1. Submission – 4 September 2018

Marine Fisheries <marfish.journal@gmail.com> Sel, 4 Sep 2018 10.50

kepada RIFKY ISMAIL

Yth. Sdr. Rifky Ismail

di tempat

Kami ucapkan terima kasih atas partisipasi Saudara untuk mempublikasikan hasil penelitian di Jurnal Marine Fisheries.

Saat ini naskah berjudul **"Kajian Baling-baling Kapal Untuk Perahu Nelayan"** dengan penulis Rifky Ismail, Mohammad Tauviqirrahman, Deni Mulyana, Fiki Firdaus, dan J. Jamari telah memasuki *review* awal untuk mengkaji kesesuaian materi naskah dengan ruang lingkup Jurnal Marine Fisheries.

Berikut terlampir surat keterangan penerimaan naskah Saudara ke Jurnal Marine Fisheries.

Demikian infomasi ini kami sampaikan, atas perhatian dan kerjasamanya diucapkan terima kasih.

Salam,

Redaksi

MARINE FISHERIES

JURNAL TEKNOLOGI DAN MANAJEMEN PERIKANAN LAUT

FORUM KOMUNIKASI KEMITRAAN PERIKANAN TANGKAP (FK_2PT)

BEKERJASAMA DENGAN

DEPARTEMEN PEMANFAATAN SUMBER DAYA PERIKANAN

FAKULTAS PERIKANAN DAN ILMU KELAUTAN

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Nomor : 126/Pemberitahuan/Marfish/08/2018 Bogor, 31 Agustus 2018
Lampiran : -
Hal : Submit Naskah

Yth. Sdr. Rifky Ismail
di tempat

Bersama dengan ini kami sampaikan bahwa naskah berjudul **"Kajian Baling-baling Kapal Untuk Perahu Nelayan"** dengan penulis Rifky Ismail, Mohammad Tauviqirrahman, Deni Mulyana, Fiki Firdaus, dan J. Jamari telah kami terima pada tanggal 29 Agustus 2018. Atas partisipasi Saudara untuk mempublikasikan hasil penelitian di Jurnal MARINE FISHERIES, kami ucapkan terima kasih.

Sesuai prosedur yang berlaku, maka naskah tersebut akan kami *review* awal untuk mengkaji kesesuaian materi naskah dengan ruang lingkup Jurnal Marine Fisheries.

Demikian informasi ini kami sampaikan. Atas perhatiannya, diucapkan terima kasih.

Pimpinan Redaksi,

Dr. Yopi Novita, S.Pi, M.Si
NIP 197109162000032001

2. Hasil review redaksi – 31 Oktober 2018

On Mon, Oct 22, 2018 at 11:51 AM Marine Fisheries <marfish.journal@gmail.com> wrote:

Yth. Sdr. Rifky Ismail
di tempat

Bersama ini kami sampaikan bahwa revisi naskah Saudara yang berjudul **"Kajian Baling-baling Kapal Untuk Perahu Nelayan"** dengan penulis Rifky Ismail, Mohammad Tauviqirrahman, Den Mulyana, Fiki Firdaus, dan J. Jamari telah kami cermati lebih lanjut. Berdasarkan hasil review tersebut, terdapat beberapa saran perbaikan yang harus diperbaiki sesuai dengan pedoman Jurnal Marine Fisheries (terlampir). Oleh karena itu, mohon kiranya Saudara berkenan untuk menyempurnakan naskah tersebut. Kami berharap naskah perbaikan dapat diterima kembali selambat-lambatnya pada tanggal **31 Oktober 2018.**

Terlampir pula form pernyataan penerbitan naskah dan surat pernyataan yang perlu dilengkapi oleh penulis dan dikembalikan sesegera mungkin kepada redaksi.

Demikian informasi ini kami sampaikan, atas perhatian dan kerjasamanya diucapkan terima kasih.

