

Technological Adaptations in Gill Nets of Gujarat

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Increased competition in the fisheries sector coupled with diminishing returns has motivated Gujarat fishermen to adopt technological innovations in order to improve landings and the cost-effectiveness of fishing operations. Cheaper HDPE twisted monofilament gill net locally called as *jada jaal* has been adopted by some of the mechanised trawlers in Gujarat. Gill nets made of discarded polyamide multifilament from the tyre manufacturing industry locally known as *lal jaal* has been adopted for catching perches and it is either used as bottom set or as drift gill net. The fishermen of this coast have effectively adopted the coloured gill nets, introduced by Veraval Research Centre of CIFT in 1980s. At present, 80-85% of the netting used for gill nets in Saurashtra coast is coloured, the order of popularity being yellow, followed by blue, white and green. In view of the vast expansion of fishing effort in the state, particularly trawling, there is an urgent need to reassess the level of exploitation, in order to ensure sustainability of resources and promote ecofriendly and low energy fishing practices such as gillnetting. In the present paper, the authors have discussed innovations and adaptations which have taken place in gill net fabrication and operation, off Gujarat coast, in recent years. Suggestions for making indigenous gear more ecofriendly and cost-effective have been highlighted.

Key words : Gill net, technological adaptation, Gujarat

Gill nets are basically passive gear and their classification is based on their construction, depth of operation, species targeted and method of operation. They are very size-selective, provided appropriate mesh sizes are selected and used. Gill nets are one of the most prominent traditional gear of Gujarat accounting for about 25% of the total landings (Anon, 2002). Gill net design and operation are continuously being adapted by the fishermen of Saurashtra coast, over the years, to the changing fishery situations, for exploiting the available multi-species fishery, cost-effectively.

Gill net fisheries of Gujarat have been discussed by Sulochanan & Rao (1964), Panicker *et al.* (1978), Kunjipalu *et al.* (1984), Rajan (1988), Pillai (1989), Pillai *et al.* (1989), Sarvaiya (1991), Rajan *et al.* (1991), Manoharadoss *et al.* (1995) and Pravin *et al.* (1998). Motorisation and mechanization of fishing

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crafts, which began in 1950s, enabled fishermen of Gujarat operating gill nets, to carry more number of units and venture into deeper waters. The second major technological development was the use of synthetic materials for the gill net fabrication. About 40 to 60% of Gujarat fishermen had started using nylon and polyethylene as netting material, by 1960 (Pravin *et al.*, 1998). Today, almost all of the artisanal fishermen are using synthetic material.

After the introduction of synthetic fibres, several innovations and improvements have been tried in order to increase the efficiency of gill nets. Changes have also been seen in the techniques of handling and operation of these nets. The catch per boat of Saurashtra coast in recent years has drastically fallen due to the indiscriminate increase in trawling effort. The number of mechanized boats has increased from 314 in 1960-61 to 18536 in 2000-2001 (Anon, 2002). The marine fish production of 0.6 million t has been stagnant during last five years. However, over a thousand boats have been added to the fleet, every year, since 1981 (Anon, 2002). This has resulted in reduction in catch per boat. At present, it is observed that on an average, the daily landings of boats engaged in trawling from Veraval are 322 kg.boat⁻¹.day⁻¹. Due to the increased pressure exerted by the trawling industry, the catches of artisanal fishermen are getting meager from the inshore waters. This pressure, in turn, has driven them to deeper waters increasing their input on fuel. The technological adaptations and innovations by the fishermen of this region in construction and operation of gill nets are presented in this paper.

Large mesh gill nets (*Jada jaal*)

Jada jaal is large mesh gill net which in vernacular means thick net. This net has been in use for the last 15 to 20 years in Saurashtra coast. It is made up of thick blue coloured high density polyethylene twisted monofilament twines (Fig.1). In the beginning, fishermen were using large mesh sizes ranging from 200-300 mm for making nets meant for catching sharks in deeper waters (Manoharadoss *et al.*, 1995). Today, based on their experience, the fishermen have reduced the mesh size to 140-180 mm. Due to this change, it is observed that a variety of fishes are being caught by this net. The catches landed by *jada jal* include white pomfret, black pomfret, sharks, bill fishes, catfishes, large sciaenids, seerfishes, leather jackets, perches, Indian salmon, snappers, rock cods and hilsa.

This gear is operated throughout the year. Fishermen generally use it for daily trips and for trips lasting for two to three days. To get maximum returns nowadays with minimum investment, long trips are preferred by the fishermen. The crafts used are mostly FRP canoes with the size ranging from 9.1 to 13.3 m, fitted with with OBM or IBM engines. 4-5 fishermen go onboard and about 80-120 units are

operated at depths ranging from 20 to 80 m. During daily trips, gill nets are usually operated in the night and soaked for 10-12 h. The units are continuously operated, during multi-day trips.

Earlier, during monsoon, some of the trawlers used to carry 150-200 units of this net. The deck fittings of a trawler like the gallows, winch and the foremast were removed for easy handling of the gear. Today, many of the trawlers are opting to operate this gear throughout the year, as trawling is no longer profitable to them. They operate 200-300 units during multi-day trips of three to four days.

