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Potential Track In North Maluku as an Alternative Rerouting Ex Ferry of The Bakauheni Merak Track

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Abstract

The potential for inefficiency in ferry transportation services due to the large number of ships operating on the Merak-Bakauheni crossing has begun to be followed up with recommendations for relocating or rerouting vessels to potential crossings. Thus, it requires a study of potential routes, especially in eastern Indonesia as an alternative rerouting location. Also, the enactment of Minister of Transportation Regulation PM 88/2014 concerning Limitation of the Size of Ships Operating in the Sunda Strait Crossing (Merak-Bakauheni), the main subject of the minimum limit of the size of ships that can operate is 5000 GT. The North Maluku region is an alternative rerouting area considering the geographical condition of the region in the form of an archipelago with many crossing routes operating currently quite a lot; 30 routes. The analysis method is carried out by looking at the potential demand in the area by considering the area's socio-economic growth and the fleet's operational utility on the existing track. In addition, the condition of the aquatic environment and the readiness of the ports in the area are considered. The results show that several existing trajectories can reroute locations, namely Bastiong - Sessionole, Bastiong - Sofifi, Ternate - Bitung, and Tobelo - Bitung. New route recommendations for rerouting locations are Tobelo – Sorong, and Ternate – Namlea.

Keywords: Ferry transportation; Rerouting; Potential demand; Transport network

1. Introduction

The Merak-Bakauheni crossing is one of the busiest routes connecting the economic corridors of Java and Sumatra. The track is served by ± 80 ships for 24 hours and six berths. With these conditions, it can be seen that the continuity of the distribution of goods and services between regions can be guaranteed. However, there is the potential for service inefficiency due to the imbalance between the number of port infrastructure and ship calls so that it can directly impact increasing the Turn Round Time of ships (especially waiting time) and decreasing ship payloads [1]. On the other hand, the Eastern Indonesia region is also geographically the majority in the form of an island group area with an economic center centered on the administrative capital area, which is very dependent on the availability of sea transportation. Although various types of sea transportation have served the accessibility needs of the archipelago people in eastern Indonesia, the number is minimal, especially in ferry transportation, where several crossing lanes are only served by one ship unit. Consequently, the frequency of services is limited, the cost of transportation is high, and the volume of logistics distribution is limited [2]. Which, in turn, will impact the slow development process in the area. The limited means of crossing in the form of ferries

on the route of eastern Indonesia causes people to have to use alternative means of crossing such as fast boats. Still, these ships have a high cost and limited carrying capacity. Sea current conditions influence their operations so they cannot be relied on at all times as a transportation backbone. Crossings, especially those that require ships capable of transporting vehicles, goods, and passengers simultaneously.

The potential for inefficiency in ferry transportation services due to the large number of ships operating on the Merak-Bakauheni crossing has begun to be followed up with recommendations for relocating or rerouting vessels to potential crossing lanes but still experiencing a small fleet of ships in eastern Indonesia. Under the enactment of the Minister of Transportation Regulation PM 88/2014 concerning the Limitation of the Size of Ships Operating in the Sunda Strait Crossing (Merak-Bakauheni), where the main subject of the minimum limit on the size of ships that can operate is 5000 GT. Based on the initial identification of the implementation of the regulation, there are about 15 to 20 units of vessels that will be inactive from the crossing operation with the status of ships belonging to members of GAPASDAP (National Association of River Lake and Crossing Transportation Entrepreneurs).

One of the potential areas as a rerouting location is the North Maluku region because of its geographical condition, which is dominated by waters, and there are many crossing routes. The potential for rerouting is based on the demand for cargo at each crossing, both passenger and vehicle cargo demand. The cargo demand will be a reference in analyzing the needs of the transportation fleet by looking at the comparison between the used capacity and the available capacity in the current ferry transportation fleet.

2. Methods

2.1. Analysis of Fleet Needs

Some considerations in analyzing the fleet's needs include the volume of cargo to be transported, the capacity of the operating fleet, and the ship's operating time when the ship provides services for its users. Therefore, it is necessary to know when the ship is not operating, that is, if a ship undergoes a docking process (non-operational time) with the formula T = 365 – ship docking time. Sailing time is the time it takes the ship to sail on a predetermined route for one round trip route [3].

