FISHERIES MANAGEMENT ON LAKE VICTORIA, TANZANIA

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INTRODUCTION

Lake Victoria is located in East Africa, on the equator, and is shared by Kenya, Uganda, and Tanzania. There are a number of current environmental problems associated with Lake Victoria and its basin. There has been a critical loss of biodiversity in the lake resulting from the introduction of exotic species. Pollution is a serious problem near the larger towns. Use of firewood in the processing of fish has made a significant contribution to the already sobering rates of deforestation in the lake basin and surrounding areas. The lake is suffering from a recent invasion of water hyacinth; an attractive, rapidly spreading, pernicious weed which blocks easy access to the lake while depleting oxygen needed by other species. While all of these problems are in need of sociological analysis this paper concentrates only on the problem of the over-fishing of the stocks of commercial fish species. The Lake Victoria fisheries are among the world's most important inland fisheries. Between 1975 and 1989 the lake fisheries produced a total value on the order of 280 million U.S. dollars (Reynolds et al. 1992).

The findings presented here are initial results of an ongoing exploration of fisheries management situation in the Tanzanian portion of lake. It should be viewed as a report of research in progress. Field work on small-scale fishing beaches was done between January and July of 1993 on six fishing beaches on the eastern and southern shores in the Tanzanian section of the lake. The field work consisted of formal surveys of boat owners, management and fishing crews as well as riparian households, and fish processors and traders (PLEA 1993). In addition focus groups and in-depth interviews were done with the same populations during the approximately two weeks that the research team stayed on each beach (Wilson 1993). In addition interviews were done with industrial level processors in the Tanzanian section. The team consisted of researchers from the Tanzanian Fisheries Research Institute (TAFIRI) and Michigan State University.

This paper describes the fisheries management situation as it relates to small and large-scale fishing and processing operations. The first section gives an overview of the Lake Victoria fisheries. The second section describes

the over-fishing problem as it attaches to small-scale fishers. The third section reviews the same problem as it relates to the industrial-level fishing and processing operations. This latter section deals with the limited but destructive use of medium sized trawlers for fishing Nile perch and the building of large, export-oriented, processing plants for the production of frozen Nile perch fillets. The analysis of each of these two levels proceeds by first describing the problem from the perspective of the health of the fishery. Then the positions, beliefs, and attitudes of the major actors are outlined. Next, the various constraints on institutional responses to the problem are looked at. Finally, for the small-scale level only, data on the fishers perceptions of the legitimacy of fisheries management measures that are now in place are reported.

OVERVIEW OF THE LAKE VICTORIA FISHERIES

The fish. An exotic species, the piscivorous Nile perch (Lates niloticus), was introduced in the late 1950s and began an explosive growth in population in the late 1970s. Predation by the expanding Nile perch population was the main cause of the extinction or near extinction of an estimated 300 fish species, mainly cichlid haplochromines (Barel 1986). In Tanzanian waters Nile perch went from 0% of the total catch in 1975 to 68% in 1988 (Bwathondi 1988). The lake was rapidly transformed from a multi-species lake to one in which there are only three major, commercially important species: Nile perch, one species of tilapia (Oreochromis niloticus), and the sardine-like *dagaa* (Rastrineobola argentea).

The change in the species composition of the lake has had important economic effects, driven by a vastly increased quantity and market value of the catch (Reynolds et al. 1992). The Nile perch, unlike the Haplochromine species it consumed, is a large, white, meaty fish which finds a ready international market and an industrial processing and export industry grew up around the lake during the 1980s (Reynolds et al. 1992). Large numbers of new fishers have been attracted to the lake, the total number in Tanzania rose from 15,194 in 1983 to 29,816 in 1989 (Bwathondi 1992).

There are signs that over-fishing and abusive fishing practices are

threatening the sustainability of the new fisheries. The least conservative estimate of maximum sustainable yield (MSY) for Nile perch in Tanzanian waters is 60,000 metric tonnes[1], the actual production in 1990 was three times this figure. The mean size of the Nile perch being caught is falling (IFIP 1990). The lake produced an average of 260,000 tonnes of fish a year during the decade of the 1980s, reaching a peak production of 450,000 tonnes in 1987 (Reynolds et al. 1992), but without increased management activity production may soon fall to 100,000 tonnes per year (Gréboval 1990).

The trawlers. There are approximately 15 trawling vessels currently operating in Tanzania. These trawlers have on average approximately 150 H.P. engines and use trawl nets with a cod-end mesh size of 2.8". The trawlers catch 25-50 kgs per trawl and do 6-8 trawls each day, seven days a week.

The export processing firms. The seven processing factories, that are currently or about to be operating, will produce an estimated 5 million dollars worth of fish per year, half the value of the regional production of cotton, the primary cash crop (Musendo 1993b). These firms fillet the Nile perch and then freeze them. This freezing capacity which determines the overall capacity of the plant. In most cases, the fish are then shipped to Nairobi, Kenya where the filleting process is completed. The firms also produce swim bladders which are exported for use in beer making. The fish "racks" which are the head, tail, remaining flesh, and bones that remain after the filleting are sold locally as is Nile perch fat which is used for cooking and making soap.

The small-scale fishers. The small-scale fishers use plank-keel canoes with an average length of 7.5 meters and an average cost of $250.00. They usually take a crew of 3 or 4. Nile perch are fished mainly with gill net and secondarily with multi-hook long-lines. Beach seines also catch juvenile Nile perch. *Dagaa* are fished at night when the moon is dark using Coleman-type pressure lamps to attract them. They are caught with several types of gear. Short purse

[1] All measurement will be given in metric units except net mesh sizes which, following common usage, will be reported in inches.

seines and mosquito nets are the most common but dip nets are also used. A much more effective type of *dagaa* fishing unit, catamarans using lift nets, are beginning to appear. Tilapia are caught with hooks and lines, and small-mesh gill nets.

