Low drag trawls for fuel saving

Sayana K.A., Remesan M.P. and Leela Edwin

ICAR-Central Institute of Fisheries Technology, Cochin

Fishing consumes 15 to 20 times more energy than it produces (Endal, 1980) and the average fuel consumption by the fishing industry is estimated at 15-21.5x10^6 t (Thomson, 1988). Increased use of fuel intensifies the carbon foot print and green house gas effect which leads to global warming, climate change, etc. Fuel consumption assumes prime importance to fishermen due to hike in operational costs apart from its environmental effects. According to Tyedemers *et al.* (2005), world fishery fuel consumption is 50 billion (5 x 10^9) liters. There is an 8% increase in the contribution of fuel cost to the total operating expenses within a period of two years (Anonymous, 2011). Annual fuel consumption of mechanized and motorized fishing sector of India is estimated to be 1220 million liters (Boopendranath, 2000) and about 60-80% of the operational cost is contributed by the cost of fuel consumed.

Trawling is the most energy-intensive fishing activity and trawlers are one among the most fuel consuming fishing systems. Compared to passive fishing methods like gillnetting and long lining, trawling consumes five times more fuel and it is 11 times more compared to purse seining. To catch one kilogram of fish, trawling requires 0.8 kg of fuel while gillnetting requires 0.15, long lining 0.25 and purse seining 0.07 kg (Gulbrandsen, 1986). The fuel consumption of trawlers which depends on installed engine horse power and duration of voyage constitute 45 to 75% of operational expenditure. The resistance offered by the gear has a high effect upon speed of vessel and fuel consumption.

Under the National Agricultural Science Funded (NASF) project on Green Fishing Systems for Tropical Seas (GFSTS), ICAR-Central Institute of Fisheries Technology (ICAR-CIFT) designed and fabricated low drag trawls for fish/shrimp of head rope length 24.47 m 33.0 m, respectively. The drag reduction measures included in the design are increased mesh size and new material (Fig. 2). The material used is ultra high molecular weight polyethylene (UHMWPE). As UHMWPE provides same strength at a lower diameter, the twine size was reduced which results in reduced twine area. For evaluation of new designs, trawl nets using conventional material, high density polyethylene (HDPE) is also fabricated and used as control. The experiments for evaluating the new design were conducted onboard M.V. Matsyakumari II.

Fig. 1. Warp tension meter in use

From the trials conducted, the average reduction in drag of new design is estimated to be 17%. The drag of control and experimental gears at different operational parameters was also analyzed and UHMWPE trawls showed lesser drag than HDPE trawls (Fig. 3). The average fuel consumption per hour of trawling for HDPE trawls is estimated to be 30 liters and for UHMWPE trawls 26 liters (Fig. 4). The average reduction in fuel consumption was found to be 10%. The fuel consumption per kilogram of fish captured was also estimated to be 2.9 liters for HDPE trawls and 1.9 liters for UHMWPE trawls with an average

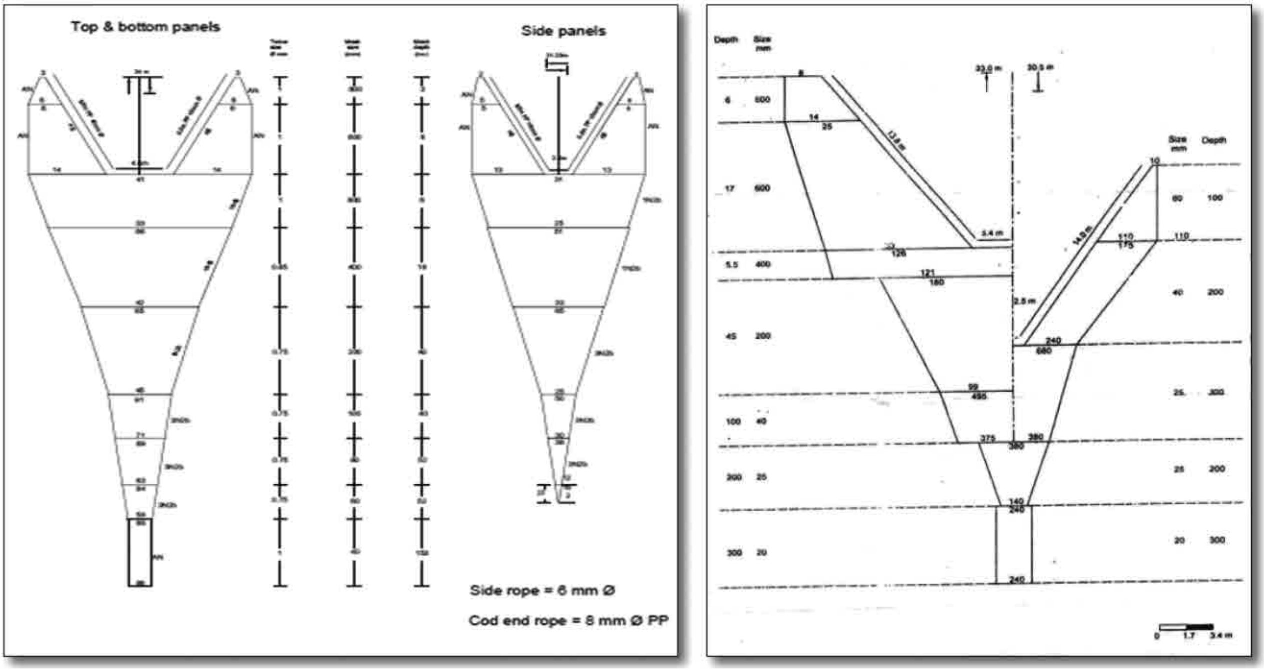

Fig. 2. Design of low drag trawls (24.47 m fish trawl and 33.0 m shrimp trawl)