Sailing time:

$$ts = S/(24.V) \quad (1)$$

Where:

V : Ship speed (Knots)
S : Distance covered in one round trip (nautical miles)

Round trip is the Fleet Shipping Frequency with the symbol (f') which is given by equation:

$$f' = \frac{T}{(tp+ts)} \quad (2)$$

Where:

T : Effective operating time per year
f' : Frequency of fleet shipments
tp : Time in port
ts : Ship sailing time

Payload is given by equation:

$$PL = V/f \quad (3)$$

Where:

PL : Payload
V : Payload volume per year
f : Expected frequency of fleet shipments per year

2.2. Ship Safety Factor Analysis

Several accidents that can occur to ships during operation are collisions with ships or other objects, running aground, catching fire, and sinking due to loss of stability caused by bad weather. Several factors that can cause a collision are bad weather, navigation equipment that is not functioning correctly, andfailure of the crew to anticipate the movement of other ships relative to the ship being steered. With an adequate maintenance system carried out regularly and supervision and inspection carried out consistently by the competent authority, navigation equipment failure can be avoided. Reducing collisions risk due to negligence crew in operating the ship can be minimized by a guidance system and supervision of the crew in terms of performance and health [4].

In bad weather conditions, the ship's movement can become unstable due to external forces and moments in wind and waves acting on the ship. Suppose the force and moment of the wind and waves acting on the ship are more significant than the force and moment of the rudder. In that case, the rudder will not be able to control the direction of the ship's motion, so that it has the potential to cause a collision, especially on a crowded shipping lane. Therefore, wind and wave conditions on a shipping route are essential to avoid potential collisions due to bad weather. Based on several research results for Indonesian ferries, especially those operated by ASDP, the maximum weather conditions where the ship can move safely are directly proportional to the size. For ro-ro ferries with a capacity of 600 GT, the maximum wind speed where the steering force and moment can control the ship's direction of motion is 24 m/s [5]. In general, the ratio of wind speed and ship speed where the rudder can still control the ship's direction of motion is 2.18. However, at low ship speeds, the ship's direction of motion can become unstable even at low wind speeds. This condition can cause a potential collision when the ship is manoeuvring in the port basin area.

3. Resutls and Discussion

3.1. The Existing Condition of the North Maluku Province Crossing Transport Network

The crossing in North Maluku Province consists of 25 crossings and five crossings between provinces with commercial and pioneer status. The tracks are also divided into commercial tracks (8 tracks) and pioneer trails (22 tracks). The ferry transportation network in the North Maluku region is served by 20 ferry boats that pass through 21 ferry ports and eight sea ports.

Figure 1. North Maluku Province crossing transport network.

3.1.1. Payload Production

The realization of trips for commercial routes in the North Maluku region in 2018 - 2019 experienced an average growth of 22.32 percent. In 2020, commercial trips decreased by an average of -34.96 percent due to the covid-19 pandemic. While the Ternate - Bitung route increased by 57.98 percent. For the pioneering track in 2018-2019, there was an increase of 19.47 percent, but for 2020, it decreased by 90.26 percent.

The production of passenger cargo for commercial routes in the North Maluku region for 2018 - 2019 decreased by 6.13 percent due to a reasonably significant decrease on the Ternate - Bitung route in 2019. Production of passenger-cargo in 2020 also decreased by 87.63 percent. For the pioneering trajectory of cargo production in 2018-2019, it increased by 77.84 percent, but in 2020 it decreased by 91.04 percent.

Production of vehicle payloads on commercial tracks in 2018-2019 increased by 10.34 percent but in 2020 decreased by 67.75 percent. The pioneer track in 2018-2019 experienced very high growth due to a surge in vehicle loads on several routes, but in 2020 it decreased by 85.45 percent.

3.1.2. Load Factor

Based on the available data, for 2019 and 2020, some of the tracks have a passenger load factor that is still low below 10 percent, especially for pioneer routes. However, the load factor is above 30 percent for most commercial routes.

It also shows that the load factor is still low on most tracks for vehicle loads. However, on several commercial routes, the load factor for vehicle loads is above 60 percent, including the Bastiong – Rum, Bastiong – Sofifi, Bastiong – Sessionoli, Ternate – Bitung, and Tobelo – Daruba routes.

3.1.2. Potential Trajectory

Several potential routes for rerouting the ferry fleet in the Ternate and Sorong service areas were selected based on the load factor value above 50 percent, the growth rate of positive cargo production, and the service area's economic development. The trajectories are as shown in the following table:

Table 1. Potential trajectory.

Trajectory	Payload LF (%)	Payload Production Growth 2019	The Growth Economic Serving Region (%)
Tobelo - Daruba	Passengers: 33.03	39.48	4.08
	Vehicles: 74.51	19.14	
Bastiong – Sofifi	Passengers : 53.00	29.55	8.25
	Vehicles: 127.09	11.20	
Bastiong - Sidangoli	Passengers: 28.02	17.01	8.25
	Vehicles: 101.7	32.80	
Ternate - Bitung	Passengers: 17.66	44.62	8.25
	Vehicles: 51.73	36.73	

3.2. Characteristics of the Rerouting Fleet

There are 15 (fifteen) fleets of ships that will be rerouted from the Merak – Bakauheni route, namely a fleet of ships with a GT below 5,000. Based on the ferry transport fleet data above, by looking at the position of the ramp door, the port needed by the ship is the port that allows the ship to lean lengthwise, namely the bow or stern of the ship on the side of the trestle/causeway. In addition, the port required by the ship is a port that allows the ship to lean transversely, namely the port side/starboard side of the ship, which is on the trestle/causeway side. By looking at the compatibility between the fleet's characteristics and the port's characteristics, most of the ships eliminated from the Merak-Bakauheni route could dock at the port longitudinally and transversely. Only three ships cannot dock transversely, namely KMP Dharma Kenaca IX, KMP Elysa, and KMP Trimas Laila.

