Fisheries Journal, 16 (3), 1607-1614 (2026)
http://doi.org/10.29303/jp.v16i3.2147

ANALYSIS OF TOTAL COLIFORM BACTERIA IN THE WATERS OF LEMBAR PORT

Analisis Total Bakteri Coliform Di Perairan Pelabuhan Lembar

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(Received March 9th 2026; Accepted May 5th 2026)

ABSTRACT

Port waters are coastal areas vulnerable to environmental pressure due to shipping activities, coastal settlements, and beach utilization. This study aimed to identify total coliform bacteria in the waters of Lembar Port and compare the results with the applicable seawater quality standard. The study was conducted from August to September 2025 at five sampling stations representing different activity zones, namely Lembar Port dock, Gili Mas dock, ship parking area, Cemare Beach, and a control area. Seawater samples were collected purposively at a depth of 10–20 cm and analyzed in the laboratory using the *Most Probable Number* (MPN) method. Temperature and pH were measured as supporting parameters, while data on ship activity and community sanitation were used as contextual information. The results showed that all sampling stations had total coliform values of <1.8 MPN/100 mL. These values were far below the seawater quality standard of 1,000 MPN/100 mL. Water temperature ranged from 29 to 30.7°C, while pH ranged from 7.71 to 8.19. Ship traffic remained active during the study period, but it was not followed by an increase in measurable total coliform. Limited interviews also indicated that households in the surrounding villages had toilets with septic tanks. Therefore, the microbiological quality of Lembar Port waters during the observation period still met the seawater quality standard for total coliform and may serve as baseline data for future port water quality monitoring.

Keywords: Coliform, Coastal Waters, Lembar Port, MPN, Water Quality

ABSTRAK

Perairan pelabuhan merupakan kawasan pesisir yang rentan mengalami tekanan lingkungan akibat aktivitas kapal, permukiman pesisir, dan pemanfaatan kawasan pantai. Penelitian ini bertujuan untuk mengidentifikasi nilai total bakteri coliform di Perairan Pelabuhan Lembar dan membandingkannya dengan baku mutu yang berlaku. Penelitian dilaksanakan pada Agustus–September 2025 di lima titik sampling yang mewakili variasi aktivitas kawasan, yaitu area Dermaga Pelabuhan Lembar, Dermaga Gili Mas, area parkir kapal, Pantai Cemare, dan area kontrol. Sampel air laut diambil secara purposive pada kedalaman 10–20 cm, kemudian

dianalisis di laboratorium menggunakan metode *Most Probable Number*(MPN). Pengukuran suhu dan pH dilakukan sebagai parameter pendukung, sedangkan data aktivitas kapal dan sanitasi masyarakat digunakan sebagai informasi kontekstual. Hasil penelitian menunjukkan bahwa seluruh titik sampling memiliki nilai total coliform <1,8 MPN/100 mL. Nilai tersebut berada jauh di bawah baku mutu air laut sebesar 1.000 MPN/100 mL. Suhu perairan berkisar 29–30,7°C, sedangkan pH berada pada kisaran 7,71–8,19. Aktivitas kapal selama periode penelitian tetap berlangsung, namun tidak diikuti oleh peningkatan total coliform yang terukur. Wawancara terbatas juga menunjukkan bahwa rumah tangga di desa sekitar lokasi telah memiliki WC dengan septic tank. Dengan demikian, kualitas mikrobiologis Perairan Pelabuhan Lembar pada periode pengamatan masih memenuhi baku mutu untuk parameter total coliform dan dapat dijadikan sebagai data dasar pemantauan kualitas perairan pelabuhan di masa mendatang.

Kata Kunci: Coliform, Kualitas Air, MPN, Pelabuhan Lembar, Perairan Pesisir

INTRODUCTION

Coastal waters serve important ecological and economic functions. They serve as habitats for various marine organisms and are also used for fisheries, transportation, settlements, and tourism. This high level of utilization makes coastal areas highly vulnerable to environmental degradation, particularly in locations close to dense human activity (Dahuri et al., 2001; Riani et al., 2019).

