



Fishing Vessel Characteristics with Multipurpose Gear to Support Fishing Operations in the Northern Sea of Java, Indonesia (Case Study in Indramayu)

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Authors' contributions

This work was carried out in collaboration among all authors. Author IMA designed the study, performed the analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AMAK, LPD and NMK managed the analyses of the study. Authors HH and AR managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study aims to analyze the ratio of the main dimensions of the vessel to see the performance of vessels with multipurpose gear. The research was conducted in February-March 2018 at the Karangsong Fish Landing Base (Ind: PPI), Indramayu. The object of research is the vessel used for fishing operations with multipurpose gear. The research method uses survey methods through the measurement of the main dimensions of fishing vessels, interviews and literature studies. The data obtained were then analyzed by comparative descriptive to compare the value of the ratio of the main dimensions of the vessel between Length and Breadth (L/B), the ratio between Length

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and Depth (L/D) and the ratio between Breadth and Depth (B/D). The calculation results of the ratio of the main dimensions of the vessel are then compared with the standard ratio values in Indonesia. Fishing vessels with multipurpose gear in Indramayu have good vessel motion characteristics but have an impact on slow speed, strong elongation strength of the vessel, and stability and ability to drive a good vessel. The dimension ratio of multipurpose gear vessels generally meets the criteria of the ratio of the main dimensions of vessels based on the method of operation in Indonesia. It should be noted that the L / B ratio tends to exceed the minimum standard criteria for the Indonesian dimension ratio, this results in slow speeds and will interfere with the setting and hauling fishing gear on seine boat and mini trawl fishing gear.

Keywords: Fisheries; fishing vessel; Indramayu; Java Sea; main dimension; ratio.

1. INTRODUCTION

The fishing sector is one of the most dangerous activities with a high mortality rate. Fishing vessels, especially small fishing boats, make up the largest number of vessels. Though they are among the most recently built, they still pose safety concerns for three factors: crew, vessel, and environment. According to Lapa [1], accidents onboard occur mainly due to the dynamic stability of the marine vehicle, meteorological conditions, vehicle location, seasons, and vehicle characteristics [1].

As a maritime country, Indonesia has the largest sea area and approximately seventeen-thousand islands scattered in the archipelago region, has the economic potential of both biological and non-biological in the maritime sector [2]. Management of fishery resources development in Indonesia is still centred on the island of Java [3].

One of the potential fishing resources on the island of Java is in the North Sea. These waters are a source of capture fisheries in Indonesia. The centre of capture fisheries exploration activities in the north sea of Java is Indramayu. Fisheries activities cannot be separated on the support of a fishing vessel to assist in the transportation of fishing base to the fishing ground or otherwise.

The importance of the role of fishing vessels in supporting the success of fishing operations so that the physical capabilities of the vessel need to be considered. However, in Indramayu, some vessels carry and operate multipurpose gear while capturing. The number of vessels using multipurpose gear is not known with certainty, because it does not have a permit by the government. This can endanger fishermen in

fishing gear operations because they carry more fishing gear than they should.

The use of multipurpose gear can be done as long as the vessel is by its characteristics [4]. Fishing vessels used in the operation of fishing gear must have appropriate main dimensions of the vessel to support the success of fishing operations [5]. The suitability of the main dimensions on the vessel can be seen from the ratio between length and breadth (L/B), length and depth (L/D) and breadth and depth (B/D). The ratio will affect the motion of the vessel used in the fishing process [6]. Thus it is necessary to calculate the ratio of the main dimensions of the vessel to see the performance of the vessel with multipurpose gear.

2. MATERIALS AND METHODS

The research was conducted in February-March 2018 at the Karangsong Fish Landing Base (Ind: PPI), Indramayu. The method used in this research is the case study method. Cases of concern are fishing vessels that have multipurpose gear. The object of research is the vessel used for fishing operations with multipurpose gear. The research method uses survey methods through direct measurement activities (Length Over All / LOA, Breadth, and Depth) and literature studies to compare the ratio of the main dimensions of fishing vessels in Indonesia. Data were collected by purposive sampling of 10 vessels. The data obtained were then analyzed by comparative descriptive to compare the ratio of the main dimensions of the vessel between Length and Breadth (L/B), the ratio between Length and Depth (L/D) and the ratio between Breadth and Depth (B/D). The calculation results of the ratio of the main dimensions of the vessel are then compared with the standard ratio values in Indonesia [4,5,6] based on the type of method multipurpose gear

operation. The main dimension ratio values can be seen in Table 1.

