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Experimental Study on the Application of a Local Propeller for Improving the Propulsion Performance of FRP Fishing Vessels

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Abstract— **This study aims to evaluate the performance improvement of fishing vessels made of fiberglass-reinforced plastic (FRP) using locally manufactured propulsion components. Two vessels, *KM. Nelayan 271* and *KM. Nelayan 371*, were tested to identify and resolve the underperformance issue, as both initially failed to achieve the target service speed of 7 knots. The experimental approach involved field installation, configuration adjustment, and sea trials. On *KM. Nelayan 271* , the original D22×P20 (three-blade) propeller was replaced with a D24×P22 (four-blade) model, resulting in a speed increase from 5.3 to approximately 7.1 knots at 2000 RPM. On *KM. Nelayan 371*, the gearbox was replaced from WHG17G (3:1) to MA125 (2:1), allowing the vessel to exceed 8.3 knots using the same propeller configuration. These results demonstrate that optimizing the gearbox ratio and propeller geometry effectively restores the propulsion balance and enhances vessel performance. The findings provide empirical validation that domestically manufactured components, specifically the B-Series propellers produced by BTH Surabaya, can meet the operational standards for small fishing vessels. This achievement supports Indonesia's initiative to strengthen the *TKDN policy* and reduce reliance on imported marine propulsion systems.**

Keywords— gearbox, fishing vessel, KM *Nelayan 271* , KM *Nelayan 371*, local propeller, propulsion performance.

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I. INTRODUCTION

The development of Indonesia's marine and fisheries sector is directed toward achieving three main to data from the Directorate of Fishing Vessels and Fishing Gear (Dit. KAPI), 754 FRP vessels of various sizes were constructed in 2016, and an additional 782 vessels were planned for 2017. This program aims to improve the operational range objectives: sovereignty, sustainability, and prosperity. One of the most strategic subsectors supporting this development is capture fisheries, which significantly contribute to the provision of nutritious food, employment opportunities, and national income growth [1]. To enhance the welfare of fishermen and strengthen the national fishing fleet, the Ministry of Marine Affairs and Fisheries launched the Fishing Facilities Assistance Program in 2016. One of the primary forms of assistance is the provision of FRP fishing vessels [2, 3]. According, efficiency, and productivity of fishermen [4], [5].

However, the results from the sea trials indicated significant variations in the maximum speed performance among the vessels, even though they used the same main engine and hull dimensions [6]. This discrepancy suggests a mismatch between the engine and propeller (engine propeller matching), often due to differences in diameter, pitch, and the number of blades resulting from the limited availability of standardized propellers in the domestic market [7]. Consequently, shipyards frequently use alternative propellers that may not conform to engine manufacturer specifications, resulting in suboptimal propulsion performance [8], [9].

Beyond technical aspects, the government has emphasized the importance of increasing the level of the domestic component (*Tingkat Komponen Dalam Negeri* [TKDN]) in shipbuilding and marine equipment. TKDN represents the percentage of domestically sourced materials, labor, and services in the production process. Enhancing TKDN in propulsion systems is essential for reducing dependence on imported components and strengthening national industrial self-reliance [10].

In this context, *KM Nelayan 371* and *KM Nelayan 271* were selected as test vessels for implementing locally manufactured propulsion components [11]. Both vessels are constructed from FRP and are powered by the same main engine model (Weichai D226B-3C1, 48 HP). However, they employ different gearbox and propeller configurations [12]. This distinction serves as the basis for evaluating the performance and compatibility (matching) of the main engine, gearbox, and locally produced propeller units [13], [14].

The performance of a fishing vessel is largely determined by its propulsion system, which converts the mechanical power of the engine into thrust to move the vessel through the water. As the vessel advances, resistance forces that oppose motion are experienced. To achieve the desired service speed, the propeller must generate sufficient thrust to overcome these resistances

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[15], [16].

The propeller is the primary component responsible for converting the rotational energy of the engine into thrust [17]. A propeller consists of several blades attached to a central hub [18]. The blade shape resembles an airfoil, generating thrust as it rotates underwater due to the pressure differences between the convex and flat sides of the blade [19], [20].

