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**Effects of Global Fisheries on Developing Countries
Possibilities for Income and Threat of Depletion**

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Abstract

This study deals with fisheries and trade, focusing on developing countries. Fish is globally traded, and for many developing countries, it is an important net export good. In most of these countries, fisheries are often characterized by poorly defined property rights, accompanied by overcapitalization where too many vessels and fishermen catch too few fish from too small stocks. Management is often de facto open access, where vessels with or without permission to fish land as much as they can catch due to limited monitoring and enforcement activities. Even in developed countries, many fisheries are poorly managed, and recent studies indicate that marine ecosystems are in global decline. While trade generally is beneficial for growth and welfare, the combination of pure open access and trade liberalization may both reduce welfare and stocks for a country—an outcome that can be reinforced by the common use of bad subsidies. However, trade liberalization may have an additional positive impact by promoting the development of property rights in response to increased fish exploitation. The WTO can play a role by adopting a broader classification of subsidies to help eliminate bad subsidies, such as like public support of vessel construction, fuel subsidies, or fishing rights outside developing coastal countries provided at limited or zero cost. The WTO can also assist by distinguishing good subsidies (e.g., improving fisheries management or improving monitoring and enforcement), which are desirable targets when rich countries allocate aid resource to developing countries.

Key Words: Fisheries, marine resources, property rights, trade and environment, WTO

JEL Classification: F18, Q2, Q22, Q56

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Håkan Eggert and Mads Greaker*

Introduction

Fish today provides the main source of animal protein for 20 percent of the world's population. At the same time, some 40 percent of the global fish production is traded internationally. During the period 1982–2002, the net exports of fishery commodities by developing countries (i.e., deducting their imports from the total value of their exports) increased from US\$ 4.0 billion to \$17.4 billion. This was greater than the net exports of other agricultural commodities, such as rice, cocoa, tobacco, and tea (Vannuccini 2004). Fish is indeed a global good, caught all around the world and exported for trade almost everywhere. The global seafood market offers a lot of opportunities, but also raises challenges in terms of how such aquatic resources are managed.

In developing countries, the exploitation of renewable marine resources, such as fish, crustaceans, and mollusks, is often characterized by poorly defined property rights, accompanied by overcapitalization where too many vessels and fishermen catch too few fish from too small stocks. Management is often de facto open access, where vessels with or without permission to fish land as much as they can catch due to limited monitoring and enforcement activities. Fisheries management can also include “regulated open access,” in which access to fishing is limited, fishing authorities place some restrictions on landings, and fishing may not be permitted throughout the whole year. However, the property rights problem is not being addressed sufficiently and the race to catch is still on. In fact, management success in terms of stock

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conservation may actually reinforce the problem of overcapitalization (Homans and Wilen 1997).

The global conditions of major fish stocks are severe. Recent studies show evidence that more than 20 percent of fish stocks have crashed, another fully 40 percent are overexploited, and the remaining 35 percent are fully exploited. The forecast is that many more stocks may collapse, and that over-fishing will not only lead to low yield and poor income but will actually threaten many marine ecosystems. They may lose their essential capability resilience, i.e., ability to adapt and recover from external shocks (Pauly et al. 2002; Worm et al. 2006). The main reason for this gloomy outlook is unsustainable fishing practices, which follow from six factors: 1) inappropriate incentives, 2) high demand for limited resources, 3) poverty, 4) inadequate knowledge, 5) ineffective governance, and 6) detrimental interactions between fishery sector and other aspects of the environment (FAO 2002). To address this problem, countries should focus on changing fisher motivation. By providing fishers with economic rights and accompanying responsibilities, incentives can be made more effective and governance improved, leading to individual and collective action to promote more sustainable fishing practices (Grafton et al. 2006). The most common form of rights-based fisheries—individual transferable quotas—has been shown to dramatically reduce the risk of stock depletion (Costello et al. 2008). The current performance of the world's marine fisheries is far below potential and the annually lost economic benefits are estimated at \$50 billion (World Bank and FAO 2008).

Trade is usually seen as a positive factor in improving the standards of living for a country's population. Based on the assumption that countries combine their resources in an optimal way to produce goods and services, trade offers an opportunity to achieve higher levels of consumption for all involved parties, compared to autarky. Hence, the general advice of economists has been to promote liberalization in trade, with the idea that developing countries will be better off if rich countries lower their tariffs and allow imports to increase. Similarly, foreign direct investment or joint venture projects in poor countries offer opportunities for technology diffusion and increased welfare (Bhagwati 2001).

More recently, a literature on trade and renewable resources has developed. Trade may be beneficial for welfare, but may also be problematic for resource conservation. In fact, when property rights are completely absent, trade can be detrimental to stocks and may also reduce the welfare of resource-exporting countries.

This paper deals with fisheries and trade, focusing on developing countries. Problems related to these issues are discussed, as are potential ways of addressing those problems.

