early 1990s (Bonfil *et al.*, 1998). A direct relationship unquestionably exists in the Senegalese case between fuel subsidies, steeply rising fleet capacity, overexploitation and enormous losses of biomass. Subsidies to variable costs pose potential dangers, therefore, over a 5-10 year period, which would need to be addressed in a broader fisheries policy.

Most countries with no catch controls and no property rights already have fishing fleets that are either close to or well above full capacity. Under these circumstances, subsidies to variable costs in fisheries are certain to be harmful to the resource.

Table 8: Expected Impact of Subsidies to Variable Costs

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Harmful	Harmful
Full capacity	Not harmful	Probably harmful	Harmful
Less than full capacity	Not harmful	Probably harmful	Probably harmful

4.7 Subsidies to income

The category of subsidies to income includes two distinct sub-categories that are different in their relationship to fishing effort. The larger and more prevalent sub-category is income support and unemployment insurance for fishermen. The smaller sub-category is subsidies to the income of vessel owners, primarily through payments for temporary cessation of fishing.

OECD countries have provided income support to fishermen through a range of social insurance programmes, including minimum basic wage levels for fishermen, unemployment insurance and compensation for days lost at sea for a certain minimum number of days in the month because of bad weather. A key distinction among different income support plans is whether the plan provides income only for wage-earning fishermen or for both wage-earners and self-employed fishermen. Where social insurance for wage-earning fishermen is in line with that available to wage earners in other sectors, it theoretically will not constitute a particular incentive for employment in the fishing sector. Similar benefits for self-employed fishermen on the other hand, would in theory, alter the attractiveness of fishing in relation to other economic activities.

The question of whether income support or unemployment insurance for fishermen provides incentive for increased fishing effort, or otherwise causes an increase in fishing effort, must be broken down into four sub-issues. First, do such programmes draw additional fishermen into the industry? Second, do they discourage exit from a fishing industry that has collapsed or is in decline because of resource degradation? Third, do they provide an incentive for fishermen already active in the fishery to increase their fishing effort, and fourth, do they increase pressure on fisheries managers to relax controls on catch or effort?

The main form of subsidy to the income of a vessel owner is a “laying up” grant to compensate for the temporary withdrawal of a vessel from active fishing for a given period of time. Such subsidies are normally prompted by a moratorium on fishing for certain depleted species and are therefore subsidies in support of idle capacity. The effect of the subsidy to idle capacity is therefore to discourage exit by vessel owners who might otherwise consider retiring from an industry that has been seriously affected by overfishing (Garrod and Whitmarsh, 1991). In the late 1980s and early 1990s, the European Union (EU) carried out a significant programme of laying up subsidies. Finland, Germany and Italy still report the use of such subsidies to the OECD (OECD 2003).

Based on the EU experience, laying up grants lend themselves to fraud and are unlikely to result in substantive reductions in fishing compared with the baseline situation. An investigation of the EU laying up grants programme from 1987 to 1990 found that it permitted vessel owners to be compensated for periods in which fishing was traditionally reduced in any case, and failed to dissuade them for fishing for the most profitable species threatened by overfishing (European Court of Auditors, 1992). Laying up is thus likely to represent a financial transfer to the vessel owners.

Effective Management

In a rights-based or community-based management fishery, income subsidies would not provide an incentive to increase fishing effort, which is determined by the individual quota. The only exception would be if the eligibility requirement were set in terms of weeks fished or income that would require a catch level higher than the quota.

The issues of adjustment and political influence of unemployed fishermen on fisheries management decisions only arise in bio-economic conditions of overexploitation. In a fishery with property rights (or other means for eliminating economic incentives to overfish) and some catch controls, self-employed fishermen would also have to be those with fishing rights. Under those circumstances, they should have no effect on adjustment to bio-economic conditions by the fishing industry, since those decisions would be made on the basis of fishing rights and anticipated future fishing opportunities.

The use of laying up grants in a fishery managed with property rights is very unlikely, since excess capacity would be eliminated by owners' adjustments, who would maintain only enough vessels in the fisheries to catch the level to which they have transferable quotas. In the unlikely event that laying up grants were offered, however, they would have no impact on the level of capacity or effort in the fishery, because the vessel owner would have no incentive to increase the level of effort.

The laying up premium issue also arises only in conditions of overexploitation of a fishery. Assuming that catch quotas are set at a sustainable level, vessel owners would have much less reason to want to increase effort beyond the level needed to catch the amount of fish to which it has been allocated rights. Laying up premiums would thus be redundant and highly unlikely to be adopted as a policy option, and would have no discernible effect on fishing effort even if they were adopted.