Owners and other management (renters or representatives of owners) of these boats almost always farm in addition to fishing. On average they receive 56% of their household income from fishing, income from fishing for the different roles in the fishing industry are reported in Table One. A solid majority, 63%, are themselves the sons of fishers. In keeping with this family tradition 72% want their children to be fishers (Wilson 1993). The owners or renters often operate the fishing boat and are almost always involved with beach activities. Their average age is 42.

TABLE ONE: PERCENT OF INCOME FROM FISHING BY ROLE IN THE FISHING INDUSTRY
(Source Wilson 1993)

ROLE	0 TO 24%	25 TO 49%	50 TO 74%	75 TO 100%	N
BOAT OWNERS	3%	40%	40%	17%	40
BOAT RENTERS	17%	42%	33%	8%	12
CREW	2%	40%	45%	13%	82

Crew members have a somewhat different profile. They are younger, with an average age of 27, many of them are teenagers, and a few are children. In our sample thirty-six percent of the crew were related to someone in the boat's management. Sixty-seven percent are sons of fishers and the youngest ones in particular are usually sons of the boat owner. Crew average the same percent of household income from fishing (57%) as management. One indicator of the different perspective the crew has on fishing is that only 41% of them want their own sons to be fishers. The most widely stated reasons for their not wanting their children to be fishers were that fishing is a difficult, dangerous and poorly remunerative occupation.

The management community. The Tanzanian fisheries management community consists of two government agencies, the Tanzanian Fisheries Research Institute (TAFIRI) and the Tanzanian Fisheries Division (TFD). TAFIRI is responsible for research and providing biological and socio-economic

information about the fisheries while the TFD is responsible for the direct fisheries management activities. The formal relationship between the two is very complex, involving three different ministries (Nhwani 1992). The Food and Agriculture Organization of the United Nations (FAO) is very actively engaged in management activities on the lake. Mainly through their efforts a tripartite Lake Victoria Fisheries Commission came into existence in October of 1992 (Grèboval 1992). There is a large and growing presence of North American and European physical and biological scientists concerned with the health of the lake. Their chief concerns are with biodiversity and the limnological condition of the lake, rather than directly with fisheries management. Their influence is crucial, particularly as it is mediated through the flow of research and management funds from government and multi-lateral agencies.

SMALL-SCALE OVER-FISHING

DESCRIPTION OF THE PROBLEM

The concept of over-fishing. Over-fishing takes various forms. The basic idea of biological over-fishing is that the fish population is unable to reproduce itself at a sustainable level. This is not simply a matter of how many fish are caught, it is also a matter of which fish are caught. If fishers are catching large fish that have already had a chance to reproduce then they are doing far less damage to the sustainabilty of the resource than if they are catching small fish that have not reproduced. This is not only because of the need for the fish to have a chance to make more fish, it is also because smaller fish put more of their energy into growth and so contribute more to the increase of overall fish biomass.

Economic over-fishing is a different concept. Economic over-fishing means that so much economic effort is going into chasing the fish that the potential rent from the resource is dissipated. Economic over-fishing can happen at a level of fishing effort that is lower than biological over-fishing, and does not necessarily mean that the MSY is surpassed. Economic over-fishing may even be a good thing if there are no alternative employment

opportunities for the fishers.

Evidence of over-fishing on Lake Victoria. During the 1980s the total fishing effort of the small-scale fishers in Tanzanian waters grew from slightly less than 5,000 boats to 7,800 boats. The Nile perch was responsible for the catch per unit effort (CPUE) almost doubling from 16 tonnes per boat per year in 1975 to 31 tonnes in 1988 (Grèboval and Mannini 1992). The CPUE is a crucial indicator of the health of a fishery because, ceteris paribus, it shows how many fish are there to be caught. CPUE, however, has already begun to fall from its high point in 1988.

Data of this sort on Lake Victoria are collected by the various fisheries departments and has a lag time of two to three years. Personal observation and the reports of fishers indicate that the size of Nile perch being caught continues to shrink. Informal observations by both fishers and fishery professionals all indicate that the CPUE for Nile perch is falling. The drop in size and catch per unit effort in the Nile perch fishery are signs that the Nile perch is being biologically over-fished.

Nothing in fisheries management is ever sure, and we cannot say for certain that the Nile perch is being over-fished even with this evidence. This is because over-fishing is not the only reason to expect declining numbers. Species introductions commonly observe a pattern of rapid, sustained population growth as they exploit virgin food sources followed by a deep crash in population as the beginnings of establishing a new equilibrium. Since the Nile perch was introduced in the 1950s and reached its peak population in the 1980s, there may be an extended period of decreasing population. In theory these oscillations in population will decrease in amplitude as a new equilibrium is established. The rise of the *dagaa* population, a type of species than lives with the Nile perch in lakes which neighbor Lake Victoria, may imply that a new equilibrium is not too far off.

Informal reports from fishers indicate that *dagaa* are getting harder to catch. In the recent past *dagaa* fishers would never fish during the week of the full moon. The moonlight dilutes the lamp light and greatly reduces the

catch. Nowadays one can see a few *dagaa* fishers out on the lake even during the full moon. This behavior could also be a result of the increasing costs of boats and nets which make it more expensive for them to be idle.

The fishing gears. Gill nets have developed a terrible reputation among lay people, basically because of well founded horror stories about huge, marine, monofilament nets which destroy ocean life indiscriminately. A small-scale, nylon, gill net fishery, however, like that of the Nile perch, has real advantages in fisheries management. Gill nets are very selective for size, if not for species. A fish cannot usually be caught in a gill net if it is too big to swim into the mesh or small enough so that it swims through without getting its gills caught by the thread.

