FISHERIES MANAGEMENT: BASIC PRINCIPLES

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Summary

The natural resources on which fisheries are based, namely the fish stocks and their aquatic habitat, are rarely subject to individual property rights. In fact, especially when it comes to ocean fisheries, these resources are usually either no-one's property or property held in common by a relatively large collection of people, sometimes the whole nation. It follows that the utilization of these resources is subject to a serious economic problem referred to as the common property problem.

In fisheries the common property problem is so pervasive that even the richest fish stocks are decimated and all the economic benefits obtainable from these resources

wasted on excessive fishing fleets and effort. Examples of this abound in the world's fisheries.

In order to alleviate the common property problem, fisheries management is needed. Fisheries management consists of three administratively and logically distinct activities; (i) a fisheries management system, (ii) monitoring control and surveillance and (iii) a fisheries judicial system. Together these three components form the fisheries management regime. For fisheries management to be effective it is necessary that all three components of the fisheries management regime be in place.

Theory and experience have established that the only effective fisheries management systems are indirect economic ones, i.e. ones that alter the incentive of fishers. Direct restrictions, irrespective of whether they are biologically or economically focussed, have been found to be wanting. The most promising indirect economic fisheries management systems are those based on fisheries property rights. Many types of fisheries property rights are conceivable. A fairly common method in relatively sedentary fisheries is territorial rights (TURFs). Individual harvesting quotas transferable (ITQs) and non-transferable (IQs) have been introduced in many fisheries with good results. In small-scale, artisanal fisheries, where quota restrictions are difficult to enforce, community fishing rights may be constitute best way alternative.

1. Introduction

Fishing is fundamentally a production activity. The fact that some people fish for recreation and some people value fish stock conservation more highly than fish products does not alter this fundamental purpose of fisheries any more than similar attitudes toward nature alter the social purpose of farming or mining.

It follows that the social purpose of fishing is to maximize the net value of production, i.e. the difference between the (true) *(If market prices are incomplete or do not reflect social values, which might happen if the market system is weak or distorted by monopolies or taxation/subsidies, the necessary adjustments have to be made to assess true values)* value of landings and the (true) cost of producing these landings. In this way the contribution of the fisheries to the GDP and, therefore also, general welfare is maximized. Anything else implies economic waste. Economic waste means that goods that could have been used to increase someone's personal utility are squandered. That, of course, is not morally defensible.

Obviously, fisheries management must be judged by the same criteria. The more net output a fisheries management regime induces the fishing industry to produce the better it is. The best fisheries management is the one that induces the fishing industry to produce the maximum sustainable net output.

It may be noted that the highest net value of production that can be generated by the fishing industry also maximizes the potential of the country for economic growth. The reason for this is simple. The availability of capital, human *(Human capital consists essentially of education and training of the population.)* and physical, imposes an upper bound on the level of production. Economic growth is made possible by investment in human

and physical capital. The higher the net value of production in fisheries (as any other production activity) the more funds can be invested in human and physical capital. For developing nations struggling to generate the investment funds needed for economic growth, it is even more imperative to run the fishing industry efficiently than it is for the developed nations.

2. The Fisheries Problem

Ocean fish stocks have traditionally been regarded and arranged as common property resources. Thirty years ago the common property arrangement was virtually universal. Today, at the outset of the 21st Century, it is still the most common arrangement in ocean fisheries.

Common property resources, it is well known and established are subject to fundamental economic problems of over-exploitation and economic waste. In fisheries, the common property problem manifests itself as:

- Excessive fishing fleets and effort,
- Too small fish stocks.
- Little or no profitability and unnecessarily low personal incomes.
- Unnecessarily low contribution of the fishing industry to the GDP.
- A threat to the sustainability of the fishery

The fundamental problem is captured by the diagram in Figure 1.

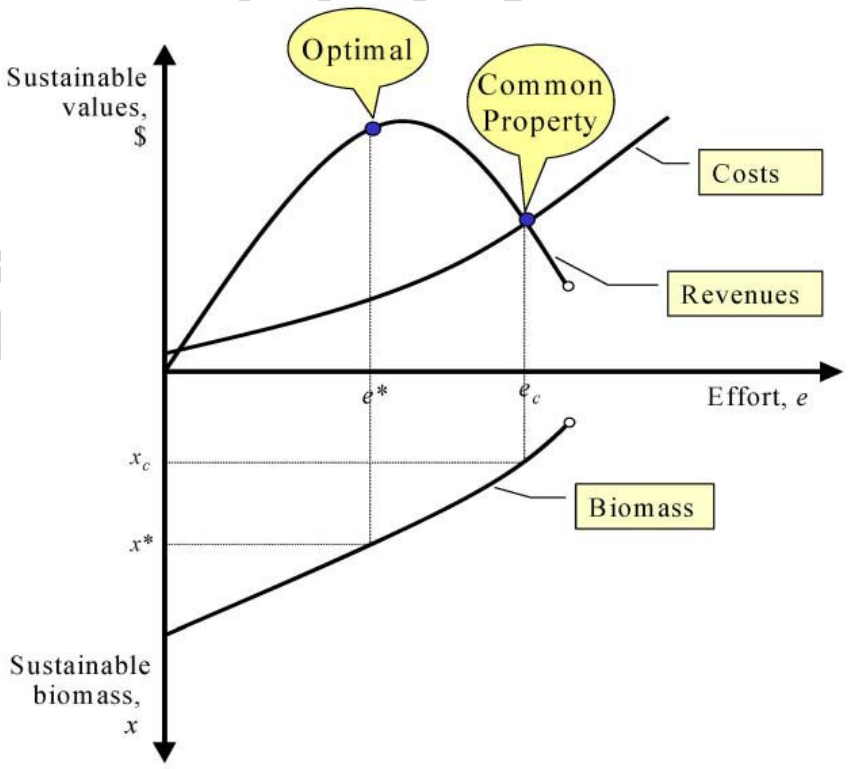

Figure 1: The sustainable fisheries model

Figure 1 illustrates the revenue, biomass and cost curves of a typical fishery as a function of fishing effort. Fishing effort here may be regarded as the application of the fishing fleet to fishing. The revenue and biomass curves are sustainable in the sense that these are the revenues and biomass that would apply in the long run, if fishing effort was kept constant at the corresponding level.

