Relationship between purse seine dimensions and catch volume in Sikka Regency, Indonesia

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Abstract. The purse seine is a very productive fishing gear for small pelagic fishes. For purse seines that are actively operated during the day-time, the dimensions of the purse seine are expected to be closely related to the number of fish caught. Field conditions indicate that fishermen use purse seines of varying dimensions. In this context, research is needed. This study aimed to analyze the relationship between purse seine dimensions and the volume of fish caught. This research was conducted in the waters of Sikka Regency, East Nusa Tenggara Province, Indonesia from November to December 2019. The parameters observed included purse seine dimensions, vessel speed and the volume of fish captured per trip. The results showed that purse seine dimensions had a very weak positive correlation ($r = 0.088$) with catch volume. This shows that the relationship between purse seine dimensions and the volume of fish caught is very weak. Most likely the differences in catch volume were caused by other factors. This is in contrast with other studies showing a significant relationship between the dimensions of the purse seine and the volume of fish caught. In the research location the fishing ground was heavily used, so that the fishing vessels were operating relatively close to one another. This may have created conditions where the net dimensions played a lesser role in increasing the volume of fish caught. In order to avoid one purse seiner being affected by the activities of another purse seiner, it would be necessary to expand the fishing ground or reduce the number of purse seiners operating in that particular fishing ground.

1. Introduction

Purse seine dimensions play an important role in determining the ability to catch fish. The principle of catching fish with a purse seine is to circle the schools of fish, then pull the drawstring line to confine the schools of fish, so that the dimensions are very decisive, especially in purse seines that do not use tools to operate or chase schools of fish.

The productivity of fish catch using purse seine fishing gear is related to the influence of the suitability of the dimensions of fishing gear, vessel capacity and fishing aids. Several studies regarding the analysis of technical aspects related to the design and construction of purse seines include research [1,2,3], the sinking speed of purse seine fishing gear [4, 5, 6]. The technical characteristics of purse seine fishing gear [7, 8], the ideal purse seine design criteria [9]. calculating the time difference in fishing gear sinking speed [10] and research regarding net sinking power and purse seine weight [11]. While research on the productivity of purse seines that affects the total catch
Purse seines based in north Java indicate the strength of the ship's engine, the power of the lights and the volume of the purse seine (fishing gear dimensions) are factors which significantly affects the catching power. The results of this study are still relevant to the results of previous studies of purse seine productivity, where fishing gear technical factors have a significant effect [13]. Most of the research showed that had any specific location that differ from one to another location. That mean any specific fishing location will affect differently with technical aspect and fishing productivity.

The ability of fishermen to catch fish in Sikka Regency varies greatly, both in the types of fishing gear and the types of fish that are the target of their catch. One of the fishing tools that are often used by fishermen is the mini purse seine. In principle, fishing using a mini purse seine is by circling a group of fish, then the bottom is wrinkled so that it forms a cod end and the fish are collected in the cod end, the nets and nets serve as barrier walls [14]. The number of fishing gears is 24 units with varying sizes, ship size, fishing gear size, number of crew. Many factors affect the purse seine catch, including netting dimensions, setting and hauling speed, engine strength, crew skills, ship dimensions, etc. Researchers are interested in examining the relationship between the dimensions of the purse seine and the volume of fish caught because the technique of operating a purse seine does not use tools, namely by chasing fish schools. Therefore, it is assumed that the purse dimension has a strong relationship to the volume of fish caught [1-6].

The catch of fishermen using purse seine fishing gear has a close relationship with the dimensions of fishing gear, boats and fishing aids, this is evidenced by partial testing of several variables, including, net length, in nets, fishing gear sinking speed, ship size and PK. engine [3]. The success of catching pelagic fish using purse seine fishing gear is influenced by technical factors, among others, the length of the net, the sinking power, the length of the ship [4]. The appearance of a fishing gear in water is determined by many factors that interact with each other, therefore the factors that are likely to affect the fishing gear must be identified and taken into account in the design of the fishing gear, especially in the design of balancing the forces acting on the gear, fish catcher in the water [15].

2. Methods
This research was conducted from November to December 2019 with the research location in the waters of Sikka Regency, East Nusa Tenggara Province. The equipment’s used in the research to be carried out are: Mini purse seine catching fleet, GPS to determine position, camera for documentation, scale for weight fish, meter roll for measuring purse seine dimension, stationery for data writing.

This study used a survey method by using 6 units of purse seine randomly out of 24 units with various sizes. The purse seine is operated during the day by chasing schools of fish. Fishermen depart from the fishing base in the morning and return in the afternoon. The mini purse seine in this area has a net length of between 250 meters - 300 meters with a depth of 12-15 meters, made of polyamide multifilament 210D / 6 and 210D / 9 with a mesh size of 1 inch. The ship is made of wood with the dimensions L (length) x B (breadth) x D (depth) = 8-9 m x 2-2.5 m x 1.5 m with 3-7 GT.