Geometric parameters, including diameter, pitch, number of blades, and blade angle [21],[22], highly influence a propeller's performance. Therefore, determining the optimal combination of the engine, gearbox, and propeller is crucial for achieving efficient propulsion performance for FRP fishing vessels such as *KM Nelayan 371* and *KM Nelayan 271* [23].

Generally, local propellers are manufactured through metal casting using sand molding techniques [24]. This process includes several stages: pattern making, mold preparation, metal melting, molten metal pouring into the mold, and finishing by cleaning and machining the casting [25], [26].

In Indonesia, the Hydrodynamic Technology Center (BTH) Surabaya plays a vital role in developing and producing locally cast propellers made of Cu-Al bronze alloys with diameters ranging from 24 to 28 inches, suitable for vessels up to 100 HP. The casting process prioritizes dimensional accuracy, surface smoothness, and dynamic balance to ensure stable propulsion performance [27].

Figure 1. presents the master design schematic for the propeller mold, a critical output from the casting preparation phase. This design was conceptualized with the primary objective of achieving high fidelity in the propeller's dimensional properties and blade configuration, factors intrinsically linked to both thrust production and vessel velocity. Through the meticulous preservation of accurate pitch and superior blade orientation during the casting procedure, the domestically fabricated propeller is anticipated to yield enhanced propulsive effectiveness and contribute to an elevated service speed during maritime trials.

The integration phase was executed aboard the experimental craft after the fabrication of the propeller and associated propulsion subsystems. **Figure 2.** depicts the precise alignment of the primary propulsion unit, reduction gearing, propeller shaft, and the propeller itself. The establishment of precise shaft alignment is a prerequisite for achieving optimal power transfer and mitigating energy dissipation through vibration, thus optimizing the propeller's thrust generation capability and fostering superior vessel speed performance.

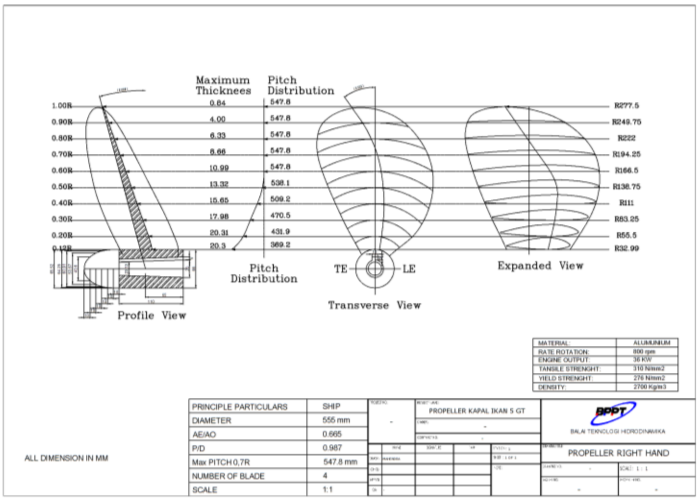

Figure. 1. Propeller mold master design

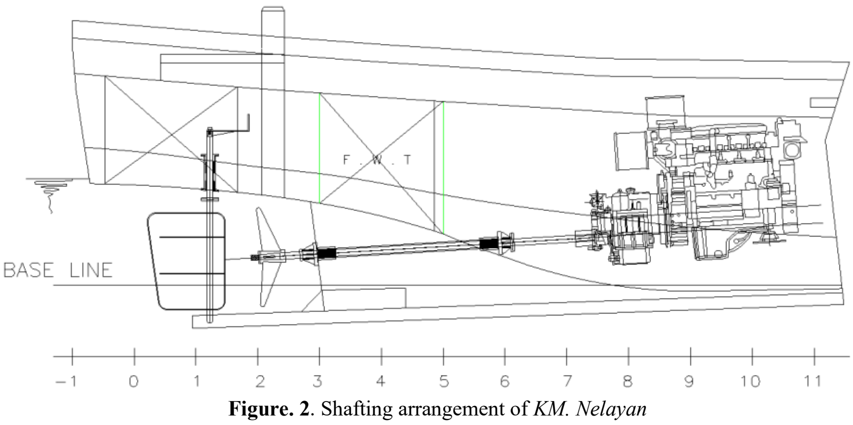

Figure. 2. Shafting arrangement of *KM. Nelayan*

The casting quality is affected by the mold type, pouring temperature, and cooling rate [28]. The sand casting method is considered the most practical and economical for small and medium scale shipbuilding industries, although continuous improvements in quality control and standardization remain necessary [6].

