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Sungkur rolling ship with pushing operation method for fish and shrimp catching in the coastal waters

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Abstract. Sungkur ship is used to catch fish and shrimp in the coastal waters of Tanah Laut Regency. The ship is operated actively in a push manner. This research aimed to: (1) Analyze the Sungkur ship enforcement arm during the fishing operation (2) Analyze the Sungkur rolling ship movement in regular wave beam seas conditions. The research was conducted in March-May 2018. The research used an experimental method of the fishing operation. Analysis of data through simulation and numerical using naval architecture formula and the results interpreted descriptively. Equipment that is used includes Sungkur fishery, camera, stationery, measuring instrument, water pass, slide, yarn, pendulum, GPS, stopwatch and computer. The results of study showed that the main dimension value ratio of sample ship L/B = 4.68-7.0, L/D = 5.0– 1.2, and B/D = 1.0-2.0. GZ enforcement arm during operation of the Sungkur ship was above the minimum standard value that has been set IMO that is equal to 0.675. Rolling highs at 14.4^{o} with a wave height of -0.46 m and the lowest rolling at -14.4^{o} with a wave height of 0.46 m.

1. Introduction

Sungkur ship is used for fish and shrimp catching activities in territorial waters of Tanah Laut Regency South Kalimantan. The fishing gear which is operated on the board ship is only one tool that is Sungkur, so the ship carrying the equipment is called Sungkur Ship. Based on the type of operating fishing gear by Sungkur Ship belongs to the towed/dragged gear group.

Ships that are belonging to the towed/dragged gear group desperately need stability and speed of the ship. When reviewed from the speed factor, the shape of a lean ship will be able to move at high speed, but from the stability factor, the slender body of the ship resulting in the ship easily shake so that the convenience of fishermen on the ship to be reduced. Lines Plan of *Sungkur* ship on the bow and stern part of the ship to form the Raked Bow ship (V), the shipshape is Double-pointed and Kasko is Akatsuki [1]. This is related to work of ship systems that focus on the bow of the ship, start from placement of the net to the capture process. The determination of the form of Kasko for a fishing ship is not due to consideration of technical advantages or feasibility when operating at sea. The hull design of the ship is made in order to the center of gravity becomes safer and more stable [2].

Any floating structure that moves above the surface always experience the isolation movement. There are 3 kinds of movement is pure isolation movement among others is rolling [3]. This movement works under force or moment of return when this structure is disturbed from the equilibrium position. A ship traveling in a wavy area will receive forces from its surroundings, where

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the greatest force moment is the hydrodynamic force and cause other motions as a response, where the size of the ship motion depends on the excitation of the moment generated by the hydrodynamic force, wave direction, dumping and reversing moment style.

Movement of the ship is increasing in addition to disturbing the stability of the ship also reduces the comfort of fishermen. When the ship performs its operations in the waters, the movements of the ship will arise due to the phenomenon of the above factors. Waves are one of the reasons that believed to be the main factor causing the movement of the ship. There are many ship movements such as surging, swaying, heaving, rolling, pitching and yawing, the three movements are oscillatory motions that are caused by the effect of the returning force or the moment of return when the ship changes from its equilibrium position, i.e. heaving, pitching and rolling. Although in fact the ship experienced six kinds of movements together but the focus of this research is only on the rolling motion. Roll motion is an important parameter in ship stability, wherein bad weather roll motion can cause capsizing [4]. On the other hand, the damping coefficient is the most important parameter for reducing roll movement.

Rolling is one of the motions of the ship that rotation motion against the longitudinal axis. Some of the negative impacts of rolling, among others, the ship can be reversed due to excessive inclination, the magnitude of endurance and poor performance of the propeller that causes the movement of the ship inhibited. Thus it is necessary to conduct a scientific study on the dynamic stability, rolling and redesign of Sungkur ship.

This research aimed to (1) Analyze the value of the enforcement arm of the Sungkur ship during the fishing operation; (2) Analyze the Sungkur rolling ship movement in regular beam seas wave conditions;

The result of stability evaluation of the ship is expected to be used to determine the feasibility of Sungkur ship and can be used to obtain an alternative dimension of the more ideal ship that has a better quality in accordance with its designation, so it can be a reference in the manufacture of similar ships in the future.

2. Methodology

2.1. Time and place

The research was conducted in March-May 2018. Measurement of Ships was done at the time of Fishing base and Fishing ground of Sungkur Ship operation in Harapan Beach Village, Tanah Laut Regency, South Kalimantan. Data processing was done in the laboratory of Fishery Equipment and Ship and Navigation Laboratory of Fishery and Marine Faculty Lambung Mangkurat University Banjarbaru.

