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Diversity of Purse Seine Vessels at Pekalongan Archipelago Fisheries Port (PPN) Above 100 Gross Tonnage

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***Abstract*— This research aims to determine the diversity of purse seine vessels based on gross tonnage measurements which was carried out from April 2023 to July 2023. This study collected sampling data on purse seine vessels in the Pekalongan PPN, both when the vessels were berthed, and collective data sourced from the authorities Archipelago Fishing Port (PPN) Pekalongan. In this formulation, it begins with identifying the dimensions of the ship, measuring the volume of the fish hold and interviewing a number of crew members who work on the ship. The aim of this research is to identify the main dimensions of ships and describe the operation of purse seine ships. with an average ship size of over 100 gross tonnages to 200 gross tonnages with a crew of 35 to 40 people.**

Keywords—purse seine, fishing boat crew, fish hold

I. INTRODUCTION

Ship accidents, especially fishing vessels, often occur in Indonesian waters. The National Transportation Safety Committee (KNKT) recorded 483 cases of fishing vessel accidents that occurred in 2018-2021 and killed 443 people. Reporting from the mass media Public Info (2018), the KM Arung Samudera ship accident occurred due to a leak in the ship's hull. Apart from that, it was recorded in the mass media Detik News (2019) that an accident occurred on the fishing vessel KM Pieces in the waters of the Makassar Strait which killed 4 crew members. Fishing boat accidents that occur are generally caused by external factors such as weather and internal factors such as ship maintenance and the availability of safety equipment.

Efforts to minimize the occurrence of ship accidents are routine and periodic maintenance of ships, as well as the availability of safety aids on board. In general, ship safety equipment is regulated by Safety of Life at Sea (SOLAS) 1974, Non-Convention Vessel Standard (NCVS) 2009, and Law Number 17 of 2008 concerning Shipping. SOLAS (1974) explains that the types of safety aids include lift boats, inflatable life rafts, life buoys, swimming vests (swimming vast). The larger the ship used, the greater the minimum number of safety equipment that must be available on board. In addition, the number of safety equipment is also influenced by the number of crew members on board, which is around a minimum of 5-10% of the total number of crew members.

One of the ports that will be discussed is the Pekalongan Archipelago Fisheries Port (PPN), which is a port located on the north coast of Central Java. It can be seen from the activity when the ship leans to load and unload the fish caught. PPN Pekalongan is a type B port located in Pekalongan City, Central Java. Pekalongan Fisheries was originally a public port which was managed by the Department of Transportation, because it was widely used by fishing vessels. Since December 1974 its management and assets were handed over to the Department of Agriculture. The Directorate General of Fisheries changed its status to a Special Fisheries Port. According to Andira et al (2019), PPN Pekalongan is one of the ports that can improve the community's economy and dominate fishing activities using purse seine fishing gear. This port has 157 purse seine vessels with ship sizes ranging from 65-200 gross tonnage (GT). The variety of ship sizes has an impact on the number of crew members on board. In general, ships measuring 65-100 GT have 15-30 crew members, while ships measuring 100-200 GT have 30-40 crew members. Each ship tends to provide personal safety equipment in the form of life jackets whose condition and quantity do not match the number of crew members. Based on the results of interviews, fishermen tend not to bring life jackets because more life jackets will require more storage space. In addition, the condition of the available life jackets is not always in a usable condition. Limited costs in maintaining and procuring safety equipment are also problems that must be faced by fishermen in PPN Pekalongan.

In the fishing area, the Ministry of Maritime Affairs and Fisheries (KKP) stipulates arrangements regarding fishing routes through the Minister of Maritime Affairs

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and Fisheries Regulation Number 71/PERMEN-KP/2016 concerning fishing routes which are divided into 3 parts of the fishing area, namely: Fishing Lane I consists of Fishing Lane IA, covering coastal waters up to 2 (two) nautical miles measured from sea level at the lowest ebb, and Fishing Lane IB, covering coastal waters outside 2 (two) nautical miles up to with 4 (four) nautical miles. While Fishing Lane II covers waters outside Fishing Lane I up to 12 (twelve) nautical miles measured from sea level at the lowest ebb. Meanwhile, Fishing Route III includes the Indonesian Exclusive Economic Zone (ZEEI) and waters outside Fishing Route II.

