Strength and structure of traditional fisheries lift nets against flow power in Pangandaran, West Java, Indonesia

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Abstract. Lift net is a traditional fishing tool used by Pangandaran fishermen. The traditional operating techniques and structural models make the lift net's operating life very limited. The purpose of this study was to determine the stability of the lift net construction against the flow, namely the current strength that affects the structure of the lift net. The study used an analysis to determine the extent of the lift net structure that is affected by flow, drag force, buoyancy and gravity. The results showed that the lift net used by Pangandaran fishermen was made from the main material of "betung" bamboo (*Dendroclamus asper*); it has a weight in water of 3937 kg. With a structure density of 1153.21 kg m^{-3}; it has a water resistance area on the diagonal side of 36.18 m^2 and a side part of 18.87 m^2. This weight will be exceeded by the amount of resistance of the lift net when the opposite current comes from a perpendicular direction and has a speed of above 7 knots or 3.6 m s^{-1}. If the current is coming from a diagonal direction (45°), the resistance will exceed the weight of the lift net when the velocity of the incoming current reaches 5 knots or 2.57 m s^{-1}.

Key Words: buoyancy, drag force, gravity, stability.

Introduction. The lift net is a passive fishing tool built by fishermen and used in shallow coastal waters, to catch small pelagic fish that have a habitat near the coast (Syahputra et al 2016). The lift net is a series or arrangements of rectangular bamboo embedded in the bottom of the water, so that it creates a firm standing framework, with a fishing net in the middle, usually with a mesh size of 0.5 cm (Silitonga & Hartoko 2014; Sudirman et al 2016; Rudin et al 2017). The lift net is a man-made structure placed in the water, functioning as a fishing structure. In this framework, there is a fishing gear that can be moved up and down when it is operated. Thus, the net, which is usually referred to as "Bagan" by local people, can be categorized in the type of lift net fishing gear (Ramadhan et al 2016).

The load supported by the lift net structure varies greatly and is influenced by several factors, one of which is horizontal flow. Thus, the design and materials are important in the supporting ability of the lift net. Several physical characteristics need to be taken into account, like the ability to withstand hydrodynamic forces and maintain the integrity of the lift net structure. Hydrodynamic forces such as currents and waves affect the stability, integrity, resistance and lifespan of the structure. Puspito (2009) states that the hydrodynamic forces consist of drag force (F_D) and lift force (F_L), which work perpendicular to one another. These forces will cause the erosion of the fishing gear itself or the erosion of the bottom sediment and displacement of the lift net structure, or even collapse, if excessive.

According to Sudrajat (2019), the calculation of the static force of the lift net needs to be known for the stability and resistance of the lift net in the water. The construction of the lift net must pay attention to the currents in the area, which will then be adjusted to the results of the static resistance calculations that have been made, so that the performance and resistance of the lift net are optimal. The maximum current speed that can be withheld so that the lift net remains standing is called the safety zone for placing the lift net in the water (Sudrajat 2019).

The fishing technique used consists of lowering the net below the surface of the sea water and then lifting it when the amount of fish that has gathered on the net is concentrated (Yuda et al 2012). Internal factors such as material and lift net contraction can be analyzed prior to the construction of the lift net, so that the shape and material used can be adjusted to the desired model and lift net specifications. However, external factors such as wind and currents can quickly change, so the lift net must be built to be able to adapt to various conditions. To overcome this problem, a lift net should be built based on the calculation of the strength of external factors and adjusted to the area of construction. Therefore, the aim of this research is to calculate the capability of the lift net used in Pangandaran, Indonesia, where the results obtained are used to determine which safe zone the lift net structure can tolerate.

Material and Method

Traditional lift net structure. Research on calculating the strength and structure of traditional fishing lift nets against flows was carried out from August to October 2019, in Pangandaran, Indonesia. The object that is used as a guideline for calculating the durability of the lift net structure against the type of current velocity is a lift net made of "betung" bamboo (*Dendrocalamus asper*) with dimensions of 10x10x15 m, built in waters with an average depth of 12 meters.

"Betung" bamboo is still abundant in Indonesia. It has a sufficient strength (external tensile strength 2850 kg cm^{-1} and inner tensile strength 970 kg cm^{-1}) (Eskak & Paramadharma 2016). Bamboo strength and resistance will increase when immersed in river or sea water (Pojoh 2017). The use of betung bamboo by the community as a building material is decreasing, causing its preservation to decrease; this is due to the lack of public knowledge about the mechanical properties of bamboo (Fahrina & Gunawan 2014).

The lift net structure consists of several parts, namely poles, embankments, and diagonals. Betung bamboo is used for poles, with a minimum length of 15 m, to support the lifting net. The lift net embankment serves to connect the poles to each other, while the diagonal bars are used as supports on each side of the lift net. The appearance of the Pangandaran net lift construction structure can be seen in Figure 1, while Figure 2 is an example of a net lift operated by fishermen.