Salam,
Redaksi

3. Hasil review mitra bestari – 12 Februari 2019

From: **Marine Fisheries** <marfish.journal@gmail.com>
Date: Tue, Feb 12, 2019 at 11:11 AM
Subject: Hasil Review Mitra Bestari Tahap ke-1
To: RIFKY ISMAIL <rifky_ismail@ft.undip.ac.id>
Cc: Yopi Novita <yopi1516@gmail.com>

Nomor : 13/HR/MarFish/02/2019 Bogor, 12 Februari 2019
Lampiran : Satu berkas
Hal : Hasil Review Mitra Bestari Tahap ke-1

Yth. Sdr. Rifky Ismail
di tempat

Bersama dengan ini kami sampaikan bahwa naskah Saudara berjudul ***"*Kajian Baling-Baling Kapal untuk Perahu Nelayan (*Investigation of Marine Propeller Design for Fisherman Boat)*"*** dengan penulis Rifky Ismail, Mohammad Tauviqirrahman, Den Mulyana, Fiki Firdaus, dan J. Jamari telah di*review* Mitra Bestari tahap ke-1 Berdasarkan hasil *review* Mitra Bestari, terdapat beberapa saran perbaikan (terlampir).

Perlu kami sampaikan pula bahwa ***Surat Accepted for Publication*** dapat dikeluarkan setelah naskah dinyatakan tidak ada perbaikan lagi dan sudah dianggap sesuai dengan saran dari Mitra Bestari. Oleh karena itu, kami meminta kesediaan Saudara untuk merevisi naskah sesuai dengan saran perbaikan terlampir. Berdasarkan *guidance for authors,* tertera bahwa Jurnal Marine Fisheries mempublikasikan hasil penelitian dilakukan paling lambat 5 tahun terakhir sebelum waktu publikasi. Sehingga berdasarkan tahun perolehan data/informasi kajian Saudara yang dilaksanakan pada tahun 2016, maka perbaikan naskah Saudara hingga dinyatakan "***Accepted for Publication***", maksimal diberikan waktu selambat-lambatnya hingga tanggal **12 Februari 2020.** Apabila hingga waktu yang telah diberikan naskah belum selesai direvisi sesuai dengan arahan tim *reviewer* dan editor, maka naskah terpaksa dikembalikan ke penulis dan dinyatakan tidak dapat diteruskan untuk proses publikasi. Prosedur publikasi sebuah naskah di Jurnal Marine Fisheries terlampir.

Besar harapan kami agar Saudara dapat segera memperbaiki naskah tersebut. Perbaikan naskah hasil revisi dari *review* Mitra Bestari tahap ke-1 ini diharapkan dapat diterima oleh redaksi selambat-lambatnya tanggal **19 Februari 2019.**

Demikian informasi ini kami sampaikan. Atas perhatiannya, diucapkan terima kasih.

Pimpinan Redaksi,

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KAJIAN BALING-BALING KAPAL UNTUK PERAHU NELAYAN

Investigation of Marine Propeller Design for Fisherman Boat

ABSTRACT

For design of marine propeller, the energy supply from marine engine to the propeller should be converted to thrust force with minimum losses. Furthermore, the unwanted vibration and cavitation due to the overlooking a detail calculation of the propeller should be prohibited for increasing the fuel efficiency and life-span of the propeller. In the last few decades, most of small and medium sized enterprises (SMEs) focusing their work on ship component industry in Central Java Province Indonesia providing the marine propeller to the ship manufacturer and ship repairmen in some shipyards in northern part of Central Java port. The design of the propeller is never been observed and optimized. The aim of the present work is analyzing a study case related to a comparison between the installed propeller on a wood boat for fisherman and the new optimized design using B-Series propeller theory. The reverse engineering method used three-dimensional scanner to obtain the geometrical data of the installed ship propeller. The new optimized propeller design was obtained from free software calculation based on the boat and engine specification. The comparison showed that the new optimized propeller design has a wider blade and larger pitch and increases 20% of the open water efficiency of the propeller performance at lower engine rotation.