The fishery management area boundary area (WPP) is regulated in Ministerial Regulation No.18/PERMEN-KP/2014 divided into 11 WPP areas, including WPP 571, 572, 573, 711, 712, 713, 714, 715, 716, 717, and 718. The limitation of this research is fishing vessels with a size above 30 Gross Tonnage, where the fishing area is focused on the fishing area line III with the most types of fishing vessels in the Pekalongan VAT are Purse Seine vessels. Referring to the problems above, it is necessary to conduct a study related to the formulation of alternative safety devices that do not require additional space. In this formulation, it begins with identifying the ship's dimensions including the overall length of the ship, the width of the ship, the ship's water draft, the gross tonnage of the ship and the type of activity of the crew members during purse seine fishing activities. The aim of this research is to identify the main dimensions of ships and describe the operation of purse seine ships. Through this research it can be used as a basic study in formulating alternative safety equipment for fishing vessels with purse seine fishing gear.

II. METHOD

his research was conducted from April 2022 to June 2023 at PPN Pekalongan, Central Java. This research uses literature study, observation and interview methods. The literature study aims to obtain data in the form of fishing routes based on the GT size of the vessel. The observation method is carried out on ships at PPN to obtain data on ship dimensions and hatch volume sizes. The interview method was carried out with Pekalongan PPN officers, ship owners and ship crew members to obtain data in the form of complete safety equipment available.

The data processing was carried out at the Fisheries Vessel Laboratory, Department of the Faculty of Fisheries and Marine Sciences, Bogor Agricultural Institute and the Computer-based Shipbuilding Structures and Systems Laboratory using several ship design software, Faculty of Marine Technology, Darma Persada University.PPN Pekalongan has 157 purse seine vessels measuring 65 - 200 GT. Around 64%, this port is dominated by purse seine vessels over 100 GT. The data collection method used in this research is accident sampling. This method is used because not all ships dock at the Pekalongan PPN at the same time. Through the accident sampling method, 100 units of purse seine vessels were obtained as research samples.

he data processing procedure is carried out by designing purse seine vessels over 10 GT, calculating the ratio of the volume of the hold to the displacement volume, calculating the ratio of the volume of the hold using the Cubic Number (CUNO) formula, calculating the ratio of the volume of the ship to the GT of the ship, and calculating the ratio of the dimensions of the hold to the sample ship dimensions. The sample ship design is made according to the shape and layout of the space which includes the top, side and front views of the ship. In calculating the displacement volume using the Acc formula equation. Sabit series 60 in Harald Poehls (1979), namely:

$$V_{disp} = LBP \times B \times T \times Cb \ [m^3] \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$Cb = 1{,}05 - (1{,}67 \times Vs/\sqrt{g.LBP}) \quad \ldots\ldots\ldots\ldots\ldots\ldots . \quad (2)$$

Where:
V_{disp} = *Volume Displacement*
LBP = *Length Bettwen Perpendicular*
B = *Breadth* atau lebar kapal
T = *Draft* atau sarat air
Cb = *Coefficient Block*
Vs = *Velocity speed*
g = Gravitational acceleration 9.8 m/sec

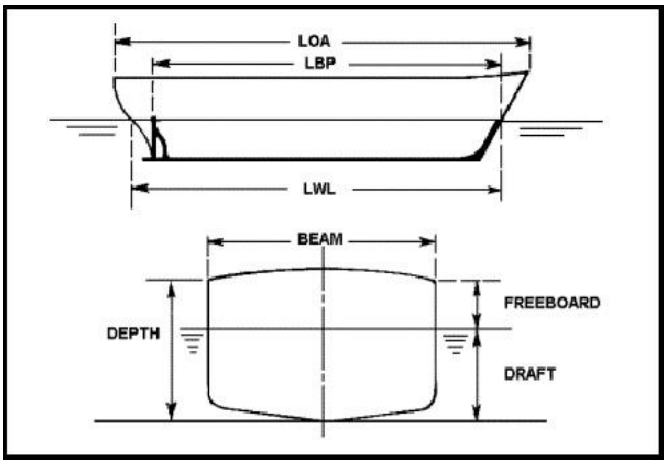

Figure. 1. Principle of Dimention

CUNO = Loa x B x Dm ……....(3)

