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On Modeling and Management of Capture Fisheries: One View

Modélisation et aménagement des pêches de capture: une optique

U.I. Enin

Abstract

Sustainability of benefits from capture fisheries has been a concern of fisheries scientists for a long time. The development of fisheries management models reflects the historical debate (from maximum sustainable yield to maximum economic yield, and so on) of what benefits are valued and need to be sustained. Social and anthropological research needs an increased emphasis on bio-socioeconomic models to effectively determine directions for fisheries management.

Résumé

Assurer la continuité des bénéfices liés à la pêche de capture est un souci que partagent les halieutes depuis longtemps. La mise au point de modèles d'aménagement de la pêche reflète bien le débat qui fait déjà histoire (rendement potentiel des pêches, maximum de rendement économique, etc.) sur l'évaluation des bénéfices et le besoin d'assurer leur continuité. La recherche anthropologique et sociale doit davantage mettre l'accent sur les modèles bio-socioéconomiques afin que puissent être dégagées les grandes orientations de la gestion des pêches.

Introduction

The term 'sustainable development' is probably the most 'catchy' phrase today. It came into common usage after the Brundtland Commission Report (WCED 1987) was published. Fishery biologists will be remembered as among the earliest originators of the sustainability concept. After Petersen (1894, 1903) distinguished between growth and recruitment overfishing in a stock of plaice, and Garstang (1900-03) showed that fish abundance in the North Sea declined by half under heavy fishing pressure, Russel (1931) delineated the four elements of fish population dynamics (the popular Russel's axiom) and identified maximum sustainable yield (MSY) as the aim of rational exploitation.

Building on the legacies of Thompson and Bell (1934) and Graham (1935), Schaefer (1954, 1957) developed the surplus production model, which related catch to stock size and fishing effort. The model determined MSY and the level of exploitation to achieve it, thus laying the foundation for the scientific management of fisheries

based on models. The advantage of the Schaefer model is that it requires simple and easily obtainable inputs (at least for industrial fisheries) such as catch and fishing effort. Its wide application in both advanced and developing countries bears testimony to its utility.

Gordon (1954) published the bioeconomic equivalent of the Schaefer model. Here, the catch was converted to its monetary value, and the effort to the cost of fishing. The model related total revenue (TR) to total cost (TC) of fishing (Fig. 1),

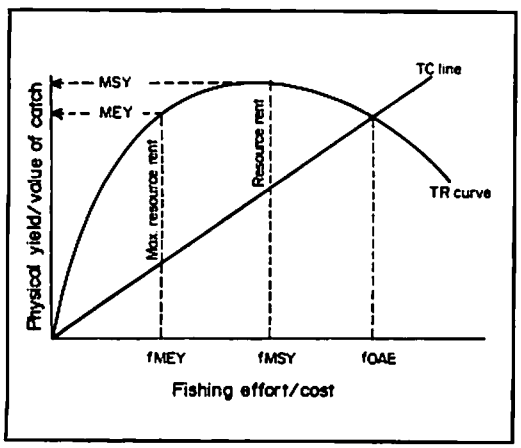

Fig. 1. Static Gordon-Schaefer bioeconomic fisheries model. f_{OAE} is the effort level of open access equilibrium (where resource rent is zero). Effort levels higher than f_{OAE} produces negative rent while lower effort produces positive rent. See text.

and its most significant finding was that maximum profits or rents from the fishery (i.e., the maximum difference between TR and TC curves) were achieved at a level of effort lower than that giving MSY. This level of economic optimum was named maximum economic yield (MEY).

Economists argue that since profit generation is the motivating factor in any economic pursuit, attempting to achieve MSY does not make economic sense since it lowers the profit to the fishery. As MSY is approached, a marginal increase in efforts results in a less than proportionate increase in yield. In other words, in terms of the additional effort required to get to MSY, the last tons of fish cost many times the average cost per ton. Hence, economists maintain that MEY should be the rational target of fisheries management. Based on this and other equally persuasive economic arguments, coupled with the western free-enterprise management philosophy, economists assumed an increasingly higher profile in fisheries management decisionmaking. It was probably the elegance of Gordon's model and the underlying arguments that virtually forced biologists to rethink the MSY concept (Gulland 1968; Gulland and Boerema 1973).

It has since been found that many fisheries, especially small-scale fisheries in developing countries and culture-related fisheries of natives in such regions as North America, cannot be managed on purely economic grounds. There are other competing interests and objectives that must be reconciled, including employment generation, increase in fish supplies for domestic consumption, income distribution and other equity issues, and access to fishing as a way of life. This has led to a greater role for socioeconomists, sociologists, and anthropologists in fisheries research and management decisionmaking.

Panayotou (1982) developed a socioeconomic model for the management of small-scale fisheries. Social considerations such as unemployment and other social problems were introduced into the bioeconomic model described above. Apart from the total private cost (consisting mainly of wages), unemployment and other social problems came into the model. The social cost of investment in fishing is high in a well-functioning economy with plenty of non-fishing employment opportunities and no serious social problems, and low or even zero where unemployment and other social problems are rife. It is in the latter situation that social factors weigh heavily in the choice of a fishing policy (Charles 1988). With the introduction of social considerations, the model showed that the maximum social benefits accruing to society from the fishery are found neither at MSY nor at MEY, but at some point in between them. This is the point of maximum social yield (MScY). In the situation of high unemployment, the wages of fishing labor become social benefits and not costs to society, thus inflating the social yield.

A major problem with the socioeconomic model is that, unlike MSY and MEY, estimation of MScY is problematic. Many of the social, cultural, or anthropological elements that must be

included in the model cannot be easily quantified or indexed. Also, the relative importance of these elements may be controversial to different interest groups. MScY seeks to balance multiple fisheries management objectives. This implies significant trade-offs between these objectives, and requires appropriate weightings of the objectives to determine their effects on successful fisheries management (Charles 1988). Because of these problems, it is yet to be seen how widely and successfully socioeconomic models can be applied in fisheries management.

In response to criticism of poor coverage of the human side (socioeconomic, institutional, legal, etc.) of fisheries management, D. Pauly pointed out (Fishbyte 9(2), December 1991), that he could not publish manuscripts he did not get. One could say, by extension, that very little research into those aspects of fisheries management was being undertaken.

Bailey (1985) was puzzled that, despite the fact that rural sociologists had established a strong record in contributing to the literature on domestic and international agricultural development and natural resource issues, "there was a near absence of rural sociologists in the literature pertaining to fisheries". He pointed out that rural sociologists are well-equipped by training and tradition to clarify the social impact of various policy options related to fisheries resource development and management.

Thus, there is the need for more intensive fisheries research from sociological and anthropological perspectives. The aim should be to develop more easily and readily determinable sociological and anthropological indices that can be incorporated into the socioeconomic models. Also, simple criteria that are readily acceptable to the managers, researchers, and industry practitioners must be developed for determining the level of exploitation and the appropriate mix of objectives that gives MScY.

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