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Trawl Gear Research in India

M. MUKUNDAN[1] and K. RADHALAKSHMY[2]
Central Institute of Fisheries Technology, Cochin 682 029

Demersal trawling is an important method of exploitation of bottom fish and shrimp resources. Among the fishing craft trawlers consume more fuel as the vessel and gear offer considerable resistance. Reduction in resistance can result in fuel saving and reduced fish production cost. Review of the trawl gear research carried out in India, with suggestions for future work is presented.

Key words: Gear research, future needs

Bottom trawling was employed in India for resource survey around 1900 (Chidambaram, 1952). But commercial trawling could not be introduced for many years due to lack of design details of the gear. With the establishment of Central Institute of Fisheries Technology in 1957, systematic research on fishing gear, particularly trawls, was carried out and documented. Trawling on commercial level commenced at Cochin during early sixties and spread to other parts of the country (Kuriyan, 1965). Empirical relationship between headrope length and horse power of the engine, belly width in relation to belly depth, length of jib and width of side wedge and, length of bosom for designing trawls were worked out by Miyamoto (1959) and, Nair and George (1964). Various designs were made available for operation from small trawlers of different sizes (Satyanarayana *et. al.*, 1962; Kuriyan *et. al.*, 1964). These designs include shrimp trawls for operation from small and medium class vessels. Miyamoto, (1959); Satyanarayana and Mukundan, (1963) and Nair *et. al.*, (1966) studied the relationship of warp length to different depths (scope ratio) and observed that the scope ratio can even go upto 8:1 for obtaining good results. Buoyancy/weight relation for bottom conduct in trawls was found to be 0.75 for better catch by Narayanappa and Satyanarayana (1973). For optimum results the depth of belly in shrimp trawls was found to be 40% of its length (Mhalathkar and Iyer, 1966; Mhalathkar and Jagatheesan, 1970). Studies on the effect of overhang and its optimum size in bulged belly trawl showed an overhang length of 1.5 m as optimum (Nair *et. al.*, 1971). The introduction of tickler chain (Deshpande and Sivan, 1962; Deshpande and George, 1965) enhanced the efficiency of shrimp trawl without adverse effect on fish catch (Deshpande and Kartha, 1967).

Trawl Spread

Horizontal spread

The horizontal spread between otter boards, the swept area and shrimp catch could be increased using sweep lines (Kuriyan, 1965; Satyanarayana and Narayanappa, 1972) Working on optimisation of bridle length Narayanappa (1968) and Mohanrajan *et. al.*

[1] 'Rasya', Cochin 682 020; [2] 'Kuttikat', Cochin 682 031

(1990) reported that bridle angle and mud cloud produced by the doors are the parameters that guide fish into the net. Satyanarayana *et. al.,* (1976) established that long-wing trawls are superior to short-wing trawls. Its efficiency has been compared at different locations (Pillai, *et. al.,* 1978; Kunjipalu *et. al.,* 1979; Mhalathkar *et. al.,* 1985) with trawls of different designs.

The lateral spread can also be increased by using suitable design of otter boards. Different types of otter boards like horizontal curved, oval single slitted and rectangular flat have been tested. The horizontal curved one has been found the most efficient (Mukundan *et. al.,* 1967; Deshpande *et. al.,* 1970). Pillai *et. al.* (1973) studied the effect of weight of otter boards on the horizontal opening of trawl nets to find out the optimum weight of otter boards that should be used for trawl gear for better efficiency. Satyanarayana *et. al.* (1978) observed better performance of V-Form door when compared with high aspect ratio cambered and low aspect ratio cambered (suberkrub) otter boards. V-Form offered less resistance and more spread and gave better catch compared to the other two (Kunjipalu *et. al.,* 1984).

Vertical Gape

Vertical opening is necessary for trawls to engulf bottom and off bottom forms. Nets rigged with gussets, gusset and kite, and gusset net with false headline could increase the vertical opening of trawl which resulted in more catch (Satyanarayana *et. al.,* 1970; Narayanappa *et. al.,* 1985)

Sail kite and flexible float

Sail kite and flexible floats have been employed to increase vertical opening. 25 m eight seam and 32m large mesh trawls rigged with sail kite caught more fish than the control nets (Boopendranath *et. al.,* 1986). Similar results were observed in 32 and 40 m trawl nets with flexible float and was found easy to rig and operate (Kunjipalu and Boopendranath, 1993).

