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Fishing Technologies for Conservation of Marine Fish Genetic Resources

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The advancements in fishing technologies over the years, had helped to significantly increase the fish production from the capture fisheries and has helped to improve the per capita consumption of fish. Increase in the fishing effort, use of unsustainable fishing gears and lack of proper monitoring and surveillance, combined with the climate related changes in the oceans, have caused serious declines of fisheries worldwide. The bycatch, discards and pollution are also becoming concern in several fisheries world over including India. Despite the fact that numerous measures, including gear-based technical measures, have been evaluated and mandated by law, the use and implementation of these measures in the field, remained largely negligible.

Ecosystem-based approaches to fishing, reducing plastic pollution, spatial planning and creating biodiversity hotspots with no-take zones, strict regulations and effective implementation strategies, as well as a concerted effort to reduce the capacity of fisheries, are required for conservation of resources.

Introduction

The global production of fish has quadrupled over the past fifty years as a result of advancements in fishing industry relating to navigation, fish finding, and the introduction of synthetic materials. This has contributed increased availability for consumption.

Although total fish output has increased, it is observed that fish harvests from the wild have stayed relatively constant at roughly 90-95 million tonnes per year since the early 1990s. Globally, the fraction of fish stocks that are overexploited has more than doubled since the 1980s; as a result, the current levels of wild fish capture are unsustainable. The fall in catches has been caused by a decline in fish availability, rather than changes in fishing effort (Thurstan *et al*., 2010).

A large range of gears are employed to harvest fish resources in the wild, in both coastal and inland waters. Among these, bottom trawling accounts for approximately 25 percent of all the fish harvested, while other types of trawling account for approximately 10 percent. Just over twenty percent of the catch is contributed by pelagic fishing techniques such as purse seine being the most prevalent (Pauly *et al*., 2020). The majority of gear used in inland waters consists of gillnets, small encircling nets, hooks, and lines that vary greatly in design and technique of operation. In addition to illicit fishing techniques, climatic and land use changes made a substantial impact on the fish diversity over the years (Miranda *et al*., 2022).

The Indian Scenario

During 2019-20, India produced a total of 14.16 million metric tonnes (MT) of fish, which accounts for around 7.6 percent of the total global fish production. Fish and fish products are also a significant source of revenue from exports, generating around $6.73 billion.

Marine Capture

More than 1500 species of finfishes and shellfish inhabit the coastal and offshore waters of India and approximately 300 are commercially significant. Numerous gears are used to harvest marine resources, including trawl nets, gillnets, seines, hooks and lines, and bag nets. The principal resources contributing to marine capture fisheries include the Indian oil sardine, lesser sardines, Indian mackerel, croakers, Bombay duck, threadfin breams, carangids and ribbonfishes among finfishes and penaeid and non-penaeid shrimps and cephalopods among shellfishes. The current marine production of 3.8 million tonnes represents approximately 71.6 percent of the revalidated fishing potential of 5.31 million tonnes. During the recent stock evaluations, it was found that the 86 percent, out of the evaluated 67 marine finfish and shellfish were being fished within biologically sustainable levels, i.e., yields from these stocks have not yet reached Maximum Sustainable Yield (MSY).

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Major Issues that Affect the Sustainability of Fishing Operations

Overcapacity

The global fishing capacity and effort grew fast from the late 1970s through 2010 before levelling off. In terms of both capability and effort, the Asian fleet is more than an order of magnitude greater than that of any other region, and it continues to grow. In recent years, developed nations as a whole have declined in both metrics and cause for stabilising the worldwide trend. Developing and underdeveloped nations continue to expand, with the former possessing the biggest fleet and exhibiting the highest relative growth. In terms of watt days of fishing effort per tonne of wild marine catch, the efficiency of the global fleet is presently lower than it was in 1950, despite significant technological developments and expansion throughout the world's oceans (Bell *et al*., 2017; FAO, 2020).

Bycatch

Bycatch refers to non-targeted species that are retained, sold, or disposed for whatever reason. Incidental catches are the retained non-targeted species, whereas discarded catch refers to the fraction of the catch that is returned to the ocean for economic, legal, or personal reasons (Alverson *et al*., 1994). The non-targeted component consists primarily of juveniles of economically valuable species and other charismatic species, such as turtles, sharks, etc., that have diverse life strategies and are frequently negatively impacted by capture and subsequent release from fishing gear or vessels. Recent global estimates of bycatch are 9.1 million tonnes, with the biggest contribution coming from shrimp trawl fisheries, contributing approximately 4.2 million tonnes (Pérez Roda *et al*., 2019).