The parameters observed were the dimensions of the purse seine, the volume of fish caught per trip. Observations are made every day if weather conditions allow. Data were analyzed by simple linear regression following the equation:

\[ Y = a + bX + e \]

Where: \( Y \) = weight of fish caught (Kg), \( X \) = dimensions of purse seine (length x width), \( a \) = constant, \( b \) = regression coefficient, \( e \) = model error.
3. Results and discussion
The types of fish caught using the purse seine during the study included frigate tuna (Auxis thazard), goldstripe sardinella (Sardinella gibbose), yellowtip halfbeak (Hemiramphus marginatus), common ponyfish (Leiognathus sp). Most of the fish caught have low economic value, only tuna has high economic value. In addition, the average number of fish caught per trip is between 110-140 kg, relatively small. Field observations indicate that erratic weather conditions accompanied by strong winds cause the volume of fish to be caught relatively low. The results of the fishermen’s interview stated that the season conditions at the time of the study were unusual. Usually November - December is the peak season.

The average volume of fish caught does not differ much between the three dimensions of the purse seine. At first glance there seems to be a difference between the 300x12m dimensions and the other two sizes. However, based on simple linear regression analysis, it turns out that the relationship between purse seine dimensions and the volume of fish caught is not significant (P> 0.05) and the relationship is also very weak (r = 0.08). This condition may occur due to the lack of variation in the purse seine dimensions, as well as variations in the volume of fish caught. One of the factors causing the lack of variation in the volume of fish caught is because the fishing area is in a bay and there is intense competition between purse seines.

| ANOVA          | df | SS    | MS    | F     | Significance F |
|----------------|----|-------|-------|-------|----------------|
| Regression     | 1  | 37776.53 | 37776.53 | 1.938319 | 0.165119       |
| Residual       | 244 | 4755395 | 19489.32 |       |                |
| Total          | 245 | 4793171 |         |       |                |

| Coefficients   | Standard Error | t Stat | P-value | Lower 95% | Upper 95% |
|----------------|----------------|--------|---------|-----------|-----------|
| Intercept      | 13.46333       | 85.22484 | 0.157974 | -154.407 | 181.3336  |
| X Variable 1   | 0.028958       | 0.0208 | 1.392235 | -0.01201 | 0.069928  |
This study shows that the effect of the purse seine dimension (X) does not provide a real relationship to the volume of fish caught. This means that the increase or decrease in the volume of caught fish is not caused by the influence of the purse seine dimensions but is caused by other factors that were not observed in this study.

The length of the net has a significant effect on the catch with the assumption that with a larger length the coverage of the net is wider, so the possibility of fish being caught will be more. Theoretically, the longer the purse, the larger the diameter of the net circle. This causes the greater the chance that the school of fish will not be distracted because the distance between the school of fish and the wall of the net can be greater, so that the fish school has a greater chance of being caught. When compared with the size of the net length which is smaller, the area of the net coverage is smaller, so that the possibility of fish being caught will be less and the chance for fish to escape is greater. This is in line with the opinion of Rizwan et al (2011), that the longer the purse seine fishing gear is, the wider the circumference, so that it is hoped that the fish in the circle will increase in number [7]. However, this will also be constrained if the trawl looping process is not done quickly because the fish schools can escape from the bottom of the trawl if the trawl is not drained immediately. This can be anticipated by increasing the number of workers during fishing operations.

The net height factor has a significant effect on production with the assumption that the purse seine fishing targets are small pelagic fish whose swimming layer is at a depth that some fishing gear cannot be reached with a net length of 29.5 - 57.7 meters, where the maximum depth calculation results. The nets operated in Bone Regency especially for catching scads fish and tuna are around 39 meters, thus the deeper the nets will be able to reach fish that are at the maximum swimming depth of the fish schools. The depth of purse seine nets must be determined by taking into account the behavior of the fish to be caught and the conditions of the local waters [17]. The minimum depth of the net is intended to follow the swimming depth of the school of fish [18, 19].

The sinking speed of the fishing gear has a significant effect on production with the assumption that the faster the fishing gear sinks to a certain depth, the faster it will dissuade fish from moving out of the target gear circle. The high sinking speed of the net will accelerate the descent of the net to the maximum depth, so that the fish cannot escape horizontally. The increase in ballast will result in a faster sinking speed and reduce the possibility of schools of fish to escape [9].

The larger the dimensions of the ship, the greater the ability of the ship to carry trawls and other fishing aids, thus the fishing ground coverage will be wider, besides that the size of the ship also affects the movement of the ship, at sea in a circular motion [20]. The size of the ship also affects the catch [21]. This is because large vessels are generally equipped with powerful propulsion engines, large nets, and accommodate larger catches. So, when operating the fishing gear, it will make the fishing process easier so that it can indirectly increase the catch [21, 22, 23]. Most likely the differences in catch volume were caused by other factors. This is in contrast with other studies showing a significant relationship between the dimensions of the purse seine and the volume of fish caught. In the research location the fishing ground was heavily used, so that the fishing vessels were operating relatively close to one another. This may have created conditions where the net dimensions played a lesser role in increasing the volume of fish caught. In order to avoid one purse seiner being affected by the activities of another purse seiner, it would be necessary to expand the fishing ground or reduce the number of purse seiners operating in that particular fishing ground.

4. Conclusion
The relationship between purse seine dimensions and the volume of fish caught is very weak, the net dimensions played a lesser role in increasing the volume of fish caught. In order to avoid one purse seiner being affected by the activities of another purse seiner, it would be necessary to expand the fishing ground or reduce the number of purse seiners operating in that particular fishing ground.
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