The fishermen of Madhavpur and Mangrol use large mesh nylon monofilament gill nets of twine size 0.6-0.8 mm dia locally known as *ek sada na jada jaal*. The mesh size of this net is between 120 and 140 mm and they are effectively used to catch sciaenids, polynemids, catfishes, seerfishes, etc.

Hathiya is another type of large mesh gill net effectively used for catching large oceanic species. It is either operated in the midwater or as drift or set gill nets at the sea bottom. It was earlier made of polyamide (PA) multifilament netting (Pravin *et al.*, 1998). Nowadays PA multifilament has been replaced by 1.5-2.5 mm dia polyethylene (PE) twisted monofilament mainly due to cost effectiveness. The technical details of the various types of large mesh gill net are furnished in Table 1.

Table 1. Details of large mesh gill nets (*Jada jaal*, *Hathiya*, *Ek sad na jada jaal*), operated off Gujarat

	<i>Jada jaal</i>	<i>Hathiya</i>	<i>Ek sad na jada jaal</i>
Netting material	PE twisted monofilament	PE twisted monofilament	PA monofilament
Twine size, mm	1.5-2.5	1.5-2.5	0.6-0.8
Mesh size, mm	120-180	350-400	120-140
Length, m	40-80	60-90	100-130
Hung depth, m	5-8	3-8	4-7
Floats	PVC; 60-70 mm dia	PVC; 60-70 mm dia	PVC; 50-60 mm dia
Sinkers	Concrete; 150 g	Concrete; 150 g	Concrete; 120 g
Depth of operation, m	>20	>40	>20
Fishing season	Throughout the year	September-May	Monsoon
Type of operation	Surface to bottom	Midwater; bottom set/drift	Bottom drifting
Catch landed	Catfishes, seerfishes, <i>ghol</i> , sharks, tuna, <i>dara</i> , leather jacket	Sharks, tuna, seerfishes, <i>ghol</i>	<i>Ghol</i> , <i>dara</i> , catfishes, seerfishes

As many trawlers are opting to operate large mesh gill nets throughout the year and ready-made nettings of suitable mesh sizes and twine sizes are available

locally, it would be appropriate to introduce simple powered gillnet haulers in order to save time and labour in the operation of the gear and to increase the fleet size for better returns.

Gill nets for rocky bottom (*Lal jaal*)

Lal jaal, which in vernacular means red net, due to the saffron colour of the material used for fabrication, is a bottom set gill net. This net has been in use in Saurashtra region for the last ten years. Earlier, tyre cords extracted from old and discarded tyres were used for its fabrication. The net was operated as bottom set, for catching spiny lobsters in rocky areas, generally during night time (Rajan & Mathai, 1988). Today, the fishermen use the discarded material sourced from the radial tyre industries for fabrication of this net. As the material is tough and cheap, it is suitable for gill nets operated in rocky areas. Earlier, the target species were mainly spiny lobsters. In recent years, in order to get good catches of perches and snappers, the mesh size has been increased to 120-150 mm from 85 mm reported earlier by Rajan & Mathai (1988). The prominent catch by this net are rock cods, sciaenids, *koth*, sharks, catfishes and lobsters. The technical details about this net are furnished in Table 2.

Table 2. Gill net for rocky bottom (*Lal jaal*) operated off Gujarat

Gear component	Specifications
Netting material	PA twisted continuous multifilament
Twine size	210dx1x2
Mesh size, mm	120-150
Length, m	40-80
Hung depth, m	12-15
Floats	PVC; 65 mm dia.
Sinkers	Concrete; 400 g
Depth of operation, m	10-25
Fishing season	Pre-monsoon and post-monsoon
Type of operation	Surface to bottom
Catch landed	Perches, rock cod, snappers, catfishes, <i>koth</i>

Coloured gillnets

The success of gillnet operation during the daytime has been known to depend on the visibility of netting underwater. Tamura (1959) has reported that young ones of *Sparus swinhonis* could detect nylon monofilament of 0.42 mm dia and had ability to perceive thinner nylon monofilament of 0.14 mm dia. Nomura (1959) described that activities of fish seem to be closely related to the degree of light underwater, and as the gill net is less visible in dark water, gill



Fig. 1. Large mesh gillnet (*jada jaal*) stowed at the Veraval fishing harbour



Fig. 2. Fleet of FRP gillnetters using yellow coloured gill nets, off Veraval

net fishing is considered to be more favourable at night than in the day. In his experiments with nine coloured nets, *viz.*, red, orange, yellow, blue, green, purple, white, grey and black, to determine their light reflection properties, he found out that at 50 m depth or deeper the reflective light energy of the different nets differ considerably, although the colours themselves are lost.