1. Economic Development and Trade

The benefits from trade were first stressed more than 200 years ago by Adam Smith. His argument was that division of labor and specialization could benefit both parties in bilateral trading, where each party was assumed to be more productive in at least one type of goods production. This requirement of absolute advantages in order to gain from trade was relaxed in the next century by Ricardo. With a simple two goods–two countries model, he showed that even if one country was more productive in producing each of the two goods, both countries could be better off by trading. This would be achieved by exploiting what Ricardo called “comparative advantages,” which only requires that the difference in performance is not identical for all goods and that the lesser productive country increase its production of the goods where the gap in productivity is the smallest.

During the 20th century, these ideas have been refined, but the general conclusion is that countries can almost always benefit from trade. Companies within a country are likely to specialize in goods and services that require intensive use of input factors which are relatively abundant, and consequently relatively cheaper, in the country. When countries start to trade, factor-price equalization will occur, i.e., the relatively cheaper input will gradually gain in price and catch up with the price of the same input in other countries’ trading.

In the 1930s, the Great Depression in the United States led to calls for protectionist tariffs in order to provide domestic employment. Countries in Europe retaliated by increasing their tariffs and the ensuing trade war substantially hurt the economies involved and reinforced the negative impacts of the stock market crashes in the late 1920s. After World War II, the General Agreement on Tariffs and Trade (GATT) was created to reduce the high tariffs and other trade barriers. The first round of negotiations had 23 participating countries. After several more rounds, GATT was replaced by the World Trade Organization (WTO) in 1995, and in 2001 the most recent round of negotiation—the Doha Round—started with 144 countries and increased to 151 in 2007. Despite current criticisms, GATT and WTO must be regarded as great successes. The average tariff level on dutiable imports was reduced from 40 percent in the late 1940s to less than 5 percent by the beginning of 2000.

Free trade is also seen as an insurance against absence of competition. Companies that grow and enter the international export market often try to eliminate competition in their home market, sometimes with informal consent from their domestic governments because growth in export is assumed to be conditional on economies of scale. Under these conditions, free trade is

one of the few options for increasing competition and securing large values in terms of consumer surplus gains.

Hence, there is strong theoretical support for the importance of trade as a means of achieving economic growth—but what about the empirical evidence? There is a comprehensive literature investigating the relationship between trade and growth. Some issues are still debated because it is difficult to fully prove a causal relationship (Rodriguez and Rodrik 2000). Still, it is undisputed that countries which have successfully increased their income levels have also done well in the export markets. The gains are partly static gains of specialization and partly dynamic gains from the positive effects on total factor productivity (Bigsten 2007). Hence, trade policy is important for developing countries.

A couple of studies have estimated the potential effects of full liberalization of global merchandise trade and arrived at long-term figures in the range of a US\$ 200–300-billion increase in world gross domestic product (Cline 2004; Anderson et al. 2006). If a country experiences growth, even the poorest people in the population will also enjoy some real growth in income. The same applies at a country level, i.e., poor countries realize real gains from improved welfare that follows from trade liberalization. Trade-liberalization studies predict that half (or almost half) of the gains will accrue to developing countries. The figures from Cline and Anderson et al. do not account for potential gains from service trade liberalization or trade facilitation and productivity gains from increasing trade. The major positive effect for poor countries from complete global trade liberalization would be in the agricultural sector, which would also entail positive distributional effects for developing countries because their farmers and unskilled labor would most likely benefit from it (Hertel and Winters 2006).

Such liberalization is not within reach in the near future. Recent trade negotiations have aimed at reaching multilateral agreements within the WTO framework. Multilateral, reciprocal, non-discriminatory trade liberalization was the objective of the Doha Round, but it has not yet been fully achieved. Reaching this objective would mean lower levels of protection, yet would still not be completely free trade.

2. Trade and Renewable Marine Resources—Some Theories

The general arguments in the previous section in favor of liberalizing trade have not been challenged in a first best world—i.e., when all requirements for a well-functioning market economy are fulfilled, trade liberalization will lead to welfare improvements. At the same time, we note that it is a well-established result that a first best policy may not be optimal in the

presence of other imperfections. For example, when property rights are poorly defined for fisheries, trade liberalization may not always lead to welfare improvements. However, this general result does not provide much guidance, and for a long time economists did not look into the particular field of renewable resources and trade. Recently, however, this has changed. This section reviews some recent theoretical work in this area, which, *inter alia*, implies that trade may be problematic if fisheries management must deal with poorly defined property rights (see Bulte and Barbier 2005, including references).

Trade and renewable resources do differ in some respects from related fields in economics:

1. the institutional arrangement, as seen below in the two polar-opposite cases where “North” has optimal management and “South” has open access;
2. the dynamic nature of management, where stock size adjusts in relation to two opposing forces—harvest and net growth; and
3. the link between the harvested resource and its interaction with a complex ecological system (which may entail non-use values and biodiversity).

Fish stocks are not simply a production factor in fisheries; they also play a part in providing ecosystem resilience. The aim here is not to provide solutions to the difficult task of designing new international treaties or suggest how WTO should handle these issues but, rather, to elaborate on what recent contributions say about trade liberalization and how it may affect stocks and human welfare under various assumptions and management conditions.