Keywords: *Marine propeller, Fishery boat, B-Series design, Optimization*

ABSTRAK

Pada desain baling-baling kapal, pasokan energi dari mesin ke baling-baling diubah menjadi gaya gaya dorong dengan kerugian minimal. Fenomena getaran yang tidak diinginkan serta kavitasi harus dikurangi untuk peningkatan efisiensi bahan bakar dan umur baling-baling. Dalam beberapa dekade terakhir, sebagian besar usaha kecil dan menengah (UKM) industri komponen kapal di Propinsi Jawa Tengah, Indonesia menyerahkan baling-baling ke produsen kapal dan reparasi kapal di beberapa galangan di sisi utara pelabuhan Jawa Tengah. Desain baling-baling tidak pernah diamati dan dioptimalkan. Tujuan dari penelitian ini adalah menganalisis studi kasus yang berkaitan dengan perbandingan antara baling-baling yang terpasang pada kapal kayu untuk nelayan dan desain optimal yang baru dengan menggunakan teori *B-Series propeller*. Metode *reverse engineering* menggunakan pemindai tiga dimensi untuk mendapatkan data geometris dari

baling-baling kapal yang terpasang. Desain baling-baling yang dioptimalkan diperoleh dari perhitungan perangkat lunak berdasarkan spesifikasi perahu dan mesin. Perbandingan tersebut menunjukkan bahwa desain baling-baling yang dioptimalkan memiliki pisau yang lebih lebar dan *pitch* yang lebih besar dan meningkatkan 20% efisiensi kinerja baling-baling pada putaran mesin rendah.
Kata kunci: Baling-baling kapal, kapal nelayan, desain *B-Series*

INTRODUCTION

Many Indonesian people lived in the north coast of Java Island works as fishermen. They work in a small group, using a wooden boat crossing the Java Sea for fishing. With respect to the wooden boat analysis, some of the researches focusing their research to analysis design and geometrical evaluation of the boat (Susanto, et al., 2011; Aydin and Salci, 2007; Kang, et al., 20017), static and dynamic stability analysis (Susanto, et al., 2011; Marjoni, et al., 2010), hull design analysis (Utama and Aryawan, 2016; Kiryanto, et al., 2012) and feasibility analysis (Muhammad, et al., 2018; Hadi, 2010). This paper focusses on the analysis of the metal propeller design and its comparison between the present design and the optimum design.

Most of the boats use metal propeller from aluminium or brass material, made by small and medium sized enterprises (SMEs) which is provided around the shipyard. Figure 1 shows fisherman wooden boats, located in a port of north Java Island and a 4 blades metal propeller. shown

(a)

(b)

Figure 1. (a) Fisherman wooden boats in a north Java Island port and (b) the propeller installed on the wood boats, made by SME in Tegal.

Marine propeller is one of the critical components in the marine boat which should be designed and manufactured precisely and should consider many parameters such as: engine specification, the hull dimension, the expected velocity and torque of the boat (Carlton, 2007; Kuiper, 2010). The design of marine propeller, especially the blades, needs to be very efficient. The energy supply from marine engine to the propeller should be converted to thrust force with only a minimum of losses. Furthermore, the unwanted vibration and cavitation are also prohibited to increase the fuel efficiency and life-span of propeller (Kuiper, 2010). The improper selection of the propeller induces a lower fuel efficiency and thrust force efficiency.

The marine propeller design technique has a significant improvement in the few last decades (Martinez-Calle et al., 2002). It can be noticed by the availability of the propeller design and analysis with different scale of difficulties published by many researchers, such as the implementation of Reynolds-averaged Navier–Stokes (RANS) equations in three-dimensional viscous flow models (Black, 1997), the lifting surface methods with respect to RANS equations to predict the viscous effects near the walls of the blade (Xie, 2011), the use of multi-objective approaches (Benini, 2004), the application of computational fluid dynamic (Yeo et al., 2014; Kuiper, 1992; Abidin and Adji, 2012), the additional of energy saving device (Putra et al., 2015) and the implementation of traditional series theory (Gaafary et al., 2009). Among the traditional series, Wageningen B-series is one of the commonly used series in

designing the propeller with simpler calculation and iteration (Ghose and Gokarn, 2004).

