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An Evaluation of Fisheries Management Policies Available for Domestic Tuna Fishery in the Maldives

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Abstract: The main prospect for economic development of the Maldives lies in the possibility of exploitation of the economic potential of its marine resources. This is because like many island developing countries, the Maldives has a narrow resource base and its main natural resources consist of fisheries and a marine area conducive for international tourism. In the absence of proper management, fishery resource tends to be exploited as a common property resource with a tendency towards over-exploitation. In the absence of appropriate property rights, the exploitation of a common property such as the fisheries may lead to over exploitation (and possible extinction of a species) and externalities both contemporaneous and inter-generational. The paper aims to identify the various economic policy instruments that may be available and then uses a 'cubic' model to select the best model suitable for the tuna industry in the Maldives. In the Maldivian context, price control is selected as the appropriate policy instrument, even though individual transferable catch quota is also a possibility in the long-run. Price control is based on levying a tax on catches and is oriented towards economic efficiency.

Key Words: Evaluation, Fisheries Management, Domestic, Tuna Fishery

Introduction

Fishing is the mainstay of the economy of the Maldives and tuna is the most abundant and most valuable commercial fish in its territorial waters. It is claimed that the purpose of fisheries management should be to control the fishery in a manner, which will continue to yield net benefits for the community, and is in accord with national goals. If society exercises no control over capital and labour, fishery resources will attract excess investments and economic rents will be dissipated (Anderson and Wilson, 1977).

Furthermore, every period of good harvest or high prices tends to result in an increased inflow of new boats and gear (Department of Primary Industry, 1986). These fishermen are not easily driven out again when the market is weak, because fishermen are notably immobile (Christy, 1976) and (Crutchfield, 1986). Thus any depression in the income of artisanal fishermen, such as in the Maldives, whose cultural fabric has been developed around traditional fisheries will result in absolute poverty in fishing communities.

In the absence of property rights the operation of the free market does not lead to a socially rational allocation of resources, even though it may appear to the individual crew to be rational. This is because individual fishermen may impose costs on one another, such as congestion cost (a contemporaneous externality), that are not transmitted through normal market forces. Thus from a fisheries management point of view, it is important to internalise these externalities.

Brief Description of Domestic Tuna Fishery in the Maldives: Type of Fishery Resource: There are two areas of fishing in the Maldives; one outside and one inside the atoll reef (but inside the island reef). About 80% to 90% of the tuna is caught outside the atoll reef but within 25km from atoll reef. This is because the Maldives does not have its own commercial tuna long-liners or purse seiners needed to operate in this area.

Of the tuna caught by the Maldivian fishermen, skipjack tuna (Katsuwonus palamis) make up the highest proportion (In 1996 it was about 75% of the total tuna catch of about 89,800 metric tons). The balance consists of yellowfin tuna (Thunnus albacares) and other tuna related species. Table 1 for fish catch by type of vessels and species for the period 1987 - 1996.Skipjack tuna is highly migratory and is widely distributed in the tropical and subtropical waters of the world's ocean (Comitini and Hardjolukito, 1984).

Table 1: Fish Catch by Mechanical Tuna Boats and Species, 1987-1986 (In Metric Tons)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
All Boats	56,992	71,483	71,245	76,373	80,713	82,035	89,938	104,046	104,472	105,413
Skipjack	42,112	58,546	58,145	59,898	58,899	58,577	58,740	69,411	70,304	66,496
Yellowfin tuna	6,670	6,535	6,082	5,279	7,711	8,697	10,109	13,126	12,493	12,439
Other tuna related species	3,204	2,970	3,575	5,185	4,492	6,177	9,651	7,062	7,055	10,884
Other fish	5,006	3,432	3,443	6,011	9,611	8,584	11,438	14,447	14,620	15,595
Mechanised Boats										
Skipjack	41,676	57,966	57,671	59,724	58,715	58,269	58,452	68,452	69,338	65,793
Yellowfin tuna	6,522	6,366	5,972	5,224	7,649	8,628	10,006	12,859	12,308	12,275
Other tuna related species	2,145	2,119	2,842	4,258	3,880	5,547	8,878	6,347	6,405	10,159
Other fish	2,339	2,167	2,310	5,068	8,450	7,341	9,936	13,198	13,845	14,764