Catch Controls

The theoretical proposition that an income subsidy will provide incentives for expanded fishing effort is based on the assumption of an open-access fishery (Poole, 2000). The question of whether an income subsidy has an effect in a fishery that imposes controls on the catch and effort must be also broken into the four sub-issues mentioned above.

Research on the impact of income support programmes on fishermen has been focused on Canada's Unemployment Insurance (UI) programme in Atlantic fisheries and particularly in Newfoundland. One study (Ferris and Plourde, 1982) argued on the basis of an econometric analysis that the UI did in fact contribute to the growth of the inshore fleet in Newfoundland. In the Canadian Atlantic provinces, self-employed fishing families received roughly 30 per cent of their income from UI benefits, and data for Newfoundland does show a marked increase in fishermen after the start of the programme (Poole, 2000).

However, Canada only established catch controls after 1977, and both the data for the next decade and their interpretation are ambiguous. The number of fishermen increased dramatically from 1977 to 1980 (Schrank, 1998), but that period coincided with the creation of Canada's 200-mile exclusive fishing zone, the expulsion of European fleets from Canadian waters and a new programme of subsidized vessel construction and modernization (Porter, 1998). Furthermore, the number of fishermen in Newfoundland's inshore fleet fell by 17 per cent during the 1980s, presumably reflecting a sharp decline in profitability as catch per unit of effort dropped off (Schrank, 1998).

The evidence from Newfoundland does not really help answer the question of whether the UI programme has had an attraction effect. Since income support programmes are established in large part because of major economic shocks affecting fleet size, it seems likely that similar results would be found in other fisheries.

The issue of whether income programmes discourage exit from a fishery has not been the subject of research and analysis. The data on Newfoundland could be read as supporting such an effect, because the per centage decline in profitability caused by changes in bio-economic conditions was significantly greater than the per centage decline in numbers of fishermen.

Poole (2000) examines the question of whether unemployment insurance provides an incentive for increased fishing effort or political efforts by fishermen to influence managers' decisions on catch and effort controls. In his model of a regulated, restricted-access fishery, if the UI payments are a function of income, they will cause an expansion of fishing effort; if it is a lump-sum income transfer with a qualifying threshold measured in weeks fished, and benefits diminish at higher income levels, the marginal incentive to fish will be minimal, unless its minimum requirements for weeks fished are greater than the cap on effort in the fishery. If the minimum requirements for weeks fished are above the effort cap, fishermen will be strongly motivated to use their political influence to loosen the restrictions on effort; on the other hand, if the requirements are below the effort cap, impacts on marginal incentives to fish will be minimal.

Apart from the relationship between an effort cap and minimum fishing period requirements, income support programmes may have an indirect political effect on fishing when a fishery has experienced serious fleet overcapacity leading to stock collapse, and income support programmes are justified as a means of tiding over the industry until "the fish return". It is under these circumstances that income support programmes are most likely to result in increased pressures on fisheries managers to reopen the fisheries prematurely (McCleod, 1996; Schrank, 1997; OECD, 2000a). Pressures for maximizing fishing opportunities would exist even in the absence of social insurance. It has been hypothesized that the effectiveness of fishermen as a pressure group in seeking to reduce catch and effort limits is directly proportional to their numbers (Poole, 2000), but such a scenario would occur only in a fishery that is already overcapitalized.

In a fishery in which some catch and effort controls have been imposed, but in which the race for fish is still a factor, a grant to the vessel owner unlinked to specific inputs or outputs does not have the same impact on industry behaviour as production or input-linked subsidies. Neither does it cause fishermen to increase the level of fishing capacity or effort. At the same time, it

has been shown to be almost completely ineffective in inducing owners to reduce the level of effort below what it would otherwise be. The ways in which the system can be manipulated to obtain payments without any actual reduction in fishing are too many and too easy.

Laying up subsidies may provide some incentive to remain in the fishery rather than to disinvest, because it increases the expected level of profitability (or reduces the level of expected loss) of the fishing industry. That means that some marginal reduction of capacity may not occur because of the provision of laying up premiums.

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In an open access fishery, an income support programme would, in theory, encourage additional entry until all rents are dissipated, and if the income subsidy is a function of monthly income, it would induce increased effort as well (Poole, 2000).

In the absence of catch and effort controls, there would be no rationale for laying up subsidies, which are supposed to be compensation for foregone fishing opportunities. Therefore, this combination of parameters and subsidy is of no theoretical or practical significance.