An optimal fishery is often described from the perspective of how a single owner would manage one fish stock, where growth is assumed to follow a logistic function and harvest takes place according to the production function described by Schaefer. An unexploited fish stock will then reach a stable equilibrium—the carrying capacity—where natural mortality is evenly offset by recruitment and natural growth. Starting to fish will diminish the stock, which will then generate an annual net surplus growth that can be sustainably harvested. In the standard case, half of the carrying capacity stock will generate the maximum net surplus growth, or maximum sustainable yield (MSY). However, because the fish are assumed to be uniformly distributed and the catch assumed to be proportionate to the stock size, the social optimal stock size is slightly bigger than the MSY stock, where the reductions in costs of catching offset the reduction in revenues and thus maximize the positive profits (the resource rent).

If a country manages its fisheries in such an optimal way, opening up to trade is welfare-improving. There will be distributional effects, and while groups (such as consumers and producers) may lose or gain, overall gains will be larger than losses. If we assume that the country has abundant fish resources, the free trade price will be higher than the previous autarky price, and the optimal stock will be reduced. Hence, trade barriers may appear to promote resource conservation. (Such arguments have been made concerning trade, for example, in sea horses.) However, if the assumptions are relaxed, allowing for a positive stock externality (such as biodiversity benefits) and assuming that the harvest is sold both domestically and for export will diffuse this result. Under such conditions, it is unclear whether a tariff would increase or decrease the stock.

An open access fishery provides the opposite of an optimal fishery. Pure open access, often referred to as the tragedy of the commons, is a fishery where a large number of unregulated fishers harvest a fish stock without any barriers to entry or exit. Any positive profit generated by the fishery leads to an increase in fishing effort until the total cost of fishing equals the total revenues from fishing. In such a regime, or rather lack of regime, fishers are completely myopic and disregard the effects their behavior today may have on the catching possibilities tomorrow. The free entry that attracts more fishers and vessels, as long as profits are positive, will lead to a pervasive over-capacity and the resource rent will be completely dissipated. Hence, in a single market model, if a resource-abundant country with open access fisheries starts to trade, the higher world market price will lead to expanding fishing effort and decreasing fish stocks, leaving welfare unchanged. The two states—before and after trade—are equal in the sense that both are open access and profits are zero.

To make things a bit more complex, we can look at a small, open economy where the open access fishery model is combined with a Ricardian model of trade. Two goods are produced in the country; one is manufactured which only uses labor, and the other is a resource good which uses labor and the resource stock. There is full employment and both sectors are assumed to produce with constant returns to scale. Since both goods are assumed to be essential, they are both produced under autarky and the wage level is thus equal in both sectors. As a result, all rents in the resource sector are dissipated due to the open access where harvest is produced according to the Schaefer production function.

The ratio between the resource's intrinsic growth rate and the size of the labor force will determine the relative prices between manufactured and resource goods in autarky. If the ratio is high enough, the autarky price of the resource good will be lower than the world market price. The country can thus be considered resource-abundant and have a comparative advantage in

resource good production. If the country starts to trade, it will increase production of the resource good and export all of it. Several scenarios are possible, but the main point is that, due to the open access condition, harvesting can drive down the resource stock, leading to decreased landings and lower wages for the larger fraction of the labor force now working in the resource sector. Hence, a country which is heavily dependent on a resource industry may in fact be worse off with trade, compared to autarky (Brander and Taylor 1997).

Again, we note that initial assumptions are crucial. If the assumption of constant returns to scale is replaced by diminishing returns to scale for the manufacturing sector—which is possible in a developing country dependent on a resource sector with a locational disadvantage in manufacturing—the result changes. The country is better off with trade, despite the open access fishery, because trade gives it the opportunity to import manufactured goods and use more of its domestic labor force in the resource sector where returns are constant.

Developed countries often have better management, while developing countries have poorer management. So far, we have looked at both optimal or absent property rights in the fishery when considering the effects of trade. It is possible of course that some cases fall in between these extremes.

The first example is similar to the small open economy above. Using the simple notion of “North” for developed countries and “South” for developing countries, North and South are identical in terms of factor endowments, technology, and preferences. However, they differ in resource management, as North has optimal management and South has pure open access. This difference leads to an apparent comparative advantage. The countries have no reason to trade, but will trade due to this difference, and South will specialize in the resource good. Hence, the apparent comparative advantage in resources is due to a market failure that will be exacerbated by trade, and South may end up worse off from trade (Chichilnisky 1994).

We now revise the conditions and assume imperfect property rights in both North and South and no monitoring and enforcement in either country. Still, the problem with overuse of the resources is assumed to be worse in the South because more people exploit the common pool resource. Further, the utility of consumers depends on two produced goods, both of which use the resource as input, but to a different degree. One is a subsistence good and is less resource-intensive. It is assumed to be the main consumption at low-income levels, but if income increases, consumers will use all income above a given level to consume the second, more resource-intensive good. Furthermore, there are two production factors, the resource and labor, and production of both goods is made with fixed proportions of inputs. As a result, labor cannot

substitute shortage of the resource stock, and vice versa. The inability to substitute implies that there can be multiple equilibriums in autarky. For slow-growing species, there may be a uniquely low equilibrium where some of the labor force is not used with low stock levels—which resembles the situation in many developing countries.