Source: Adopted from the Statistical Year Book of Maldives, 1998, 263-264

Fishing Methods: Live bait pole-and-line fishing catches over 90% of the tuna. This is carried out in locally built wooden boats with a carrying capacity of 4 – 6 Tons, known locally as 'masdhonis'. Mechanisation of these 'masdhonis'commenced in 1974/1975 and now these mechanised boats conduct virtually all pole-and-line fishing. Since these boats do not carry ice, they return the same day with their catch. Pole-and-line fishing takes place throughout the year except when the sea is rough which is generally during the southwest monsoon (April through August).

Fisheries Objectives of the Maldives: The stated objectives of the Fifth National Development Plan (1997 – 2000) (Republic of Maldives, Ministry of Planning, Human Resources and Environment, 1998) are:

- To increase subsistence fishery production and assist in the development of commercial fisheries by the private sector.
- (a) To develop and manage both the reef associated fishery and pelagic fishery on a sustainable basis and (b) to develop a comprehensive and an integrated reef resources management system to sustain the biological diversity of the marine environment.
- To strengthen the scientific, technical and technological capabilities in the conservation and sustainable use of marine bio-diversity.

Maintaining a constant stock of renewable fishery resource is a necessary condition for sustainable exploitation of a fishery. Maintaining a constant stock of fishery resource is necessary to meet both the present and future needs of the population. In other words, it is aimed at maintaining inter-generational equity.

It is a well-known fact that in a common property situation, reducing the use of the resource by one individual will contribute to the available supply of the other users. Therefore, the user has no incentive to conserve the resource in a sustainable manner. This action could ultimately lead to the depletion of the renewable resource beyond recovery (not in the case of migratory tuna). Therefore, to overcome this problem some form of quasi property rights have to be given to these resources. This is only possible by some sort of administrative mechanism.

The other necessary condition for sustainable fisheries management is to prevent the dissipation of rent. When individuals are unable to appropriate some form of property rights, the average product of effort and not the marginal product of effort is the relevant measure with which to compare someone's income as opposed to when you have property rights (Tisdell, 1983). When average product is equated to average cost, rent is dissipated. As resources belong to the society it is important to prevent any rent dissipation. When you have property rights to a resource, then the marginal product of the individual's effort is the relevant measure with which to compare someone's income from alternative employment. In such a situation the marginal cost will be equated to the marginal social product and the rent from the resource will be maximised (Sathiendrakumar, 1996).

The allocation of property rights should not be aimed at giving those rights to the powerful and rich lobby groups only. To deal with the intra-generational equity problem the Government should also give property rights to the fishery resource to the poor as well. Economically rational exploitation of fisheries would effectively raise fishermen's incomes.

The overall national goal of the Republic of Maldives is raising the national income, the levels of living, revitalising the economy of the atolls, and maintaining a resource-base for future growth. But to achieve the overall national goal, two important objectives should be included. These are:

- Socio-economic Efficiency: that is, achieving a level of catch so that rent will not be dissipated on the one hand, and the employment in the fisheries sector will be optimal on the other (by using shadow cost for labour and capital). The latter deals with the question of productive employment and social equity, which are fundamental to the process of economic development. To take the above objective into consideration, the following questions have to be answered:
  (a) What are the best methods of managing the fishery without rent dissipation?
  (b) Who is to be allowed to participate?
- Redistribution: To redistribute earnings between fishermen equitably in a manner. The question that has to be answered here is how are losers to be compensated by the gainers?

Selection Criteria for Fishery Management Strategies for the Republic of Maldives: The skipjack tuna, which is the major species, caught in the Republic of Maldives is a highly migratory species. Furthermore, the pole-and-line fishermen do not fish beyond 25km from the atolls and therefore the unfished skipjack outside the Maldivian range of fishing is sufficient to prevent the stock levels of this species from reaching levels where recruitment declines (Sathiendrakumar and Tisdell, 1987). Thus stock externalities (Agnello and Donnelly, 1976) are not relevant in this case. But crowding and density-reduction externalities are relevant to the Maldivian tuna fishery because of the congestion and intensity of fishing within the 25km range of fishing grounds.

