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Marine Pots and Traps of the South-West Coast of India: A Review of their Design, Operation and Fisheries

K. K. Prajith[1], S. Chinnadurai[2] and M. P. Remesan[1]
[1] *ICAR-Central Institute of Fisheries Technology, Matsyapuri (PO), Cochin - 682 029, Kerala, India*
[2] *Veraval Research Centre of ICAR-Central Institute of Fisheries Technology, Veraval - 362 265, Gujarat, India*

Abstract

Pots and traps are passive fishing gears that have a low impact on the environment and are highly selective and thus have advantages over other fishing methods. In India, pot and trap fishing are an age-old practice that is very common in inland waters. However marine trap fishing in the country is restricted to the Gulf of Mannar, Palk Bay of the South-east coast of India and the Enayam-Kadiyapattinam coastal belt of the South-west coast. Rectangular and semi-cylindrical-shaped traps are the common designs used for catching lobster and arrow-shaped traps fabricated with natural material are the common fish traps operated in India. Presently there is no recommended minimum mesh size for trap fishing in the country. A recent trend of shifting from natural material to synthetic material for fabrication of traps was observed. In India catch data from the trap fishing sector is limited. The paper discusses key issues in trap fishing and suggests recommendations for sustainable marine trap fishing in India.

Keywords: Responsible fishing, selective fishing, pot fishing, trap fishing

Introduction

Pots and traps have high species and size selectivity, energy efficiency, easy to operate and require less attention during fishing (Miller & Hunte, 1987). Technically, traps are referred as the large structures fixed to the shore, whereas pots are smaller, movable traps, enclosed baskets or boxes that are deployed from any craft (Slack-Smith, 2001). Pot fishing is normally based on attracting target organisms by bait through one or several entrances (Bjordal, 2002). In India, the usage of "Pot" is not common and the fish trapping devices are generally termed "Traps" (Prajith & Remesan, 2019). Several designs of traps and pots are used in the inland waters of India, but the operation of marine traps on a commercial basis is highly restricted to the Southern coast of the country, especially in the state of Tamil Nadu. This is mainly due to the geographic conditions of these areas and the skill of the fishermen to operate pots and traps. The South-east coast of the Indian peninsula is known for its rich diversity of corals and rocky ecosystem. These shallow waters are rich in commercially important demersal fish species (Ramadhas et al., 1999; Jayakumar et al., 2016). This paper describes different designs of traps and pots used in the marine sector of the country, so as to provide insight into the status and perspective of traps and pot fishing in India.

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*Email: prajithkk@gmail.com

Fish pots and traps along the South-west coast of India

The Colachel and Muttom regions in the state of Tamil Nadu are considered one of the major fishing grounds for lobsters in India. Besides traps, gill-net and trammel-net, are also used for harvesting lobsters in the region (Radhakrishnan et al., 2005). The first report on trap fishery from the South-west coast of India was given by Miyamoto & Shariff (1961). Rajan (1993) reviewed the fish trapping devices and methods employed in Southern India. Balasubramanian et al. (2001) investigated the fishing efficiency of lobster traps of six different designs and found better catch rate in semi-cylindrical traps.

Trap fishing is mainly practised in the Gulf of Mannar, Palk Bay on the South-east coast of India, and the Enayam-Kadiyapattinam coastal belt of the

South-west coast (Beenamol et al., 2017) (Fig. 1). The first study on trap fishing along Indian waters by Prabhu (1954), gave a detailed account of the perch fishery of the Gulf of Mannar and Palk Bay (South-east coast). Mohan (1985) reported the catch composition and seasonal variation of catch during 1973-1975.

According to Vineeta (1997), three hundred fishermen family from seven fishing villages near the Gulf of Mannar depend on traditional trap fishing. Dugout canoes are used to reach the fishing ground and the operation is mainly done by two persons using shrimp heads as bait. Fishing in the Gulf of Mannar region is carried out during North East Monsoon and shifts to Palk Bay for the next six months. The author also observed that trap fishing is carried out responsibly without causing any damage to the fishing environment.

