MAXIMUM ECONOMIC YIELD AND ITS IMPORTANCE IN FISHERIES MANAGEMENT

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Introduction

Fishery resources are renewable natural resource but are liable to become extinct (as witnessed in many cases across the globe) if continuous and indiscriminate harvest is adopted Here the size of the stock (population) depends on the biological, economic and social considerations. Since fisheries resources are mostly coming under common property resources, its management becomes a complex issue (due to which a comprehensive management measure could not be exercised) and we have to resort to various management intervention options to ensure sustainable harvest as well as to maintain inter and intra generational equity. The management issue gains more significance in India wherein species diversity is very high and so the diversity among the fishing communities involved in fishing operations. "In an open access regime like fishery, negative externalities are many, which implies that uncontrolled fishery will bound to end up in what is called tragedy of commons.' (Grafton et.al, 2006).

There are many fishery management indicators, or reference points, which are estimated based on the systematic landing data and stock assessment studies. These indicators form the basis for formulation of various management measures in the country. Among such reference points, maximum economic yield (MEY) is one. The concepts, estimation of MEY and its significance in fishery management are dealt with in the following sections.

Sustainable Yield

Before actually proceeding to MEY, it will be better to have an understanding on the concepts of sustainable yield for a better understanding.

Fisheries are classified under renewable natural resources. However such resources are also liable to become extinct if the rate of harvest or exploitation is higher than the rate of regeneration or reproduction. Here the size of the stock (population) depends on the biological, economic and social considerations.

The sustainable yield in fishing commonly referred to as "Maximum Sustainable Yield (MSY) is a biological phenomenon. MSY means that level of fish catch or yield that can be harvested from a given system in perpetuity without affecting the stock of the system (or the sea). In other words, a catch level is said to be sustainable whenever it equals the growth rate of the population since it can be maintained for ever. As long as the population size remains constant, the growth rate will remain constant as well.

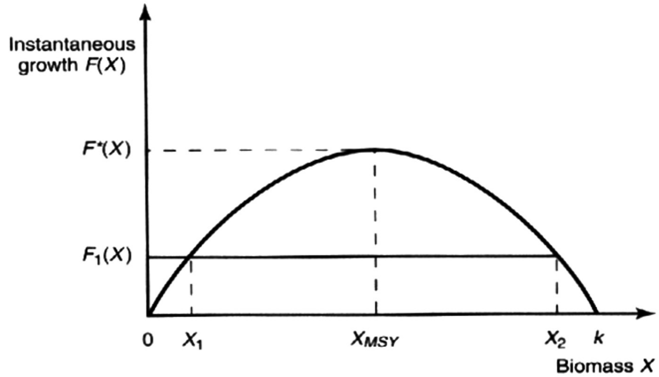


Fig. 1. Sustainable Yield Curve

Source John A. Dixon, Fisheries and Aquatic Resources World Bank Institute

What is MEY?

Maximum economic yield is that yield level, which coincides with the level of harvest or effort that maximized the sustainable net returns from fishing. A MEY harvest is desirable because it is the catch level that enables society to do the best it can with what nature has provided. (Grafton et al, 2006). Maximum Economic Yield (MEY) which includes the monetary terms of the effort and returns in sustainable yield formulation.

In fisheries terms, maximum sustainable yield (MSY) is the largest average catch that can be captured from a stock under existing environmental conditions. Relating to MSY, the maximum economic yield (MEY) is the level of catch that provides the maximum net economic benefits or profits to society.

MEY is a long-run equilibrium concept which refers to the level of output and the corresponding level of effort that maximize the expected economic profits in a fishery. In most cases, this scenario results in yields and effort levels that are less than at maximum sustainable yield (MSY) and in stock biomass levels greater than at MSY (Mardie 2002, Bromley,2009)

Earlier only biological aspects were considered in fisheries management. But they were aimed at controlling fishing effort and they did not consider the economic or social aspects of fishing methods. The net income from fishing and the subsequent use of income for the livelihood of fishers is also of vital importance. Besides the cost and returns in fishing plays a significant role as incentives for engaging in fishing as an occupation. This thought gave way for the economics to be included in fisheries management.

Economists have long argued that a fishery that maximizes its economic potential also usually will satisfy its conservation objectives (Walters 1993; Mardie 2002). This scenario is encapsulated in the concept of maximum economic yield (MEY), a long-run equilibrium concept that refers to the level of output and the corresponding level of effort that maximize the expected economic profits in a fishery. In most cases, this scenario results in yields and effort levels that are less than at maximum sustainable yield (MSY) and in stock biomass levels greater than at MSY (Mardie 2002, Bromley,2009). Lower levels of fishing effort also generally result in fewer adverse environmental impacts. Developed initially in the context of single-species fisheries (Walters, 1993), MEY was extended to multispecies fisheries under the assumption that the species are caught in fixed proportions. The optimal catch and biomass for any single species in a multispecies fishery may be greater or less than at MSY (Bromley, 2009).

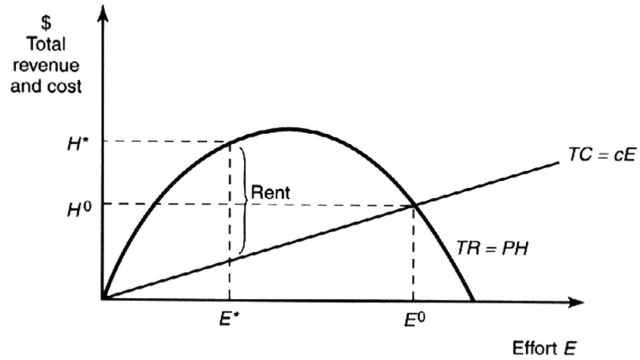


Fig. 2. Maximum Economic Yield

When the relationship between effort and money are measured, it was observed that when stock is low, effort must be high.

