

Characteristics of *Trammel net* in east coast Pangandaran, West Java, Indonesia

Lantun Paradhita Dewanti^{1*}, Aida Nurul Aulia², Dedi Supriadi³, Izza Mahdiana Apriliani⁴, Junianto⁵, Alexander Khan⁶

¹⁻⁶ Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Bandung-Sumedang, KM 21, Jatinangor, Indonesia

Abstract

This study aims to determine the construction of trammel net based in East Coast Pangandaran, West Java, Indonesia. Data collection was carried out from September 2019 to April 2020 using trammel net fishing gear located on the East Coast, Pangandaran. The method used is quantitative descriptive by analyzing the construction of the fishing gear, fishing method, the composition of the type of catch and the size of the main catch. The results showed that the trammel net fishing gear used by fishermen in Pangandaran had a construction consisting of 4 mm buoy rope with polyethylene (PE) material, 5 mm upper rope with polyethylene (PE) material, 16-inch picture strap mm with polyethylene (PE) material, outer net body with polyethylene (PE) monofilament material and mesh size of 1.75 inches and inner net body with polyamide (PA) monofilament material and mesh size of 1.75 inches, Y-30 float and lead ballast. The Hanging Ratio (E) of the outer net is 0.54 and the inner net is 0.47. The method of operating the trammel net in Pangandaran is carried out by being pulled or dragged at the bottom of the water by the ship so that it forms a circular net or by active fishing system method. The main catches consist of *Penaeus merguensis* and *Metapenaeus ensis* as much as 70% and 30% bycatch, and the composition of mature size catch on main catches is 78.66%.

Keywords: characteristic of fishing gear, hanging ratio, trammel net, East Coast Pangandaran

1. Introduction

Potential fish resources in Pangandaran as a part of Indian Ocean consist of large pelagic fish, small pelagic fish, demersal and crustaceans. Crustaceans (shrimp) became one of the commodities with the highest production of the 10 leading commodities, from 2013 to 2015, even in 2013 the shrimp became the commodity with the highest number of catches production in Pangandaran with 674.35 tons production ^[1]. The main challenges in catching shrimp are the use of fishing gear, *trawl* or causing damage to habitat, waste of marine resources, and triggering social conflict between fishermen. Decree of the Minister of Maritime Affairs and Fisheries Number 2 of 2015 concerning the Prohibition of the Use of Trawl (including equipment of *trawling*) in All Fisheries Management Areas (WPP) of the Republic of Indonesia including in Pangandaran Regency ^[2]. Regarding to the enactment of these regulations, an attempt is made to find alternative ecofriendly fishing gear as a solution to the diversion of shrimp trawl fishing gear. *Trammel Net* (triple layer net type of gill net) is one of the eco-friendly shrimp fishing gear with minimal environmental impact. This fishing gear is quite effective and can be operated by small scale fishermen, with lower capital ^[2].

A trammel net is a type of fishing net because fish or shrimp caught are caused by being caught or trapped in the net. The construction of the net consists of three layers, namely the outer layer has a larger mesh size, while the one in the middle has a smaller mesh opening and is mounted more loosely ^[3]. It is important to look at the characteristics of a trammel net that is for the management and development of sustainable fishing in the future by observing construction, management of fishing operations, and catching trammel nets used by Pangandaran fishermen. However, information

about research into trammel nets in Pangandaran Regency is not yet available, especially regarding the construction of a trammel net. Based on this, this research needs to be done to provide information on the construction of trammel net in Pangandaran.

2. Research Method

This research was conducted from December 2019 to January 2020 at East Coast Pangandaran, West Java Province. This study used trammel net fishing gear as a research object. This study using catches, stationery, rulers, documentation tools, scales, raffia ropes, wood, meter roll and interview guide to collected data.

Methods used are descriptive. Ruseffendi^[4] said that descriptive research is research that uses observation, interviews or questionnaires about the current situation, regarding the subject we are studying. Through questionnaires and so on we collect data to test hypotheses or answer questions. Through this descriptive research the researcher will explain what actually happened about the current situation that is being studied.

