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The Applicability of Individual Transferable Quotas for the Fisheries of Lake Victoria

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Abstract
Their common-pool resource characteristics make fish stocks susceptible to overexploitation. Lake Victoria, the largest inland fishery in Africa, has seen dwindling fish stocks and profits in recent years. Entry to Lake Victoria is unrestricted and regulation is instead characterized by restriction on gears and fishing periods. *Individual Transferable Quotas* (ITQs) have gained traction in recent decades and are used to transform fish stocks from being common-pool resources into being properties with entry restricted to quota owners. This papers sets out to evaluate whether ITQs could improve the profitability and sustainability of the fisheries of Lake Victoria, and if an implementation of them is possible. By studying the theoretical effects of ITQs, the experiences from ITQ managed fisheries, and the fisheries of Lake Victoria, the author concludes that ITQs would be beneficial for the lake and that an implementation is possible in the long run.

Keywords ITQs Common-pool resources Overfishing Lake Victoria

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Introduction

In centuries past when population and technology levels were lower, the impact of mankind's resource gathering was limited. Today, the situation is different and sustainable management of natural resources has become a pressing issue for the human community. With persistent population growth and increasingly efficient technology, the issue is bound to increase in importance.

One resource that is in peril of depletion is fish. Once, it was a widespread view that fish stocks were inexhaustible and that mankind could not affect their abundance. This sentiment is captured in a quote from 1883 by the scientist T.H. Huxley. He wrote (Gordon 1954, p. 126): "...probably all the great sea fisheries, are inexhaustible: that is to say that nothing we do seriously affects the number of fish. And any attempt to regulate these fisheries seems consequently, from the nature of the case, to be useless." This optimistic view had some proponents well into the twentieth century. Today, however, scientists paint a bleaker picture. In 2006 it was estimated that more than a quarter of all commercial fish stocks had already collapsed because of overexploitation and environmental encroachment, and that if trends continue, all commercially fished stocks will have collapsed before the middle of this century (Worm et al. 2006).

An extinction of the world's fish species would not only be disastrous because of the intrinsic value of fishes, it would also have far-reaching consequences for the human species. Fish is the single most important protein source for the world's human population (Tidwell and Allan 2001). Considering the renewable nature of fish stocks, the situation is not irreversible. And indeed, much effort has been exerted by scientists and governments around the world in order to find a remedy. Although a wide variety of solutions have been put forward, debate has often centred on the fact that open access to fish resources creates incentives for short-sighted exploitation rather than careful management.

In the last couple of decades, *Individual Transferable Quotas* (henceforth: ITQs) have gained traction among economists and fisheries scientists for their theoretical effects on fish stocks and profitability, and by account of their success in many fisheries. In essence, this quota system is intended to transform fish stocks from open-access resources into properties with entry restricted to quota owners.

ITQs have predominantly been implemented in the fisheries of industrialised countries, for example New Zeeland, Iceland and the United States. The problem of overfishing, however, knows no political boundaries. Many vulnerable and important fish stocks live in the waters of developing countries, where fish may be an important source of food and income, and creating sustainable fisheries thus an urgent matter.

One fishery in need of change is Lake Victoria. The lake, shared by Kenya, Tanzania and Uganda, has had a troubled history marked by overexploitation and the introduction of ecosystem-altering exotic species. Nevertheless, the lake has seen record catches in the last decades and remains to this day the site of Africa's largest fresh water fisheries. But in recent years there are troubling signs that fish stocks in the lake have diminished and that current catch levels are not sustainable in the long-run. Further, the profitability of the lake's fisheries is deemed by researchers as much below its potential (Arnason 2009; Balirwa et al. 2003; Matsuishi et al. 2006).

There is no catch limit in Lake Victoria and entry is unrestricted. The authorities have instead chosen to regulate catches by banning fishing during certain months and by restrictions on gear. Judging by the state of Lake Victoria's fisheries, this seems to be an inadequate response (Njiru et al. 2008). The question of whether ITQs could be used as the resource management scheme in Lake Victoria is interesting not only for the sake of the lake itself and the people living in its vicinity, but also for terms of principle. The fisheries in Lake Victoria are gigantic in scale. Commercial fishing exists side by side with artisanal fishing and the total number of people depending economically on the fishing industry is estimated at 3 million (Njiru et al. 2008). This contrasts with the waters in which ITQs have been established at present. A successful establishment in Lake Victoria could perhaps set an important precedence for other water bodies in the developing world.

No thorough study on the possibility of implementing ITQs in Lake Victoria has been made, however Brown et al. (2005) and Arnason (2009) have discussed ITQs in the context of Lake Victoria and both suggested that ITQs could be a fitting treatment for the ailing lake, based on their success in other fisheries. However, experience from around the world shows that the implementation of ITQs can be an arduous process and that success is not guaranteed. The purpose of this paper is to evaluate whether ITQs could be used to improve the profitability and sustainability of the fisheries of Lake Victoria, and if an implementation is possible. This purpose is manifested in the question this paper sets out to answer: are ITQs applicable for the fisheries of Lake Victoria?

To achieve the purpose of this paper we need to know how ITQs work and what they can do, the conditions under which ITQs can be successfully implemented, and the nature of the problems afflicting Lake Victoria. The literature on the respective topics of Lake Victoria and ITQs is vast, which necessitates a selection. How this selection is made will be expanded upon in the following sub-section.

Structure

The structure of this paper is intended to step-by-step reveal to the reader the theories and facts that are relevant for the subject matter. The next section (section 2) will put the paper in a context by giving a brief review of common-pool resources and their associated problems. Section 3 will describe why overfishing is such a widespread phenomenon in open-access waters, as well as provide definitions and information needed to understand fishing management. Section 4 is a theoretical and empirical review of ITQs intended to demonstrate some of their effects on fisheries, how these quotas can solve the problem of overfishing, and to present the pre-requisites for an implementation of them. Section 5 is an empirical review of the material covering the historical and present status of fishing and fishing management in Lake Victoria. In section 6 the key-characteristics of Lake Victoria will be analysed in light of the pre-requisites for an implementation of ITQs. Finally, in section 7 the conclusions will be presented. This section will in addition contain reflections intended to widen the scope of the paper by not just asking what ITQs can do for Lake Victoria, but also what Lake Victoria can do for the body of knowledge concerning ITQs.

Common-pool resources

In this paper the terms common good and common-pool resource are used interchangeably and the definition that is used is borrowed from Elinor Ostrom. She writes (2000, p. 148): "Common-pool resources are natural or humanly created systems that generate a finite flow of benefits where it is costly to exclude beneficiaries and one person's consumption subtracts from the amount of benefits available to others."

H. Scott Gordon was one of the first to argue that the problem of overfishing could not be solved purely by biological measures. He particularly emphasised the common-pool resource characteristics of fish stocks, insisting that overfishing had its cause in the economic organisation of the fishing industry and that economic analysis was essential in finding solutions (Gordon 1954). The implications of non-exclusivity and rivalry for a good are significant, and much ink has been spilt on the subject.

