



# Beach seine fishery of India – A Review

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## Abstract

Beach seines are surrounding nets operated with two long ropes, set from the shore for encircling a school of fish in shallow coastal waters. In India, beach seining is the livelihood of the deprived groups of marine fisher. This review article gives an overview of designs, catch composition, prospects, issues and guidelines for the beach seine operations in India. Design of beach seines vary in structure and size based on the geography and resources. Natural and biodegradable materials were used for the fabrication of seine nets which are now replaced with polyamide for its durability and less resistance in water. Motorised and non-motorised wooden/fibre reinforced plastic sheathed plywood boats are used for the operation of beach seine. Normally beach seines are non-selective fishing gears with small mesh sizes and are operated during the post-monsoon season due to the high availability of coastal pelagics. Studies conducted by ICAR-Central Institute of Fisheries Technology, found that the number of beach seines has been declining in India during the last two decades. ICAR-CIFT has derived technical guidelines for the operation of beach seines along the Indian coast for reduction of juvenile incidence by increasing the existing cod-end mesh size and recommends square mesh at the cod-end. Suggestions were made to avoid ecologically sensitive areas for beach seine operations. This review article concludes that technical improvements and the introduction of measures for the reduction of juvenile catches will lead to better sustainability and the management of the beach seine fishery which is a source for livelihood for the aged traditional fisherfolk.

**Keywords:** *Karamadi*, design, operation, juvenile incidence

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## Introduction

Seine nets were used by Greeks in 3<sup>rd</sup> millennium BC and later Romans employed a large gear referred to as “*sagena*”, which was later introduced to several other countries (Brandt, 2005). It is a rectangular shaped long net to encircle a fish school in shallow coastal waters around a certain area. From the age old days, seines like *ayilakollivala*, *arakollivala*, *choodavala*, *discovala*, *deppavala*, *ringvala*, *kudukkuvala*, *thanguvala*, *kollivala*, *koruvala*, *mathikollivala*, *paithuvala* were operational in the southwest coast of India (Pillai et al., 2000; Edwin et al., 2015). The International Standard Statistical Classification of Fishing Gear classifies beach seines under the ISSCFG code of 02.00. According to FAO (2001) seine net is a very long net with or without a bag in the centre, which is set either from the shore or from a boat for surrounding a certain area to operate with two long ropes fixed to its ends for hauling and herding the fish. Seine nets are classified into two categories, beach seine/shore seine and boat seine with and without cod-end (Tietze et al., 2011). Beach seine is a seine net operated from the shore composed of a bunt (bag or loose netting), two long wings extended with ropes for towing the gear to the beach and the head rope with floats remains on the surface while the footrope remains attached to the bottom, forming a barrier which prevents the fish from escaping once enclosed (FAO, 2001).

Beach seining is age-old fishing method practised globally and has been used for fishing in all the continents for several thousand years (Gabriel et al., 2005). In India as well, this method of fishing is widely adopted in Malabar, Konkan and the Coromandel coasts (Salagrama, 2008). Various studies have been reported on the design, operation, and economics with the fishery of beach seines in India (Nair, 1958; George et al., 1983; Rao, 1987; Prakasan, 1988; Thomas, 1989; Bennet & Armugam, 1993; Vivekanandan, 1997; Sathiadhas & Narayanakumar, 2002; Salagrama, 2008; Tietze et al., 2011; Swathi Lakshmi et al., 2014; Saleela et al., 2015; Surya et al.,

2018; Raj et al., 2017; Lekshmi et al., 2019; Edwin et al., 2020). Salagrama (2008) reported that the beach seine was operated from all the coastal states of India except Gujarat. Saleela et al. (2015) accounted a total of 2,227 beach seines in different names operated along east and west coasts of India, in the states of Gujarat, Maharashtra, Goa, Karnataka, Kerala, Andhra Pradesh, Puducherry and Tamil Nadu. In Kerala and Tamil Nadu, beach seines are locally known as *kambavala/karamadi* which have a separate bag like cod-end. The traditional beach seine operated in Maharashtra, Goa and Karnataka is called *rampani/rampan*. This *rampan* gear is named after the Portuguese Parish priest (Hornell, 1923) which is without a specific cod-end but only have loosely hung meshes (Panikkar & Sathiadhas, 1993; Alexander, 1995). Chennubhotla (1999) has described that the beach seine used along the coast of Andhra Pradesh which was known in two local names; *pedda vala* and *alivi vala*. The beach seine in Kakinada of Andhra Pradesh was employed for prawn fishery (Rao, 1981). Tietze (1985) reported the operations of beach seine in Orissa while Vivekanandan (1997) and Salagrama (2003) confirmed the presence of this gear in Andhra Pradesh. The operation of beach seines at Digba and Chandipur areas of West Bengal were also reported (MFIS, 1985).