But, what happens if North and South start to trade? With this fairly rich and complex model, there are several potential outcomes. If all labor is employed in both countries, total harvesting is not influenced by trade. However, the output mix may change if the South, with its apparent comparative advantage, increases production of the more resource-intensive good. When some labor is unemployed under autarky, total extraction may also increase with trade. In this model, trade may lead to inefficient flows, which can outweigh the general benefits from trade and decrease overall welfare in the South.

Trade also has the potential to lead to stock collapse in the South and trigger import and resource degradation in the North. This worst-case scenario can arise when property rights are also imperfect in the North. On the other hand, there are circumstances where trade makes both parties better off. Mixed outcomes are possible, of course, which can be interpreted as depending on parameter values. Trade liberalization can lead either to reductions or increases, both in terms of welfare and stock conservation (Karp et al. 2001). Ideally, an analyst may succeed in identifying the perspective most likely to occur for a set of given conditions. More generally, the model points to a key role for the intrinsic growth rate of a resource stock. Hence, slow-growing species and poorly-defined property rights, combined with free trade, imply problems.

The models reviewed so far have assumed poorly, moderately, or well-defined property rights, given exogenously, and the focus of the analysis has been on what would happen if such countries open up for trade. However, property rights are not given to a country deterministically (like its geography), but are developed like other market institutions, in order to facilitate transactions and protect scarce resources in the country (Copeland and Taylor 2004). Trade liberalization implies changes of market conditions and may well lead to changes in property rights. Hence, rather than treating property rights as exogenous, they can be seen as part of the market development and may be more accurately modelled as endogenously determined. Copeland and Taylor (2004) used such a framework to study the impact of changes in world prices on the enforcement of property rights. The outcome depends on the resource growth rates, time-preference rates, population size, regulatory enforcement, and the technology level. Based on these parameters, resource-rich countries will differ in their ability to enforce property rights as world prices vary.

The first group of countries—with poorly defined property rights—often has a large number of resource users with high time-preference rates,¹ slow-growing resources, and a government with limited enforcement abilities. In addition, they will be stuck in the open-access trap, where all of their resource rents dissipate. These countries are worse off with trade liberalization because the poor property rights imply that increasing prices only will involve more users, without generating any more resource rents, and will reduce overall welfare long-term as stocks are depleted.

The second group of countries—with moderately defined property rights—has open-access conditions for low prices, but increasing prices afford some protection for the resource(s) and a little resource rent is generated. For these countries, the limited management is developed by the increasing prices. Thanks to more secure property rights, trade liberalization—leading to higher prices—can improve welfare both in the short and the long term.

The third group of countries (well-defined property rights) will also experience open access if prices are low enough. As prices increase, management will develop to the intermediate level or even become fully efficient if prices are high enough. Hence, these countries are even more likely to benefit from trade liberalization and improve their welfare.

3. Trade and Fisheries: The Empirical Cases of Argentina and Tanzania

The theoretical work reviewed in the previous section confirms that both critics and proponents of free trade with renewable resources have valid points. Trade may be harmful to stock conservation and may even lead to welfare losses, but it can also generate benefits and may sometimes lead to improvements in stock conservation. What are the real world experiences so far? In this section, we review two cases, Argentina and Tanzania, examples of different experiences that reflect some of the issues discussed.

3.1 Argentina

In the 1990s, the government of Argentina adopted a far-reaching structural adjustment program, which implied several reforms, including a fixed foreign-exchange rate, a tight monetary policy, privatization of public utilities and enterprises, deregulation of markets and

¹ The users are myopic and assign considerable weight to what they get today, and rapidly reduce the value of future outcomes the more remote they are.

economic activities, and openness of trade regimes. As a result, several conditions changed at the same time, so the impact of the trade reform cannot be seen in isolation. Many of these changes came into play in Argentina's fisheries sector. Although its citizens did not have a high domestic consumer preference for fish, Argentina expanded its fisheries sector for export. It was a minor sector before this change, but started to grow at unprecedented rates until it became one of the country's most dynamic economic sectors. Value-added increased steadily and exports grew by almost 500 percent between 1985 and 1995 (Abaza and Jha 2002b).

The fisheries sector was characterized by a high degree of economic protection in the 1980s, where the most important legislation said that only Argentine-flag vessels could fish within the "extended economic zone (EEZ)." Hence, the initial expansion of the fleet came about mainly through incorporation of new Argentine-flag ships, some of which were owned by foreign capital with firms settled within the country. Several rules were modified in the early 1990s, which allowed imports of second-hand vessels and reduced the required proportion of domestic crew members. In 1994, Argentina signed an important agreement with the European Union—one quite different from the typical agreements previously made between EU and many African countries. One novelty was that it did not ask for a general authorization for EU-flag vessels to fish in Argentine waters. Further, it was based on subsidies from the EU to establish joint-ventures with local firms in order to provide access for EU member-country vessels within the EEZ of Argentina. While some saw this arrangement as an improvement (compared to previous agreements), severe deficiencies in law enforcement and other control measures plus widespread bribery and corruption undermined it and led to a crisis in the Argentine fisheries by the end of the century.

