Fishermen Resistance to Exit Fisheries

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Abstract
Excessive harvesting pressure is an important force behind the decline of East Africa's Lake Victoria fisheries. The question of entry-exit is, therefore, crucial. This paper uses micro-data collected from the Kenyan side of Lake Victoria to analyze this issue. Results indicate that fishermen are in their current enterprise because alternatives are lacking. In spite of the "commons" nature of these fisheries, over two-thirds of the fishermen would welcome more fishermen, as the positive externalities of this exceed the negative ones. Opportunity cost of exiting, fishing experience, and whether the skipper of a fishing unit is its owner or an employee, are the significant determinants of resistance to exit from these Kenyan fisheries. Exit inertia usually associated with imperfect capital malleability and attachment to fishing is lacking, or minimal, in these fisheries.

Key words Exit-entry, fisheries, imperfect capital malleability, Kenyan fisheries of Lake Victoria, opportunity cost of exiting, resistance to exit, Willingness to Accept (WTA) compensation.

Introduction

Of the numerous factors leading to the serious decline of the Kenyan fisheries of Lake Victoria that have been observed since the 1960s, excessive harvesting pressure is arguably the most important. Harvesting pressure has not only been expanded by an unprecedented increase in the number of fishermen and fishing vessels, but also by an enormous increase in the fishing intensity of already existing effort. Several forces underlie this escalation of fishing effort and its intensity. These include a high population growth rate, increasingly limited opportunities for alternative employment, expanding fish markets in the domestic and external arena, the emergence and rapid expansion of the fish processing sub-sector, collapse of traditional fishery management structures, lack of well-defined property rights to replace the collapsed structures, policy failure and inability of the government to enforce regulatory measures, and falling fishery productivity (catch per unit of effort) due to unsustainable harvesting practices and ecological upheavals resulting from these practices and pollution.

Given this background, the question of exit from the fisheries is crucial because the current level of effort is excessive and cannot be supported by the resource base.
Means and incentives that can induce exit are required. This paper analyzes the determinants of fisherman resistance to quitting the Kenyan fisheries of Lake Victoria. These determinants may play a substantial role in the management of these important fisheries.

The paper proceeds as follows. It starts with a short description of the fisheries and a note on the data used. This is followed by an overview of the long-run issue of entry and exit in these fisheries as a motivation for the model on resistance to exit that follows. The model is then estimated using econometric tools, and finally, the results discussed. In this discussion, emphasis is placed on the management implications of the model results.

The Kenyan Fisheries of Lake Victoria

Kenya is a coastal state, and like other coastal states, has jurisdiction over 200 nautical miles of the ocean from its shore, thanks to the 1982 Law of the Sea Conference. The country has rich marine resources along its 640-kilometer coastline. Technological capacity constraints have, however, meant that the potential of these resources has remained largely inaccessible to Kenyans. Thus, marine fisheries contributed only 3% of the 194,000 tons of fish produced in Kenya in 1995, compared to about 95%, from the lake fisheries. Even though the country has several lakes, Lake Victoria dominates the fishing sector. In 1995, Lake Victoria accounted for 94% of Kenya’s total fish catch.

Fishing makes a small but increasing contribution to Kenya’s GDP. This contribution averaged 0.2% between 1971 and 1981. By 1989/90, however, it had increased to about 2% of the GDP attributable to the nonmonetary economy and to 4.4% of the monetary sector’s GDP. This increase is attributable to the exports of filleted Nile perch that began in earnest in the mid-1980s. The country earned Kshs 1.5 billion in foreign currency from fish exports (excluding earnings from sporting activities) in 1995. The relatively small contribution to the GDP notwithstanding, the fishing industry is the lifeline for the Kenyan communities living around Lake Victoria and the coast. In 1995, the Fisheries Department estimated that 798,000 Kenyans were either directly or indirectly supported by the sector.

Lake Victoria is the world’s second largest freshwater body (after USA’s Lake Superior), covering a surface area of 68,800 km². The biological diversity of the lake has declined from an estimated 350–400 species of fish in the earlier years of this century, to less than 200 at present (Achieng 1988; Witte and Van Densen 1995). This loss of biodiversity is one manifestation of the decline that has characterized the fishery over the century. The decline has been so severe that the lake fishery now supports a three-species-only commercial fishery, based on the Nile perch, *Rastrineobola argentea*, and the exotic tilapia, *Oreochromis niloticus*. There is currently intense pressure to reduce further to a two-species fishery. While the share of catch volume of exotic tilapia rose to a peak of about 23% in 1990, it dropped sharply to less than 3% by 1995. Conversely, Nile perch and *R. argentea* have experienced literally uninterrupted dominance, with the two species accounting for about 88% of the lake’s total landings in 1995.

The lake is common property of three East African countries, shared as follows: Kenya (6%), Uganda (45%), and Tanzania (49%). Each of these countries manages its portion of the lake independently, so there are different regulatory and enforce-
ment strategies. However, the recently formed Lake Victoria Environmental Management Project (LVEMP) aims at the formulation of a unified management and regulatory framework for the entire lake.