Tragedy of the commons

The problems created by common-pool resources are captured in a concept called *tragedy of the commons* (Henceforth: TOC). The term was coined by Garrett Hardin (1968) in an article in which he argues that the problem of managing commons are not soluble by technological means, but instead require a change of mind-set. To illustrate TOC he uses an example of a pasture with unrestricted entry, used for grazing. All herders will want to keep as many cattle as possible on the pasture, knowing that all the benefits of adding cattle will befall themselves while the downside is not felt by them alone but shared with all cattle keepers.

This incentive structure is not conducive to sustainable usage. Instead, the rational goal within these constraints is to extract resources faster than what your rivals can extract. The end-result of such a usage scheme is often depletion or destruction of the good, to the detriment of all involved. In his assessment of solutions, Hardin rejects voluntary withdrawal or an appeal to the users' temperance (1968, p. 1247): "When we use the word responsibility in the absence of substantial sanctions are we not trying to browbeat a free man in a commons into acting against his own interest?"

Hardin's solution to the problem of diverging individual and collective goals is what he calls "a mutually agreed upon coercion", which can take the form of government regulation, a privatisation of the common, or by giving it the status of a public property with restrictions regarding entry and use (Hardin 1968). As we shall see, other authors have disagreed with the notion that governmental intervention is necessary to manage common goods.

Collective action

Ostrom (1990) recognised the similarity in the underlying mechanics of TOC and *the prisoner's dilemma*, a classic puzzle from game theory. In both cases, there are incentives for individual decisions that in the aggregate will lead to irrational outcomes. Simply put, the participants choose to act in ways that make them worse off than they could be. However, she writes that the tragedy of the commons may not be as inevitable as Hardin suggests. Indeed, Ostrom finds many examples of healthy common-pool resources around the world that are governed by local communities. One example is grazing grounds in Swaziland that for centuries have been protected by user associations that enact and enforce rules concerning the amount of livestock on the grounds. Ostrom's main point is that government intervention is not the best solution, since governments often lack knowledge of local conditions. She notes that in order for a group to obtain sustainable management of a common-pool resource, a certain set of institutions for collective action must be in place, such as clearly defined boundaries of the group accessing the common good and locally adapted rules that are decided and monitored by those who are affected by them.

Owner-rights

Hardin (1968) and Ostrom (1990) agree that arrangements are needed so that free entry to commons is avoided. The main difference between their views is on how these arrangements should be created and upheld. Open-access has been identified as the central obstacle to sustainability within the specific context of fish stocks too. Paulrud and Waldo (2011), for instance, argue that owner-rights are essential in order to align the economic interests of the fishermen with other stakeholders' interest in the well-being of oceans and lakes. One specific owner-rights solution is the aforementioned ITQs. But to properly evaluate whether they are a viable solution for Lake Victoria, much additional information is needed.

The Economics of Fishing

So far this paper has dealt with common-pool resources in general. This section will delve deeper by describing the economics of fishing in unrestricted waters. The intention is to uncover the mechanisms which lead to open-access fisheries being neither biologically nor economically sustainable, and to provide definitions for important terms used in future sections.

Two characteristics highlight the usefulness of economic analysis when it comes to designing fishing policies. First, fish stocks are an interactive resource because their size is a function both of biological rules and human actions. Second, there are many harvest levels with which extinction can be prevented, necessitating a choice to be made between them. Tietenberg and Lewis (2009) emphasise this notion and add that many approaches to fisheries management have historically been erroneously focused on maximising total catches rather than net economic benefit. This is misguided, because even if a fishery is biologically sustainable it may not be economically sustainable. Low profitability makes conservation measures difficult to apply and incentives to transgress the regulations may gain a foothold.

Why is there a problem with open-access fisheries?

Fish stocks are sometimes singled out as a resource especially susceptible to overexploitation. There are several reasons for this. It is hard to establish conventional ownership over fish stocks by virtue of their often non-stationary nature and when it comes to larger fisheries, restricting entry may be difficult since water is not easily enclosed. Further, what is caught by one fisherman cannot be caught by another, and catches made today affect the sizes of catches tomorrow.

Tietenberg and Lewis (2009) identify two costs arising from unrestricted fishing - a contemporaneous external cost and an intergenerational external cost. The former stems from the fact that too many resources (boats, fishermen, effort) are committed to the harvest and the latter is a result of the reduction of future stocks by overfishing. These forces combine in making the present and future rate of return lower than they could have been.

Why is unrestricted fishing economically and biologically unsustainable? Presume a fishery is in a state in which it is maintaining biologically sustainable levels of catches, and that each fisherman earns a profit. Further presume that open-access is introduced. The profit being non-zero will attract new entrants until the point where marginal benefits equal marginal costs for the last entrant. Too many fishermen will then be fishing after too little fish. In all likelihood, this will not only depress profits but also lead to overfishing since the asset value becomes zero and only the use value keeps its relevance. The long-term survival of a fish stock harvested by such means will be at the mercy of the efficiency of the catching techniques used (Tietenberg and Lewis 2009).

The income in an open-access fishery is the money received from selling the catch, whereas the costs are the investments in boats, labour and so forth. Crucially, the raw material in the industry, namely the fish, is cost-free and the cost of declining stocks is not included in the cost functions of fishermen. As long as the income exceeds the costs of catching, fishing will be profitable for an individual participant. From a societal point of view however, too large a fishing fleet will fish after too small a stock, and the fishery will be unprofitable (Paulrud and Waldo 2011).

What is sustainability in a fishery?

Authors sometimes talk of the relation between fish stocks and catches as akin to that of capital and interest. This can be illustrated by making a comparison with personal savings. Savings are a renewable asset in the sense that interest, r, is accumulated over time. Barring any other sources of income, the saver is faced with the decision to consume more than or less than r. A consumption that is greater than what is saved will decrease the future earnings from interest and vice versa. Thus, the savings rate will affect future consumption levels. It is not hard to utilise this line of thought in the management of fisheries. The decision of whether to consume or save is analogous with the decision of whether to catch or to abstain from catching (Gordon 1954).

A *sustainable yield* is defined as a catch level which is equal to the growth of the fish population. Barring any other influences, such a catch level will hold the population constant in terms of size. Since growth rate is a function of the population level and there are many potential population levels, there are many different sustainable yields. The *maximum sustainable yield* is consequently equal to the maximal population growth. In the short run it is possible to exceed the maximum sustainable yield, but doing so will reduce population levels (Tietenberg and Lewis 2009).

Effort matters

The fisher does not choose the volume of the catch beforehand, simply because it cannot be known for sure. Rather, he or she chooses how much effort to exert. This is the logic behind the concept *catch per unit of effort* (Henceforth: CPUE).[1] Measuring effort levels together with catch levels are helpful in determining the health of a stock. It is possible to increase or keep catches constant even in a declining stock. Indeed, there are many examples of fisheries where catches were at their highest level just before they collapsed. The effort used will however most likely increase as stocks decrease. CPUE is not only a useful measure for conservation purposes, it can also tell something about the profitability in the fishery. Higher effort is associated with higher costs because of investments in equipment and labour. It is possible to achieve a certain yield level for a small stock by exerting high effort as in a large stock by exerting low effort. In fisheries with free entry, individual and total effort levels will often be higher than if entry is restricted, because of a larger number of participants and smaller stocks (Brady and Waldo 2008).