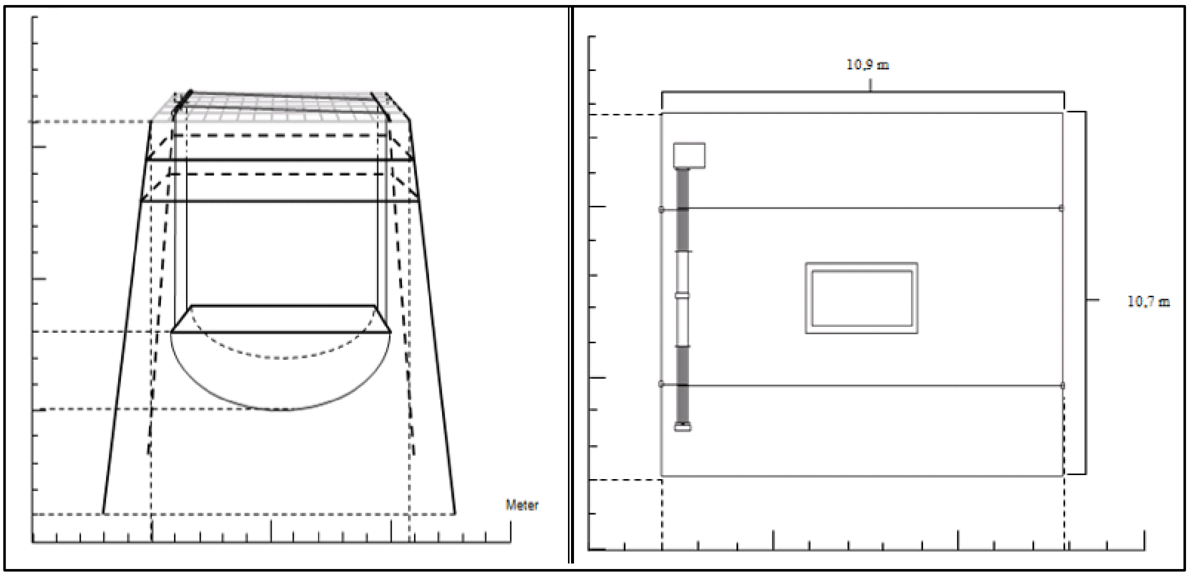

Figure 1. Lift net structure.

Figure 2. Lift net operated by fishermen.

The lift net structure used as the object of calculation is built with 16 bamboo poles, 12 bamboo bunds, and 24 diagonal bamboos. However, not all of the lift net parts were built offshore. The average height of the lift net built in Pangandaran waters exceeds with 3 m the surface of the water at high tide. So the submerged part of the lift net in water ranges from 0 to 12 m. This is used as the basis for the part of the lift net affected by the current strength in the range of 0-12 meters from the bottom of the water. Pangandaran lift net structure can be seen in Figure 3

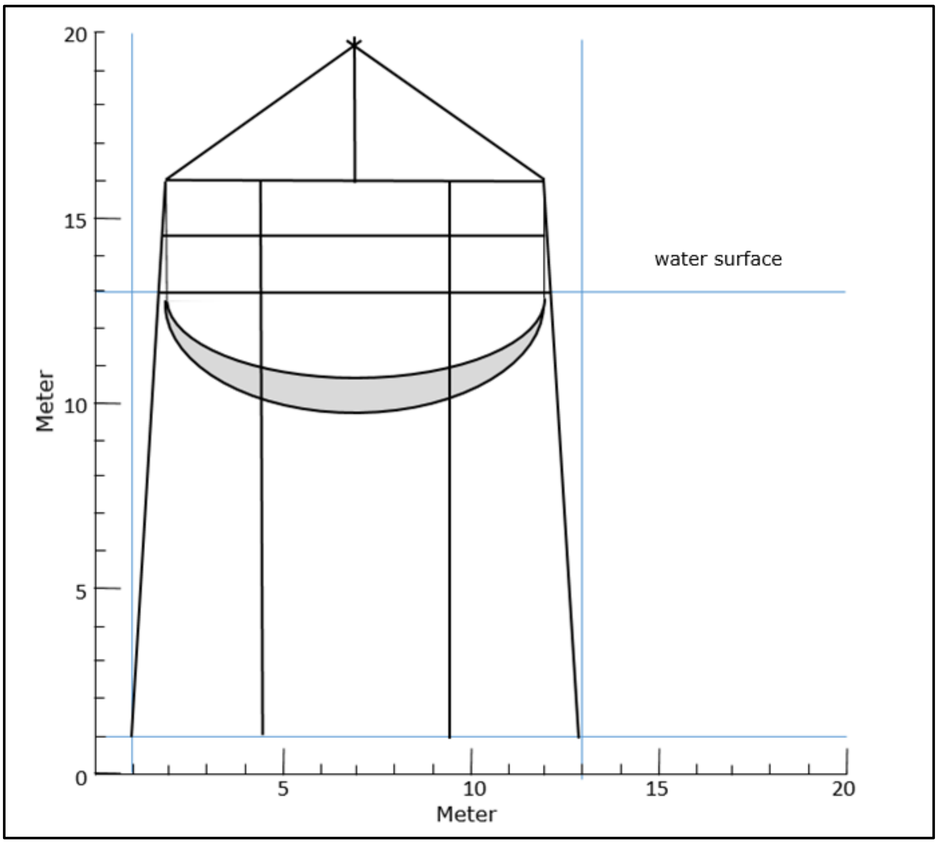

Figure 3. The structure of the submerged lift net.

Another factor that affects the resistance of the fixed lift net structure is the direction of the flow. Different current directions will result in differences in the surface that directly opposes the current direction. A larger surface that resists against the flow will need a larger lift net structure. In this case, the wet surface (A) directly facing the current consists of two forms, namely the side direction and the diagonal direction.

On the direction of the wet surface facing the current, the sides of the lift net are presented in Figure 4 (because the direction of the incoming flow is perpendicular to the side of the lift net). The diagonal side where A is directly facing the current, there are 2 slanted sides (Figure 5). This is due to the current coming from a diagonal direction.