In a status report on the fisheries of Tamil Nadu state, Murugan & Durgekar (2008) provided a brief description of the trap, locally known as *adapu valai* operated along the Palk Bay. Varghese et al. (2008) reported that trap-based fishing in the Gulf of Mannar region and has a detailed record from Keelakarai, one of the major traditional trap fishing sites of the Gulf of Mannar. Venkatesan (2010) reported the emergence of shore fish traps (in local parlance *'pattivalai')* and their design and economics of operation along the Gulf of Mannar. Anand et al. (2016) provided a detailed account of lead traps, which catch a significant quantity of juveniles and brooders. The study summoned that lead traps are more effective but non-selective and could be threat to biodiversity. Varghese et al. (2017) studied the diversity of reef fishes in trap fishery at the Gulf of Mannar, the South-east coast of India. Arunjenish et al. (2018) tested the comparative efficiency of fish traps with different funnel shapes *viz*., rectangular, oval, heart-in, and circular shaped. These designs were tested in a serial collapsible fish trap. A significant difference in the overall catch rate of the experimental trap with respect to funnel designs were observed. Among the four types of experimental funnels, the catch rate was significantly high in traps with oval shape funnels.

Marine fish pots and traps from other parts of India

In India, as the fish trap operation in the marine sector is restricted to the coast of Tamil Nadu and dedicated landing data from fishing pots and traps are not available. Other than the Tamil Nadu coast, trap fishing is restricted to either a specific resource or a region. In Gujarat, there are reports of various trapping techniques used for catching gobies from the Bhavnagar and Bharuch districts (Balan et al., 1987; Gadhavi et al., 2017; Kanejiya et al., 2017). All the devices recorded from these regions were very lightly constructed entangling devices or mechanical processes which trap the fishes from the marshy exposed coast. Use of marine pots are not common in the states of Maharashtra, Goa and Karnataka. In all these states crab traps are commonly used in estuarine areas (Sreekanth et al., 2015). In Kerala, there are reports of lobster trap operations from Vizhinjam and Mullor of the southernmost district of Thiruvananthapuram (Benedict, 2017; Radhakrishnan et al., 2019).

A detailed survey by Sridhar & Muralidharan (2013) on the craft and gear along the 24 fishing villages of the State of Odisha which include pots and traps. Maheswarudu (2013) discussed the prawn fisheries of West Bengal and reported a 39 % reduction in traps operated for the prawns. In a report on fish and fisheries of the Digha coast of West Bengal, Chatterjee (2000) stated that the traps are one of the traditional fishing gear operated on the coast of Digha.

Ravikumar et al. (2016) documented the traditional knowledge and fishing methods of Andaman and Nicobar Islands and mentions that fish traps are used to catch mullets, milkfish and carangids. Similarly, Kumar et al. (2017) reviewed the fishing craft and gears of the Lakshadweep Islands and reported two types of traps in the Kalpeni. Which is used to catch fishes like lutjanids, goatfishes, rock cods, sharks and rays (Anon, 1986; Anand, 1990). The structural and operational details of pots and traps were not provided by the authors in the study.

Design and operation of pots and traps

In South-west coast of India, the most widely used pots are rectangular-shaped for finfishes and semi-cylindrical-shaped designs for lobsters. Traps operated in the Enayam-Kadiyapattinam region of Tamil Nadu are modified traps made of iron frame (Mild steel) and covered with polyethylene (PE) webbings. In the Gulf of Mannar, the most common traps are arrow-shaped traditional traps made of natural materials as well as polyethylene meshes (Fig. 2)

