Recent developments in trap fishing: design and materials

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Introduction

Advancements in fishing technology, modernization and increased fleet size had detrimental impacts on the fish stocks and ecosystem which resulted in the over-exploitation of fishery resources. It is essential to ensure that the resources are utilized sustainably and responsibly through the adoption of national and international policies and programs. The main objective of responsible fishing is maximizing economic returns to the fishermen without affecting the long-term sustainability of the fishery resources and with minimum impact on the ecosystem. Technologies for responsible fishing are generally oriented towards the optimization of fishing fleet, implementation of closed fishing season to rejuvenate the depleted fish stocks, reduction of by-catch of non-target species, protected species and juveniles, minimise the environmental impact of fishing gear and their operation and minimizing the energy use per unit volume of fish landed, during fishing operation.

The concepts of ideal fishing gear ensure sustainable and responsible fisheries. Ideal fishing gear is a device which is 100% effective in catching target species with high selectivity. It captures targeted species over a particular size within its operating area while excluding all other non-targeted species. Also, it consumes less fuel for its operation. However, needless to say, this ideal is rarely met (Pravin et al., 2011) and there is no perfect fishing gear which can be said to be ideal for fishing. By examining characteristics like species-selectivity, size-selectivity, catch ability of target species, low interaction with environment, catch per unit of effort, fuel etc. Traps satisfy most of the characteristics required for an ideal fishing gear.

Pots and traps are gears which make the entry of the aquatic species easy and make the escapement difficult due to special designs. The parts of traps which prevent the escapement may be chambers, flaps, narrow paths, funnels etc. Enormous designs of pots and traps exist throughout the world. Based on the abiotic and biotic factors, pots and traps differ regionally in size, design, operation etc.

Pots and traps

According to Foos and Agricultural Organization, traps are large structures fixed to the shore. Pots are smaller, movable traps, enclosed baskets or boxes which are deployed from any craft. In India, the usage of “Pot” is not very common and the fish trapping devices are generally termed as “Traps”. Traps are generally operated in areas where other types of fishing gear cannot be operated due to uneven bottom or submerged obstacles. The advantages of trap fishing are

- Trap fishing is economic and low energy is required when compared to active fishing methods. They are highly fuel efficient both in terms of f returns and biomass per unit of fuel consumed (Wilimovsky and Alverson, 1971, Mohan Rajan, 1993).

- Organisms caught in the trap can be retrieved alive in an undamaged condition
- Traps can fish continuously day and night and require only periodical tending (Pravin et al., 2011)
- They can be left in the sea during unfavourable weather conditions and can be collected when favourable conditions set-in.
- Capital investment is relatively low and many traps show a high degree of selectivity.

Mechanism & Type of Fish Trapping

In India, based on the area of operation, pots and traps are classified mainly into pots and traps of the marine and inland sectors. The inland traps and pots are very common and popular throughout the country. Even though various marine fish traps are operated for livelihood subsistence, organized marine trap fishing exists only on the Southern coast of the country, especially in Tamil Nadu. Depending on the level of modernisation, traps are also classified into traditional traps and modern traps. Plunge baskets, box traps, filter traps, aproned filter traps screen barrier, bamboo screen barrier, net barrier, *Chemballi koodu, chevu*, Kalava traps, lobster traps, crab traps etc are some of the example for the traditional trapping systems (Remesan, 2006, Remesan and Ramachandran, 2008).

Targeted species

Most of the fishes, crustaceans and cephalopods can be caught with traps and pots. The catch rate of the trap fishing depends on the distribution and assemblage of the targeted species in the fishing ground also the behaviour of the fishes. In India,, shallow-water reef and estuarine fish and shellfish are commonly caught with traps and pots, Most pots and traps used in the tropics have been designed for fishing in reefs, rocky areas and on the rough bottom. The fish, cephalopods and crustaceans taken include snappers, emperors, groupers, parrot fish, surgeon fish, squirrelfish, angelfish, tropical rock lobsters and others. Pot fishery is widespread in mangrove creeks and estuarine areas for various crabs (mud crabs, swimmer crabs, spanner crabs, etc.), adult prawns (giant freshwater prawn) and a number of offshore shrimps. Various types of squid and octopus are also trapped in most tropical waters

Factors considered during the fabrication of fish traps.