While Kenya’s share of the lake surface area is only 6%, its share of the shoreline is about 22%, or 760 km. This is the portion of the lake most heavily fished and commercialized. Thus, it is estimated that Kenya’s share of Lake Victoria’s total catch of 555,300 tons in 1990 was 33% (Ikiara 1999). Between 1973 and 1995, the number of fishermen operating on the Kenyan part of the lake increased by 200%, while that of vessels increased by about 95%. In 1985, it was estimated that about half of the effort on Lake Victoria was exploiting only 2% of the entire lake surface, Kenya’s Nyanza Gulf (Ikiara 1999). Rapid population growth, lack of alternative employment opportunities, the lucrative nature of fishing since the mid-1980s, and the open-access nature of the lake fisheries have meant that the majority of fishers are permanent and that the lake fisheries continue absorbing an increasing number of new fishers every year. Rising demand for fish in domestic and external markets, relatively better availability of credit from the fish processing and marketing subsector, falling catch per unit of effort, and rising cost of living have led to expansion of effort from existing harvesters.

The pressure associated with this increase in fishing effort and other factors poses substantial challenge to the fishery’s capability to maintain a flow of services to posterity. Already, total fish output from the Kenyan side of the lake has levelled off (figure 1), while fishing effort continues to expand. Other manifestations of the stress under which the fisheries have been subjected to include: loss of biodiversity; declining productivity; increasing juvenile harvest rates; increasing desperation and use of destructive technology, such as chemical fishing; worsening pollution; and infestation of the lake ecosystem by the water hyacinth.

![Figure 1. Quantity of Fish Produced in Kenya](image-url)
In Kenya, the lake constitutes the main resource for an area that is highly populated (290 persons/km²), and there is a very limited alternative means of livelihood. Rainfall is low and the soil is poor in the region, severely limiting agriculture. Most agricultural activities in the area are basically at a subsistence level, with cotton the only cash crop (Ogutu 1988). The cotton industry, however, collapsed many years ago and does not offer a viable alternative to fishing.

In the backdrop of this escalation of fishing effort, the question of resistance to exit or willingness to accept compensation to quit the Kenyan fisheries of Lake Victoria is pertinent. The remainder of this paper uses data collected from the Kenyan side of Lake Victoria to address this issue.

Even though exit is not the only feasible management strategy for Lake Victoria fisheries, the paper focuses on it for two reasons. First and foremost, exit will be a key component of any management strategy for these fisheries, as the overfishing taking place indicates that the current level of effort is suboptimal. Exit strategies will be crucial to rationalize effort in community self-management that we think is the best option for these fisheries. Secondly, the government (the current regulatory agency) has failed to effectively enforce existing regulations on gear limitations, closed seasons and areas, and trade in juvenile fish. This failure is attributable to a myriad of obstacles, ranging from lack of resources and strong vested interests, to corruption and lack of motivation. While exit will not remove these obstacles, it is relatively easier and cheaper to control entry than enforce input and output regulations.

**A Note on Data**

In the task of reducing the depletion speed of vital stocks of resources, managers frequently have to concentrate on the individual firms exploiting them. This requires microdata, ideally at the individual vessel trip level. Such data were lacking for the Kenyan fisheries of Lake Victoria, and available data were largely aggregate. Even these were of highly suspect quality due to the sampling methods used in their generation and failure to record data on weekends and public holidays, among other shortcomings. The importance of microdata for fishery management and the lack of available data compelled us to collect our own. Data were collected through the administration of a structured questionnaire from a sample of about 500 fishing units exploiting the Kenyan fisheries of Lake Victoria. This sample was selected using proportional purposive sampling to choose the landing beaches, and random sampling to pick 10–15 fishing units from each of these. In terms of scope of coverage, this produced a sufficiently large and representative sample.

Being the basic unit of production in fisheries, a “fishing unit” is used here to refer to the vessel, its head, crew, and fishing gear. The head of the fishing unit was the respondent to our questionnaire. The head of the fishing unit is the appropriate sampling unit, as he is the decisionmaker and, in most cases, the owner of the vessel and fishing gear. He is, therefore, likely to be relatively more resistant to exiting the fisheries than other crew members. He is also the most appropriate to target for

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1 This figure is obtained from Hoekstra et al. (1991).
2 There are five administrative districts sharing the lake on the Kenyan side, each with a different number of landing beaches. The number of beaches in the first stage sample from each district was determined by its share of the total number of beaches, estimated to have been 208 by the time of the survey. Instead of random selection, the actual beaches from each district were picked purposively in order to capture all sizes of beaches, in terms of the number of active fishing units based there, and other unique features.
3 In this paper, the terms “skipper” and “captain” are used to refer to the head of the fishing unit.
forced or other forms of exit, since his departure would be accompanied by a reduction in other dimensions of effort (boat and gear). In addition, the number of boats is a more significant determinant of fishing pressure than the number of “crew.”

Production-related data and other data were obtained on a daily basis from the sample of fishing units for three staggered months (May, August, and November 1995). These months were chosen to capture different seasons as comprehensively as possible. Data on technological parameters were taken as well.