One coastal area experiencing high activity pressure is the port area. This area experiences ship traffic, loading and unloading activities, interactions with coastal settlements, and various other economic activities that directly and indirectly increase the pollution load on water bodies. In this context, port water quality needs to be monitored regularly to ensure its use remains within the environmental carrying capacity (Setiawan et al., 2020; KKP, 2023).

In water quality studies, microbiological parameters are a crucial indicator because they relate to sanitation aspects and the potential for biological pollution. Total coliform is often used as an indicator of microbiological pollution because this group of bacteria is commonly found in environments that receive domestic wastewater input. Although not all coliforms originate from fecal sources, their presence remains relevant as an early indicator for assessing the possibility of biological contamination in water bodies (APHA, 2017; WHO, 2017).

The presence of coliform in water is influenced not only by pollutant input but also by environmental conditions. Temperature influences the metabolic rate and growth of bacteria, while pH determines whether water conditions support or inhibit the survival of microorganisms. Therefore, interpretation of total coliform will be more robust when complemented by environmental parameters such as temperature and pH (Effendi, 2003; Madigan et al., 2018).

Lembar Port in West Lombok Regency is a strategic port connecting Lombok Island with Bali and is located close to the Cemare Beach tourist area. This condition influences the area's influence by maritime transportation activities, port operations, coastal settlements, and beach tourism. However, empirical information regarding the microbiological conditions of Lembar Port waters, particularly regarding total coliform as an indicator of water quality, is still limited. These data limitations are important to consider because good aquatic environmental quality is a prerequisite for sustainable coastal use.

Several previous studies have shown that high coliform levels in coastal areas are generally related to anthropogenic pressures, particularly domestic runoff, dense settlements, and inadequate sanitation. Askar et al. (2018) reported increased coliform levels in tourist and residential areas in the Seribu Islands.

Anisafitri et al. (2020) found that river segments receiving domestic waste in Mataram City exhibited very high coliform levels. Meanwhile, Yolanda (2023) showed that in the Belawan Port area, the potential for biological pollution is more influenced by coastal community sanitation than by ship activity alone..

These findings indicate that the microbiological condition of the port area cannot be separated from the surrounding environmental context.

Based on this description, this study was conducted to identify the total coliform bacteria levels in Lembar Port waters and compare them to applicable quality standards. The results are expected to provide a picture of the actual microbiological quality of the waters as a basis for monitoring and managing the port area environment.

RESEARCH METHODS

This research was conducted from August to September 2025 in the waters of Lembar Harbor, Lembar District, West Lombok Regency, West Nusa Tenggara. The research location was chosen because it is a coastal area with high port activity and proximity to residential and tourist areas, making it potentially susceptible to microbiological pollution. Based on your thesis, the research was conducted at five sampling points representing different activity characteristics: the Lembar Harbor dock area, the Gili Mas dock area, the boat parking area, the Cemare Beach tourism area, and a control area that is relatively less affected by port activity.

The sampling points were determined using a purposive sampling method, which involves deliberately selecting points based on the nature of the activity and potential sources of pollution in the surrounding area. This approach was used to ensure that the samples taken represent the variation in microbiological conditions in areas experiencing different anthropogenic pressures. Seawater samples were collected at a depth of approximately 10–20 cm using a bucket and then placed into 500 mL sterile glass bottles at an angle of approximately 45°. After collection, samples were stored in a cool box to maintain their stability during transportation to the laboratory. The samples were then immediately analyzed for total coliform counts.

Total coliform analysis was conducted using the Most Probable Number (MPN) method in accordance with SNI 01-2332.1-2006. The initial stage involved a presumptive test using Lactose Broth Triple Strength (LBTS) and Lactose Broth Single Strength (LBSS) media. Tubes showing gas formation were then subjected to a confirmatory test using Brilliant Green Lactose Bile Broth (BGLBB) media. The MPN value was determined based on the combination of positive tubes and expressed in MPN/100 mL. The measurement results were then compared with seawater quality standards stipulated in Government Regulation Number 22 of 2021 and Decree of the Minister of State for the Environment Number 51 of 2004, which stipulate a total coliform threshold of 1,000 MPN/100 mL for marine waters.