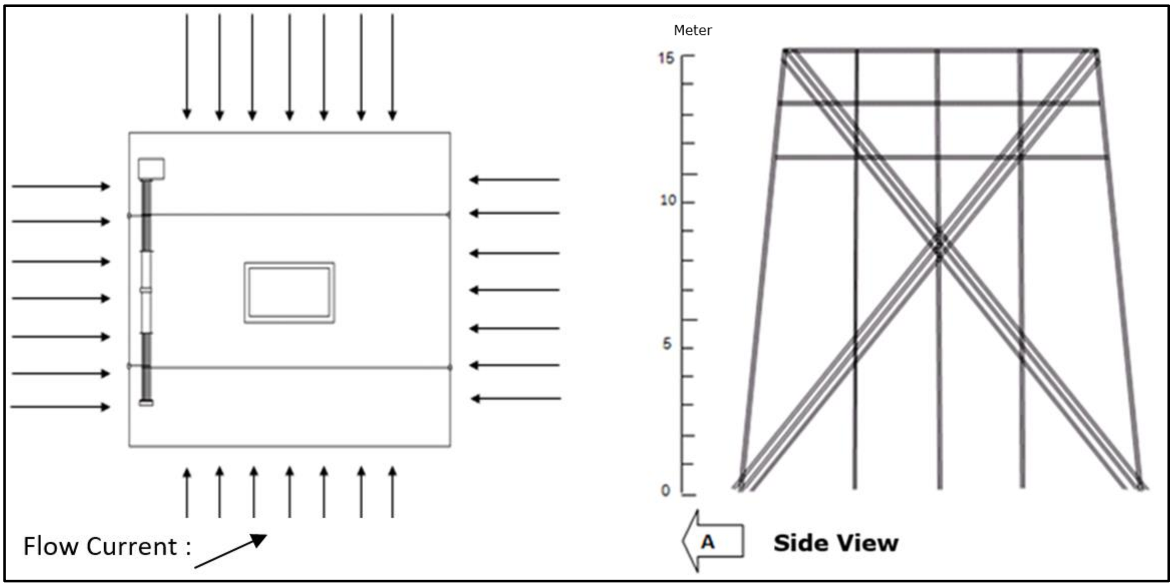

Figure 4. Side view of the lift net and direction of current from top view.

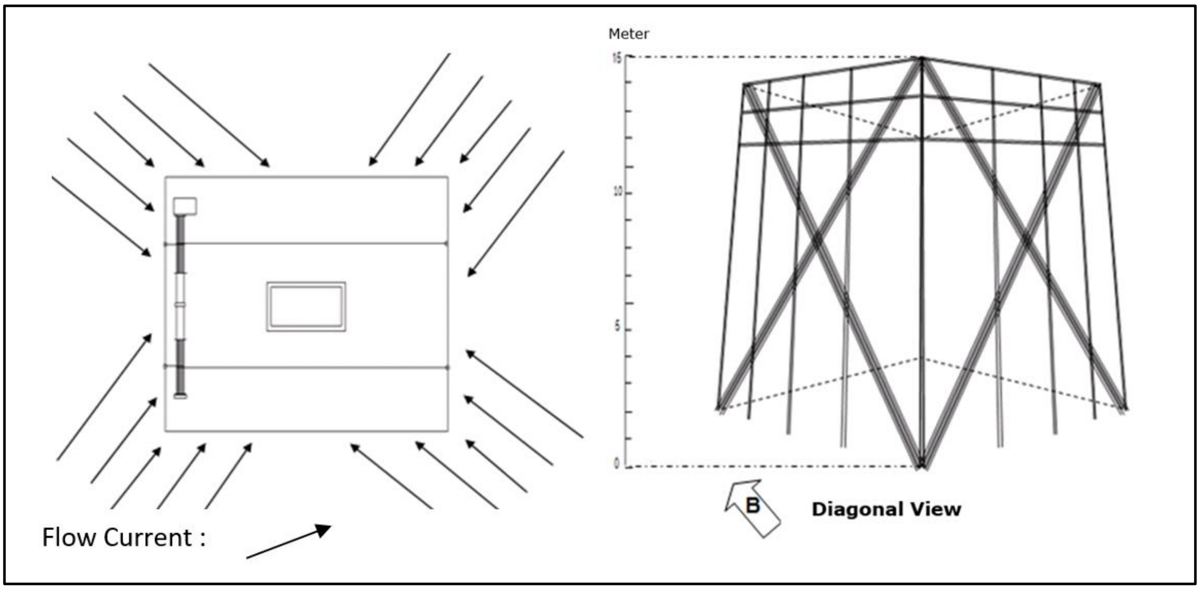

Figure 5. A diagonal view of the side of the net lift and direction of current from top view

Wet surface. The lift net used in this study was shaped like a cube, where the basic structure is made of betung bamboo with a diameter between 6.5-25 cm. The betung bamboo has 14.5-16.5 m length, with a decreasing diameter from the base (20 cm) to the top (Maulana 2018). The lift net building has the aim of operating a lift net with an average load of 200 kg for each setting. However, the catch of the lift net could reach 273 kg per setting (Julianus & Patty 2010).

The lift net that is used as the object of calculation is presented in Figure 6 and the amount of material and cross-sectional area of bamboo required in 1 unit of the lift net are presented in Table 1.

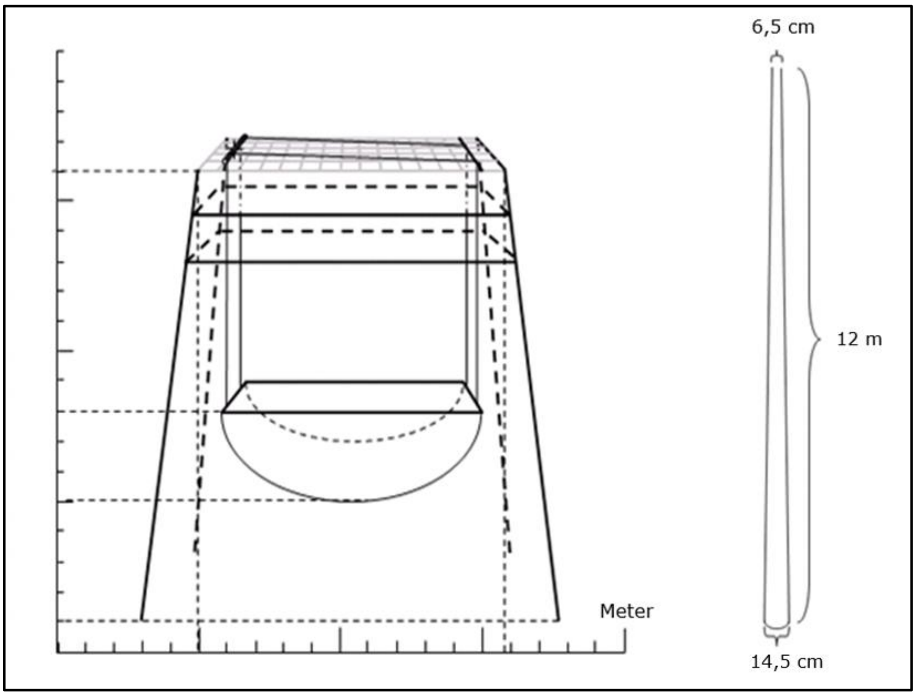

Figure 6. Pangandaran lift net and bamboo structure.