Currently, reliable database on the number of beach seines operated along the coasts of India is lacking. Nayar (1958) opined that the *karamadi* of Kerala is perhaps the only gear in this category which has withstood the test of time. In order to keep up with the changing needs, beach seine itself has undergone several important changes from place to place, in terms of design, mesh size, fishing methods & operations, ownership, labour recruitment, marketing and sharing patterns. Rao (1981) reported the decline of *alivi vala* in Kakinada, Andhra Pradesh which could primarily be attributed to the improved activity of the trawlers which had restricted the operational range of the beach seines. The decline of *rampani* seine has directly affected the fishing villages of Maharashtra which in turn created drastic economic imbalances in the traditional fish processing activities (Bhatta, 2003). The advancements in other fishing gears and mechanisation led to a decline in beach seining particularly in states like Karnataka (DOF Karnataka, 2005). In the Palk Bay, trawling activities superseded beach seine fishing (Kumaraguru et al., 2008). A decline in the use of beach seines has been reported from the

Coromandel Coast of Tamil Nadu, Andhra Pradesh and North Orissa (Tietze, 2011). Salagrama (2008) compared the district wise spread of beach seines along the coastal districts of Kerala where South Indian Federation of Fishermen Societies (SIFFS) reported 1115 beach seine operations in 1998 while CMFRI reported 3302 numbers during 2005. From the studies conducted by ICAR-CIFT, it is found that the number of beach seines has been declining on the south-west coast of India during the last two decades. The varying estimates in the number of seines are intriguing but the gear is actively operated in specific locations (Edwin et al., 2020).

### Design and types of the beach seines

Nayar (1958) described that the beach seine "*Karamadi*" from Vizhinjam region of Kerala consists of three parts; namely warps/*kamba* (minimum 214 m), wings/*kayaru* (coir of 300-600 m) and a funnel net (with two pieces). George et al. (1983) described a beach seine prototype for the reservoirs with a length of 179.2 m along the head rope and a depth of 12.7 m consisting of five major sections, two outer wings, two inner wings and a central part based on bottom topography and depth of the fishing ground. Rajeshwari & Prakash, (2007) from Vishakhapatnam coast reported *alivi vala* a type of beach seine with large nets made of polyamide without a cod-end consisting of a wall of webbing with about 16 units having 30 mm mesh size with tapering ends of 20 m length attached on either side. The case of *pedda vala* which has five segments; in the first segment of the wing part of the net was fabricated with 4 mm coir rope of 1800 mm mesh size having 100 meshes in length and 40 meshes in width on both sides. The cod-end is attached to the conical part and is fabricated with nylon with 10 mm mesh size having a length of 13.5 m and depth of 9 m. The length of the net was 470 m and depth of 56 m and the head rope of *pedda vala* and *alivi vala* was of 16 mm diameter HDPE with the thermocol floats. Rao (1987) recorded that for beach seine in Andhra Pradesh, cement sinkers of 80 mm diameter were used. Nirmale & Metar, (2003) reported that *rampan* used along Konkan coast, had a length of 800-1000 m while Lal (1989) reported overall length of 548 m and depth which increased gradually from 2 to 4.5 m at the outer end of the wing to 7 m towards the centre. The detailed designs of *rampani* operated in Ratnagiri, Maharashtra was given by Warhekar (2012) and reported the mesh size of wings was 40-50 mm, shoulder 20-30 mm, and 10-15 mm for the

bunt region. He described that in Ratnagiri, polypropylene rope of diameter 12 mm was used as a head rope with plastic floats of 75 mm diameter. Similar observations were recorded by George et al. (1983) from Burla, Orissa for the head rope of beach seine but with aluminium floats of 150 mm diameter. Vaidya et al. (2010) reported that the codend mesh size of the *yendi* of Karnataka was 4 mm. Saleela et al. (2015) reported 6 mm mesh size for the lower portion of the cod-end in the beach seines of Poovar region and Lekshmi et al. (2019) reported 8-10 mm mesh size from Vizhinjam region of Kerala ( Fig. 1). The codend mesh size of beach seine in different states is also summarized in Table. 1.