3. RESULTS AND DISCUSSION

Fishing vessels, fishing gear and fishermen are three factors that support the success of a fishing operation. Based on Basya et al. [7], fishing operations are risky activities because the situation on the high seas is unpredictable. All fishing activities are concentrated on the deck of the vessel. Therefore the condition of the vessel must be suitable to support fishing operations.

According to Karto [8] the PPI Karangsong which is a Fish Landing Base center represents the central part of the Java coast. This PPI has 1.101 fishing vessels consisting of inboard vessels with 10 - 30 GT as many as 162 vessels, 30 - 50 GT as many as 148 vessels, vessels more than 50 GT as many as 19 vessels while outboard motors <5 GT as many as 772 vessels [9]. Each vessel is generally used to operate one fishing gear. The results of field observations in Indramayu Regency contained vessels with multipurpose gear. This can affect the motion of vessels at sea.

One of the basic methods to determine the suitability of vessels in doing vessel movements in the waters is to find out the ratio of the main dimensions of the vessel [5]. Measurement of the main dimensions of the vessel was conducted to determine the ratio of the main dimensions of fishing boats, where the value of the ratio L/B, L/D, B/D is very important in making or designing the vessel because it will affect the strength, speed, and stability of fishing vessels [10]. Fyson [11] states that the values of L/B, L/D, and B/D can be used as a reference for analyzing the motion resistance and stability of the vessel, the longitudinal strength and if the motion of the vessel, and the stability and ability to push the vessel. The results of measurements of the main

dimensions of vessels carrying multipurpose gear are presented in Table 2.

Based on Table 2 it can be seen that the vessel carries multipurpose gear including squid jigging, seine net and mini trawling. According to Bjarnason [12], Squid jigging is carried out using mechanically powered jigging machines with 20 to 25 jigs attached to each line. Squid jigging vessels have overhead lights which illuminate the water and attract squid, which then gather in the shaded area under the boat. The boat seines consists basically of a conical netting body, two relatively long wings and a bag. The boat seine are operated from a wide range of rather small and simple boats and by modern specialized medium size units with specific deck equipment, and seine nets can be operated by medium and large decked vessels [13]. Mini trawl is a smaller version of the trawlnet used by mechanised trawlers for shrimp fishing. in the traditional sector, the fishermen ingeniously devised in the late eighties, a simple method of fishing for shrimps from nearshore regions. They operated a smaller version of shrimp trawl net locally called mini trawl from plank, built boats, which fetched good returns [14].

The main dimensions of vessels with multipurpose gear in PPI Karangsong have lengths ranging from 7,05 – 10,7 m and the average is 8,38 m. Breadth between 3,05 – 3,95 m and an average of 3,43 m. Depth range between 0,87 – 1,3 m and an average of 0,87 m. The results of the main dimensions of the vessel are presented in Fig. 1. Breadth and depth tend to have almost the same value, namely breadth of 3 m and depth of about 1 m, but have a different LOA. This main dimension value variation is because the vessel is still made in a traditional vessel yard. Tangke [10] states that traditional vessel building is usually not based on hereditary plans and calculations so that in its manufacture there are always changes in the characteristics of the shape of the vessel.

Table 1. The ratio of the main dimensions of the fishing vessel based on the fishing method in Indonesia [9]

| Fishing method | Main Dimension Ratio | | |
|--------------------|----------------------|--------------|-------------|
| | L/B | L/D | B/D |
| Encircling Gear | 2,60 – 9,30 | 4,55 – 17,43 | 0,56 – 5,00 |
| Towed/Dragged Gear | 2,86 – 8,30 | 7,20 – 15,21 | 1,25 – 4,41 |
| Static Gear | 2,83 – 11,12 | 4,58 – 17,28 | 0,96 – 4,68 |
| Multipurpose gear | 2,88 – 9,42 | 8,69 – 17,15 | 0,53 – 6,09 |

