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Large Pelagic Mechanised Gillnet Fishing Systems of Odisha Coast, India

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Abstract- Mechanisation brings about major developments in fishing systems. Main fishing gear operated in Odisha state targeting large pelagics are drift gillnets. Odisha coast is an ecologically sensitive area having one of the four significant *arribada* beaches of Olive Ridley turtle, with three mass nesting beaches. Large mesh drift gillnets are reported to be the main gear contributing to incidental catch of turtles. The gillnet fishing sector has undergone many changes during the last few decades in terms of size of craft and gear, area of operation and trip duration. This paper deals with design and general features of mechanised gillnet fishing system operated in the coastal waters of Odisha. Presently mechanised gillnetters of 8-19 m L_{OA} with 70 to 140 hp inboard engines go for voyage fishing of up to 30 days. Drift gillnets of the states are made of Polyamide (PA) and High Density Polyethylene (HDPE) having mesh size ranging from 80-380 mm. Total fleet size of the net increased substantially over the years extending up to 9300 m. Drift gillnets targeting tuna, seerfish, bill fish and shark are operated mainly during night time in waters up to a depth of 1200 m. In view of the increase in the size of the gear running several kilometres, there are more chances of turtle kill which calls for monitoring and surveillance.

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Abstract- Mechanisation brings about major developments in fishing systems. Main fishing gear operated in Odisha state targeting large pelagics are drift gillnets. Odisha coast is an ecologically sensitive area having one of the four significant *arribada* beaches of Olive Ridley turtle, with three mass nesting beaches. Large mesh drift gillnets are reported to be the main gear contributing to incidental catch of turtles. The gillnet fishing sector has undergone many changes during the last few decades in terms of size of craft and gear, area of operation and trip duration. This paper deals with design and general features of mechanised gillnet fishing system operated in the coastal waters of Odisha. Presently mechanised gillnetters of 8-19 m L_{OA} with 70 to 140 hp inboard engines go for voyage fishing of up to 30 days. Drift gillnets of the states are made of Polyamide (PA) and High Density Polyethylene (HDPE) having mesh size ranging from 80-380 mm. Total fleet size of the net increased substantially over the years extending up to 9300 m. Drift gillnets targeting tuna, seerfish, bill fish and shark are operated mainly during night time in waters up to a depth of 1200 m. In view of the increase in the size of the gear running several kilometres, there are more chances of turtle kill which calls for monitoring and surveillance.

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I. INTRODUCTION

Gillnetting is a highly selective fishing gear and one of the predominant energy efficient fishing methods spending fuel mainly for propulsion. Drift netting is a type of gillnetting in which the net is freely allowed to drift in the sea. Drift nets having fleet length up to 15000 m are in operation in coastal and deeper waters of India. Drift gillnet is mainly operated in high seas to catch large pelagic species like seerfish tuna, sailfish, sword fish and shark.

The gillnet fisheries of India are considered to be the mainstay of the artisanal sector, comprising of small scale localised operation (Thomas, 2010). The gillnet fisheries of Odisha were the major gears contributed towards the marine fish landings. Among the major maritime States of India, Odisha stands 8th in marine fish production (Kumar and Shivani, 2014). Successful introduction of large pelagic gillnets in east coast of India was reported by Pajot, (1993). Scariah et al., (1995), reported marine fisheries of Odisha and production trends. Chaidee et al. (2007)

effectively used drift gillnets in marine resource surveys conducted in Bay of Bengal. Fishing crafts and gears operated off Orissa reported by (Sivakami and Kuriakose, 2009). Details of gillnet fishing systems of Odisha coast were reported by (Edwin et al, 2014). In the mechanised fishing system of Odisha 35% crafts are gillnetters (Kumar and Shivani, 2014). Thomas (2005) reported HDPE as a new material for gillnets along with nylon multifilament which is used in north east and west coast of India.