Ligvoet and Mkumbo (1990) found that in the Mwanza Gulf in Tanzanian waters, on average, male Nile perch become sexually mature by an age of two years and a length of 60 cm. Females become sexually mature by an age of three years and a length of 97 cm. Other researchers have found some differences but these figures are the modal findings. They found that the selectivity of gill nets for Nile perch in 1987 followed the equation Length = 2.8*cm mesh + 16.5. This would indicate that if one wanted to ensure that half the catch of females had reached sexual maturity (i.e. had a chance to spawn) one would want to use a mesh size of 28.75 cm or 11.5 inches. Nevertheless, the recommendation from the Tanzanian Fisheries Research Institute (TAFIRI) is that nets of 7" and 8" be used in the Nile perch fishery (Bwathondi 1992). This is because the Nile perch is so fecund that it is not necessary for anywhere near half the population to spawn in order to maintain their numbers. According to our survey 54% of the gill nets being used in the Tanzanian part of the lake have a 7" or larger mesh.

TABLE TWO: MESH SIZES OF ALL NETS OWNED BY RESPONDENTS
(Source: Wilson 1993)

Mesh size	Target Species	Frequency	Percent	Cumulative Percent
< .08"	*Dagaa*	8	4.8	4.8
.08" to < .5"		3	1.8	6.6

.5"		7	4.2	10.8
> .5" to < 2.5"	tilapia / Nile perch	3	1.8	12.6
>= 2.5" to < 5"		13	7.8	20.4
>= 5" to < 6"		7	4.2	24.6
>= 6" to < 7"	Nile perch	35	21.1	45.7
>= 7" to < 11"		89	53.6	99.3
>= 11"		1	.7	100
Total		166	100	

There has also been heavy use of mosquito seines with very tiny mesh sizes (.08") in the *dagaa* fishery. The current recommendation is that the minimum mesh size for *dagaa* be .4" (Ssentongo 1992).

There are several other small-scale fishing practices that are destructive. Beach seines are long nets with mesh sizes ranging from .5" to 2.5", which are anchored by one end on the beach and then carried out in a great loop by a boat until the other end is brought back to the beach. The net is then pulled in by hand, usually by a group of eight to twenty teenagers. Beach seines are often of small mesh size and they pull in everything in their path, including even very small juvenile Nile perch and tilapia eggs. Another practice is the use of pesticides in fishing which kills all fish and eggs in the area. Beating the water to drive fish into the nets and fishing in breeding areas are proscribed but still go on.

POSITIONS, ATTITUDES, AND BELIEFS OF THE RELEVANT ACTORS

The management community. The Tanzanian biological experts' only public recommendations are for control of gear rather than controls on access. Restrictions on gears are much more effective if they can be enforced on the beach because of the difficulties of enforcement out on the lake. This makes mesh size restrictions a good choice of management measure. In Tanzania, however, there are still some fishers who target tilapia and a fisher can always claim that he is using a small mesh size for tilapia. This is one

reason that, while TAFIRI and the TFD are recommending that gill nets larger than 7" be used in the Nile perch fishery (Bwathondi 1992), they are recommending a legal minimum of 5" while further research is done on the effects of gill nets on the tilapia (Ssentongo 1992).

They are also publicly recommending a ban on beach seines and mosquito nets, a minimum mesh size for *dagaa* of .4" and the enforcement of the restriction on trawling to depths of 20 meters or more. Privately, however, some fisheries officers do not support the ban on beach seines. They argue that the beach seines may be destructive where they are used, but that there are so few places on the Tanzanian lake shore where they can be used because of rocks and vegetation that their destructiveness is insignificant. This does not respond to the problem of disturbing tilapia eggs because these eggs are laid on the same sandy near-shore bottoms that the beach seines use.

The beach seine operators. Beach seine operators deny that their nets are as destructive as the biologists claim. One that we interviewed claimed that his mesh size, 2.5", was large enough so that the juvenile fish escaped. The definition of "juvenile" is fluid. According to the work of Ligvoet and Mkumbo (1990) cited above one could call a Nile perch a 97 cm long a juvenile, but, while accurate, this is not the common usage. We observed Nile perch as small as 20 cm in this person's catch.

The processing plants. The directors of the large processing plants are very concerned with the management of the small-scale Nile perch fishery. The larger investments represented by the processing equipment means that they are looking at a more extended period of time before their investments can be recouped than most other actors in the fishing industry. They say they are interested in remaining in this business for as long as they can. There is evidence of this concern reflected in their programs to provide gear to the small-scale fishers. They will provide nets with mesh sizes from 6", 7" and 8", but they encourage the fishers to take nets larger than 6". The processing firms have minimum purchase sizes, ranging from one half kilogram to two kilograms, however these sizes are much smaller than would ensure that they are not using juvenile fish. They also support controls on gear over limits on

access.

The small-scale fishers. In our survey small-scale fishers who worry about having enough fish in the future and those who don't split almost evenly; 88 respondents don't worry and 86 respondents do worry. This variable is significantly related to perceived past changes as can be seen in Table Three. The differences follow the main diagonal: the majority of the fishers that are catching more are not worried while the majority who see themselves as doing poorly are worried. This pattern is disrupted only by the fact that a slight majority of those catching fewer fish are not worried. The beach they come from makes no significant difference in their response.

TABLE THREE: PERCENTAGE OF NILE PERCH FISHERS WHO WORRY ABOUT THE FUTURE BY PERCEIVED CHANGES IN CATCH

(Source Wilson 1993)

		PERCEIVED CHANGES IN CATCH					
WORRY ABOUT ENOUGH FISH IN FUTURE		MANY MORE	MORE	THE SAME	FEWER	MUCH FEWER	TOTAL N
	NO	7	14	7	61	3	27
	YES	3	3	0	44	50	32

Five year Nile perch fishers only, 1 respondent is missing, relationship is significant at .01

The ones who are worried were asked the reason for their worry. Table Four reports these results. Most often they cited changes in the weather as the primary reason for changes in numbers of fish. Weather is the clearest English translation of the Swahili expression "hali ya hewa" or "condition of the air" but it does not totally capture the sense. What they are pointing at with this expression are general changes in the physical conditions of the lake and the environment which affect both numbers of fish and the ease of fishing. Several times they specified drought as the main cause, others mentioned water temperature, and some talked about changes in wind patterns which make fishing more difficult.