The development of Argentina's fisheries during 1985–2000 in many respects mirrored the textbook description of an open-access fishery. In 1990, landings were 500,000 tons. They gradually increased and peaked at 1,340,000 tons in 1997, followed by a reduction to 1,000,000 tons in 1999. At the same time, effort increased, seen by the increase in the aggregate motor power of the fleet fishing from 25,000 horsepower (hp) in 1990 to almost 200,000 hp in 1995.

An interesting sideline of this period is the role of developed countries, particularly the EU. The EU gave subsidies in conjunction with its agreement with Argentina (to gain access to the Argentine waters) estimated at US\$ 230 million. They were classified as "good" subsidies because it was assumed they were to reduce pressure on stock in European waters. Similarly, the collapse of the cod stocks outside Newfoundland led to a Canadian vessel buy-back program, where vessel owners received payments for withdrawing capacity and then sold the vessels to other parts of the world—mainly to developing countries, including Argentina. (This was yet

another example where public funds were used to shift excess capacity from rich countries to developing countries.) Further, the active EU role seems to have contributed to the rise in bribery and other substantial corruption practices. Vessel licensing was irregular, there were indications that catches were not being reported, and practices with permits to fish often did not meet required criteria.

In 1998, the European Court of Auditors scrutinized EU-subsidized programs of joint ventures which transferred capacity outside Europe—which at the time only took place in Argentina. Several strange situations were found and categorized as “bordering on the toleration of fraud” (Court of Auditors 1998), such as subsidies and overpayments for exaggerated capacity, including sunken and inactive vessels, vessels not suitable for the fisheries, and even non-existent companies. The audit concluded that the EU should revise its monitoring and control procedures and recoup misused grants.

The trade liberalization and the development of the fisheries sector in Argentina during the period 1985–1999 is an example of both positive and negative impacts. Fisheries production increased, e.g., fisheries exports and employment in the remote south (Patagonia) and in the harvest sector. The increased economic activities included improvement and growth of the fisheries fleet, technological innovations in the sector, creation of new markets and trade exchanges, and development of regional infrastructure, such as new ports and roads. In addition, it brought increased tax revenues to the public.

On the other hand, several negative effects have been documented. Fish biomass degraded and marine ecosystems experienced decline. In addition, corruption became endemic during this time, and over-capitalization developed, not only in terms of the fleet but also ports and other fisheries-related investments. Working conditions deteriorated and unemployment even caused social unrest, particularly when the declining hake catches led to stricter regulations. According to stakeholders directly involved in fisheries, the positive impacts outweighed the negative, but this position has been criticized. Abaza and Jha (2002a) used a cost-benefit analysis to estimate the potential gains of an optimally managed fishery, using MSY stocks as optimal size and a fairly high real social discount rate of 4 percent to arrive at a net present value of US\$ 5.1 billion. Hence, it seems fair to say that trade liberalization led to welfare improvement and reduced stocks, but the development was far from an optimal, implying that welfare gains could have been substantially larger.

In response to the declining fish stocks and catches in the late 1990s, Argentina revised its fisheries management. In 1997, Argentina passed the National Fisheries Law, which

implemented a quota management system for the fisheries. Under this law, the government set quotas and shares of individual transferable quotas, which were requisite for fishing and which were to be bought and sold in a secondary market. This reform met a lot of resistance and implementation has been slow. It is too early to assess the impact of the reform, but at the same time, it is difficult to say what would have happened without it, both in terms of stock conservation and welfare effects. As an example, the hake stock that was severely over-fished during the 1990s had an aggregate catch of 1,000,000 tons in 1999, and the corresponding figure in 2005 was 900,000 tons. Still, we note that trade liberalization and the increasing exports in the case of Argentina led to reconsideration of the fisheries management.

3.2 Tanzania

Lake Victoria is the largest tropical lake in the world and the single most important source of inland fishery production in Africa. Its waters are shared by Tanzania (49 percent), Uganda (45 percent), and Kenya (6 percent). In the 1950s and 1960s, two non-indigenous species—Nile perch (*Lates niloticus*) and Nile tilapia (*Oreochromis niloticus*), both higher-value species that were more easily caught—were introduced to compensate for depleted low-value small fish. This situation had a minor impact for many years, but during the 1980s, landed quantities were radically amplified and their value increased rapidly. Tanzania, as well as Kenya and Uganda, saw the establishment of fillet-processing industries by the lake, and the current export contributes to a substantial share of their foreign currency earnings. During the 1980s, Nile perch provided a new source of inexpensive protein for people around the Tanzanian shoreline—local fishers called it the “savior.” Later, a growing share of Nile perch catches began to be exported, primarily to Europe.

The rapid growth of Nile perch came at the expense of a severe reduction of the available number of species. Lake Victoria was known for more than 600 species of *Haplochromine cichlids*. About 40 percent of these species disappeared and the Nile perch seems to have been a key contributor to this mass extinction, along with environmental changes. Today the fisheries mainly consist of three commercially important species: Nile perch, the sardine-like dagaa (*Rastrineobola argentea*), and the Nile tilapia. Recent estimates show that Nile perch, dagaa, and Nile tilapia constitute 45 percent, 40 percent, and 8 percent, respectively, of Tanzania’s total Lake Victoria landings.