2.1 Data Analysis

Analysis of construction and method of operation of the trammel net

Information on construction, fishing vessels and trammel net fishing gear operations method at the location of the study conducted with a qualitative descriptive approach. According to Sugiyono ^[5] the qualitative descriptive objective in this study is to provide a systematic, factual and accurate picture of certain facts. This particular fact is about the construction and method of operating the trammel net.

Analysis of catches trammel net

Composition of The composition of catch catch types is

analyzed in a comparative descriptive manner, namely by differentiating catches. The catches are divided into two categories namely the main catch and bycatch or *by catch*. Existing data is presented in tabular form and processed using a simple calculation that is by looking at the percentage (%).

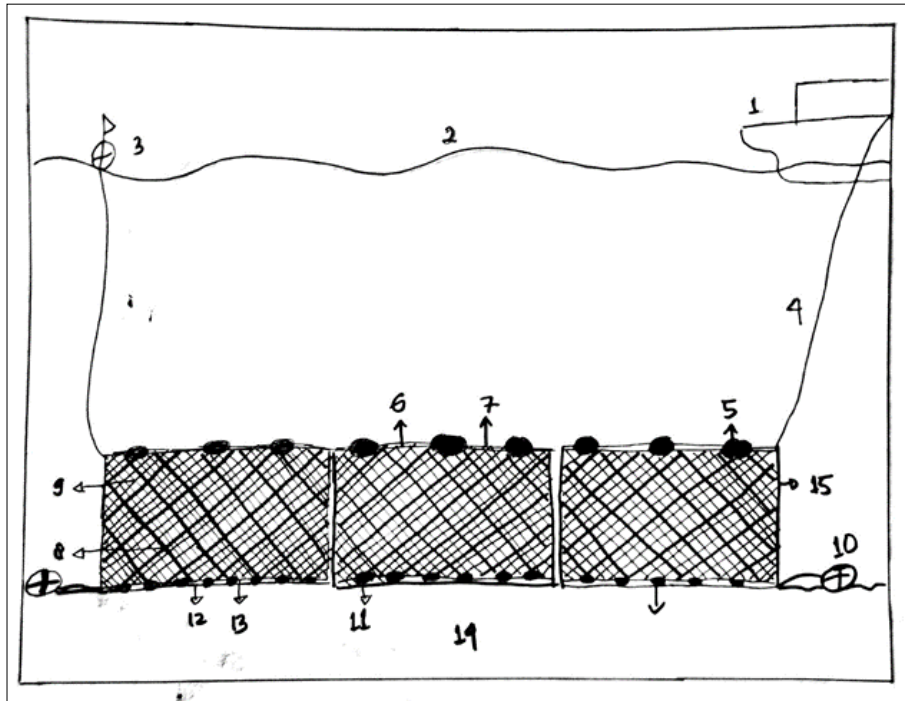
Analysis of composition of main catch size of trammel net
 Before analyzing the length of main catch size data, the data is first processed using Microsoft Excel to see its frequency. The size composition of each type of main catch is determined by the length class.

3. Results and Discussion

3.1 Construction of Trammel net

Trammel net is a gill net consisting of three layers of a net, where the layer net (*inner net*) has a smaller mesh size and is located between two (*outer net*) which has a larger mesh size. Pangandaran fishermen used to call this fishing gear by the name of the *ciker*.

Pangandaran fishermen's trammel net are using rectangular consisting of three layers, an *outer net* measuring 5.2 inches (132.08 mm) and an *inner net* measuring 1.75 inches (44.45 mm). Components trammel consists of several parts that will be explained further on its respective segment, while net trammel net design shown in Figure 1.



Description

- 1. Boat 2. Surface Water 3. Buoy marks 4. Selambar Ropes 5. Buoy 6. Ropes float 7. Ropes above ris 8. Outer-net 9. Inner net 10. additional ballast 11. Ballast 12. under main ropes 13. ballast ropes 14. Waters 15. Selvedge

Fig 1: Sketch Trammel Net

Component and netting material trammel net more (in one *piece*) shown in Table 1 of the identification results in the field of measurement gear directly comparable with the

results of research on the specifications of trammel net fishing gear in a different location from previous studies.

