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Designing Local Culture-Based Radar Reflector for Increasing Safety Fishing Practices on Indonesian Traditional Fishing Vessel

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***Abstract*—The probability for collisions between commercial vessels and traditional fishing vessels remains relatively high in Indonesian waters. Some cases indicated that the crash between traditional fishing boat and commercial vessel resulted from the failure of large vessel on detecting the fishing boat clearly, especially at night or during foggy weather conditions. This problem can be overcome by installing Radar Reflector on fishing vessels so that the presence of fishing vessels can be detected on the radar screen of large vessels. The possibility of using radar reflectors on traditional fishing vessels in Indonesia is assessed by taking into account the technical and also the social aspects of the acceptance of fishing communities. The radar reflector design is adjusted to the ornamentation found on traditional fishing vessels to increase the level of acceptance of the fishing community. The technical aspects were reviewed from the recommendations submitted by FAO regarding application of radar reflectors on fishing vessels.**

Keywords—radar reflector, ship collisions, Muncar

I. INTRODUCTION

International Labour Organization (ILO) mentions the work of fishermen as one of the highest-risk jobs in the world. The ILO records an average of 24,000 work accidents experienced by the fishermen in global fisheries sector each year [1].

Health and safety standard on fishing vessel also becomes a major problem in the Indonesia fishery. Although there is no exact data on the number of accidents in the Indonesia fishery each year [2], data from KIARA (People's Coalition for Fisheries Justice) shows the fatal accident rate that causes extremely high deaths occur in the national fishery sector. According to KIARA, there were 186 deaths in the fisheries sector in 2012, 225 people died in 2013 and 210 people died in 2014 [3].

One of work accident which commonly happens in the national fishery sector is collisions between fishing vessels and larger steel vessels, such as cargo ships. One of the accidents was the collision between fishing boat and a container ship in Masalembu waters, Madura, where 12 fishermen crew were rescued by a Tug Boat that passed through around, in November 2019 [4].

The collisions between traditional fishing boat and large vessel frequently occur because the existence of a traditional fishing boat is rarely detected by large ship captain. It happens especially at night or during foggy weather conditions when the view is relatively limited. One of the root causes of the incidents is the absence of safety requirement which should be used by traditional fishing vessels, such as the use of navigation standard lights. This leads to bigger collision risks between large ships and traditional fishing boat.

Research conducted by Wibawa [5] determined that navigation light is one of safety tools for shipping that is rarely found on traditional fishing vessels in Brondong and Muncar regions. Brondong and Muncar are two large fishing communities in East Java which are generally operating in the northern waters of Java and Bali strait. This water area is traversed by many commercial vessels, ferries and coal-carrying vessels which often experience accidents involving traditional fishing vessels. The use of navigation lights on fishing vessels is absolutely necessary to give sign to large

vessels about the existence of a fishing boat, as well as the type of fishing equipment used.

Besides the navigation lights, according to FAO's recommendations in the *Safety Recommendations for Decked Fishing Vessels of Less Than 12 Meters in Length and Undecked Fishing Vessels*, another required navigation equipment to be mounted on fishing vessels is *Radar Reflector*. Radar reflector functions to reflect radar waves back from large ships, especially on small ships made of non-metallic materials such as wooden ships and Fiberglass Reinforced Plastic (FRP), thus the existence of small vessels equipped with radar reflectors can be detected by large vessels. Installation of radar reflector can be seen in Fig. 1.

Chapter 10.1 at FAO regulations "the *Safety Recommendations for Decked Fishing Vessels of Less Than 12 Meters in Length and Undecked Fishing Vessels"* about navigation equipment requires each fishing vessel to have a Radar Reflector on board, where the radar reflector used must have the minimum standard requirements for a radar reflector.

According to The Maritime Safety Committee standard in ANNEX 28, RESOLUTION MSC.164 (78) (adopted on 17 May 2004) about "REVISED PERFORMANCE STANDARDS FOR RADAR REFLECTORS" determined as follows:

- All ships must be equipped with radar reflectors in order to be detected by ships navigating with radar in 9 GHz and 3 GHz bands
- Radar reflectors must have a Stated Performance Level measured in Radar Cross Section (m2 RCS) of at least 7.5 m2 on X-bands and 0.5 m2 on S-bands mounted at a minimum height of 4 m above the water surface.
- Mounting arrangements must be provided on board so that the reflector can be mounted either on a rigid stand or mounted on the rigging system of the ship.
- For small vessels, the maximum weight of a radar reflector for installation at a height of 4 m is 5 kg. Reflectors designed to be mounted at a greater height must have a calculated weight equal to, or less than 4 m / 5 kg.
- The physical size of the radar reflector must be minimized and must not exceed 0.05 m3.

Fig. 1. The installation of radar reflector on canoe and mast of ship.

