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Conflicting goals in fisheries management—A study of the Norwegian cod fisheries

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ABSTRACT

A multi-objective programming model has been applied to investigate conflicting goals of the Norwegian cod fisheries. The goals included in this article are economic rent and employment. Fisheries managers are confronted with the problem of how best to allocate the total allowable catch (TAC) of cod among eight vessel groups. Compromise solutions taking into account both objectives by giving them equal weights in the multi-objective programming model are calculated and discussed. This article is an extension of an earlier article in which the trade-off analysis was performed using data only for North Norway and one particular year. The present analysis includes the entire Norwegian cod fisheries and is carried out using time series data for 2003–2007, examining the annual variations of key economic and technological parameters of the cod fisheries. Based on the results from compromise programming, the article discusses management and policy implications of reallocation of the TAC by vessel groups.

1. Introduction

Fisheries management deals with diverse and often conflicting goals. In Norway, fisheries management has traditionally included these four objectives:

- Sustainable fish stocks;
- Economic efficiency and profitability of the industry;
- Sustainable fishing communities throughout the country;
- Safe and healthy working conditions for fishermen [1].

These objectives correspond mainly to three commonly stated sustainable development objectives – ecological, economic and social development – in addition to the regional objective [2]. Multiple-criteria decision-making (MCDM) techniques are useful tools to analyse the trade-off of conflicting objectives. Good reviews of the application of MCDM techniques to fisheries management can be found in [3–5].

The main purpose of this article is to provide some insights about the policy implication of the trade-off analysis conducted in an earlier study [6], in which various "optimal" plans for quota allocation among vessel groups were highlighted. The earlier model was implemented using 1992 data for North Norway. The authors pointed out that general conclusions should not be drawn regarding the management of the cod fisheries from empirical data for only one particular year. One suggestion was to explore in future research the management implications of taking into account the annual variations of key economic and technological parameters of the cod fisheries. The present study can therefore be regarded as an extension of the earlier study with a policy oriented focus.

Four objectives of fisheries management were introduced above. The first objective, sustainable fish stocks, is an overall goal for fisheries policy and a guideline for determining the TAC in the yearly Russian–Norwegian fisheries negotiations. This article focuses on how Norway manages its share of the TAC and sustainable fish stock is therefore not included in the MCDM model. The second objective, economic efficiency and profitability of the industry will be included in the model using economic rent as the indicator for this goal. The third objective is sustainable fishing communities. To secure sustainable fishing communities, the single most important instrument is to create job opportunities in the local society. Therefore number of fishermen employed is used in the model as indicator to secure sustainable fishing communities. It might seem as a paradox that Norway is focusing on job creation in fishing communities. The country has a low unemployment rate, high net immigration and a high number of migrant workers. However, the job creation is concentrated in the largest cities. The official Norwegian policy is a more balanced regional growth in employment and for this reason job creation in rural areas is stated as an objective in fisheries policy. The last

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objective is safe and healthy working conditions for fishermen. There are a number of laws and regulations taking care of this issue that can be regarded as restrictions to exercise the occupation as a fisherman. This objective is not included in the MCDM model, but some comments to this goal are made in the summary and conclusion section. Economic rent generation and employment will be analysed using time series data for 2003–2007 for the cod fisheries in Norway. Applying time series data will make it possible to draw conclusions with greater certainty, which will be more useful as policy advice for fisheries managers.

2. The cod fisheries of Norway

2.1. The fleet

The cod fisheries in this article include catches of the main bottom species: cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), saithe (*Pollachius virens*), Greenland halibut (*Reinhardfius hippoglossoides*) and two species of red fish (*Sebastes marinus* and *Sebastes mentella*). These species are on the same trophic level within a complex ecosystem and hereafter these species will be refer to as "cod fish".

The cod fishery consists of a number of different vessel groups that vary both in size, gear use and handling of fish. This influences the composition and the quality of the fish landed. Table 1 shows how the vessels have been organised into eight groups. These groups are compatible with the vessel groups for the cod fisheries in the profitability study conducted by the Directorate of Fisheries in Norway [7], which is the main source of data for this study. Table 1 also gives the number of vessels by vessel group.