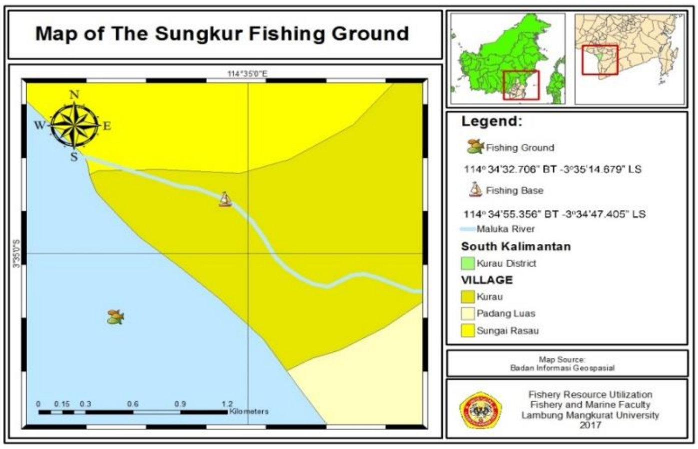

Figure 1. Map of Fishing Ground for Fish and Shrimp Catching with Sungkur Fishery in South Kalimantan Waters Scale Bar 1: 15000

2.2. Research methods
The research used an experimental fishing method. The case studied Rolling ship is obtained through a calculation using the formula naval architecture and the results are interpreted descriptively so it is easier to understand.

2.3. Research equipment
The Equipment used is cameras, stationery, measuring instruments, water pass, slide, yarn, pendulum, stopwatch, GPS and computer. Calculations are performed with the appropriate software.

2.4. Data analysis
The data analysis is used design suitability analysis to observe the value of the main dimension ratio of the ship: (The L / B ratio = the ratio between length and width affects ship resistance; L / D ratio = the ratio between length and height affects the strength of the length of the ship; the B / D ratio = the ratio between width and height affects the stability of the ship as a comparison of the standard ratio range in Nomura and Yamazaki (1977) [5].

The stability of the sample vessel was analyzed through the GZ stability curve using the Attwoods formula method at the angle of 0-90^o [6]. The shaking period as one of the parameters for determining the working comfort level on the vessel is calculated using three different amplitudes of wave values with the same wavelength. The three regular amplitudes used are obtained from the theoretical high wave prediction of the value of wind speed obtained.

The rolling parameter was analyzed based on the value of regular wave amplitudes at an angle of 90° by using *seakeeping* analysis on the regular beam seas waves [7].

- Wave Frequency (ω_w) =$\sqrt{2\pi g/Lw}$ …………………..……….(1)
  Where; Lw: wavelength and g: gravity
- Number of waves, $k=2\pi/Lw$ ………………………………….. (2)
- Encountering Frequency (ω_e) = $\omega_w - \omega_w^2/g\ v \cos\mu$ …….………(3)
  Where; v: ship speed dan μ: encounter angle

3. Results and discussion

3.1. Result

3.1.1. Ship Main Dimensions. Sungkur is a fishing gear with crossed mouth opening forming a triangle with a bag behind, the base part is not the frame. Sungkur fishing gear is a development of push net.

The main size of the ship the size consists of Length (L), Breadth (B), Depth (D) and *Draft* (d). The characteristic of the ship can be seen based on the ratio of the ship main dimensions. The main ratio values of each L/B, L/D, and B/D can be seen in table 1.

Table 1. The Ratio of the Ship Main Dimensions

Ship Dimension	Ship 1	Ship 2	Ship 3	Ship 4
L (Length)	7.5	7.5	11.2	7.5
B (Breadth)	1.6	1.6	1.6	1.5
D (Depth)	1.5	0.8	1.0	1.5
Ratio L/B (2.86 – 8.30)	4.68	4.68	7.0	5.0
Rasio L/D (7.20 – 15.12)	5.0	9.0	11.2	5.0
Ratio B/D (1.25 – 4.41)	1.07	2	1.6	1.0

Sources : (Rusmilyansari et al, 2017) [8]

3.1.2. Stability. The ship that has a good stability is a ship that can return to its original position after experiencing rocking. The stability of the fishing ship is the ability of the fishing ship to return to its original position after experiencing influence from outer forces or external forces [9]. External factors include the influence of wind and waves, the presence of fishing gear in the water that can increase the slope of the ship and reduce the ability of the ship to back upright or minimize the value of the moment of enforcement (*righting moment*). The ship has its own ability to back upright well on transverse stability, statical stability, or longitudinal stability. Based on the provision that the fishing ship must have initial stability is not less than 0.6 meters.