Besides these data, information was obtained through interviews or personal communication with various stakeholders in the fishery sector. These include District Fisheries Officers (DFOs), senior officials of Fisheries Department headquarters, representatives of several Nile perch processing firms, and officials of the Lake Basin Development Authority (LBDA) and OSIENALA (an NGO involved in the protection of the lake ecosystem). Secondary data were obtained from the Fisheries Department, the Kenya Marine and Fisheries Research Institute (KMFRI), government statistical publications, and other publications.

In spite of two revisits to the same sampling units and substantial logistical difficulties, the survey response rate was high. An insignificant number of unit heads declined to participate when initially selected and were replaced with other random choices. Of the 526 fishing units initially included in the sample, 75.6% remained in it until the end of the survey. The rest either migrated, ceased operations, were not enumerated due to enumerator failure, or declined further participation. The use of people known in the fishing villages as enumerators ensured a high degree of response and cooperation.

The Long-run Entry Decision

Fishermen exploiting the Kenyan fisheries of Lake Victoria are in their current enterprise not because it is more profitable or desirable relative to other enterprises, but because it is the only one accessible to them. Our survey indicates that about 70% of the fishermen took up fishing because it was their only source of income, due to their lack of education and the unavailability of alternative employment (table 1). Another 18% of the fishermen took up fishing naturally, either in accordance with the dictates of family tradition or because of their proximity to the lake. The relative ease of entry into the fishing sector has also played a substantial role in attracting effort into these Kenyan fisheries, as table 1 further demonstrates.

It is remarkable that, in spite of the stock and crowding externalities engendered by the open-access nature of these Kenyan fisheries, 68% of the heads of fishing units in our sample indicated that they would like more people to fish in their fishing areas. Generally, users of resources that are overexploited, owing to their “commons” nature, are expected to be opposed to new competitors. Apparently, this is not the case here. Could it be that there is no externality in these fisheries or that, if present, it is not perceived by fishermen? Evidence returns an emphatic no to both aspects of the question. An overwhelming majority of the fishermen (91%) affirmed that catch per fishing unit had declined over the years. Moreover, about 62% of the fishermen cited stock reductions, reduced species diversity, and fall in the average size of fish caught as the changes they observed over time. In addition, depletion of

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6 Table 1 and Oduor-Otieno et al. 1978.

7 It is noteworthy, however, that artisanal fishermen were engaged in frequent conflicts with trawlers before trawling was banned in 1989. Moreover, Oduor-Otieno et al. 1978 report that migrant fishermen often face hostility.
fish stocks is the negative externality cited as the reason for opposing new entry by the majority (72%) of the fishermen who responded. Other negative externalities cited include social problems such as theft, disease outbreaks, and fights.

The reasons provided for preference of new entrants indicate that positive externalities associated with more fishermen joining a landing beach far outweigh the negative ones. Thus, 79% of the fishermen who prefer more entrants do so because more fishermen would contribute to the rapid development of the beach (table 2). This development could be facilitated by the exchange of ideas and competition, through contributions to beach and cooperative society by more fishermen, creation of employment, and increased demand for other services. Specifically, fishermen are aware that larger beaches attract more buyers and, thus, are associated with higher fish prices and other benefits. These would more than compensate them for the reduced CPUE arising from increased effort.

A crucial implication of the findings of this section is that fishers are primarily concerned with securing a (current period) means of livelihood, even if this is at the expense of the fishery. This, furthermore, implies that if fishermen were to be provided with alternative or supplementary means of livelihood, not only would the entry rate be reduced, but the attitudes of fishermen towards competition and resource health would also undergo change.

The Long-run Exit Decision

In spite of a general awareness among fishermen of the opportunity cost of remaining in the fishing industry, labor turnover is not high. Reasons for this include the relatively low risk of losing the fishing job, low overhead costs, and the possibility of massive losses (following exit) for those with large investments in the fishing sector, due to low second-hand prices for fishing equipment (Oduor-Otieno et al. 1978). It should be noted that the opportunity cost of remaining in the lake fisheries for most fishermen is very low, particularly since the mid-1980s. High unemployment rates in the country, in general, and in the lake region, in particular, coupled with the low agricultural potential of the area, have meant that the opportunity cost of fishing for most fishermen is very low. In addition, positive fish price movements

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
<th>Percentage of Respondents</th>
</tr>
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<tbody>
<tr>
<td>Only occupation/source of income and food</td>
<td>207</td>
<td>39.4</td>
</tr>
<tr>
<td>Lack of alternative employment</td>
<td>118</td>
<td>31.0</td>
</tr>
<tr>
<td>Ease of entry, as it requires no qualifications</td>
<td>114</td>
<td>21.7</td>
</tr>
<tr>
<td>Likes and enjoys fishing and being his own boss</td>
<td>31</td>
<td>5.9</td>
</tr>
<tr>
<td>Family tradition (father is/was a fisherman)</td>
<td>40</td>
<td>7.6</td>
</tr>
<tr>
<td>Lives next to the lake; fishing a way of life</td>
<td>57</td>
<td>10.8</td>
</tr>
<tr>
<td>Fishing is highly profitable, with daily cash income</td>
<td>11</td>
<td>2.1</td>
</tr>
<tr>
<td>As a temporary job</td>
<td>3</td>
<td>0.6</td>
</tr>
<tr>
<td>Persuaded to try it</td>
<td>5</td>
<td>1.0</td>
</tr>
<tr>
<td>Total*</td>
<td>586</td>
<td>120.1</td>
</tr>
</tbody>
</table>

