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Marine capture fisheries: Sustainability issues

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Abstract

Marine capture fisheries play a critical role in sustaining and nourishing human society. It is an important source of food, economy and well-being of coastal population since time immemorial. But in recent years, human activities are threatening the health of the ocean and putting enormous pressure on marine ecosystems. Overfishing, pollution, indiscriminate fishing practices and climate change are together causing, irreversible changes in the ocean that could threaten its environmental health and economic vitality. Hence, there is urgent need of strengthening sustainable practices and policies in fisheries around the globe to drive marine capture fisheries towards sustainability.

Keywords: Marine capture, sustainability, sustainable

Introduction

Demand for seafood and advances in technology have led to fishing practices that are depleting fish and shellfish populations around the world. Fishers removing nearly around 80 million tonnes of wildlife from the sea each year. Continuous fishing at this rate resulted in collapse of many stocks and overexploitation of many fish species. In order to continue relying on the ocean as an important food source, we need to employ sustainable fishing practices.

The 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report on global biodiversity concluded that fishing has had the greatest impact on marine biodiversity in the past 50 years (IPBES, 2019) [9]. Marine capture fishery crisis is evident with the increased percentage of stocks fished at biologically unsustainable levels from 10% in 1974 to 34.2% in 2017 (FAO, 2020) [7]. This continuous increasing trend warrants further effort and solid actions to combat overfishing. Overfishing and indiscriminate fishing practices not only causes negative impacts on biodiversity and ecosystem functioning, but also reduces fish production, which subsequently leads to negative social and economic consequences.

Though total marine captures are relatively stable in recent years, catches of major species have undergone marked variations over the years, as well as fluctuations in the catches among the top producing countries. This may be because of well managed fisheries in some places and that fisheries management works, allowing fish stocks to recover. Hence, the best solution for fishery sustainability around the world is to stop overfishing, reduce harmful unsustainable fishing practices and implement effective fisheries management.

The discussion below highlights the issues in marine capture fisheries and the means to address them. Though some of them have been or being implemented already, several are only at an early stage.

Underlying conceptual problems in marine capture fisheries

The major identified problems include overcapacity, overfishing, habitat alteration, climate change, pollution, IUU fishing.

Open access fishery

Open access fisheries, in which the right to catch fish is available to all, is a well-known problem causing excess capacity and overfishing of the marine ecosystem. With more inputs used than necessary to catch the fish, the economic health of the fishery may be threatened.

Overcapacity

Overcapacity refers to an excess of effort that is required to harvest fisheries resources within sustainable limits (Buckworth 1998) [3]. Overcapacity - too many boats chasing too few fish -

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is a critical issue, in marine capture fisheries. It is aggravated by the provision of open access in fisheries and government subsidies that promote fishing activity beyond levels that stocks can support. Overfishing caused by overcapacity can result in changes in trophic structures and species composition, habitat degradation, species extinction etc.

The global fishing fleet is estimated to be 250% larger than needed to catch what the ocean can sustainably produce (Ref.1).

Overfishing

Overfishing is the removal of fish species faster than they can replenish themselves. Based on FAO's assessment, the fraction of fish stocks that are within biologically sustainable levels decreased from 90 percent in 1974 to 65.8 percent in 2017 (FAO, 2020) [7]. Reasons for overfishing include: harmful fishing subsidies; poor fisheries science; poor decision-making mechanisms; lack of precautionary management; lack of transparency; and IUU fishing.

Overfishing is driving serious species depletion and also reduces fish production. About 80% of all the top predatory fish have gone from coastal areas of the North Pacific and North Atlantic (Tremblay-Boyer *et al.*, 2011) [15]. In the last 30 years, European eels have experienced up to 99% decline in some regions (Correia *et al.*, 2018) [4]; Pacific bluefin tuna has declined by over 97% (Nickson, 2016) [11]; and Atlantic bigeye tuna populations are approaching collapse (Galland, 2018) [8].