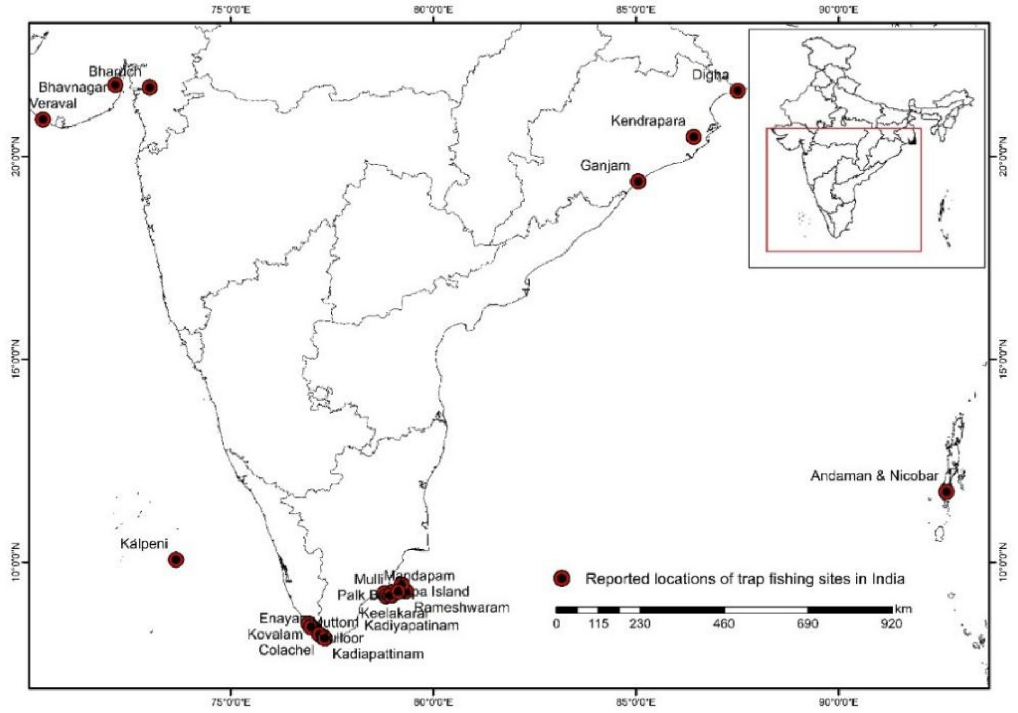

Fig. 1. Map showing the major marine fish trap operating locations in India

Depending on their design, traps may have one or two funnel-shaped openings through which fish can enter (Kalaiarasan et al., 2015). Some of the trap designs recorded from the Tamil Nadu coast are provided in Fig. 2 to 4.

Hornell (1950) described the skill of Rameshwaram fishermen in the construction and operation of perch traps. Prabhu (1954) reported that traps used in the Rameshwaram are fabricated with hexagonal-shaped meshes with a dimension of 1-1 ½ inches. Further the traps of this region are fabricated with natural materials with an upper and lower sheet to form an undivided spacious side chamber. The number of entrances varies from 3-5. Kalaiarasan et al. (2014) documented the traditional trap designs and catch composition of the traps operated along Keelakarai. The study recorded four different types of designs from this coast, which was similar to the observation made by Prabhu in 1954. Further, the study reports traps with single entrances and with more operational volume provided better catch compared to the trap with two and three entrances. The catch significantly varied between the seasons and designs. The traditionally operated traps of the Enayam coast are box-shaped with a dimension of 116 cm x 88 cm x 58 cm (LxBxH), with mild steel (MS) rods of 10 mm diameter. The traps were covered with polyethylene webbing of 40 mm diamond-shaped meshes. The thickness of twine is 2 mm (Beenamol et al., 2017) but Rajan et al. (1988) observed that trap with a semi-cylindrical shape performs better when compared to the conventional box traps.

There is no legally recommended minimum mesh size for trap fisheries in India (Vadziutsina & Riera, 2020). Murugan et al. (2014) and Beenamol et al. (2017) reported the use of 32 mm and 40 mm mesh size in traps from various regions. In the present study along the Gulf of Mannar and Palk Bay, found that the mesh size of the trap is decided based on the size of the trap. It varied between 25 to 60 mm and 40 mm size is the most commonly used one. Prajith et al. (2015) made a preliminary study to test the efficiency of modified *gargoor* fish traps on the west coast of India. Trap designs with four mesh sizes were tested. The study revealed that traps with smaller mesh sizes (40 mm and 50 mm) reported higher catches, compared to the designs with larger mesh (80 mm and 100 mm).