Table 1: Specifications of Trammel Nets in Multiple Locations

No.	Components	Locations		
		Pangandaran	Sukabumi	Banten
I.		Rigging		
1.	life rope	Polyethylene (PE); Ø 4 mm	Polyethylene (PE); Ø 4 mm	Polyethylene (PE); Ø 4 mm
2.	Rising straps for	Polyethylene (PE); Ø 5 mm	Polyethylene (PE); Ø 5 mm	Polyethylene (PE); Ø 4 mm
3.	Straps like	Polyethylene (PE); Ø 16 mm	Polyethylene (PE)	Polyethylene (PE)
II.		Net		
		external netting(<i>outernet</i>)		
1.	Polyethylene	(PE)Monofilament; Ø 0.3 mm	Nylon	Polyamide (PA) Monofilament
2.	Mesh size	5.2 inch (132.08 mm)	5.2 inch (132.08 mm)	7 inch (177.8 mm)
3.	Hanging ratio	0.47	0.43	
		net in the (<i>innernet</i>)		
1.	Material	Polyamide (PA)Monofilament; Ø 0.12 mm	Nylon	Monofilament Polyamide (PA)
2.	Mesh size	1.75 inch (44.45 mm)	1.5 inch (44.45 mm)	1.75 inch (44.45 mm)

3.	<i>Hanging ratio</i>	0, 54		
III.	Completion of the jarring			
1.	Buoy	Y-30	<i>Styrofoam</i>	<i>Stereofoamsinker</i>
2.	tin	Lead; weight @ 16 gr	Tin	Tin
IV.	Reference			
			Astrini ^[6]	Panbudi ^[7]

Based on table 1, it can be seen that the specifications of the trammel net fishing gear in various locations are relatively similar. Modifications are made by fishermen in each area to adjust to the existing material and water characteristics in the area. Modifications were made to the rigging components, the material and size of the mesh, as well as the ballast and buoy composition. The difference between the trammel net from these three locations lies in the net material used. The use of different net materials will affect the buoyancy and sinking force of one net unit. Thus the design of the buoy and ballast composition also differs from one trammel net to another trammel net.

3.2 Trammel Net Fishing Method

A net capture pattern is generally a one day trip, with up to four to five times setting. The trammel net unit in Pangandaran has a variety of boat sizes. Boat sizes range from 1 to 3 GT (Gross Tonnage). This type of boat material is made from a combination of wood and glass fiber. The process of fishing method using trammel net is assisted by a crew of two to three people. The range of LOA (L) trammel net vessels ranges from 8.2-12.1 meters, B max (B) is 1.05-1.57 meters and Depth (D) is 0.78-1.05 meters. The engine used is generally a Yamaha of 15 PK. The durability of the ship is approximately 10 years and the engine endurance is approximately 6 years, the durability of the ship and the engine depends on the care and usage of each fisherman. Ships used in trammel net fishing operations are equipped with outriggers mounted on the right and left of the boat. Outrigger installation on fishing vessels serves as the balance of the boat so that during big waves the ship does not stumble. There is also a flag as the identity of the ship tied to bamboo as high as 2 meters.

In this study trammel net are operated by being pulled or dragged at the bottom of the waters by ships so that can be a circular formed. The area of fishing operations is around Pangandaran.

In general, fishermen leave in the morning and return to the *fishing base* in the afternoon. In 1 (one) ship consists of 5 units of nets, each unit consists of 10-50 pieces of nets. The method can be described in three stages, there are setting (drop teh net to the water), drifting and lifting the net (hauling). The stages of operation trammel net are as follows:

1. Preparation

- The fishing begins with preparation in the morning, then departs by boat to the fishing area. On the way to the fishing area, fishermen preparing fishing gear so they can be operated immediately.
- The fishing master determines fishing ground, after the area of capture is determined then the fishing gear is reduced (setting).

2. Setting

- When *setting*, the initial deployment is followed by

marker buoys with nets and ropes, last main ropes then additional ballast and the ship keeps moving at low speed.