Recent developments in fishing vessel propulsion technology have focused on integrating advanced computational design and hybrid power systems to improve operational and hydrodynamic performance. Hybrid-electric fishing vessels can achieve improved propulsion performance under various propeller configurations [29]. This technological evolution demonstrates that optimizing the relationship between the propeller geometry, gearbox ratio, and main engine load distribution can significantly influence the overall thrust output and cruising speed of a vessel. Modern fishing vessels are increasingly adopting hybrid or partial-electric propulsion systems, which allow better control over propeller revolutions per minute (RPM) and improved torque delivery at lower fuel consumption rates. However, to avoid energy and mechanical losses, such systems still rely heavily on accurate engine propeller matching. [30], [31].

Simultaneously, computational methods continue to advance the design optimization of hull and propeller geometry [32], including the use of hydrodynamic simulations, reduced-order modeling, and optimization algorithms to predict the resistance and thrust characteristics under different sea conditions. These approaches enable engineers to model the interaction between hull flow and propeller wake more precisely, thereby allowing more accurate prediction of service speed and reducing empirical dependence on trial-and-error field testing. The integration of such computational tools with experimental validation, such as the sea trials performed in the present study, provides a balanced framework for evaluating the effectiveness of local component manufacturing and for aligning practical vessel design with theoretical hydrodynamic models. Ultimately, the convergence of hybrid propulsion research and computational optimization in hull-propeller design underscores a global shift toward energy-efficient, locally adaptive small-scale fishing vessel technologies that can be replicated within domestic shipbuilding industries.

This study aims to implement and test the application of new propulsion components, specifically the MA125 gearbox and a locally manufactured propeller, on fish-reef fishing vessels. The primary focus includes component installation, propulsion alignment, and sea trial testing on two test vessels: *KM Nelayan 371* and *KM Nelayan 271* .

The success criteria are based on achieving optimal propulsion performance, including a service speed exceeding 7 knots. The findings are expected to provide empirical evidence that domestically produced propulsion components can effectively replace imported ones, supporting the implementation of TKDN policies and strengthening the competitiveness and independence of Indonesia's small to medium scale shipbuilding industry in the capture fisheries sector.

II. METHOD

A. Vessel data and technical specifications

The study involved two test vessels, *KM. Nelayan 371* and *KM. Nelayan 271* , both constructed from fiberglass-reinforced plastic (FRP) and operating as small-scale fishing boats using crab traps (bubu rajungan) as fishing gear [33]. Both vessels were part of the government's fishing fleet assistance program aimed at strengthening domestic shipbuilding capacity and improving the use of local components [29].

This vessel has an overall length (LOA) of 11.0 m, a beam of 2.6 m, and a depth of 0.95 m. A Weichai D226B-3C1 diesel engine (48 HP) powers the vessel, connected to a 2:1 ratio MA125 reduction gearbox.

The propulsion system used a fixed-pitch propeller, with both three- and four-blade configurations tested, each having dimensions of 22 inches × 20 inches, made of brass. The propeller shaft was 1.5 inches in diameter and 2 meters long and made of stainless steel. The rudder measured 60 × 47 cm (top) and 60 × 39 cm (bottom), with a shaft diameter of 1.5 inches.

The second test vessel is *KM. Nelayan 271* , which is also made of FRP, has similar hull characteristics. The vessel uses a Weichai D226B-3C1 engine (48 HP) coupled with a WHG17G gearbox (3:1 reduction ratio)

The tested propellers were D22 × P20 (three-blade) and D24 × P22 (four-blade) fixed-pitch propellers. This vessel was primarily used to evaluate the influence of propeller size and blade number on vessel performance under identical engine conditions.

Figure 3. shows the procedure for orienting the gearbox and primary engine in relation to the propeller shaft during the assembly phase. This crucial alignment was undertaken to facilitate unimpeded power transfer from the engine to the propeller, thereby enabling the propeller to achieve peak rotational efficiency. The precise alignment of these interconnected components is instrumental in minimizing energy dissipation and guaranteeing that the resultant propulsive force optimizes the vessel's operational velocity as determined during sea trials.