Odisha State has the coastline of 480 km among the maritime states of India. The continental shelf up to 200m depth covers an area of 24,000 sq. km, which is 4.5% of the total area of the country's continental shelf. It has 6 coastal districts viz. Ganjam, Puri, Jagatsinghpur, Kendrapara, Bhadrak and Balasore. The mechanised sector mostly uses trawl net and gillnets. As per marine fisheries census conducted by CMFRI, 2010 a total of 20257 mechanized gillnetters are operated in the Indian waters. In Odisha coast, there are 2248 mechanised fishing crafts in Odisha state; of which 781 are gillnetters (Fig.2) (CMFRI, 2010). These vessels operate, gillnets made of Polyamide (PA) and HDPE. Probably, Odisha is the only state in the country to witness an increase in the traditional fishing vessels along with modern fishing technology during the same time. Therefore the aim of the study was to document the design and structural details of mechanised gillnetters and large mesh gillnets operated in the Odisha coast.

II. MATERIALS AND METHODS

The data was collected during January 2012-2013 from the selected fishing harbour and landing centres of Odisha using structured questionnaire covering details of the mechanised gillnet fisheries sector in Odisha. The details crafts and gears were recorded according to Fyson (1986), Sree Krishna & Shenoy (2001), and Thomas & Hridayanathan, (2002). Design details were depicted as per Nedelec (1975). Representative samples of fishing vessels were selected based on the most prevalent designs of the region and the type of operation. Lines plan and structural details of most widely used gillnetters were collected during the survey. The details of the engine power, fish hold capacity, number of crew, type of fishing, average fuel consumption etc. were collected.

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The scantling details of different parts such as hull, deck and wheel house were measured and recorded.

Data on gillnet designs, fabrication, operation and investment details were collected and recorded. The structural, operational and design differences in the

common large mesh gillnets operated in different coastal districts viz., details regarding the dimensions, materials, accessories like floats, sinkers and operational parameters of the gillnets were also covered.

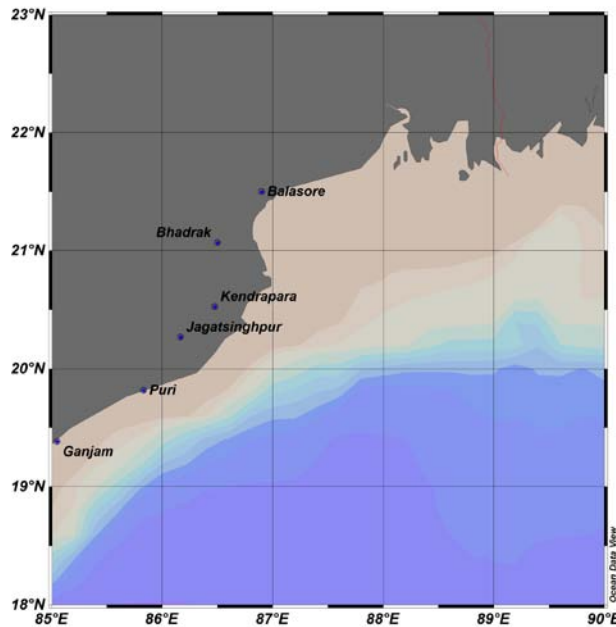


Fig. 1 : Coastal map of Odisha showing study area

III. RESULTS AND DISCUSSION

a) Fishing vessel

The details of gillnetter operating from Odisha are given in table 1 and the detailed specifications of large mesh drift gillnets are given in Table 2. The design of large mesh drift gill net are given in Fig.2-3.

Table 1

Type of gillnetter	L _{OA} (m)	Horsepower
Small gillnetters	8 – 12	70-97
Medium size gillnetters	13- 18	97-110
Large gillnetters	18-22	106-140

The drift gillnets of India which was small-scale in nature, till early 2000s, showed a clear shift to the large scale operations, at least in certain pockets of the country (Thomas, 2010). The change in the fishing systems from subsistence-based activities to commercial operations from simple, low-cost operations to comparatively hi-tech, high-investment operations. Earlier the gear is deployed from mechanised boats (10 m) in the inshore waters within 10-15 km from the foreshore (Pati and Pati,1982). Among the different types of crafts used in mechanized sector of Odisha, 35% are gillnetters (Kumar and Shivani, 2014).