Entry into the Lake Victoria fisheries is open to anyone with enough capital and the necessary skills. There is no catch limit, and participating fishers thus can catch as much as the stock level and the capacity of their vessels allow. Fishing requires an annual license fee of about

US\$ 20, which corresponds to gross revenues from two days of fishing and cannot be seen as a limited access policy.

During 1968–82, total catches were fairly stable around 100,000 tons, with Tanzanian fishers landing roughly half of that. Then, for seven years, landings started to increase dramatically up to an all time high of almost 600,000 tons in 1989. From 1990–2003, some reductions were noted, but total landings remained quite stable above 500,000 tons, with a Tanzanian share of about 40 percent. The crude impression may be that Lake Victoria is experiencing stable open-access equilibrium, but there are several indicators that stocks may collapse.

A study based on data up to 1990 found considerable depletion of the Nile perch stock and warned that increasing effort (such as in the late 1980s) could soon lead to a stock collapse (Pitcher and Brundy 1995). The increase in vessels pretty much followed the worst case scenario until 2000 and continued to increase even more rapidly through 2002, but the stock has not collapsed so far. However, clear signs of a declining stock are apparent. A rough measure of catch per unit effort (CPUE), expressed as average catch per vessel per year, indicated a fairly stable level of biomass in 1968–82, with about 10 tons per boat per year. CPUE in 1983–89 grew steadily to 35 tons and then, equally steadily, declined to less than 10 tons in 2002.

The reaction to the upsurge in landings, which began in 1983, was quite slow and the number of fishing vessels stayed stable around 10,000 during 1968–85. At that time, each vessel had a larger crew. Rough “guesstimates” put the total number of fishers around 50,000 before the boom started. In 1986–2002, there was a dramatic increase in vessels, where some replaced sails with outboard motors and reduced their crew size in response to lower catches. The total number of vessels in 2002 was 60,000 and the average vessel had a crew of three, indicating that 180,000 fishers then exploited the stocks of Lake Victoria (Eggert and Lokina 2007).

Gill nets are the major fishing gear in Lake Victoria. Tanzanian regulation requires a minimum mesh size of 5 inches (127 mm) for Nile perch and tilapia, and 10 mm for dagaa. Previously, larger mesh sizes than required were frequently used, but today most fishers use the minimum size. As a result, the average size of Nile perch caught was reduced from 70 kg in 1981 to 7 kg in 1996. Catch per net declined by almost 60 percent in the Tanzanian section of Lake Victoria, and some fishers responded with new techniques, such as mounting multiple nets vertically to cover the whole water column. Such mounted nets were also tied onto boats with engines and towed slowly over a large distance. A more recent study concluded that doubling of

fishing effort over the next few years will result in a Nile perch stock collapse (Mkumbo et al. 2002).

Recruitment remains good, but too many immature fish are being caught. Nile perch feed upon dagaa and other small fish in the lake. Hence, a reduction in Nile perch is likely to be accompanied by an increase in dagaa and other small species. Such development has been confirmed in recent years and implicitly so by landings of dagaa that grew from 40,000 tons in 1986, to 100,000 in 1991, and 220,000 tons in 2000. The corresponding figures for Nile perch are 240,000 tons in 1987, 400,000 tons in 1990, and down to 240,000 tons in 2000. The over-fishing of Nile perch has not only meant an increase in the dagaa stock but also the re-emergence of several other native species in retreat or considered extinct. Hence, greater fishing pressure on Nile perch appears to be good for biodiversity (Matsuishi et al. 2006).

Regulation measures used in Lake Victoria includes licensing, closed areas/seasons, and bans on use of poison, dynamite, and other destructive gear (beach seines and mosquito nets). In 1998, the Tanzanian government, through the Lake Victoria Environmental Management Project, introduced local management units, commonly known as beach management units (BMUs). These units were established to enhance community participation in the surveillance and management of the lake resources. Although BMU leaders do not have legal power to arrest anyone, they can point out culprits to enforcement officials. Their most important task, and where they have been most successful, is helping prevent the use of poison or dynamite.

The most common infringements of regulations are the use of too-small mesh size and use of beach seines. Tanzanian fishers' compliance with the legal mesh size is low compared to what is generally found in studies of fishers in developed countries. Membership in a BMU did not influence fishers' decision to violate or not violate, i.e., always obey the mesh size regulation. An additional problem is the ubiquitous prevalence of corruption. According to Transparency International (TI), the TI Corruption Perceptions Index 2005 found rampant corruption in Tanzania. The fisheries sector was not exempt: all of the almost 500 respondents in the study had experienced arrest and 40 percent had used bribes to avoid being taken to court. In addition, non-violating fishers often used bribes to avoid the bother of court proceedings and risk of conviction despite being innocent. A more promising measure to reduce systematic landings of immature fish is the introduction of a slot size (55 cm to 85 cm) for Nile perch by the processing industry, which has promoted more mesh-size compliance among those fishing for Nile perch (Eggert and Lokina 2005).