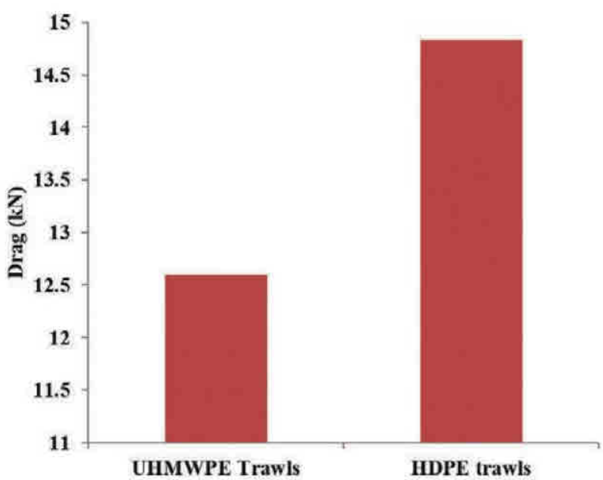

Fig. 3. Average drag of HDPE and UHMWPE trawls during one hour of trawling

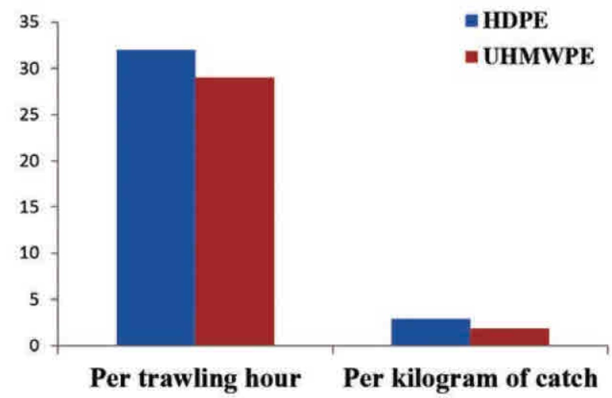

Fig. 4. Comparison of fuel consumption of conventional and low drag trawls

reduction of 35%.

As the name indicates, the drag and the fuel consumption of low drag trawls are 17% and 10% lower when compared to conventional HDPE trawls. Hence it is evident from the study that increased mesh size, reduced twine size and usage of energy saving material like UHMWPE will reduce the drag and thereby fuel consumption of trawlers considerably.

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Demonstration and operational efficiency of Off-Bottom Trawl System (OBTS): A new initiative in Goa by ICAR-CIFT

Chinnadurai S., [1]Sreekanth G.B., Renjith R.K. and Madhu V.R.

ICAR-Central Institute of Fisheries Technology, Cochin

[1]ICAR-Central Coastal Agricultural Research Institute, Goa

Fishing contributes significantly to the economy of Goa, where bottom trawling is widely practiced. Several reports on the adverse effects caused by demersal trawling is available (Smith *et al.*, 2000). The physical damage often caused by the gear on the sea bottom are highly detrimental to the bio-flora and fauna and it may take long time for recovery (Bijukumar and Deepthi, 2007; Gibinkumar *et al.*, 2012 and Bhagirathan *et al.*, 2014). Issues of bycatch in bottom trawling is also a major concern, especially in tropical countries like India due to the multispecies fishery (Velip and Rivonker, 2015). In this connection, ICAR-CIFT developed Off-Bottom Trawl System (OBTS), an ecofriendly trawl (Boopendranath *et al.*, 2011) capable of harvest of large demersal and semi-pelagic resources selectively with the aim to reduce bottom contact was demonstrated at Goa.

Experimental fishing trials of OBTS were conducted onboard a commercial trawler (S.F.X. Divine, L_{OA}-12 m, 120 hp) off-Chapora (Latitude 15° 36' and Longitude 73° 43') coast (Fig.1). Chapora is a major fishing ground for flat fishes and penaeid shrimps along the Goa coast. A 22 m, four seam OBTS having codend mesh size of 35 mm fitted with 65 kg suberkrub otter boards was used. Trawl operations were carried out in presence of trawl fishermen on 13 and 14 November 2016 along the coastal waters off-Chapora, Goa (Fig. 2). Five hauls of one hour duration each were conducted at depths ranging between 10 to 12 m. The haul-wise catch was quantified onboard and length and weight of individual species was recorded. Fourty one species of finfish and shellfish were identified in the catch of which 20 species belonged to demersal, 17 were pelagic species and two species of Molluscs and Crustaceans. Quantitatively, demersal, pelagic crustacean and Molluscan groups contributed 63.3%, 23.4%, 4.6% and 2.7%, respectively to the total catch. The count of commercial value (targeted) and low value bycatch (non-targeted) low value species belonging to pelagic fishes were 10 and 7, respectively. Similarly, for the demersal fishes it was recorded 10 species of each category. In the case of Crustacean and Molluscs, all the four species caught in the net were commercially important. The targeted commercial catch recorded for the OBTS was 70.3% and non-targeted low value catch was 29.7% of the total catch. There were no bottom dwelling organisms like shrimp, squilla and gastropods in the catch. Razorbelly scad (*Alepes kleinii*) formed the largest portion (19.1%) of the fish catch, followed by the yellowtail scad (*Atule mate*) and shrimp scad (*Alepes djedaba*) - 15.1% and 13.3%, respectively (Fig. 3).

The commercially important species like *Rastrelliger kanagurta* (1.5%), *Pampus argenteus* (2.2%), *Trichiurus lepturus* (2.2%),