3.3. North Maluku Water Environment Condition

Environmental data is used as a variable determining aspect of shipping safety in this study. Three environmental conditions are reviewed: tides, waves, and the depth of the harbour pool.

3.3.1. Tides

Based on the tidal data, the tidal range greater than two meters occurs in the waters of the Tobelo port, Morotai.

3.3.2. Slope of The Wave

The following figure shows the Slope of the waves in several areas, which are considered in determining the rerouting of ferries. The wave data used to determine the Slope of the wave is a 10-year return period with a measurement range of 6 hours [6].

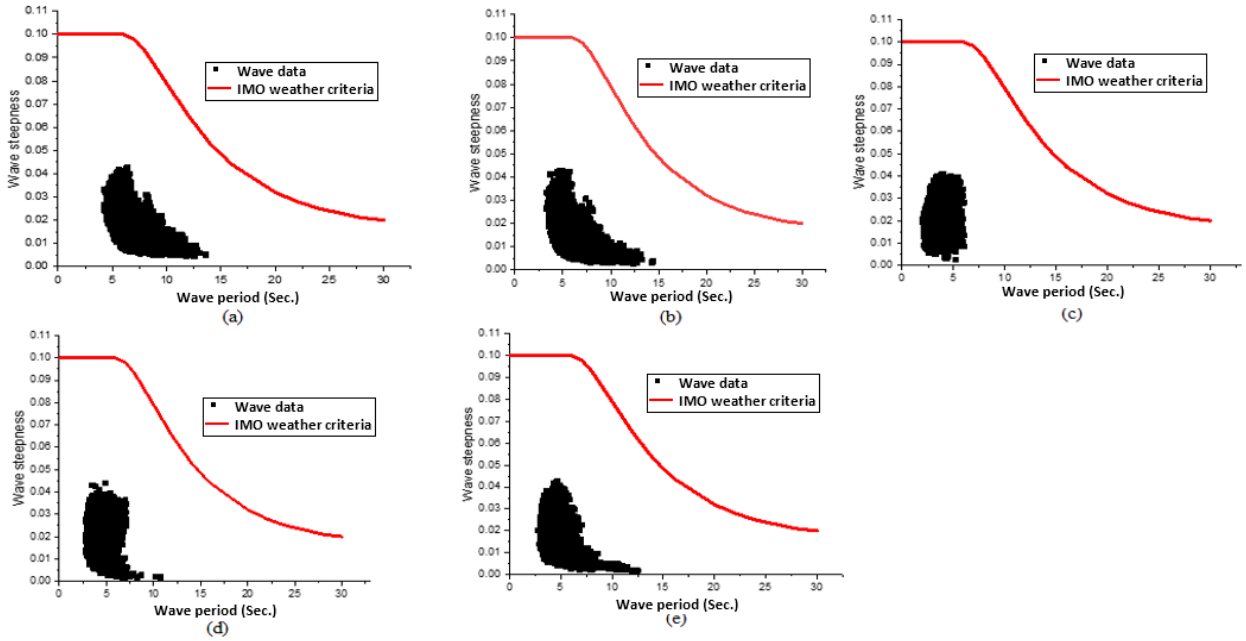

Figure 2. Slope of waves: (a) Makassar 1 waters; (b) Makassar Waters 2; (c) Makassar Waters 3; (d) Bitung waters; (e) Tobelo waters.

According to the wave data, the wave slope at 5 locations is smaller than the wave slope given in the IMO weather criteria. The maximum wave slope based on wave data at the 5 locations given is 0.045, smaller than the wave slope according to IMO weather criteria, which is 0.10 in the same wave period [7]. This fact shows that ships that meet the IMO weather criteria are safe to operate at the five locations in terms of ship stability.

4. Conclusions

Based on the results of data analysis and discussion in this study, it summarised as follows:

1. Vessel routes with potential cargo in the Ternate area are Tobelo – Daruba, Bastiong – Sessionole, Bastiong – Sofifi, and Ternate – Bitung.
2. Ships that meet the safety requirements for rerouting to the North Maluku region are KMP Nusa Dharma, KMP Mutiara Persada II, KMP Elysa, and KMP Trimas Laila.

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