

# Fisheries Management Techniques As An Efficient Tool in Sustainable Fisheries - A Review

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**Abstract:** Fisheries being categorized as a common property resource is under continuous exploitation. In 2019, only 64.6% of the population of the fishing stock fell within the range of sustainable norms. As the fisheries resource is considered as a renewable resource, effective fisheries management could successfully rebuild stocks and increase catches within ecosystem boundaries and thereby contribute to sustainable fisheries. However, the phase of the fishery viz. underdeveloped, developed and depleted, decides the management strategies to be implemented in order to conserve the stock. The paper reviews the different phases of fishery and some of the important management measures that are in effect.

**Keywords:** Common Property Resource, fisheries management, sustainable fisheries, phases of fishery.

## I. INTRODUCTION

The contribution of fisheries and aquaculture sectors towards global food security and nutrition is been evident for over the last two decades. According to [1], 214 million tonnes of overall fisheries and aquaculture production, including 178 million tonnes of aquatic animals and 36 million tonnes of algae, were produced in 2020 (Fig. 1). Exports provide an opportunity to bring foreign currencies into a country [2]. A revenue of USD 151 billion was generated through the international trade of fisheries and aquaculture products in 2020. Statistics as received from [1], states that India was ranked fifth in export of aquatic products in 2020, with an export value of USD 5.8 billion. However, India's trade in fish and fishery products has been affected by the COVID-19 pandemic.

Fishery resources are renewable natural resource but are not inexhaustible if the rate of harvest or exploitation is higher than the rate of regeneration or reproduction. The size of the fish stock depends on the biological, economic and social considerations. Fisheries come under common property resource (CPR), due to which many of the world fisheries are exploited. In 2019, only 64.6% of the population of the fishing stock fell within the range of sustainable norms [3].

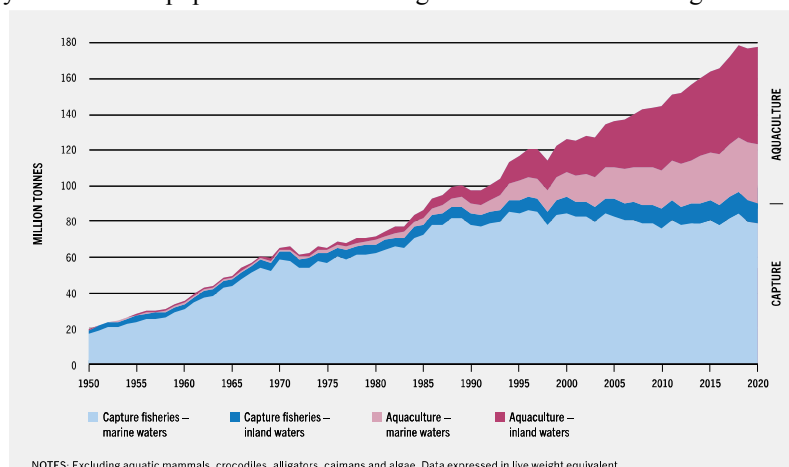


Fig. 1. World capture fisheries and aquaculture production (Source: SOFIA 2022)

Improving the global fisheries management techniques offers an important measure to restore ecosystem to a healthy and productive state and thereby conserve the stock. Rebuilding the collapsed fishery demands effective fisheries management which could improve the fisheries stock in a particular area. However, the fisheries stock continue to face

challenges towards its sustainability through corruption, poor management, illegal, unreported, and unregulated (IUU) fishing despite improvements in fishery management.

## **II. FISHERIES MANAGEMENT**

The overall objective of fisheries management is to particularly allocate ecological, financial, and institutional resources of a fisheries exploitation system so as to benefit the society[4]. The development of fishery over the time scale is categorized as a) Predevelopment Phase b) Growth Phase c) Full exploitation phase d) Overexploitation Phase e) Collapse Phase and f) Recovery Phase[5]. Management of fishery resource in an effective way depends on the phase of fishery. A fishery in its predevelopment phase has to be promoted, in its growth or fully exploitation phase should be maintained and if in the overexploitation phase, attempts should be made for its recovery[6].