Table 9: Expected Impact of Subsidies to Income

	Effective Management	Catch Controls	Open Access
Overcapacity	UI: Not harmful LU: Not harmful	UI: Possibly harmful LU: Harmful	UI: Harmful LU: Harmful
Full capacity	UI: Not harmful LU: Not harmful	UI: Possibly harmful LU: Harmful	UI: Harmful LU: Harmful
Less than full capacity	UI: Not harmful LU: Not harmful	UI: Possibly harmful LU: Harmful	UI: Harmful LU: NA

NA=Not Applicable, UI=Unemployment Insurance, LU=Laying up Subsidies

4.8 Price support subsidies

Price support subsidies are mechanisms for increasing fishing industry revenues, with the bulk of the benefits going to vessel owners. Price support programmes use different mechanisms and provide different levels of compensation to the industry. Some compensate for any market price reduction below a target level that is well above the world price, whereas others only compensate for serious falls from the world market price. The EU price intervention regime is of the latter type. It has several intervention mechanisms, including withdrawal prices, carry-over aid and private storage aid. Withdrawal price, limited to 24 specific products, is the most widely used (OECD, 2000a).

In economic theory, a subsidy to producers through price intervention will cause fish production to rise above the level that would have been produced in the absence of the subsidy. The actual effect of either a price support subsidy, however, depends on the management and bio-economic conditions of the fishery. The analysis that follows focuses on price support subsidies.

Effective Management

In a fishery with both property rights or community-based management and an effective system of catch and effort controls, the effect of price support on fishing effort should be negligible if the fishing fleet is already over-capitalized or at full capacity. Vessel owners would be motivated to reduce fleet capacity to the level necessary for MEY or to keep it at that level, despite artificially higher prices. Fishing effort would be restrained by the desire to ensure future sustainability as well as by the catch quotas and monitoring and surveillance systems. Under these circumstances, the subsidy would be a straight resource transfer from taxpayers or consumers to the fishing industry.

If the fishery had these management characteristics, but the fleet was below the capacity necessary for MEY, price supports would provide the incentive for fishing effort to rise to the level of MEY. However, it is highly unlikely that both catch controls and property rights would be established in a fishery that is not already fully exploited.

Catch Controls

In a fishery without individual fishing rights, price supports provide an incentive to increase production. Although catch controls should in theory constrain this incentive effect, in reality the constraint is limited. As has been noted earlier, at high levels of fleet overcapacity in a fishery without allocation of fishing rights, catch quotas and systems of monitoring and surveillance provide only a partial defence against the effect of price support policies in inducing higher levels of fishing effort and catch. Fishermen are motivated and able to use their political influence to pressure fisheries managers to compromise the scientific integrity of catch quota decisions and to flout the quotas.

In a fishery in which fishing effort is at or above a biologically sustainable level, price support measures cause some harm to fish stocks, depending on the degree of reduction of biomass already taking place. The clearest case study of the impacts of price supports as the dominant form of subsidy to the fishing industry is in Norway, where price support represented as much as 75 per cent of total transfers in the late 1970s and 40-50 per cent in most of the 1980s. Annual average price supports for cod in the North and Northwest of Norway increased five-fold from 0.2 NKr/kg in 1978 to 1.08 NKr/kg in 1985, which represented an increase from 5.5 per cent of the total price of cod to 16 per cent. The level of the subsidy was set in relation to landed value, so it provided a powerful incentive for both increased investment in the industry and increased fishing effort (OECD, 2000b).

Norway's price support subsidies allowed the industry to ignore the signals that Norwegian fisheries were already seriously over-capitalized. Thus gross tonnage of the Norwegian fleet increased by roughly 30 per cent between 1973 and 1987, even though its purse seine and herring fleets were already seriously over-capitalized. This caused depletion of stocks, and a 28 per cent decline in catch from 1978 to 1984 (Salz, 1991; OECD, 2000b; Flaaten and Wallis, 2000). New investment in the fisheries continued, as the financial effects of this decline were masked by the increase in price support subsidies (OECD, 2000b; Flaaten and Wallis, 2000).

If the fishery is exploited at levels well below a biologically sustainable level, the incentive effect of price support measures would not necessarily result in harmful impacts on stocks, but it could cause the level of effort to increase to a point above the biologically safe level of exploitation.

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In the absence of catch controls and incentives for sustainable fishing, the impacts of price support interventions are quite similar to those in a fishery with catch controls, but they will be of greater magnitude, given the same bio-economic circumstances and rates of price support. Instead of impaired effectiveness of catch and effort controls, the fishery will have no limitation on the incentive effects of price supports. If a fishery’s resources are being overexploited, price support subsidies will certainly induce increased fishing effort and cause stocks to decline.