Vfh = CUNO x 0,14 + 10 % ……(4)

Where:
Loa = Overall length of the ship
Dm = Ship height is measured in the midship section
Vfh = Multiplier factor for the hold

Furthermore, the calculation of the GT of ships that function in classifying ships in the Pekalongan PPN is based on the size of the GT. Based on the provisions contained in the International Convention on Tonnage Measurement of Ships 1969, the GT of ships is determined according to the formula:

GT = Kl.V …… (5)

Where:
GT = *The gross tonnage of the ship or the volume of the ship's space* (m3)
K1 = Logaritma 0,2 + 0,002 log1.V

dimensions of the overall ship length (Loa), which ranges from 32.08 to 35.73 meters, the length of the ship's waterline (Lwl) ranges from 25.05 - 29.91 meters, the width of the ship (B) ranges from 8.03 - 9.05 meters,

V = The total contents of all enclosed spaces expressed in cubic meters (m^3).

After data processing is carried out, it continues with data analysis. Data analysis can be done using descriptive analysis. This analysis aims to explain the design or design and dimensions of purse seine vessels with sizes above 100 GT and to describe the placement and position of several other rooms as a complement to the main space of purse seine vessels used on board to carry out fishing operations and storage of caught fish as well as explains several fishing operation methods used on purse seine vessels registered with PPN Pekalongan

III. Results and Discussion

A. Purse seine Ship Design and Dimensions

Purse seine vessels in PPN Pekalongan are generally dominated by vessels over 100 gross tonnages. On the 10 purse seine vessels, the sample results from field measurements and data collection (Table 1) have and the height/depth of the ship (D) ranges from 2.48 - 3.43 meters. Apart from that, all of these sample ships also have a gross tonnage ranging from 117 GT -198 GT.

Table 1.
SAMPLE DATA OF PEKALONGAN PPN

No	Ship name	GT	Main size					V hold(m^3)
			Loa	Lwl	Breadth (B)	Depth	Draft	
1	KM. Bintang Mas Samudra - A	148	35,51	28,91	8,15	3,02	2,416	306,81
2	KM Berkah Samudra B	192	32,2	25,05	8,9	3,3	2,64	394,63
3	KM. Bintang Mas Samudra - I	148	35,31	29,02	8,32	3,21	2,568	226,4
4	KM. Maju Arindo Utama	147	33,31	27,42	8,08	3,1	2,48	278,43
5	KM. Sinar Mina Lestari	159	32,08	26,78	8,08	3,07	2,456	237,85
6	KM. Putra Sukses Mandiri-A	198	35,42	28,66	9	3,35	2,68	261,77
7	KM. Sumber Jaya A	168	34,68	26,99	8,45	2,78	2,224	275,2
8	KM. Harapan Bintang Surya	117	32,34	26,25	8,03	2,48	1,984	203,09
9	KM. Sumber Jaya A	168	34,68	26,99	8,45	2,78	2,224	275,2
10	KM. Sumber Rizqi A	197	35,73	29,91	9,05	3,43	2,744	365,15

Based on these 10 sample ships, a ship design was made using the average value of all sample ships. The ship design is assumed to represent the design of all sample ships. The main dimensions of the ships obtained can be seen in table 2.