Regulatory approaches

The rules of the game influence the players' actions. In an open-access fishery, there is no point in unilaterally improving behaviour since catches abstained from will be caught by someone else. Fishers are seeking to maximise their profit within the constraints they face, and conducting fishing operations in a manner that will overexploit the fish stocks in the long run is perfectly rational from a business point of view in an open-access fishery. Thus, in order for change, the rules of the game need to be changed.

If entry is free and owner-rights are not established, a command and control approach such as forbidding certain techniques, closing fishing areas or imposing temporary bans may in the end not lead to lower catches, but only to larger expenditures to catch the same volume of fish. The incentives fishermen face will not change in any substantial way, but their means of conducting fishing will. In such a fishery, the rational thing to do will still be to try to increase one's share, but legislation on gear and so forth will make it costlier to do so. In light of this it becomes clear that fisheries stand to gain by a regulatory approach that limits the number of fishermen and improves their behaviour.

[1] Determining effort levels can be somewhat complicated. The boat's engine capacity, level of electronic equipment, and size of crew and so forth must be taken into account (Brady and Waldo 2008). For our purposes though, it is enough to note that a higher CPUE is better.

McCay (1995) writes that the notion that open-access was the greatest obstacle to sustainable fisheries, was prominent in the debate well before the idea behind ITQs was formulated General quotas have been used extensively, but they not only often fail to solve the initial problem, but also spawn new ones. In a general quota system the fishermen are often engaged in a *race to the fish*. In anticipation of the quota being reached and thus fishing halted, fishermen will try to catch as much fish as possible as fast as possible. To avoid ending up a loser in the race to fish, participants often turn to investing in boats and fishing gear. This in turn often leads to increases in effort to make use of the equipment, exceeded quotas and escalating costs, short seasons with widely fluctuating market prices, and hazardous working conditions (McCay 1995; Paulrud and Waldo 2011; Costello et al. 2008).

One regulatory response to this problem has been to allot individual quotas with certain user-rights to individual vessels or fishermen. The first fisheries to make these quotas transferable were the herring fisheries of Iceland, which following a total fishing moratorium implemented individual quotas in 1975 and made them transferable four years later (Chu 2009). Transferability made market forces responsible for how quotas were allocated and in turn how capital and labour were utilised in the fishery. With this, Individual Transferable Quotas had been introduced (McCay 1995).

Individual Transferable Quotas in theory and practice

The following section is intended to give an understanding of ITQs in general, how they affect fisheries in theory and practice, and the conditions needed for them to be implemented and work successfully. The overarching goal of ITQs is to prevent overfishing and to reduce excess fishing efforts by transforming fish stocks into collectively owned properties with owner-rights (McCay 1995). ITQs are not restricted to the realm of theory. By 2009 over 249 species in 18 countries were managed by ITQs and the catches made in ITQ programs amounted to 10 percent of the total marine catches that year (Chu 2009).

While it has long been established that ITQs help in allocating resources efficiently and downsizing industries, the empirical evidence speaking in favour of ITQs as conservation measures seemed for a long time to be inconclusive (McCay 1995). In response to this, Costello et al. (2008) published a study with the intent of isolating the causal effect of ITQs on fish stocks. By collecting a database of 11,135 of the world's commercial fisheries from 1950 to 2003 and using advanced econometric methods to isolate the ceteris paribus effect of ITQs, they found that the fraction of collapsed fisheries using ITQs was half that of the fisheries not using it. Further, ITQs not only slowed down the decline in fish stocks but in many cases halted it, and in some reversed it.

The basics of ITQs

In setting up an ITQ system the first step is to determine the *total allowed catch* (henceforth: TAC). The TAC is an annual total quota for a single species, most often stated in terms of weight and typically determined by fisheries experts together with fishing authorities (Arnason 2002). Once the TAC has been decided upon, the next step is to determine the number of quotas and how to allocate them among the fishing population. This step is generally considered to be the most cumbersome in the process. The problem is twofold: who are eligible and what should be the allocation mechanism?

There are several approaches. The government can auction off the quotas, in which case the rent produced befalls itself, or it can hand out the quotas to fishermen in proportion to their historical catch. In this case the rent befalls the current generation of fishermen (Tietenberg and Lewis 2009). Neither method is problem-free. An auction might disproportionally benefit affluent or powerful actors. On the other hand Chu (2009) notes that if quotas are given according to historical catches, unscrupulous fishermen may provide falsified catch data.

Holding one of the quotas gives the long-term right to a set quantity or weight of fish or to a percentage of the TAC. Percentage based quotas are better suited to protect the stock, since it allows for flexible changes of the TAC, but they increase the financial risk for quota holders. The sales price of a quota in an efficient market is equal to the expected profit discounted by the market interest rate.

ITQs will by themselves not lead to fisheries that are respectful of biodiversity and eco-systems at large, because in contrast to increased stocks of commercially valuable species, healthier eco-systems will not in themselves result in higher profits for fishermen. Paulrud and Waldo (2011) argue that this means that there is an important role for government and environmental legislation to play in fishing management after ITQs are introduced.

There is a multitude of applications regarding the particulars of an ITQ system. But that multitude is really just manifestations of an underlying uniformity. The particular rules of an ITQ system are intended to allow for the properties of ITQs to act on a fishery. Tietenberg & Lewis (2009) have identified the three cornerstones that are in common to any well-designed ITQ system:

1. Quota holders should be entitled to a specified share of the TAC for a certain species.
2. The sum of all quotas should equal the efficient catch for the fishery. This ensures biological sustainability by keeping catches at a sustainable yield.
3. The quotas should be freely transferable between fishermen and the transfer price should be determined by the market in which the quotas are traded. This cornerstone allows for quotas to be allocated in the fisheries to create economic efficiency.

The theoretical effect of ITQs on fisheries

In theory, ITQs create fisheries that are both biologically and economically sustainable by removing the common good nature of fish stocks. The TAC is a tool which directly limits level of catches and granted that it is appropriately set, can allow for a biologically sustainable fishery. The economic properties of ITQs change the behaviour of fishermen by changing the constraints within which they operate. The value of quotas depends on the health and size of the underlying fish stocks. Larger and healthier stocks will bring about a higher value of the quotas. This relationship between fish stock and quota value will in theory induce the quota holders to carefully manage the fish stocks in order to secure maximum future gains. For example, fishermen with long-term rights may be more tolerant of total quota cuts since they know that the future benefits of the cut will accrue themselves. Costello et al. (2008) write that some degree of self-enforcement of rules is likely to occur since rule-compliance lies in the interest of quota-holders, and Chu (2009) notes that the fees levied in an ITQ system can be used to increase rule-compliance by funding monitoring agencies. Arnason (2007) notes that if the fish stocks underlying the ITQ system have alternative uses, for example for sports fishing or other recreational purposes, the total societal value of the fish stock will be reflected in the market price for the ITQs and guide the decision on how quota holders exercise their right.