There are only a few studies that report the bycatch from fishing vessels along the Indian coast. Pramod (2010) estimated the bycatch discards from mechanised trawlers operating in Indian EEZ at 1.2 million tonnes. The same study estimated 56.3% of the total catch of shrimp trawlers as bycatch. Estimates by Dinesh Babu *et al*. (2013), show that landing of low value bycatch (LVB) in trawl fisheries has increased from 14% in 2008 to 25% in 2011. There are reports on the significant interactions of cetaceans in high sea gillnets (Anderson *et al*., 2020) and in surrounding gears like ring seines.

Though there are many technical measures that are used worldwide (Kennelly and Broadhurst, 2021), the adoption of these measures is found to be limited including the tropical countries, where shrimp trawls are widely used. The low adoption of technical devices is attributed to the resistance from the fishers towards the modification and inherent fear of commercial catch losses (Suuronen, 2022). Abandoned, lost, or otherwise discarded fishing gear (ALDFG) is another issue that is gaining importance due to the negative impacts of plastics in the ocean and by affecting the food chains and ultimately the biodiversity of the oceans (Gilman *et al*., 2021).

Lack of Implementation of Management Measures

Despite the fact that many nations have implemented localised management measures for the conservation of resources, the implementation in the fishery is frequently hampered by numerous obstacles: effective monitoring, control, and surveillance is frequently a problem, especially in the south Asian nations where the number and scale of fishing operations are quite high. Recent studies however show that the implementation of the CCRF has increased, as also the utilisation of bycatch as secondary raw material or for other traditional purposes (Roda *et al*., 2019).

Technologies for Responsible Fishing

Use of Bycatch reduction devices (BRD) can address the problem of capture of non-targeted catches, provided the devices have been tested in the fishery for optimizing the size, shape and operational parameters. Square mesh cod-ends, Fisheye BRD, Sieve Net BRD, Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD), etc. are some of the BRDs that were field-tested for their effectiveness in the Indian scenario (Kennelly and Broadhurst, 2021). Species that are at risk due to climate-induced changes such as sea turtles and other Endangered Threatened and Protected (ETP) species often form a bycatch in different gear systems like trawls and long lines. Field studies have shown the utility of Turtle Excluder Devices (TEDs) to release turtles getting in the way of trawl nets and, use of circle hooks, to reduce mortality associated with hooking.

Modified designs of gears to reduce negative impacts, are also widely used. Trawls that reduce impacts to the bottom, include semi-pelagic trawls, short belly trawls, cut-away trawl designs. Modifications to the anterior region of the trawlnet and other significant changes to the designs are reported (Kennelly and Broadhurst, 2021). The outcome of these designs has been the reduction in

the non-targeted catches, either by preventing entry to the gear (which is more beneficial in reducing post-release mortality) or the easy release from the anterior parts of the trawls that again benefits in terms of reducing post-release mortality.

Use of bird scare lines and chutes, to set the baited hooks deeper are often employed in longline fisheries to reduce the incidental capture of seabirds. While regulation in mesh size, is the common intervention to reduce capture of juveniles in surrounding gears, use of medina panels and backdown techniques etc. are the interventions to reduce cetaceans being accidentally caught during seining operations. Deterrent devices such as pingers, though effective in reducing the incidence of cetaceans in fishing gears, subsequent reduction in effectiveness of the device is reported due to habituation to the sound by the animals.

Future Prospective

The following action points are recommended

1. Ecosystem-based approaches to fisheries management
2. Spatial planning and effective implementation of temporal and/or spatial regulations
3. Effective quotas for regulating the catch and bycatch in different fisheries
4. Creation of marine protected areas and regulation of all activities that directly or indirectly affect the biodiversity
5. Measures to decrease plastic pollution from fishing operations, including rigorous rules, marking of fishing gear, and measures to reduce runoff contamination into the oceans.
6. Understanding the intricacies of marine fisheries through strong collaboration with fishermen is crucial for the development and implementation of diverse approaches to prevent the loss of fish diversity.
7. Restrictions on the use of illegal fishing gears and fishing methods that cause severe damage to flora and fauna

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