The next most commonly cited reason from this group is over-fishing, which is also expressed in the responses of too many fishers and too many

gears. Predation by Nile perch was also cited. Finally there was a group of

TABLE FOUR: REASONS GIVEN FOR WORRY BY THOSE WHO ARE WORRIED ABOUT HAVING ENOUGH FISH IN THE FUTURE	
REASON	PERCENT OF FISHERS MENTIONING THIS REASON
CHANGES IN WEATHER	45
OVER-FISHING	25
TOO MANY GEARS	16
PREDATION BY NILE PERCH	12
FISHING WITH POISON	10
FISHING IN BREEDING GROUNDS	9
TOO MANY FISHERS	7
FISHING FOR JUVENILES	4
N=67, these data are for fishers only, not fishers and traders, each fisher was given the opportunity to mention up to three reasons.	

destructive fishing practices that were mentioned: fishing in breeding grounds; fishing for juveniles; the use of poison. Beach seines, small mesh sizes, and beating the water were each mentioned once.

Table Five reports that those who do not worry about the number of fish in the future cite the rapid reproduction of the Nile perch most often as the reason they are not worried. Nile perch are a highly fecund species. Several said that the catch is not bad now and that people have been fishing for a long time without consuming the fish. Others expressed the opinion that thereare actually few fishers on the lake and that they are using primitive gears not capable of finishing the fish. One fisher said he was not worried because if the fish became depleted "they would just put in another species".

In the focus groups people would disagree about both the causes of changes in catch rates and whether or not anything could be done about them. Some believed that these changes reflected God's will. Most saw humans as the

TABLE FIVE: REASONS GIVEN FOR NOT WORRYING BY THOSE WHO DO NOT WORRY ABOUT HAVING ENOUGH FISH IN THE FUTURE	
REASON	PERCENTAGE OF FISHERS MENTIONING THIS REASON
HIGH FECUNDITY OF NILE PERCH	77

THERE ARE FEW FISHERS ON THE LAKE	12
PRIMITIVE GEARS CAN'T FINISH FISH	9
THE CATCH IS NOT BAD NOW	5
WE HAVE FISHED HERE FOR YEARS	4

N=74, these data are for fishers only, not fishers and traders, each fisher was given the opportunity to mention up to three reasons.

prime agent. One interesting observation was that it is impossible to predict what will happen with the fish in the future because the "scientists" could introduce a new species at any time.

TABLE SIX: CHANGES IN PERCEIVED CATCH RATES

(Source Wilson 1993)

Percent of fishers who had fished the same species 5 years ago: Compared to five years ago do you now catch more or fewer of this species?

Change	Nile perch	Tilapia	*Dagaa*	Total
Many more	5	12	19	9
More	8	12	14	10
The same	3	0	24	8
Fewer	53	61	43	51
Much fewer	31	12	0	22
Total N	61	8	21	90

Fishers who had been fishing a particular species five years ago and were fishing for that same species now were asked about changes in their own catches. The results reported in Table Six indicate a perception that catches are in decline.

On the whole "science" is perceived by the fishers as a source of valid truth. Scientists know what they are talking about because they have been educated and "it is their job". One fisher told us that for 10 years the scientists have been saying that there was going to be a drop in the fish population and they turned out to be right. Scientists are viewed as honest and given great respect.

CONSTRAINTS ON INSTITUTIONAL RESPONSES

The management community. Lake Victoria is a very large lake and changes in fishing regulations take time. The enactment of new regulations can take 5 to 6 years and then they will often lack a management framework. In 1972 the Tanzanian government, as part of a broad development initiative, decided to pursue a radical decentralization of its policy apparatus for the development and management of the fishery. Lower echelon fisheries staff were removed from the TFD and placed under local development directors. This made it increasingly difficult for centralized research to have an input in policy (Nhwani 1992). Another result was a great number of poorly defined plans for the lake existing at various levels. At least three different ministries are involved in fisheries management in Tanzania, and the flow of administrative decision making is incongruent with the flow of research information (Nhwani 1992). The government is currently involved in reorganization efforts, including bring TAFIRI and the TFD into a closer institutional relationship.

It was not until 1988 that a concerted fisheries policy was developed, but enforcement of fisheries regulations still remains under the ineffective control of local authorities (Nhwani 1992). These local authorities have enforcement staff, but there are conflicts between their enforcement duties and formal revenue gathering duties (Nhwani 1992). In an interview, a former, national Director of Fisheries told me that there is still a strong constituency within government which opposes a reorganization because it would be seen as a defeat for decentralization.

There is a formal recognition by management officials that participation by local fishers in the formation and enforcement of the regulations would be a good thing (Ssentongo 1992) but there are no formal mechanisms for participation. The ad hoc mechanisms being used, for example the public meeting about the whole fish export ban described below, tend to include only the wealthiest of the small-scale fishers.

The experience of Kayenze beach indicates that local fisheries officers can play a very positive role if they are so motivated. An important thing to understand is that theft of nets is considered by the fishers as far and away the most important community level problem facing them. Fully 70% of our

respondent fishers had a boat or some sort of fishing gear stolen from them in the last five years, 14% of them more than once. For all respondents, the pursuit of security was the third most common reason cited for deciding what beach to move to, after following the fish and finding better prices. On Kayenze beach, due to the efforts of a very active fisheries officer (100% of fishers reported seeing him every day) they are already organizing around the theft issue, and a recent influx of fishers into Kayenze can be partly attributed to the belief that the beach is safer because of it. The Kayenze organization is considered quite successful by some, one man claimed that they had not been robbed since they began. Fisheries officers in general do not seem to be very active in training. The survey found that the regularity of fisheries officers visits to the beaches did not have any affect one way or the other on fisher's knowledge of the regulations.

The fishers often expressed worry about corruption in respect to fisheries officers, particularly in their appointment. There was a feeling that the local officers' jobs were patronage jobs that were sometimes given to unqualified people. There were intimations of corruption in the enforcement process. While management, in general, is seen as an honest attempt to conserve the fishery, individual officers are not seen as necessarily a part of that effort. There is a real sense among the fishers that the government as a whole, while they are very dependent on it for leadership and development, has neglected the fishers and their communities.