The cost for material and the charge for fabrication of fishing traps should be made minimal, by using locally and easily available materials. The material used for the construction should be durable and should be able to withstand the physical stress of the fishing environment. If the traps are for marine use, the material used should be sturdy in sea water or it should be coated or treated with suitable anti corrosion agent. By using biodegradable materials, ghost fishing can be prevented in the event of losing the trap during operation. The design should be simple and easy to set and haul. The gear should be easy to carry in the vessel and should not have any complex structures, projections or attachments. The catch quantity can be improved by using more number of traps. For this stackability of the gear plays an important role. If the traps are of light weight and collapsible, more number of gear can be accommodated in boat or

vessel. The design should be selected based on the biological characteristics of the targeted species like morphology, feeding and swimming behavior, niche etc.

Parts of a typical fishing trap

A typical fish trap consists of the following parts

Main frame skeleton (rib): frames are the main skeleton or ribs of trap. Usually strong materials prevent the traps and pots from losing their shape during fishing. Wood, bamboo or metal are the commonly used materials for the fabrication of main ribs,

The outer covering: This part may be with bamboo slits, synthetic meshes or metallic webbings. In traditional pots, coconut or palms leaves are used. The selection of material is mainly based on the traditional usage, cost and availability.

Funnel (entrance): funnel or entrance is the major part of a trap. These are the entrance to the trap. The number of funnel varies depending on the design of the trap. The entrance may be single or multiple. Studies show that more number of funnel increases the catching efficacy of the gear.

Door: Doors are referred to the catch collecting area**.** Some designs may be provided with, an area where the meshes can be opened and closed for collecting the catch

Escape gaps: An Escape vent ensures responsible fishing. These are the gates for the escapement of juveniles entering inside the gear (Fig 1). Escape gaps are common in lobster traps in many parts of the world, but not in India.

Bait area: normally bait will be provided in the trap to attract the fishes. Bait will be fixed in the main chamber of the trap with suitable bait bags or chambers. Small pelagic fishes, slaughter house waste and small animals are commonly used as bait for attracting the fishes. Even artificially formulated bait can be used in traps.

Ballast: In the area with higher tidal flow or current, suitable weights need to be provided in the traps to prevent losing of traps. Ballast are normally used in the traps constructed with light weight material. Ballast also helps to maintain the original posture of the traps during operation.

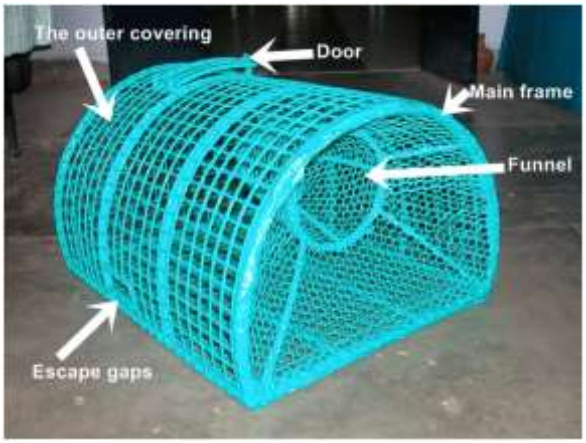

Fig 1. Modern lobster trap (ICAR-CIFT Design)

Operation of traps

Before operating traps, we should have some basic idea on the type of targeted fish, bait, post-harvest handling, storage of catch and market for the harvest. (Slack-Smit, 2001). Simple trapping and potting can be carried out from small boats or canoes or from large vessels. The efficiency of fishing with pots or traps can be improved by the use of equipment like power winches, haulers etc. Once the fishing grounds are fixed, traps can be setup at any time of a day.

Buoys or floats are normally attached to mark the location of the traps. There will be a buoy line attached to the traps/pots for the operation. Proper rigging is essential for the successful operation of the gear. The type and size of the buoy and the length of the buoy line varies based on the area of operation. Normally the length of float line is kept as one and half to twice the water depth of the fishing ground. The length of the line can be increased if the water current is higher at the fishing site. Bright coloured flags, radar, reflectors and even radio beacons are used in advanced trap designs for easy identification. Traps can be operated as single or in series (Slack-Smit, 2001).