As supporting parameters, water temperature and pH were also measured at each sampling point. In addition, this study utilized secondary data on vessel activity obtained from the Lembar Fisheries and Marine Resources Management Agency (KSOP), as well as limited interviews regarding toilet or septic tank ownership among the surrounding community as contextual information to aid in understanding the environmental conditions surrounding the research location.

Data were analyzed using exploratory descriptive methods. Laboratory test results, environmental parameter measurements, and supporting field data were presented in tabular form and then interpreted based on quality standards and relevant literature.

RESULT

Total Coliform Test Results

Laboratory analysis results showed that all seawater samples from five observation points had total coliform values <1.8 MPN/100 mL. This value indicates that coliform levels were undetectable at all sampling points within the limits of the MPN method used. The main results of your thesis indicate that all points, including the dock area, boat parking area, coastal tourism area, and control area, had similar values.

Table 1. Results of Total Coliform Bacteria Analysis

No.	Sample location	Total coliform (MPN/100mL)	Weather conditions
1.	ASDP Pier (T1)	<I,8	Sunny
2.	Gili Mas Pier (T2)	<I,8	Sunny
3.	Ship parking area (T3)	<I,8	Sunny cloudy
4.	Cemare Beach (T4)	<I,8	Sunny cloudy
5.	Pollution control area (T5)	<I,8	Sunny cloudy

Based on these results, there was no significant difference in total coliform values between areas close to port activities and the comparison area.

Temperature and pH Parameters

Physicochemical parameter measurements showed that the water temperature during the study ranged from 29–30.7°C, while the pH ranged from 7.71–8.19. The highest temperature was recorded at point T1, while the lowest temperatures were recorded at T4 and T5. Overall, all temperature and pH values remained within the normal range for tropical marine waters.

Table 2. Results of Water Temperature and pH Measurements

No.	Sample location	Temperature (°C)	pH
1.	ASDP Pier (T1	30,7	7,71
2.	Gili Mas Pier (T2)	30,5	7,96
3.	Ship parking area (T3)	29,8	8
4.	Cemare Beach (T4)	29	8,2
5.	Pollution control area (T5)	29	8,13

Ship Activities

Field observations and secondary data indicate that port activity continued throughout the study period. KSOP Lembar data recorded 18 vessels operating in August 2025, compared to 19 in September 2025. This finding indicates that the study area was in an active port operational condition during data collection.

Table 3. Result of ship activities

No.	Month	Number of ships per month	Total crew per month	Description
1.	August	18	450	Low season
2.	September	19	475	Low season

Community Sanitation Data

Limited interviews in four villages surrounding the research site revealed that all respondent households had toilets with septic tanks. However, field notes indicate that solid waste management in some locations is still suboptimal, and littering is still common.

Table 4. Results of Interviews with Village Leaders

Village	Number of families	Have a toilet/septic tank	Waste management	Notes
Gok Bay	93	93	Public	Still throwing rubbish carelessly
Cemare	500	500	Village community	Still throwing rubbish carelessly
East Lembar	421	421	Village community	Still throwing rubbish carelessly
Waru Bay	405	405	Managed by the village	Still throwing rubbish carelessly

DISCUSSION

The research results show that all observation points in Lembar Harbor waters had total coliform values <1.8 MPN/100 mL. This value is well below the seawater quality standard of 1,000 MPN/100 mL as stipulated in Government Regulation Number 22 of 2021 and Ministerial Decree Number 51 of 2004. Therefore, based on the total coliform parameter, the microbiological quality of Lembar Harbor waters during the study period still met applicable quality standards. This general conclusion also aligns with the summary and results-discussion chapters in your thesis.