Materials used for trap fabrication

During the early eighties, Rajan et al. (1981) reviewed the fishing techniques for spiny lobster and lobster traps used in India and other countries. Subsequently, a preliminary study was carried out by Rajan & Meenakumari (1982) on the west coast of India with three trap designs, namely rectangular, Australian pot and ink-well traps and found that Australian pot and rectangular traps were more efficient than the ink-well traps. Meenakumari & Rajan (1985) conducted a comprehensive study on lobster traps made of different materials such as palm leaf stalks (*Phoenix dactylifera*), splinters of bamboo (*Ochalandra travancorica*) and coconut (*Cocos nucifera*) leaf stalks. The study also tested the performance of wood (*Tetrameles nudiflora*) as a trap material and found that wood is not a preferred material for the construction of lobster traps. Rajan et al. (1988) developed a semi-cylindrical trap, a modified version of the Australian pot with a rectangular base and semi-circular ribs. These plastic-coated metal traps were found to be more efficient than traditional traps and had a life of 5-6 years.

The trap operated for spiny lobster in the southwest of India is known as 'Colachel traps', made of palmyra (*Borassus flabellifer*) leaf-stalks, which consist of three parts (floor, top and sides). The different parts were generally tied together with natural fibres that are biodegradable and have less durability in the marine environment. These traps consist of a bamboo, wooden, or steel frame covered with chicken wire with a mesh size ranging from 2–5 cm (Meenakumari & Rajan, 1985). Colachel traps were not popular in other parts of the country because the construction technique of these traps is known to only a few fishermen in this region (Rajan et al., 1988). A study along the Enayam coast of Tamil Nadu observes a full shift from the conventional biodegradable material to durable materials like polyethylene, mild steel (MS) rods, etc. (Beenamol et al., 2017).

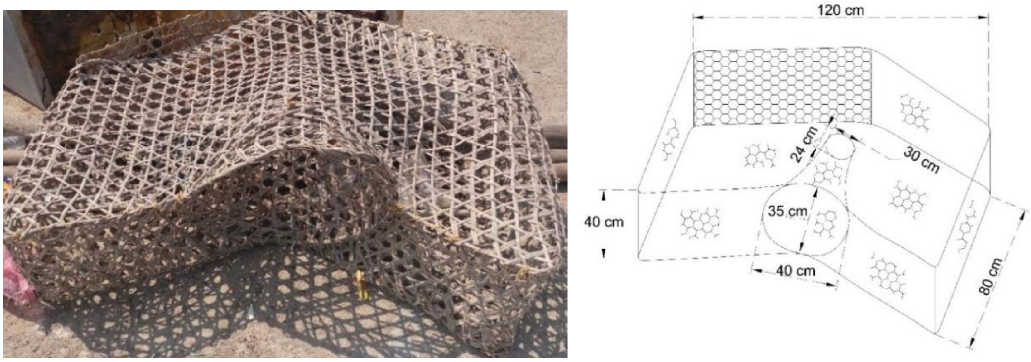

Fig. 2. Traditional fish trap of the southeast coast of India made of *Acacia* root fibers