3. Drifting

- After all the nets are lowered and the rope is tied to the bow of the ship, the ship moves to pull the net at the bottom of the water so that net forms a half circle, this process is carried out for approximately 60 minutes.

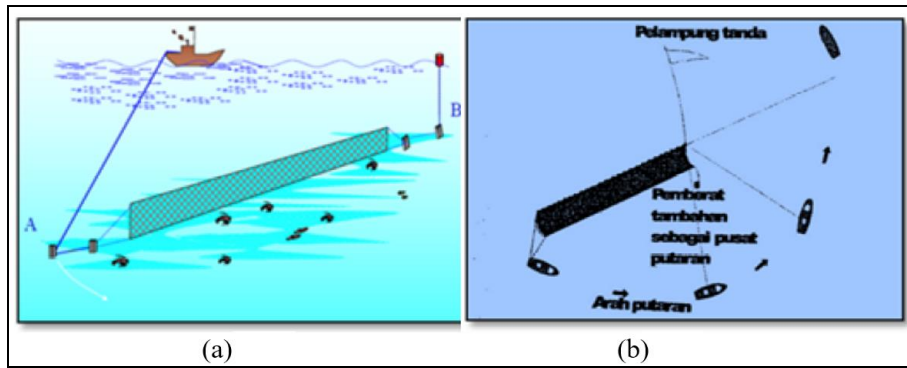
4. Lifting the net (*hauling*)

- The process of sweeping the net at the bottom of the water carried out for approximately 60 minutes after that the net was lifted onto the ship (*hauling*) and carried out catches from the body of the net.
- The catch is put into a storage box in which there is already ice (*ice box*).
- Preparation of the net decline is done after the process is *completed*.
- After *setting down* and *hauling the* nets up to 4-5 times and all catches have been *handled*, the ship returns to the *fishing base* in the afternoon to land the catch on the East Coast Fishing Base of Pangandaran.

According to Indonesian National Standarization ^[8] operations of *trammel nets* carried out using 2 (two) methods of capture, there are passively and actively. Active operation is operated by turning the net from the back end by using a boat. Whereas passive operation is operated by letting the net drift with the boat or by installing it fixed.

According to Kurniawan *et al.* ^[9] the method of operating trammel net in Cilacap Regency is actively carried out, nets are rotated up to 45°. The target shrimp is caught in the net by being entangled in the gills or by being thickened on the body parts. The pattern of capture is generally one day trip, with up to eight times settings. In general, fishermen leave in the morning and return to the fishing base in the afternoon. In one boat consists of two nets, each unit consists of 9 pieces nets. Meanwhile according to Sururi *et al.* ^[10] operation method for catching trammel net shrimp nets in Kaimana Waters of West Papua Province operated passively. Setting process using net being spread from one side of the hull of the boat or ship with the direction of the crossing flow crosses. The front end of the net is attached to a stone ballast and the back end is connected by a rope tied to a boat or boat, then a trammel net shrimp net *allowed* to drift along with the current.

This shows that the method of operating trammel net in several locations is carried out in different ways. Trammel net fishermen in Pangandaran operate the trammel net actively as is done by fishermen in Cilacap. The operation of an active system can only in waters that are not too deep, there are no obstacles in the form of trash or wooden poles, and the substrate in the form of sand or muddy ^[10]. Pangandaran and Cilacap have the same substrate characteristics in the form of sand and mud.



Source: Kurniawan et al. [9]

Fig 2: Illustration of the process of turning-routed nets in water (a). seen from the horizontal direction, and (b) viewed from the vertical direction (from above).

3.3 Composition of Catches of Trammel Nets

Types of catches are divided into main catches and bycatches. Main catches are species that are targeted by capture operations while bycatch are species that are not targets of capture operations. Catches of trammel net in Pangandaran are dominated by *Penaeus merguensis* and *Metapenaeus ensis*. In accordance with the statement from Iskandar [11] that the catch of the trammel net is more dominated by white shrimp which is the target of capture. This is because of the construction of the bicycle net which consists of three layers so that at the time of the trammel net actively operated in the direction of the current coming from the front and back of the gear can still form a pocket to catch shrimp. Besides that, the net on the outer net and the inner net are relatively loose so that the shrimp can be

caught well entangled.

