Resource and energy conservations measures in fishing gears

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Introduction

Due to various factors like climate change induced water quality issues, excess fishing capacity, over exploitation and IUU fishing, fishery resources are declining. Several species were disappeared in the fish landing during the past few decades, especially in the coastal waters. As a result, to make the fishery economically viable mechanised sectors started catching everything across the depth zones with high powered vessels and large sized fishing implements resulting in huge quantity of bycatch in the landings. Conservation of fishery resources is very important as the demand for fish for human consumption and fishmeal is increasing. To sustain the fish production in the present level resource conservation measures, need to be implemented urgently. Though the statistics is showing an increasing trend in the marine capture fish production, it may not be sustainable as IUU fishing is contributing significantly in the marine fish landings as reported by FAO and the bycatch and discards issue is continuing in the world fisheries.

Resource conservation measures

Excess fishing capacity leading to over fishing is a big challenge in world fisheries. Number of vessels, their size, engine power and fish hold size are much more than the actual requirement. Similarly, the dimensions of the fishing gears have been increased to several folds corresponding with the vessel size. Large sized vessel and gear and industrial fishing practices had negative impact on fishery resources, which are either touched or already crossed the maximum sustainable yield in many fisheries.

Ways to control and manage fishing capacity (FAO; 2001)

- Input control: moratorium for new vessels
- Output control-catch limit
- Fleet size regulation based on total allowable catch
- Regulated access based on licensing
- Buyback programs
- Gear and vessel restrictions
- Area and time (fishing ban) based restrictions on fishing- MPAs/ sanctuaries
- Followed by mesh regulation,
- minimum landing size,
- Ban on destructive fishing,
- Restructuring/diversification of fishing effort to under exploited areas

- Conversion of destructive fishing methods to selective fishing
- Regulation on gear dimensions
- Regulations on bycatch & discards

Mesh size regulation

Selectivity of fishing gears mostly depends on the mesh sizes and shapes. Small mesh size fishing gears usually catch variety of species including juveniles. Mesh shapes and sizes prescribed in the Fisheries Regulation Acts should be implemented properly. Endangered Threatened and Protected species are landed in trawls, gillnets, lines and purse seines. Appropriate bycatch reduction devices (BRDs) need to be implemented to conserve biodiversity. Minimum Legal Size fixed for the landings of commercially important species are another measure to control juvenile fishery.

Energy Efficiency of Trawl Systems

Trawling is the most energy intensive fishing method. Globally 50 billion litres of diesel is burnt by the fishing fleet annually. In India 1378.8 million litres of diesel was burnt in 2010 and released about 3.13 million tonnes of CO_2.To catch 1kg of fish trawling requires 0.8kg fuel, gillnetting 0.15kg, long lining 0.25kg and purse seining 0.07kg (Gulbradson, 1986). Drag is the most important factor responsible for fuel consumption of active gears like trawls. Estimated drag of commercial trawls in Kerala ranges from 1.37 to 48.94 kN

Factors affecting trawl drags are

- design of the vessel,
- engine power
- speed of propulsion
- type and size of fishing gear and accessories
- location of the ground
- skill and knowledge of the crew
- atmospheric and sea conditions.
- design of trawl net,rigging and operating conditions
- depth of operation, type and length of warp, etc.