In theory, price support in a fishery that is clearly at less than full exploitation may not harm stocks immediately, but will certainly speed up the transition to overexploitation and may do so very rapidly. As noted above, in practice, such subsidies are likely to be used only under conditions of overexploitation.

Table 10: Expected Impact of Price Support Subsidies on Fish Stocks

	Effective Management	Catch Controls	Open Access
Overcapacity	Not harmful	Harmful	Harmful
Full capacity	Not harmful	Harmful	Harmful
Less than full capacity	Not harmful	Possibly harmful	Harmful

5. Summary

Using an analytical framework that takes into account different combinations of management parameters and the degree of exploitation in a fishery, this study has examined the impact of eight categories of fishing subsidies on fishery resources. For each category of subsidy, the expected results for each of three combinations of management parameters and three bio-economic parameters have been translated into a matrix format.

The methodology used for this analysis involves the use of both case studies of specific subsidy programmes from the literature, and a set of simplified fisheries management regimes: catch controls with property rights (or other means for eliminating economic incentives to overfish), catch controls without property rights and no catch controls. The assumption is also made that, even in a management regime with catch controls and no property rights, the combination of overcapacity, inappropriate quotas, imperfect monitoring and surveillance and the continued existence of a race for fish leads to some degree of overexploitation of the fishery. An “effective” management regime, therefore, is one that combines a scientifically-based catch and effort controls, adequate monitoring and surveillance measures and socio-economic incentives for sustainable fishing. Finally, the analysis assumes that the total biomass of commercial fish stocks in an overexploited fishery is not increasing at the time the subsidy is applied. Therefore, under this simplified model of the impacts of fisheries subsidies, an increase in effort will have a negative impact on fish stocks in a fishery that is already overexploited.

It is important to recall that the category of “effective” management regimes is remains extremely rare in the real world. The vast majority of the world’s fisheries conform to the conditions specified in either the “catch control” or “open access” management regimes described.

The results of the impact analysis for each of the eight categories can be summarized as follows:

- **Subsidies for fisheries infrastructure** are expected to be harmful to fisheries resources except where incentives ending the race for fish are provided by an effective management system or where the fishery is clearly less than fully exploited. While subsidies to infrastructure might not cause actual increases in fishing effort within “catch control” regimes, they would provide disincentives to reduce capacity, even in an overexploited fishery. As in the case of all fisheries subsidies other than management services, subsidies to infrastructure will always be harmful in an open access regime that is fully exploited, over-exploited, or capitalized to or beyond full capacity.
- **Subsidies to management services and research** have not proved harmful to fishery resources. Subsidies to research that clearly benefits only the fishing industry and is not in the general public interest are an exception, although these are likely to be marginal in their impact.

- **Subsidies for access to foreign countries' waters** could theoretically be beneficial in the presence of effective management. However, such subsidies are expected to be harmful to fisheries resources, unless the fisheries covered by the agreement are clearly undercapitalized. Unfortunately, bilateral access agreements in the real world have almost universally involved host country fisheries in which capacity or exploitation levels are already high, and/or in which management controls are absent or weak.
- **Subsidies to decommissioning of vessels and license retirement** are provided only in fisheries that are already overcapitalized and usually are also overexploited. In the presence of effective management controls, including property rights, a vessel decommissioning or license withdrawal programme can often be successful in substantially reducing capacity and effort in the fishery. However, effective property rights regimes should be able to reduce or prevent overcapacity without resort to decommissioning subsidies. Historically, in fisheries with systems of catch control but no property rights or community management, catch quotas and enforcement systems have not prevented stocks from being overfished. In some such cases, decommissioning subsidies have increased rather than reduced capacity. In an open access fishery, the likelihood of actually reducing either capacity or effort through a decommissioning scheme is low, and the danger of worsening the state of the stock is significantly greater.
- **Subsidies to capital costs** are expected to be harmful in all circumstances unless the fisheries management system provides for property rights, community-based management, or other means for eliminating economic incentives to overfish. They can be harmful even in fisheries that are less than fully exploited, where subsidies to capital costs encourage the adoption of much more powerful fishing technologies, potentially causing an overshoot in fleet capacity well beyond a biologically sustainable level. Only under the extremely rare ideal circumstances of an effective management regime, could such subsidies be benign.
- **Subsidies to variable costs** provide an incentive for vessel owners to use more powerful and fuel-consuming engines and are expected to be harmful unless "effective management" exists or the fishery is less than fully exploited. These subsidies are similar to subsidies to capital in their potential for harm, although in "catch control" fisheries that do not suffer from overcapacity or overexploitation, the likelihood of harm is considered "probable".
- **Subsidies to income**, particularly for vessel owners, could be harmful if the fishery is fully or overexploited and lacks economic incentives to eliminate the "race for fish", or when open access prevails. Income subsidies in the form of "laying up" subsidies are likely to have the effect of discouraging reductions in capacity that would otherwise be financially more attractive. Where catch control fisheries are at or beyond full capacity, the impacts of unemployment insurance schemes are likely to be less harmful than "laying up" subsidies.
- **Price support subsidies** are expected to be harmful in all circumstances unless the fishery has appropriate economic incentives to eliminate incentives for overfishing, such as property rights or community-based management. Price supports have had a clear impact on levels of fishing effort, and can speed up the transition from a condition of less than full exploitation to overexploitation.