Table 2. The main dimensions of the fishing vessel with multipurpose gear in Indramayu

| No. | Vessel name | Fishing Gear | LOA (m) | Breadth (m) | Depth (m) |
|-------------|-------------------|---------------------------------------|---------|-------------|-----------|
| | | | L | B | D |
| 1. | KM. Nanjung | Squid jigging, seine net | 10,7 | 3,37 | 0,95 |
| 2. | KM. Sari Mulya | Squid jigging, boat seine, mini trawl | 7,93 | 3,2 | 0,68 |
| 3. | KM. MR | Squid jigging, boat seine, mini trawl | 8,16 | 3,65 | 1,03 |
| 4. | KM. Mulya Sari | Squid jigging, boat seine, mini trawl | 7,4 | 3,05 | 0,8 |
| 5. | KM. Putri Tunggal | Squid jigging, boat seine, mini trawl | 7,4 | 3,52 | 0,73 |
| 6. | KM. Sinar Mulya | Squid jigging, boat seine, mini trawl | 8,12 | 3,37 | 0,9 |
| 7. | KM. Yopi Jaya | Squid jigging, boat seine, mini trawl | 8,9 | 3,72 | 1,3 |
| 8. | KM. Jaya Mulya | Squid jigging, boat seine, mini trawl | 9,9 | 3,95 | 0,69 |
| 9. | KM. Jaya Mulya | Squid jigging, boat seine, mini trawl | 8,25 | 3,13 | 0,9 |
| 10. | KM. Damar Wulan | Squid jigging, boat seine, mini trawl | 7,05 | 3,37 | 0,75 |
| Average (m) | | | 8,38 | 3,43 | 0,87 |
| Maximum (m) | | | 10,7 | 3,95 | 1,3 |
| Minimum (m) | | | 7,05 | 3,05 | 0,68 |

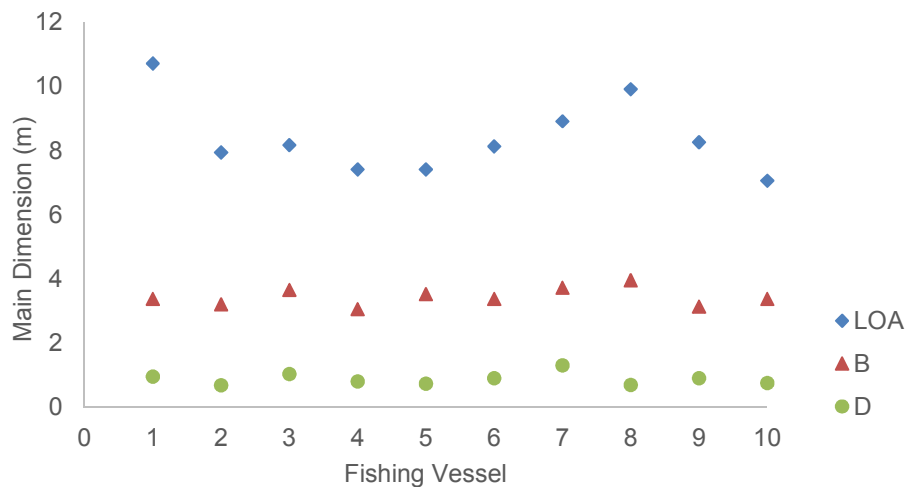


Fig. 1. The main dimensions of the fishing vessel with multipurpose gear in Indramayu

Fishing ground for vessels in indramayu, namely the Water Management Area (WPP) 711 covering the waters of the Karimata Strait, the Natuna Sea, and the South China Sea and WPP 712 covering the Java Sea Waters. The condition of these waters affects the characteristics of fishing vessels that support the region. Vessels used must pay attention to vessel viability at sea

in the process of fishing. Conditions that relate directly to the high seas will affect the characteristics of fishing vessels that support fishing operations in the region. Vessels used in multipurpose gear capture operations are traditional vessels. However, the design of the vessel must still be considered to maintain the viability of the vessel at sea in the process of

fishing operations. According to Fyson [11] an important thing to consider in the design of a vessel is the characteristic comparison of the main dimensions. The comparison includes the ratio between length and width (L/B), the ratio between length and depth (L/D) and the ratio between width and depth (B/D). Vessels that are the object of research are included in the group of multipurpose gear vessels because they carry out fishing operations with more than one fishing gear on the same vessel. Therefore, the ratio value of the main dimensions of multipurpose gear vessels (Table 3) will be compared with the value of the ratio of the main dimensions of multipurpose gear group fishing vessels in Indonesia (Table 1).

3.1 L/B Ratio

Palembang et al. [15] states that the L/B ratio in vessel design is used to analyze the motion and speed of a vessel. The smaller the value of the L/B ratio, the vessel has a good boat motion and influence on the speed of the vessel resulting in slow speed. Conversely, the greater the L/B ratio, the vessel has poor vessel motion and high vessel speed. L/B ratio calculation results have values between 2,09–4,03 and an average of 2,45. The L/B ratio is relatively small because it has passed the minimum limit of Indonesian multipurpose gear vessels based on Table 1 which is worth 2,88.