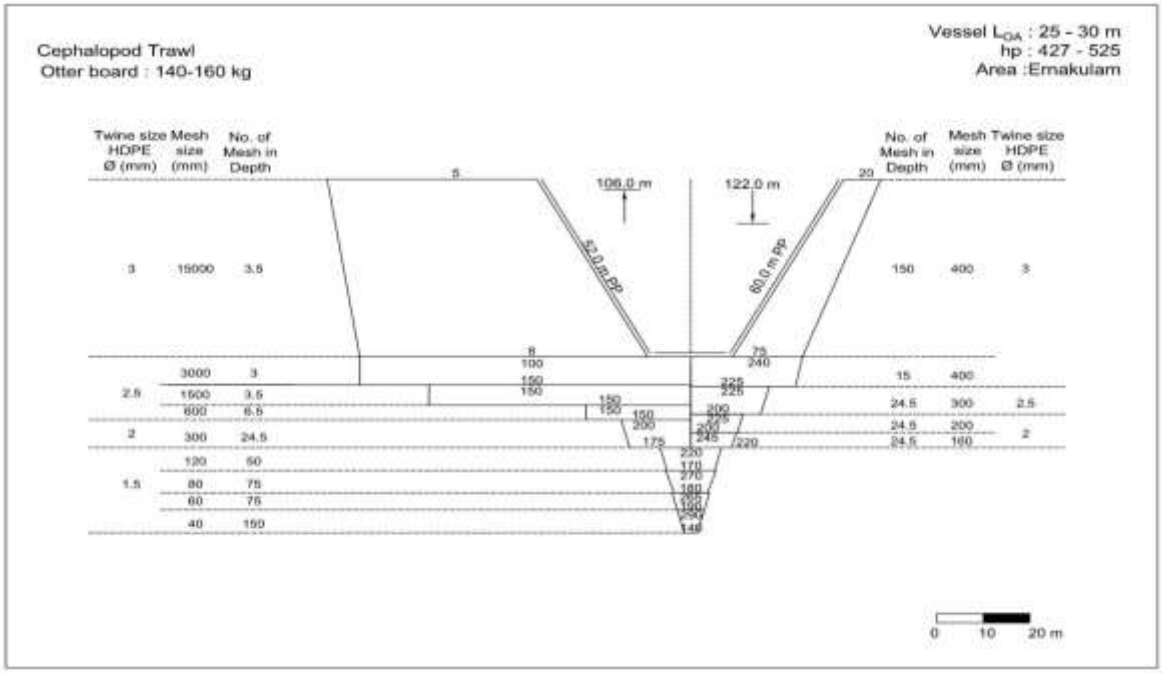
Factors to reduce trawl drag	**Reduction in drag (%)**
Operate multi-rig trawls	25-30
Use thinner twine for trawls	7.0
Use large meshes in the front	7.0
Use knotless netting	7.0
Use curved otter boards (OBs)	4.0
Use optimal angle of attack for OBs	4.0

Use slotted OBs 2.0

Low drag trawls developed at CIFT

Large mesh trawl

ICAR-CIFT introduced large mesh trawls in 1970s at Veraval in Gujarat for conservation of the resources and reduce the trawl drag for energy saving. The concept was well appreciated by the trawl operators in the country and fish trawls with mesh size up to 5000mm in the wing are common at present (Figure1) (Edwin, et al., 2014).



Design of a large mesh trawl from Cochin

UHMWPE trawls

Ultra-high molecular weight polyethylene (UHMWPE) twine is a strong material, which is being used for net making. A study by CIFT revealed that average fuel consumption of HDPE trawls was 31.86±1.25 l-h whereas it was 25.31±1.38 l-h for UHMWPE trawl. Results shows that material substitution, coupled with improvement in trawl design, appropriate gear accessories and towing speed can help significantly in reducing the drag and concurrent reduction in fuel use.

Particulars	UHMWPE trawl	HDPE trawl
Head rope length	24.0 m	24.0 m
Weight of netting	8.0 kg	14.48 kg
Twine size	1, 0.85, 0.75 mm	2, 1.5, 1.25 mm
Drag of the trawl	12.6 kN	14.83 kN
Fuel consumption	26 liter/h	30 liters/h
Cost for a net	Rs. 48,609.0	Rs.17,264.0