The result of stability analysis on the condition of Sungkur Fishery Ship when in Fishing Base (Static Stability) at the moment there is no wave and stability when heading to Fishing Ground (Dynamic Stability) on condition (Wavelength = 5 m and Wave Height = 0.5 m), refers to the Torremolinos International Convention for The Safety of Fishing Ship (1977) [10] indicating that the Sungkur ship is safe enough to be used for fishing operations because all stability calculation criteria exceed the criteria of IMO with a margin of more than 50%. Comparison analysis results of static stability and the dynamic stability of the Sungkur ship can be seen in figure 2.

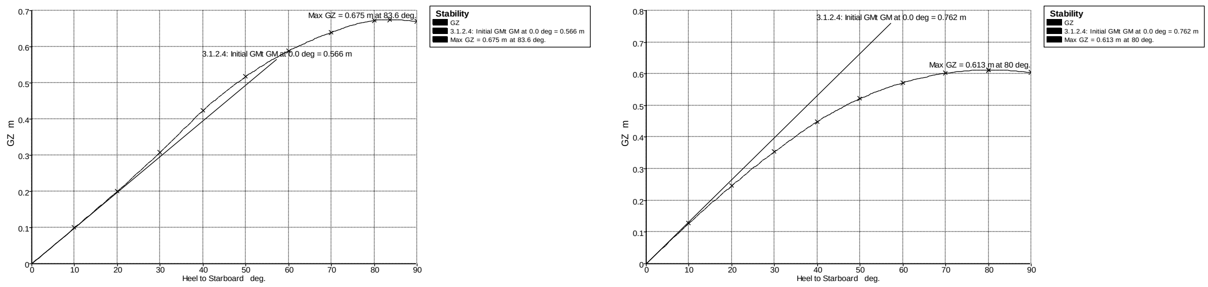

Figure 2. The curve of static stability (left) and dynamic stability (right)

3.1.3. Rolling. The rolling motion is usually very real so that the real resonance approaches the undamped natural roll frequency. Damping increases with increasing speed. This provides a great decrease in roll response and a small decrease in the frequency at which the roll peak response occurs. At zero frequency (δ=+90^o), the roll phase is an indication of the positive roll (to the starboard) to the maximum wave drop with a quarter period. At a natural roll, the phase frequency of the roll is zero (δ=0^o) and then the maximum roll equals the peaks and valleys of the wave. At high frequency (δ=-90^o) and the ship has roll opposite the wave slope. The rolling motion then gradually becomes small.

The rolling value of the sample ship can be seen in figures 3 and 4 that show the rocking of the ship in seconds' unit when it is affected by the wave (δ = 90°).