Tanzania's open access fisheries in Lake Victoria and its export orientation since the mid-1980s have generated a substantial increase in welfare. At the same time, the rapid increases in export and the open-access nature of the fisheries have led to over-fishing of the major commercial stocks. So far, the attempts to improve resource management have been fruitless. From other examples in resource economics, we know that reducing the value of a resource may be detrimental to conservation, e.g., banning ivory trade lowered the price of ivory and led to more elephants being shot. Similarly high export revenues could be an input to reform management, which may be the case in Argentina. It is too early to assess whether its reform process initiated in the late 1990s will be successful, but it likely has halted the degradation of Argentine fish stocks. A parallel development is missing in Tanzania. The BMUs seemed like a first step toward management reform, but so far several field trips and interviews with management staff, BMU leaders, and fishers indicate universal agreement that access to BMU membership, and hence fishing in Lake Victoria, should stay open to all.

4. Fisheries Subsidies and the World Trade Organization

For a long time, coastal states could control only their nearby waters and the *Mare Liberum* idea, forwarded by the Dutch author De Groot in the 17th century, was also the practice in fisheries. This meant that fishing vessels from any country could catch fish as long as they were more than three nautical miles from the shore. Hence, almost all fisheries were, in a true sense, open access. Over-fishing is likely to have occurred at least locally by the beginning of the 20th century and, by the late 1950s, technological progress led to more obvious evidence of declining stocks, followed by *inter alia* the collapse of several North Sea herring stocks in the late 1960s. This process was reinforced by heavily subsidized fleet expansions in developed countries—such as Japan, the former Soviet Union, and countries in Eastern and Western Europe—which aimed at developing distant water fleets to race for catch on a global scale. In response, coastal states like Iceland and Peru started to claim extended fishing waters, which led to the extended fisheries jurisdiction (EFJ) and the creation of exclusive economic zones (EEZs) of 200 nautical miles by the late 1970s (later ratified via the UN Third Conference on the Law of the Sea in 1982). The establishment of EEZs dramatically changed the conditions for fishing with some 90 percent of the global catches within domestic waters. Still, the incentives for exploitation did not change within many countries, stocks were shared between two or more countries, and some fish appeared or occasionally migrated outside the EEZs. Poor coastal countries lack the capital to exploit their EEZs, while many developed countries have over-fished stocks which reinforces their problems with over-capitalization.

Governments around the world still provide substantial subsidies to their fisheries. A World Bank study arrived at a figure—which Milazzo (1998) described as “probably err[ing] on the low side, perhaps by a considerable margin”—of US \$14–\$20 billion annually. At the time, it corresponded to 20–25 percent of first-sale global landing values, and the OECD countries and China were responsible for up to 75 percent of these subsidies (Milazzo 1998). A more recent study estimated subsidies to be \$30–\$34 billion per year (Sumaila and Pauly 2006). This study also provided a classification of subsidies, where “good” subsidies support stock conservation by improving fisheries management, monitoring, and enforcement. “Bad” subsidies lead to growth in fishing effort and include public support of vessel construction and fuel subsidies.

A third category, labelled “ugly” subsidies, references ambiguous effects on fishing effort. Buy-back schemes and decommissioning programs are examples of “ugly” subsidies, which under ideal conditions may reduce fishing effort. However, in general, buy-back programs merely subsidize remaining vessels, which then increase their efforts (Weninger and McConnell 2000), and the overall effect of these programs is often very limited (Holland, Gudmundsson, and Gates 1998). In fact, if fishers expect future buy-back schemes, this may increase their willingness to invest in vessels and support long-term increases in fishing effort (Clark et al. 2005). As noted earlier, buy-back programs often accept the export of vessels outside the domain of the subsidizer, meaning that the effort is not at all reduced. Sumaila and Pauly (2006) found that 70 percent of the subsidies were “bad” and another 10 percent were “ugly,” with developing countries providing about 60 percent of the “bad” subsidies.

WTO has long considered subsidies as potential non-tariff barriers to trade. Currently the core multilateral attempts to discipline subsidies are stated in the WTO’s “Agreement on Subsidies and Countervailing Duties.” Articles 1 and 2 of the subsidies agreement define subsidy as including grants, loans, loan guarantees from a government, tax credits, and general price and income support, etc. Per usual, several potential loopholes exist. Article 8, for example, protects subsidies that assist disadvantaged regions and help adapt existing facilities to new environmental requirements. Complaints to WTO against subsidies generally require the complainant to show trade-related harm. Article 6.1 under the subsidies agreement provides presumptions for proving trade harm, referring to “serious prejudice.” One example is when the value of the subsidy exceeds 5 percent *ad valorem*. Hence, with subsidies of almost 20 percent of revenues, plenty of room exists to establish serious prejudice.

Regarding trade and marine resources discussed above, we note that weak resource management corresponds to an export subsidy on producers, which potentially could be met by countervailing duties under trade law (Reichert 1996; Yechout 1996). If agreements are made

and ratified within WTO, measures against member countries which deviate from the agreement should be considered, such as the use of border tax adjustments to support stringent emissions trading when addressing climate change (Ismer and Neuhoff 2007).

