

*“Extreme Wave Height affects the level of shipping safety hazards, especially vessels with tonnages between 10-30 GT.... “*

### Context and Issues

The increase in surface air temperature is the main parameter in the issue of climate change, which is closely related to the increase in CO<sup>2</sup> and other greenhouse gases. Observations from several stations in Indonesia over a 100-year period indicate climate change has occurred in Indonesia. These temperature data indicate a rise in temperature of 0.5°C in the 20<sup>th</sup> century. The magnitude of the temperature increase is in line with the increase in global temperature written in the IPCC AR-4, which is 0.7°C ± 0.2 every century.

Rising sea surface temperature is a direct result of an increase in surface air temperature. Based on the analysis of trends in historical data, sea surface temperature increases on Indonesian surface are expected to increase by 0.65°C in 2030, 1.10°C in 2050, 1.70°C in 2080, and 2.15 ° C in 2100. Changes in sea surface temperature and air temperature can change the condition of marine environment and affect climate variability. For example, the incidence of ENSO (La Nina and El Nino) will occur more frequently, from intervals of 3-7 years to 2-3 years. This change will eventually lead to changes in sea level, sea climate and trigger extreme storms / waves. Changes in ENSO variations are believed to provide changes in wave height of 2-5 meters.

Climate change that causes wave height changes and triggers extreme storms or waves has the potential to cause hazards in the marine sector, especially hazards related to sailing safety. Extreme weather and high waves can endanger shipping lanes and areas and obstruct Indonesian ships. This shipping safety is related to many other sectors that require sea transportation, such as the trade and fisheries sector. Sea shipping is a fundamental part of National Maritime Policy (Presidential Decree No.16 Year 2017) which is the goal of the Indonesian government in becoming the world's maritime axis. This national maritime policy is included in the Sea Toll, Indonesian Archipelagic Sea Flow program, optimization of PELNI shipping, optimization of ASDP shipping, and cargo shipping.

The Shipping Safety Hazard study objectives for vessels under 10 GT, between 10 GT and 30 GT, between 30 GT and 5,000 GT, and above 5,000 GT are to carry out analysis and projections of wave analysis until 2045 as consideration and input into development planning, especially in the marine sector.

## Findings

1. Wave climate simulation results for baseline conditions and projections up to 2045, generally show that Indonesia's internal sea waters are exposed to waves with a height of 0–2 meters, while outside sea areas (EEZ area) are exposed to waves with a height of more than 3 meter. Projections in 2045 show that climate change has resulted in an increase in wave height from 0.5-1 meter, especially in the waters of southern Java, NTB and NTT, eastern Indonesia, north Sulawesi, north Halmahera, northern Papua, northern Timor, and the western waters of Aceh, North Sumatra and West Sumatra. The projection also shows high waves closer to the beach.
2. In general, for baseline conditions and projection conditions, the waters of eastern Indonesia are vulnerable areas for shipping due to high wave conditions, especially for vessels under 30 GT. Bad weather that results in high waves in addition to endangering the safety of shipping which results in a decrease in the frequency of crossings between islands also reduces the efficiency of ships (more fuel needed).
3. Projections up to 2045 shows no changes which means the area is safe for ships under 10 GT. However, safe areas for vessels under 10 GT are limited to the coast.
4. Projections up to 2045 show an increase in the hazard area (wave height above 2 m) covering the northern Madura to the north of Flores, south of Kendari, the western Karimata Strait and the northern waters of North Sulawesi for vessels weighing between 10-30 GT.
5. Indonesia's internal waters are relatively safe for ships with sizes between 30-5,000 GT, where only the eastern part of Indonesia needs to be watched out. Projections up to 2045 show an increase in the area of "alert" (3-4 meter wave height) covering the northern areas of Madura to the north of Flores in the west, south of Kendari, the western Karimata Strait and the northern waters of North Sulawesi. The coverage of the "dangerous" area (wave height above 4 m) also expanded to include areas north of Halmahera and in the western part of the Karimata strait.
6. Indonesia's internal waters are safe for ships larger than 5,000 GT (PELNI vessels).

## Implication

The implications of climate change, in this case the potential for extreme waves in Indonesian waters causes increasingly prone to ship accidents, especially in the waters of eastern Indonesia, southern Java and western Sumatra. The time period of not being able to go to sea for fishermen who have vessels under 10 GT will be longer and the possibility of isolated small islands from large islands due to high sea wave conditions.

## Policy Recommendation

1. Early warning about weather conditions and ocean waves issued by BMKG needs to be socialized to fishermen and other stakeholders to prevent and reduce accidents in the sea due to weather.
2. Government assistance through the Ministry of Maritime Affairs and Fisheries to fishermen in the form of 10 GT vessels needs to be accompanied with counseling to change the culture in the fishing duration which is only a day to more than a day. In addition, it is necessary to provide fuel subsidies for fishermen who will go to sea because sailing under high wave conditions will reduce the efficiency of the ship.
3. The Ministry of Transportation and the Ministry of Maritime Affairs and Fisheries have enacted regulations prohibiting ships (fishermen) with a size below 10 GT to go to sea if the estimated wave height is above 1m, for ships with 10-30 GT size if the forecast wave height is above 2 meters while for ships with sizes 30-5,000 GT if the wave height is above 4 meters.
4. Coordination between parties, such as BMKG, the Ministry of Maritime Affairs and Fisheries, and the Ministry of Transportation in making marine hazard maps and making regulations related to shipping security to prevent and minimize ship accidents at sea due to weather. Forecasts of weather conditions and wave conditions in Indonesian waters issued by BMKG must continue to be improved in order to produce reliable marine hazard maps.
5. There is a guarantee from the Ministry of Transportation to maintain connectivity between small islands and large islands so that small islands are not isolated from large islands due to high sea wave conditions.
6. With the increase in sea wave height due to climate change, there is a possibility that fishermen with vessels under 10 GT cannot go to sea for more than 6 months. This condition needs to be anticipated by the Ministry of Manpower and the Ministry of Social Affairs to prepare alternative work when fishermen cannot go to sea.

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