Note: * The total is greater than 526 (the number of fishing units) because some respondents provided more than one reason. Source: Own field data, 1995.
spurred by the expansion of fish processing and marketing, particularly since the mid-1980s, have widened the gap between earnings in the fishing sector and outside (table 3). This has entrenched the fishermen deeper into the fishing business. Given this situation, the opportunity cost of leaving the fishing enterprise would be expected to be crucial in the exit decision.

The second-hand market for fishing vessels is rather small. Only 8% of the fishing vessels in our sample had been previously used by the time they were purchased by the current owners. In addition, there is a close correspondence between vessel age distribution and the period the vessel has been in the possession of the current owner. It appears, therefore, that there is hardly any exit from the fisheries, or that exit generally occurs after the stock of fishing capital has depreciated completely. The small size of this market implies low demand, and therefore, price, for second-

### Table 2

Reasons Why Fishermen Would Like More Fishermen to Join Their Beaches

<table>
<thead>
<tr>
<th>Reason</th>
<th>Frequency</th>
<th>Percentage *</th>
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<tbody>
<tr>
<td>Facilitate rapid development of the beach</td>
<td>281</td>
<td>78.9</td>
</tr>
<tr>
<td>Lake is not mine alone; not selfish</td>
<td>44</td>
<td>12.4</td>
</tr>
<tr>
<td>Improve the supply of fishing crew</td>
<td>32</td>
<td>9.0</td>
</tr>
<tr>
<td>Improve the security at the beach</td>
<td>10</td>
<td>2.8</td>
</tr>
<tr>
<td>To ensure I can also fish in their areas</td>
<td>6</td>
<td>1.7</td>
</tr>
<tr>
<td>Fishing industry needs more people</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Other reasons</td>
<td>2</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>376</td>
<td>105.7</td>
</tr>
</tbody>
</table>

Note: * This is the number of respondents citing a particular reason as a percentage of the 356 respondents who desire more fishermen to join their beaches. Total percentage is greater than 100 because some of the respondents gave more than one reason.

Source: Own field data, 1995.

### Table 3

Average Ex-vessel Prices for Selected Species, Lake Victoria (Kenya) (Constant 1990 Prices)

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</tr>
</thead>
<tbody>
<tr>
<td><em>Lates niloticus</em></td>
<td>6.48</td>
<td>8.60</td>
<td>6.06</td>
<td>2.84</td>
<td>2.93</td>
<td>4.07</td>
<td>10.02</td>
<td>11.58</td>
<td>10.85</td>
</tr>
<tr>
<td>(Nile perch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><em>Tilapia niloticus</em></td>
<td>—</td>
<td>15.17</td>
<td>15.02</td>
<td>11.33</td>
<td>10.41</td>
<td>13.24</td>
<td>7.09</td>
<td>11.05</td>
<td>10.76</td>
</tr>
<tr>
<td>(Nile tilapia)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td><em>R. argentea</em></td>
<td>9.81</td>
<td>6.69</td>
<td>5.44</td>
<td>2.22</td>
<td>2.26</td>
<td>3.63</td>
<td>4.92</td>
<td>2.20</td>
<td>4.36</td>
</tr>
<tr>
<td><em>Haplochromis</em></td>
<td>6.48</td>
<td>6.35</td>
<td>4.71</td>
<td>2.51</td>
<td>6.01</td>
<td>5.23</td>
<td>5.80</td>
<td>7.51</td>
<td>6.37</td>
</tr>
<tr>
<td><em>Proopterus</em></td>
<td>7.71</td>
<td>10.96</td>
<td>8.90</td>
<td>6.43</td>
<td>7.53</td>
<td>5.38</td>
<td>7.71</td>
<td>27.57</td>
<td>11.02</td>
</tr>
<tr>
<td><em>Clarias</em></td>
<td>7.52</td>
<td>7.42</td>
<td>7.31</td>
<td>4.51</td>
<td>5.43</td>
<td>4.71</td>
<td>3.91</td>
<td>12.99</td>
<td>9.54</td>
</tr>
<tr>
<td><em>Mormyrus</em></td>
<td>5.90</td>
<td>8.26</td>
<td>6.45</td>
<td>3.90</td>
<td>4.27</td>
<td>13.46</td>
<td>8.51</td>
<td>15.47</td>
<td>7.96</td>
</tr>
</tbody>
</table>

Source: Compiled from various issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya. The prices are deflated with the aid of a series of consumer prices for low-income people in Nairobi (1990 = 100), obtained from the International Monetary Fund (IMF), *International Financial Statistics Yearbook* (various issues).
hand fishing equipment. Imperfect malleability of capital could be a significant variable in firm exit decisions.