In India, cotton, jute, hemp and coir were the materials used for fabrication of seine nets. The natural biodegradable materials like coir, coconut leaves and natural fibres are still in use for the beach

seine operation in Kerala (Edwin, 2019). After the introduction of polyamide in the 1960s and 1970s in the east coast of India, cotton was replaced with polyamide due to its lightweight and less resistance in the water, facilitating operation and handling (Rao, 1987). In Andhra Pradesh, the state government promoted polyamide as an alternative netting material and the village Mulapeta made the first nylon beach seine in 1985 (Southwold, 2006a). Chennubhotla (1999) and Rajeswari & Prakash (2007) observed in *pedda vala* and *alivi vala* of Andhra Pradesh, cotton was fully replaced with polyamide twine. The comparative strength of polyamide enabled larger nets to be used for greater catches per haul and the transparent twine improved the catch rates and reduced the days lost for net repairs (Southwold, 2006a). Vaidya et al. (2010) observed that polyamide is the material used for the fabrication of beach seine "*yendi*" in Karwar region.

Table 1. Beach seines in different states with its cod-end mesh size

State	Vernacular name	Cod-end mesh size (mm)	Reference
West Bengal	<i>Sarini jal, Ber jal, Ghanal jal, Charbel jal</i>	0.5 - 10	MFIS,1985
Orissa	<i>Bara jal, Pedda jal, Bada jalo Sarini Jalo, Khia Badia Jalo, and Gheri Jalo</i>	5- 20	George et al., 1983; Tietze, 1985; Salagrama, 2008.
Andhra Pradesh	<i>Konti vala</i>	15-20	Rao, 1987; Vivekanandan, 1997; Salagrama, (2003); Rajeswari & Prakash, 2007; Tietze, 2011; Chennubhotla et al., 1999.
	<i>Pedda vala, Chinna alivi Vala, Chinna ayila vala, Pedda alivi vala, Pedda Ayila vala</i>	10 -15	
		15-20	
Tamil Nadu	<i>Peria valai, Thallu valai, Karamadi valai, Kara valai or Badi Valai, Kattu valai, Iluppu valai.</i>	0.65 - 15	Thomson, 1989; Hopewell, 2004; Tietze (2011); Raj et al., 2017; Surya et al., 2018; Salagrama, 2008.
	<i>Marukku valai, Ola valai, Vidu valai, Kolache valai, Mada valai</i>	10-50	
Pondicherry	<i>Periya valai, Kara valai</i>	0.65-15, 10-12	Bhakthavatsala Bharathi, 1999.
Kerala	<i>Chavittu vala, Kamba vala, Karamadi, Noona vala</i>	6-10	Nayar, 1958; Saleela et al., 2015; Lekshmi et al., 2019; Edwin et al., 2020.
Karnataka	<i>Kairapani, Rampani Yendi</i>	10-18	Dharmaraja & Jacob, 1980; Pravin, 2014; Swathi Lakshmi et al., 2014; Vaidya et al., 2010
		4-15	
Goa	<i>Rampani, Yendi</i>		Nirmale & Metar, 2003.
Maharashtra	<i>Rampani</i>	10-30	Prakasan, 1988; Warhekar, 2012.