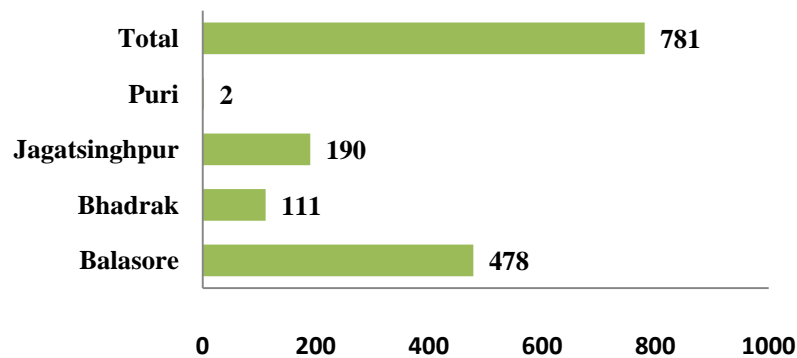


Fig.(2) : Distribution of gillnetters along coastal districts in Odisha (Source of data: CMFRI, 2012a)

Previously mechanised Pablo boats ranging 10 to 20 m L_{OA} with drift gillnet is operated for harvesting large pelagic fishes of Odisha coast (Silas and Pillai, 1985., Pravin et al, 2008). Presently small gillnetters operating in Odisha have range of 8 m to 12.0 m L_{OA} and they are constructed of wood. These vessels are fitted with Indian made engines with engine power in the range of 70-97hp. Box type of steering are usually used in these fishing vessels. Electronic equipments such as GPS and echosounder are used for monitoring the depth of operation, nature of fishing ground, safety, navigation and location of fishing grounds. Most of the vessels are dry docked once in a year. The number of crew onboard is 4-6 including serang and engine driver.



Fig. 2 and 3 : A view of typical mechanised gillnetters operated from Odisha

The size of large gillnetters exceeds 18 m L_{OA} . Wood and fibre glass are the main construction material used in this type of vessels and the vessels are well equipped for multiday deep sea fishing. Large gillnetters are installed with engines of 106-140hp. The fish hold with made with wood and fibre and can store

400 kg to 10 tonnes of fish. Generally 2-4 diesel tanks are provided with a total capacity of 3,000-7,000 litres. The steering used is of box type. Large gillnetters undertake multiday fishing extending from 10 to 17 days with crew complement of 8-12 fishermen.

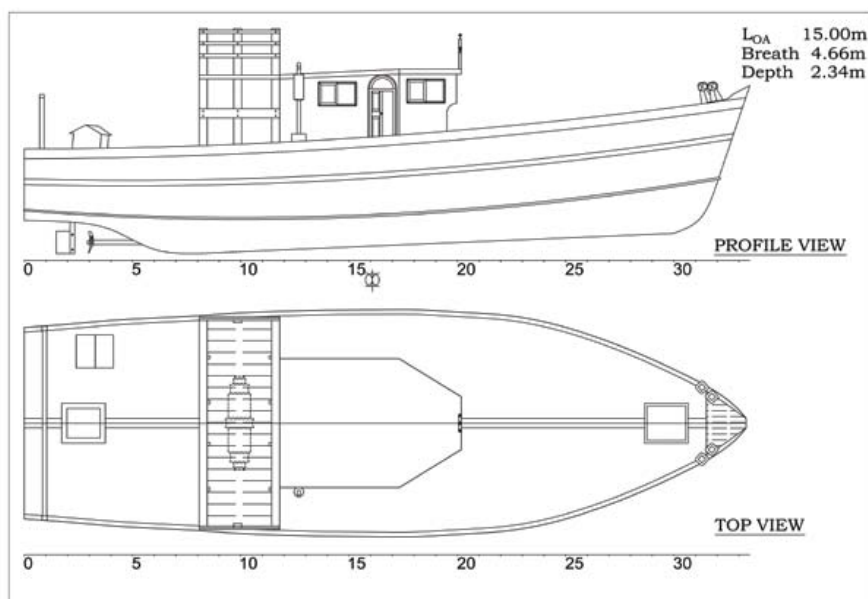


Fig.4 : Profile and deck layout of a typical gillnetter from Odisha

The engine used in Odisha by mechanized is Indian made marine diesel engines. Large sized mechanized prefer high power Indian made diesel engine. Diesel cost forms the major share in the operational expenditure of the gillnetters. The diesel consumption per hour varied from 6 to 20 litre h⁻¹, depending on the size, installed engine horse power and displacement of the vessel, location of the fishing ground and duration of the fishing trip.