The use of radar reflectors on fishing vessels in Indonesia is urgently needed because fishing vessels in Indonesia are generally made of wood and fiberglass reinforced plastic (FRP) materials. Especially for traditional fishing vessels, even all of them are made of wood obtained by fishing boat craftsmen around the fishing community [6]. The use of wood or FRP material on fishing vessels requires a radar reflector to reflect radar waves from large vessels to avoid collisions.

Radar reflector is very potential to be applied to fishing vessels in Indonesia, mainly because of its simple shape with relatively easy manufacturing methods, yet very effective to prevent the possibility of collisions with large vessels. However, radar reflector has not become a common navigation equipment found in fishing vessels in Indonesia especially traditional fishing vessels. This phenomenon is due to the unfamiliarity of radar reflector technology by the fishing community in various regions in Indonesia. In addition, it takes a relatively long time to introduce a new technology to the fishing community in Indonesia.

The introduction of new technology to the fishing communities in Indonesia cannot be done in a short time. The rejection of grant fishing vessels made from FRP from the Ministry of Marine Affairs and Fisheries in the period of 2010 - 2014 in several fishing communities shows that an adequate approach to the fishing community about which new technologies to be applied, is really needed [7]. In addition, many of the fishing communities in Indonesia are very concerned with aspects of local culture that are reflected in the ornamentation that can be found on local fishing vessels. The ornamentation on Slerek vessels in Muncar area can be seen on Fig. 2.

Fig. 2. The ornamentation on Slerek vessels in Muncar.

The introduction of new technology in the fishing community should consider the concern of the fishing community for local culture if one wants to ensure the acceptance of the fishing community for new technologies or new designs for fishing vessels [18].

Concerning the acceptance of a fishing community group on new designs and technologies influenced by local culture; the design of the radar reflector that will be installed on local fishing vessels should also reckon the design or ornamentation that is on the local fishing vessel.

II. RESEARCH METHODS

Focus Group Discussion (FGD) is the form to identify the fishermen's understanding of radar reflector and its functions, as well as fishermen's opinion on the form of radar reflector that is suitable for application on local fishing vessels involving fishing groups in Muncar area, Banyuwangi, East Java. The fishing community in Muncar area was chosen because this area is one of the largest fishing communities in East Java, with fishing areas that intersect with the shipping lanes of large vessels, both commercial and ferry vessels.

To do the Focus Group Discussion, the instrument of questionnaire was used to get the fishermen's opinion on the form radar reflector. The questions consist of 3 points, the first is about fishermen identity, the second is about fishermen fishing frequency, and the third is about understanding of the radar reflector usage. The questionnaire distributed to more than 100 active fishermen which can be seen in detail below:

The data from the questionnaire given to be focused of FGD. Somehow, the Focus Group Discussion only involved 20 fishermen representing several pillars of fishermen in Muncar District. All participants are fishermen one day fishing less than 24 hours, with an average operational area on Bali strait.

No	Items	
1	The number of fishermen	≥ 100
2	Age if fishermen	20-45
3	Fishing frequency	6 times in a week (15 hours)
4	Type of catch (fish)	tuna
5	Type of fishing vessel	Speed vessel
6	Fishing tools	Net and waring

FGD topics include the practice of fishing by local fishermen, the safety aspects of shipping on local fishing vessels, the use of safety equipment on fishing vessels in the Muncar and surrounding areas, and the possibility of using radar reflectors on local fishing vessels. As a discussion aid, the prototype of the radar reflector and the design of the proposed radar reflector based on local culture were demonstrated during the FGD. The standard form of radar reflector uses the design recommended by FAO according to the guidelines in the Safety Recommendations for Decked Fishing Vessels of Less Than 12 Meters in Length and Undecked Fishing Vessels, as shown in Fig. 3.

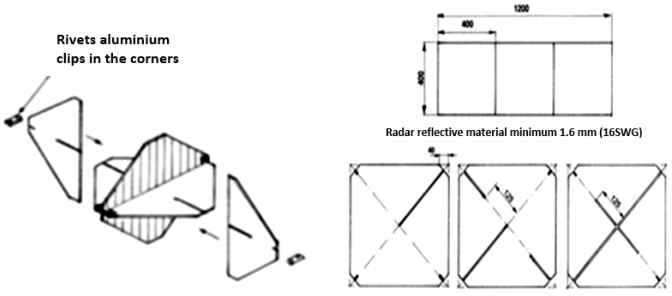


Fig. 3. Standard design of radar reflector according to FAO recommendation.

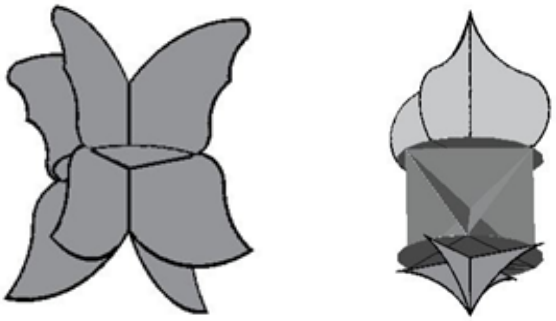
While the alternative designs submitted to the fishermen group are designs that are adapted to the forms of ornament commonly found on local fishing vessels.