Table 3. The ratio of the main dimensions of multipurpose gear fishing vessels in Indramayu

| No | Vessel Name | Main dimension ratio | | |
|-----------|-------------------|----------------------|-------|------|
| | | L/B | L/D | B/D |
| 1 | KM. Nanjung | 3,18 | 11,26 | 3,55 |
| 2 | KM. Sari Mulya | 2,48 | 11,66 | 4,71 |
| 3 | KM. MR | 2,24 | 7,92 | 3,54 |
| 4 | KM. Mulya Sari | 2,43 | 9,25 | 3,81 |
| 5 | KM. Putri Tunggal | 2,10 | 10,14 | 4,82 |
| 6 | KM. Sinar Mulya | 2,41 | 9,02 | 3,74 |
| 7 | KM. Yopi Jaya | 2,39 | 6,85 | 2,86 |
| 8 | KM. Jaya Mulya | 2,51 | 14,35 | 5,72 |
| 9 | KM. Jaya Mulya | 2,64 | 9,17 | 3,48 |
| 10 | KM. Damar Wulan | 2,09 | 9,40 | 4,49 |
| Average | | 2,45 | 9,90 | 4,07 |
| Ratio Max | | 3,18 | 14,35 | 5,72 |
| Ratio Min | | 2,09 | 6,85 | 2,86 |

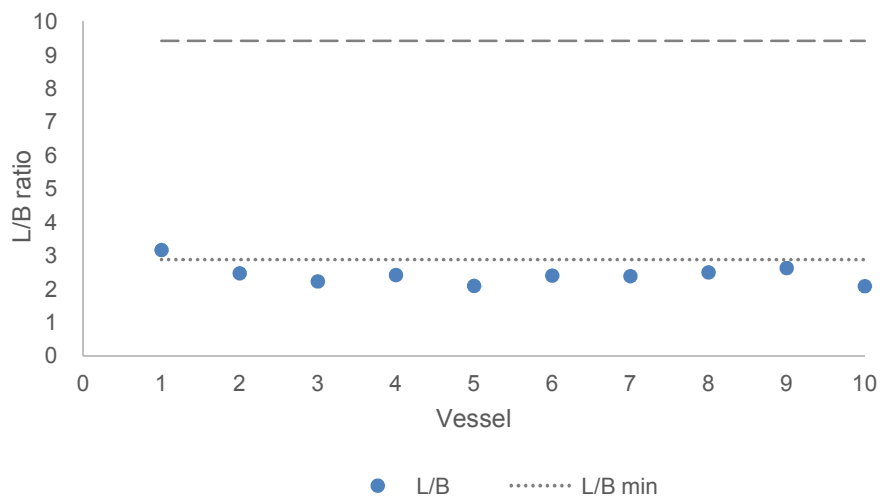


Fig. 2. L/B ratio of multipurpose gear fishing vessels in Indramayu

Fig. 2 shows that the L/B ratio of multipurpose gear vessels in Indramayu has a value below the standard dimension ratio of vessels in Indonesia. The L/B ratio below this minimum value means that multipurpose gear vessels in Indramayu have a hull shape that tends to be wide/fat so that it has good vessel motion but has an impact on the slow speed to operate the multipurpose gear. This wide hull shape has a positive impact because the vessel has a wide deck area to place the fishing gear and the vessel tends to have good movement. The multipurpose gear vessel in Indramayu carries 2-3 fishing gear (Table 2) in one vessel and has a different operating method. Therefore, the condition of vessels that have a slow speed will disrupt the process of setting and hauling fishing gear on a fishing ground.

3.2 L/D Ratio

Palembang et al. [15] state that the L/D ratio is the value of the vessel's elongated strength. L/D ratio which is getting bigger will have an impact on the weakening of elongated strength, but the smaller the L/D ratio will cause the vessel's elongated strength to get stronger [16]. Calculation of L/D ratio of multipurpose gear vessels in Indramayu has varied values which tend to be at a minimum value based on the ratio of multipurpose vessels in Indonesia (Table 1).

The results of the L/D ratio calculation have values between 6,85 – 14,35 and an average of 9,90. Fig. 3 shows the L/D ratio has a small tendency and is at the minimum value of the ratio

of vessels in Indonesia with the multipurpose gear method. Small value tends to cause multipurpose gear vessels to have strong elongation strength. Pangalila [17] states that the ratio of length and in large vessels gives effect to the elongation strength of the vessel so that the vessel is not easily broken when obtaining external forces acting to influence the elongated strength of the vessel.