During the last decades in Central Java Province, some of the propellers for fisherman wooden boat are supplied by small medium sized companies from the same province. However, the design, geometry and performance of the propeller are never been checked and observed. As a critical component, it induces the fuel consumption and the boat performance which leads to a comprehensive study of the propeller design.

The objective of the research were to conducts a design analysis of the installed propeller on a fisherman boat, manufactured by SMEs, and a comparative study of the marine propeller design on the installed propeller by implementing the B-Series theory. The simplest calculation was selected to be discussed in this paper so the results can be transferred easily on the several concerned parties, such as government, SMEs and shipyards.

RESEARCH METHODOLOGY

The observation on the fisherman boat was conducted in Tegal, Central Java, Indonesia where the boat was still repaired in a shipyard, in October 2016. The general boat specifications and the hull dimensions are listed in Table 1 and Table 2, respectively, obtained from the field measurement. Tabel 1 is related to boat capacity, the engine spesification, the velocity, the exisiting propeller and airfoil design. Table 2 consists of the dimensions of the hull which have the corellation with the boat capacity, 28 GT and the maximum power of the boat, 110 HP.

The installed propeller of the boat was manufactured by an SME in Tegal which focused in manufacturing the boat components. Then, based on the boat specifications and dimensions a new optimized propeller was designed using B-

series theory by implementing free propeller design software. The design and the analysis using free software follow the flowchart, shown in Figure 2.

Table 1. Specification of the boat

Parameters	**Specification**
Boat capacity	28 Gross Ton (GT)
Engine	4 cylinders Diesel Engine
Maximum power	110 HP
Maximum rotation	2900 rpm
Gearbox ratio	4 : 1
Displacement	Full displacement
Number of engine	1
Number of propeller	1
Number of blades	4
Velocity	7 knot

Table 2. The hull dimensions.

Parameters	**Dimensions (m)**
L_{OA} (length over all)	16.15
L_{WL} (length of water line)	14.324
B (breadth)	3.5
B_{WL} (breadth of water line)	3.7
B_{OA} (beam/ breadth over all)	3.461

D_s (draft)	1.4
I (immersion)	0.6

The new propeller design and the calculation for the observed marine boat were compared to the installed propeller design. The optimization constrains in this case were the diameter of the propeller and the number of the blades. The ship resistance was designed for the speed velocity 2 – 9 knots whereas the input data of appendages, waves and winds were neglected. The output of the propeller design was the main dimension of blades namely the pitch (P), the pitch-diameter ratio (P/D) and blade area ratio (A_e/A_o). The differences between the new propeller design and the installed propeller was showed to compare the dimension. The open water efficiency was then calculated using the same software and compared for the two designs.

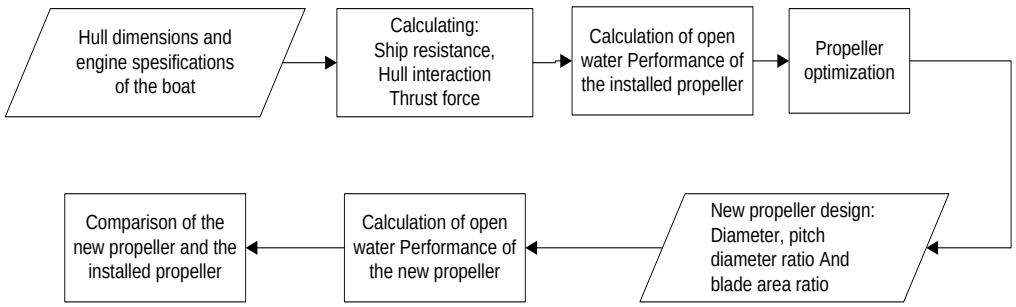


Figure 2. Flowchart of the B-Series propeller design and optimization using free software.