Habitat alteration and degradation

The man induced alteration of the physical, chemical and biological integrity of air, water, soil and other media is causing, in several cases, irreversible damage to the structure and function of ecosystems. Many species are put at risk through habitat alteration.

Coastal land reclamation is potentially the greatest cause of marine habitat destruction or fragmentation. This destruction occurs when coastal areas are converted for urbanization, industrial and port development, tourism, or resource extraction, including sand mining for industry and construction.

Construction of Dams divert nutrient-rich water from entering into the sea, and obstruct the migratory path of some fishes.

Indiscriminate fishing practices such as dynamite fishing and cyanide fishing are destructive to fisheries habitats, lost or discarded fishing gear is also destructive to underwater habitats. Deep-sea trawling is particularly harmful to ecosystems because it strips the entire environment of all living things including deep ocean corals. Continued stripping of deep-sea areas may cause species to become extinct before they have a chance to be identified by science.

Climate change

Climate change can bring cumulative effects to every environmental issue, fisheries is no exception to this. According to the Intergovernmental Panel on Climate Change's fifth assessment report 100% of the warming is because of human activities. The Earth's temperature increased by 0.85 [0.65–1.06] °C from 1880 to 2012 owing to increases in the concentrations of CO₂ and other greenhouse gases (Stocker, 2013) [14] according to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2013) [10], and the average global temperature has climbed sharply in the past 30 years (Qin & Stocker,

2014) [13].

Rising atmospheric temperatures are expected to change ocean temperatures, sea level, circulation patterns, the frequency and intensity of storms, salinity, and oxygen levels and thus impact the availability of fish resources by affecting their abundance and distribution. The more mobile species would be able to migrate to favourable areas over time, but less mobile and sedentary species may not be in a position to do so.

Coastal zones, the world's most densely populated regions, are increasingly threatened by climate change stressors — rising and warming seas, intensifying storms and droughts, and acidifying oceans.

Pollution

Direct dumping of pollutants into the ocean affects the daily life of fish and other marine creatures. Runoff from domestic, municipal and industrial wastewater discharges and agricultural fields, solid waste disposals, discharge from ships oil spills from tankers changes chemical nature of water. Depending on the intensity, these interferences may affect the physiological processes of growth and reproduction of aquatic organisms, causing mass kills, biodiversity loss and displacement of species.

Nutrient overload caused by excess agricultural runoff result in eutrophication. The threats posed by eutrophication include reduced water clarity, oxygen depletion, and toxic algal events that result in critical habitat losses such as coral reefs, seagrass meadows and mangrove forests. Other serious consequences include mass mortalities of marine animals, loss of biodiversity and threats to human health.

Illegal, Unreported, and Unregulated fishing (IUU fishing)

Illegal, unreported and unregulated fishing is an international issue around the world, facing marine fisheries. It occurs both on the high seas and in areas within national jurisdiction. IUU fishing takes advantage of corrupt administrations and exploits weak management regimes, in particular those of developing countries lacking the capacity and resources for effective monitoring, control, and surveillance (MCS). It undermines our efforts to conserve and manage fish stocks and, as a consequence threatens marine biodiversity, food security for communities who rely on fisheries resources for protein, economic security and inhibits progress towards achieving the goals of long-term sustainability.

Inappropriate and destructive Exploitation Patterns

Overexploitation of the inshore and reef artisanal fisheries, using non-selective and destructive practices of dynamite fishing, purse-seining and drag-netting cause severe damage to habitat. Use of trawls with small meshed cod ends is a cause large-scale destruction of juveniles of many important commercial fishes. The use of small mesh-size nets is also widespread due to its perceived effectiveness in catching juvenile fish.

Management Approaches for Sustainable Development

The goals of management are, first, to prevent biological and commercial extinction, and, second, to optimize the benefits derived from the fishery over an indefinite period; in summary - the goal is to use resources sustainably.