Kunjipalu *et al.* (1984) based on their studies on influence of colour of netting on the catch of gill nets, recommended yellow coloured netting for hilsa-pomfret gill nets, due to significant improvement of hilsa catches in yellow coloured nets. In recent years, yellow coloured PA multifilament gill nets for hilsa and pomfret have become very common in Saurashtra coast (Fig.2). By late 1980s coloured gill nets became very popular among fishermen and about 80-85% of the nettings used for gill nets in Saurashtra coast were coloured. Colour of netting, in the order of popularity, were yellow, blue, white and green (Rajan & Mathai, 1988). Saffron coloured tyre cord is successfully used in bottom gill nets, especially for rocky fishes and spiny lobsters. White, blue and green are common in PA monofilament and blue, green, orange, yellow and brown in twisted PE monofilament nets. Today among all the colours, the yellow coloured gill nets have been in maximum use and the fishermen report good catches. The technical details about these nets are furnished in Table 3.

Table 3. Details of coloured gillnets operated off Gujarat

Gear component	Specifications
Netting material	PA twisted continuous multifilament
Colours used	Yellow, blue, white and green
Twine size, mm	210dx2x3
Mesh size, mm	80-100
Length, m	35-50
Hanging coefficient	0.5
Hung depth, m	5-7
Floats	PVC: 90 mm dia
Sinkers	Concrete: 300-500 g
Depth of operation, m	50-70
Fishing season	September-May
Type of operation	Bottom set or bottom drifting
Catch landed	Pomfrets, hilsa, seerfishes, wolf herring, sciaenids, clupeids

Gill nets operated during monsoon

PA monofilament and multifilament nets locally known as *ghandhai* or *pambede* and *thobadi* or *khandhari*, respectively, are used during monsoon. The mesh size in *ghandhai* are between 15 and 60 mm and twine size varies according

to the target species. This net is operated to catch fishes like sciaenids, wolf herring, clupeids, shrimps and mullets. They are generally operated as bottom set. This gear records good catch throughout the monsoon period. *Thobadi* has larger mesh size ranging between 100 and 150 mm and is targeted to catch mainly pomfrets, seerfishes and carangids. This gear is generally operated as bottom set or drifting. The catch in *thobadi* is reported to be good by the end of monsoon. The technical details of these two types of gill nets are furnished in Table 4.

Table 4. Details of gill nets (*Ghandhai / Pambede* and *Thobadi / Khandhari* operated during monsoon, off Gujarat

Gear component	<i>Ghandhai / Pambede</i>	<i>Thobadi / Khandhari</i>
Netting material	PA monofilament / PA multifilament	PA monofilament / PA multifilament
Twine size	0.20-0.28 mm dia / 210dx2x3	0.28-0.30 mm dia / 210dx2x3
Mesh size, mm	15-60	100-150
Length, m	30-40	30-60
Hung depth, m	2-3	5-8
Floats	PVC; 65 mm dia	PVC; 115 mm dia
Sinkers	Concrete; 200 g	Concrete; 250 g
Depth of operation	10-40 m	15-60 m
Fishing season	Monsoon	Monsoon
Type of operation	Bottom set or bottom drifting	Bottom set or bottom drifting
Catch landed	Small sciaenids, seerfishes, wolf herring, clupeids, shrimps, mulletts	Pomfrets, seerfishes, carangids

Small mesh gillnets

In the 1980s, the fishermen of Saurashtra used to operate bottom set gill net for catching mullets. This operation was done from two boats and after encircling the shoal, the boats stay anchored for two hours (Rajan & Mathai, 1988). The fishes were scared by splashing oars in the water and driven into the net where they get gilled. This type of fishing is no more common mainly because of the drastic decrease in the mullet catches. The mechanization of the crafts has prompted the fishermen to use similar type of practice for catching flying fishes. The fishermen cast 15-20 units of nylon monofilament gill nets of twine size 0.16-0.28 mm commonly called as *pathera jaal*. This unit has a mesh size of 10-20 mm and is generally operated in the surface waters. Once all the units are spread, the fishermen slowly move the craft to the other side of the fish shoal. The shoal is then scared by switching on outboard engines of the canoes to drive the fishes towards the nets. The technical details of the small-meshed gillnets are furnished in Table 5.

Table 5. Small mesh gillnet (*Pathera jaal*) operated off Gujarat

Gear component	Specifications
Netting material	PA monofilament
Twine size, mm	0.16 and above
Mesh size, mm	10-20
Length, m	30-50
Hung depth, m	4-6
Floats	PVC; 40 mm dia
Sinkers	Concrete; 50 g
Depth of operation, m	10-30
Fishing season	November-December
Type of operation	Surface set
Catch landed	Flying fishes and other pelagic shoaling fishes

The simplicity of gill net design, construction, operation, its low energy requirements and good economic return on investment make it one of the most popular eco-friendly fishing gears. Gill nets are highly size-selective, when mesh size is optimized for the target species. Selectivity data relating to different gill nets with respect to different target species need to be determined, where such information is lacking, for improving the selective nature of the gear, further. In recent years, the tendency among fishermen has been to use smaller mesh sizes in order to maximize landings of the target species and bycatch. From the point of view of resource conservation, however, the mesh size of gill net has to be regulated in such a way so that the optimum length caught by the gear is well above age of sexual maturity and beyond the active growth phase of the target species.

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