Sustainability, Livelihood, Production and Effort Supply in a Declining Fishery. The case of Kenya's Lake Victoria fisheries
Ikiara, M.M.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Part Three

Vessel effort supply and migration behaviour
Introduction

That understanding fishermen behaviour is, perhaps, more critical than understanding fish behaviour is becoming increasingly apparent. Knowledge about fishermen behaviour is important for a number of reasons. First, the knowledge facilitates the anticipation of, and therefore control for, fishermen response to economic incentives and to fishery management regulations, which affect those incentives [Charles River Associates 1980; Bockstael and Opaluch 1983]. This is what Bockstael and Opaluch (1983) refer to as a "satisficing" approach to fisheries management. This approach is arguably more pragmatic than the traditional bioeconomic modelling that seeks optimal solutions to management problems. It is more pragmatic because regulated industries are hardly completely controllable (recall the nebulous nature of "effort" alluded to in Chapter 4) and because of the dearth of the perfect information required to arrive at the optimal solutions [Bockstael and Opaluch 1983; Wilen 1979]. Lack of complete control may mean, for instance, that management regulations aimed at dealing with specific problems may inadvertently lead to others [Ward and Sutinen 1994; Bockstael and Opaluch 1983].

Secondly, the behaviour of fishermen appears to be perverse [Gautam et al. 1996]. Thus, depending on the circumstances facing them, commercial fishermen reportedly respond to falling or rising output prices by increasing their effort [Gautam et al. 1996]. Uncertainty regarding the fishermen's response to changing prices and other economic variables in most of the world's fisheries underscores the role that research into fisherman behaviour can play in the rationalization of the fisheries.

Thirdly, study of effort supply behaviour enables the consideration of economic factors in the analysis of vessel production levels rather than physical factors only as is the case with production function studies [McGaw 1981]. Finally, knowledge about fishermen response to different incentives and policy environments could illuminate the relative efficacy of price and quantity controls as competing regulatory tools. For instance, the "...choice between price and quantity controls in the fishery depends critically on the extent to which fishermen respond to economic incentives". In a fishery where inertia or resistance to change is high relative to the responsiveness to economic variables, for example, price controls are likely to be relatively ineffectual as control tools [Bockstael and Opaluch 1983].

Effort supply decisions in a fishery can be differentiated into short run changes in effort, changes in the longer adjustment period and long run decisions, all of which are important but likely to be under different influences [Bockstael and Opaluch 1983]. Short run response may include the decision of going to fish or staying onshore to enjoy leisure, the decision about the length of the fishing trip, the decision about the size of fishing crew to use on a particular fishing trip, and the decision to alter the target species within a multispecies fishery. Over a longer adjustment period, the fisherman may decide to re-outfit his vessel or relocate geographically with the objective of switching fisheries [Bockstael and Opaluch 1983]. Entry-exit decisions and new vessel purchases are typically long run.

57 See, for example, Gautam et al. [1996], Bockstael and Opaluch [1983], Ludwig et al. [1993], Wilen [1979] and Ward and Sutinen [1994].
Important aspects of effort supply behaviour in the Kenyan fisheries of Lake Victoria are analyzed in this part of the dissertation. In chapter 6, vessel effort supply decisions in the short and long run are analyzed. These include the daily decision, by the head of the fishing vessel, to supply or withhold effort; the determinants of the total amount of effort supplied in a month; and fishermen resistance to exiting the fishing industry. Vessel migration behaviour and the practice of changing landing ports (beaches) are, on the other hand, analyzed in chapter 7. Since the theoretical framework of the behaviour analyzed in this part of the thesis is basically the same, we present it in the next section to avoid repetition in chapters 6 and 7.

**Theory and literature**

The change in total effort in a fishery is proportional to the change in the fishery's current profits [Smith 1968, 1969]. Like Smith, Gordon (1954) assumed an instantaneous entry into the fishery in response to profits. He posited that fishermen enter the fishery in response to attractive rents, more and more doing so until the point is reached where effort earns only its opportunity cost. Following the work of Gordon and Smith, bioeconomic modelling has invariably assumed instantaneous adjustment of effort to changing profits. The implicit assumption of this modelling is that management has complete control over effort [Bockstael and Opaluch 1983] or that potential entrants into a fishery have myopic, adaptive expectations [Berck and Perloff 1984].