RESULT AND DISCUSSION

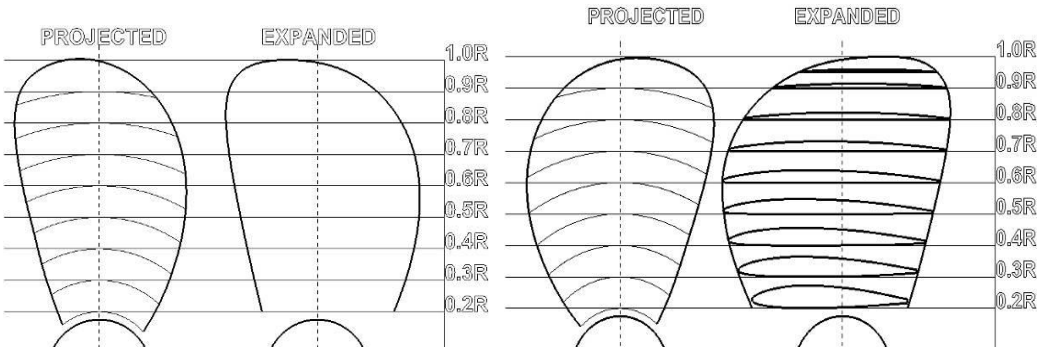
The iteration of the B-Series design using the free software based on the condition discussed in the previous section results in the new propeller design. The reverse engineering method was used by implementing three-dimensional scanner to obtain the geometrical data of the installed ship propeller. The geometry of the propeller was successfully transferred to the CAD software.

The comparison of the pitch (P), the pitch-diameter ratio (P/D) and blade area ratio (Ae/Ao) of the new optimized design and the installed propeller design is shown in Table 3. With the same diameter, it is noticed that the new design has larger pitch, pitch-diameter ratio and blade area ratio. The pitch and pitch-diameter ratio of the new design is 80% larger and the blade area ratio is 27% larger than the installed one..

In order to see the detail of the propeller blade, the three-dimensional model was drawn for the new and the installed propeller. The chord length, blade thickness, maximum chamber for every blade section as a function of the radius was calculated as well as the air foil coordinate and pitch distribution. The comparison of the new optimized and installed propeller is shown in Figure 3. The projected and expanded profile of the propeller blade is showed as a function of radius section. It is clearly found that the new dimension has larger blade dimension.

Table 3. Comparison propeller parameters of installed and the new optimized propeller.

Observed parameters	**Installed propeller**	**Optimized propeller**	**Differences**
Diameter (D) = 2R	0.8 m	0.8 m	-
Pitch (P)	0.4 m	0.72 m	80%
Pitch-Diameter Ratio (P/D)	0.5	0.9	80%
Blade Area Ratio (Ae/Ao)	0.55	0.7	27%



(a) (b)

Figure 3. The comparison of the propeller: (a) the installed propeller and (b) the new optimized propeller design using B-Series theory.

The calculation was then continued by comparing the open water characteristic of the new and installed propeller. Based on the software calculation, the open water efficiency for the installed propeller (boat speed = 7 knot) is 0.48 at 604 rpm. At the same boat speed, the open water efficiency for the new propeller increases 20% with respect to the larger the pitch (P), the pitch-diameter ratio (P/D) and blade area ratio (Ae/Ao). At the lower rpm (418 rpm), the open water efficiency was 0.58 for the new propeller design. It indicated the new propeller had a better design in providing the thrust force of the boat. The price of the new design will be higher compared to the installed propeller due to the larger blade and higher mass but is can be compensated with the lower fuel consumption.

The better performance of the new propeller compared to the installed propeller assumed that:

1. Naval engineers and SMEs in metal manufacturing company do not put more attentions on the design and dimension of the boat propeller;
2. In some case, the engineer considers the propeller availability in the market with neglecting the detail calculation and the suitability of the propeller to the boat; and

3. In SMEs, the design of the boat propeller, made from brass or aluminium is frequently based on the former design in their company and overlook the propeller performance with respect to open water efficiency.