The small-scale fishers. In spite of the fact that they understand the reasons, and in many cases agree with them, fishers are not in a position to change gears easily. Ninety meters, the standard unit, of new factory made gill net costs an average of $35.00. Nile perch fishing crew see advancement in the industry as following an ideal path which they believe a "good" crew member should be able to achieve. This path begins by working for a net owner (the net owner is the more important employer than the boat owner, but they are very often the same person) until they can buy their first small net. This gives them a much higher share of the catch, as net owners get an average of three times the share of a crew member. This way they can work their way up to

owning a large net, some of which can be several kilometers long. The next step is usually renting a boat and hiring a crew to work the large net, and finally to buying a boat. Given this pattern and the expense of the nets, changing nets quickly to accommodate changes in mesh size regulations is unlikely. *Dagaa* nets are less expensive than the Nile perch nets because fewer are needed.

One area of specific interest for us was how the fishers' perceived the constraints on their own abilities to participate in fisheries management. This concept of "comanagement" has become very salient in recent fisheries management literature (Jentoff 1989). The initial reaction to the idea of fishers participating in the management of the lake fisheries was positive, but many reservations were also expressed.

A number of doubts about organizing for comanagement and mutual protection were expressed. The size of the lake and the inability to know what other areas are doing raises questions about coordination. They wanted to know how comanagement attempts in a small area do any good if others are not doing it. Leadership is a problem. It is hard to find non-corrupt leaders and past cooperative attempts have failed because of a lack of leadership. They also feel that they would need organizational and material help from the government if they are to be successful. Seminars and training were mentioned often as well as modern gears as an incentive.

Some felt that for comanagement to work that everyone would have to make some sort of investment in it, yet many would be reluctant to do so. Many said that it would be difficult because they are used to watching out for themselves, especially 'these days'. Thieves and those who lack faith in the organization will break it down. Some said that this sort of organization should proceed slowly.

Another fear was that comanagement would be good for boat owners and net owners but not for crew. It would be difficult for them to move between boats to get jobs. It was also pointed out that many crew members moved from beach to beach and this would present organizational difficulties.

Another important perception is what they see as true about their own abilities to affect the situation. In focus groups they expressed a perception of heavy limits to their potentials for affecting the fisheries. They have experienced changes in the fisheries as depending on acts of God, on acts of the government and the scientists, and on the actions of fishers at an individual level. These is little or no experience with fishers working together on a community level as a source of positive changes in the fishing situation.

Many fisheries management systems depend on limiting the number of fishers by limiting access to the fishery. One belief that was strongly held by many people in the focus groups was that any Tanzanian has a right to fish in Lake Victoria regardless of their original home. In one focus group a respondent said that "in fishing there is no segregation" using a Swahili word, *ubaguzi*, which has strong historical overtones from colonial abuses and the fight for independence. During the survey respondents were asked to order sets of statements in terms of degree of agreement. This was done several times with different sets of statements in which the same ideas were phrased in different ways. This belief about outsiders being allowed to fish was easily the most frequent belief to be rated as high agreement. It probably stems from their own desire to be able to move freely to follow fish, prices, and safety. On one beach a focus group suggested some more reasons. They saw outsiders as a source of new ideas and techniques. One man said that "before the Tarime[2] people came we did not even know that there were *dagaa* in Lake Victoria, we thought they were only in Lake Tanganyika".

Beach seine owners. The owners of beach seines are perceived to be a powerful group. Beach seines are very expensive compared to other nets, and they cannot be effectively purchased in small increments the way a gill net can. With the rise in theft, beach seines are an increasingly attractive alternative to gill nets that cannot be so easily stolen. Some Tanzanian biologists explain the

[2] A district near the Kenya border, a long distance from the beach where this focus group took place.

failure to ban the beach seines by the fact that beach seine operators are a powerful, behind-the-scenes political group. They are not, however, formally organized.

THE PERCEIVED LEGITIMACY OF MANAGEMENT MEASURES BY SMALL SCALE FISHERS

The openness of rule breaking varies from rule to rule. Catching juvenile Nile perch is technically illegal but it goes on without embarrassment. So does the use of mosquito nets for *dagaa,* when the law requires a minimum mesh size of 0.4". On the other hand fishing using the hated poison is done at night and remains hidden from the other fishers. Drumming the water to push the fish into nets is frowned upon by most fishers and those who practice will do so out of sight of other fishers. Fishing for juveniles and in breeding areas were not considered good practices by most fishers, but they did have their defenders in people who did not think it made much difference.

Compliance with closed seasons is variable. On the one hand, the reasons for them are easily understandable and seen to be in the general interest. The poverty of the fishers, however, is such that many of them cannot afford to go for six months (the current closed season is January to July in all bays and river mouths) without any fishing activities. We did observe a large, but not absolute, drop in fishing in these areas during the closed season. The general pattern is that those fishers who are mobile enough or close enough to get to the main lake during the first half of the year do so, while the others ignore the ban. In these situations there seems to be a tacit agreement with the officers not to press enforcement.

The use of pesticides in fishing is scorned by almost all fishers. The practice is considered much more of a criminal act than any other violation of fishing regulations. An arrest of a poisoner is news to be broadcast on the radio. One interesting question for further study is how poisoning became so heartily disliked. The fishers say it is because they are so destructive they even kill eggs, but the same can be said of small mesh beach seines which are much more acceptable to most fishers.

INDUSTRIAL OVER-FISHING

The question of over-fishing as a result of industrial level fisheries development involves both fishing using trawlers and the development of a large scale export processing industry for Nile perch.

DESCRIPTION OF THE PROBLEM: THE EXPORT PROCESSING FIRMS

The export processing industry has had a number of effects on both the fishery and the access of riparian peoples to fish for their own food. There are few alternative sources of the quality protein that fish provide. In areas where the export industry has penetrated, Nile perch prices have risen and become more stable (Grèboval 1990). On the lake as a whole dollar prices fell from 1975 to 1985 and then began to rise again because of long distance and export demand, this rise was felt later in Tanzania than elsewhere because it is more remote from the export market (Reynolds et al. 1992).