Almost all mechanized gillnetters in the Odisha are equipped with modern electronic equipment such as GPS, echosounder and VHF transceiver. Mobile phones are also used for shore communication. The wheel house is constructed on the middle of the main deck

and an awning is provided behind the wheel house. Even in multiday fishing vessels toilet facilities are not provided. In medium size and large gillnetters food is prepared onboard. Berth facilities for crew are provided in all medium size and large gillnetters.

As the initial investment for a fishing vessel is high, most of the fishing vessels are of multiple ownership. Fishing vessels are built by order of the investor and construction takes 3-4 months. Total investment including engine, gear and accessories range from 1.75 million for small wooden gillnetter (8.7-12.0m L_{OA}), Rs. 4.6 million for large steel gillnetter (>16.0m L_{OA}), to Rs. 5.7 million for medium size FRP gillnetter (12.1- 16.0 m L_{OA}) (Table 3).

Table 3 : Investment for gillnetter, gear and accessories

L _{OA} (m)	Type of trawler	Horsepower	Investment, Rs. x 10 ⁵			
			Vessel	Engine	Gear and accessories	Total
8.0-12.0	Wooden	07-97	15	7	5	27
13.- 18.0	Wood FRP	97-110	30	12	5	47
>18.0	Wood FRP	106- 140	45	18	7	70

b) Fishing Gear

Polyamide monofilament and multifilament netting are used for making gill net in Odisha. Large meshed (100 mm) and very large meshed (150-200mm) are very common types of gillnets operated along the

coast (Pillai et al., 2000). Gill nets and lines are used all along the coast, but have different specifications in the north and south of Orissa (www.uaadodisha.org). Details of drift gillnets used for fishing operations from mechanized gillnetters from Odisha are given Table 4.

Table 4 : Details of drift gillnets operated from Mechanized gillnetters from Odisha

Vernacular name	Mesh sizes, mm	Fleet length, m	Depth, m	Target species
Bhetki	85	10,000	18	Hilsa
Bahaljaal	95	12,000	16	Pomfrets, Hilsa
Phasijalo	100	8000	15	Tuna ,sword, dolphin fish
Nakundajalo	110	6,500	15	Seerfishes, tunas
chandijalo	80	1,500	15	Seerfishes

i. Design details Gill nets for large pelagic fishes

Gill nets for seerfishes and tunas are operated as drifting gear at the surface or in the column waters. Gillnet is generally held vertically by a buoyant float line at the top of the net and a lead line at the bottom. However, the large mesh polyamide (PA) multifilament twines were used drift gill nets for seerfishes and tunas operated from the mechanized boat are free of sinker line or even footrope. These are operated in column or surface depending on the swimming layer of the fish during different seasons. At times the float line is rigged in such a way that it remains below the surface by adjusting the buoy lines which are attached to the float line at regular intervals. Drift nets are usually operated during night-time. Large mesh sized gillnets, meant mainly for Hilsa and pomfrets, are used in the northern side of Odisha coast (Edwin, 2014).

PA monofilament and multifilament twines were used throughout the Odisha coast for Hilsa, seerfish and tuna gill nets. Coloured multifilament yarns were used as

netting material throughout the coast. Green and red colours were commonly used. Yarn having specification of 210d×2×3 to 210d×12×3 were most commonly used according to the mesh size. PA monofilament of mesh size 0.50 to 1 mm diameter and selvedge meshes of PE of 1 to 4 mm diameter is used gillnets for shark. During December-January months, when comparatively larger specimens of seerfish occurred in the fishery, PA 210d×9×3 (Rtex 683) and 210d×12×3 (Rtex 911) were used. The use of 210d ×2×3, 210d×4×3 and 210d×12×3 was observed at different coastal belts of Odisha. The mesh size ranged between 90 and 200 mm, however the most common are 90 and 160 mm. The fleet lengths of net ranged between 3900-9300m. PA multifilament twines were used throughout the coast for seer fish and tuna nets. The operation of large mesh drift gill nets, for high sea pelagic species is at 100-1200 m depth zones. The hanging coefficient of the gear varied between 0.45 and 0.6 in different regions. The net is free of footrope or sinkers for effective entangling. The hung depth of the

nets ranged from 10 to 18 m. Regional variations exists in hung depth of the gear.