Figure 4. provides a visual representation of the Universal joint installation, which serves as the nexus between the gearbox's output shaft and the propeller shaft. The incorporation of a universal joint accommodates minor deviations in angular orientation between the connected elements, thereby promoting more fluid power transmission and consistent propeller revolution.

Figure. 3. Adjusting the Gearbox and Main Engine Angles Relative to the Propeller Shaft

Figure. 4. Universal joint installation

B. Gearbox replacement and alignment

The original KM gearbox. *Nelayan 371*, model WHG17G (3:1), was replaced with a MA125 gearbox (2:1) to optimize thrust performance and match the operational characteristics of the main engine.The replacement process involved:

1. The engine room access is expanded to remove the old gearbox.
2. Dismantle the WHG17G gearbox by detaching the clutch, cooling system, and propeller shaft.
3. The MA125 gearbox is installed using lifting aids (wooden blocks and ropes).
4. A new gearbox mount was fabricated due to dimension differences and the cooling water pipelines were modified to fit the new layout.

Figure. 5. Gearbox MA-125

Figure 5. depicts the MA125 gearbox, a component used in the substitution procedure. This particular gearbox, featuring a reduction ratio of 2:1, was implemented to augment the propeller rotational velocity and consequently enhance the vessel's operational speed. The transition from the antecedent 3:1 gearbox facilitated a more efficient transfer of power from the propulsion unit to the propeller, thereby yielding augmented thrust generation and superior velocity characteristics throughout the sea trials.

A misalignment was observed between the engine output shaft, gearbox, and propeller shaft, requiring realignment by adjusting the engine bed height and creating a custom coupling. Because the new lacked concentricity, it was replaced with a universal joint to improve angular flexibility and alignment accuracy.

This study employed a quantitative field experimental method conducted directly on fiberglass (FRP) fishing vessels *KM. Nelayan 371* and *KM. Nelayan 271* was subjected to real-world operating conditions at sea. The primary objective of this study was to analyze the effect of different configurations of propulsion systems on vessel performance. To this end, the following approaches were adopted: first, the gearboxes were replaced; second, propellers with varying diameters and blade counts were installed; and third, vessel performance was tested through sea trials.

Figure 6. presents the engine revolutions per minute (RPM) and global positioning system (GPS) measurements acquired during the sea trials. These data served as the basis for quantifying the correlation between engine speed and vessel velocity after the gearbox modification. The incorporation of the MA125 gearbox, in conjunction with the deployment of domestically manufactured propellers, effectively elevated the vessel's speed, measured in nautical miles per hour, thereby achieving the primary objective of optimizing propulsion efficacy.

Data collection was conducted using measuring instruments, such as tachometers, which were employed to gauge the revolutions of the engine and propeller shafts. GPS technology was employed to ascertain the vessel velocity. After the installation of domestically produced components, all data were meticulously tabulated and analyzed to evaluate the performance of the propulsion system [34].

Figure. 6. Engine RPM and GPS During the Sea Trials

The research activity was divided into three main stages, namely: The research was divided into three stages. The first stage involved testing on *KM Nelayan 271* , and the second stage was conducted on *KM Nelayan 371*. Both stages were conducted in Gempolsewu Village, Kendal Regency, Central Java, Indonesia. The third stage comprised the fabrication and casting process of the propeller mold at the BTH in Surabaya.

The equipment used in this study included questionnaires for conducting interviews with ship owners and technicians, voice recorders, writing instruments, digital cameras for documentation purposes, measuring tapes, calipers for measuring propellers and shafts, wooden blocks and ropes to assist in the installation of the gearbox, GPS for recording vessel position and speed, tachometers for measuring propeller rotation, and thermometers and pressure gauges for monitoring gearbox temperature and pressure during trials [35]. The principal components employed in this study comprised the MA125 gearbox (2:1 ratio), the WHG17G gearbox (3:1 ratio), and locally cast propellers with configurations of D22×P20 (three blades) and D24×P22 (four blades). A universal joint was also used to align the gearbox output shaft with the propeller shaft, thereby ensuring proper installation angle compensation [32].

