Assessment of Economic Loss due to Use of Legal Codend Mesh in Multi-day Trawlers in Gujarat

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Introduction

The current trawling practices result in high exploitation of juveniles of all commercial and non-commercial species, in all maritime states of India (Najmudeen and Sathiadas, 2008). For example, the percentage of juveniles exploited by trawl can be as high as 20 to 60% in the case of seerfishes and groupers and as much as 12% in the case of squids (Mohamed *et al*., 2009a). In other words, there is substantial amount of growth overfishing taking place for all commercial stocks in the trawl fisheries of India. Growth overfishing occurs when too many small fish are harvested, usually because of excessive effort and poor selectivity of the gear (e.g. too small mesh sizes) and the fish are not given the time to grow to the size at which the maximum yield-per-recruit would be obtained from the stock. A reduction of fishing mortality on juveniles or their outright protection, would lead to an increase in yield as well as profits from the fishery.

In recent times, Gujarat state has witnessed the serious decline in catch and catch rates from trawlers. The catch in Veraval has declined from about 37,000 t in the year 2000 to 7500 t in 2004. Similarly, the catch per trawler has declined from 76 to 29 t annual during the past years. This alarming trend has been brought about by the uncontrolled increase in trawling effort and the systematic reduction in codend mesh sizes of trawl nets resulting in growth overfishing for the majority of large predatory fishes.

Although the Marine Fishing Regulation Acts (MFRAs) of maritime states have regulations on the codend mesh size of trawl nets (40 mm square mesh in the case of Gujarat), compliance to such regulatory measures are very poor. Multi-day trawl fishermen throughout the country carry more than half a dozen nets with codend mesh sizes varying from 10 to 40 mm. A recent study on compliance to CCRF of FAO and MFRAs and MCS measures by Indian maritime states indicates poor observance (Varkey *et al.*, 2006). This is detrimental to the long-term sustainability of the trawl fisheries, affecting the future of both the fishers and the seafood export industry. This is particularly important when many importing countries are insisting on sustainability certificates.

Many trawl fishers believe that, not catching the young ones of commercially important species ultimately results in this species becoming unavailable to them as they would migrate outside the present fishing areas (in the case of Gujarati trawl fishers, it is Pakistani waters). In reality, unlike the pelagic fishes, demersal fish stocks undertake only limited migrations. Most trawl fishers and fleet owners believe that using larger codend meshes would not be an economically viable proposition and would make their operations unviable. In the light of the above it can be easily realized that it is difficult to convince trawl fishers about the soundness and inevitability of following the MFRAs, particularly that pertaining to codend mesh sizes, unless it is demonstrated to them.

Therefore, in this study, 3 commercial trawl vessels fishing from Veraval and Porbander ports were operated for one fishing season using legal GMFRA (Gujarat Marine Fisheries Regulation Act) notified codend meshes with an objective of demonstrating the economic viability of such trawl operations as compared to the existing trawling practice using small meshes.

Materials and Methods

The vessels used were all wooden multi-day trawl units with L_{OA} of 16.5 m, having 8-10 tonne fish hold capacity and endurance of 15 days. Trawls were rigged with codend of 40 mm square mesh and a codend cover of 20 mm mesh in order to quantify the escapement through 40 mm meshes. Commercial trawls used for the observations included 21.6 m shrimp trawl, 57 m cuttlefish trawl and 86.5 m ribbonfish trawl with codend covers. Trawler fishermen were asked to operate the trawls as per their commercial interests. Enumerators participated in alternate trips

of the trawlers for data collection. The data logs used were trawl log sheet, biology log sheet and trawl economics log sheet.

All data were converted into worksheets in MS EXCEL format and standard mathematical computations were employed to arrive at catch per unit effort (CPUE; catch per haul in kg) for the whole fishing season for each vessel. These values were averaged for the 3 vessels to represent the overall picture. Other parameters computed were value realized per haul, value per kg, CPUE of escaped catch, value of escaped catch, CPUE of low value bycatch and value of low value bycatch. The CPUE and price data were also subject to one-way ANOVA to test for significant difference between hauls with trawls of 20 mm and 40 mm mesh codend. Statistical analysis was carried out using SPSS software. Data on operational costs of the vessel (diesel, lub oil, ice and ration) were consolidated month-wise and compared with revenue earned per month and finally an average profit per month value was derived.