Total catches on trammel net fishing gear a total of 1,373 fish (32.72 kg). In more detail the composition of the catch obtained in trammel net fishing gear can be seen in Table 2 and 3.

Table 2: The weight of the catch trammel net in Pangandaran

Type	Species	Weight (kg)	Subtotal (Kg)
Maincatch	<i>Penaeus Merguensis</i>	6.65	22.62
	<i>Metapenaeus ensis</i>	15.97	
Bycatch	<i>Penaeus monodon</i>	0.79	10.10
	<i>Parapenaeopsis sculptilis</i>	5.65	
	<i>Sepia sp</i>	0,82	
	Mixed	2.84	
	Total	32.72	32.72

Table 3: Total catch nets trammel net in Pangandaran District

Type	Species	Number (fish)	Subtotal (fish)
Maincatch	Jerbung shrimp (<i>Penaeus Merguensis</i>)	113	967
	Shrimp Dogol (<i>Metapenaeus Ensis</i>)	854	
HTS	Prawn (<i>Penaeus monodon</i>)	9	407
	TigerKrosok Prawn (<i>Parapenaeopsis sculptilis</i>)	362	
	Cuttlefish (<i>sepia sp</i>)	13	
	Mixture	22	
	Total	1373	1373

Based on the table, the catch during research on trammel net fishing gear was able to catch 1,373 fish with a total weight of 32.72 kg. The total catches of trammel net during the study were almost all dominated by the main catch, there are *Penaeus merguensis* and *Metapenaeus tenuipes*. A total of 967 *Penaeus merguensis* and *Metapenaeus tenuipes* which were the main catch targets of fishermen during the study were the main catches with a percentage of 69.12%. The proportion of the number of bycatch on the trammel net fishing gear during the study amounted to 407, consisting of 4 fish species with a percentage of 30.88%.

Based on the results of research conducted by Kartawijaya et al. [12] showed that the composition of the trammel net in the Pelabuhanratu Fishing Port consisted of shrimp at 32% and fish catches at 68% of the total catch. The most caught fish are *Leiognathus equulus*, *Thryssa hamiltonii* and *Upeneus sulphureus* while for the most caught shrimp are *Squilla sp*, *Metapenaeus endevouri* and *Metapenaeus ensis*, this is not in accordance with the results of research conducted in Pangandaran waters because shrimp as the main catch is more than other species as bycatch targets. Based on the results of the study, seen from the proportion

of the composition of the types of catches trammel net in Pangandaran and compared with research conducted by Kartawijaya et al. [12] shows that fishing gear trammel net in Pangandaran pret ty good at capturing the main target compared bycatch. This can be interpreted that the level of selectivity of trammel net used by Pangandaran fishermen can be categorized into fishing gear that is more selective in catching shrimp and will increase the level of eco-fiendly of the fishing gear, compared to trammel net (*trammel net*) used in Teluk Palabuhanratu.

3.4 Composition of Main Capture

Length of catch fish is one of the criteria in determining the feasibility of catches. This information can be known by knowing the length limit of the fish when reach length at first maturity (*Lm*). Catching above the size can provide opportunities for the target fish to be able to reproduce. The process of recruitment of the small fish phase into the adult fish phase can run [13]. The proportion of fish worth catching biologically is known by measuring the length of the fork (in fish), carapace length (in crustaceans), and coat length (in cephalopods) which are then compared with *Lm* in the

literature.