### **Underdeveloped/ Developing fishery - Promote:**

A fishery resource in this stage has to be promoted by stimulating the fishing related activities. The management for the stock should focus on providing suitable fishing opportunities and easing pressure from the majority of overfished fisheries. This could aim at improving the economic incentives to the fishers in the form of fishing gear and vessel which will be best suited for exploiting the identified stock. Planning at this stage is extremely necessary to prevent the collapse of the fishery if exploitation goes uncontrolled.

### **Developed fishery- Maintain:**

Strategy for maintaining a developed fishery need to focus on the future prospects of the stock. The fishery has to be restricted or promoted based on the collected information on the fish stock and state of fisher folk. In case the fishery has to be restricted, proper methods are to be identified and adapted. To maintain a developed fishery, actions in reverse to those adopted for developing fishery need to be practiced such as introduction of disincentives, reallocation of catch, alternative fishing activities or occupations.

### **Depleted fishery- Rebuild:**

Rebuilding of depleted fisheries demands to know the cause of depletion whether environmental or fishing. If a particular fishery is known to have depleted due to fishing, then corrective steps like a fishing ban or mesh size regulation have to be used. Substitute employment opportunities should always be opened up for the fishers well prior to imposing a ban.

## **III. MANAGEMENT TECHNIQUES**

Fisheries are open access resource or common property resource where everyone has an equal right to fish. In these situations, there is no tracking of the amount of harvest by the respective fishing sector. This leads to faster harvest of the stock and leaveless resources for the future or even for the same generation. To ensure the best possible harvest of the resources, it is necessary to regulate the fisheries in such situations. The issue with the fisheries sector is that it is challenging to apply any regulating measures because of the open access nature of the fishery as an inherent characteristic. The following is a description of a few of the regulatory measures that have been enacted:

### **Total Allowable Catch (TAC)**

The capture limit established for a specific fishery, typically for a year or fishing season, is known as the total allowable catch (TAC). It is typically represented in tonnes of live-weight equivalent, but it can also be set in terms of fish numbers [7]. TACs are concerned with ensuring that total fish landings don't go beyond the catch limit. Under this system TAC for each stock is set based on the Maximum Sustainable Yield (MSY). The TAC is then divided among the fishing fleet based on its efficiency and capacity. Any vessel with a capacity exceeding the TAC would be constrained of its activity to prevent its catches from exceeding the TAC [4]. The fish catch of each fleet is regularly reported to the concerned authorities through the fish marketing organisations. TAC is known to act as an efficient management tool with the correct estimate and reporting of catches.

### **Individual Quota (IQs) and Individual Transferable quotas (ITQs)**

Individual Quota (IQs) divide the total annual catch quota (TAC) into individual quota allocations which are then distributed to the fishers. For this reason, IQs have been referred to as "TAC shares" [8]. In this method, each fisher is allotted a specified annual quota, which may be caught as and when desired by the fishermen. The overall quotas are determined by the fishery management authority. The TAC quota units for each species and vessel are transferable and can be purchased or sold. By making the quotas transferable, however, an incentive is provided to reduce the fleet by combining the quotas onto fewer vessels and getting rid of the rest. This transferability provides the opportunity for more efficient vessels to buy the quotas from least efficient vessels which in-turn could benefit both the parties [9].

### **Closed fishing seasons**

Closed fishing season is yet another temporo-spatial management measure adopted in India to reduce the fishing effort on the species during their spawning period which usually falls during the monsoons [10]. This is imposed during the breeding period in order to simulate the reproductive output and yield [11]. The period and duration of closure of fishing operation by the mechanised vessels are decided by the maritime state governments normally prior to or during the onset of the southwest monsoons [6]. Studies as in [12] confirmed that closure of fishing during the breeding period was found to be effective only for those species that are either disturbed by fishing or those that aggregate to breed. Despite widespread notion that it will increase reproductive success, they claimed that the frequent application of closed seasons to species that are not disturbed by harvesting or that do not aggregate to breed are often invalid.