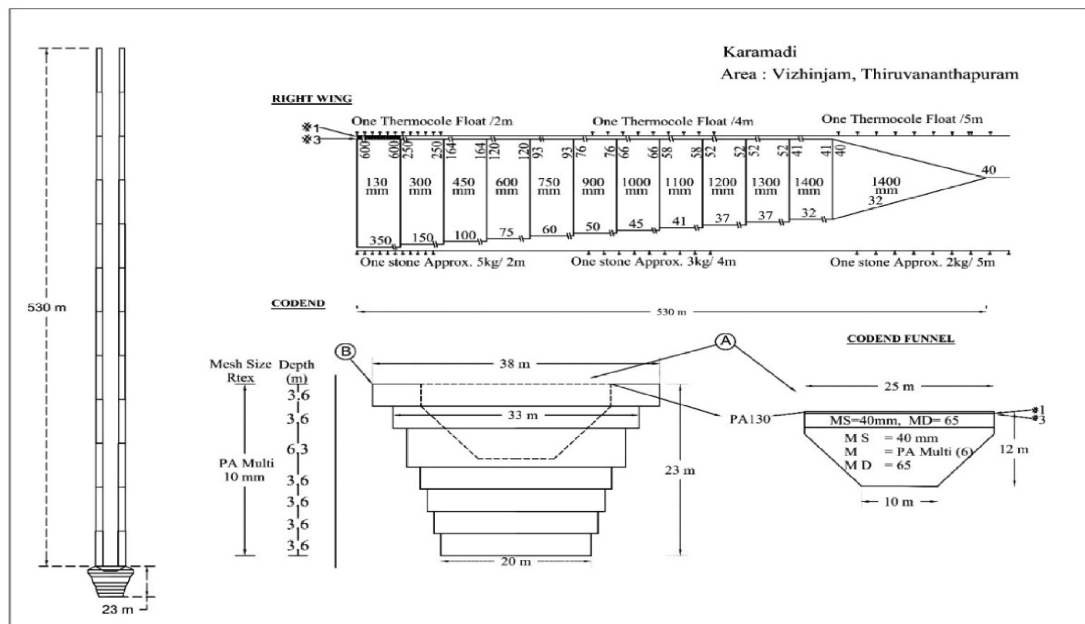


Fig. 1. Structure and design of a typical beach seine; *Karamadi* from Kerala (Source: Lekshmi et al., 2019)

Warhekar (2012) observed that polyamide webbing is more common for *rampani* compared to polyethylene multifilament webbing used in Ratnagiri, Maharashtra. *kairampani* in Karnataka is the smaller version of the *rampani* which has fully replaced the *rampani* seine since, 1989 (Pravin, 2014). Design variants of beach seines were also noted from Kerala. Nayar (1958) reported a slightly modified *karamadi*, from Vizhinjam which is locally known as *churukkumadi* targeting the tuna sp. Lekshmi et al. (2019) reported a modified *karamadi* as *muralvala* from the Quilon region of Kerala targeting *Hemiramphus* sp.

## Beach seine operation

Beach seines are operated by setting the first towing line fixed ashore, and then the line, the first wing, the bag, second wing and second-line set out in a wide curve and took back to the beach. One group of fishermen remains on the shore holding one end of the hauling warp. The second group carrying the gear on a boat along with the other end of the hauling rope, encircles the fish shoal/fishing area and sets out the gear in a wide semi-circular manner and brought the other end to the shore, which is a certain distance away from the starting point. The hauling ropes are then hauled simultaneously to the beach by two groups of fishers. For the successful operation of beach seine, it is appropriate that the ground rope reaches the beach first, to bring the gear

beneath the fish (FAO, 2001). Normally beach seines were operated in shallow water bodies targeting the coastal pelagic shoals. The maximum depth of operation for the beach seine was reported from Orissa of about 18 m for *bada jaal* (Sridhar & Muralidharan, 2013) and the minimum depth of operation was reported from Tamilnadu of below 2 m by using *karamadi* (Raj et al., 2017; Surya et al., 2018). The *kairampani* of Karnataka was also observed to be operated from shallow depth (Swathi Lekshmi, 2014). Beach seines were mostly operated during the post-monsoon season due to the high availability of coastal pelagics. Depending upon the size of the gear and topography the number of fishers involved in the fishing operation varied from 20-100. Tamil Nadu and Maharashtra reported the maximum number of fisherfolk involved in a single beach seine operation; 60-100 and 30-100 respectively (Table 2).