When open-access is removed and individual catch shares introduced, the efforts to increase catches by investing or thwarting rivals will be transformed into efforts to increase productivity and cut costs, since the latter will be the only viable profit increasing measure. Since the catches of one fisherman do no longer affect the catches of another, there will no longer be a race to the fish. Instead, fishermen can concentrate on harvesting their quota in the most efficient manner possible, instead of trying to beat rival fishers (Paulrud and Waldo 2011).

Transferability allows for the entitlement to fish to be allocated to the fishermen who stand the most to gain from it. Quota holders with relatively high costs will find that selling quotas is more profitable than exercising the right to use them. Via these mutually beneficial transactions, quotas will flow from high cost holders to low cost holders and in the process the number of quota owners will decrease, the fleet capacity shrink to match the TAC, and the overall profitability in the fishery increase (McCay 1995; Tietenberg and Lewis 2009; Paulrud and Waldo 2011). Too many restrictions in the trading of quotas will compromise transferability and in turn their efficient allocation. That is not to say that markets should be left alone. Chu for instance, remarks that the culling of unprofitable fishing companies might give birth to social problems by leading to a consolidation of fishing efforts which put small-scale fishers at risk of being displaced and become discontented with the quota system (Chu 2009).

Experiences from fisheries around the world

This subsection supplements the theoretical subsections by describing experiences and adding insights gathered from around the world. New Zealand's ITQ program, which is generally considered successful in the respect that it has been successfully implemented and increased profitability and sustainability, will be contrasted with the cases of Chile and Norway, where implementations have failed. In addition, the pseudo-ITQ system of Namibia will be described, to highlight the flexible nature of ITQs.

In the late 1970s, the native fishing industry in New Zealand felt threatened by fishing fleets from foreign countries harvesting many offshore stocks. Supported by the large majority of the fishing industry, the government established a small quota system in 1983 for companies which harvested offshore species. This precursor later grew into a comprehensive ITQ system which today encompasses all commercial species (Chu 2009). The TACs for the fisheries of New Zealand are set with the long-term goal of achieving the maximum sustainable yield. The quotas were at first allotted according to historical catches and were given free of charge to fishermen. In the early years of the program, the quotas were given in absolute numbers and the TAC was actually above the maximum sustainable yield which later forced the government to buy back shares in order to reduce the total catches. To avoid having to repeat this rather costly undertaking, starting in 1990 quotas were changed into a percentage share of the TAC, giving the government a more flexible and less costly way of adjusting the total catches (Newell et al. 2002).

In recent years non-commercial stakeholders have started to play an important role for the fisheries of New Zealand. For instance, recreational fishing groups and environmental groups have formed organisations in order to influence the fisheries policies. The former group participates in policy negotiations while the latter have filed suits against the Ministry of Fisheries to combat instances of what they call overexploitation. Not all quotas are held by commercial fishermen or anglers. Quotas are leased to Maori tribes at a discount, and legislation was passed in 1996 to allocate 20 percent of all quotas in the future to the Maori community (Dewees 1998). Enforcement of the system is ensured by detailed reporting procedures and on-sea patrols and in some cases observers on the fishing boats. Monitoring and compliance operations are labour-intensive and costly. Large fleets of small vessels which target many different species have posed particular difficulties for authorities (Chu 2009). The efficient monitoring and the support of a critical mass of the fishing industry have been key factors in the success of New Zealand's ITQ programs (Hannesson 2004; Newell et al 2002)

Not all implementations of ITQs have been trouble-free. In Chile, declining stocks and frustrated fishers prompted the government to propose an ITQ strategy in the late 1980s. The first attempted implementation failed because Northern Chilean firms saw their livelihood threatened by the elimination of free entry into the fertile waters of South Chile. Hannesson (2004) concludes that the division in the industry was the decisive factor which caused the Chilean attempt to fail. A compromise was later reached in which only half of the TACs were managed by ITQs (Chu 2009).

Following much bickering over the initial allocation of quotas, individual quotas were introduced in the fisheries of Norway in the late 1970s. After much debate, a gradual development towards making the quotas transferable was evident starting in the late 1980s. But in 2005, the trading of quotas was put on hold. Hannesson (2008) writes that the fishing industry in Norway is not first and foremost seen as a potential income source for the country, but as a mean of employment, receiving considerable subsidies. The opposition from academia, politicians, and fishermen towards ITQs has been the decisive factor behind the failure to implement ITQs. There is a well-entrenched view in those circles that the fishing industry should aim to provide employment and keep communities alive in areas with few other opportunities. The properties of ITQs that make industries smaller and more efficient are in this context viewed as being negative.

The fisheries of Namibia provide an interesting case because pseudo-ITQs are used, and in an African context. In Namibia, an extension of the exclusive economic zone and imposition of conservative TACs were some of the first measures undertaken by the newly formed republic following independence in 1990. These measures were aimed to limit the extensive fishing conducted by foreign fleets off the Namibian coast. The TAC is set by the Ministry of Fishing, and licenses which in practice give the right to a certain percent of this total quota is handed out annually to rights holders. These fishing rights are not permanent. Their period of validity range from two to ten years, and they are officially not transferable, but in practice there is a significant trade with rights, though it seems to require a tacit approval by the Ministry of Fishing. The integrity of the system is upheld by an extensive and efficient monitoring system funded by fees levied on fishing activities. Since fishing legislation was revamped, most species seem to have improved their population numbers, profitability in the fishing industry has increased, and the fishing industry's share of the GDP has grown from 4 to 10 percent. This is impressive considering the fast growth of the Namibian economy in general (Arnasson 2002).

Pre-requisites for ITQs to be implemented and work as intended

In light of the material reviewed thus far, it seems as ITQs are potentially powerful measures to create profitable and sustainable fisheries. But what are the pre-requisites needed in order for ITQs to be implemented and function as intended? Drawing from the material reviewed thus far in the paper, and by introducing conclusions from other authors, I have identified three pre-requisites.

1. ITQs need to be adapted to local conditions. Arnason (2009), for instance, stresses the need to take into account the circumstances of the body of water that is to have ITQs implemented.

2. There is a need to garner broad support for the quota system to avoid disruptive fights and different interest groups forming. This is evidenced by the differing fates of ITQ programs in New Zealand, Norway and Chile. Related to this is the need of any fishing management scheme to balance stakeholder influence to ensure that the system is viewed as legitimate (Nijiru et al. 2008).

3. Well-functioning ITQ systems are characterised by efficient monitoring and enforcement of rules, and many researchers stress the need of this, for instance Arnason (2002). If ITQs are imposed but harvesting is possible without ITQs, there is an obvious disadvantage of paying for quotas. To maintain long-term stability of the system, it is of critical importance to make fishing with ITQs more profitable than without ITQs, and to ensure that quota holders do not exceed their quotas. In multinational ITQ systems, monitoring might be extra important. Otherwise, the occurrence of a particular country trying to benefit on the expense of others might compromise the integrity of the system.

These pre-requisites will be used in the analysis and they are also important to keep in mind as we head into the empirical content regarding Lake Victoria.

Fishing and regulation in Lake Victoria

The following is an empirical section regarding the historical and contemporary attitude and regulatory approach towards fishing management in Lake Victoria. The material presented herein is chosen to enable an evaluation of whether ITQs would be beneficial for the lake, and whether an implementation of them is possible. In addition, it will summarise the previous research that has been conducted on the subject of ITQs and Lake Victoria.