The largest processing firm is a joint venture involving Tanzanian, Kenyan, and Dutch interests. It has a current capacity of 40 metric tonnes of whole fish per day which produces 20 tonnes of fillets. These fillets are then sent to Nairobi, Kenya where processing the fish for export is completed and the frozen fillets are shipped to Israel, Europe, and North America. This firm hopes to double its processing capacity in the future. A Nairobi based firm is currently installing processing capacity of 100 tonnes whole/50 tonnes fillet per day. A Tanzanian firm is building a 90/45 tonne per day plant, an expatriate, family-owned firm already has 100/50 tonnes per day filleting capacity, and another joint venture is putting together a smaller 15/7 tonnes per day factory. Two other processing plants are near operation, but we don't yet have data on their capacity.

What do these plants mean for the Nile perch fishery? These plants alone have a yearly capacity of 140,525 tonnes, and, considering that Tanzania exported five tonnes of Nile perch in 1986 and 820 tonnes in 1989 (Maembe 1990), this represents an increase of more than two levels of magnitude in three years. There are few good data on sustainable yields. The least conservative estimate, based on extrapolations from nearby Lake Kyoga, which

has a similar fishery, indicates an annual MSY for the whole lake of 120,000 tonnes for Nile perch (Reynolds and Gréboval 1988). Other estimates of MSY for Nile perch, however, have been as low as 69,000 tonnes for the lake (Ssentongo and Welcomme 1984). Taking the larger estimate, we can assume an MSY of 60,000 tonnes per year, as Tanzania owns 49% of the lake. Thus, the capacity of the plants we have current data for, ignoring the other two plants and all other uses for Nile perch, is 2.4 times the maximum sustainable yield.

It is true, however, that the plants do not have to run at full capacity to make a profit. Using Grèboval and Mannini's (1992) conservative approach and assuming 300 working days at 60% capacity we arrive at a figure of 69,300 tonnes per year for these plants. A figure which is still greater than the estimated maximum sustainable yield of Nile perch for the whole country for only these five plants. The actual production of Nile perch in Tanzania in 1990 was 175,000 tonnes (Grèboval and Mannini 1992).

This export capacity competes directly with the dietary needs of the local people. Table Eight shows that since 1989 there has been a clear drop in the amount of fish eaten by households that are located in fishing villages but not involved in the fishing industry. At the same time that there has been an increase in the fish eaten by households where at least one member is a fisher.

A distinction needs to be made here between the direct and indirect effects of the introduction of the Nile perch on the nutrition of lake-side peoples. Direct effects have been positive. Grèboval and Mannini (1992) argue that the overall impact of the introduction on local diets must have been

TABLE EIGHT: AMOUNT OF FISH EATEN COMPARED TO FIVE YEARS AGO BROKEN BY HOUSEHOLD INVOLVEMENT IN FISHERY - PERCENTAGES

p=.000 (Source Wilson 1993)

AMOUNT OF FISH EATEN COMPARED TO FIVE YEARS AGO		FISHER HOUSEHOLD	FISH TRADER HOUSEHOLD	HOUSEHOLD UNRELATED TO FISHING

MUCH MORE	2	0	0
MORE	54	28	13
THE SAME	18	35	27
LESS	24	35	52
MUCH LESS	2	2	8
TOTAL N	146	43	40

positive, since the production of table fish has increased from 44,000 to 405,000 tonnes between 1975 and 1989. This figure does not include *dagaa* and the haplochromines and they argue that these two fish have traditionally been food fish of last resort. This claim was confirmed in my interviews as far as the haplochromines are concerned, and *dagaa* production has certainly increased during this time period.

The indirect effects operating through the rise of the export market, have been negative in that they have reduced the magnitude of the positive effects in a time of general food scarcity due mainly to drought. The Table Eight comparison is with five years ago, the peak point of the Nile perch production. It indicates that for non-fishing households the fall in production combined with export demand is reducing the benefits of the Nile perch. The increase in fish eaten in the fisher household probably reflects both an increase in investment in fishing gear, as well as a general drop in the availability of other foods, which is also indicated by our survey. The fisher households are able to use the fish as a substitute for other foods, while the non-fishing households are not because of the increasing price.

POSITIONS OF THE RELEVANT ACTORS: INDUSTRIAL PROCESSORS

The management community. Tanzanian biologists are very concerned about he degree of investment in industrial processing. Prof. Bwathondi, the director of TAFIRI, has been quoted as saying "If all these plants start operating next year, there will be no fish for the ordinary people and two years later Lake Victoria will be dry of fish" (Musendo 1992).

TAFIRI biologists report that they have never received requests for information from anyone investing in the industrial fishery. When the

investors were questioned on this point they gave several responses. One told me that he relied on hearsay, believing that the data he would get from TAFIRI would not be reliable. Another told me that he had seen one report from FAO and that is what he based his decision to invest on. The manager of a parastatal reported that his firm had a good working relationship with TAFIRI, but he had never asked them for information.

The export processing firms. The processing plants, naturally, see themselves as crucial to the economic development of the area and the majority of related government officials agree. They see themselves as very much on the side of rational, long-term management of the fishery. This even extends to controls on their own industry. One manager of an established plant, one that had received concessionary terms from the government when it was being set up, is now concerned that the drive for foreign exchange is going to lead to more and more supported processing plants. He does not want any more firms to get government support to be established.

The large scale fish traders. Traders that until recently had been dealing in exporting whole Nile perch have expressed a different perspective. The many changes in the fishery and its development policy have left some of them taking a very short term view, and seeing it in their interest to exploit the fishery heavily while the returns are high. In one interview I did, an executive in a whole fish exporting firm indicated that current returns on investment are so high that his firm expects to recoup their investments in a year, and is not concerned with any possible collapse of the fishery.