### Fishing vessels used for beach seine operation

Motorised and non-motorised Wooden/ FRP sheathed boats were used for the operation of beach seines. Hauling of beach seine is manual in most of the regions of India. Hence fuel usage is negligible as compared to the other fishing gears. In northern coast of Andhra Pradesh and Orissa, *masula* boat has been traditionally used for shore seine operations. It is locally known as *padava/kuttupadava* and built with light wooden planks without frame or ribs



Table 2. Details of beach seine operation

State	Local name	Depth of operation (m)	Operation time (h)	Peak Season	CPUE (kg)/operation	No of crew member	References
Maharashtra	<i>Rampani</i>	8-10	3-4	Monsoon & Post-monsoon	70-80, 2000-6000	30-100	Lal, 1989; Nirmale & Metar, 2003; Prakasan, 1988; Salagrama, 2008; Warhekar, 2012; Khandagale, 2015.
Karnataka	<i>Kairampani</i>	1-4	1-2	Monsoon	2000-4000	50-60	Swathi Lekshmi, 2014; Pravin, 2014.
Tamil Nadu	<i>Karamadi/ Mada valai</i>	1.8-3.6	1-3	Monsoon & Post-monsoon	700-2000	60-100	Bennet & Armugam, 1993; Hopewell, 2004; Salagrama, 2008; Raj et al., 2017; Surya et al., 2018.
Kerala	<i>Kambavala/ karamadi</i>	5-7	4	Post-monsoon & monsoon	74-139	20-40	Ammi, 2010; Saleela, 2015; Lekshmi et al., 2019.
Orissa	<i>Bada Jalol/ Ber jal</i>	18	1-3	Post-monsoon		30-40	Tietze, 1985; Salagrama, 2008; Sridhar & Muralidharan, 2013.
Andhra Pradesh	<i>Pedda vala, alivi or ayila vala</i>	10-15	4-5	Post-monsoon	10000	30-70	Chennubhotla et al., 1999; Salagrama, 2008; Alagaraja et al., 1987.
West Bengal	<i>Sarini Net</i>				1667		Salagrama, 2008.

(Chennubhotla et al., 1999). The Length overall ( $L_{OA}$ ) of *masula* boat is in the range of 3-12 m. But in central Andhra Pradesh, *masula* boat was replaced by the wooden plank-built *Nava* boat for the operation of bigger and heavier *alivi* nets. The *nava* is nine to twelve meters long and is a crescent shaped, plank built, row boat. In Tuticorin area of southern Tamil Nadu, motorised boats are used for launching the beach seine operation (Bennet & Arumugam, 1993). Non mechanised wooden fishing boats locally called as *hodi* (constructed by fixing mango or teak wood planks) with a length of 6 to 8.78 m are used in Ratnagiri coast of Maharashtra (Warhekar, 2012). Concurrently *akada hodi* is used in Konkan district of Maharashtra and Kanara district of Karnataka (GOI, 1961). In poovar region of Kerala, beach seine is operated by using canoes, catamaran and fiberglass boats (8.5 to 11.0 m  $L_{OA}$ ) at 5 to 7 m depth within 0.5 km to 3 km from the seashore (Saleela, 2015). Lekshmi et al. (2019) reported that the *karamadi* from Vizhinjam region of Kerala is operated from wooden/FRP sheathed fishing vessels with or without outboard motor of 9.9 hp. The overall length of the vessels ranged from 6 to 12 m  $L_{OA}$  and operated with in the depth of 25 m (Fig. 2). Most of the areas, the traditional and motorized crafts are used for beach seine operation, hence the energy utilization and emission of  $CO_2$  to atmosphere is very low. The fishing vessel is used

for spreading the gear does not exceed 12 m  $L_{OA}$ . The engine used for propulsion was of a relatively lower hp (9.9 hp) compared to engine used in other types of fishing. Hence the fuel consumption is very low that is, about 5- 6 l / operation. The maximum requirement of fuel used is 1:6 in proportion of petrol and kerosene. Although the main portion of the gear is made of polyamide netting materials, the bridles (wings) are made of natural fibres like coir. All the above features render this gear as an eco-friendly alternative to the increasing use of synthet-

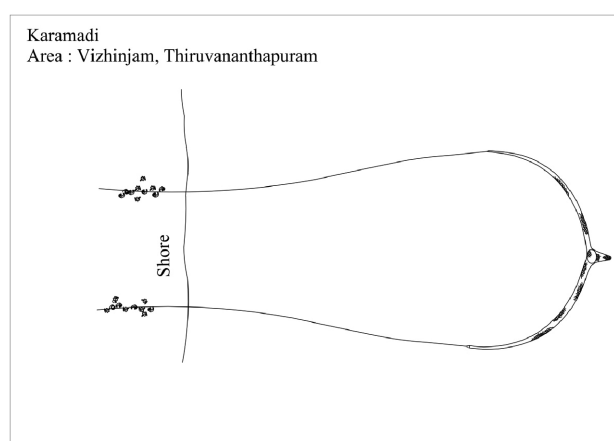


Fig. 2. Schematic representation of operation of *Karamadi* from Kerala (Source; Lekshmi et al., 2019)

ics in the fishing industry. The resultant carbon footprint of this gear will therefore be considerably lower compared to other contemporary gears.