Table 1

Bamboo composition and cross-sectional area of the lift net structure

No	*Bamboo length*	*High A*	*High B*	*Radius "r" (m)*		*bamboo surface area (m²)*	*Total area (m²)*
				Base of rod	*Top of rod*		
1	Verical Pole	15	16	0.0725	0.0325	3.1280	50.0481
2	Horizontal pole	10	4	0.0725	0.0325	2.0856	8.3428
3	Diagonal Pole	16	24	0.0725	0.0325	3.3362	80.0705
							138.4614

The strength and durability of the lift net structure is greatly influenced by several factors such as materials and external forces. Problems with materials can be overcome by carrying out regular maintenance. Factors that are difficult to predict are external factors such as currents. Current conditions in waters can affect the structural resistance of the lift net. Other events can also damage the nets, like in the case of the 2006 tsunami, when all lift net in Pangandaran were slammed onto the mainland (Sartika 2011).

This study aims to determine how much current velocity the lift net structure can withstand or tolerate. Thus, the construction of the lift net considered the current velocity with the aim that the built lift net could last a long time and could guarantee the safety of the crew or fishermen who operate it.

Information that needs to be known to determine the level of tolerance of the lift net to flow velocity includes: field of resistance (wet surface), density of material and direction of flow. In this case, the current direction is considered to be the side direction and the diagonal direction to the lift net structure. The side direction is the direction where the current is directly facing perpendicularly (90°) the side of the lift net, so that there is only one side of the lift net that interacts directly with the current strength. The diagonal current is the incoming current from a 45° angle, so that there are 2 sides of the lift net that interact with the current.

Data collection. The data required in the calculation of the static power of the lift net structure includes the weight of the lift net, the size of the lift net and the size of each lift net compiler. Measurement of the weight and size of the lift net, length and diameter of the lift net building material was done manually and adjusted to the literature. The data to be collected is presented in Table 2.

Table 2

Static power data and analysis of lift net

Data	*Data collection method*	*Analysis*
Weight of the lift net in the air	Weighing samples of lift net construction parts	Descriptive
Length, width, diameter of the bamboo and polyamide mesh width	Measure on any part of the lift net	Descriptive
Seawater density, friction coefficient, non-dimensional coefficient	-	Study of literature

Data analysis. Not all parts of the lift net are submerged in water. The part that is submerged in the water consists of lift net poles, which support the structure from the bottom of the water. The pole section of the building will affect the calculation of the hydrodynamic force (F) and drag coefficient (Cd). If the resulting drag coefficient (Cd) is greater, the resulting resistance will also be greater and vice versa (Dani et al 2019; Sulistyono et al 2013).

The calculation of F (hydrodynamic force) will follow the equation of Nakamura (1982); thus, the calculation of the current force in the lift net structure can be seen as the following formula:

$$F=\tfrac{1}{2}\rho v^2 ACd$$

Where: F - hydrodynamic force (kg m s^{-2}); A - reef area receiving water resistance (right angle shadow) (m); ρ - density of sea water (kg m^{-3}); v - current velocity (m s^{-1}); Cd - drag coefficient.

The drag coefficient (Cd) of the bamboo material depends on the Reynold number (Rn) and other factors. Rn is one of the most important dimensionless numbers in fluid mechanics, namely the ratio of the inertia force (vsρ) to the viscous force (μ L^{-1}). It quantifies the relationship between the two forces in a certain flow condition. The Rn is used to identify different types of flow, for example, laminar or turbulent flow (Wibowo et al 2018). The formula for Rn is generally the following (Wibowo 2017):

$$Re = \frac{L\rho v_s}{\mu} = \frac{Lv_s}{v} = \frac{Inertia\ force}{Viscous\ force}$$

Where: v_s - fluid velocity; L - characteristic length; μ - absolute viscosity of dynamic fluid; v - kinematic viscosity of the fluid; v = μ/ρ; ρ - density of fluid.

The bamboo that is used as the main material for building lift nets is generally shaped like a long cylinder. The Cd of objects that have regular shapes such as cylinders can be calculated using the following formula (Wibowo et al 2018):

$$C_d = \frac{0.075}{(\log R_n - 2)^2}$$

Where: Cd – coefficient drag; R_n – Reynold number.

The formula for calculating the unit weight of the lift net so that it is resistant to the pressure that comes from a strong current or commonly called a slip is as follows (Sudrajat 2019):

$$W > \frac{F}{\mu\left(1 - \frac{\rho}{\sigma}\right)}$$

Where: W - weight of lift net (in water) (kg); F - hydrodynamic force on reef (kg m s^{-2}); μ - coefficient of friction between reef and water bed; σ - density of reef (kg m^{-3}); ρ - density of sea water (kg m^{-3}).

Results and Discussion. The sides of the lift net consist of 5 bamboo poles, 2 bamboo sticks and 6 diagonal bamboos crossed from each corner of the lift net side (Figure 7). From the amount of bamboo, the wet surface calculated is presented in Table 3.

