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Purse Seine Design and Construction in Barru District Waters, South Sulawesi

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ABSTRACT

The research conducted on July to August 2014 in Barru Regency, South Sulawesi Province. The aim of the study was to analyze the purse seine design and construction. Survey methods applied with selected five purse seine units randomly as samples. Result of the study shown that the purse seine in Barru can be categorized as American one boat type with pocket located in the side part of the net. Purse seine dimensions length was ranged from 300 – 800 m and the depth was ranged from 40 – 50 m, with 2 inches mesh size. Plastic ball used as floats with total 1500-2250 floats in each unit. Netting materials consist of polyamide multifilament 210D/9 in all part of the nets. Sinker materials consist of tin with ring form, weight range 1-2 kg each, and the total weight of the rings ranges from 92 – 251 kg per purse seine units. Analyses of result showed the all purse seine were not fit to standard criteria, mainly net depth, mesh size and sinking force. To meet the standards criteria and also to refer to sustainable fisheries and CCRF, the purse seine design need to be improved.

Keywords: *purse seine, design, sustainable*

INTRODUCTION

Purse seine is also known as a ring net because equipped with ring in order to the pursing of the purse line. Nowadays, purse seine is still the most productive fishing gear for small pelagic fish species including skipjack. Information on design and construction is very important, mainly in the developing the fishing business. The fishing capacity of fishing gear was mainly depend upon their design and construction. Information on fishing gear design and construction was very important in developing fisheries business, since the fishing efficiency depend upon gear design and construction and supported by the fishermen's skill who operated the fishing gear.

In designing the net base fishing gear, there were several factors that should be considered namely: net dimension (length and height), hanging ratio, buoyancy force, sinking force, twine material and size (Fridman, 1986; Ben-Yami, 1994; Najamuddin, 2012). Fish behavior were also need to be studied as a basic consideration in selecting fishing gear operation technique, mesh size, and net dimension of gear to construct (Nomura and Yamazaki, 1977).

Purse seines in the Barru district were mainly be constructed by fishermen themselves, based on their previous experiences and without any design plan. Materials selection were based on their experiences and its availability in the local market and suspect to inappropriate in its design performance. For those reasons, the researchers interested to analyze the purse seine design and construction in the research site.

MATERIALS AND METHODS

The research conducted on July to August 2014 in Siddo Village, Barru District, South Sulawesi (Fig 1). Survey methods were applied with selected 5 samples seine units randomly. Barru district located at

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geographic position 119°37'17" E; 4°13'58,4" S. Parameters observed were the purse seine dimension, netting materials, mesh size, ropes, floats, sinkers, and rings.

Data analyses that are consisted of sortening, net depth, net weight, buoyancy force, sinking force, time to sink of sinker and sinking speed were calculated based on the following formulas:

$$S = \frac{L_o - L_i}{L_o} x100\% \quad (1)$$

where :
Lo = net length before fix in the float line
Li = net length after fix in the float line