Results and Discussion

Vessel operations

A total of 540 hauls were made during 25 fishing trips from October 2008 to May 2009 by the 3 trawlers. Maximum trips and hauls were made by the vessel 01P (MFV Yash Sagar, KR Seafoods, Porbandar). The vessel 01V (MFV Vijaydoot, Deepmala Seafoods, Veraval) operated as a gillnetter during the months of December-February. The number of fishing trips and hauls became less as the season progressed and in the month of May, fishing trips were not made. In total, 233 days at sea were spent by all 3 vessels and the average duration of a fishing trip was 9 days (range: 5-14 days). It was observed that the vessel 01P based from Porbandar mainly operated off Saurashtra coast and west of Gulf of Kachchh. While the vessels based at Veraval (01V and 02V) mainly operated off southern Saurashtra and northern Maharashtra, and in some months even up to Ratnagiri (Maharashtra).

Although vessel owners and operators agreed to use only the legal square mesh codend of 40 mm mesh size as per the MoU signed, it was observed that, in practice, operators of the vessels were very reluctant to use the prescribed mesh size. Instead, they mostly used 20 mm diamond mesh codend. Consequently, of the total hauls (482) only 23% (111) were done with 40 mm square mesh codend. However, this did not in any way affect the overall outcome of the study, and in fact, it enabled haul-wise comparisons.

CPUE Analysis

The analysis of CPUE data is presented in Table 1. The CPUE was higher in the 20 mm diamond mesh codend and the difference was on an average 10 kg (Fig. 1). Consequently, the price realized was also higher with a difference of Rs. 115/- (Table 1; Fig. 2). However, the unit price realized in hauls using trawl fitted with 40 mm square mesh codends was higher than that in hauls using trawls fitted with 20 mm diamond mesh codends by about Rs. 11 per kg (Table 1; Fig. 2). The average CPUE of low value bycatch in both 40 mm square mesh and 20 mm diamond mesh codend trawls were similar.

Table 1: Comparison of vessel-wise CPUE and price of catch, low value bycatch and excluded catch

Vessel	Codend	Catch kg.haul^{-1}	Price realized, Rs.	Price per kg, Rs.	Excluded catch, kg.haul^{-1}	Price realised for excluded catch, Rs.	Low value bycatch, kg.haul^{-1}	Price realised for low value bycatch, Rs.
01P	40 mm	34.9	2431.7	69.7	7.0	12.9	30.5	66.6
	20 mm	51.2	2247.6	43.9	-	-	15.3	25.3
01V	40 mm	41.6	2095.1	50.4	5.4	12.1	8.3	24.1
	20 mm	32.3	1615.1	50.0	-	-	11.6	41.6
02V	40 mm	12.7	601.9	47.4	13.8	54.0	2.4	6.8
	20 mm	38.5	1801.4	46.8	-	-	13.9	31.6
Average	40 mm	31.8	1817.6	57.1	8.1	23.3	14.2	33.9
	20 mm	42.1	1932.9	45.9	-	-	14.0	31.1