Ownership of beach seines and wage-share arrangements vary from place to place. In Konkan coast, individual as well as collective ownership was reported where in the former case generally with one fisherman. Usually the most experienced head fisher gets 50% of the share of the income with the rest being divided equally among the others after deducting maintenance costs. The communal ownership was monitored in *rampani* operation in the Konkan coast, where the contribution of the crew can vary from pieces of webbing to cash inputs. Rotation is a characteristic feature of beach seine operation in the Konkan coast where each group taking turns to operate. This is mainly due to avoid crowding and possible conflicts (Nirmale & Metar, 2003). Collective ownership has also been reported in southern Tamil Nadu (Hopewell, 2004). Salagrama (2008) reported the individual ownership of beach seines in the areas of Uppada and Mulapeta of Andhra Pradesh. In Ganjam district of Orissa, beach seine catches are shared by value, in which 10% of the net income for the two people that have the responsibility of keeping the mouth of the net open while hauling, 30% goes to the owners and the remaining 60% is shared by the crew (Salagrama, 2008). In Kerala normally 40% of the share goes to the owner and 60% to the workers, with each fisher earning up to Rs. 500-1500 on an average per operation (Edwin et al., 2020).

### Composition of catch from beach seine

Beach seines are mainly targeted for the coastal pelagic shoals. The dominant species landed by *karamadi* in Kerala includes mackerel, sardines, lesser sardines, anchovies, silver bellies, halfbeaks, full beaks, trevallies, herrings, silver whittings, lizardfish, shrimp etc (Saleela, 2015; Edwin et al., 2020) while in Tamilnadu the fishery includes sardines, lesser sardines, anchovies, needle fishes, snappers, silver bellies, carangids, mullets, cephalopods, crabs and shrimps etc (Bennet & Arumugam, 1993; Muthiah, 2000; Rekha, 2005; Raj, 2017). In Palk Bay, more than 30% of cephalopods are caught in beach seines (Kumaraguru et al., 2008). Muthiah (1998) reported the unusual heavy landing of the toli shad, along the Palk Bay, Tamilnadu. The main species caught in the beach seines of Andhra Pradesh include sardines, carangids, *Stolephorus*

spp., mackerel, *Thryssa* spp., seer fishes, ribbon fishes, silver bellies, mullets etc (Chennubhotla, 1999). Rao (1981) reported that *M. brevicornis* was a main constituent of the shore-seine prawn fishery at Kakinada which amounts to 60% of the prawn landings. Other major species includes *M. monoceros*, *M. affinis*, *Penaeus monodon*, *M. dobsoni*. Nirmale & Meter (2003) observed the major fishery as Indian mackerel, oil sardine and ribbonfish from the Konkan coast. Pravin (2014) described that catch depends on the season and the major groups of fishes landed in *kairampani* are oil sardines, mackerels, crockers, flatfish, shrimp, white pomfrets, seabass, seer fish, squids, carangids etc from Karnataka. Reports indicated that along Ratnagiri and Sindhudurg districts of Maharashtra catch includes mackerel and sardines in addition to penaeid prawn, seer fish, pomfret and catfish in *rampani* (Deshmukh, 2013). Further, reports by Khandagale (2015), indicated that in Maharashtra, Goa and Northern Karnataka region, species viz., mackerel (*Rastrelliger kanagurta*) was the dominant group caught in *rampani* nets. Sridhar & Muralidharan (2013) reported the species caught from the beach seine of southern Odisha were sardines, anchovies, ribbon fishes and silver *sillago*. The main species caught in the beach seines of West Bengal includes sciaenids, hairfin anchovies, grenadier anchovies, pomfrets, silver bellies, polynemids and catfishes (Dan, 1985).