3.3 B/D Ratio

The B/D ratio is the value used to analyze the stability and ability to drive a vessel [15]. Novita et al. [18] state that the greater the B/D ratio, the stability of the vessel will increase but the ability to push is reduced. The smaller the B/D ratio, the stability of the vessel is reduced and the ability to push faster. The results of the calculation of the B/D ratio of gillnet vessels in PPI Karangsong have values in the range between 2,86 – 5,72 and an average of 4,07. This value is included in the value of vessel ratio in Indonesia with the multipurpose gear method.

Fig. 4 shows the B/D ratio in the middle between the minimum and maximum B/D ratio values in Indonesia with the multipurpose gear operating method. Thus, multipurpose gear vessels in Indramayu have good stability and movement of the vessel. Mulyanto et al. [19] stated that fishing vessels require high stability because the way of operation of the net is on one side of the hull which causes the load-bearing to be in that place and when the net is lifted onto the vessel it will incline.

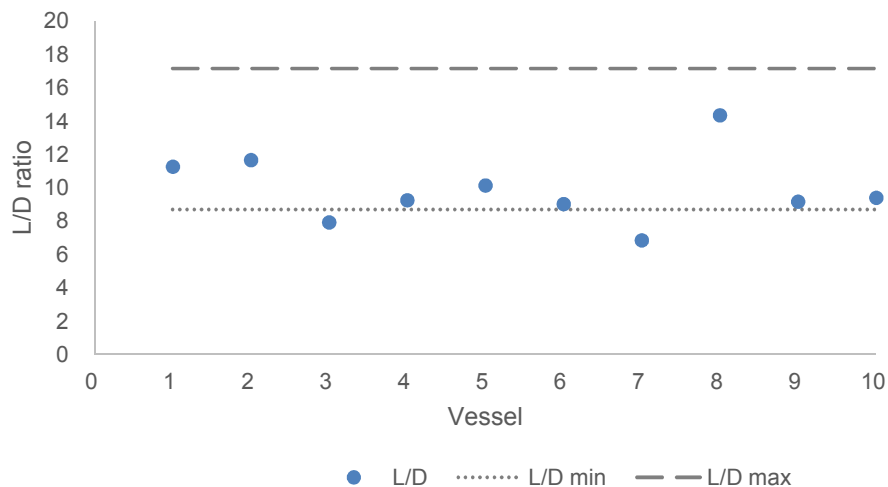


Fig. 3. L/D ratio of multipurpose gear fishing vessels in Indramayu

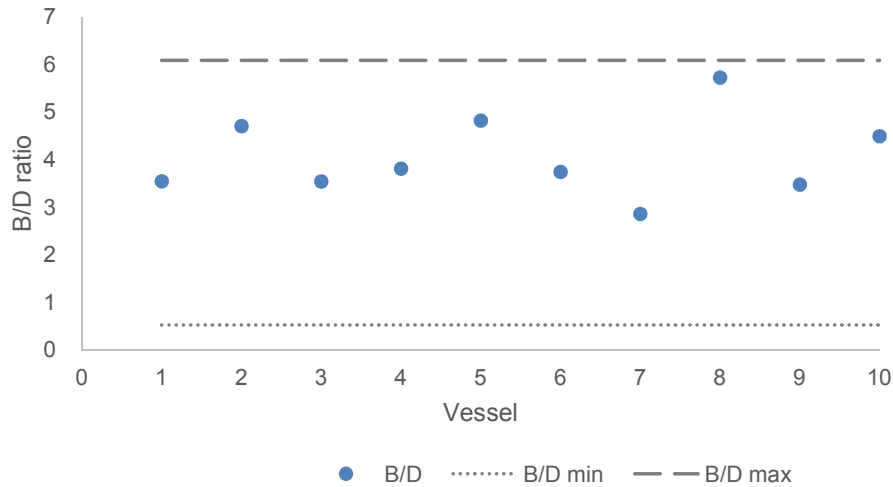


Fig. 4. B/D ratio of multipurpose gear fishing vessels in Indramayu

4. CONCLUSION

Fishing vessels with multipurpose gear in Indramayu have good vessel motion characteristics but have an impact on slow speed, strong elongation strength of the vessel, and stability and ability to drive a good vessel. The dimension ratio of multipurpose gear vessels generally meets the criteria of the ratio of the main dimensions of vessels based on the method of operation in Indonesia. It should be noted that the L / B ratio tends to exceed the minimum standard criteria for the Indonesian dimension ratio, this results in slow speeds and will interfere with the setting and hauling fishing gear on seine boat and mini trawl fishing gear.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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