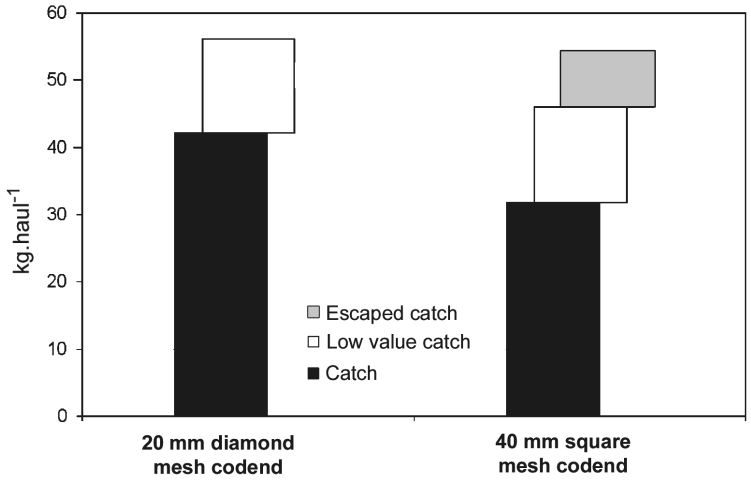

Fig. 1: Comparison of catch, low value catch and escaped catch retained in 20 mm diamond mesh and 40 mm square mesh codends

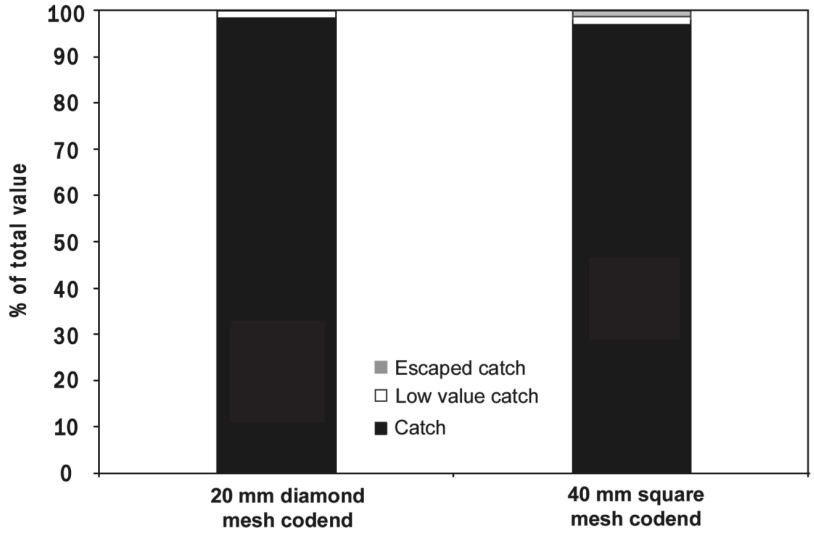

Fig. 2: Average price realised for catch, low value catch and escaped catch in 20 mm diamond mesh and 40 mm square mesh codends, as percentage of total value

The escaped catch varied from 5.4 to 13.8 kg per haul with an average of 8.1 kg per haul. This amounted to 20% of the average catch. The average loss per haul was estimated as Rs. 23.3 which is only 1.3% of the total value realized per haul. The results have clearly shown that the loss of revenue due to compliance to the legal mesh size is very small. Moreover, the difference in CPUE and price between 20 mm diamond mesh and 40 mm square mesh codend trawls were not significantly different ($P > 0.05$). A clear difference was observed in the unit value of fishes caught, with the 40 mm square mesh codend trawls consistently performing better in Porbandar as well as Veraval (Table 1).

Economics of vessel operations

The cost of monthly vessel operations and the revenue earned was subject to analysis and the results are shown in Table 2. The vessels economics could not be compared on the basis of 20 and 40 mm cod-end mesh sizes as the vessels operated both type of nets in all trips. In the month of January and April, the vessels operated on thin margins or on loss due to paucity of good catches. The main expense in operational costs was due to diesel (85%) and the remaining was on ice, others (water, ration, salt, wood kerosene etc) and lubricating oil. On an average (for all 3 vessels) the monthly profit was about Rs. 76,000 (Table 2). Since the loss in terms

of value of escaped catch was determined as 1.3% on account of using 40 mm square codend mesh, it is not expected to make any significant impact on vessel economics and overall profitability of operations.