Any economic instrument used in managing the tuna fishery in the Maldives should satisfy the following three important criteria, namely:

- The economic efficiency principle or the cost minimisation principle. That is, it should provide a least cost solution, including the administrative and compliance cost.
- The equity principle. That is, its effect on the distribution of wealth and on other supplementary goals such as employment must be considered.
- The acceptability principle. That is it should be acceptable to both the politicians and the fishermen as a tool that will effectively control fishing effort. Acceptability also includes flexibility so that it will allow for proper reaction to changes in both economic and biological conditions. That is it is dynamic.

The Cubic Model: We could represent the above three principles, namely: efficiency, equity and acceptability principles as a 'cubic' model. The framework in Fig. 1 is in the form of a cube whose surfaces represent cost effectiveness, equity and acceptability principles.

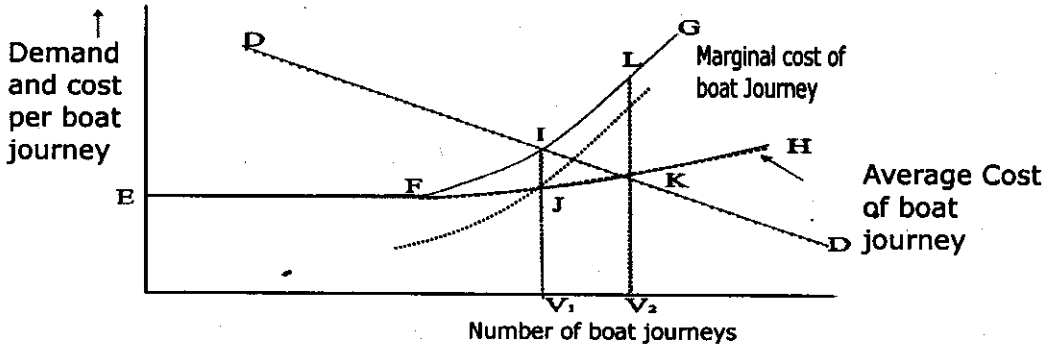

Fig. 1:Total Number of Boat Journeys Per Unit of Time between two Fixed Points when Congestion Begins at Point F