The methodological implementation comprised three stages: exploration, observation, and measurement [36], [7].

1) The exploration stage involved coordination with the vessel owner to assess the propulsion conditions and identify the required modifications.
2) The observation stage was conducted at the Kendal shipyard and BTH Surabaya to identify the mechanical and dimensional requirements for installation and casting.
3) The measurement and testing stage involved conducting sea trials under calm water conditions to measure the speed of the engine, propeller, and vessel (in knots).

The test data from both vessels were analyzed to determine the relationship between the engine RPM, propeller rotation, and vessel speed across different gearbox ratios and propeller configurations. This study's success criterion was solely based on achieving a service speed exceeding 7 knots.

III. Results and Discussion

The central issue addressed in this study originates from field observations showing that several government-assisted FRP fishing vessels failed to reach the target service speed of 7 knots. Despite having identical engine power (Weichai D226B-3C1, 48 HP), significant differences in the propulsion performance were observed in the propeller geometry and gearbox ratios. This section presents the experimental evidence of these limitations and the solutions implemented to overcome them.

A. Vessel Underperformance (KM. Nelayan 271)

The first experimental stage focused on the *KM. Nelayan 271* , which was originally operated using a WHG17G gearbox (reduction ratio 3:1) and a D22×P20 three-blade fixed-pitch propeller. Sea trials were conducted using GPS tracking devices to measure the engine and propeller revolutions per minute (RPM) and the vessel speed.

The results **Table 1.** indicate that *KM. Nelayan 271* could not achieve the expected service speed of 7 knots. Even at a maximum engine speed of 2000 RPM and a propeller speed of 662 RPM, the maximum recorded speed of the vessel was approximately 5.3 knots. This demonstrated that the existing propulsion configuration produced insufficient thrust, likely due to the relatively small propeller diameter and higher gearbox reduction ratio that limited the propeller rotational output.

TABLE 1
SEA TRIAL RESULTS USING PROPELLER D 22, P 20 (3 BLADES)

Direction	Engine RPM	Propeller RPM	Speed 1 (knot)	Speed 2 (knot)
Against the current	1800	595	4.9	5.0
Against the current	2000	662	5.2	5.3
With current	1800	595	5.3	5.3
With current	2000	662	5.4	5.3

B. Vessel Underperformance (KM. Nelayan 371)

During the preliminary testing, the KM The *Nelayan 371* was equipped with a WHG17G gearbox with a 3:1 reduction ratio and a D22×P20 fixed-pitch propeller. Despite operating within normal engine parameters, the vessel exhibited propulsion underperformance, with the propeller rotation speed being too low relative to the main engine speed.

Field observations revealed that even when operating at high engine revolutions, the vessel struggled to reach the target service speed of 7 knots. The 3:1 reduction ratio significantly decreased the propeller shaft rotation, resulting in reduced thrust generation. This mismatch between the engine output and the propeller loading condition resulted in the vessel operating below the optimal propulsion performance.

The condition was confirmed during the early sea trials, where *KM. Nelayan 371* could only achieve approximately 7.07 knots at near-maximum throttle **Table 2.** Thus, the underperformance was attributed to the excessive reduction in the gearbox ratio, which limited the propeller output speed and overall thrust capability. These findings established the need for the propulsion system to be reconfigured, particularly by replacing the gearbox and realigning the power transmission components.

TABLE 2
SEA TRIAL RESULTS USING PROPELLER D22, P20 (3 BLADES)

Direction	Engine RPM	Propeller RPM	Speed 1 (knot)	Speed 2 (knot)
Against the current	1800	890	7.11	7.07
Against the current	2000	990	7.4	7.5
With current	1800	890	7.08	7.14
With current	2000	990	7.5	7.6

C. Solution A: Propeller geometry optimization (KM. Nelayan 271)

To address the performance shortfall, the propeller was replaced with a D24×P22 four-blade configuration, featuring a larger diameter and pitch. This change aimed to increase the thrust coefficient of the propeller and improve the energy transfer between the engine and propeller.