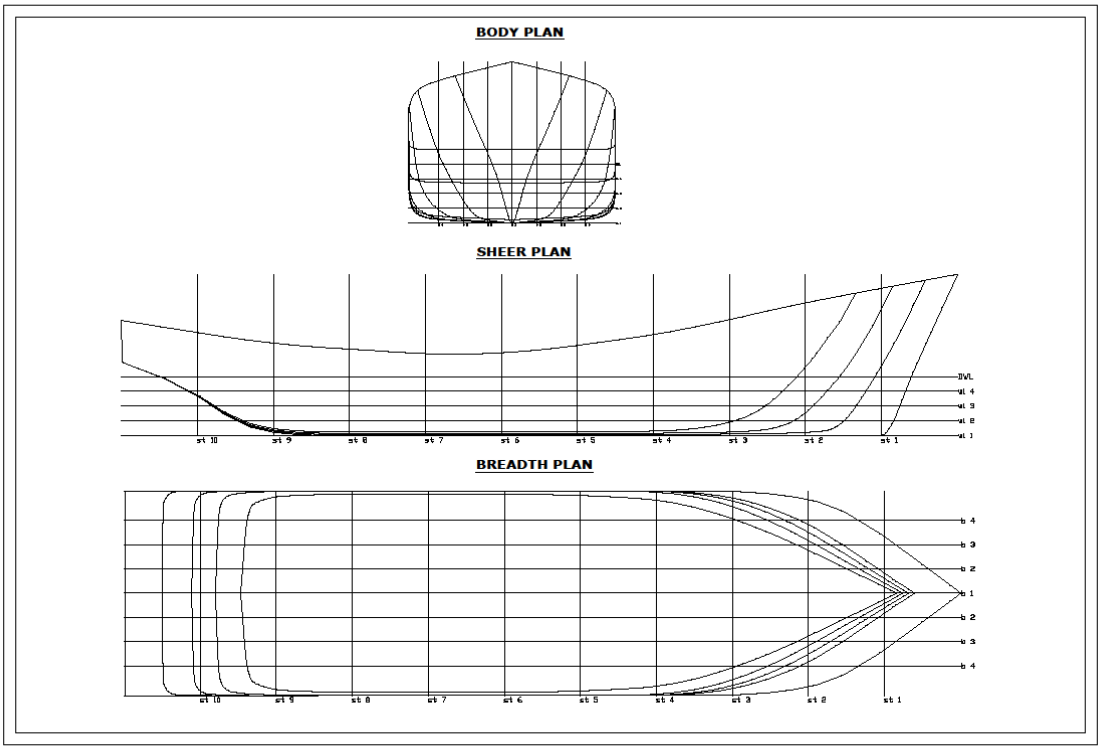

Figure. 2. Lines Plan

TABLE 2.
SHIP DIMENSIONS

Purse Seine Vessel Redesign Size	
Length Over All (*Loa*)	34,126 meters
Length water line (Lwl)	27,598 meters
Breadth (B)	8,451 meters
Length Between Perpendicular (Lbp)	29,171 meters
Higth(D)	3,052 meters
Draft(d)	2,442 meters

TABLE 3.
COEFFICIENT VALUE

Calculation	Value	Unit
Displacement	473,688	tonne
Volume	462,134	m^3
WSA	331,384	m^2
Cp	0,776	
Cb	0,729	
Cm	0,939	
Immersion (TPc)	2,336	tonne/cm
Gross Tonne	164	Tone

The calculation results obtained from the main dimensions of the purse seine ship redesign obtained displacement values, vessel volume, ship wet area (WSA), coefficient, ton per centimeter (TPc), and ship gross tonne. The results of these values can be seen in table 3.

The purse seine ship design at PPN Pekalongan has a raked bow type bow with a transome type stern. This ship has several rooms, namely accommodation room (wheel house), crew room, main engine room, refrigerator room for frozen fish and fish hold for storing frozen fish.