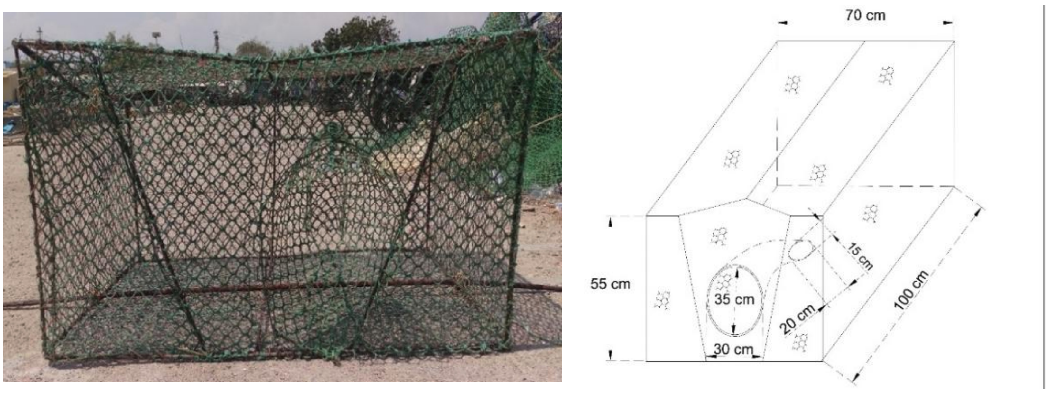

Fig. 3. Rectangular trap with iron frame

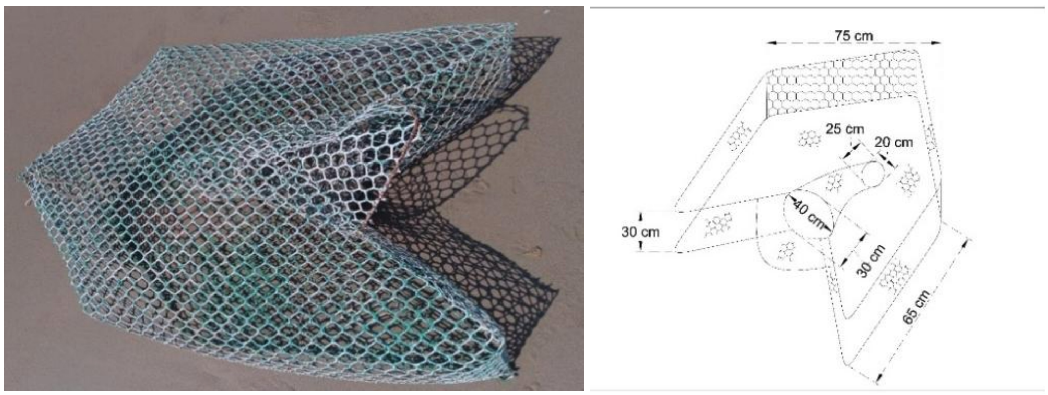

Fig. 4. Trap made of synthetic garden fencing net

Prabhu (1954) made a detailed investigation on the trap-based perch fishery of the Gulf of Mannar and Palk Bay. The traps were recorded to be made out of split branches of *Acacia planifrons*, thin bamboo strips, and midribs of palmyra leaves and operated in soft sandy bottom Gulf of Mannar and hard rocky (Palk Bay) bottom. Prior to the construction of traps, the materials are soaked in water to increase their strength and durability. Varghese et al. (2008) studied materials used for the fabrication of traps. They recorded four types of natural materials such as Odai tree sticks (*Acacia planifrons*), Eeecha tree sticks (*Phoneic dactylifera)*, Palmyrah roots and leaves (*Borassus flabellifer*), and one synthetic material, polypropylene, locally known as 'wire', which is usually used as a packing strap for cartons. The 'wire' is a recently introduced material for the construction of traps, which normally lasts for 5 years. The traps made of the Odai tree usually last for 1 year and those of the Eeecha tree last for about 2 months. Kalaiarasan et al. (2014) recommended the use of tree sticks of *A. planifrons*, roots of *P. dactylifera* and leaves of *B. flabellifer* for the fabrication of low cost and efficient traps. However, in recent years there is a major change in the materials used for trap fabrication. Polyvinyl chloride garden fencing mesh is one of the recent materials used for trap construction. This material is preferred by fishermen because of its flexibility, lightweight and durability (Beenamol et al., 2017) but may contribute to marine litter.