Lake Victoria is shared by Kenya (6 %), Tanzania (49 %) and Uganda (45 %). The surface area of 68 870 km^2 makes it the world's third largest fresh-water lake. In 2001, an estimated population of more than 30 million people resided within its watershed and the population growth was rapid, with 6 and 3 percent respectively for urban and rural areas (Ntiba et al. 2001). Since time immemorial fishing has been conducted in the lake. Today, it is the site of Africa's largest inland fisheries in terms of catch volume and the participants range from subsistence-fishers to Nile perch-fishing operations with fleets of boats and plants to process and export the catches (Brown et al. 2005). The fishing industry of the lake is an important source of income for more than 3 million people (Njiru et al. 2008).

From subsistence-fishing to big-business

In pre-colonial times (that is, before the twentieth century) a mixture of formal and informal regulation upheld multi-species fisheries that were both productive and sustainable. Fishing was restricted to certain sub-clans and catches made by their simple techniques were much lower than what could have been achieved using conventional methods, such as nets. The point was not to maximise the catch, though, but to minimise the time spent fishing. That is, to minimise effort. Although there was a widely respected bartering system in place to allocate surplus catches, a low demand for fish seems to have restricted the amount of fish caught. No problems with overfishing are known from this period. Elinor Ostrom might characterise this fishery as a well-managed communal property (Geheb 1997).

Colonisation brought change. Two important devices revolutionised fishing in Lake Victoria in the beginning of the twentieth century: nets and sailboats. The region around the lake was transformed too, by other inventions. A railroad was connected to the shores of the lake in the beginning of the twentieth century, and the colonising power strove to create a cash-based economy. The railroad expanded the market area, which previously had encompassed only a few square kilometres near the shores, to the inland and to large cities, such as the Kenyan capital Nairobi. Immigrants brought with them an entrepreneurial spirit and before long, fishing stations had popped up along the shores of Lake Victoria. The natives were encouraged by this rapid expansion to move away from subsistence-fishing to commercial fishing. Cash made wage labour possible, something which greatly increased the number of fishers. This process produced fissures in the informal regulation which still held sway in some parts of the lake (Geheb 1997).

Njiru et al. (2007) reports that before the 1920s, the fisheries of Lake Victoria obtained adequate catches with little effort, even using only the inshore areas. But reports on declining stocks started to appear during the 1940s and 50s. Problems accelerated during the 1960s and some species had all but disappeared by the middle of the decade. But the states did not have the political will or the resources needed to adequately address the ailing lake's problems. The ill-funded and inefficient regional authority Lake Victoria Fisheries Service (LVFS) became unpopular with the fishing communities because of their sometimes harsh methods. In addition, the fishing communities did not share the authority's views on how to address the problem of declining fish stocks. The prevailing view among the fishermen at this time was that it was impossible to exhaust the lake's fish stocks.

By the mid-1960s the lake had become a de facto open-access resource, which further contributed to the erosion of the sense of ownership that once had existed among the local communities (Njiru et al. 2007). During the 1950s and 1960s, management focus shifted from regulatory measures to biological solutions. Proposals grew loud to introduce a commercially valuable predator species that could benefit from the lake's multitude of small-size species (Geheb 1997). Eyes were soon set on the Nile perch (*Lates Niloticus*), a species which had been introduced with positive results in several other African fisheries. Following an illegal introduction, official efforts of introducing the Nile perch started in 1962. In the late 1970s the Nile perch had established itself in the lake in great numbers and the initial caution the locals had shown toward it had begun to taper off. From 1978 to 1981 catches of Nile perch grew more than twentyfold, from 1,066 to 22,834 tonnes (Geheb 1997). The introduction of the Nile perch had important consequences for the dynamics and distribution of species in the lake. More than 60 percent of the endemic fish species were wiped out during the 1970s and 1980s (Cowx et al. 2003). But many observers suggest that the high-yielding Nile perch saved the fishing industry in Lake Victoria from collapsing. Njiru et al. (2007) write that this commercially attractive fish transformed the fisheries of Lake Victoria into big-business.

Current state of fishing and regulation

There are three species caught in the fisheries of Lake Victoria today. The Nile perch is by far the most commercially valuable, constituting some 90 percent of the total value of fish exports. The other two species are caught in significant volumes, but they are for the most part consumed in the vicinity of the lake (Kateka 2010). With the Nile perch boom, the fisheries no longer cater only to the surrounding region's demand for fish. Today, the engine which powers the fish processing plants around the lake is the global demand for fish and in particular for Nile perch. These factories in turn, are served by stand-alone individuals or groups conducting the actual fishing (Njiru et al. 2008).

The annual catches in Lake Victoria are around 5-800,000 tonnes and the fisheries generate an annual income of $600 million. More than 3 million fishermen, employees in the fish processing factories, and their families, depend on fishing for their livelihood. It is generally considered that there is a problem in the region because of a lack of job opportunities outside of fisheries (Kateka 2010). Taking into account the value of licenses required for export and boat registration and so forth, the fisheries of Lake Victoria amount to 2-3 percent of the annual GDP for each of the three riparian states (Njiru et al. 2008; Cowx et al. 2003). According to Njiru et al. (2007), the fisheries have an important multiplying effect on many industries, including the building industry, the air industry, and packaging industry in all three countries.

Many fishermen are directly employed by the fish processing factories. Geheb et al. (2008) write that the fish processing factories seem to have the upper hand in this relation. Working conditions for fishermen are tough and the income that is produced by the fishing industry is unevenly distributed in favour of the fish processing centres. Some fishermen are lent nets and engines and more or less obliged to sell their catches to a certain supplier. In addition to fishermen serving processing plants there are many so-called artisanal fishermen, conducting fishing on a small scale for subsistence or cash (Geheb 1997).

Lake Victoria is economically important not only for fishermen and workers in the processing industry, but also for the region and the riparian states. The potential benefits may be even larger than the actual. Arnason (2009) writes that the Nile perch fishery of Lake Victoria has the potential to be one of the world's most profitable fisheries. Does this mean that the lake is carefully managed to ensure future benefits? That seems not to be the case. Njiru et al. (2008) report that due to increased fishing pressure and environmental devastation in the last decade, the already vulnerable fish stocks have for the most part declined further.

According to Kateka (2010) the biomass of Nile perch decreased from 1.2 to 0.331 million tonnes between 2000 and 2009. By using a combination of qualitative analysis and predictive modelling, Matsuishi et al. (2006) concluded that the fishing of the Nile perch is not long-term sustainable given current trends. To maintain catches, more boats and more efficient fishing gear, as well as an increase in total effort have been used. The number of fishers and boats almost doubled between 1990 and 2000, and expanded even faster between year 2000 and 2002. But even with the increased capacity and effort exerted, the catch per boat has decreased and the CPUE has declined by almost 45 % per boat during this period. The increase in participants and efforts has been accompanied by severely reduced income to individual fishers and diminished profits to fish processors (Cowx et al. 2003; Matsuishi et al. 2006). Arnason (2009) calls attention to a recent study which concluded that the potential profits in the Nile perch fisheries are $200 million, compared to the actual $50 million. To achieve the higher profit level, a fishing management regime needs be put in place that reduces total fishing efforts by 50 % and allows the total biomass (and subsequently the sustainable yield) to grow much larger.