Article 25 of the WTO subsidies agreement obliges all members to formally notify the WTO of all subsidies provided them. Schorr (1999) found that less than 10 percent of global fishery subsidies, as defined in Articles 1 and 2, were actually reported to the WTO in 1996. Overall, the current WTO agreements provide some room for action against a fraction of existing subsidies, but so far little has been achieved. Sumaila et al. (2007) argued that the current Doha round should aim to 1) create a multilateral enforceable agreement, 2) terminate the exemption for developing countries which subsidize fisheries in order to develop fisheries for local demand and export when fish stocks in the developing countries are already over exploited, and 3) adopt a broader definition of subsidy, i.e., to identify “bad” subsidies per Sumaila and Pauly (2006). Compared to Articles 1 and 2, “bad” subsidies would also include government support of fuel, foreign access agreements, fishing port construction and renovation, tax exemptions, and general shipbuilding, irrespective of whether they are specific to the fisheries sector or not. Foreign access agreements paid by the EU, for example, are clearly a “bad” subsidy that increases fishing effort. However, at the same time, they provide valuable foreign exchange earnings to poor countries in West Africa and in the Pacific Islands. A shift in policy should be accompanied by some adjustment program for these countries in order to provide alternative earnings to accompany the reduction in over-fishing.

5. Discussion

Fish is a globally traded good. For many developing countries, it is an important net export good, but in most of these countries management is poor. Marine ecosystems are in global decline. The main reason is unsustainable fishing practices, which follow from six factors: inappropriate incentives, high demand for limited resources, poverty, inadequate knowledge, ineffective governance, and interactions between fishery sector and other aspects of the environment (FAO 2002). In order to address this problem, more focus should be put on changing the motivation of the fishers. By providing fishers with economic rights and accompanying responsibilities, incentives can be made effective and governance improved, leading to individual and collective action to promote more sustainable fishing practices (Grafton et al. 2006).

Trade liberalization is an important tool to generate economic growth and thereby address poverty. Yet, increasing trade combined with poor property rights poses an additional problem

for renewable resource management. For this paper, we reviewed some recent theories that analyze trade and renewable resources. The common theme is that one trading party, North, is assumed to have better management than the other, South, and the outcome is evaluated in terms of welfare and stock conservation. Simple models can yield clear-cut conclusions—such as trade improves welfare for both North and South, while stocks deteriorate for South. When the models are made more complex, the outcome is uncertain, but the intrinsic growth rate of a resource stock is often important. A slow-growing species and poorly-defined property rights combined with free trade increases the risk of both reduced stock and welfare.

Two countries that have liberalized trade and experienced dramatic increases in fish exports over the last 20 years are Tanzania and Argentina. The rising exports have increased welfare in both countries, but the gains have been far from optimal. Fish stocks have deteriorated rapidly in both countries, but the managerial response differed. In Tanzania, the Nile perch fishery in Lake Victoria is still open access, despite indicators that the stock is about to collapse. In Argentina, the rapid decline of fish stocks during the 1990s led to reforms by the end of the millennium.

WTO should continue its work on facilitating trade and removing distorting policies. Such policies not only reduce welfare but may also have a negative impact on fish stocks. A relevant example for fisheries is subsidies. The extent of success for the fisheries is ultimately determined by the WTO member countries. Hence, OECD countries—such as Japan and the EU, as well as Russia, Poland, Republic of Korea, and Taiwan—should stop using subsidies altogether. Together with other WTO members, they could promote a broader definition of subsidies to speed up their remission. In addition, adjustment programs that encourage developing countries to abandon subsidy exemptions are desirable.

Positive examples for developing countries exist. The Namibian government made serious efforts to improve its fisheries management when the country became independent in 1990 and has had some success (Bonfil et al. 1998). Monitoring and enforcement was also improved with support from Norway, which is an example of aid providing good subsidies. Aid programs have often been aimed at (and sometimes still are) increasing domestic fishing effort, which is unfortunate. Similarly, another type of bad subsidy that should be abandoned is the practice by OECD country governments of buying fishing rights from developing coastal countries and giving them gratis to their own fishing fleet.

Acquiring fishing rights in developing countries also has distributional concerns. The government receives the money while poor artisanal fishers lose their income. These fishers also

lose out to industrialized fishing fleets making illegal, unregulated, and unreported landings in developing countries, including so called “roving bandits” (Sumaila et al. 2006; Berkes et al. 2006). Support from rich countries to the fisheries sector in developing countries should avoid increasing or reallocating domestic over-capacity and, rather, support capacity building in fisheries management, such as stock assessment and monitoring and enforcement.

Copeland and Taylor (2004) pointed in the direction that many countries are better off from trade because it has both a direct welfare effect from higher prices and an indirect welfare effect from improved management. At the same time, other countries lacking strong or efficient institutions are trapped in an open-access state where trade lowers welfare. Hence, the greatest future challenge for researchers, politicians, and other policy makers is to find ways to support development of institutions and property rights in countries burdened by the open-access trap to achieve a sustainable use of marine resources that would enable them to benefit as well from the welfare-improving effects from trade.

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