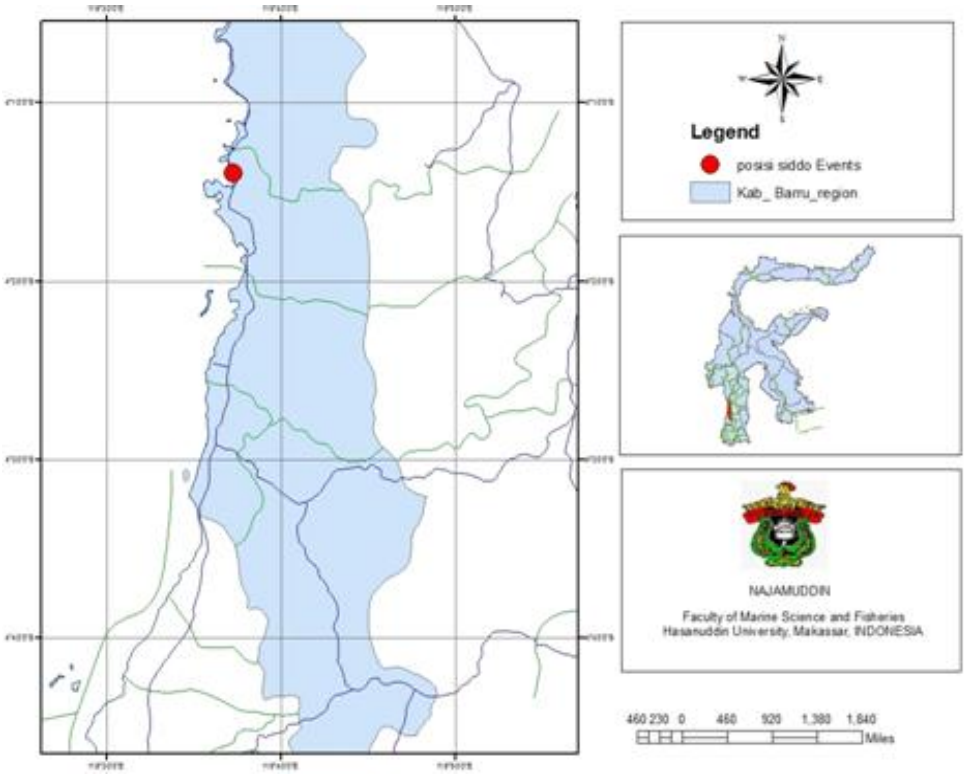

Figure 1. Research location

Net weight (Wt) calculated according to Clive formula (Najamuddin, 2012)

$$Wt = \frac{\left(\frac{N+n}{2}\right) x H\, x\{(2\,x\,S)+K\}}{1000\,x\,R} \quad (2)$$

where :
S = net mesh size

K = knot content
R = runnage (m/kg)

Wt = net or rope length / R (3)

Net depth (Hk) was calculated based on the following formula:

$$H_h = \sqrt{(1-E_1^{\,2})}.H_o = E_2.H_o \quad (4)$$

Time to sink of the sinker was calculated based on Fridman (1986) formula as follow:

$$T_s = 0{,}9\ H\sqrt{\frac{H}{F_s}} \quad (5)$$

Sinking speed of sinkers was calculated based on Fridman (1986) formula as follow:

$$V = \sqrt{\frac{F_s}{1{,}8\ H}} \quad (6)$$

Where :
Ts = time to sink the sinker (second)
H = purse seine depth (meter)
Fs = sinking force per meter (kgf/m)
V = sinking speed for sinker (m/sec)

RESULTS AND DISCUSSIONS

The design of the purse seines in the research site were rectangular shape with the same materials and construction in all parts of the seine and categorized as American one boat type with pocket located in the side part of the net. Seine dimensions were various, 300 – 800 m in length and 40-50 m in depth. Normally, purse seine consists of wing, body, shoulder and pocke were commonly used in purse seine and twine size will vary among locations, dimension and fish target.

Purse seine designs (Figure 2) were the simplest one with the same materials in all parts of seine and also without cutting system. Many design, they apply cutting system to form specific shape required and also more efficient in materials used. Since skipjack fish as a target species, the seine dimension should be considered carefully, and how the seine operated. The purse seine were operated by chasing the fish school at the sea surface, so the boat speed

The purse seine dimension range from 300 – 800 m, based on the fishermen consideration. They realized that skipjack as a fish target have a high swimming speed and tend to form a schooling fish, so the seine size should be relatively longth and has appropriate depth. Polyamide multifilament materials were used in all part of the seine due to its availability in the market and its characteristics that is very strong and flexible. Netting size number 9 were already suitable for the fish targets, but mesh size 2 inches is not fit the standard of the Ministry Regulation No. 18/2013, that stated that the minimum mesh size was 3 inches. Kulst (1987) stated that polyamide (PA) materials has 2 superior characters namely:

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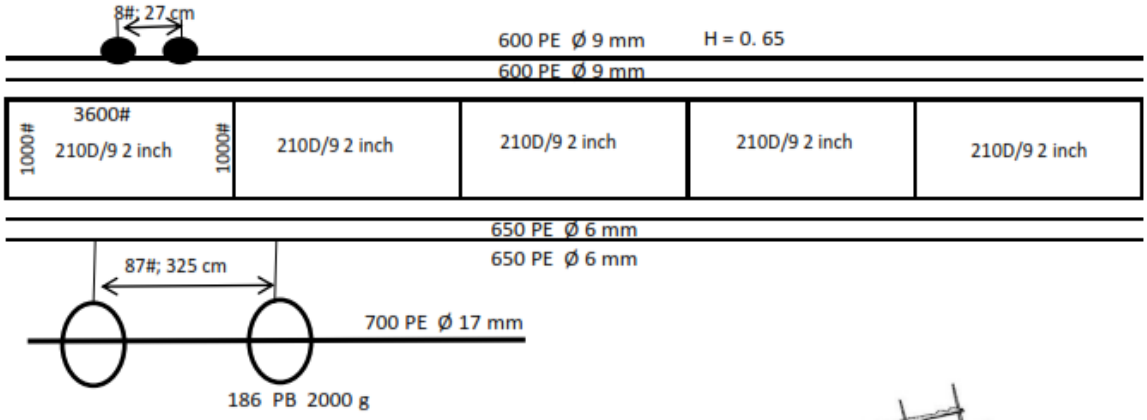
resistance to spoiled and friction. Moreover, PA materials also had a slippery and smooth surface, so can reduce water resistance and improve sinking speed.

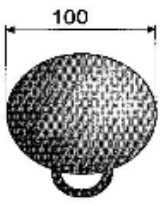
Material calculation shown that all purse seine units were constructed from 55 – 210 pieces of standard netting material (100 yards length and 100 meshes deep), with 5-11 pieces in the horizontal dimension and 10-15 pieces in the vertical dimension. Selection of material and number of pieces used refers to the purse seine dimension. As purse seine dimension increase, the materials require also increase, and the fish catches may also increase significantly. The main consideration for seine dimension was basically from fishermen themselves.

Wing and body part of purse seine were act as a wall to prevent the fish to escape, due to this reason, the net mesh size should refers to target fish size. For catching the skipjack fish, 2 inches mesh size was too small the minimum mesh size stated by the Ministry of Marine and Fisheries No 18/2013 regulation was 3 inches for purse seine with big pelagic fish target. In order to fit the standard regulation, the net mesh size should be modified into 3 inches and it may increase the benefit for the fishermen, as the seine will be lighter due to less hydrodynamic forces and the bigger fish might be caught. Based on technical point of view by Fridman (1986) that small mesh size suitable for purse seine were However, refer to the Ministry regulation and also CCRF (FAO, 1995), the net with 2 inches mesh size may captured the under size (young fishes), and it may threat the sustainability of fisheries resources in the nature

Purse Seine
Target species : skipjack fish
Location : Siddo Barru, South Sulawesi

BOAT :
Dimension : 17 x 4 x 1.5 m
Crew : 13-15 persons





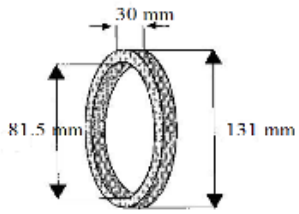


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Figure 2. Purse Seine Design.

Ropes for purse seine consist of head line, float line, ground rope, sinker line and purse line. Ropes were made from polyethylene (PE) materials with various size and dimension depend on its application. Ropes for head line and float line were made with the same twist direction

Most of the fishermen do not care about twist direction. Klust, 1982 and Najamuddin, 2012 stated that it was inappropriate to use the same twist direction ropes in head line and ground rope, due to in fishing operation procedure will occur turning force that cause the rope become tangled. Ropes for purse line applied 16-17 mm diameter already appropriate since fishermen pull the purse line by hand with supported by line hauler.

Purse seine floats purpose to float the fishing gear. Plastic balls are commonly used as float as it is cheap in price and plenty availablein the market. However, the problem in plastic material used is that it is not resistance to sunlight exposure. Floats were tightened along the float line with range 27 to 32 cm distance. The plastic ball floats with 100 mm diameter, with short distance and red color has advantage as it supports in protecting the fish from escaping through the float line. Fridman (1986) mentioned that shorter floats distance is better since floating force distribution even along the float line. Najamuddin *et al* (2006) found that floats distribution of purse seine in Kendari uneven along the float line, 5 – 7 floats per meter in the wing and body part and 6-10 floats per meter in the bag parts More floats were set in the bag part in order to maintain the position of the bag in the water surface even though fish caught concentrate in the bag. Due to these reasons the additional floats to maintain the ratio between sinking force and loading of fish caught in the bag. According to Ben-Yami (1994) the fine floating force ratio between bag part and another seine parts was 3 : 1.