### **Gear regulations and mesh size regulation**

The Code of Conduct for Responsible Fisheries (CCRF) stresses the need for sustainable fisheries management which insists on gear selectivity and mesh size regulation [13]. Gear regulations may be used to eliminate the undesired species from the harvest lot and thus can reduce the fishing effect on the particular stock. Mesh regulations may be an effective means of increasing the average size of the stock. By increasing the size of the codend mesh of a trawl, the fishing mortality exerted on small fish is reduced [14]. As the cod end mesh size of most of the trawls is very small, studies by [15] insisted on a compulsory mesh regulation by legally imposing a minimum stretched mesh size of 35 mm as prevalent against 10-20mm, that could help protect significant number of juvenile fishes as well as shrimps. Recent technological developments have encouraged the use of devices that allow turtles to escape from shrimp trawls (Turtle Excluder Devices, TED), reduce entanglement of mammals in drift-nets and purse seines, and the use of semi-pelagic trawls that could reduce the environmental impacts of the bottom gears ([16]; [17]).

### **Creation of refuge areas**

When the conventional management practices such as closed seasons, gear regulations etc. fail to create the desired effect on the stocks, a new idea of imposing a total ban of fishing in certain areas emerged [6]. It was then that studies [18] conducted proved that the creation of no-fishing areas or protected areas allows the rapid build-up of fish spawning stock biomass. Closed areas are now becoming more important as far as fisheries management is considered [19]. The idea behind reserves focuses on the fact that if the stock is unfished, there would be an increase in the mean size and age of the resident population ([6]; [20]). The adult fishes tend to remain in the protected areas and there is a spill over to the oceans which could increase the catch from the adjacent areas [21].

### **Incentive- disincentive plans**

Incentive-disincentive plans may be considered as variations of taxation and subsidies depending upon how they are implemented. To prohibit or promote the harvesting of a specific species, both strategies affect the ex-vessel price and consequently income. Incentive-disincentive plans attempt to redirect vessels and harvesting from one species to another, making the price of the first species less attractive than the price of the second [14]. The incentive is financed by a system of subsidies which would be extended for purchase of vessels or for modernization, fuel tax exemptions, or for environmental protection programmes such as TED.

#### IV. CONCLUSION

Sustainable fisheries, call for the day, demands responsible fishing practice which could protect and conserve the environment. Several management measures are in record to achieve the sustainability of these fisheries resources. These management measures are to be amalgamated in order to refrain the issues that could sweep in. These management policies are known to involve high cost of implementation and requires effective monitoring for which trained personnel are required. However, ultimate success could only be achieved through the combined effort of the fishers, locals and Institutions in implementing these laws in order to achieve sustainable fisheries development.