Fishing in Lake Victoria is, however, still unrestricted. There is no limit to the number of fishing vessels that can be registered or the number of nets that can be used. Neither is there a catch limit. The only requirement for becoming a fisher is that a small registration fee is paid. There are however restrictions on the type of gears that can be used, and there are fishing-bans certain months in some of the riparian states (Ntiba et al. 2001; Njiru et al. 2008). Njiru et al. (2007) writes that these restrictions have been helpful but insufficient considering the increased demand from world markets.

Matsuishi et al. (2006) calls the situation in Lake Victoria a classical free-for-all situation with the associated problems thereof. They write that the lake is viewed by the riparian states as being poverty alleviating by absorbing labour. Matsuishi et al. (2006) add that restricting access is one of the key changes needed and that the riparian states need to acknowledge that the lake's resources are not infinite and that effort levels cannot be increased forever. Arnason

(2009) and Kateka (2010) both write that Lake Victoria has fallen victim to the common-pool resource problem, and that this is the fundamental cause of the excessive effort used, the low profitability, and the declining stocks.

Notwithstanding the question of whether the chosen regulatory approach is appropriate, there seems to be a consensus among authors that there is a problem upholding it. Kateka (2010) for instance, writes that is not the absence of governance that is the main problem, but the poor quality of the governance. Njiru et al. (2008) bring attention to the laxness with which the regulation that does exist is enforced. There are more than 1,500 official landing sites in Lake Victoria, but these are monitored by a staff of only 115 officials, and some of the landing sites are too remote to be reached by the staff's often primitive boats. Further, the low wages of the fisheries staff pose a significant problem, making them susceptible to corruption and collusion with fishers.

Making matters worse, there is a widespread sentiment among fishermen that illegal gear is needed to obtain a large-enough catch. Kateka (2010) calls illegal fishing one of the greatest threats to the ecosystem and the fisheries of the lake. Illegal fishing has accelerated in recent years, because the CPUE is steadily declining, making fishing with legal methods and gear unprofitable for all but the largest actors. There is a problem with information dissipation as well. A 2005 survey revealed that 52 percent of survey takers were not aware of the allowed minimum size for gill nets in Lake Victoria (Njiru et al. 2008).

Most authors seem to agree that there are two roots to the problems with monitoring and enforcement: the lack of harmonised legislation across national boundaries and the discontent with the top-bottom management of the lake. The latter means that policy making, monitoring and enforcement is done without involving local fishermen or taking heed to their opinions (Njiru et al. 2008). Cowx et al. (2003), for instance, reports that command driven regulation imposed by the government and its authorities has alienated fishing communities and led to a lack of cooperation by their part, adding that the fishing communities are often aware of the overexploitation of fish stocks in their immediate vicinity, but are unlikely to respond to calls for moderation because they lack knowledge of the full situation. In the opinion of Cowx et al. (2003), cooperation between regulatory agencies, researchers and the fishing community are key factors in creating a sustainable fishery. Njiru et al. (2008) agree that the top-bottom command system used today is inefficient, adding that since users are likely to be the fastest responders to environmental degradation, they are vital in any policy making process. Further, they criticise the regulation for having been developed without involving fishers, traders and processors. Matsuishi et al (2006) add that lack of community representation has prevented a sense of ownership developing, and consequently limited support for conservation.

The regulation in Lake Victoria is generally not harmonised across countries. The sanctions imposed on transgressing the rules (in those cases where rules are uniform throughout the lake) are likewise not harmonised. Cowx et al. (2003) note that fishing is not restricted by national boundaries. For instance, fishermen from Kenya regularly transgress the borders of Tanzania and Uganda in their fishing operations. The problems of the lake are well-known by riparian governments, and there have been some attempts to harmonise regulation and conservation measures in the lake in the recent years, which some authors attribute to the increasingly influential idea of viewing Lake Victoria as a single ecosystem. These factors resulted in the formation of the regional organisation The Lake Victoria Fisheries Organisation (LVFO) in 1994. Its objectives are to coordinate measures to conserve and manage the biological resources of the lake and to optimise its socio-economic benefits (Njiru et al. 2008). According to Cowx et al. (2003), efforts are underway to make local communities active in data collection and monitoring of the fisheries. LVFO has the stated intention of implementing co-management in the lake, and some steps are already being taken. In Tanzania for instance, so-called Beach Management Units are used to curb illegal fishing at the local level. Kateka (2010) writes that these efforts have not been very successful, because of a reluctance of governments to relinquish control.

Previous research on ITQs in Lake Victoria

In a paper about the theoretical optimal harvest rate in a fishery consisting of two species, Brown et al. (2005) briefly discuss the potential merits of ITQs in Lake Victoria. They note that conventional methods such as top-bottom restrictions on gear, total quotas or landing taxes are unlikely to save the lake's fisheries, given their lack of success in other parts of the world and in particular their bleak record in Lake Victoria. They recommend a bottom-up ITQ system, with the local communities having the final say in matters of fishing management. However, they anticipate that the scientific decision of setting the TAC must be made by regional agencies and not the local communities. They also predict that the well-being of threatened species not targeted by commercial fisheries will depend on authorities higher than the local communities. One potential matter of dispute they identify is the reluctance of the three riparian states to allow trade of quotas across borders. They note that fears might arise of fishing rights becoming concentrated in other states than one's own. Their proposed solution to this matter is that trade should be restricted to ecologically distinct regions of the lake. Brown et al. (2005) end their article by proposing small-scale ITQ experiments to take place in nearby lakes, to convince fishermen and policy makers about the feasibility of ITQs for Lake Victoria. They conjecture that this would foster support for ITQs among the local fishermen and that news would spread around Lake Victoria by word of mouth.

Arnason (2009) also discusses ITQs in the context of the failures of the Lake Victoria fisheries. He believes that the present state of the fisheries is inevitable considering the lack of rights-based fisheries management. He goes on to suggest that ITQs may be useful in the lake by evoking their success in other parts of the world but notes that a closer study is needed. He suggests giving quotas to communities instead of individual fishermen. He further wants all riparian states to have separate quotas they can allocate to communities. Overages by one nation should be subject to a penalty fee to the other nations. He ends by noting that if this system is to succeed, each nation need to show a high degree of responsibility (Arnason 2009).

Analysis

The problems associated with common-pool resources which were expanded upon in previous sections of this paper, are present in Lake Victoria today. These problems include catch rates being above sustainable levels, the number of fishers being too high and their efforts being splintered instead of concerted which makes profitability low for all participants. Faced with declining efforts, the response by fishermen has not been restraint, but rather increased effort. The worsened profitability of fishing has led to illegal fishing being rife. Several authors conclude that these problems stem from entry being unrestricted and lack of owner-rights (Arnason 2009; Matsuishi 2006).