Subsequent sea trials **Table 3.** confirmed a substantial improvement in performance. The vessel achieved a service speed of approximately 7.1 knots at 2000 rpm, thereby meeting the operational target. The increase in diameter (from 22 to 24 inches) and the addition of an extra blade provided greater water displacement per revolution, enhancing the propulsive thrust while maintaining stable rotational dynamics. This finding confirms that appropriate propeller selection can effectively resolve underperformance issues without altering the main engine.

TABLE 3
SEA TRIAL RESULTS USING PROPELLER D 24, P 22 (4 BLADES)

Direction	Engine RPM	Propeller RPM	Speed 1 (knot)	Speed 2 (knot)
Against the current	1800	595	6.49	6.5
Against the current	2000	662	7.0	7.1
With current	1800	595	5.9	6.0
With current	2000	662	6.6	6.7

D. Solution B:Gearbox Ratio Adjustment (KM. Nelayan 371)

The second stage of testing involved *KM. Nelayan 371*, which was equipped with a new gearbox model MA125 (reduction ratio 2:1) and locally cast propellers of D22×P20 dimensions. Unlike the 3:1 ratio on *KM. Nelayan 271* , this configuration allowed for a higher propeller shaft speed, improving the engine torque–propeller load balance.

The sea trial results **Table 4.** demonstrated that *KM.* The *Nelayan 371* not only achieved but also exceeded the 7 knot target, reaching 8.3 knots at 1800 RPM with the four-blade propeller. This outcome confirms that optimizing the gearbox ratio in conjunction with a properly matched propeller geometry can significantly enhance the propulsion performance and vessel speed.

TABLE 4
SEA TRIAL RESULTS USING D22, P20 (4-BLADE) PROPELLERS

Direction	Engine RPM	Propeller RPM	Speed 1 (knot)	Speed 2 (knot)
Against the current	1500	726	7.3	7.3
Against the current	1800	890	8.2	8.2
With current	1500	726	7.4	7.4
With current	1800	890	8.3	8.2

Figure. 7. Replacement of D20, P18 (4 blades) with D22, P20 (3 blades)

Figure. 7. Replacement of D22 and P20 (3 blades) with D24 and P22 (4 blades)

Figure 7. depicts the substitution of the D20×P18 four-blade propeller with a D22×P20 three-blade configuration on *KM. Nelayan 371*. This alteration was undertaken to enhance the vessel's operational velocity by adjusting the propeller dimensions and pitch to align with the revised gearbox ratio (2:1). The implementation of the D22×P20 three-blade propeller facilitated an elevated rotational velocity and superior propulsive efficiency, thereby contributing to augmented vessel performance during maritime evaluations.

Figure 8. exemplifies the exchange of the D22×P20 three-blade propeller for a D24×P22 four-blade configuration on *KM. Nelayan 271* . The adoption of a propeller with a greater diameter and pitch was intended to augment the propulsive force of the vessel and attain a desired speed exceeding 7 knots. This recalibration effectively enhanced propulsion efficacy, underscoring the importance of judicious propeller selection in elevating vessel speed under comparable engine parameters.

The combined findings from the *KM Nelayan 371* and *KM. Nelayan 271* established a clear causal relationship between the configuration of the propulsion system and vessel performance. Initial trials on *KM. Nelayan 271* revealed a major operational problem: despite using a 48 HP Weichai engine, the vessel failed to reach the target service speed of 7 knots, recording only about 5.3 knots at 2000 RPM with the D22×P20 three-blade propeller and a 3:1 gearbox ratio. This underperformance demonstrated that the excessive reduction ratio and undersized propeller geometry limited thrust generation and hydrodynamic performance.

The problem was effectively addressed through two complementary solutions. Solution A involved upgrading the propeller to a D24×P22 four-blade configuration on the *KM. Nelayan 271* , which improved the water displacement and thrust continuity by increasing the propeller diameter and pitch. This modification successfully raised the service speed to approximately 7.1 knots, proving that a larger propeller geometry can restore the vessel's propulsion balance. Solution B, implemented on the *KM. Nelayan 371*, replaced the WHG17G gearbox (3:1) with the MA125 gearbox (2:1). This reduction ratio optimization increased the propeller rotational speed, enabling the vessel to exceed 8.3 knots during sea trials while maintaining stable propulsion performance. Together, these results confirm that the propeller geometry and gearbox ratio are interdependent parameters that critically determine the performance of small vessels.