In accordance with the results of the interview, the main catch on the trammel net is *Penaeus merguensis* and *Metapenaeus tenuipes*. The size needed to compare with *Lm* in shrimp is a measure of carapace length. Data during the study were taken as many as 300 wild shrimp and 300 *Metapenaeus ensis* captured by trammel net fishing gear. Jerbung prawns measured in carapace length come from East Coast Pangandaran Fishing Port. The results of the measurement of the length of the carapace of the *Penaeus merguensis* caught on the trammel net fishing gear are in the range of 2.9 - 8 cm. The highest number of captured shrimp is 6.5 - 7 cm in size, which is 58 heads, the lowest number of captured shrimp is at carapace length of 5.3 - 5.8 cm, which is 3 heads with an average shrimp jerbung caught has a carapace length of 5.5 cm. *Metapenaeus tenuipes* caught on trammel net fishing gear obtained 1,128 fish. 300 *Metapenaeus tenuipes* were sampled to measure carapace length. The length measurement results obtained, the length of the *Metapenaeus ensis* from the trammel net is in the range of carapace lengths of 3 cm - 7cm. The most number of *Metapenaeus ensis* caught was in the size of 5.5-5.9 cm which is as much as 65 tails, the least number of *Metapenaeus ensis* caught was in the length of carapace 7 - 7.4 cm which is as much as 3 tails, with an average *Metapenaeus ensis* carapace length of 5.1 cm.

Table 4: Measurements of Carapace Length of Shrimp First Time Ripe Gonad (*lm*)

Location	Lm (cm)	Reference
<i>Penaeus merguensis</i>		
Northern Waters Central Java	4.3	Tirtadanu <i>et al.</i> (2016)
Cenderawasih Bay	3.9	Kembaren (2015)
Arafura Sea	4	Melmambessy (2015)
Cilacap	3.9	Saputra <i>et al.</i> (2013)
<i>Metapenaeus ensis</i>		
Cilacap	3.6	Saputra <i>et al.</i> (2013)
Batang	3.9	Taufani <i>et al.</i> (2017)
Arafura Sea	3.6	Suman <i>et al.</i> (2017)

Table 4 shows the length of the carapace of first-time cooked gonads (*lm*) in various locations with different values. According to Effendie^[14] differences in the value of growth parameters can be caused by 2 factors, namely internal factors and external factors. Internal factors that can influence are heredity, parasites and diseases, while external factors that can affect are temperature and food availability. Perbedaan values *lm* at various locations suspected to be caused by genetic factors and environmental conditions at each location. Therefore, to determine *lm* which can be compared with *lm* a net catches trammel net in Pangandaran Regency waters can be seen from the characteristics that are similar to Pangandaran district or locations near Pangandaran district. According to Saputra *et al.* ^[15] Cilacap waters condition has almost similar characteristics, namely deep and steep with generally sand bottom waters. This is in accordance with the statement of Azam ^[16] which states that the state of the land in Pangandaran consists of sandy beaches, rocky beaches and rocky beaches and has sea waves in the form of *swell* waves or open sea waves, where these waves can occur in the deep sea. So the value of *LM* that will be compared with the catch of trammel net in Pangandaran Regency is the shrimp originating from Cilacap Waters with the size of *lm* of shrimp as 3.9 cm

while for *Penaeus merguensis* 3.6 cm. Proportion of size of carapace length of main catches of trammel net that have and have not exceeded *lm* can be seen in Table 5.

Table 5: Proportion of Size of Carapace Length Capture

No.	Main Catches	Length	
		> <i>Lm</i> (%)	< <i>Lm</i> (%)
1	<i>Penaeus merguensis</i>	75,33	24,67
2	<i>Metapenaeus ensis</i>	82	18

Measurement of carapace length of the first mature gonad shrimp was done to determine the proportion of biologically viable catch size. *Penaeus merguensis* that have reached catch size are 226 fish (75.33%), while 24.67% or 74 have not reached catch size. In contrast to the number of *Metapenaeus ensis* that reach catchable size that is as many as 246 shrimp (82%), while 18% or 54 *Penaeus merguensis* have not reached catching size. This makes the trammel net fishing gear used by fishermen in Pangandaran Regency with a size of inner *net* 1.75 inch and outer *net* 5.2 inch selective for catching both shrimp and *Penaeus merguensis* because of shrimp and *Penaeus merguensis* caught more than 50% are eligible to be caught.