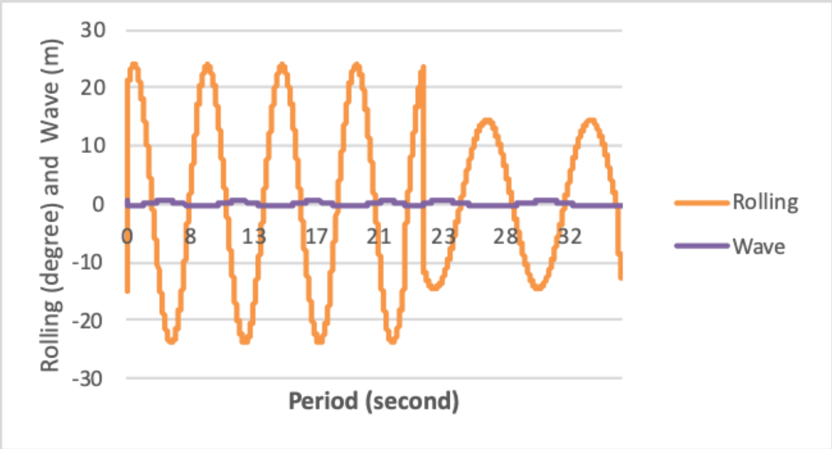

Figure 3. Sungkur rolling ship 1

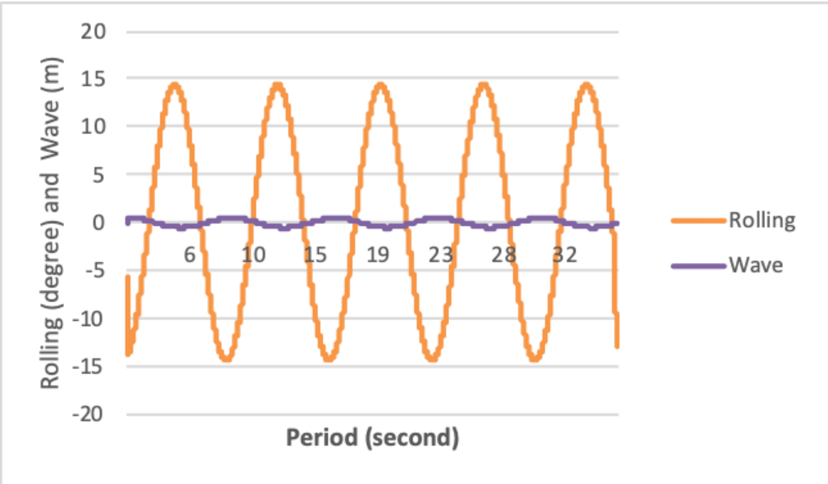

Figure 4. Sungkur rolling ship 2

3.2. Discussion

3.2.1. Main ship dimension. Based on Table 1. The ratio value of L/B Sungkur ship has fulfilled the established standards value, however, the ratio value of L/D and B/D do still not fulfill the requirements, are at the lower of the threshold. The L/B value is relatively close to the lower limit, it shows that the motion resistance experienced is minor, this matter has an effect on the speed of the ship.

The ratio of B/D affected the stability of the ship and its thrust. The value is relatively close to the lower limit there is even less than the lower limit, the stability is good enough however the propulsive ability can deteriorate if the resistance of the fishing gear that is used is large.

Based on the calculation results of the L/D ratio do not fulfill the standard, namely longitudinal strength which has a bad effect on the motion ability. (propulsive ability). Thus the ship has trouble in turning both left and right. However, because the nature of the operation is driven so that it does not require a turning motion during the fishing operation.

The value of the main dimension of the ship is a simple approach and can easily determine the size of the ship. The ratio of the main dimension of the ship is a parameter that is very influential on Sea Worthiness. L/B value of Sungkur ship is relatively close to the lower limit compared to the upper limit, plus the value of resistance of the large Sungkur fishing gear greatly affects the efficiency of the catch, should not exceed the thrust of the ship, because of this condition requires greater engine power from the ship to be able to provide a balanced thrust during fishing operation. The greater the value of L/B, the smaller the resistance experienced by the ship [11].

3.2.2. Stability. Figure 2 shows that the GZ enforcement arm of the sample ship is positive, which means the ship can return to its original position after experiencing rocking. Static stability is obtained when the vessel's condition is stationary, while dynamic stability is obtained after the ship experiences an external force and there is an addition of a load such as a haul. When a stable ship experiences an external force and causes the ship is shaky, then the center point of the buoyant force of the ship will experience displacement to the lower place [12]. The increase in payload causes a shift in metacenter values and overload can reduce the stability of the ship [13]. The maximum stability is the maximum GZ value that can be achieved by the ship at certain angles and conditions, while the stability range is the largest angle of the ship's slope without the occurrence of negative GZ [14].

3.2.3. Rolling. The curve on figure 3 and 4 shows the relationship between the wave and the rolling angle of the sample ship. Based on the curve it can be explained that the wave height affects the rolling angle of the ship. The curve shows the relationship between the wave and the rolling angle of the sample ship. Based on the curve it can be explained that the wave height affects the rolling angle of the ship. The higher the wave, the greater the rolling angle experienced by the ship.

The ship takes about 5 seconds to perform a one-time shaky movement. The highest rolling is at 14.4 with a wave height of -0.46 m and the lowest rolling is at -14.4 with a wave height of 0.46. This is due to the influence of the wave when there is a rise in the wave will decrease the value of rolling. Vice versa, when the wave slowly decreases will cause an increase in rolling value.

Based on the comparison of sample ships 1 and 2, the resulting rolling is different due to one of the fatter ship designs than the others. Rolling can be identified based on the shape of the vessel's body. Where the rolling can take affect the increase of the ability of ships that have the form U and V [15]. Some important factors influence the ships rolling include wavelength, wave height, encounter angle of the seaway, ship speed, surging motion, GM value, and bilge keel [16].

The rolling motion of ships when there is an increase in frequency, the RAO value is close to zero. Response Amplitude Operator (RAO) or also known as the Transfer Function is a function of the response of a structure due to the wave load on floating objects at a particular frequency [17]. RAO is called Transfer Function because RAO is a tool for transferring external load (wave) in the form of a structure.

The value of rolling ships is influenced by wave height. The higher the wave of waters, the rolling angle will be greater. The greater the value of the shaking period indicates that the ships are becoming slower. Therefore, the ship requires energy return, so it can return to its original position. The slow-rolling shaking period will provide a better level of comfort. The smaller rolling value will make the ship rolling ability better [18].

4. Conclusion

The Sungkur ship has a positive enforcement arm value when conducting a fishing operation indicates that the ship still has good stability so that the ship can return to its original position after experiencing shaking. The Sungkur ship has a positive enforcement arm value when conducting a fishing operation indicates that the ship still has good stability so that the ship can return to its original position after experiencing shaking.

Rolling ship samples at regular beam seas wave conditions indicate a small value. It means the sample ship has good rolling capabilities when operated.

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