The Tanzanian government. With the important exception of TAFIRI, and a few lower level TFD personnel, most sectors of the Tanzanian government are firmly behind continued investment and protection of the Nile perch processing industry. All of the processors that I interviewed had been certified by the Investment Promotion Center in Dar es Salaam. This meant that they had received tax breaks through individually negotiated agreements in return for attracting foreign investment. The struggle for whole fish export ban, described below, provides strong evidence of the political power of the processing industry.

There is a five percent royalty on fillet exports. This tax is ostensibly to support the management efforts of the Tanzania Fisheries Department. One firm reported that this tax is a larger expense than their labor costs or their debt service. Several plant managers expressed resentment that this tax is paid but little management is seen. One complained that he had been paying $6500.00 a month and the "Regional Fisheries Officer doesn't even have a boat or a car".

CONSTRAINTS ON INSTITUTIONAL RESPONSES: INDUSTRIAL PROCESSORS

The industrial Nile perch processing efforts enjoy powerful support from the government and the business community. Whatever institutional responses can be made to the excess capacity, it is politically very doubtful that it will be feasible to bring about a reduction of current capacity. This support is well illustrated by the struggle over the recent ban on the export of whole Nile perch.

In February 1993, in response to complaints from the processing plants to the highest levels of government (Musendo 1993a), a ban was clamped on the export of whole, unprocessed fish from Lake Victoria. Whole fish had been going to Kenya to be filleted in plants there. The Tanzanian processors were claiming, with little justification, that there was a scarcity of fish for their operations. The sub-text was that there was a scarcity of fish at conveniently located beaches at the prices they wanted to pay.

The immediate effect of this ban was to push the ex-vessel price of Nile perch down 30%. Predictably, the hue and cry raised by the fishers was extensive and the story got a great deal of play in the newspapers. The original ban had been planned to take affect in January but was postponed. After the February ban, a high-level team led by the director of the TFD came out from Dar es Salaam and held a meeting with fisheries officials, industrial processors, and "prominent fishers". A local fisheries management official told me that prominent meant '20 boats or more', which implies only the very wealthiest of the small-scale fishers were given a voice. All that resulted from all this discussion, however, was a 45 day postponement of the ban.

The government had several reasons to impose the ban beyond a simple reflection of the power of the industrial processing plants. One is that export taxes are easier to collect from the factories that they are from trucks which would go directly from the beaches to the Kenyan border. Another is the loss of revenue due to the more informal nature of the whole fish trade. Most of this trade is was done in local currencies, Kenyan and Tanzanian shillings which are exchanged for one another in an extensive black market along the border. The result of this was that Kenya was gaining most of

the foreign exchange benefits of the Nile perch export trade. A third reason was the value added by filleting was accruing entirely to Kenya.

Small-scale fishers argued that the fall in price not only hurt them, but would lead to an increase in smuggling of whole fish to Kenya, particularly across the lake. Fisheries officials, however, expressed reasonable doubts about this. Smuggling is already wide spread because of customs and price differences for Nile perch between Kenya and Tanzania that had existed before the ban. On-lake smuggling is particularly prevalent north of the town of Musoma, where the Kenya border is within easy reach by canoe. Kenyan collection vessels have been sighted as far south as Lukuba, an island near Musoma (van der Howen and Budeba 1992). There is a much larger amount of smuggling by road (van der Howen and Budeba 1992). Van der Howen and Budeba (1992) estimated that about 20% of the pre-ban Nile perch exports to Kenya were undeclared. While increased price differences should increase smuggling to some degree, most of the fishers who had been selling to the whole fish exporters are not within easy reach of the Kenyan border. Smuggling whole fish by road will be made more difficult by the ban.

From the perspective of the health of the lake the ban is probably a good thing. The drop in prices should reduce fishing effort. Additionally, the price drop will make Nile perch more accessible to local, small scale fish processors. This was one argument raised against the ban, in fact, because the most common small-scale processing method for Nile perch is smoking and it was pointed out that the ban would, therefore, contribute to the terrible deforestation problem in the lake-shore region.

DESCRIPTION OF THE PROBLEM: TRAWLERS

The second aspect of the development of the industrial fishery is the use of trawlers. The development of trawlers in the Tanzanian part of the lake dates back to the 1960s when FAO, in cooperation with the government fisheries research institutes on the lake, formed the Lake Victoria Fisheries Research Project (LVFRP). The major recommendation of this project was to began work on developing a fish meal industry exploiting the then common haplochromines. In 1973 Tanzania became the first riparian nation to introduce modern trawlers.

These Dutch financed trawlers were larger and better equipped than what the LVFRP had proposed (Jansen 1977). By the early 1980s this fish meal industry had collapsed due to the predation of the Nile perch on the haplochromines. The trawlers then shifted to fishing for Nile perch. By 1988 there were 13 trawlers operating in the Tanzanian waters.

Compared to the potential damage to Lake Victoria arising from excessive demand from industrial processing or over-fishing by the much larger small-scale industry, the 15 trawlers are a minor danger. They are, however, the source of some problems. The major one is that trawl nets are relatively unselective in comparison with the gill nets used by the small-scale fishers. While there are no recent hard numbers, a trawl operator estimated for me that an average of 10% of his catch was made up of fish smaller than the 2 kgs (approximately 50 cm) that is acceptable to the processing factory he sells to. This self-reported estimate should be biased downward.

A second problem with trawlers is that they destroy the nets of the small-scale fishers. Legally, trawlers are not allowed to fish in waters less than 20 meters deep, but this prohibition is widely and openly ignored. During 1993 there was an agreement, brokered by the fishery authorities, between the small-scale fishers in Speke Gulf and seven trawlers that have concentrated in that area. The small-scale fishers agreed to put out their nets only at night and retrieve them early in the morning and the trawlers agreed not to fish before 6:30 am. This represented a large concession by the small-scale fishers, many of whom would normally not place and remove their nets every day. In spite of this, the agreement is reported to have broken down.