c) *Operational details*

Mechanised vessels operating from Odisha operated deeper than their motorized counterparts. The depth of operation of mechanized crafts ranged between 100 and 1000 m and similar observations were reported by Akhilesh et al. (2012). Previously the operations of large mesh gillnets were limited to 100 m depth (Thomas, 2001). Larger vessels, with higher engine power and ice storage facility conducted operations in distant and deeper waters. The drift gillnets are operated by fishermen from inboard engine fitted vessels with of 12-18 m L_{OA} and having navigational and fish finding electronic instruments like GPS,

Echosounder and VHF transceivers are used for navigation and fishing in the high seas of Odisha .

During operation nets were freely allowed to drift along with the boat for 4-6 h during night time and one end of the net is tied to the vessel after shooting the net. Hauling is done manually. Indicator flag lights are attached to the two ends of the net during night operation. It helps fishermen to avoid heavy losses because their nets are damaged or cut loose by passing ships or other larger vessels (Pajot, 1980). After hauling the net, the catch is sorted species wise. In late 1990's one to two weeks multi voyage fishing started for gillnet fishing (Thomas, 2001). Now this trip duration is increased changed and they are going for 20-30 day long trip to for high sea fishing in Odisha coast.

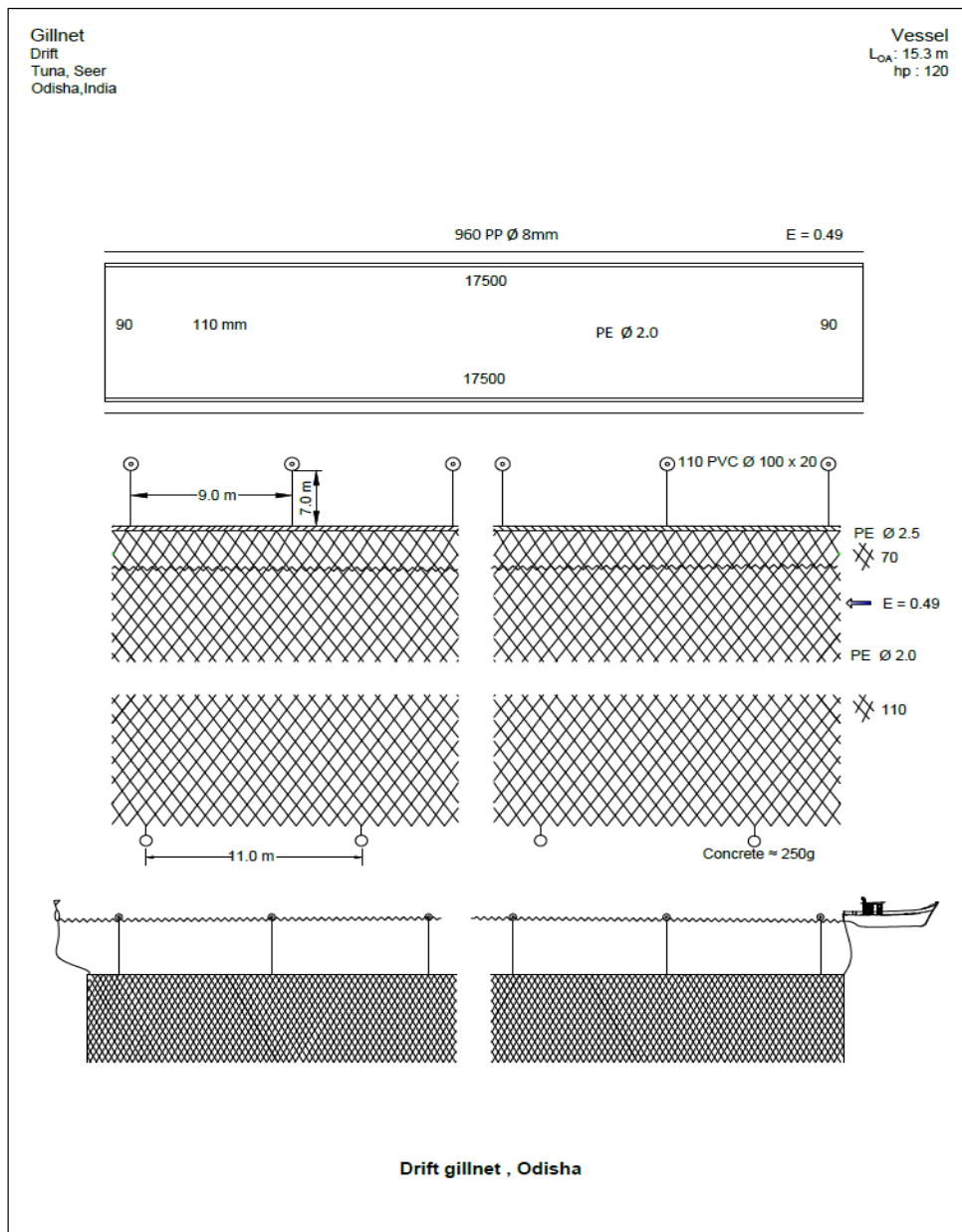


Fig. 5 : Design of a typical of a typical HDPE drift gillnet operated in Odisha

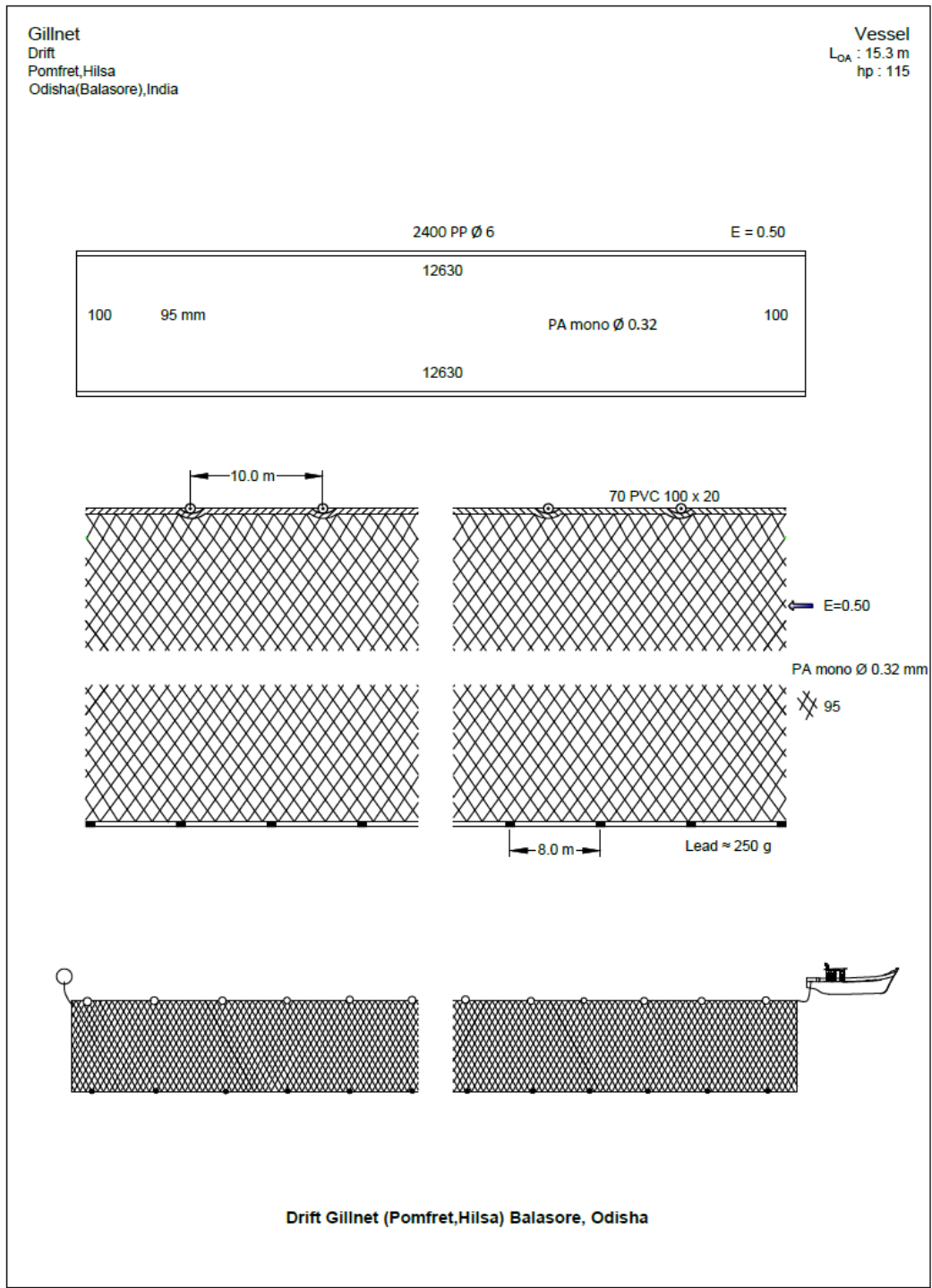