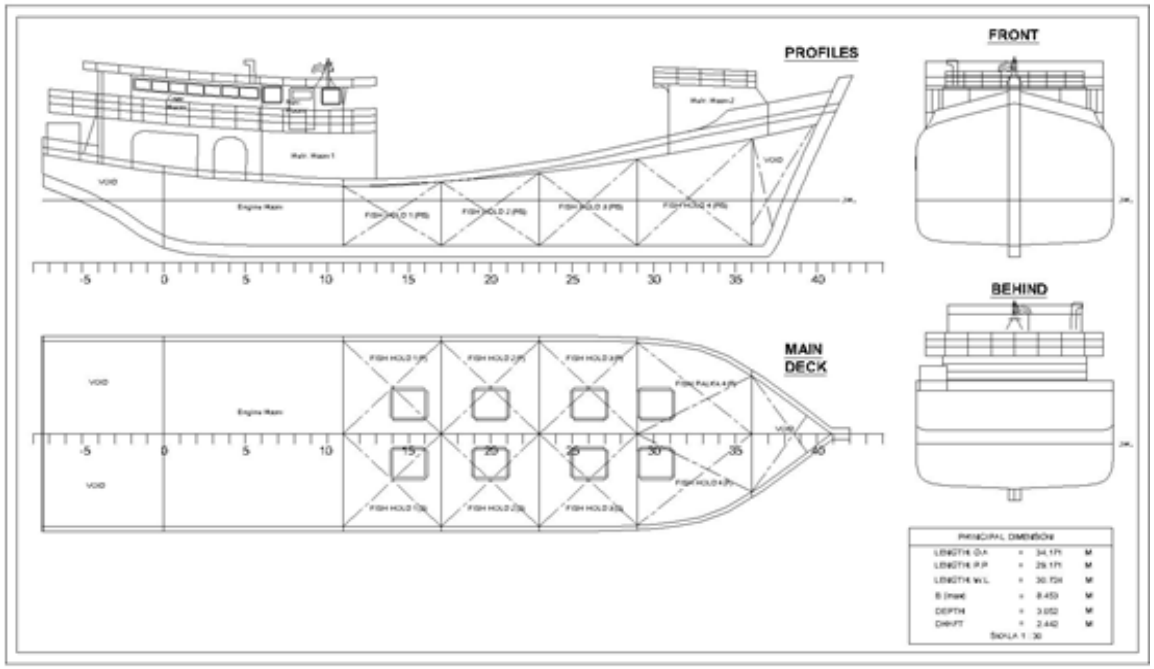

Figure. 3. The design shape of the PPN Pekalong purse seine ship

The ship's steering room measures 3.5 m x 6.15 m x 2 m and is located near the stern of the ship. The fish freezing room has 2 parts, located under the steering room and measuring 4.9 m x 6.15 m x 2.2 m and the bow section with dimensions 4.2 m x 6 m x 2.6 m while the ship's engine room is below the ship's freezing room. The fish refrigeration system on vessels over 100 GT generally uses a Refrigerator Sea Water (RSW) system to maintain the quality of the storage of caught fish, even though the length of the voyage during fishing operations can be carried out for a long period of time without affecting demand. ice to freeze and cool caught fish.

This ship also has 8 hatches in the hull which are arranged side by side so that separate compartments are formed, limited by walls which are part of the permanent construction, thus increasing the strength of the ship both longitudinally and transversely. The dimensions of the entire hatch space are 17.5 m x 8 m x 3.5 m. Hatch 1 (P and S) 45,230 m³ total volume 90,460 m³, hatch 2 (P and S) 44,225 total volume 88,459 m³, hatch 3 (P and S) total 85,436 m³ and hatch 4 (P and S) total volume 80,410 m³ overall (table 4).

TABLE 4.
COEFFICIENT VALUE

Information	Volume Area (m³)	Total (m³)
Hold 1 (P)	45.230	
Hold 1 (S)	45.230	
Hold 2 (P)	44.225	
Hold 2 (S)	44.225	334.756
Hold 3 (P)	42.718	
Hold 3 (S)	42.718	
Hold 4 (P)	40.205	
Hold 4 (S)	40.205	

The purse seine fishing gear is in the form of a net that is placed on the floor of the boat deck when heading to the fishing area (fishing ground). For fishing operations using nets and the help of smaller boats (Figure 3). The operating pattern for fishing with a purse seine is to circle the group of target fish caught with a net, then after forming a circle with the help of a small boat which is always carried on the deck of the ship as one of the advantages in the operation of setting the net, then the corrugated rope at the bottom is pulled to form a bag. This activity aims to prevent the target fish from escaping from the net. This tool is intended to catch (fish target) pelagic fish, especially pelagic fish which have high economic value and are profitable for fishermen (Bambang, 2020; PPNP, 2019). The characteristics of the purse seine are located in the ring at the bottom of the net and are grouped into 5, namely: (1) net body, (2) crimp rope, (3) ring, (4) float and weight, and (5) rope sheet (Martasuganda, 2004).