The lower part of Figure 1 describes what happens to sustainable biomass as fishing effort is increased. Note that the level of biomass is measured in a down ward direction so that the sustainable biomass is monotonically reduced as fishing effort is increased. If, as illustrated in the diagram, fishing effort exceeds a certain level, the stock size becomes insufficient for regeneration — the fishery is no longer sustainable at that effort level — and a stock collapse occurs.

The upper part of Figure 1, is the well known sustainable fisheries model initially forwarded by Scott Gordon in 1954. As illustrated there, sustainable revenues initially increase with fishing effort but at a declining rate as the biomass is reduced. At a certain level of fishing effort, sustainable revenues are maximized. If fishing effort is increased beyond this point, sustainable revenues decline as the biomass level is reduced still further. Finally, at a certain level of fishing effort, the fishery is no longer sustainable. The stock collapses and there will be no sustainable revenues. As drawn in Figure 1, costs, on the other hand, increase monotonically with fishing effort.

Looking at Figure 1, quickly reveals that the socially optimal level of the fishery occurs at fishing effort level e^*. At this level of fishing effort, profits and consequently the contribution of the fisheries to GDP is maximized. *(This assumes that all the relevant prices are true market prices.)* Notice that the optimal fishing effort e^* is less than the one corresponding to the maximum sustainable yield. Consequently, the optimal sustainable stock level, x^*, is comparatively high as can be read from the lower part of Figure 1. The optimal fisheries policy, consequently, is biologically conservative. Indeed the risk of a serious stock decline is generally very low under the optimal sustainable fisheries policy.

Under the common property arrangement of the fishery, the fishing industry will find an equilibrium at fishing effort level, e_c. At this level of fishing effort, costs equal revenues and there are net profits or rents in the fishing industry. If, at the same time fishing labour is paid its reservation wage the net contribution of the fishery to the GDP is approximately zero. *(The assumption that labour receives its reservation wage is, in the market economy, equivalent to assuming that the labour market is in equilibrium, including no involuntary unemployment. In a situation of excess supply of labour in the fishing industry or generally, even a common property fishery will generate some additions to the GDP.)* In other words the competitive fishery contributes virtually no net benefits to the economy. Notice that this is the equilibrium outcome in any common property fishery irrespective of the size and productivity of the underlying natural resource.

The reason for this unfortunate outcome is not difficult to understand. Assume for instance that fishing effort is below the equilibrium level, e_c. At this level of fishing effort there will be profits. This does two things. It encourages the existing fishermen to expand their operations in order to increase their profits. It attracts new participants

wanting to partake in these profits into the fishery. Thus investment in fishing capital takes place and fishing effort rises. Obviously this process will continue as along as there are any profits to be had in the fishery. Equilibrium in the common property fishery will only be reached when there are no profits, i.e. at effort level e_c.

Compared to the net-benefits obtainable by the optimal fishery, the common property arrangement is highly wasteful. Not only does it generate little or no net economic benefits, it also implies a much smaller biomass level. Indeed, as can easily be verified from inspection of Figure 1, the common property fishery may easily imply the exhaustion of the biomass altogether.

It is important to realize that fishermen subject to the common property arrangement can do nothing to avoid this wasteful outcome. When many fishermen share ownership in a common fish stock, each one has every reason to grasp as large a share of the potential yield as possible. Prudent harvesting by one fisherman in order to maintain the stocks will, for the most part, only benefit the other more aggressive fishermen without preventing the ultimate decline of the stocks. Thus, each fisherman, acting in isolation, is powerless to alter the course of the fishery. His best strategy is to try to grasp as large a share in the fishery as possible while the biomass is still large enough to yield some profits.

This in a nutshell is what has been called the tragedy of commons. The common property arrangement in fisheries basically forces the fishermen to overexploit the fish resources, even against their own better judgement. As a result, the potential benefits of these resources, no matter how great, become wasted under the onslaught of a multitude of users.

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Biographical Sketch

Ragnar Arnason is a professor of fisheries economics at the University of Iceland. With a master's degree in mathematical economics and econometrics from the London School of Economics, he received his Ph.D in natural resource economics from the University of British Columbia in 1984. He has been the chairman of the Institute of Economic Studies at the University of Iceland since 1994. Since becoming a professor in fisheries economics in 1989, professor Arnason has primarily conducted his research in the area fisheries economics and fisheries management where he has an extensive publication record with over 130 scientific articles and several books to his name. Professor Arnason has been a visiting scholar in several universities and international organizations including the FAO. He has organized a number of large scale research projects in fisheries including some funded by the EU. He has organized and participated in numerous international conferences on natural resource utilization including those sponsored by the World Bank, OECD, FAO, EU, WWF and many others. Professor Arnason has played an important role in the development of the Icelandic fisheries management system and was a member of the country's Committee on Natural Resources which was charged with the responsibility of proposing the best arrangements for natural resource utilization including the environment. Professor Arnason has also provided advice on fisheries management and environmental issues to the governments of several countries in Europe, America, Africa and Asia.