In this section, we develop a model of fisherman resistance to quitting the industry that helps to understand the role of opportunity cost, imperfect capital malleability, and other factors in the exit decision. In one of the survey questions, heads of fishing units were asked a question akin to the willingness to accept (WTA) questions posed in the valuation of nonmarket environmental goods or services: *What is the minimum salary (per month) would you be willing to accept to quit fishing?* This measure is comparable to what Gautam, Strand, and Kirkley (1996) refer to as “fishermen satisfaction bonus.” They define it as the amount of money that a fisherman would have to be paid to leave the fishery and assume another occupation. While there is a lump-sum measure, ours is a monthly salary whose termination date is not specified. It is this “fisherman resistance to exit,” which we label as WTA subsequently, that we explain in our model. Even though biases were not as elaborately controlled for as in contingent valuation (CVM) studies, responses to this question are reasonable estimates of fishermen resistance to quitting the industry.

We believe that the estimates are reasonable, because most of the fishermen reported figures of WTA that were consistent with their fishing incomes and opportunity cost of fishing. Some, nevertheless, gave obviously exaggerated figures for strategic reasons. In fact, some of them said that they would not accept anything to quit fishing. Others did not respond to this question at all. It is conceivable that some would be willing to pay some money to secure continued access into the fisheries.

About 92% of the respondents revealed a salary preference of more than zero, ranging from Kshs 700 to 3 million (mean is Kshs 34,538 while the median salary is Kshs 6,000). The remainder includes nonresponses and those who would not accept anything to exit the fisheries. The genuineness of zero WTA responses is highly doubtful, as is the possibility of negative WTA values. This is so because the fishermen would have already quit the fishery. Excluding the nonresponses and some of the extreme cases, we use those cases that revealed a salary preference of Kshs 1,000–50,000 to model fisherman resistance to exit. This amounts to 89% of the entire sample, or 97% of the sample revealing a positive salary. As an alternative to this limit of dependent variable truncation, we excluded the extreme cases so that the truncation is over 1,000–15,000. In this case, there are 428 cases, or 81% of the total. Missing data for the dependent and explanatory variables imply a further reduction of observations.

Simple calculations show that the elicited WTA data are realistic. About 82% of the fishing units fish for 21–31 days every month. Based on this, gross revenue receipts for the month of May 1995 averaged Kshs 19,012 per vessel and ranged from 1,202 to 189,487. Using the various schemes used in the sharing of vessel catch proceeds, weighted by the proportion of vessels using each of the schemes, we estimate that a vessel owner’s net income is, on average, 47% of the gross revenue. This implies that the vessel owner obtained an average net income of Kshs 0.47*19,012 = 8,936 in that month. Now, the proportion of fishing units whose owners received a net monthly income of at least Kshs 6,000 (the median WTA) is 60%, indicating that the WTA data are reasonable.

### A Model of Fisherman Resistance to Exit

Let the latent variable, $WTA_i^*$, represent the value reported for the “willingness to accept” variable, before truncation. Then,
Following the above description of the dependent variable, the appropriate model is, obviously, a truncated regression model. In a truncated regression model, the sample used consists only of cases where observations for the dependent variable fall within a specified range. Once the data are collected, through random sampling for instance, noneligible cases are discarded so that information regarding their dependent and independent variables is not used in the model. The truncated regression model is derived from equation (1):

$$WTA_i^* = x_i'\beta + u_i; NID(0, \sigma^2)$$  
(1)

Theory guides the choice of the explanatory variables (vector $x$). In fishery economics, a fishery’s total effort is usually assumed to adjust instantaneously to its profits following Gordon (1954) and Smith (1968, 1969). Some adjustments to this basic model have been made. Clark’s (1976) model, for instance, includes an adjustment parameter relating the speed of effort adjustment to profits, while Clark (1980) specifies different conditions for entry and exit decisions due to imperfect capital malleability. Thus, fishing vessels are more willing to enter the fishery in response to increasing profits than exit when profits decline (Smith 1968, 1969; Clark, Clarke, and Munro 1979; Ward and Sutinen 1994). The manner in which expectations are formed also determines entry and exit from the fishing industry. With adaptive, myopic expectations (based on current values) fishing vessels enter the fishery only when the stocks are in excess of their steady-state level. With rational expectations, however, vessels may enter the fishery even when the stocks are lower than the steady-state level, as long as the fleet size is sufficiently small (Berck and Perloff 1984). Moreover, exit may occur at higher stock levels in the rational model relative to the adaptive expectations model.

These models suggest that current or expected profits from a specific fishery relative to the employment alternatives open to the fishermen are the major determinants of the entry-exit decisions. Ward and Sutinen (1994) applied this framework to study the dynamics of the Gulf of Mexico shrimp fishery. In their discrete choice model, the probability of entry into or exit from this fishery is specified as a function of ex-vessel prices, operating costs, generalist versus specialist vessel operations, fixed vessel characteristics (such as vessel length and gross tonnage), and other variables that describe the firm’s indirect profit function.