The overall results of the impact analysis across all eight categories of fisheries subsidies are summarized in Table 11. The analysis has shown that most subsidies have the potential to be harmful to fish stocks, particularly in the absence of effective management. In the real world, few if any fisheries are subject to management that is sufficiently “effective” to ensure that fisheries subsidies will not harm fisheries resources. Subsidies that contribute directly to increased fishing capacity or effort are among the most harmful.

Five categories of fisheries subsidies (subsidies to fisheries infrastructure, subsidies for access to foreign waters, subsidies to capital costs, subsidies to variable costs, and marketing and price support subsidies) can be expected to be harmful to fisheries resources under the management and bio-economic conditions found in the vast majority of fisheries today.

There remains substantial need for further discussion of subsidies associated with fisheries access agreements. It is generally acknowledged that access agreements have the potential to provide benefits, but inappropriately designed agreements can contribute to overexploitation and to inequities in the distribution of rents from fisheries resources. To date, these agreements have not returned the benefits hoped for by many developing countries, and have often been associated with stock depletion and with negative developmental results.

Properly designed fisheries subsidies can contribute to the achievement of sustainable fisheries, through government programmes for the reduction of fishing capacity, the improvement of fishing techniques, or the limitation of fishing effort, provided that effective safeguards are put in place. It has been shown that subsidies for decommissioning are likely to be harmful to fisheries resources under the conditions found in the fisheries where they have been and are likely to be used. Stringent policy conditions are necessary to accompany such a subsidy programme in order to avoid altered incentives to enter or exit the industry or to invest in modernization of purchase of new vessels. These safeguards could include mandatory physical scrapping of vessels, prohibition of introduction of new vessels, and commitment to time limits of the programme.

This analysis has used the “matrix approach” to assess the resource impacts of different types of subsidies under a number of management and bio-economic conditions. This analysis could usefully be developed further to include other environmental, social and economic impacts, aquaculture and the fishing processing industry. It could also address the dynamics of subsidies and fisheries management systems, elaborate further on the differences of scale of subsidies and their impact taking into account the differences of subsidies to small-scale and artisanal fishing and those to large-scale and industrial fishing. Such further analysis could feed into the international discussions and negotiations on fisheries subsidies in a variety of fora, including the WTO.

Table 11: Impact of Eight Categories of Fisheries Subsidies on Fish Stocks

	Effective Management ³			Catch Controls			Open Access		
	Over-capacity	Full capacity	Less than full	Over-capacity	Full capacity	Less than full	Over-capacity	Full capacity	Less than full
Fisheries Infrastructure	NH	NH	NH	H	H	NH	H	H	NH
Management Services	NH	NH	NH	NH	NH	NH	NH	NH	NH
Access to Foreign Waters	NH	NH	NH	H	H	NH	H	H	NH
Decommissioning	NH	NH	—	PH	PH	—	H	PH	—
Capital Costs	NH	NH	NH	H	H	H	H	H	H
Variable Costs	NH	NH	NH	H	PH	PH	H	H	PH
Subsidies to Income	NH	NH	NH	PH	PH	PH	H	H	PH
Price Support Subsidies	NH	NH	NH	H	H	PH	H	H	H

NH = Not Harmful⁴
 PH = Possibly or Probably Harmful
 H = Harmful
 — = Not Applicable

³ Note that “effective management” here refers to an ideal management regime in which legal and regulatory systems operate in such a way as to eliminate or radically reduce the “race for fish” incentives and in which cheating on quotas is practically eliminated. Such regimes are very rare in the real world.

⁴ Note that the term “not harmful” here is narrowly defined to mean that a given subsidy type under given conditions cannot create a direct economic incentive to overfish. This definition assumes the subsidies in question will not be able to encourage cheating on catch limits or other regulations. It also ignores possible political impacts of subsidies, such as the creation or maintenance of enterprises which may have a vested interest in relaxed management controls.

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