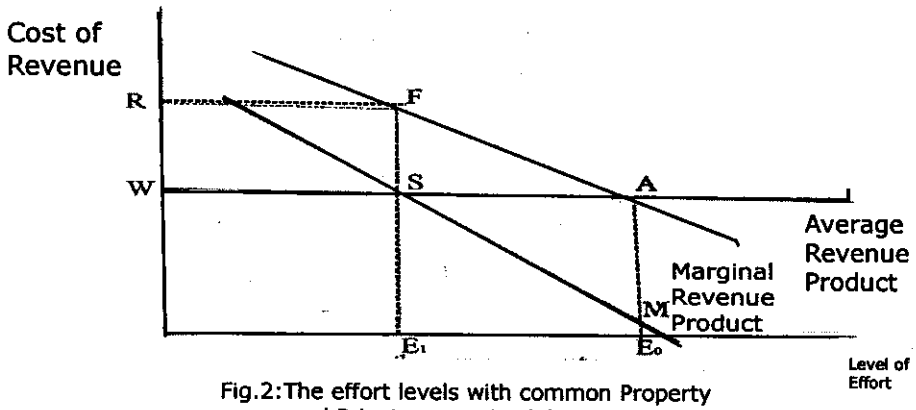

Fig.2:The effort levels with common Property and Private property rights

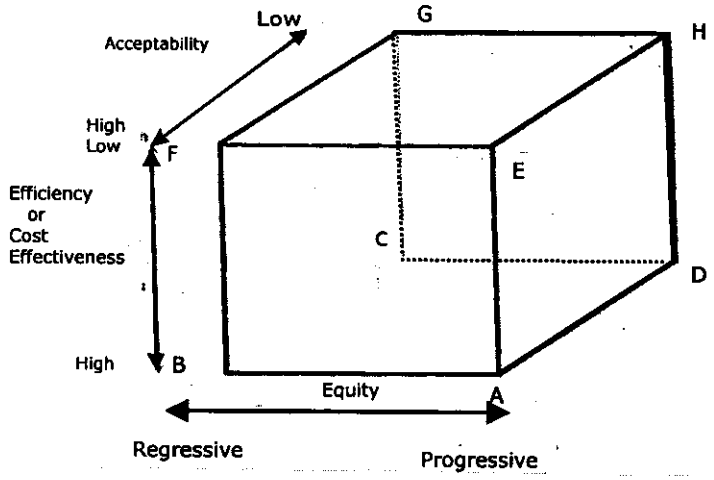

Fig.3:Framework Representing the Cost Effectiveness,Equity and the Acceptability Principle

The eight corners of the cube are labelled as 'A', 'B', 'C', 'D', 'E', 'F', 'G', and 'H'. The positions 'A', 'B', 'C', and 'D' are the ones that satisfy the efficiency principle (or cost effectiveness principle). Likewise, the corners 'E', 'F', 'A' and 'B' are the ones that satisfy the acceptability principle. The corners 'A', 'D', 'E' and 'H' are the ones that satisfy the equity principle. Therefore, the policy instrument that satisfies all three principles is in position 'A'. The position that satisfies at least two of these three principles are corners 'E', 'D', and 'B'. Therefore, we could use the above framework to select the appropriate policy instrument that could be used to satisfy the principles that we aim to achieve, namely, efficiency, equity, and acceptability. The economic instruments that are considered are discussed in the next section.

Choice of Management Methods: There are many fisheries management measures that can be considered by a Government. For the purpose of our discussion, five principal management mechanisms listed by the Department of Primary Industry (1986) will be examined in this section as they could easily be applied to the artisanal tuna fishery of the Maldives. These measures are namely:

- Limited entry
- Catch quotas (open or individual)
- Gear restrictions
- Financial controls

Limited Entry: A limited entry system enables the achievement of economic efficiency in the fisheries sector (Christy, 1976) in the long run, by controlling all dimensions of effort so as to achieve the optimal level of effort. This will prevent dissipation of rent.

Limited entry involves the setting of a maximum limit on the number of boats allowed to participate. Limited entry system prevents the dissipation of economic rents in fisheries. Limited entry in its simplest form does not impose any restrictions on boat size, gear type etc. Therefore, some form of licensing of tuna boats is required.

Economic theory predicts that in the absence of zero elasticity of substitution between the restricted and the unrestricted dimensions of effort, the unrestricted dimensions of effort will be substituted for the restricted ones. This substitution will be possible only for the rich fishermen because of the high cost of the unrestricted dimensions of effort. Therefore, this policy will be regressive in terms of equity.

Pearce and Willen (1979) Fraser (1979) and Kailis (1982) document examples of restrictive licensing of just a few effort components resulting in the expansion of other components such that the least cost combination is not achieved. Therefore this fails in the cost minimisation aspects as well. Furthermore, restricting all dimensions of effort through licensing will hinder technical progress in the fishing industry and therefore will not be efficient.

Auctioning of initial number of licenses has the desired economic advantage of selecting the most efficient fishing fleet (Crutchfield, 1986). But, because the Republic of Maldives is a Muslim country, such an auctioning may not be politically and socially acceptable. Therefore, in the Maldivian context this policy will be a failure on all three aspects, even though, it prevents the dissipation of rent from the fishing industry.

Catch Quotas: Catch quotas may be either open quotas or individual transferable quotas. Either type of quota can be effective in achieving the biological goal of stock protection. However, as mentioned earlier, the skipjack tuna stocks that migrate through the Maldives do not appear to need such protection at present. With open quotas individual fishermen tend to increase their effort in order to take a larger share of the total allowable catch. This in turn will result in over capitalisation and the resulting under-utilisation of fishing boats. Therefore, the use of open quotas in managing the tuna fishery in the Maldives will not be considered.