Table 3

Surface area of the wet side of the lift net

No	*Bamboo length*	*Height*	*Amount*	*Radius "r" (m)*		*Total*	*Wet surface (m^2)*
				Base of bamboo	*Top of bamboo*		
1	Vertical Pole	12.19	5	0.0725	0.0325	15.64	7.82
2	Horizontal Pole	8.13	1	0.0725	0.0325	2.0857	1.04
3	Diagonal Pole	13	6	0.0725	0.0325	20.0176	10
	Wet surface (m^2)					37.7434	18.87

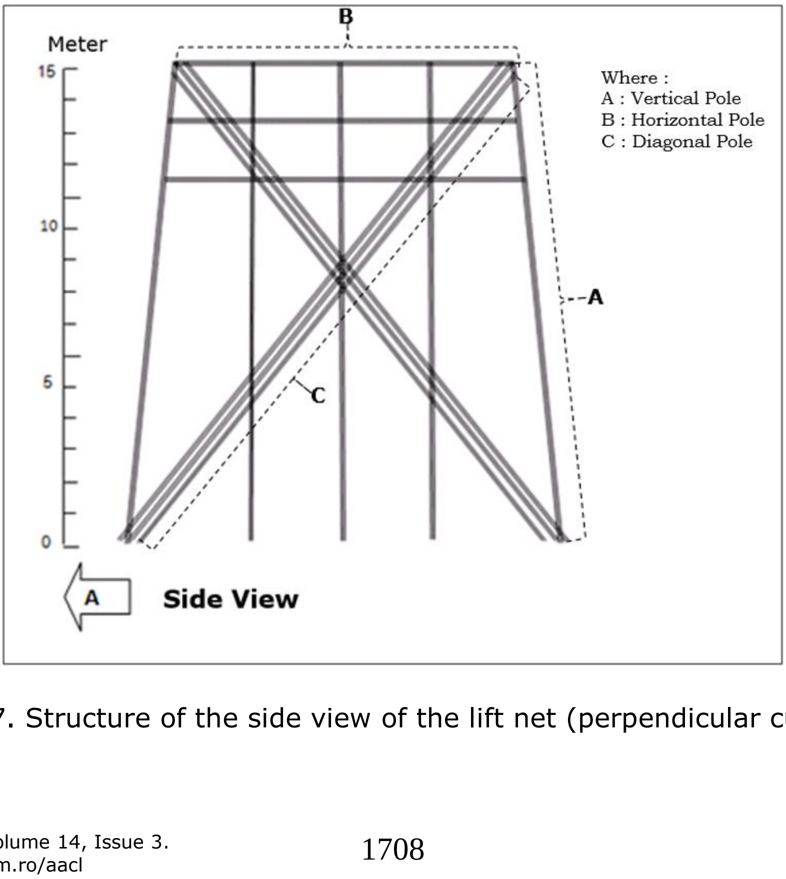

Figure 7. Structure of the side view of the lift net (perpendicular current).

The side of the lift net consists of 9 bamboo poles, 2 bamboo bunds and 12 diagonal bamboos that are crossed from each corner of the lift net side (Figure 8). From the number of bamboo components, the wet surface calculated that is on the diagonal side is presented in Table 4.

Table 4

Extensive wet surface area of the diagonal side of the lift net

No	*Bamboo length*	*Height*	*Amount*	*Radius "r" (m)*		*Total*	*Surface (m^2)*
				Base of bamboo	*Top of bamboo*		
1	Vertical Pole	12.19	9	0.0725	0.0325	28.15209	14.08
2	Horizontal Pole	8.13	2	0.0725	0.0325	4.171395	2.08
3	Diagonal Pole	13	12	0.0725	0.0325	40.03523	20.02
		Wet surface area (m^2)				72.35872	36.18

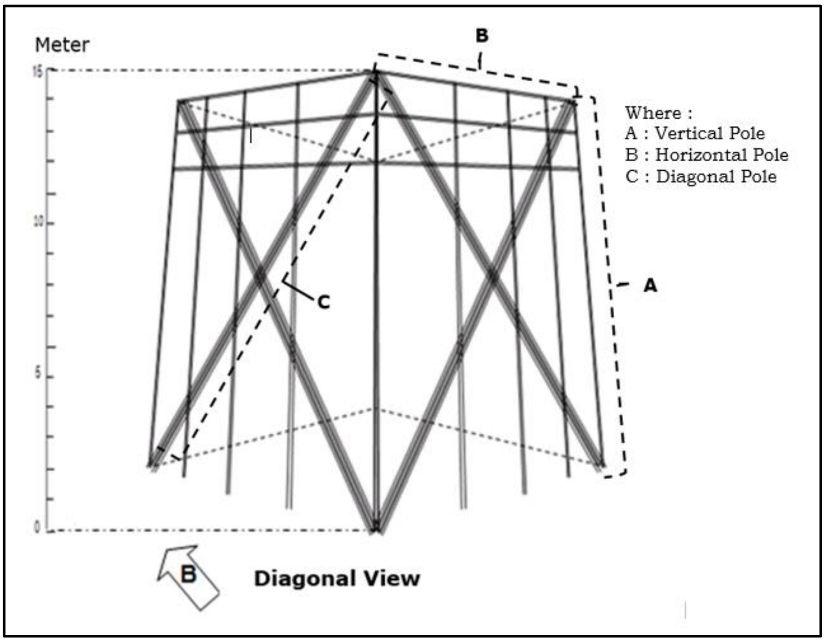

Figure 8. Diagonal view of the structure of the lift net (direction of diagonal current 45°).

Calculation of the static resistance of the lift net structure. The weight obtained from the lift net structure is that of the 52 betung bamboo components, of which there are 16 bamboo poles, 12 bund bamboo sticks and 24 diagonal bamboos, with a total weight of 3937 kg. The lift net structure parameters used to predict the hydrodynamic force (F) are presented in Table 5.