Fishermen in the research site were using ring and sinker together. The rings were constructed by their own, using lead material, and the size and weight various among the samples, they were 1 to 2 kg each. The fishermen construct their own ring since the ring available in the market did not fit to their requirement. The weight of the rings that is available in the market in average were below 1 kg each; while the ring needed by the fishermen was at least 1 kg each. Number of sinker used islow and this causing the low sinking speed of the lead line. The sinking speed need to be increased in order to improve purse seine performance and fishing efficiency.

Data calculation shown that the shortening range 27.88 – 38.03 % (Table 2). The shortening values were in the range of ideal as suggested by Sadhori (1983). In purse seine fishing gear, net were acted as a wall and Maximum opening meshes were occurred when shortening 29.29 %. In that condition, the hydrodynamic force was acting on the net were also minimum (Najamuddin, 2012) (Table 1).

Table 1. Shortening and hanging ratio of purse seine sample.

Unit	Shortening (%)	Hanging ratio (%)
1	35.09	64.91
2	38.03	62.97
3	35.09	64.91
4	35.89	64.11
5	27.88	72.12

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Purse seine samples depth were range from 40-60 m. Fridman (1986) stated that there are two factors in design seine depth, namely the maximum depth that fish can rich and their speed during seine encircles; The seine length and depth ratio to perform the seine shape required during pulling the purse line. Normally it was need an additional extra 20 – 30% deeper than the maximum fish swimming depth. Table 3 shows the ratio between depth and length of purse seine range 0.067 to 0.133. Fridman (1986) mentioned that ratio between depth and length (H/L) range 0,1-0,2, however Ben-Yami (1994) suggested that the ratio is up to 0,33. This fact indicated that overall purse seine in this site is below the standard, and it is needed to improve the net depth. Moreover, the purse seine in this location is operated by chasing the fish shcool, so it required a deeper net in order to prevent the fish from escaping through

Tabel 2. Depth and length ratio of purse seine in each sample.

Component	Purse seine sample				
	1	2	3	4	5
Net depth (m)	40	40	40	60	40
Net length (m)	600	500	350	800	300
D/L	0,067	0,08	0,114	0,075	0,133

Table 3. Calculation of buoyancy forces and sinking forces

Unit	Fishing Gear Component						
	Buoyancy force (kgf)			Sinking Force (kgf)			Buoyancy & Sinking Force Ratio
	Floats	Ropes	Total Buoyancy	PA Net	Sinkers	Total Sinking Forces	
1	553.75	27.54	581.29	53.59	339.08	392.67	1.48
2	454.42	43.95	498.37	48.23	343.18	391.41	1.27
3	341.67	17.45	359.12	32.15	88.05	120.21	2.99
4	664.60	32.14	696.74	112.54	254.31	366.85	1.90
5	247.36	16.12	263.48	29.47	156.51	185.98	1.42

Calculation on forces acting on purse seine was shown in Table 3. Ratio between buoyancy and sinking force were ranged from 1.42 to 2.99. This fact indicated that the purse seine position in the surface water area. Fridman (1986) stated that floats must support all sinking parts of seine and all vertical sinking force arise during setting and hauling process and also forces load acting on netting due to fishes. .

Based on calculation sinking force range 0.34 – 0.78 kgf/m and sinking speed were range 0.065-0.104 m/sec (Tabel 4). This condition indicated very low sinking force and will cause low sinking speed and took more time for sinker line rich the seine depth normally. Fridman (1986) stated that sinking force minimal 2 kgf/m. In order to fit the standard, the sinking force should increase at list by 6 times.

Table 4. Calculation for sinking force, time to sink and sinking speed of purse seine

Unit	Net length (m)	Net depth (m)	Sinking force per meter (kgf)	Time to sink (detik)	Sinking speed (m/det)
1	600	40	0.65	281	0.095
2	500	40	0.78	257	0.104
3	350	40	0.34	389	0.069
4	800	60	0.46	618	0.065
5	300	40	0.62	289	0.093

Tabel 4 showed that time to sink of sinker line were range 257 – 618 seconds or 4.3 – 10.3 minutes. Sample 4 was the lowest sinking speed, the latest time to sink of sinker line, since this seine was also the longest one. It seem that the sample 4 was modified in length Improvements should be done to all samples but mainly to sample