The low total coliform values at all points indicate that no measurable microbiological contamination was found during the observation period. This finding is important because port areas are generally associated with high anthropogenic pressure. However, the results of this study indicate that port activity does not always correlate with high coliform levels. In other words, port activity pressures need to be interpreted in conjunction with environmental conditions and the characteristics of pollutants, rather than being directly assumed to be the source of the increase in indicator bacteria.

Compared with studies in other port areas, the microbiological conditions in Lembar Harbor waters are considered good. Yolanda, (2023) reported that total coliform levels in Belawan Harbor waters ranged from 157 to 665 MPN, still meeting quality standards. Compared with these results, a value of <1.8 MPN/100 mL in Lembar Harbor waters indicates a much lower level of contamination. This finding confirms that each port area has different environmental dynamics, depending on the magnitude of waste input, hydrodynamic conditions, and the characteristics of the surrounding area.

The temperature and pH measured during the study also support this interpretation. Water temperatures ranging from 29–30.7°C and pH 7.71–8.19 indicate normal conditions for tropical marine waters. Theoretically, stable temperature and pH can support, or at least prevent, extreme conditions that trigger drastic changes in microbial communities. In marine environments, enteric bacterial persistence also tends to be lower due to osmotic pressure from salinity and exposure to sunlight, which can reduce bacterial viability (Cabral, 2010; Korajkic et al., 2018). Therefore, the low total coliform counts at the study site are suspected to be related

not only to the small input of biological pollutants but also to the natural characteristics of the seawater itself.

Ship activity continued throughout the study period, as evidenced by KSOP Lembar data showing ship mobility in August and September 2025. However, this activity was not accompanied by a measurable increase in total coliform counts. This indicates that at the time of the study, ship activity was not yet a dominant factor influencing total coliform parameters. This finding aligns with the view that port operations do have the potential to impact water quality, but the impact is not always immediately visible on every water quality parameter within a single observation period. Arianti & Fadilah, (2023) and Ghaisani & Fadilah, (2023) also emphasized that the influence of ports on water quality is highly dependent on the type of pollutant, activity intensity, and measurement time.

The sanitation conditions of the surrounding community also provide important context for the research results. Limited interviews revealed that nearby households have toilets with septic tanks. This indicates that the input of fecal-based domestic waste into the water body is likely relatively more controlled compared to coastal areas with poor sanitation. However, field notes showing the persistence of indiscriminate waste disposal suggest that environmental pressures remain, although this is not directly reflected in the total coliform parameters at the time of observation. Therefore, the environmental conditions of coastal areas still require a comprehensive assessment, not just focusing on a single microbiological indicator.

Although the research results indicate good conditions, their interpretation requires caution. Low total coliform values only reflect the condition of the waters at the time of sampling. This means that these results do not necessarily represent temporal variations that can occur during different seasons, particularly when rainfall increases or when there are changes in activity patterns on land and in ports. In many cases, residential runoff during the rainy season can significantly increase coliform levels (Utari et al., 2023). Therefore, the results of this study are best understood as an initial overview of the microbiological condition of Lembar Harbor waters and as baseline data for further monitoring.

Overall, this study shows that Lembar Harbor waters remained in good microbiological condition during the observation period, based on total coliform parameters. These results support the importance of regular monitoring in the port area, particularly to ensure that water quality remains maintained as coastal utilization activities increase.

CONCLUSION

1. The total coliform bacteria count at all observation points in Lembar Harbor waters was <1.8 MPN/100 mL. This value indicates that no measurable coliform contamination was found at the five sampling points during the study period.
2. When compared to the seawater quality standard of 1,000 MPN/100 mL, all measurement results were well below the permissible threshold. Therefore, the microbiological quality of Lembar Harbor waters during the observation period met the quality standard for total coliform parameters.

ACKNOWLEDGEMENT

The author would like to express his gratitude to Dr. Paryono as the main supervisor and Sholihati Lathifa Sakina, S.Si., M.T. as the co-supervisor for their guidance and input during the research and writing of this manuscript. He also expressed his gratitude to the Faculty of Agriculture, Mataram University, the laboratory staff who assisted with the sample analysis process, as well as the KSOP Lembar and the local community around the research location who assisted during data collection.

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