In light of this, it seems as if ITQs, which are tools that restrict entry and create ownership, could improve the profitability and sustainability for Lake Victoria's fisheries. Given that appropriate TAC levels were set, fish stocks would start to replenish. Apart from ensuring biological sustainability, this would have the added benefit of decreasing effort levels. Thus ITQs would address two of the key-problems in Lake Victoria's fisheries: effort levels being too high and stocks being too small. The economic properties of ITQs and their transferability would make the fishing industry smaller, by quotas being transferred to the most efficient fishers. This reduction in fleet and personnel to match the TAC would reduce total effort levels and increase total profitability. The sense of ownership that was lost when commercial fishing and state regulation ended communal governance would be reinstated in an explicit fashion by owner-rights, and make way for careful management of fish resources, and support of conservation measures, instead of prodigious catches until stocks collapse. In essence, eliminating free entry and capping total catches by introducing ITQs would move the fisheries towards the bio-economic optimal path, and thus make it possible for Lake Victoria to realise its potential as a very profitable resource. But perhaps it would be most accurate to say that the effects of ITQs *would* be beneficial *if* they acted upon the fisheries of Lake Victoria. Because the question of whether it is possible to implement ITQs in Lake Victoria remains.

Recall the pre-requisites for an ITQ system to be implemented and upheld successfully: it is adapted to local conditions, has a broad support, and is monitored and enforced efficiently. The remainder of this paper will discuss the key characteristics of Lake Victoria while keeping in mind the pre-requisites for an implementation, to conclude whether it is reasonable to expect an implementation of ITQs in Lake Victoria to succeed.

The pre-requisites are somewhat interrelated. For instance, support depends on (among other things) whether the system is locally adapted. The critical question to ask is then whether there is an adaption which can garner broad support and be upheld by effective monitoring. If so, according to the criterions raised by this paper, ITQs could be implemented.

A gradual implementation

Recall that there are three cornerstones to a well-designed ITQ system: the sum of all individual quotas make up the TAC, and this TAC is the efficient catch for the fishery, and the quotas are freely transferable. The general nature of these cornerstones gives considerable leeway to adapt the ITQ system to local conditions.

A gradual development towards ITQs could ease the transition for governments, participants, and regulatory bodies in going from open-access to a new management scheme. At first, TACs and rule-compliance could be implemented via a general quota to make people acquainted with other systems than open-access, and then after some years, quotas with limited transferability could be implemented. Hannesson (2004) emphasise the dual nature of ITQs, where TACs and monitoring ensure biological sustainability whereas the ownership and transferability of quotas ensure economic sustainability. Thus some beneficial effects would act upon the fisheries even during the development towards a full-blown ITQ system.

To ease the transformation even more, it might be preferable if at first only one or a few species were managed by ITQs. For example, Nile Perches could be the first species to be subject to ITQs. Nile perches are predominantly caught by large-scale operations, and those participants are likely to most readily learn the workings of an ITQ system. This would have the benefit of easing the administrative burden for regulatory bodies as well as transmitting results from ITQs to fishermen in order to raise support. I would thus rather have “experiments” on single species within the lake as opposed to the probably costly and complicated idea put forward by Brown et al. (2005) to conduct lake-wide experiments outside of Lake Victoria.

One system

The quota system needs to be imposed in the whole lake. A unilateral implementation of ITQs would put the system at a risk. It can be expected that if ITQs are not implemented in the whole lake, that fleets from a country which utilises ITQs would enter the waters of states in which fish stocks are still open-access. This would increase stress on the stocks in countries which are open-access, and since fish stocks are generally not stationary it can be expected that this would affect the fish stocks of the ITQ country too. Thus, a beneficial effect of ITQs in one country would be offset by negative effects in other countries. The efforts of the LVFO taken towards harmonisation are positive, but more work is needed if ITQs are to be implemented. In order for a well-functioning quota system to be upheld, a strong regulatory organisation, probably aided by international organisations and at first funded by developmental aid, is needed. I foresee a time consistency problem in the setting of the TAC if the responsible body is not independent and representing all three riparian states. There might be a temptation for politicians to set higher TACs in election times in order to reward special interest groups for their vote.

The proposal by Arnason (2009) to have separate quotas for the three countries is not well-suited for Lake Victoria, and neither is the view of Brown et al. (2005) that trading of quotas should be permanently restricted to ecologically distinct regions. But their cause of concern is valid: that fears of quotas becoming concentrated in foreign countries are likely to arise and stress the system. Separate quota systems would obstruct harmonisation of regulation, complicate the setting of TACs, increase the administrative and monitoring burden, and make the market for quotas smaller. A better solution is to have temporary restriction of quota trades over administrative regions which are then gradually relaxed.

Commercial and subsistence-fishing side by side

One thing that needs to be taken into account is the fact that modern fishing fleets and subsistence fishers share the lake. Obviously these two extremes have altogether different approaches to fishing. Is it possible to design an ITQ program that allows for both subsistence and commercial fishers and has their support? One solution could be to create several ITQ systems existing side by side but disallowing trade across boundaries. This would geographically separate tribes from modern fishermen, but also create compartmentalisation and increase the administrative burden of the system. Apart from reasons put forward earlier regarding the suggestions of Arnason (2009) and Brown et al. (2005), geographic separation is ill-suited because tribal fishermen and modern fishers may very well live side by side and fish in the same waters. The second solution is inspired by the New Zealand experience. A portion of the TACs could be reserved to tribes and the decision of how to use it be left to them.

Given that many fishermen can't even afford to buy their own gear, it can be expected that if ITQs are implemented without proper precautions taken, that small-scale fishermen lacking the monetary means to buy quotas will be supplanted by modern fishing operations. Such a system will not be supported by small-scale fishers. One solution is to make it so that the initial allocation of quotas is given according to historical catch rates, in order to avoid small-scale fishers being displaced. Further, the transferability of ITQs could be restricted for some time and selling only allowed to the regulatory body. This system has been used successfully in the Halibut fisheries of British Columbia (Dewees 1998). The pseudo-ITQs of Namibia suggest another solution is possible. Quota trades could (for the first years) require the approval of the regulatory body.

Stakeholder balance

There is one feature of the fisheries of Lake Victoria which implies that an ITQ system should not be implemented as a single measure, but as an instrument in a broader transformation of the Lake Victoria basin. There are more than 3 million people depending on fishing for their income. Further, it can be expected that rapid population growth will increase the number of aspiring participants, and especially if ITQs help make the fisheries more profitable. An implementation of ITQs would decrease the number of people employed, at least when it comes to actual fishing. Labour streams would need to be redirected away from the fisheries. In western countries, exiting fishers can be directed elsewhere, and already from the outset there are fewer fishermen in western fisheries. Nevertheless, as Hannesson (2008) reports, ITQs in Norway have not been very successful because of resistance from politicians and the fishing industry against downsizing. Thus it is probably important that the region is not as dependent on Lake Victoria to serve as its labour market as it is today. Creating alternative employment in the region will be a central task if ITQs are to have the support of the people. A healthy lake could probably support tourism and sports-fishing ventures, thereby moving at least some labour from fishing to these industries. Matsuishi et al. (2006) speaks of the lake being used as a poverty alleviating measure, and perhaps the lake being used as an absorbent of labour is one of the main reasons that governments have not yet restricted entry to the fisheries or set up quotas of some sort. In other words, the well-being of the lake has been subordinated for political reasons. It is likely that for this reason ITQs would be opposed by parts of the government. On the other hand, to keep status quo should not be an option for any government. The fisheries of Lake Victoria are bound to collapse if change does not occur, and the riparian governments seem to be aware of this. However, an implementation of ITQs hinges on the riparian governments becoming convinced of the advantages of transforming the lake from being a labour absorbent into being a profitable and sustainable resource.