### Issues in beach seining

Beach seines are operated by the traditional fisherfolk and currently, this gear is considered only as an option for secondary livelihood. In India beach seining is the livelihood employment for the poorest and the most vulnerable groups of people (Salagrama, 2008; Edwin et al., 2020). Pravin (2014) also reported that beach seines are still an important source of employment and supports the livelihood of coastal communities in Karnataka. Gear setting and soaking of beach seine require minimum time compared to gillnet and longline. Thereby fishers considered this gear as a secondary livelihood. Hauling is manual in the operation of beach seine; hence the energy is utilised only for the propulsion of the fishing boat and carbon emission is minimal compared to other fishing operations like trawling, purse seining etc. (Edwin, 2019). As it is targeted fishing, discards are comparatively very low and in the developing countries traditional beach seines are listed as fisheries with low to negligible discard rates

(Kelleher, 2005). On the contrary Raj et al. (2017) and Kumaraguru et al. (2008) observed the detrimental effects of beach seines in Tamil Nadu especially in Palk bay and reported the bycatch including sponges, starfishes, sea cucumbers, sea horses, coral rubbles, seagrasses, mollusc, ascidians, sea anemones and fish fingerlings etc. (most of the groups are categorized as protected) which were thrown on the shore. A study conducted by Beckley & Fennessy, (1996) at Durban, Kwazulu-Natal, South Africa suggested installing a drawstring in the cod-end of the beach seine to enable the gear to be opened to release the bycatch.

Beach seines with small mesh sizes create a negative impact on the environment. It is a non-selective method, negatively affects the aquatic fauna including larval forms, fry, juveniles and ova (Tietze, 1985). Salagrama (2008) supported the statement that the environmental impact of beach seine was due to the use of very small-mesh at the centre of the net and the fishing operations were very close to the coastline which are the breeding and nursery grounds for many fish species. The gear is operated for the shallow coastal fishery and the depth of operation is not more than 10 m (Lekshmi et al., 2019). Fennessy (1994) and Mann (1995) assumed that the small mesh size and the slow speed of retrieval of the net resulted in high incidence of juveniles in beach seine rather than other fishing gears. In the east coast of India, the immature scombrids caught in association with mackerels using small-mesh are reasonably resilient to overfishing, however needs to be considered with caution (BOBLME, 2012). The juvenile incidence in the gear is the major drawback due to the very small mesh-size at the cod-end region. Surya et al. (2015) reported from the Dhanuskodi Island, Tamil Nadu where more than 75% of the catch were juveniles. Saleela et al. (2015) suggested for increasing the mesh size to 18-25 mm from 6 mm. Studies conducted by ICAR-CIFT also reported the use of small diamond meshes of less than 10 mm at the cod-end in Kerala (Lekshmi et al., 2019). Yohannan & Sivadas (2003) described the non-selectivity of the large seines and the heavy exploitation of juvenile mackerel during monsoon and suggested the mesh size regulation for the control of growth overfishing than the total ban on this gear.

Many states have policies and regulations for the cod-end mesh size for beach seines eg. in Lakshadweep fisheries regulation act, beach seine of

less than 20 mm mesh size is prohibited and in Andaman and Nicobar islands beach seines and dragnets with mesh size above 25 mm only are allowed to operate. In West Bengal beach seine/dragnet with mesh size below 25 mm are not operational. But in Kerala and other states of India, there is no such regulation for the mesh size of the cod-end of beach seine (Rajesh, 2013).

### Sustainable operation of beach seines

From the studies conducted by ICAR-CIFT on the design and operation of beach seines some technical guidelines were derived for the operation along the Indian coast. To reduce the incidence of juveniles the existing cod-end mesh size of below 10 mm has to be increased to 22 mm. Square mesh is recommended at the cod-end region, because of the time hauling the diamond mesh tends to close up preventing the escapement of juvenile fish. Beach seining has to be avoided in ecologically sensitive areas (coral reef, sea grass, seaweed, mangrove etc). The catch can be collected on a clean surface like sheets made of synthetic material instead of unloading the catch on the beach sand for ensuring hygiene/quality. The departments of fisheries may develop a reliable database on beach seining as it forms an important secondary livelihood for fishers.

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