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Table 5

Lift net structure parameters

Parameter	*Lift net structure*
Weight of lift net	3937 kg
Density of lift net structure	1153.21 kg m^{-3}
Water resistance field	Perpendicular side: 18.87 m^2 Diagonal side: 36.18 m^2
Sea water density	1025 kg m^{-3} (Fatnanta et al 2008; Pratama et al 2016; Samuel 2016)

The value of the water resistance area of the lift net structure is 18.87 m^2, if the current originates from the perpendicular direction, and 36.18 m^2, if the current originates from a diagonal direction. The results of the calculation of the hydrodynamic force on the structure of the lift net where the incoming current is perpendicular to the side of the lift net is presented in Figure 9. The structure of the lift net at a current speed of 0.5 knots or 0.26 m s^{-1} will receive a force of 1.65 kg m/s^{-2}. Furthermore, if the current speed is increased to 1 knot or 0.51 m s^{-1}, then the lift net structure will receive a force of 5.88 kg m s^{-2}. The average increase in hydrodynamic force with increasing current of 0.5 knots or 0.25 m s^{-1} is 41%.

Furthermore, the results of the calculation of the hydrodynamic force on the structure of the lift net where the current is coming diagonally can be seen in Figure 10. The structure of the lift net at a current velocity of 0.5 knots or 0.26 m s^{-1} will receive a force of 3.11 kg m s^{-2}. Furthermore, if the current speed is increased to 1 knot or 0.51 m s^{-1}, the lift net structure will receive a force of 11.1 kg m s^{-2}. The average increase in hydrodynamic force with each 0.5 knot or 0.25 m s^{-1} increase in current is 34%. The hydrodynamic force is greater when the current is coming from the diagonal direction than the hydrodynamic force when the incoming current is perpendicular to the side of the lift net. This is because the dimensions of the wet surface facing the current are wider when the current is coming from the diagonal direction.

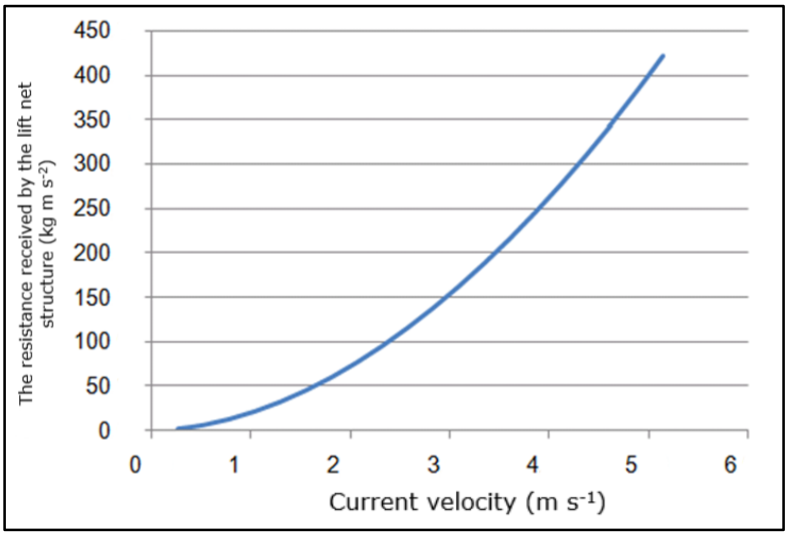

Figure 9. Hydrodynamic forces of vertical current flow structure (perpendicular).

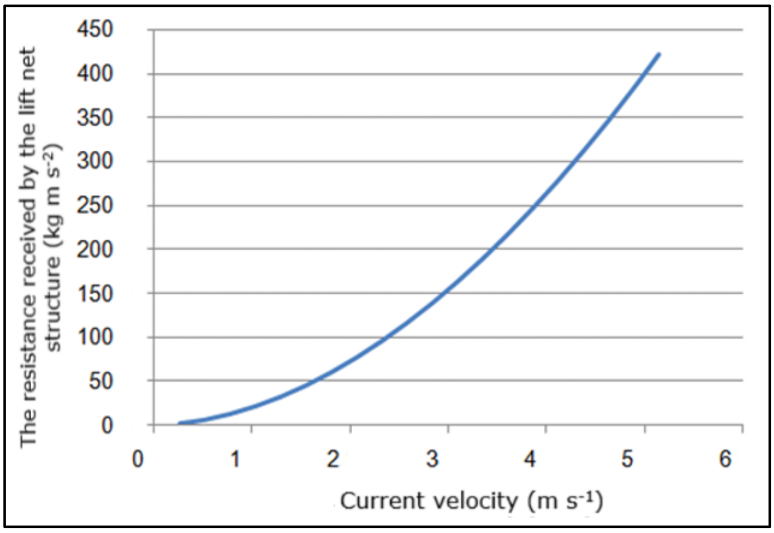

Figure 10. Hydrodynamic force structure of the diagonal current (45°).

Lift net stability to current direction. The lift net supporting structure will begin to slip at a current speed of 7 knots or 3.6 m s^{-1}, if the current is coming from the perpendicular direction and the influence of the supporting strength of the bamboo structure in the water is neglected. This can happen because, at a current speed of 7 knots or 3.6 m s^{-1}, the hydrodynamic force received by the lift net structure reaches 3895.2 kg m s^{-2}, so if the current acceleration increases, the resulting hydrodynamic force can exceed the weight of the lift net structure (Figure 11).

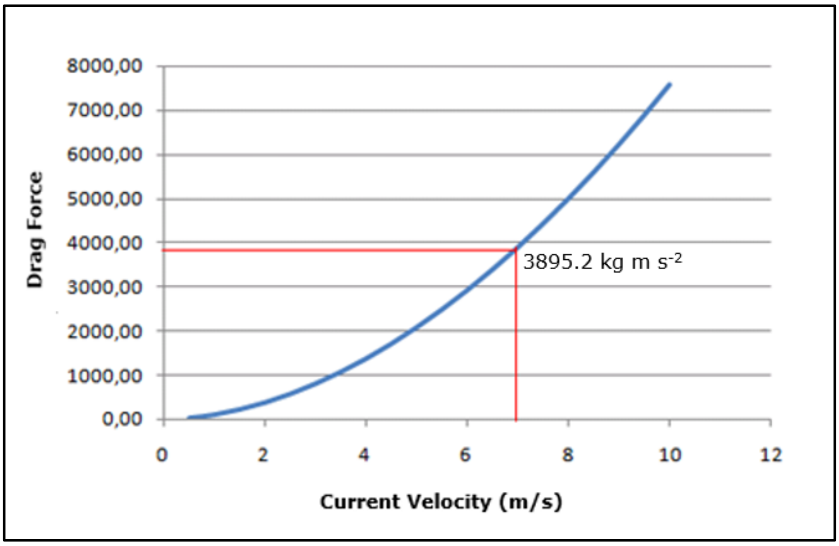

Figure 11. The structure of the lift net starts to slip in a perpendicular current.