#### REFERENCES

- [1] FAO (Food and agriculture Organization of the United Nations). “*The State of World Fisheries and Aquaculture, Towards Blue Transformation*”. Rome, 2022. Pp:236.<https://doi.org/10.4060/cc0461en>
- [2] N. B. Khanal and U. Deb, "Fish and Fishery Products Trade by India: Trends, Competitiveness and Comparative Advantage." *Asian Journal of Agriculture and Development* 19(2): 51-72, 2022.
- [3] A. Frank and S. D. Martin, “Trade and fisheries: Key issues for the World Trade Organization”, WTO Staff Working Paper, No. ERSD-2010-03, *World Trade Organization (WTO)*, Geneva, 2010.
- [4] G. Silvestre and D. Pauly. “Management of tropical coastal fisheries in Asia: an overview of key challenges and opportunities”. In: Status and Management of Tropical Coastal Fisheries in Asia (G. Silvestre and D. Pauly, eds.). *ICLARM Conf. Proc.*,1997, (53), 8-25.
- [5] J. Csirke and G. D. Sharp (eds), 1984 “Reports of the Expert Consultation to examine changes in abundance and species composition of neritic fish resources”. San José, Costa Rica, 18–29 April 1983. A preparatory meeting for the FAO World Conference on fisheries management and development. *FAO Fish. Rep.*, 1984, (291) Vol.1: 102 p.
- [6] E.Vivekanandan, “Fisheries management techniques: *In Technical notes for the winter school on Ecosystem based management of marine fisheries held at CMFRI*, 2004 (Mohammed,K.S. ed.): 98-109.
- [7] FAO (Food and agriculture Organization of the United Nations), *The state of world fisheries and aquaculture, 2018*. Rome.
- [8] R. Arnason, “The Icelandic Individual Transferable Quota System: A Descriptive Account”. *Marine Resource Economics*, 8, 201-218. 1993.
- [9] R. Hannesson, “Fishery management in Norway. In: Managing Fishery Resources” (E.A. Loayza, ed.). World Bank Discussion Papers, Fisheries Series, 1994, 217, 11-21.
- [10] LIFE (Lawyers Initiative for Forest and Environment), 2014. “Legal Framework for Conservation of Coastal and Marine Environment of India: A Review”. *CMPA Technical Series No. 02*. Indo-German Biodiversity Programme, GIZ- India. Pp: 35, New Delhi.
- [11] Y. Ye, “Assessing effects of closed seasons in tropical and subtropical penaeid shrimp fisheries using a length-based yield-per-recruit model”. *ICESJ. Mar. Sci.* 55, 1112–1124, 1998.
- [12] C. J. Arendse, A. Govender and G. M. Branch, “Are closed fishing seasons an effective means of increasing reproductive output?”, *Fisheries Research*, 85 (1-2), 93–100. 2007. <https://doi.org/10.1016/J.FISHRES.2007.01.001>
- [13] FAO (Food and agriculture Organization of the United Nations). Code of Conduct for Responsible Fisheries. Rome, FAO. 1995. 41 p. ISBN 92-5-103834-5
- [14] M. P. Sissenwine, J. E. Kirkley and Northeast Fisheries Center (U.S.). & United States. National Marine Fisheries Service. Northeast Fishery Management Task Force, 1980, “Fishery management techniques, a review”. Woods Hole, Mass : U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Center.
- [15] A. G. Kalawar, M. Devaraj and A. Parulekar,. “Report of the Expert Committee on Marine Fisheries in Kerala”. CIFE, Mumbai,1985, pp: 467.
- [16] O. A. Misund, J. Kolding and P. Freon, “Fish Capture Devices in Industrial and Artisanal Fisheries and their Influence on Management”. *Fisheries*, 2008, 13–36. <https://doi.org/10.1002/9780470693919>.
- [17] M. R. Boopendranath, “ Biodiversity Conservation Technologies in Fisheries”. *Journal of Aquatic Biology & Fisheries* Vol. 1(1 & 2) 2013 : 10-22, 2013.

- [18] C. M. Roberts and N.V.C. Polunin, "Are marine resources effective in management of reef fisheries?" *Rev. Fish. Biol.*, 1, 65-91, 1991.
- [19] L. J. Sanchez, "Closed areas for fisheries management: How much is enough?". *Mediterranean Num Esp.*, 2015, 41 52.10.14198/MDTRRA2015.ESP.03.
- [20] A. Lopez- Sanz, V. Stelzenmuller, F. Maynou and A. Sabates, "The influence of environmental characteristics on fish larvae spatial patterns related to a marine protected area: the Medes islands (NW Mediterranean)". *Estuarine, Coastal and Shelf Science*, 92:521-533, 2011.
- [21] A. Forcada, C. Valle, P. Bonhomme, G. Criquet, G. Cadiou, P. Lenfant and L. J. Sanchez, "Effects of habitat on spillover from marine protected areas to artisanal fisheries". *Marine Ecology Progress Series*, 2009, 379: 197-211.