Encyclopedia of Earth

Economics of fisheries

Lead Authors: **Jonathan M. Harris (other articles)**
and **Anne-Marie Codur (other articles)**
Content Partner: **Global Development and Environment Institute (other articles)**
Article Topics: **Environmental economics *and* Fisheries**
This article has been **reviewed and approved *by the following Topic Editor:*** **Tom Tietenberg (other articles)**
Last Updated: November 7, 2008

Table of Contents

Introduction

(Source: NOAA)

Fishing in open seas is a typical illustration of a situation where the tragedy of the commons is likely to occur. All the conditions described by Hardin are met in this case: an unrestricted number of users, unfettered by any limits on their access, extract an increasing share of a resource until natural resources are severely depleted, sometimes to the point of no return. Fishers tend to have little incentive to practice conservation, for they know that if they do not catch the available fish, someone else probably will. Without limits in place, fishers try to catch as many fish as they possibly can.

Many traditional societies have evolved rules limiting the seasons or days when particular seafood species could be harvested (for example, prohibiting fishing at spawning season), or the amount that could be taken. In recent years these rules have in many cases been swept aside, in part due to population pressures. Other reasons for a break-down in the balance have included institutional failures, when some interest from outside of the community acquires the power to override the traditional patterns of property rights.

In industrial societies, the problem of over-fishing rapidly affects whole lake and ocean fisheries. Today the problem is global in scope:

> In 1871, the U.S. government created its first federal conservation agency, the Commission of Fish and Fisheries, in response to the decline of fisheries off the coast of New England and in inland lakes. Fishery declines were nothing new even in 1871 – in the mid-1800's drastic declines of whales had captured people's attention.
>
> Today as a result of excessive exploitation and other abuses, most of the highly prized marine fisheries around the world are on the verge of collapse. The warning signs are clear: 11 of the world's 15 most important fishing areas and 60% of major fish species are in decline, according to the U.N. Food and Agriculture Organization (FAO).

With the introduction of modern vessels like commercial trawlers, fishing became an operation of massive harvesting without discrimination. Fishers can now "wipe out entire populations of fish and then move on either to a different species

or to a fishing area in some part of the world."

One fourth of all catches are discarded, either because they are undersized or nonmarketable. Fish or marine mammals brought on board and then thrown back — usually dead or dying — are known as bycatch. "Global bycatch was estimated at more than 28 million tons in 1994... bycatch is associated with industrialized fishers who use indiscriminate gear to catch as much as they can, but generally keep only the fish they are legally permitted to catch or those that make money."

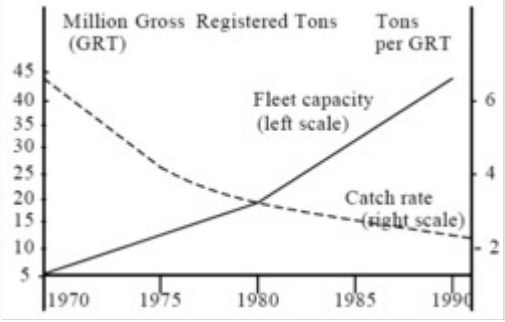

Figure 1: Global Fleet Capacity and Catch Rate, 1970-90. (Source: Global Development And Environment Institute, Tufts University)

In the case of a common property resource such as a fishery, economic incentives work in a perverse way. In response to declining yields, operators increase their effort, often investing in more efficient equipment, which accelerates the decline of the fishery. In most economic situations, competition and increased efficiency are good market characteristics, but in the case of a free-access resource, they lead to over-investment and rapid resource depletion. Between 1970 and 1990, global fleet capacity has more than quadrupled, whereas the average catch per boat (catch rate) has dropped by a factor of three (see Figure 1).

Policies for sustainable fisheries management

From an economic point of view, the problem with fisheries is that important productive resources – lakes and oceans – are treated as free resources, and are therefore overused. A simple solution is to place a price on the resource. In the case of a small lake, this might be done by a private owner.

Certainly no private owner would allow unlimited numbers of people to fish for free, depleting the stock of fish until the resource was worthless. S/he would charge a fee to fish, which would bring income to the owner and limit the number of people who would fish. While the owner's motivation would be to collect economic rent, the people doing the fishing would also benefit – despite having to pay a fee – because they would have access to continued good fishing instead of suffering depletion of the fish stock.

In the case of an ocean fishery, the private ownership solution is not possible. The oceans have been called a common heritage resource – they belong to everyone and no one. But under the 1982 Law of the Sea, agreed to under United Nations auspices, nations can claim territorial rights to many important offshore fisheries. They can then limit access to these fisheries by requiring fishing licenses.

Fishing licenses can be sold for a set fee, or a limited number can be sold at auction. In effect, this establishes a price for access to the resource. Notice that we can also view this as internalizing a negative externality. Each fisher now has to pay a price for the effect that one extra boat has in depleting the resource. The economic signal sent by this price will result in fewer people entering the fishery.

This approach, however, will not necessarily solve the problem of over-investment. Once a boat owner has paid for a license, there will be an incentive to obtain the maximum catch by adding new equipment such as sonar devices to track fish, bigger nets, and more powerful engines to travel further. There will also be an incentive to spend as much time as possible at sea, to get the maximum return for the investment in the license and equipment. If all fishers do this, the depletion problem might remain just as bad. A possible policy response is the use of individual transferable quotas (ITQ's).

Like transferable emissions permits, ITQ's impose a maximum limit on the quantity of fish that can be taken. Anyone purchasing such a permit can catch and sell a certain number of fish – or can sell the permit, and fishing rights, to someone else. Assuming the quota limits can be enforced, the total catch from the fishery will not exceed a certain predetermined level.