Ward and Sutinen (1994) find changes in harvesting costs and ex-vessel prices to have equal but opposite effects on the probability of entry and exit of vessels in the fishery. Moreover, vessels are found to be more willing to join the fishery when profits increase than exit when profits decline. Existence of economic and noneconomic inertia is supported. Crowding externality, measured by fleet size, is found to induce exit and discourage entry into the fishery. Increase in shrimp abundance is found to increase the probability of entry into the fishery. Fixed vessel characteristics are also found to be statistically significant determinants of the probability of entering the fishery. Further results suggest that experienced fishermen are more likely to enter the fishery, while less experienced ones are more likely to fail and exit once they have joined it. Market and biological variability variables are not significant statistically, indicating that the magnitude of variability over the period under analysis may not have been sufficient to induce fishermen response.

From the foregoing and the peculiarities of the fisheries under study, vector $x$ in equation (2) consists of the following explanatory variables:
(i) Opportunity cost of exiting as measured by foregone income from fishing, \( OPC \). \( OPC \) is measured by the average daily catch value—not by the monthly catch value—because, for one reason or another, vessels did not fish for the same number of days in the month. \( OPC \) is a good measure of the vessel owner’s opportunity cost of exiting because, as calculated above, the vessel and gear owner is entitled to about 47% of the net value of daily catch. Since the unit owner is the overall decisionmaker on the critical issue of exit, his net income from fishing, \( Y \), may be more illuminating than \( OPC \). The partial derivative of \( WTA \) with respect to \( Y \) is calculated by dividing the derivative obtained with respect to \( OPC \) by 0.47. \( OPC \) is constructed using May data only, since this is the month when fishermen responded to this question. We assume that what they had not observed (August and November prices and catches) would not have been useful in their estimation of opportunity cost. The derivative of \( WTA \) with respect to \( OPC \) is expected, \textit{a priori}, to have a positive sign.

(ii) Level of investment, \( INV \). Due to imperfect malleability of capital, the higher the investment a fisherman has in the fishery, the higher his resistance to quitting (that is, high \( WTA \)) is expected to be, \textit{ceteris paribus}. This variable is captured by the estimated current (or resale) value of the fisherman’s vessel and gear. The vessel and gear characteristics are, therefore, also expected to be important determinants of the resistance to quitting.

(iii) The fishing experience (\( EX \)) and level of education (\( EDU \)) of the fisherman are also likely to be important, as they determine his opportunity cost and opportunities outside the fishing sector, respectively. \( EX \) is the number of years the head of the fishing unit, who is taken to be the unit’s decisionmaker, has worked as a skipper, not only with the current vessel, but on other vessels as well. \( EDU = 1 \) if the head of the fishing unit has at least Form IV level of education. It takes the value of zero otherwise. Estimated coefficients for \( EX \) and \( EDU \) are, thus, expected to have positive and negative signs, respectively.

(iv) The existence or nonexistence of alternative sources of income or occupations, \( ALTINC \).\(^8\) \( ALTINC = 0 \) if the head of the fishing unit indicated no alternative occupations either in the wet or dry season or both. \( ALTINC = 1 \), otherwise. Heads of fishing units with alternative occupations or sources of income are expected to have a lower \( WTA \) relative to those who rely on fishing only. That is, a negative sign is expected for the coefficient estimated for \( ALTINC \).

(v) The effect of family tradition (captured by whether the respondent’s father was a fisherman or not), \( TRAD \). \( TRAD = 1 \) if the respondent’s father is/was a fisherman and is 0 otherwise. Fishermen whose fathers were also fishermen are assumed to come from a family with a fishing tradition and are expected to be, all else remaining constant, relatively more resistant to exiting. Thus, a positive sign is expected for \( TRAD \)’s estimated coefficient.

\(^8\) We agree with a review that “...individuals react to the amount of other income they have, not just whether they have it” but, unfortunately, we do not have the data on the amounts of alternative income to prove it.
Whether a respondent is the owner of the vessel or not, \( \text{OWNER} \). \( \text{OWNER} \) takes the value of 1 if the head of the fishing unit is either the vessel’s owner, co-owner, or renter and 0 if the head is an employee of the vessel owner. Vessel renters are categorized as owners and not as nonowners, as their production behavior is closer to the former than the latter. In terms of entrenchment into the fishery, vessel renters are closer to vessel owners than to employee skippers as they are, in fact, prospective vessel owners. Vessel renting is, moreover, not widespread in these fisheries according to our survey results. Vessel owners are expected to be more resistant to exiting (higher \( WTA \)) relative to employed captains because they have a closer (perhaps more intimate) relationship with the fishery relative to employees. One could visualize a situation where fishermen start off as employees, graduate into vessel renters as they gain experience and accumulate capital, and finally become vessel owners. We posit that the intimacy with and entrenchment into the fishery increases with these graduations.