III. RESULTS AND DISCUSSION

Based on observations on fishing vessels in Muncar and FGD with local fishing groups, it is known that the length of traditional fishing vessels in the Muncar area, for the number of crew members to a maximum of 3 people, ranges from 7 meters to 10 meters. The fishing area is generally the waters of Bali strait for Sardine, in certain seasons fishermen will move further to south from the eastern tip of the island of Java or south of the island of Bali. But the arrest time still ranges from 12 hours to 15 hours.

The results of the FGD with the fishing community in that area also showed that fishing vessels in the area were not yet equipped with adequate safety equipment on board which is related to the use of radar reflectors on board. These fishing vessels are not equipped with radar reflectors because of local fishermen's ignorance about the functions and benefits of radar reflectors for shipping safety.

The presentation on radar reflector with some prototype radar reflectors to fishermen gives sufficient understanding to fishermen. The results of the discussion showed that Muncar fishermen were very interested in using radar reflectors on their fishing vessels. All FGD participants expressed interest in using radar reflectors on their fishing vessels, mainly because the Bali strait water is a relatively busy shipping lane of large ships.



Butterfly Design Dome Design

Fig. 4. Alternative forms of radar reflectors.

The result of the observations on local fishing vessels in Muncar and discussions with local fishermen also indicate that aesthetic factors are an inseparable part of fishing practices in Muncar region, Banyuwangi. Besides, related to personal pride and fishing groups, the decoration on the fishing boat is related to the "Petik Laut" tradition which is a way for local fishermen to express gratitude for the seafood they have obtained for one year. With these considerations, Muncar fishermen pay close attention to the ornament that will be installed on their fishing vessels. This was also seen from the FGD participants' choice of alternative radar reflector designs that were appropriate for

their ship. Three alternative radar reflector designs were introduced to FGD participants, as shown in Figure 4. The first design was a standard design according to FAO recommendations, while the second and third designs were based on ornament designs on local fishing vessels. The second design is in a butterfly form, while the third design is dome form of the mosque. Both of these designs are often found in ornamentation on mast of fishing vessels in Muncar as shown in Fig. 1 above.

In addition to the alternative design of radar reflector adapted to the ornament design commonly found on local traditional fishing vessels, the technical aspects of the radar reflector designed for Muncar fishing vessels have also been adjusted to the recommendations of The Maritime Safety Committee in ANNEX 28, RESOLUTION MSC.164 (78) especially related to the height of installation on the ship, the volume and weight of the radar reflector.

The minimum average mast height for fishing vessels in Muncar is 4 meters, so the height of the radar reflector installation is according to the minimum height standard. While for the maximum allowable weight is 5 kg with a maximum volume of 0.05 m3. The results of weight and volume design on alternative radar reflectors submitted to Muncar fishermen can be seen in Table 1.

TABLE I. WEIGHT AND VOLUME OF ALTERNATIVE RADAR REFLECTORS

No	Design of Radar Reflectors	Volume (m^3)	Weight (kg)	Suitability FAO recommendation
1	FAO Standard	0,027	1,512	Suitable
2	Butterfly Design	0,027	1,512	Suitable
3	Dome Design	0,032	2,450	Suitable

The FGD participants' choice of the alternative radar reflector designs which are suitable for installation on Muncar fishing boat shows their attention to the aesthetic aspects of the radar reflector to be installed on their ship. It can be seen from the percentage choosing shapes based on ornamentation often found on local fishing vessels reaching 80% as shown in the pie chart in Fig. 5 below.

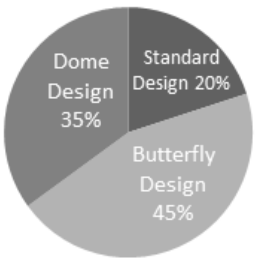


Fig. 5. Choice of radar reflector shapes for Muncar fishing vessels.

IV. CONCLUSION

The conclusions from the design of local culture-based radar reflectors and Focus Group Discussions regarding the possibility of installing radar reflectors on fishing vessels in Muncar area are as follows:

- The use of navigation equipment by fishing vessels in Muncar, Banyuwangi is still very low. No local fishing boats were found using radar reflectors. This is mainly due to the fishermen's ignorance of the benefits of using radar reflectors on their boats.
- Muncar fishermen have an interest in installing radar refletors on their ships. However, the shape of the radar reflector installed must be adjusted to the forms of ornament that are already on the ship to maintain the aesthetic aspects of the Muncar fishing vessel.

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