Table 2: Details of operational costs, revenue earned and profit per month (Rs.) of vessels operated

Vessel		Monthly costs								Revenue per month	Profit per month
		Diesel	Ice	Oil	Others	Kerosene	Water	Ration	Total		
01P	Average	55509	4451	484	124	720	957	3000	63942	173374	109433
	Minimum	38400	3400	284	90	550	700	2500	46404	43060	-15956
	Maximum	72960	6000	710	180	900	1000	3500	81340	562886	516482
01V	Average	60536	4050	700	330	-	767	4233	69926	140362	70436
	Minimum	51324	3750	420	270	-	700	4000	60719	115230	38754
	Maximum	67116	4275	980	360	-	800	4500	76476	172195	111476
02V	Average	47263	3964	640	64	-	757	3657	55664	103808	48144
	Minimum	25709	1500	420	0	-	400	2000	29729	26295	-4499
	Maximum	78960	5625	700	240	-	1000	5000	89625	265212	175587

This study has very clearly brought out that the monetary loss that the Gujarat trawl fishers will have to suffer on account of using the legal 40 mm square mesh codend is insignificant. Among all maritime states in India, Gujarat is the only state which has stipulated 40 mm square mesh codend for trawls. Compliance to the legal mesh size in trawls is virtually non-existent in all maritime states of India. The use of legal mesh size would pave the way for certification of the fisheries as sustainable, a requirement which is being increasingly demanded by importers. However, compliance to FAO's CCRF, of which mesh size regulations are a part, is poor even in developed nations (Varkey *et al*., 2006). Fishermen are usually driven by short-term economic benefits and, from their point of view, it is necessary that a management action such as an increase in mesh size change should promise better catches or better catch value in the not-too-distant future (Laevastu and Favorite, 1988). The present study has shown that there is an increase in unit value of the catch due to use of 40 mm square mesh codend. In a study on the short and long term effects of an increase in trawl codend mesh size from 20 mm to 36 mm on catch weight and value per recruit and on the stock biomass of herring in the northern Baltic, Kuikka *et al.* (1996) concluded that magnitude of the estimated reduction in catch varied greatly with the growth and natural mortality of the population. The present study showed that though there was a reduction in the catch rates of hauls using 40 mm square mesh codend, it was not statistically significant when compared to the conventional 20 mm diamond mesh codend.

Bahamon *et al.* (2006) showed that for European hake, Norway lobster, poor cod and greater forkbeard, the square mesh showed a significantly higher mean selection length (L_{50}) than the diamond mesh codend. They suggested a substantial improvement in size-selectivity for these commercially important species, achieved by switching from 40 mm diamond mesh codend to a 40 mm square mesh codend. For hake, Norway lobster, poor cod and greater forkbeard populations Bahamon *et al.* (2007) suggest that immediately after implementing the selectivity measures, the yield-per-recruit (Y/R) would be reduced by 20% for the three fish species, but that after 5 years the Y/R would increase more than 50% if fishing effort were not changed. The above study also highlighted that significant long-term benefits could be obtained in the Catalan Sea by changing to 40 mm square mesh codends.

According to Suuronen *et al.* (2007), the adoption of a codend design that offered a modest increase in selectivity, and offers a good match with the legislated minimum landing size (MLS), leads to greater compliance. It was also obvious to them that, generally, the fishing industry did not tolerate large short-term losses. The evaluation of Suuronen *et al.* (2007) is that overly ambitious rules will be circumvented and frequent and incoherent changes in the regulations represent bad management practice. They conclude that a gradual introduction of restrictions and participation by fishers in the decision making process will increase compliance. Unmistakably, this is what is missing in the Indian fisheries management setting, with very little or virtually no consultation with stakeholders when framing rules and regulations. Long term benefits of mesh size changes are very difficult for fishers to comprehend and accept. Indeed, even demonstrating the long-term benefits and short-term losses does not make fishers convinced of the need for conservation and change (Mohamed *et al.,* 2009a), as field level extension work is poor and considerable awareness needs to be developed among fishers so as to move towards sustainable marine fisheries in India.

Conclusion

The study has shown that the loss in terms of value of escaped catch was only 1.3% on account of using legal 40 mm square mesh codend. This small difference is not expected to make any significant impact on vessel economics and overall profitability of operations. The use of legal mesh size would pave the way for eventual certification of the fisheries as sustainable, a requirement which is being increasingly demanded by importers.

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