Shift from Open-access to User rights

Shift from a free and open access system to a regulated

fishery with the introduction of appropriate measures to allocate resources and establish user rights will provide greater incentives to reduce excess fishing capacity/pressure which is one of the major factors responsible for overfishing and unsustainable development.

Reduction of fishing effort

The restriction of fishing effort could be in various ways such as restriction on number of vessels, number of days at sea, fishing days/hours, engine power, fish hold capacity or length of nets etc. The fishery regulation through effort reduction is chiefly aimed at mechanized sector.

Licensing

Over-capitalization is normally associated with the open - access fisheries as in India. To regulate this, registration should be made mandatory for larger mechanized fishing boats. In 2013 Ministry of Shipping had made registration mandatory for Indian flagged fishing boats with a length of 20 metre and above. These vessels had to be registered with the Mercantile Marine Department.

Diversification of Fishing Effort

In recent years, with rising global population and improved fishing technology, near-shore fisheries have been under tremendous amounts of pressure. Hence, to reduce fishing pressure existing trawler vessels maybe upgraded to harvest under-tapped areas with enormous resources in the oceanic and deeper waters.

Mesh - size regulation

The fine meshes of gears like trawls and bag nets cause large - scale destruction of juveniles of many important commercial fishes. For every shrimp seed collected, hundreds of other larvae and juveniles of commercially important species of finfishes and shellfishes are destroyed.

To control this fishery scientists have suggested a minimum stretched mesh size of 35 mm which permit the escapement of juveniles hoping that their growth would largely compensate the loss and increase the exploitable biomass.

Imposing of Minimum Legal Size

One of the methods to discourage the indiscriminate exploitation of juveniles is to impose a Minimum Legal Size (MLS) which is the size at which a particular species can be legally retained if caught. The advantage of MLS is that it aids in the control of two major problems in the fisheries management, growth overfishing and recruitment overfishing either by increasing the minimum size of harvest or by increasing or maintaining the size of the spawning stock.

Halt on Illegal fishing

Illegal fishing is most prevalent where governance measures to manage fisheries are the weak. Hence, strengthening fisheries governance at national and regional levels has been increasingly recognized as main requirement to reduce illegal fishing activities. According to the Food and Agriculture Organization of the United Nations, IUU fishing represents up to 26 million tonnes of fish caught annually, valued at between \$10 to \$23 billion USD (Ref.2).

Total allowable catch & individual transferable quota

The most common fisheries management method followed in many countries is to impose an upper limit on the total

allowable catch (TAC). By setting an upper limit on how much can be caught, most fish stocks in the northeast Atlantic Ocean are now controlled. Concepts such as TAC and ITQ have been used in certain countries like Canada and Australia.

Marine Protected Areas (MPAs)

Governments establish marine protected areas to shield threatened marine ecosystems and other undersea resources from intrusive human activity. Thus, allow rapid build - up of fish spawning stock biomass. Marine parks, marine reserves and sanctuaries come under MPAs. According to the United Nations, as of September 2017, Marine Protected Areas cover 6.35% of the ocean. CBD Aichi Biodiversity Target 11 aims to cover 10% of the world's marine areas by 2020 (Deguignet *et al.*, 2014) [5].

Seasonal closure of fishing

A seasonal closure is a form of spatial control in certain fishing grounds to protect spawning of fishes. The objective of seasonal closure is to reduce the annual fishing effort of mechanised vessels, particularly the effort of the trawlers during the spawning season of the fishes, and thereby to replenish the fish stocks.

Along the west coast of India, the ban is from June 1 to July 31 during the southwest monsoon and along the east coast, the ban is during April 15 – June 15.