- Total revenue (TR) = Price (P) × Catch (H)
- TC = Unit cost (c) × Effort
- Rent = TR – TC

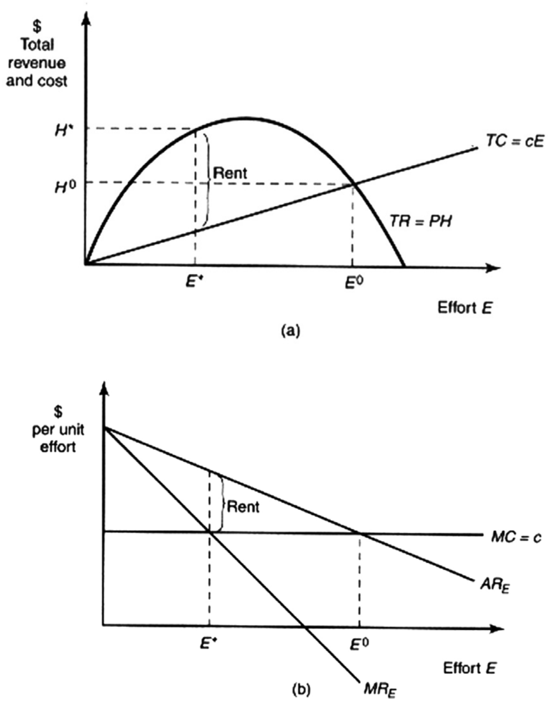
The rent is maximized at the point E*.Please note that here,

- MEY is left of MSY
- Optimal harvest (H*) is less than the MSY harvest
- But rent is larger than at MSY

The point E* is that effort level at which the MEY occurs. At this point of effort only the difference between the total revenue from fishing and total cost of fishing is the maximum. **This difference is also referred to as resource rent.**

The marginal analysis can show that the MEY occurs at the point where MC =MR. It is observed that for marginal unit of effort, marginal rent is = 0 and average rent >1.

Dixon concludes that the "Goal of traditional fisheries management: achieve MSY. However the economists aim for MEY in contrast to MSY. AT MEY, compared to MSY, the fish catch is lower, fishing profit is higher, fishing effort is lower and the fish stock is higher. Thus the author concludes that MEY is where more fish is conserved. (Dixon, 2005)



Source: John A. Dixon, 2005

Steps in estimation of MEY

p = a -by...(1)

Where,

p is the price per unit weight of fish
y is the annual yield

The average price per unit weight of fish (p) is generally a monotonically decreasing function of annual yield (y)

The profit is obtained as a difference between total revenue (TR) and total cost (TC), i.e.,

Π = TR – TC = (p-c)y ....(2)

Where

'c' is the cost of harvesting one unit weight of fish. From this, a cost function will be fit from the data collected

MEY = (a – c) / 2b ....(3)

$f_{mey} = [a +/- (a^2 - 4\ b\ MEY)]^{1/2} / 2b$ ...(4)

where, a = intercept; b, c =regression coefficients

From f_{mey}, the optimum fleet size is obtained by dividing 'b' by the average annual fishing days. Based on this the excess capacity and thus the capital investment (over and above the optimum fleet size) can be worked out

Factors Affecting MEY

While estimating the MEY, three assumptions have been made such as zero discount rate; cost of fishing is a simple linear function of stock size; fishing costs rise proportionately with effort

The cost of fishing is an important component that decides the MEY. Generally the cost of fishing increases with a decrease in stock size at an increasing rate. This is the characteristics of the fishing practice. Under such a situation, it will be desirable to have a catch and effort level further to the left of the bionomic equilibrium

If the discount rate is very high or large, the MEY will correspond to a bionomic equilibrium (Clark, 1990), because it will be profitable to harvest the stock today itself if the loss of future net returns are very heavily discounted. Maximizing economic viability of fisheries is compatible with economic sustainability of the fisheries.

Estimation of MEY becomes complicated due to biological interactions; apportioning of the cost of fishing; value of target versus by catches and splitting the efforts and related aspects; lack of complete biological data to calculate the stock-recruitment relationship; inability to accurately measure the actual catch and effort of fishers and the current size of the fish stock; price of fish and the precise cost of fishing**.** A fall in fish price or an increase in cost of fishing will lead to lower harvest with a less fishing effort and a larger stock size in order to maximize the economic profits (Grafton et.al. 2006)

Importance of MEY Fisheries Management

MEY is a good target reference point for fisheries management despite the assumptions made. MEY ensures that the stock levels in many fisheries are larger than those associated with the traditional MSY target. MEY also ensures that the major inputs like fuel and labour are optimally utilized to maximize the profit. MEY helps to estimate the excess fishing capacity in the sector, which provides one of the strong bases for recommending optimum fleet size. If the resources are used beyond the MEY target, it will result in excess fishing capacity, lower returns and thus lower profits. Hence it pays rich dividend to follow the MEY as an important component for aiming at a sustainable fishery.

Conclusion

MEY acts an important link between the biological and economic implications of fisheries management. Taking cue from tragedy of commons that unmanaged natural resources are depleted completely and some sort of regulation measures are need to ensure sustainable utilization. In case of fisheries the economics of fishing operations (cost and returns) determine not only the profitability of the profession but also the driving force for remaining in the sector. In this context, the MEY which incorporates the costs of fishing the revenue earned into the sustainable yield models, provide an acceptable method for formulating fishery management plants. As reported by a few studies, the biological reference point (MSY) and the economic reference point (MEY) are always compliments to each other and they should be employed in formulation of any fishery management policies in the country.

Suggested Reading

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