With individual transferable quotas, individual quotas are allocated as a share of the total catch. Therefore, it is left to the individual fishermen to determine the most profitable way of harvesting the fish. This will satisfy the cost minimisation strategy. Furthermore, it will be an equitable policy. But, because the administrative capabilities of the Maldives are currently limited, the implementation of a quota system that is also transferable may be difficult in the short-run. But in the long run, the Maldives should be able to overcome this difficulty and therefore, such a policy will satisfy all three objectives of our 'cubic' model.

Gear Restrictions: In the Republic of Maldives use of nets in tuna fishing, is prohibited by law and pole-and-line fishing is allowed (Sathiendrakumar and Tisdell 1987). In pole-and-line fishing the size of fish caught can be influenced by the size of the hooks, but the relationship is not exactly known (Anderson, 1977). Controlling the size of hooks in the Maldivian tuna industry is likely to increase the cost of tuna fishery (tuna is a highly migratory species).

The value of management by controlling the size and/or the number of hooks in the Maldivian tuna fishery will depend largely on the extent of crowding in the fishery, the degree to which 'real' fishing effort depends on the size and/or the number of hooks and the practical enforceability of the system. In the Maldivian context this may not be a preferred management option because of the significant surveillance and enforcement difficulties. Thus it fails the effectiveness principle.

Financial Controls: Management by financial controls involves providing access to all subject to the payment of an appropriate tax. This financial control could be of two forms

- Tax on inputs
- Tax on catch

Tax on Inputs: This is based on the fact that a tax on effort will increase the cost of fishing, which in turn will reduce the total effort by removing those fishermen who are unwilling or unable to pay the tax. But "tax on effort is likely to induce changes in the method of production, leading to higher total costs for society" (Anderson and Wilson, 1977) resulting in a regulation induced inefficiency. Furthermore, tax on inputs will be successful only if it is possible to prevent alternative non-taxed inputs being used by the fishermen to increase their effort or when tax is applied to all dimensions of effort. There are two problems with the latter approach. First problem is that such a measure will not encourage technological progress that may reduce the cost of fishing. Good management schemes

should also allow for technical improvements, which can be reflected as a net gain to the society. The other problem is that effort is difficult to define and measure (Treschev, 1978), especially because it is subjected to continuous revision as technology changes. Since this management measure fails to satisfy the efficiency and the flexibility criteria, it is not recommended as a management measure for the Maldivian tuna fishery.

Tax Based on Catch: The tax on catch is oriented towards economic efficiency. The economic effect of imposing a tax on catch is to increase the cost of fishing or reduce profitability. This increased cost deters the marginal fishing fleet from fishing and therefore will result reducing the size of effort to the most efficient level. Since most of the tuna that is caught in the Maldives is exported it may be easy to enforce such a tax. The only catches that may escape this tax would be those caught for domestic consumption. But in the case of the Maldivian fishing industry, whenever fish are landed on each island an official from the islands chief's office will be there to record the catch in terms of the number of fish that is caught and their sizes. A conversion table is then used to estimate the fish catch in weight. Therefore, it might be possible to impose a tax on fish that are used for domestic consumption also.

Tax on catch satisfies all three faces in our 'cubic' model, namely efficiency, equity and acceptability. Of all the alternatives that were discussed tax on catch is the only policy instrument that satisfies all the three policy objectives. It also allows for technological progress in the long run.

Conclusion

At present biological overfishing is not a problem in the Maldives. Therefore the management policy should be to control economic over-fishing. In the Maldivian context only one management policy, namely tax on catch is the one that satisfies all the three policy objectives that was specified in the model (including the economic efficiency criterion). Furthermore a tax on fish catch also has the added advantage of not limiting technical progress in the future unlike a tax on effort. Also this tax on catch will provide the opportunity to generate funds that may be used to defray the cost of fisheries management.

The present pricing policy, although implemented with the objective of raising revenue to subsidise imported staple commodities to consumers mainly living in the capital Male, has helped in preventing socially wasteful employment and investment in the fisheries sector even though it has not completely eliminated. But a methodology could be easily developed to determine the optimal tax that will achieve the socially optimal level of fish catch in the Maldives. This tax will obviously vary when ever the world price of tuna is altered or whenever the cost of tuna fishing in the Maldives varies.

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