Studies on baits used in trap fishing

Bait is an important factor that decides the success of a trap operation (Lokkeborg et al., 1990). Worldwide many natural and artificial types of bait are being used for fishing. In India, only natural baits are used in commercial trap fishery. Prabhu (1954) made a record of various types of bait used in traditional trap fisheries viz. *Neptunus pelagicus,* clupeid fishes, crabs, jellyfishes and dried or decaying holothurians. Hamsa et al. (1994) studied the trap-based perch fishery of the Gulf of Mannar and concluded that the increase in perch landings and the change in the succession of species are attributed to the change in mode and area of operation and the increase in the usage of prawn peelings predominantly as baits in place of traditional baits. Similar observations were made by Mohan (1985). Rajan et al. (1995) evaluated the efficacy of mussels (*Perna* spp.), sea urchins, cattle hocks, animal gut and diesel oil as bait for trap fishery and concluded that mussel is the best bait for lobster traps. But due to the discontinuous availability of mussels, diesel oil is a cheaper alternative.

Varghese et al. (2008) found shrimp heads as the commonly used bait in traps along the coast of the Gulf of Mannar. It was reported that when jellyfish were used as bait, more *Siganus* spp. were caught. According to the present study, the most common bait used for traps is brown mussels and clupeid fishes in Enayam-Kadiyapattinam coastal belt. Whereas, shrimp peelings are commonly used in traps operated along the Gulf of Mannar and Palk Bay of Tamil Nadu. Poultry waste and trash fish are the major bait used in traps operated along the Maharashtra and Goa coasts.

Studies on artificial bait for the trap in India are limited. Karunanithi et al. (2018) developed and tested artificial bait for fishing traps. The formula-

tion was prepared by combining various percentages of tuna red meat and shrimp head powder. The field study with the new bait reported a significant increase in catch rate (38 No./five socking days/trap) over the conventionally used bait squid meat (17 No./five socking days/trap) and sardine (23 No./five socking days/trap).

Catch per Unit Effort (CPUE) and Catch composition

In 1954, Prabhu reported annual fish landing by traps in the Gulf of Mannar and Palk Bay as 10.45 t and 36.83 t, respectively. Mohan (1985) reported more than 25 species from the same site where the majority of the fishery is contributed by three species *viz., L. nebulosus* (45 %), *Siganus canaliculatus* (26.2 %) and *S. ghobban* (10 %). In the same study, a comparison on the average monthly catch, from fishery of Palk Bay and Keelakarai, were made. It was found that species diversity was less in Palk Bay due to the increase in the number of prawn peeling plants and availability of new bait. The catch rate from Keelakarai was 10.5 kg trap^{-1} per month and 2844 kg per month while it was 8.5 kg trap^{-1}per month and 1329 kg per month in Palk Bay.

About 113 species of reef fishes belonging to 25 families were reported by Jayakumar et al. (2016) from various fishing gears of the Gulf of Mannar whereas Murugan & Durgekar (2008) reported 78 species of fish belonging to 18 families from the same region. Kalaiarasan et al. (2014) reported 56 species of fish belonging to 23 families and the peak season of trap fishing was from September to February and the top landed species were *Pomacentrus caeruleus, Amphiprion sebae* (Ornamentals) *Scarus* spp. and *Epinephalus* spp. (food species). The efficiency of modified Norwegian traps for marine ornamental and food fishes off the southeast coast of India was conducted by Kalaiarasan et al. (2015). The study reported 8 species of food fishes and 38 species of marine ornamental fishes belonging to 16 families. It was found that the dominant ornamental fishes were, Pomacentridae (31 %) followed by Chaetodontidae (26 %) whereas in food fishes *Siganus* spp., *Scarus* spp. and *Epinephelus* spp. which contributed to about 20 % of the total catch followed by *Lethirinus* spp. (14 %).

Varghese et al. (2017) reported average landing from the trap fishery along Keelakarai, Gulf of Mannar was around 109 t year^{-1}. The average catch per trap was recorded as 1.59 kg which was the highest catch data recorded from this region. Siganidae, Scaridae, Lethrinidae, Serranidae, and Mullidae were the major fishes that landed during the study in which *S. canaliculatus* contributing 28 % followed by *Scarus ghobban* (21 %). Murugan & Durgekar (2008) reported that 92 fish species were recorded from traps employed in the Gulf of Mannar group of Islands, which included non-target species from 19 families. The food fish comprised 29 species from eight families whereas 63 species were considered as bycatch. The study also noted that the highest species diversity in food fish was recorded during the post-monsoon period. Parrot fish (Scaridae) and rabbitfish (Siganidae) were the major catch during that season. While Groupers (Serranidae), goatfish (Mullidae) and emperor fish (Lethrinidae) dominated with high biomass during the monsoon period.