Expected life	2year	1year
Reduction in av. annual operational expenditure	7.5%	

Semi-pelagic trawl

Semi-pelagic trawl system was developed as an alternative to shrimp trawling and it reduce the trawling impact on benthic ecosystem as it is operated 1-1.5m above the sea bottom. High aspect ratio Suberkrub otter boards are used for better opening of the net. Shoes of these boards periodically only touch the bottom and front weights or depressors are used for vertical opening. The trawl system is selective, resource friendly and energy efficient

44 m Cut away top belly shrimp trawl

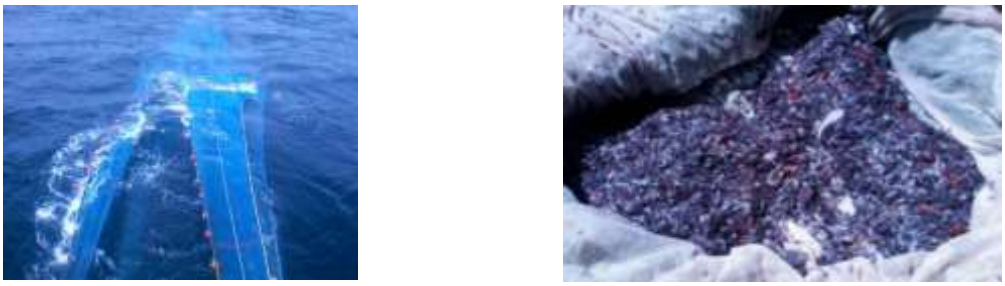
This trawl is without overhang and top belly is partially removed to reduce the drag without affecting the catch of shrimps. Better swimming fishes can swim up from the front of approaching trawl thereby bycatch quantity is also less. Due to less twine area energy efficiency of the trawl is improved.

27m Short body shrimp trawl

The length of the trawl body has been reduced by increasing the taper ratio to reduce drag. Vertical opening of the mouth has been reduced to eliminate bycatch by reducing number of floats in the head rope. The relatively better swimming ability of finfishes compared to shrimps help them to counter the short and lower vertical height of trawl and swim out of the net. Because of the larger horizontal spread of the trawl mouth, the effective sweep area is more, which is an important requirement for an efficient shrimp trawl.

Trawling for mesopelagics

Mesopelagic community consists of myctophids, salps, jellyfish, finfish, crustacean and cephalopods. Midwater trawl with a small mesh nylon net inner lining is required to retain the mesopelagics



Mesopelagic trawl operation and the net showing inner lining and catch

Gear accessories for resource and energy conservation

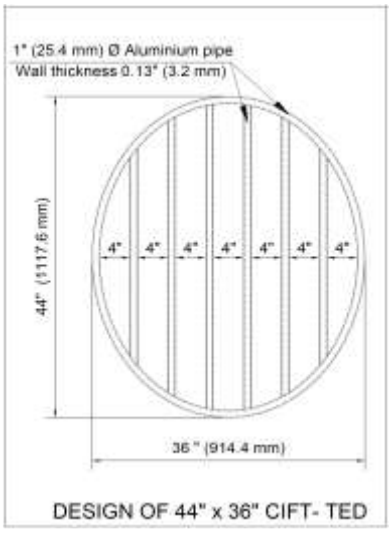
CIFT has popularised the v-form otter boards, which are stable and durable, and the performance, including trawl opening, was better. To reduce the drag of this otter board and conserve diesel CIFT has introduced the V-form double slotted bards (fig.8). Slots were made in the front part of body of otter boards to allow smooth flow of water through the boards to reduce drag and resultant fuel consumption. Compared to traditional v-form boards the slotted

otter board showed reduction in diesel consumption about 2-3 l/h. About 30% of the trawlers have already adopted this technology.

1500mmx 900mm (110kg) V-form double slotted otter board

CIFT-TED

CIFT-TED was introduced to protect turtles from shrimp trawls and minimise fish catch loss. Trials revealed 100% exclusion of turtles with a catch loss of 0.19% for shrimp and 2.07% for non-shrimp components.