The structure will begin to shift at a current speed of 5 knots or 2.57 m s^{-1}, if the current is coming from a diagonal direction (45°) and the influence of the supporting strength of the bamboo structure in the water is neglected. This can happen because at a current speed of 5 knots or 2.57 m s^{-1}, the hydrodynamic force received by the lift net structure reaches 3936.37 kg m s^{-2}, so if the current speed increases, the resulting hydrodynamic force can exceed the weight of the lift net structure (Figure 12). Based on the results of these calculations, the weight of the lift net structure can affect the strength and stability when in the water. Increasing the weight of a lift net with more material will increase the current velocity that the bag can withstand against shifting. Vice versa, by reducing the weight on the lift net, the lift net's ability to withstand the flow that opposes it will decrease.

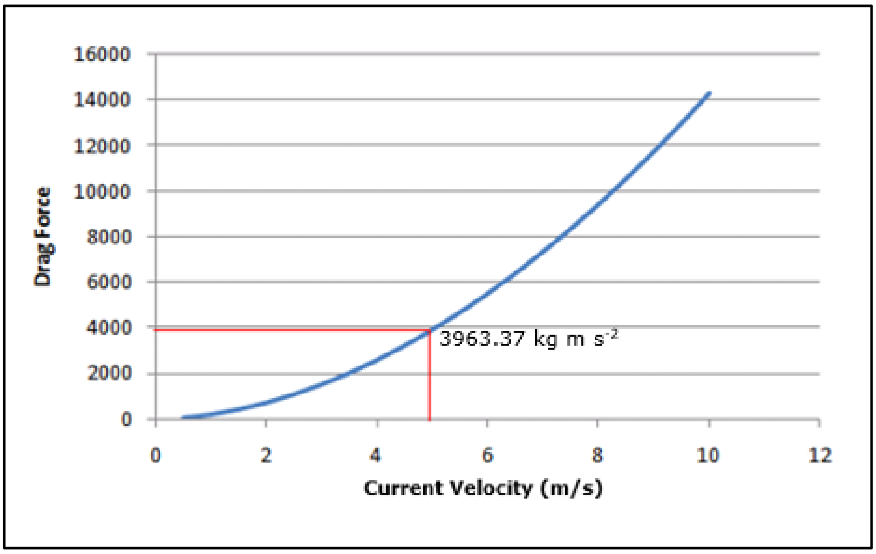

Figure 12. The structure of the lift net starts to shift on a diagonal current.

The current speed that can be accepted by the lift net structure before shifting, with a weight of the lift net at sea of 3973 kg, is depicted in Figure 13. The current speed that can be withheld when it comes from the direction perpendicular to the side of the lift net is 3.6 m s^{-1}.

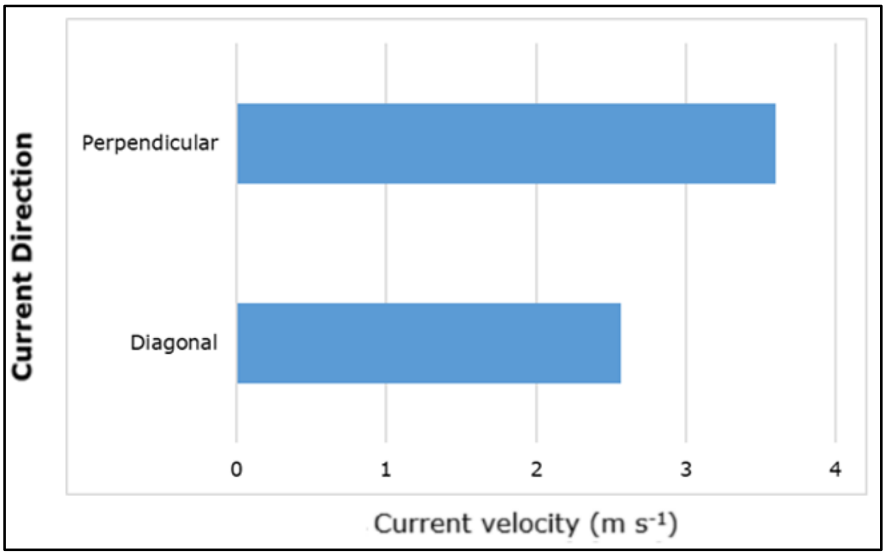

Figure 13. Current velocity that can be held by a lift net so it does not slip.

The selection of the place for the construction of the lift net must pay attention to the current in the area, needing to be a safety zone. Furthermore, if the current in the area suddenly exceeds the safety zone limit, the safety zone limit itself can be increased by reducing the hydrodynamic force or by increasing the weight of the material used to build the lift net.

Lift nets in Pangandaran, Indonesia, are built by fishermen at a water depth of approximately 12 m, where the transparency of 3.5 m (Rosada et al 2017). The lift net has dimensions of 10x10x15 m, and the main material, the betung bamboo, has a weight of 3937 kg. The weight will be exceeded by the of resistance received by the lift net when the current comes from a perpendicular direction and has a speed of above 7 knots or 3.6 m s^{-1}. The current velocity tends to be lower when compared to the rip current speed that occurs on Pangandaran beach, where it can reach a speed of 3 m s^{-1} (Sutiyoso & Egon 2019).