Traps and pots can be operated with or without bait. In the case of habitat traps, there will not be provision for the bait attaching area. Funnel shape and positioning of the bait play important role in catch rate. Normally, centre of the traps is the ideal location for attaching the bait. The position of the bait can be optimised by fishers by continuous trial and error method. Depending upon the targeted species, waste from poultry slaughter house, fish and shrimp waste, molluscan meat, wheat flour mix etc can be used as bait. Quality of a good bait include effectiveness to attract targeted species, easy to attach in the gear, long lasting, local availability, low cost etc.

Soaking time also depends on the targeted species and its behaviour. It also depends on the species abundance at the fishing ground. Soaking time varies from few minutes to two to three days while 12- 24 hours is ideal soaking time. After suitable soaking time, traps can be hauled onboard. This can be done either by hand or by mechanical hauler. After collecting the catch, re-baiting can be done and traps can be deployed again in the same or different location.

Material used for trap fabrication

Almost four decades ago, fishing trips were fabricated using natural materials only. A study by Meenakumari and Mohan Rajan (1985) reported that lobster traps were 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. Mohan Rajan et al. (1988) developed an efficient trap for lobster fishing. The semi-cylindrical traps used were a modified version of an Australian pot with a frame of rectangular base and semi-circular ribs. These plastic-coated metal traps are more efficient than traditional traps. The life of the new traps was reported as 5-6 years.

The trap operated for spiny lobster in the southwest of India is known as 'Colachel traps', these traps are traditionally 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 with biodegradable materials which have less durability and life in the sea. In this region, traps were typically consisting of a bamboo, wooden, or steel frame covered with chicken wire with a mesh size ranging from 2–5 cm (Meenakumari and Mohan Rajan, 1985). Colachel traps don't have much popularity in the other part of the country because the construction technique of these traps was known to only a few fishermen in this region (Mohan Rajan et al., 1988). A recent 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 (Beena mol et al., 2017).

Prabhu (1954) made a detailed investigation on the trap-based perch fishery of the Gulf of Mannar and Palk Bay. He recorded that the traps were made out of split branches of *Acacia planifrons*, thin bamboo strips, and midribs of palmyra leaves and operated in soft sandy (Gulf of Mannar) bottom and hard rocky (Palk Bay) bottom. Prior to the construction of traps, the materials are soaked in water to increase their strength and durability. Similarly, Varghese et al. (2008) also surveyed on materials used for the fabrication of traps. They recorded four types of natural materials such as Odai tree sticks, Eeecha tree sticks, Palmyrah roots, and Palmyrah leaves, 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 (*Acacia planifrons*) usually last for 1 year and those of the Eeecha tree last for about 2 months. After assessing the cost of construction and efficiency of fishing in terms of size and quantity, Kalaiarasan et al. (2014) reported the use of tree sticks of *Acacia planifrons*, roots of *Phoneic dactylifera* and leaves of *Borassus flabellifer* for the fabrication of traps. However, in recent years a noted a major change in the materials used for trap fabrication. Polyvinyl chloride (PVC) nylon 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.

Ghost fishing in the trap sector

Due to bad weather conditions, gear conflicts, the physical condition of the fishing ground, entangling of large marine animals etc., there will be a chance to lose or abandon the fishing gear during operation. These lost or discarded fishing gear which are no longer under a fisherman's control known as derelict fishing gear (DFG), can continue to trap and kill fish, crustaceans, marine mammals, sea turtles, and seabirds. The most common types of DFG to ghost fish are gillnets and pots/traps. Ghost fishing can impose a variety of harmful impacts, including the ability to kill target and non-target organisms, including endangered and protected species; causing damage to underwater habitats such as coral reefs and benthic fauna; and contributing to marine pollution (NOAA, 2015). To prevent ghost fishing in trap fisheries, the following steps can be adopted.

- Using proper ballast and anchoring mechanism
- Always operate traps in good weather conditions

- During unfavourable conditions, remove traps from the fishing ground
- Select a suitable site for the installation of traps
- Always provide an escape vent or escaping mechanism in the design.
- Use of biodegradable meshes in specific locations

Conclusion

Traps are highly energy efficient low-cost fishing gears with high size selectivity. Trapping allows some control over the species and sizes of the catch. The trap entrance, or funnel, can be regulated to control the size of fish that enter. Fresh and live catch ensure premium prices to the fishers. Once the traps are set, the fishers can operate other gear or engage in other works to increase their income. In the context of energy conservation and responsible fishing techniques, trap fishing in the artisanal sector needs to be promoted.

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