Beenamol et al. (2017) reported an organized trap fishery along the Enayam coast of Tamil Nadu, which lasts for seven months from October to April. Lutjanida, Scaridae, and Siganidae were the major families that dominated throughout the season. An interesting observation was the high landings of Siganidae species during October to January and total absence during summer. Month-wise catch data reveals that more than 50 % of the catch was during November and December.

Rajan et al. (1988) conducted experimental trap fishing to compare the efficiency of newly developed designs with the traditional designs in two locations on the Tamil Nadu coast. The average catch rate of traditional traps from Kadiapatnam and Enayam were 0.7 and 0.5 lobster trap^{-1} respectively, whereas the catch rate of the newly developed traps from the same locations was 4.0 and 1.6 lobster trap^{-1}. Prajith et al. (2015) conducted field trials with modified gargoor fish traps in Veraval coast, Gujarat around the open sea cage culture farms. The major catch reported were demersal fishes and crabs.

Conclusion

In many countries there is well organised commercial fishing using moder traps. In India, Pots and traps are operated by traditional fishermen and there is no report of mechanized or commercialised trap fishing. There is enormous scope for modernizing the traditional fish traps with the most efficient designs and durable gear materials. For this traditional trapping devices need to be documented

properly. There are several locations in India, which are suitable for coastal trap fishing. Untapped areas which are not accessible for other fishing gear should be documented and organized trap fishing need to be promoted with modern traps.

There is a need for proper documentation of trap fish landing in the country. Even though the quantity is negligible compared to the landing from other fishing systems, proper documentation and a database of trap fishery are required. It should also reflect in the total fishery statistics of the country. Ghost fishing is one of the most discussed impacts of trap fishing, which is caused by derelict fishing traps lost during operations. The contribution of trap fishing to ghost fishing and technological measures to reduce ghost fishing needs further investigation

In India presently, there are no policy regulations and guidelines for trap fishing. A standard guideline is required on the operational aspect, mesh size, use of juvenile escapement devices, etc. India still follow the old age trap fishing practices. The sector needs technological updates with proper training and awareness programs. In recent years, small-scale and energy-efficient fishing practices are getting more attention. In this context, to make fishing more selective and ecologically sustainable, fishing methods like trap/pot fishing need to be popularized and promoted.

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Table 1. Catch details reported from fishing pots and traps of Indian waters by various researchers

Sl. No.	Catch rate	Region	Remarks	References
1	10.45-36.83 t/Year 0.3 kg/trap/day	Gulf of Mannar & Palk bay	Studies on trap-caught perch fishery	Prabhu (1954)
2	10.5 kg/Trap/Month 2844 kg/Month; 0.48 kg/trap/day	Keelankarai	Studies on changing catch trends in the traditional	Mohan (1985)
3	8.5 kg/Trap/Month 1329 kg/Month 0.34 kg/trap/day	Palk bay	Trap-fishery of Keelakarai and Rameswaram	Mohan (1985)
4	3.8-8.2 kg/ trap/Month	Gulf of Mannar	Data from July 2011 to June 2012	Murugan et al., 2014
5	109 t/Year	Gulf of Mannar	Studied trap fishery for 6 years	Varghese et al., 2017
6	1568-11823 kg/ month/1225 trap socking days	Enayam, Tamil Nadu	Study conducted for seven months, from October 2013 to April-2014	Beenamol et al., 2017
7	0.5-0.7 kg lobster /traditional trap 1.6-4.0 lobster / newly developed trap.	Kadiapatnam and Enayam, Tamil Nadu	Compared efficacy of newly developed design and traditional design	Rajan et al., 1988

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