Fridman (1986) stated that if seine is too long, it will late in encircling process, and the fish maybe escape through the net gap in the seine tip. High sinking speed of the lead line will speed up the seine up to maximum depth, so the fish cannot escape through net in horizontal direction. Analisis on

Sustainable Purse Seine Fisheries. According to code of conduct for responsible fisheries (FAO, 1995) stated that all fishing activities should be responsible to fisheries resources sustainability of its target. Sustainability of fisheries resources around fishing ground will maintain the sustainability of fishermen business its self (Charles, 1994, 2001). Government as a guarantor for sustainable fisheries resources should ensure the balance between fisheries resources and the ecosystem.

Purse seine conditions in the research site, based on technical point of view were unable to maintain the sustainability of skipjack stock. This indicated by net mesh sizes 2 inches (50.8 cm) with skipjack fish as target. Mallawa *et al.* (2012) reported that skipjack first mature at standard length 60 cm for female fish and 56.1 cm for male fish. Ministry of Marine and Fisheries regulation No. 18 year 2013, stated that purse seine for big pelagic fishes including skipjack should have mesh size >= 3 inches. For those conditions, it is need further research to evaluate the impact on purse seine fishing toward skipjack fish population in the research site. Anticipation for improving the seine selectivity's by applying an escaping windows in the pocket part with square or hexagonal meshes. These techniques commonly used in trawl fishing (Fonteyne, and M'Rabet, 1992; Walsh,*et al.*, 1992); and purse seine (Misund and Beltestady, 2000). Furthermore, in tropical conditions with multispecies and also various fish size causing difficulties in applying mesh size standard.

CONCLUSIONS

Purse seine dimension (LxB) range 300 – 800 m, 40 – 60 m respectively, PA multifilament materials 210D/9 with 2 inches mesh size in all part of seine. Purse seine in the research location were still not fit to the standard purse seine design and also regulation, mainly mesh size and also low in sinking force.

RECOMENDATIONS

In order to perform the ideal design it is suggested to modify design and construction based on analyses shown in this paper. Refer to sustainable fisheries resources, the seine mesh size should be modified to 3 inches minimum.

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REFERENCES

Ben-Yami, M. 1994. Purse Seining Manual. Published by arrangement with the Food and Agriculture Organization of the United Nation (FAO) by Fishing News Books. London. 406p.

Charles, A.T. 1994. Towards Sustainability: The Fishery Experience. *Ecological economics,* 11: 201-211.

----------. 2001. Sustainable Fishery Systems. Blackwell Science. London. 370 p.

FAO. 1995. Code of Conduct for Responsible Fisheries. FAO Fisheries Department. 24 p. (Online) (http://fao/fisheries/code, diakses 9 Juli 2002).

Fridman, A.L. 1986. Calculation for Fishing Gear Designs. Fishing News Books Ltd. England. 241p.

Fonteyne, R., M'Rabet, R., 1992. Selectivity experiments on sole with diamond and square mesh codends in the Belgian coastal beam trawl fishery. *Fish. Res.* 13, 221–233.

Klust, G. 1982. Netting materials for fishing gear. Published by arrangement with the Food and Agriculture Organization of the United Nation (FAO) by Fishing News Books Ltd. Farnham, Surrey, England. 175p.

Mallawa, A., Musbir, Amir, F., dan Marimba, A. A. 2012. Kajian pemanfaatan berkelanjutan sumberdaya ikan cakalang di perairan Teluk Bone, Sulawesi Selatan.. Laporan Penelitian. LP2M Unhas. Tidak Dipublikasikan.

Misund, A .O, and Beltestady, A.K. 2000. Survival of mackerel and saithe that escape through sorting grids in purse seines. *Fisheries Research* 48 : 31-41.

Najamuddin. 2012. Fishing gear design. Arus Timur Makassar.

Nomura, M. and Yamazaki, T. 1977. Fishing Techniques (1). Japan International Cooperation Agency. Tokyo. 206p.

Sadhori, S.N. 1983. Bahan dan Alat Penangkapan Ikan. Yasaguna. Jakarta.

Walsh, S.J., Millar, R.B., Cooper, C.G., Hickey, W.M., 1992. Codend selection in American plaice: diamond versus square mesh. *Fish. Res.* 13, 235–254.