Conclusions. The weight of the bamboo (3937 kg) will be exceeded by the amount of resistance received by a lift net (10x10x15 m), when the current comes from a perpendicular direction and has a speed of above 7 knots or 3.6 m s^{-1}. If the current is coming from a diagonal direction (45°), the resistance received will exceed the weight of the lift net when the incoming current reaches 5 knots or 2.57 m s^{-1}.

Conflict of Interest. The authors declare that there is no conflict of interest.

References

Dani A. P., Rubiono G., Mukhtar A., 2019 [Hydrodynamic analysis of 7 (seven) ships bow shape (bulbous) with constant velocity]. V-Mac (Virtual of Mechanical Engineering Article 4(1):1–3. [In Indonesian].

Eskak E., Paramadharma H., 2016 [Krawangan carving technology on betung bamboo (*Dendrocalamus asper*)]. Dinamika Kerajinan dan Batik: Majalah Ilmiah 31(1):1-10. [In Indonesian].

Fahrina R., Gunawan I., 2014 [Utilization of Bangka betung bamboo as a substitute for bamboo reinforced concrete beams]. Jurnal Fropil 2(1):56-68. [In Indonesian].

Fatnanta F., Pratikto A. W., Citrosiswoyo W., Armono D. H., 2008 [The influence of the slope and configurations of sandbag on the sandbag breakwater stability]. Dinamika Teknik Sipil 8(2):101-107. [In Indonesian].
Julianus N., Patty W., 2010 [Differences in the use of light intensity on the catch of floating charts in the waters of the Rosenberg Strait, Southeast Maluku Regency, Kei Islands]. Jurnal Perikanan dan Kelautan Tropis 6(3):134-140. [In Indonesian].
Maulana S., 2018 [Physical, mechanical, and durability of oriented strand board bamboo andong and betung with steam treatment on strand]. Phd Thesis, Bogor Agricultural Institute, Bogor, Indonesia, 45 p. [In Indonesian].
Nakamura M., 1982 The planning and design of artificial reefs and tsukiiso. Japanese Artificial Reef Technology, Technical Report 604, pp. 49-66.
Pojoh B., 2017 [The effect of immersion in river water and sea water on the durability of petung bamboo reinforcement from Tomohon]. Jurnal Penelitian Teknologi Industri 9(1):37-48. [In Indonesian].
Pratama Y. A., Yudo H., Adietya B. A., 2016 [Analysis of winch structural strength against tension force of warp rope on Pp II 29 Gt Traditional Fishing Vessels in Batang Regency using finite element method]. Jurnal Teknik Perkapalan 4(4):878-888. [In Indonesian].
Puspito G., 2009 [Effect of current on voltage and curvature of trammel net model]. Jurnal Mangrove dan Pesisir 9(1):38-47. [In Indonesian].
Ramadhan H., Wijayanto D., Pramonowibowo, 2016 [Technical and economical analysis of the boat lift net at the Morodemak Coastal Fishing Port, Demak Regency]. Journal of Fisheries Resources Utilization Management and Technology 5(1):170-177. [In Indonesian].
Rosada K. K., Pribadi T. D. K., Putri S. A., 2017 [Phytoplankton community structure at various depths on the east coast of Pananjung Pangandaran]. Jurnal Biodjati 2(1):30-37. [In Indonesian].
Rudin M. J., Irnawati R., Rahmawati A., 2017 [Differences of fixed lift net catch result by using Cfl lamps and underwater led in Banten Bay Water]. Jurnal Perikanan dan Kelautan 7(2):167-180. [In Indonesian].
Samuel S., 2016 [Component analysis of traditional fishing vessel barriers in Cilacap waters]. Jurnal Kelautan: Indonesian Journal of Marine Science and Technology 9(1):1-6. [In Indonesian].
Sartika I., 2011 [Fisherman empowerment policy evaluation]. Jiana (Jurnal Ilmu Administrasi Negara) 11(2):111-124. [In Indonesian].
Silitonga M. F., Hartoko A., 2014 [Analysis of the distribution of lift nets and catches in the waters of Bandengan, Jepara, Central Java]. Journal of Fisheries Resources Utilization Management and Technology 3(2):77-84. [In Indonesian].
Sudirman S., Najamuddin N., Palo M., 2016 [The effectiveness of using different types of electric lights to attract small pelagic fish at elevator net lift]. Jurnal Penelitian Perikanan Indonesia 19(3):157-165. [In Indonesian].
Sudrajat D., 2019 [Design and construction of squid attractor based on a 2 inch PVC pipe]. Dissertation, Bogor Agricultural Institute, Bogor, Indonesia, pp. 33-51. [In Indonesian].
Sulistyono W., Finahari N., Farid A., 2013 [The effect of tail and front boat installation on aerodynamic performance in sedan vehicles]. Proton 5(1):49-54. [In Indonesian].
Sutiyoso H. S., Egon A., 2019 Hydrodynamics and sediment characteristics on a bathymetrically-controlled rip channel in Pangandaran Beach. Bulletin of Geology 3(3):442-448.
Syahputra R. D., Bambang A. N., Dewi D. A. N. N., 2016 [Technical and financial analysis comparison of lift net catching equipment with floating charts in Ppp Muncar Banyuwangi, East Java]. Journal of Fisheries Resources Utilization Management and Technology 5(4):206-215. [In Indonesian].
Wibowo B., 2017 [Mini line hauler design with bio-engineering approach for hand line fishing]. Dissertation, Bogor Agricultural Institute, Bogor, Indonesia, pp. 1-12. [In Indonesian].

Wibowo B., Sondita F. A., Iskandar B. H., Haluan J., Soeboer D. A., 2018 [Estimation of the attractiveness of mini hauler ropes for application to tuna hand line fishing in the Indian Ocean south of Java]. Jurnal Penelitian Perikanan Indonesia 24(2):137-148. [In Indonesian].
Yuda L. K., Iriana D., Khan A. M. A., 2012 [Environmental friendly level of Bagan fishing equipment in Palabuhanratu waters, Sukabumi Regency]. Jurnal Perikanan Kelautan 3(3):7-13. [In Indonesian].

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