These empirical outcomes are consistent with the findings of recent research. Lee et al. demonstrated that optimized propeller configurations in hybrid-electric fishing vessels enhance propulsion stability through improved thrust alignment [37]. Wardhana et al. reported that computational optimization of hull propeller geometry significantly improves hydrodynamic performance and cruising speed in small FRP vessels [32].

This study provides direct field-based validation of these theoretical insights, showing that precise engine-propeller-gearbox matching can achieve substantial performance gains even within conventional DPSs. Furthermore, the observed results align with those of Putra and Hidayat, who emphasized that domestically manufactured propellers can match the performance of imported products when designed with proper dimensional calibration and hydrodynamic testing [38].

Mechanistically, the improved momentum transfer performance arises from the enhanced momentum transfer performance when the gearbox ratio and propeller geometry are properly balanced, propeller slip decreases, thrust generation stabilizes, and resistance losses are minimized. This relationship corroborates the fundamental principles of the Rankine-Betz momentum theory and the vortex-blade element model, which predict higher thrust performance under optimized propeller loading conditions. Thus, the field validation in this study substantiates the theoretical models with measurable empirical data.

Nonetheless, one important limitation must be acknowledged: the comparisons of the gearbox ratios were conducted on two different vessels (*KM. Nelayan 371* and *KM. Nelayan 271*). Although both had comparable hull types and engine ratings, the results may have been influenced by minor structural and operational differences. Therefore, future research should use a single standardized vessel to isolate the influence of the gearbox ratio and propeller configuration under identical hydrodynamic conditions.

These findings have significant industrial relevance beyond the technical implications. The successful integration of locally manufactured propulsion components, specifically the B-Series propellers produced at the Hydrodynamic Technology Center (BTH) Surabaya, demonstrates Indonesia's readiness to supply reliable propulsion systems that meet international operational standards. Despite minor production delays due to equipment constraints, the BTH fabrication process confirmed the local propeller casting and finishing's technical feasibility. This success reinforces Indonesia's national initiative to increase the *Tingkat Komponen Dalam Negeri* (TKDN), promoting industrial self-reliance, reducing dependence on imported components, and strengthening the domestic shipbuilding and marine engineering sectors' sustainable growth.

IV. CONCLUSION

Experimental implementation and sea trials on *KM. Nelayan 371* and *KM. Nelayan 271* confirm that vessel operational performance improved significantly through two distinct solutions: installing a locally produced propeller on KM 271 and optimizing the gearbox ratio on KM 371. On *KM. Nelayan 271*, replacing the original propeller with a D24×P22 four-blade configuration offering a larger diameter and pitch than the D22×P20 three-blade model raised the service speed from about 5.3 to 7.1 knots at 2000 RPM, illustrating the impact of propeller geometry on thrust.

On *KM. Nelayan 371*, replacing the WHG17G (3:1) gearbox with the MA125 (2:1) gearbox refined the engine-propeller rotational relationship, allowing the vessel to exceed its target service speed and achieve up to 8.3 knots during sea trials. These results confirm that the gearbox ratio and propeller geometry match plays a decisive role in enhancing the propulsion performance of small FRP fishing vessels. Nonetheless, the gearbox tests were performed on two different vessels rather than a single controlled platform, which introduces limitations in isolating the effects of the gearbox ratio from other hull-related variables. Therefore, future studies should employ standardized hull and engine configurations to more accurately evaluate the interaction between the gearbox reduction and propeller performance. The successful fabrication of the B-Series master propeller pattern at the Hydrodynamic Technology Center (BTH) Surabaya further validates Indonesia's domestic industry's capability to design and produce reliable marine propulsion components that meet operational standards. Future applications should ensure precise matching between propeller dimensions, mass, and main engine specifications to avoid excessive mechanical stress to sustain and improve these outcomes. Moreover, stronger coordination, quality assurance, and technological readiness are essential to support Indonesia's Tingkat Komponen Dalam Negeri (TKDN) initiative's long-term advancement and the national maritime manufacturing sector's growth.

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