To determine the maximum sustainable yield level, policy-makers will need to consult marine biologists, who can estimate the sustainable level of fish population. Once ecological sustainability has been assured in this way, the permit market will

promote economic efficiency – those who can fish most effectively will be able to outbid others to acquire the ITQ's.

A more difficult problem concerns species that are highly migratory. Species like tuna and swordfish continually travel between national fishing areas and the open ocean. Even if good policies for resource management exist in national waters, these species can be harvested as a global resource in open access, which almost inevitably leads to the tragedy of the commons. Only an international agreement can solve an issue concerning global commons.

In 1995, the first such agreement was signed: The Convention on Highly Migratory and Straddling Stocks. "This convention marks the first international fisheries treaty or agreement to reject maximum sustainable yield as the standard for fisheries management, and the first to advocate a new standard: the precautionary principle." Rather than waiting until depletion is obvious, this principle suggests controlling access to the fishery early, before problems appear, establishing data collection and reporting systems, and minimizing bycatch through the use of more selective gear.

Demand-side issues: changing consumption patterns

The demand for fish and fish products is unevenly distributed. People in industrialized countries (about one fifth of the world's population), consume 40% of the global fish catch. But fish is especially important in the diets of people in developing countries, supplying them with a large share of their animal protein needs. With increasing population and income in developing countries, global demand for fish and fish products can be expected to grow steadily. But most ocean and inland fisheries are clearly at or near their capacity limits, or already in decline. World fish catch per person has not increased significantly for over 20 years, and may now be starting to decline.

About one third of world fish production is not consumed directly by humans, but is used as feed for livestock and in aquaculture. With appropriate economic incentives, other sources of protein, such as soymeal, might be substituted for fish in animal and fish feed. This would relieve pressure on fisheries, and potentially make more fish available for direct human consumption.

Shifting human consumption patterns is also important. Public education campaigns which identify fish and seafood produced with environmentally damaging techniques may lead consumers to avoid these species. For example, a boycott of swordfish aimed at stopping the decline of this species has gained the support of numerous restaurant chefs and consumers.

Ecolabeling, which identifies products that are produced in a sustainable manner, has the potential to encourage sustainable fishing techniques. Sometimes the products of certifiably sustainable fishing practices can command a slightly higher market price. In this case, consumers are implicitly agreeing to pay for something more than the fish they eat; they are paying a little extra for the health of the ocean ecosystem, and the hope that there will be fish to feed people in the future as well as in the present. These consumer choices give the fishing industry a financial incentive to use sustainable methods.

In economic terminology, we can say that consumers are internalizing the positive externalities associated with sustainable fishing techniques through their willingness to buy ecolabeled products. The certification of sustainable fish products can be done by governments or by well-respected private agencies. A prominent example is "dolphin-safe" ecolabeling, which has been instrumental in reducing the numbers of dolphin killed as bycatch during tuna fishing.

Another area where government policies can assist in internalizing positive externalities is the provision of subsidies — for example, to assist in developing or acquiring equipment designed especially to release bycatch, or to avoid major disturbances of the seabed.

Policies for ecological sustainability

While the identification of the maximum sustainable yield for a fishery can help to maintain an individual species, the issues of ecological sustainability are more complex. Depleting one species may lead to an irreversible change in ocean ecology as other, often less desirable species, fill the ecological niche formerly occupied by the harvested species. For example, dogfish and skates have replaced cod and haddock in major areas of the North Atlantic fishery.

Fishing techniques such as trawling, in which nets are dragged along the bottom of the ocean, are highly destructive to all kinds of benthic (bottom-dwelling) life. In large areas of the Gulf of Maine, formerly productive ocean floor ecological

communities have been reduced to virtual deserts by repeated trawling. Thus fisheries management needs to be guided by information about whole ecosystems, not just individual species.

The most rapidly growing area of fish production is aquaculture – fish farming, often in large offshore pens. Recent increases in world fish production have been primarily due to rapidly expanding aquaculture. However, from an environmental point of view aquaculture may pose as many questions as it solves.

Modern aquaculture techniques rely on “very intensive monoculture systems raising predominantly carnivorous, highly profitable species that demand large amounts of feed, water and fertilizers.” The economic returns from aquaculture do not take into account ecological losses such as habitat degradation. By converting diverse ecosystems to simple ones, a whole set and purifying water, cycling nutrients, removing contaminants and buffering the land from coastal storms.

Given the rapid growth in aquaculture, a global strategy to encourage less-resource-intensive forms of production is needed. Reviving and encouraging traditional pond systems, which used to be well-integrated with the local environment and within the boundaries of available resources, would contribute to minimizing aquaculture’s impact on the environment.

On a modestly local scale, inland aquaculture can be environmentally beneficial, encouraging multiple use of water systems for crops such as rice as well as fishponds. Whether ocean aquaculture can be practiced on a large scale without irreversible damage to ecosystems remains to be seen.

Further Reading

- Global Development And Environment Institute, Tufts University

This is a chapter from *Environmental and Social Issues in Economics (collection)*.
Previous: *Policy responses to climate change* | Table of Contents | Next: *Trade and the environment*

Citation

Harris, Jonathan and Anne-Marie Codur (Lead Authors); Global Development and Environment Institute (Content Partner); Tom Tietenberg (Topic Editor). 2008. "Economics of fisheries." In: Encyclopedia of Earth. Eds. Cutler J. Cleveland (Washington, D.C.: Environmental Information Coalition, National Council for Science and the Environment). [First published in the Encyclopedia of Earth October 23, 2006; Last revised November 7, 2008; Retrieved February 10, 2009]. <http://www.eoearth.org/article/Economics_of_fisheries>