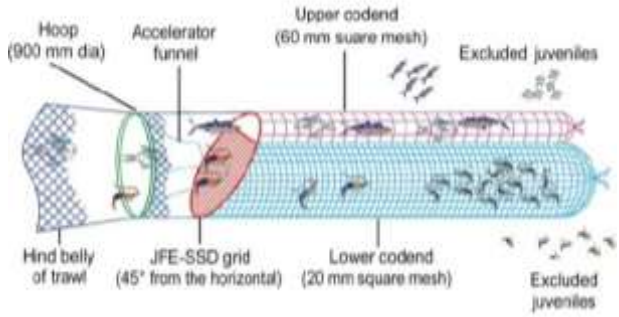


New grid of CIFT-TED

1200mmx1000mm Turtle Excluder Device

Juvenile Fish Excluder cum Shrimp Sorting Device (JFE-SSD)

It is a bycatch reduction device with an in situ sorting mechanism, which replaces the conventional codend in a trawl. The device was designed to catch shrimps and commercially important fish species using a specially designed oval sorting grid with appropriate bar spacing and dual codends. Juvenile fishes are eliminated though the 60mm upper square mesh codend.



Juvenile Fish Excluder cum Shrimp Sorting Device

Square mesh codend with base panel

It was developed to improve the selectivity of square mesh codend by introducing a square mesh panel at the base of the codend. In the very first field trail of one hour trawling off Cochin using the new codend onboard CIFT research vessel RV. Matsyakumari-II about 150 kg juveniles of *Decapterus russelli* could be excluded through the base panel.

Square mesh codend with base panel

Jellyfish Excluder Device

It is a hard BRD with a metallic oval grid with vertical bars having 50mm bar spacing and an exit hole and flap cover like a TED.

Jellyfish Excluder Device

Bycatch reduction measures for long line fishing

Sea birds & turtles are hooked accidentally. Area, time, and depth to be more or less selective to certain spp. Use weights to ensure the lines sink quickly to avoid birds. Setting the lines during night reduce mortality of birds. Dying of bait, Bird scaring line, Underwater bait setting device are other options to reduce mortality of birds.

BRDs for bag net

Square mesh window fixed in stationary bag nets and bycatch from bag net

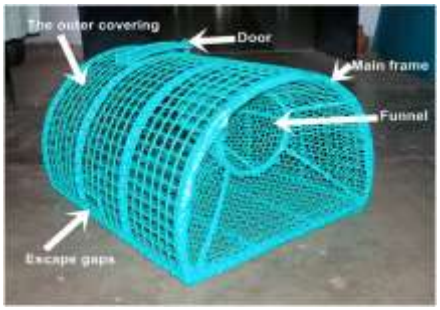
Rescue of dolphins in purse seines

Backdown procedure

The backdown occurs after most of the net is on board. At this point net retrieval is stopped, the net is tied to the vessel and the engine is put into reverse. This creates a water current that causes the remaining net to form a long channel in the water. The water current pulls the end of the channel underwater, with the corkline sinking a few meters, thereby providing an area for dolphins to escape (dolphins remain close to the surface while the tunas are lower in the net The **Medina Panel**, or dolphin safety panel, is a section of small-meshed webbing (net liner) at the apex of the net, which helps keep the dolphins from entanglement. It helps to increase resistance to the water flow and increase sinking of the corkline. DWN is operated in Kerala, India during March to May to protect ring seines from dolphin bite. While hauling DWN encircles the original net and prevents dolphins approaching the bunt with catch

CIFT-Collapsible fish trap for estuarine fishing

CIFT-Collapsible fish trap



CIFT lobster trap

Conclusion:

Responsible fishing gears and practices are promoted globally for resource and energy conservation, reducing the emission of greenhouse gases, minimizing the impacts of climate change and sustainable fisheries for food, employment and income for our survival. Let us together protect the natural resources.