In an improvement of the bioeconomic model, Clark (1976) incorporates an adjustment parameter that relates the speed of effort adjustment to profits. Further, owing to imperfect malleability of capital, entry and exit conditions are postulated to differ by Clark (1980). 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].

The manner in which expectations are formed also determines entry and exit from the fishing industry [Berck and Perloff 1984]. Thus, with adaptive, myopic expectations (expectations based on current values) fishing vessels enter the fishery only when the fish stocks are in excess of their steady state level whereas with rational expectations, that is perfect foresight, vessels may enter the fishery even when the fish stock is lower than the steady state level, so 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 one.

The short run effort supply decision, to fish or not to fish, is also a function of stock abundance and trip fish price [Doll 1988]. There is probably, therefore, a minimum abundance level below which the fishermen will not go fishing. Nevertheless, if the fisherman would be certain of some catch he would still supply effort even when this minimum is violated provided the price is sufficiently high. The generalized trip supply function is, therefore, a function of stock abundance and price; with the minimum supply price being a function of abundance and supply response to price increase being perfectly inelastic for a constant level of abundance [Doll 1988].

Literature on the modelling of fishermen behaviour and the estimation of resultant behavioural relationships is sparse. Nonetheless, there are excellent pieces on the topic. These include Bockstael and Opaluch (1983) who use a utility theoretic approach to derive a model that predicts the probability of New England groundfish fishermen switching fisheries in response to economic incentives; Dupont (1993) who improves on the framework built by
Bockstael and Opaluch and applies it in a study of fishing location choices made by fishers engaged in the British Columbia salmon fishery; Ward and Sutinen (1994) who utilise a myopic profit maximisation framework to model the probability that a vessel will enter, exit, or remain in the Gulf of Mexico shrimp fishery; and Gautam et al. (1996) who apply a dynamic utility-theoretic framework to model contemporaneous and intertemporal trade-offs between labour and leisure in the Mid-Atlantic sea-scallop fishery. Each of these is briefly reviewed.

Bockstael and Opaluch (1983) model inertia and uncertainty of returns from different fisheries as key determinants of the fishery chosen. Inertia is related to economic (cost involved in the conversion of a vessel for use in an alternative fishery owing to imperfect malleability of capital) and noneconomic (psychic costs of changing fisheries due to family traditions, preferences, and fishery-specific experience) factors. This variable is captured through the inclusion in the model of a conversion cost threshold which economic incentives must surpass to induce change of fishery. Fishermen expectations of net returns and their variance are used to capture uncertainty. In a nutshell, the model specifies the fishing firm's choice of fishery as a function of the fisherman's initial wealth, the conversion cost thresholds, expected net returns, and the variance of returns for each fishery.

Estimation results demonstrate fishermen response to economic incentives; positively to an increase in expected returns and negatively to increased variability of returns (risk). Evidence of substantial inertia is, in addition, adduced. Risk aversion is shown to be a decreasing function of wealth which, in turn, is highly correlated to vessel size.

Dupont (1993) justifiably criticises the assumption, made by Bockstael and Opaluch, that fishers have knowledge regarding the average location-specific returns of different vessel classes by arguing that fishers are unlikely to reveal these to their competitors. Moreover, these average returns mask differences in performance between good, average, and poor fishers. Bockstael and Opaluch (1983) are, in addition, unable to separate the effects, on fishing location choice, of expected profitability from that of wealth or stock effect [Dupont 1993]. Following this critique, Dupont uses micro-level data to generate vessel-specific expected seasonal profit and its variability and expected wealth (the sum of known pre-season wealth and expected seasonal profitability of a given location) and its variability. Dupont considers the effects of uncertain output prices alone on location choices made by fishers exploiting the British Columbia salmon fishery using a random utility model. Assuming that fishers make forecasts of season output prices under rational expectations, Dupont first develops and estimates Autoregressive integrated moving average (ARIMA) models (shown to have a number of the properties of the rational expectations model) to generate expected prices. These are, subsequently, used as instrumental variable regressors in models that predicts the profits that each fisher can expect in each of the three alternative fishing locations. Finally, these location-specific expected profits together with their variability and expected wealth and its variability are used, in Multinomial Logit models, to study location choices.