The first four vessel groups, the small-scale and the coastal vessels, have an operating activity that is very different from oceangoing conventional vessels and trawlers. They depend basically on fish in the coastal waters and each trip lasts from one to a few days. The small-scale and the coastal vessels use mainly passive gear types like gillnet, long line and hand line and, to a certain extent, active gear like purse seine and Danish seine. These vessel groups are also very dominant with respect to the number of vessels. There are 1054 small scale vessels (less than 15 m) which constitute 77% of all vessels in the population. The number of coastal vessels (15–28 m) is 219 or 16% of the total number. Altogether small scale vessels and coastal vessels account for 93% of the total number of vessels.

The oceangoing vessel groups consist of trawlers and conventional vessels larger than 28 m, which mainly fish with long line. The trawlers are divided into three groups. The factory trawlers are equipped with a fish processing line enabling them to process the fish at sea. However, today most of the factory trawlers do not utilise this equipment and only freeze dressed fish on board like most of the trawlers. The rest of the trawlers are commonly referred to as wet fish trawlers as they used to land the fish fresh, although today they are equipped with freezing equipment. In the categorisation made by the Directorate of Fisheries, the wet fish trawlers are divided into two groups based on how the quotas for the different fish species are allocated to these trawlers. The first group of trawlers has a full cod and haddock quota while the second group has less than a full cod and haddock quota. However, based on the fact that the vessels in the first group are considerably larger than in the second group, this article will refer to these two groups as "large" and "small" trawlers. The longliners and trawlers fish in the open ocean and are normally at sea from one week to several months. The total number of oceangoing vessels is 95 or 7% of the total number.

Table 1
Categorisation and number of vessels by vessel groups. Average numbers 2003–2007.
Source: Based on data from the Directorate of Fisheries. Bergen.

Vessel groups	Length	Number of vessels	%
Small-scale vessels	8–9.9 m	357	26%
Small-scale vessels	10–14.9 m	697	51%
Coastal vessels	15–20.9 m	179	13%
Coastal vessels	21–27.9 m	40	3%
Ocean going conventional vessels	> 28 m	38	3%
Factory trawlers		14	1%
Trawlers large		27	2%
Trawlers small		16	1%
	Total	1368	100%

2.2. The management

The Northeast Arctic (NEA) cod is by far the most economically important species for the vessel groups included in this study. More than 50% of the value of the landing comes from NEA cod catches. Saithe is the second most important species and haddock the third most important. Together these three species account for more than 80% of the value of the total catches in the cod fisheries. The NEA cod and haddock are shared species between Russia and Norway. Even though the NEA cod and haddock are straddling stocks that partly migrate into international waters, third parties like EU, Greenland, Faroe Islands and Iceland have recognised the joint responsibility of the two countries to manage these stocks. However, each year these third parties receive 14.15% of the total quota of NEA cod. EU has by far the largest share of the third party quota. The background for the quota share to EU is the fisheries by EU countries in the Norwegian and Barents Seas before the introduction of the EEZ in 1977.

Russia and Norway meet annually to decide on the total allowable catch (TAC) of the shared species. The focus of this article is on how Norway manages the cod and haddock quotas and other species that are not included in the Russian–Norwegian fisheries cooperation. As the aim of this article is to analyse the reallocation of the total quota by vessel groups, the focus of the management section will be on vessel group specific management and how these management tools can be used to improve the performance of the fishery in respect to the two objectives of employment and economic rent.

A limited entry scheme in the cod fisheries was first introduced for trawlers as early as 1938. This was formalised in the "Trawler Act" of 1951 stating that any fishing vessel wanting to use trawl for catching codfish had to obtain a licence from the Government. In 1978, a total quota (TQ) was introduced for the trawlers and in 1982 individual vessel quotas (IVQ) was introduced. The conventional vessels, however, operated relatively freely until 1989. This lack of management of the conventional vessel groups resulted in excessive fishing effort. The fishery managers feared that the stocks would collapse and the cod fisheries were closed in April 1989. This crisis led to a number of important institutional changes in the rebuilding of the fish stocks. The most important management measure was to close the fishery and to introduce individual vessel quotas (IVQ) also for the conventional vessels groups. To obtain an IVQ the vessel had to fulfil certain requirements with regard to historic catches. Those vessels that did not fulfil these requirements were allowed to harvest in an open group within a given group quota (GQ). Participation in the closed vessel groups was and still is limited by annual permits in combination with IVQs, the basic quota of the vessel [8]. In addition subsidy to the fishing fleet was reduced substantially and by the mid1990s the