Purse seine vessels usually use one main engine (single main engine) where the size of the thrust (horse power) is influenced by the dimensions of the vessel and the speed set during operations towards the fishing ground. All major dimensions of the ship.

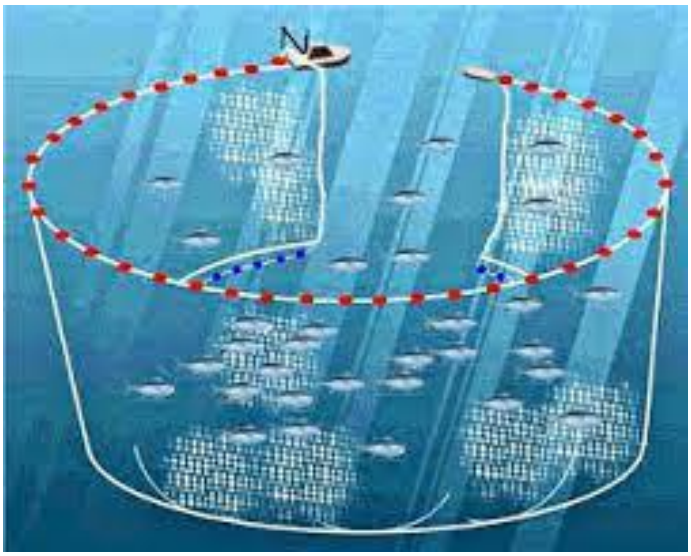

Figure 4. Pure seine catching pattern

Based on the value of the ratio of the hatch volume to the Cubic Number (CUNO), calculate the ratio of the volume of the ship to the GT of the ship, and calculate the ratio of the ratio of the hatch dimensions to the dimensions of the sample ship. CUNO hatch design is an approach method for determining the hold volume by multiplying the overall length of the ship (Loa) by the width (B) and height (Dm). *Cubic Number Method* (CUNO).

Loa x B x Dm = CUNO, Vfh = CUNO x 0,14 + 10%
Where:

- *length over all*(Loa) = 34,126 m
- *Breadth* (B) = 8,451 m
- Depth moulded (Dm) = 3,052 m

CUNO = Loa x B x Dm
CUNO = 34,126 m x 8,451 m x 3,052 m
CUNO = 880,193 m
Vfh = CUNO x 0,14 + 10%
Vfh = 880,193 m x 0,14 + 10%
Vfh = 211,25 m^3
the volume of the hold obtained from the Cubic number method is 211.25 m^3

B. Operation Method

The zoning of the PPN Pekalongan capture fisheries area has 5 WPPs, namely WPP 712, WPP 713, WPP718, WPP 572, and WPP 573 (figure 5), with an average of vessels operating in fishing areas of 2 WPP to 3 WPP fishing operation areas .