Fig. 6 : Design detail of typical PA multifilament drift gillnet operated in Odisha

d) Species composition

The main targeted species are tuna *Euthynnus affinis*, seerfish (*Scomberomorous commerson* and *S. guttatus*), Rays (*Himantura bleekeri*, *H. uarnak*) and shark (*Carcharinus sorrah* and *Sphyrna lewini*) and billfish *Istiophorous platypeterus*, Barracudas, *Sphyrna barracuda* and other fishes like *Ilisha elongata*, *Epinephelus chlorostigma*, *Pampus argentus*, *P. chinensis*, *Tenualos ailisha*, *Eleutheronema*

tetradactylum. Studies with the large mesh gillnets showed that, it is the effective fishing method for exploiting large pelagic fish species found in the high seas, which are not being caught by other fishing gears (Pravin et al., 2002). The main fishing season was from January to March and peak catch was observed during January. Pati and pati (1982), reported drift gillnets are the principal gear used in the coastal waters of Odish to catch hilsa, pomfrets, seerfish, marine catfishes, silver-

bars and sharks and minor quantity of horse mackerel, long-finned herring, shad, Indian salmon, serranids and sciaenids

Polyamide multifilament is widely used for the fabrication of gillnets in India, which is gradually being replaced by HDPE in late 1990s (Pillai, 1989, Pravin et al. 1998, Rao et al. 2002, and Thomas & Hridayanathan, 2002). Even though motorization of country crafts took place during 1986-87 periods in Orissa, the same was reflected in Puri district only in 1989. From 1991 onwards an increasing trend was observed in fishing by motorized crafts using gill nets and hooks & lines (Ammini, 2008).

The Government of India (GOI) also states that the fishing operations done by vessels using winches and other mechanised system for fishing operations maybe stated as mechanised fishing. The fishing operations on the Orissa coast by these above mechanised vessels using gill nets is carried out without the use of winches or any mechanised system, and is totally manual in nature. Therefore it is only accurate to say that the mechanised vessels of these regions conduct non-mechanised fishing, which is not prohibited by the Orissa Marine Fisheries Regulation Act (OMFRA), 1981. This clause in the OMFRA is misused by the fisher people of Odisha to meet their objectives which leads to the mass mortality of the turtles.

Clearly, the marine fisheries sector in Odisha deserves a special research attention for several reasons. First, it is a sector that provides employment to a large number of people, even if at a subsistence level. Second, the sector has witnessed a remarkable growth that need to be explained further. Thirdly, the sector has witnessed a remarkable technological advancement although substantial sections of the people drawing a living from it are still doing that with traditional and non-mechanised methods of capture. It is in this context that we seek to observe the labour market outcomes in the sector in Odisha. The information on design, structural parameters and operation of mechanised gillnetter and large mesh pelagic drift gillnets would serve as baseline data which would help future study.

IV. ACKNOWLEDGMENT

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