Results obtained by Dupont indicate that expected seasonal profitability is a significant determinant of fishing location choice and that expected wealth, plays an even bigger role in this salmon fishery. Unlike Bockstael and Opaluch, results of Dupont's work provide some evidence of risk loving behaviour among fishers. In general, however, variability of profits and wealth are less significant determinants of fishing location choice. Dupont suggests that
evidence that fishers respond to economic incentives could be used in a policy of differential royalty taxes aimed at altering the dispersion of fishers over fishing locations.

Dupont's work is an excellent albeit partial, analysis of fisher location decisions. It is partial because it ignores uncertainty related to stock abundance, and therefore catch rates, yet this uncertainty might be more important than price uncertainty in determining expected profit. According to Mangel and Plant (1985), for instance, the choice of a fishing ground depends on the expected catch on that ground and the expected gain in information from fishing on that ground. Moreover, catch rates are highly erratic not only at the aggregate level but also at the vessel trip level [Gates 1984; Mangel and Plant 1985]. According to Calson (1973) [Thunberg et al. 1995], the prevailing fish price and the known or perceived abundance of the targeted species are the variables that enter the planning of a fishing trip. Fishing units that are price takers in the output market make a fishing trip with the objective of, given relative prices, catching the optimal species mix that maximises trip revenues [Thunberg et al. 1995].

In Gautam et al. (1996) the vessel captain's choice of leisure (days spent onshore) and labour (days spent at sea) within a particular period, are assumed to be simultaneously determined by daily profits, the square of daily profits, the net present value of remaining profits, and the number of days spent at sea and on shore, respectively. Through the share, or lay, system the captain's profit, and thus his optimal choice of leisure and labour, is a function of ex-vessel prices, costs, and catch rates. The net present value of future profits is specified as a function of current prices and stock abundance, specific vessel effects and monthly (seasonal) effects. A fixed-effects model is used to wipe out the effects of other factors, such as geographical differences in fleets and captain skills, that might influence the time at sea, expectations of future profits and time onshore. Binary variables are included in the equations to capture seasonal factors other than variation in stock abundance, such as weather, that could affect the captain's allocation of time between leisure and labour. A binary variable is used to account for institutional changes also. The institutional change modelled is a proposal to grant scallop vessels annual fishing time on the basis of historical effort levels.

Except for current stock abundance, the other factors are found to be statistically significant determinants of the net present value of future profits. The hypothesis of backward-bending labour supply in fisheries is supported. Thus, as profits per day increase, captains reduce the time spent on leisure and increase the time spent at sea. Once the profits per day reach a sufficiently high level, however, further increases induce captains to increase leisure time and decrease labour time. Indeed, the backward-bending labour-supply phenomenon is observable even with the sole consideration of the contemporaneous tradeoffs between leisure, labour and profits.

The results suggest, further, that captains more easily adjust time onshore relative to time at sea in response to changes in daily profits. Intertemporal effects are also found to have statistically significant impact on the captain's labour supply decision. Thus, the higher the expectations about future profits the captain has, the less labour is he likely to supply in the current period. The proposed institutional change is found to have a significant negative effect on time spent onshore and positive effect on time at sea, suggesting that captain's expectations of future regulations influence their current labour supply decisions. Seasonal effects are found to be statistically insignificant.

Ward and Sutinen (1994) apply the profit maximisation framework to study the dynamics
of the Gulf of Mexico shrimp fishery. A discrete choice model, the multinomial logit, is specified and estimated. It is hypothesized that the probability of a firm entering a specified fishery will increase as profits in the fishery increase relative to the employment alternatives open to the fisherman. In the discrete choice model, therefore, the probability of entry or exit 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. The latter include fleet size, to capture crowding externality, and stock abundance. “Generalist versus specialist vessel operations” and a vessel mobility variable are included to account for market and biological variability in the fishery. Theoretically, increased abundance should attract entrants into the fishery by increasing catch per unit effort and reducing the unit harvest cost and, thus, increasing the fishery's profitability.

Changes in harvesting costs and ex-vessel prices are found 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 the less experienced ones are more likely to fail and exit once they have joined the fishery. 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.