However, the present study limits the discussion only on propeller design and the open water efficiency using free published software. The further computational analysis using computational fluid dynamic (CFD) and advance RANS calculation will increase the precise calculation and strengthen the propeller design results.

Based on the present study, the government, SMEs and naval engineer, related to the marine ship components need to work together in order to produce suitable propeller based on certain wooden fishing boat specifications to make better boat thrust performance. This could be increase fuel efficiency.

CONCLUSION

1. By using the same diameter and the number of propeller blades, the new optimized propeller design had a wider blade and larger pitch.
2. New optimized propeller design increases 20% of the open water efficiency of the propeller performance at lower engine rotation.

ACKNOWLEDGEMENT

The authors aknowledge to UPTD Laboratory of Dinas Perindustrian dan Tenaga Kerja Kabupaten Tegal in Dampyak Tegal which provide the 3D scanner equipment for measuring the real propeller and the SME in Kabupaten Tegal which manufacture the propeller for wood boat.

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4. Proofreading

On Thu, May 14, 2020 at 8:30 PM Marine Fisheries <marfish.journal@gmail.com> wrote:
Yth.
Sdr. Rifky Ismail
di tempat

Terima kasih atas kerjasamanya dalam merevisi naskah hingga akhir. Untuk selanjutnya bersama ini kami informasikan bahwa naskah Saudara yang berjudul **"Redesain Baling-Baling Kapal Nelayan Berdaun 4 (Empat) di Salah Satu Galangan Kapal di Tegal Jawa Tengah (*Redesigning of 4 (Four) Blades Propeller Installed in a Wodeen Fishing Boat in a Ship Yard in Tegal, Central Java Povince*)"** dengan penulis Rifky Ismail, Mohammad Tauviqirrahman, Deni Mulyana, Fiki Firdaus, dan J. Jamari sudah dalam proses pengecekan akhir di redaksi Jurnal Marine Fisheries. Sebelum naskah kami cetak, dimohon agar penulis dapat mengecek kembali isi naskah. Jika naskah sudah sesuai, kami mohon agar penulis dapat mengisi form *proofreading* (terlampir) dan jika terdapat ketidaksesuaian, kekeliruan, dan kekurangan mohon agar dapat disampaikan kepada redaksi untuk dapat direvisi. Dikarenakan ada keterlambatan dalam penerbitan edisi November 2019 dengan ini kami mohon kesediaannya untuk segera mengembalikan **Form *Proofreading*** kami tunggu **paling lambat tanggal 15 Mei 2020**.

Demikian informasi yang dapat kami sampaikan. Atas perhatian dan kerjasamanya diucapkan terima kasih.

Pimpinan Redaksi,

Dr. Yopi Novita, S.Pi, M.Si
NIP 197109162000032001

F - 07

MARINE FISHERIES

JURNAL TEKNOLOGI DAN MANAJEMEN PERIKANAN LAUT

FORUM KOMUNIKASI KEMITRAAN PERIKANAN TANGKAP (FK_2PT) BEKERJASAMA DENGAN
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SURAT PERNYATAAN *PROOFREADING*

Saya yang bertandatangan di bawah ini:

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No HP	:	0815 666 5414
Berperan sebagai	:	Penulis pertama

Dengan ini menyatakan bahwa naskah yang berjudul:

REDESAIN BALING-BALING KAPAL NELAYAN BERDAUN 4 (EMPAT) DI SALAH SATU GALANGAN KAPAL DI TEGAL JAWA TENGAH

Dengan tim penulis

Rifky Ismail, Mohammad Tauviqirrahman, Deni Mulyana, Fiki Firdaus, Jamari

Isi naskah sudah dibaca dengan seksama dan disetujui untuk dipublikasikan di Jurnal Marine Fisheries.

Demikian surat pernyataan ini saya buat untuk digunakan sebagaimana mestinya.

Semarang, Mei 2020
Penulis,

(Dr. Rifky Ismail, ST, MT)