Conclusion

The results of research on the characteristics of trammel net fishing gear used by fishermen in Pangandaran Regency landed at TPI Pangandaran, can be concluded as follows:

1. Characteristics of trammel net fishing gear used by fishermen in East Coast Pangandaran have a construction consisting of a float rope measuring 4 mm with a material Polyethylene (PE), 5 mm upper main rope with Polyethylene (PE) material, 16 mm selambar rope with material Polyethylene (PE), outer mesh body with Polyethylene (PE) monofilament material and mesh size of 5.2 inch and the inner net body with polyamide (PA) monofilament and mesh size of 1.75 inch, Y-30 float and lead ballast. The Hanging Ratio (E) of the outer net is 0.54 and the inner net is 0.47.
2. The method of operating the net trammel net in East Coast Pangandaran is carried out by being pulled or dragged at the bottom of the water by the boat so that it forms a circular net. With the stages of net settings, drifting, and lifting nets (hauling) in one day fishing.
3. The main catches consist of *Penaeus merguensis* and *Metapenaeus ensis* as much as 70% and bycatch by 30%, and the proportion of catch size worth 78.66%.

References

1. BAPPEDA West Java Provincial Government. Yearly Repport 2016. West Java Gouvernment, 2017.
2. WWF. Catching Environmentally Friendly Shrimp with Three Layer Net Trapping (Trammel Net). Jakarta, 2015.
3. Subani W, Barus HR. Fishing Equipment and Sea Shrimp in Indonesia. Journal of Marine Fisheries Research, 1989, 50.
4. Ruseffendi ET. Basics of Educational Research and Other Non-exact Fields. Bandung: Tarsito, 2010.
5. Sugiyono. Qualitative and Quantitative Research Methods and R&D Bandung: Alfabeta, 2009.
6. Astrini ED. Trammel Net Selectivity for Shrimp in Ratu, West Java. Bogor: Institut Pertanian Bogor, 2004.
7. Panbudi R. Modification Constructions of Trammel Net

- to Increasing catch. Bogor: Institut Pertanian Bogor, 2017.
8. SNI. Indonesia Patent No. SNI 01-7237-2006, 2016.
 9. Kurniawan W, Riyanto A, Santoso AE. Environmentally Friendly Fishing Equipment Operational Test Ciker Nets (Three Layer Net or Trammel Net). *Litkayasa Engineering Bulletin*. 2017; 15(1):47-55.
 10. Sururi M, Razak AD, Mustasim Suruwaky A, Muhammad S. Trial Operation of the Trammel Net Shrimp Net in the Kaimana Waters of West Papua Province. *Journal of Aquatics*. 2018; 3(2):144-150.
 11. Iskandar D. Comparison of Shrimp Catching Results Using Lapdu, Giltong and Trammel Net in the Saengga Waters of the Regency of the Gulf. *Faculty of Fisheries and Marine Science. Bogor Agricultural University*. 2009 6(1):22-29.
 12. Kartawijaya T, Ardani E, Hamka D, Komarudin, Jati AK. Analysis of the Level of Environmental Protection of Trammel Net Fishing Devices in Palabuhanratu Bay. *PSP Bulletin*. 2011; 19(3):253-266.
 13. Maulidin F. Level of Purse Seine Hospitality to the Environment Judging from the Results of Arrests Landing in the Lhokseumawe Pusong. *Sumedang: Faculty of Fisheries and Marine Sciences, Padjadjaran University*, 2011.
 14. Effendie. *Fisheries Biology*. Yogyakarta: Yayasan Pustaka Utama, 1997.
 15. Saputra SW, Solichin A, Rizkiyana W. Diversity of Species and Biological Aspects of *Metapenaeus* Shrimp in Cilacap Waters, Central Java. *Journal of Management of Aquatic Resources*. 2013; 2(3):37-46.
 16. Azam DH. Study of Post Tsunami Capture Fisheries Development Prospects in Pangandaran PPI, West Java. *Bogor Agricultural Institute*, 2009.
 16. Rahman A, Mahreda ES. Marketing channels of marine fish in Banjarmasin fishing port, Indonesia. *Marketing*. 2019 Jul;4(3).