OLS estimators from the truncated sample will be biased and inconsistent because truncation distorts the scatter of observed points (Stewart 1991; Greene 1995). The OLS estimates are usually biased towards zero (Greene 1995). Maximum likelihood estimation is, on the other hand, appropriate since the likelihood function, whose log is maximized to yield estimates of \( \beta \) and \( \sigma^2 \), reflects not only the probability of generating an eligible observation, but also the distribution of the eligible observations (Stewart 1991). Maximum likelihood is, consequently, used to estimate the likelihood function associated with equation (2). Starting values for this maximum likelihood estimation are obtained from an OLS regression of the dependent variable on the regressors (Greene 1995). Estimation is done with the LIMDEP software that uses Newton’s method and Olsen’s transformation of the parameters for the truncated regression model (see Green 1995).

**Results and Discussion**

Estimation results differ substantially depending on the thresholds of truncation chosen. In the model specification in which \( 1,000 \leq WTA^* \leq 50,000 \), only \( \text{OPC} \) among the explanatory variables is statistically significant at the 10% level, while in the alternative specification, \( \text{OPC} \), \( \text{EX} \), and \( \text{OWNER} \) are significant at the same level. Moreover, the partial derivative of \( WTA \) with respect to \( \text{OPC} \), the variable of utmost importance, is higher in the first specification, at 0.70 compared to 0.33 in the specification in which \( 1,000 \leq WTA^* \leq 15,000 \). \( \text{OPC} \) is more significant in the latter specification, being significant at the 5% level. All of these variables have the expected signs. Given that we did not elaborately control for possible biases in the \( WTA \) responses, upward (principally strategic) bias is likely to be substantial. For this reason, estimation results pertaining to the 1,000–15,000 \( WTA \) truncation range are deemed more realistic and are reported in table 4.

That \( \text{OPC} \) is significant in both specifications highlights its importance in the exit decision. As expected, opportunity cost, in terms of foregone fishing income, is the most critical factor in this decision. An increase by Kshs 10 of

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\( ^9 \) Greene (1995, 1997), provides details on how the density, conditional mean, and log-likelihood functions can be derived from equation (2).
the vessel owner’s daily net income from fishing, for example, would increase his resistance to exiting the fisheries by Kshs 7; that is, he will require Kshs 7 more per month to accept to quit, ceteris paribus. The results suggest that fiscal measures, such as a tax on landings that reduce the net revenue owners of fishing firms receive from the fishing enterprise, could reduce their resistance to exiting the fishing sector. One way in which this information could be used is if individual catch quotas could be determined for each vessel and an annual fee imposed for these quotas. The revenue generated in this way could be used to buy back the quotas, and, therefore, the right to fish, from those with relatively lower resistance to exit. While such a strategy would facilitate compensated exit, regulatory capacity for the administration of such a scheme is currently lacking.

The level of investment in the industry appears not to influence the exit decision in Kenya’s Lake Victoria fisheries. There is, therefore, no support for the common argument that capital malleability increases fisherman resistance to exit the fishery sector. This is, in fact, not surprising given that most of the fishermen use small, fairly old canoes and cheap gear technology, including homemade fishing nets.

The basic model in which profitability alone is the determinant of entry-exit decisions is, therefore, supported for these fisheries. This has significant implications for management. A management strategy aimed at the reduction of the number of harvesters in these fisheries only needs to reduce the level of profits. This conclusion is reinforced by the fact that family tradition presents no inertia to exit.

Like Ward and Sutinen (1994) found for the Gulf of Mexico shrimp fishery, less experienced fishermen are more likely to exit from the Kenyan fisheries of Lake Victoria, too. Fishing experience of the head of the fishing unit, EX, is highly significant (at the 1% level of significance) and has a high partial derivative, 34.9. Thus, all else being equal, a one-year increase in the experience of the head of a fishing unit increases his WTA (that is, resistance to quitting the fisheries) by Kshs 35. This suggests that the economic value of a year’s experi-

Table 4

| Variable | Coefficient | ∂E[WTA|x]/∂x | Std. Error | t-ratio |
|----------|-------------|-------------|------------|---------|
| Constant | 3,636.4000** | 2,186.9000 | 712.87 | 5.10 |
| OPC      | 0.5529**    | 0.3325     | 0.27     | 2.07   |
| INV      | 0.0002      | 0.0001     | 0.00     | 0.25   |
| EX       | 57.9990**   | 34.8810    | 22.50    | 2.58   |
| EDU      | 699.6100    | 420.7500   | 521.47   | 1.34   |
| ALTINC   | 283.0400    | 170.2200   | 479.91   | 0.59   |
| TRAD     | -7.2364     | -4.3520    | 420.70   | -0.02  |
| OWNER    | 834.3200*   | 501.7600   | 467.18   | 1.79   |
| F        | 2,906.9000**| 165.17     | 17.60    |        |