Artificial Fish Habitats (AFHs)

Artificial Fish Habitats are an excellent fisheries resources enhancement tool. AFHs provides substrate, feeding location and shelter young fish and other small aquatic animals. Thus, encourage growth and development of a great number and variety of marine organisms. These artificial fish attractors are constructed from PVC pipes, plastic barrels, and corrugated plastic pipes, or evergreen trees.

Sea Ranching

Sea ranching or artificial recruitment of aquatic organisms into their natural habitat is one of the alternatives for stock improvement or enhancing the production or for conservation of resources. In sea ranching, selected species are bred, hatched and reared in hatcheries up to juvenile or fingerling stage and released, normally in bays, lagoons and in the protected ecosystems.

Establishment of Monitoring, Control and Surveillance (MCS) System

Regular monitoring, control and surveillance of fishing vessels is an important element of fisheries management strategy and it is key to put off illegal, unreported and unregulated fishery. Vessel monitoring systems (VMS) are important instruments used for fisheries monitoring, control and surveillance (MCS) which at regular intervals provides data on the location, course and speed of fishing vessels to the fisheries authorities for the purpose of management of fishing effort and fisheries resources.

Participatory management

Management of fisheries can be made more effective if the principal stakeholders are involved in the decision making and its implementation. Fishermen who are vested with the responsibility of protecting the fisheries resources they harvest, should be made aware of the conservation and sustainable use of fish stocks by constant interactions with the

scientific community. Such interactions will be mutually beneficial to the fishermen, fishery scientists and the policy makers and make the implementation of the management measures in smooth and effective way.

Ecosystem - based Fisheries Management (EBFM)

Ecosystem approach to fisheries management, also referred to as an ecosystem approach to fisheries (EAF), is a practical way to sustainably maximize the ecosystem benefits of a fishery system. The aim of EAF is to sustain healthy marine ecosystems and the fisheries they support by addressing some of the unintended consequences of fishing, such as habitat destruction, incidental mortality of nontarget species, and changes in the structure and function of ecosystems (Pikitch *et al.* 2004). The overall objective of EAF is to minimize the impact of fisheries on the ecosystem to the extent possible.

Implementation of FAO Code of Conduct for Responsible Fisheries (CCRF)

The Code of Conduct for Responsible Fisheries (FAO, 1995)^[5], is a tool which focuses mainly on achieving sustainability through responsible fishing practices. The code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, after taking into account relevant biological, technological, economic, social, environmental and commercial aspects.

Strict implementation of Marine Fishing Regulation Acts (MFRAs)

The Marine Fishing Regulation Acts (MFRAs) have provision for regulating fishing and conservation of fishing stocks. These include regulation of mesh size to avoid catch of juvenile fish, regulation of gear to avoid over exploitation of certain species; reservation of zones to traditional fishermen and declaration of closed seasons.

Pressing for better regulation of fishing vessels and their activities, with a slew of new rules, including harsher penalties for captains and companies found to have broken the law, thus minimising negative impacts and preventing the degradation of the marine environment is necessary to keep fisheries sustainable.

Conclusion

According to FAO, marine fisheries directly or indirectly employ more than 200 million people worldwide, and the livelihoods of more than 3 billion people depend on marine and coastal biodiversity. However, much of the world's oceans are heavily affected by human activities, including pollution, overfishing, and coastal development. These activities resulted in depleted fisheries and loss of coastal habitats, posing a major threat to marine biodiversity and the food supply of millions of people.

The marine capture fisheries sector makes a crucial and increasing contribution to economic growth, food, nutrition and livelihood security. As per FAO (2020)^[7] report, 34.2 percent of assessed fish stocks are fished at levels that exceed biological sustainability. Furthermore, the fish stock status in developed countries is improving, while many developing countries face a worsening situation in terms of overcapacity, production per unit of effort and stock status. Therefore, this sector is in need of significant management action in some regions, particularly in the context of the

expected impacts of climate change in coming decades. Managing fish populations sustainably requires commitment and cooperation at all levels, including from individuals, local communities, governments, and institutions across the globe.

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