Trawlers are not as profitable as small-scale canoes. Reynolds and Grèboval (1988) compared the profitability of a 12 meter wooden trawler with a 105 HP engine, and 15 traditional wooden canoes without engines. The canoes were found to be 10 times as profitable (148% as opposed to 14.7%) and to employ 9 times as many fishers (5 as opposed to 45).

Trawlers, in spite of lower profitability, seem to have found a niche in the Nile perch fishery. All seven of the trawlers mentioned above that are

operating in Speke Gulf hold long term contracts with a major exporter of Nile perch fillets. Hoza and Mwamoto (1992) suggest that such linkages are the only way that trawlers can remain profitable. They provide this factory with a manageable and steady supply of fish which the small-scale fishers, particularly given the acquired distaste for cooperatives held by peasants of all stripes in northwest Tanzanian, are not able to match. The trawler companies, many of whom are parastatal, have credit facilities not available to the small-scale boat owner.

Positions of the Relevant Actors: Trawlers.

The management community. While, particularly in the seventies, some of the more fisheries development oriented voices have given tentative approval (CIFA 1981) most biologists concerned with fisheries management have been criticizing trawling for years (CIFA 1983, Grèboval 1989, HEST 1987, Jansen 1977, Siwo 1988). Biologists opposition has been somewhat tentative, however, and official publications have called only for enforcement of the 20 meter depth limit (Ssentongo 1992).

The export processing firms. The processing plant managers are concerned about trawlers. One manager of an industrial processing plant is adamantly opposed to trawling and thinks that they should be banned immediately. Another is leaning in that direction. Neither of these people buys their fish from the trawlers.

The small-scale fishers. Local fishers are very much opposed to the trawlers. Agreements that have been made to keep the trawlers that are illegally fishing shallow waters from destroying gill nets have broken down on at least two separate occasions. In one incident a technique that the small-scale fishers described as witchcraft was used against an intruding trawler. The trawler found that it had caught a dead cow. The captain of the trawler would not agree that the incident had involved witchcraft, but said that he would not return to the area in question.

Constraints on Institutional Responses: Trawling.

Uganda and Kenya have both banned trawling in Lake Victoria. Potentials

for Tanzania's following suit are complexified by various types of current government involvement in this type of fishing. The largest trawling operation, with two operational and two non-operational boats, is a government parastatal which currently does not have any operating processing equipment. They are, however, exploring the possibility of using equipment left over from the haplochromis fish meal operations of the 1970s to manufacture fish meal from the post-filleting offal of the Nile perch.

In addition to the parastatal trawling company, both TAFIRI and the Nyegezi Fisheries Training Institute, which is responsible for training fisheries officers and fisheries extension for Lake Victoria, are using their respective boats to do commercial trawling. This is understandable given that their current operating budgets are not able to meet their needs. It is a block to potential change, however, when the people who understand best the problems with trawlers and who are the leading advocates of sustainable fishing practices are themselves dependent on trawling to fund their own operations.

The majority of the large-scale Nile perch processors, however, are not looking at trawlers as an important source for their fish in the future. All those I have spoken to are investing in small-scale fishing equipment, including engines, which they are then providing to fishers on credit terms. One firm has already provided 54 outboard engines on this basis. This is a very common phenomenon in fishing communities across the world because if guarantees steady supplies (Platteau and Abraham 1987). While the fishers are paying for the equipment they are obliged to supply the firm with their fish.

All the industrial processors that I have spoken to are investing in long distance transport boats which will purchase fish on remote fishing beaches. Currently, the five processors in Mwanza town rely more or less heavily on purchasing their fish at the same five landing beaches that are near town, accessible by truck and which handle enough fish to make the trips worth while. This pits each of the large buyers against each other and forces prices up. They each hope that their transport fleet can be built up sufficiently that they can get away from each other to more remote beaches and

thus push the prices down. This downward pressure on prices may put the non-parastatal trawling operations out of business.

CONCLUSION

Potential for positive change in the fisheries management situation on Lake Victoria does exist. Out of the discussion above several key facts stand out as definitive of this potential.

1. The export processing industry is going to be the driving force in the Nile perch fishery for some time to come. There is too much invested and too much support from the Tanzanian government to expect any other outcome. Competition for fish purchases with this industry has negative implications for the nutrition of the riparian peoples, particularly those who live in non-fishing households. But the industry has also demonstrated an interest in effective management.

2. The difficulties and basic lack of profitability of the trawler operations, in addition to the procurement policies of the export processors, indicate that it is going to continue to be small-scale fishers that dominate harvesting. These procurement policies also indicate that more and more these fishers are going to be tied into the export sector through both gear loan schemes and a growing fleet of transport boats owned by the processing sector.

3. There is a good deal of concern in the small-scale fisher community about the future of the fish resources, much of this concern is based on a relatively sophisticated grasp of what is going on in the lake. There is a willingness to organize, particularly around security issues. But there is also a dependency on outsiders for catalyzing organization and providing leadership.

4. The Tanzanian government is not going to be able to increase its involvement in the management of the lake for some time. This is due mainly to budget constraints and lack of equipment, but also the demands of reorganization.

Given current potentials the best outcome might be that the export processing industry expand the organizational efforts they are currently putting into setting up a procurement system to include enabling management

efforts. This could be done by providing appropriate gear, training of the local fishers, funding researchers in monitoring the fishery, and providing organizational support at the local level for comanagement organization. One effect of this would be to reduce competition for fish on particular beaches which would put downward pressure on prices.

Such an effort would, of course, have to involve the government to provide legitimacy and to ensure that the local fishers continue to receive a just price for their fish. Lower prices will reduce fishing effort, which will reduce over-fishing and perhaps mean higher catch rates in the future. Lower prices would also make fish more available to local customers. The increased involvement of the export industry, whether or not it involves an expanded management role, will have to be monitored to ensure that it does not become a situation where the local fishers are exploited by the large organizations.

Fisheries management on Lake Victoria has never been successful. If this is going to change then innovations are going to have to be developed that involve the participation of all key players. Each of them must be able to see how they will benefit from better management.

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