* These are the partial derivatives of expected WTA with respect to the vector x. They are computed at the means of the x’s. All observations are used in the calculation of the means. **denotes statistical significance at the 5% level. Truncated regression; dependent variable = WTA (in Kshs per month); N = 396; iterations completed = 4; log L = −3,023.36; lower limit for WTA = 1,000; upper limit = 15,000.
ence as a captain is Kshs 35 per month for the remaining lifetime. This result underscores the role of fishing profitability in the exit decision, since more experienced fishermen are likely, all else equal, to perform better in the fishing enterprise relative to less experienced counterparts. This result has important policy relevance. A program aimed at retiring some fishermen from these fisheries, through compensation, would be much cheaper if targeted at less experienced fishermen whose resistance to exit is relatively lower.\(^\text{10}\)

Owner-headed vessels have a monthly \(WTA\) value that is, on average and all else remaining the same, Kshs 502 higher than that of fishing units headed by employed captains. In other words, owner-headed fishing units are 8.4\% (evaluated at the median \(WTA\)) more resistant to exit relative to those units headed by employed skippers. The significance of this variable, coupled with insignificance of INV, suggests that it is not really the level of investment that influences the exit decision in these fisheries, but other effects of vessel ownership. These include the closer relationship that vessel owners and renters may have with the fishery as a result of a longer period of association with it.

It is not entirely surprising that variables capturing economic opportunities outside the fishing sector (EDU and ALTINC) are not significant at all. As mentioned already, there are very limited opportunities outside the fishing industry in the lake region. Moreover, of all the means of livelihood open to fishermen in the lake region, fishing offers the best alternative in terms of relative earnings. Lack of data on the level of alternative income precluded a more rigorous testing of its effect on the exit decision. We believe, nevertheless, that the sustainable use of the lake fisheries has an integrated development program of the lake region as its key pillar. The revival of the cotton industry and initiation of small-scale industrial projects would, for instance, generate incomes comparable or higher than those available in the fishing sector, especially for less experienced fishermen. This would provide economic incentives for the less experienced fishermen to exit, leaving only the most experienced to continue fishing. Such an integrated development program would complement that of retiring the less experienced fishermen through compensation.

**Summary and Conclusions**

An emerging view is that to improve the management of fisheries, understanding fishermen behavior is as important as, if not more important than, understanding fish behavior. In agreement with this reasoning, this paper has analyzed the long-run entry-exit decision. Results indicate that fishermen are in their current enterprise not because it is more profitable or yields higher utility relative to alternatives, but because alternatives are lacking. Of the alternatives open to the fishermen, fishing offers relatively higher earnings. The fishery resource is, consequently, absorbing an increasing number of unemployed people every year. The situation has been exacerbated by the relative ease of entry into the fishing industry.

\(^{10}\) An anonymous reviewer has suggested that if more experienced fishermen are really more successful in harvest performance, then perhaps buying out a more experienced fisherman could cost less than a less experienced one in terms of getting more fisheries conservation per dollar. While this is an insight that we appreciate, we are taking a more holistic approach to fisheries management than just conservation. Retaining the more experienced fishermen has efficiency benefits, which less experienced counterparts do not have. On balance, therefore, we feel that it may be cheaper to buy out the less experienced fishermen.
A striking finding regarding the issue of entry is that in spite of the “commons” nature of these fisheries, more than two-thirds of the heads of fishing units would welcome the entry of more fishermen! The reason for this “strange” behavior is that the positive externalities associated with new entrants far exceed the negative ones. Positive externalities include beach expansion and an associated increase in fish price, creation of demand for commercial and service enterprises, and other development. The negative externalities are environmental, such as declining catch per unit effort, and social, such as theft and conflicts. A crucial implication of this finding is that fishers are primarily concerned with securing a (current period) means of livelihood, even if this is at the expense of the fishery resource. They would not mind if more fishermen overexploit the fisheries, so long as they can create demand for consumer goods and services, and thus create jobs at the beaches. An integrated development program of the lake region that would create alternative employment opportunities would then obviously take some pressure off the fisheries. This is, consequently, a major pillar of the sustainable exploitation of these fisheries.

This paper has used a simple WTA CVM framework to analyze the factors that drive the exit decision in the Kenyan fisheries of Lake Victoria. The opportunity cost of exiting, fishing experience, and whether the skipper of a fishing unit is its owner or just an employee of the owner, are the significant determinants of unit resistance to exit from these fisheries. Thus, a Kshs 10 decrease in the unit owner’s daily fishing income reduces his resistance by Kshs 7 per month; a one-year decrease in the fisherman’s experience reduces his resistance by Kshs 35 per month; while a skipper who is also the owner of the fishing unit is, on average, 8.4% more resistant to exit compared to a hired skipper. We find no support for the common argument that capital malleability increases fisherman resistance to exit the fishery sector.

The results emerging from our model have potent management implications. They suggest that exit inertia usually associated with imperfect capital malleability and attachment to fishing (as a way of life and family tradition) is lacking, or minimal, in these Kenyan fisheries. Consequently, all a management strategy aiming at the rationalization of the number of harvesters needs, is the use of fiscal and other instruments to reduce the level of profits accruing to the harvesters. This would have the effect of forcing the less experienced and, therefore, less successful fishermen out of fishing. It would also have a greater chance of success if an integrated development program is initiated for the lake region, as it would provide alternative means of livelihood.

References