New trawl design concepts

Two-seam trawls have poor flow pattern inside, choking and spilling of water at mouth, more resistance, swollen fore-body with rapid tapering and narrowing of aft belly (Hamuro, 1959). Four seam trawls are reported to be better than the two seam type (Perumal and Sreeram, 1962; Sreekrishna, 1970; Satyanarayana *et. al.,* 1972). Based on this a bulged belly four seam trawl was designed and tested. The new trawl was found more effective for catching shrimp and fish compared with the conventional trawl (Varghese *et. al.,* 1968). Multi-location comparative tests were made with this gear, both on the east and west coasts, to assess its efficiency (Pillai *et. al.,* 1979; Mhalathkar *et. al.,* 1985; Abbas *et. al.,* 1991; Rao *et. al.,* 1987). The Bay of Bengal Programme (BOBP) of FAO/SIDA made many modifications in trawl nets to deploy the existing shrimp trawls in Tamil Nadu (Pajot and Crocket, 1980; Pajot *et. al.,* 1982, 1983), Orisssa (Pajot and Mohapatra 1986) and Gujarat (Raja, 1983) for catching more fish.

Multi-seam and BOBP trawls

Fishing trials with six seam trawls (Deshpande *et. al.*, 1970; Kunjipalu *et. al.*, 1979), eight seam trawls (Kunjipalu *et. al.*, 1994) and large mesh trawls (Pillai *et. al.*, 1979) reduce trawl resistance without permitting fishes to escape through the fore parts of the trawl.

Long-wing, bulged belly and six seam trawls have been tested to ascertain suitable net and door combinations. Each net was rigged with rectangular and horizontal curved doors. Bulged belly trawl and flat door combination recorded better shrimp and fish catch (Mhalathkar *et. al.*, 1985). Kunjipalu *et. al.*, (1990) modified eight seam to a six seam, large mesh 25 m trawl and compared with a highly successful BOBP trawl, 25 m two seam and large mesh (Pajot and Crocket, 1980). Former net landed higher percentage of quality fishes. Nayak and Shesappa (1993) compared 28.6 m four seam large mesh trawl and 26.7 m high opening two seam trawl. The large mesh trawl registered less resistance; so also the calculated resistance for net alone.

Rope Trawl

Further extension of the large mesh concept is the use of ropes in the front region of the trawl thereby reducing the resistance without sacrificing fish herding effect. Catch efficiency of rope trawl and standardised bulged belly trawl, both of 25 m headline length has been evaluated. Rope trawl caught more fishes like silver belly, anchovy, sciaenids and pomfrets. The fuel consumption is also reported to be less (Rao and Narayanappa, 1994). A 35 m rope trawl operated from FORV Sagar Sampada, 71.5 m OAL and 2285 bhp, registered a catch of 395.6 kg/h (Rao *et. al.*, 1994).

Mesh selection

Satyanarayana (1965) studied the size groups in trawl catches. This was followed by escapement studies by Panicker and Sivan (1965) who recommended an increase of codend mesh size from 25.4 to 41.65 mm for capture of commercially dominant shrimp of size group above 80-85 mm. Diamond shaped netting is commonly used for trawl, inherent defect of which is stretching and narrowing of lumen during operation preventing easy fish escape. Another view is that when catch accumulates in codend, it bulges and mesh lumen opens and permits fish escapement. To permit effective fish passage through mesh it has to remain open. This condition can be achieved by the use of square mesh.

Codends with 30 and 40mm mesh were used to evaluate the escapement pattern (Kunjipalu *et. al.*, 1994). Comparative selection behaviour of diamond and square mesh of 20 mm has been studied by Varghese *et. al.* (1996) for four species of fish and two species of shrimp. The mean selection length was found greater for square mesh indicating its superiority for permitting escapement of juveniles.

Underwater measuring instruments

Sivadas *et. al.* (1982) developed instruments to measure different parameters like measuring angles of heel, tilt and attack, resistance, fore and aft of door, door and

wing spread. With these instruments Mukundan and Hameed (1995) studied the above parameters using two otter boards, low and high aspect ratio. High aspect ratio cambered door was found more efficient in terms of less drag and more shear force. Various indigenous electronic instruments to monitor the operational parameters of trawl in small and medium size vessels have been developed at Central Institute of Fisheries Technology (Anon, 1996).

Model studies

Model testing of fishing gear offer many advantages. Model test results can be projected to full scale and this result can be compared with the field tests. Perumal *et. al.* (1973) conducted a study with the model of a 31 m trawl and found model and full-scale test results comparable. Models of two nets 18.0 and 23.4 m were tested and values projected for the prototype nets (Baiju *et. al.*, 1995).

Trawl drag calculation

Trawl drag methods could be applied to evaluate performance of trawl and other conical net designs. This approach was not popular in India. Mukundan and Hameed (1995) calculated drag of different parts of three sizes of trawl nets. The results were comparable with the projected and measured values when the method of Kowalshi and Giannotti (1974) was applied while they were not comparable when calculated by the method of Dickson (1979). Few studies on models of trawls have been carried out, fewer still are the approach of calculation and measurement.

Future needs

- Model studies may be given due importance.
- Flume tank testing facility must be introduced in the country.
- Underwater instrumentation should be given stress and elaborate field tests conducted with the instruments already developed for making necessary modifications.
- Large mesh, six seam rope trawls should be studied extensively.
- Codend mesh selectivity studies may be extended to all commercially important species.
- Fish behaviour studies in relation to fishing gear and tactics may be taken up.

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