Many authors are proposing devolving responsibility for fishing management communities, for instance Cowx et al. (2003), Njiru et al. (2008) and Matsuishi et al. (2006). I think there is an important balancing act to be made when it comes to designating the role of the fishing communities in a hypothetical ITQ system. On one hand, their support is needed, but on the other hand the system needs to be stable. There is little to suggest that communities by themselves will create a sustainable fishery following a power transfer. Communities cannot be expected to by themselves have the overview or restraint that is needed to design and conduct sustainable fishing policies for a lake the size of Lake Victoria.

There is no inherent contradiction between Ostrom's notion of collective action and ITQs. Collective action describes the way in which control structures for common goods may be set in place but it does not prescribe a specific control structure. Co-management can serve as the framework in which the particulars of the ITQ system are determined. Indeed, Arnason (2002) reports that the problem of allocating the initial quotas has in some cases been solved by co-management. Communal involvement could be used on a micro-level, for resolving some issues, but the ITQ system must be imposed and governed by coordinated behaviour by the riparian states and preferably aided by international organisations. My suggestion is thus that a top-bottom structure is implemented which incorporates the views of the bottom. In this way, the legitimacy and support of the system is ensured, as well as the stability and coordination that is needed.

Owner-rights is one feature of an ITQ system that could be used to relieve the alienation felt by some stakeholders and harness some of the positive effects authors foresee with increased stakeholder participation. A sense of ownership and "home rule" over the lake and fish stocks are reinstated by owning quotas. On a micro-level some of the aspects of fishing management can be said to be transferred to fishermen away from governmental institutions, because the quota owners can decide by themselves how and when to catch fish and in addition the structure of the quota system means that external enforcement of rule-compliance will be supplemented by self-enforcement. ITQs could thus create more independency and stakeholder participation than is present in the lake today.

Monitoring and enforcement

To uphold an ITQ system, efficient monitoring and enforcement of rules is needed. An ITQ system in Lake Victoria would most probably fail if the current dismal levels of monitoring and enforcement were kept. But is it reasonable to assume that this level could be raised to allow for an ITQ system? The properties of ITQs might be beneficial in this regard in two ways. It has been shown that ITQs can increase self-enforcement of rules (Chu 2009). Further, Kateka (2010), for instance, writes that illegal fishing has been particularly rife because of decreasing fish stocks and profitability. Thus, an ITQ system which raises profitability and increases the size of fish stocks might require less monitoring than the current open-access scheme to ward off illegal fishing. Nonetheless, there is a need for an external regulatory body as well. It could be partially funded by fees levied from fishing activities, like in Namibia (Arnason 2002). But the effectiveness of this body hinges on the support it receives from the riparian states and how it is viewed by fishermen. As noted before, the history of monitoring and enforcement in Lake Victoria has been marked by troubles, in part because of lack of funding and because the fishermen perceive that it does not act in their interest. The question of monitoring and enforcement thus ties in to the question of whether support for the ITQ system can be garnered.

Concluding remarks on the applicability

I think a reasonable conclusion in light of this analysis is that a swift implementation of ITQs without making preparations would fail. The problems of monitoring and enforcement, and the huge size of the industry are too big obstacles to allow for an implementation of ITQs as is. However, a gradual implementation of an ITQ system adapted to the circumstances of the fisheries of Lake Victoria might be able to garner the support needed from stakeholders and be properly monitored and enforced. The qualitative nature of the pre-requisites and the approach used necessitates caution with the results, but it seems as if the pre-requisites can be fulfilled and thus an implementation is possible in the long-run. The answer to the central question of this paper is then: yes, ITQs are applicable for the fisheries of Lake Victoria.

Conclusions and reflections

The purpose of this paper was to evaluate whether ITQs could be used to improve the profitability and sustainability in the fisheries of Lake Victoria, and if an implementation is possible. The paper concluded that ITQs would have beneficial effects for the fisheries of Lake Victoria. The problem of free entry would be addressed, and fish stocks would be turned into properties which would incentivise stewardship and careful management instead of exploitation. By restricting entry the overcapacity currently afflicting the fisheries would be alleviated and thereby the profitability in the fisheries would increase. On the question of whether an implementation is possible, the paper concludes that it is possible to create an ITQ system that fulfils the three pre-requisites for a successful implementation: adaption to local circumstances, broad support, and efficient monitoring and enforcement of rules. In turn, this suggests that ITQs can be implemented in the fisheries of Lake Victoria in the long-run.

It was stated in the introduction of this paper that the issue of human resource extraction is likely to increase in importance in the future considering the current rapid population growth. ITQs certainly represent an interesting example of how not just technological, but also theoretical development can be used to mitigate this process. ITQs are a theoretical device intended to change the rules of the game of fishing and as such they tie into a broader debate of private property and the status of our commons. The nature of ITQs and our appreciation of them are likely to change with time and experience, and thus I caution against viewing ITQs as a miracle cure. No resource management system can raise the theoretical maximum sustainable yield of a fishery. In concrete terms, this might be construed to mean that changing the rules of the game will not create more fish than the natural limit of our waters allow. No matter how fishes are harvested, they will always be a finite resource. One cannot sustainably extract more fish just because there is a sound theoretical foundation underlying one’s management scheme. My point is that ITQs by themselves will not resolve the fishing crisis since demand for fish and food is likely to increase. But they will certainly help if there are concurrent efforts aimed at relieving demand for fish caused by growing populations.

Regarding the nature of ITQs, I think the main point that Lake Victoria can illustrate is that ITQs may very well create economically efficient fisheries, but that in some cases, this might mean sub-optimisation of the economy. In developed countries, the fishing industries might be some of the least well-functioning sectors of the economy and bringing it up to par is entirely beneficial for societies. In developing countries, an ill-functioning fishing industry may still be a relatively speaking well-functioning economic sector. The implications of this are important. In the world of theory and in the well-developed and diverse economies in which ITQs are predominantly used, unemployment caused by the culling of unprofitable actors can be disregarded or quickly absorbed by the surrounding economy or by welfare systems. In a developing country with few other job opportunities, the layoffs created by ITQs might cause ripples through society. These discontented exiting fishermen may be joined by aspiring entrants and their resentment might together very well undermine the whole system, particularly in countries where politics of redistribution are prioritised above private property. Thus, the long-term goal of governments becomes important if ITQs are to be used. Are water-resources a potential source of profit or are they first and foremost a poverty alleviating measure?

To accommodate for these exiting fishermen, I suggested that the region of Lake Victoria should provide opportunities for other sources of livelihood. This is of course a very general answer to a question that has no easy answer. I think that there is much room for discussion on how the excess labour should be treated. If this subject is not taken seriously, the risk is that in developing countries at least, the economic efficiency of ITQs means that an ITQ system bears within itself the seeds of its own destruction.

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