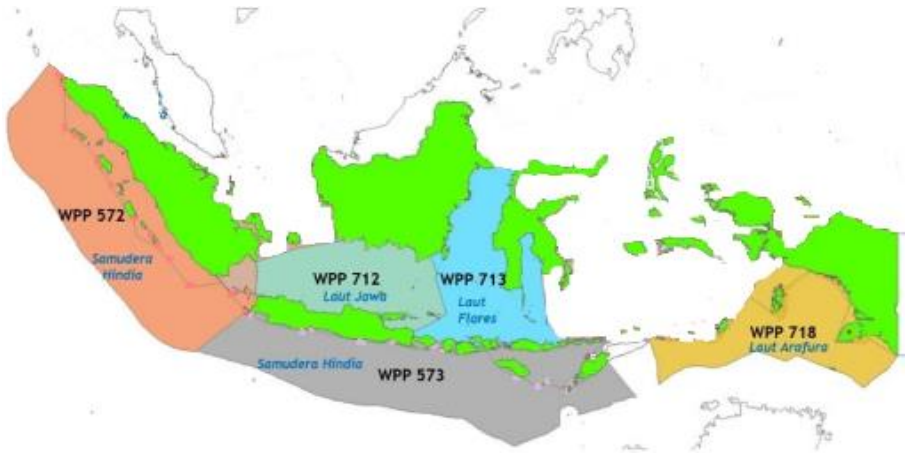

Figure 5. Fishing Area Map According to WPP Division

The number of crew members of the Purse seine boat is the largest number of crew members in fishing operations to require energy when pulling fishing nets onto the ship. With the division of tasks including the captain/helmsman (fishing master) or what is often called tekong, engineer or engineer (kwanca), boat carrier (skoci), ballast arranger, cook (stoker) and net arranger (Doni, 2003). Purse seine fishing gear measuring more than 100 GT (big purse seine) usually carries nets as a fishing tool with a net length of more than 500 m. Purse seine vessels have a workforce that is influenced by the size of the GT of the ship. The average number of crew members on ships ranging from 100 GT to 200 GT reaches 40 people so that the total weight of all crew members on board can be known (table 3). Therefore, the maximum individual weight is 73 kg so

that the total crew of the ship is assumed to be 2,920 kg or 2.92 tons. Apart from the number of crew members, no less important is the operational speed of the ship to the fishing area. The speed of the boat must exceed the swimming speed of the fish so that the boat can catch the target fish caught in the fishing ground. Fishing operations usually take more than 60 days to more than 1 year to return to the port of origin as a registration port (PPN Pekalongan)

TABLE 5.
RATIO OF HEIGHT TO WEIGHT

Human body size shape			
Height (cm)	**Small**	**Currently**	**Big**
157	51 - 53	54 - 59	57 - 64
160	52 - 56	55 - 60	59 - 66
162	54 - 57	56 - 62	60 - 67
165	55 - 59	58 - 63	61 - 69
168	56 - 60	60 - 65	63 - 71
170	58 - 62	62 - 68	65 - 73
173	60 - 64	63 - 69	67 - 75
175	62 - 66	65 - 71	69 - 77
178	64 - 68	66 - 73	71 - 79
180	66 - 70	68 - 75	72 - 81

By: P2PTM Kemenkes RI

97.07% of the types of fish landed were pelagic fish and the remaining 2.93% were demersal fish. Of the total pelagic fish, there are 32 types, including Tembang / Jui Fish (Sardinella fimbriata), Flying Fish (Decapterus sp) including potential commodities and Mackerel Fish (Rastrelliger sp) as a superior commodity for capture fisheries in PPN Pekalongan and large pelagic fish such as fish. Setuhuk (Makaira mazara), Tongkol (Thunnuss tonggol) and the like. Meanwhile, there are 28 types of demersal fish caught, such as Red Snapper (Lutjanus malabaricus), Shark, Sebelah Fish, there are also several types of large pelagic fish such as White Setuhuk, Sailfish and Gray Tongkol (PPNP, 2019) .

The wave height in the North Sea of Pekalongan ranges from 1.25-2.5 meters with a "medium" wave height status (Syahbandar PPNP, 2021). According to Al Fajar (2019), Pekalongan's ship operation area is not only in the North Sea of Pekalongan, but also to the Makassar Strait, south of Java Island, and south of Sumatra. In the southern region of Java, the wave height is greater than in the north of Pekalongan, namely around 3-4 meters. Apart from that, the sea breeze is also an obstacle for fishermen. Currently the sea breeze ranges between 4-15 knots.

IV. Conclusion

From the results of research on the diversity of purse seine vessels at Pekalongan Archipelago Fisheries Port (PPN), it can be concluded:

1. Zoning of the capture fisheries area in Pekalongan Regency has 5 WPPs, namely 712, 713, 718, 572, 573, with an average vessel in the fishing area of 2 to 3 WPPs.
2. The size of the hold depends on the main size of the ship and the shape of the ship's hull (Coefficient Block).
3. Fishing operations are relatively far away and more than one WPP so that the landing time at the port of origin (PPN Pekalongan) is relatively long (more than 1 year) therefore landing the caught fish in the nearest fishing port area where the end of fishing to fulfill volume of fish hatch loading space.
4. The larger the dimensions of the purse seine vessel, the more crew members will be involved, thus requiring more energy during fishing operations, because pulling nets for purse seine vessels is still manual.
5. There are still many fishing vessels, especially purse seine vessels, with minimal availability of safety equipment, both in terms of their presence and quantity, we can see that purse seine vessels have the largest number of crew members for fishing.

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