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# Assessment of The Marine Water Quality Along Selangor State's Coastline

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**Abstract:** Marine water quality is essential for sustaining marine biodiversity, protecting public health, and supporting coastal economic activities. The Selangor coastline plays an important role in fisheries and tourism; however, rapid coastal development and anthropogenic activities may degrade marine water quality if not properly monitored. This study evaluated marine water quality at three selected locations along the Selangor coastline by analysing key physicochemical and biological parameters and classifying the water quality using the Malaysian Marine Water Quality Index (MMWQI). Marine water samples were collected using in-situ measurements and laboratory analyses. The results showed that several parameters exceeded the Malaysian Marine Water Quality Standards (MMWQS), including phosphate (3090 µg/L), ammonia (1197 µg/L), faecal coliform (7200 CFU/100 mL), turbidity (416 NTU), and total suspended solids (380 mg/L). The calculated MMWQI values were 21 for Bagan Lalang Beach, 22 for Tanjung Harapan, and 16 for Redang Beach, classifying all locations as Poor. These findings indicate that tourism, industrial activities, agriculture, and domestic wastewater significantly influence marine water quality. The results provide valuable information for local authorities to strengthen pollution mitigation strategies and promote sustainable coastal management.

**Keywords:** Marine water quality, Selangor coastline, Anthropogenic activities, Malaysia Marine Water Quality Index (MMWQI), Sustainable coastal management

## 1. Introduction

Coastline of Selangor stretching approximately 291 kilometers which has important role in Malaysia's economy, especially in fisheries and tourism industry. Coastal environment consists of sandy beaches, mangroves forest and mudflats making it's a critical habitat for marine ecosystem [7].Therefore, these coastline facing environmental pressures from many type of anthropogenic activities including industrial, shipping navigation and tourism development which potentially lead to marine water pollution [6] if not manage with proper method. Effective management and conservation measures are necessary to keep maintain the marine water quality.

Assessment on marine water quality is crucial for ensuring compliance with the Malaysian Water Quality Standard (MMWQS), which helps to identify pollutants in coastal waters. The quality of marine water is altered by multiple of physical, chemical and biological parameters such as pH, turbidity, nutrient concentration, dissolved oxygen, presence of heavy metals and pathogens [2]. Due to the increasing rate of industrialization and population growth in Malaysia has negatively impacting marine ecosystems [5]. Pollutant from land-based sources, like industrial discharge, agricultural runoff and domestic waste pose a threat to marine life and coastal communities [12][9].

Degradation of marine water quality can create environmental issues, like eutrophication and waterborne diseases spreading. Coastal pollution is critically important when untreated waste flows directly into the sea and disrupting marine ecosystems. Due to these challenges, its essential to conduct continuous monitoring and assessment of marine water quality to enable early detection of potential pollution. Effective assessment also can provide valuable knowledge for environmental authorities to implement mitigation plan and ensure sustainable coastal management [3].

Clean marine water is essential for supporting diverse ecosystems, including coral reefs, mangroves and estuaries, which play role as breeding grounds for various species of marine life. These ecosystems also act as natural buffers to protect coastal communities from extreme weather and mitigate climate change impacts. Even though human activities influence the change of marine environment, people still need to rely on marine ecosystems for resources and services [4]. Therefore, maintaining marine water quality is not only important for biodiversity conservation but also for sustaining economic activities along the coastline.

The objective of this assessment is to evaluate the marine water quality at selected locations along Selangor coastline by analyzing key parameters and classifying the results based in

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Malaysian Marine Water Quality Index (MMWQI). Sampling was conducted through in-situ and laboratory analysis methods to ensure the accuracy of the data. The data obtained from this assessment provide information for understanding the impact of various anthropogenic and human activities on marine biodiversity and improving mitigation plan.

By determining sources of pollutant and assessing their effects on marine ecosystem, this study lead to provide valuable knowlegde for environmental conservation. The results serve as a benchmark for further research and regulatory improvements, and ensuring that marine resources remain preserved for future generations. Implementing effective pollution control and developing sustainable development along the coastline will be important in protecting the ecological and economic values of Malaysia's marine environment.

## 2. Methodology

The purpose of this study is to analysis the quality of marine water compliance with authority standards based on selected parameters. Study locations were chosen based on its varying human activities. Sampling analysis involved in-situ and laboratory method. The impact of development and activities on water quality will be identified through dekstop study and on-site observation after the marine water quality data was collected. The collected data also required to classified the level of marine water cleanliness using Malaysian Marine Water Quality Index (MMWQI). Figure 1 shows the flow chart of this assessment.

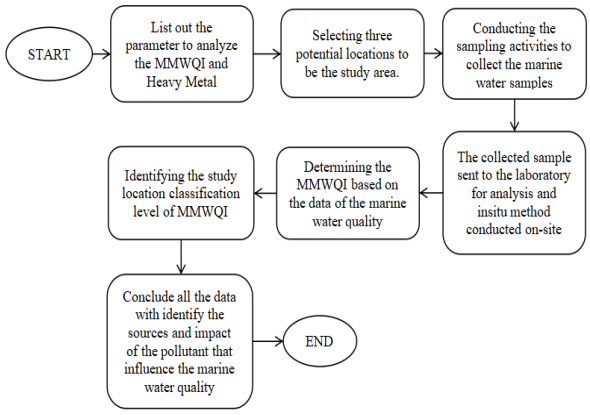


Fig. 1 - Flow of the assessment

This assessment was conducted along the Selangor coastline and three location was selected which is Bagan Lalang Beach, Tanjung Harapan and Redang Beach based on their variety of environmental, geographical and human activities. These areas governance under different local authorities and represent diverse coastal condition, ranging from tourism attraction to industrial and fishery zones.

Marine water samples were collected during low tide and under dry weather conditions to prevent dilution factor. Marine surface water was sampled near the shoreline and stored in high-density polyethylene (HDPE) bottles and transported to the A&A Laboratory (A&A Scientific Resources Sdn Bhd) for analysis. Marine water quality was analyzed using in-situ and ex-situ methods [11]. Dissolved oxygen and pH was measured on-site with multi-probe equipment. Other parameters like faecal coliform, total suspended solids and nutrient were analyzed in the laboratory following APHA standard methods.

Table 1 - Coordinate of the Study Location

| Location | Coordinate |
|---|---|
| Bagan Lalang Beach, Sepang | 2°35'51"N 101°41'31"E |
| Tanjung Harapan, Klang | 3°00'05"N 101°21'50"E |
| Redang Beach, Sekinchan | 3°30'09"N 101°05'38"E |

## 3. Data And Result

The data of the water quality have been recorded after the samples were analyze by the A&A Laboratory. For the data of the water quality showed in Table 2.

Table 2 - Data of Marine Water Quality

| Parameter | Unit | Standard Limit (Class 3) | Location | | |
|---|---|---|---|---|---|
| | | | Bagan Lalang Beach | Tanjung Harapan | Redang Beach |
| Temperature | °C | - | 29.7 | 29.9 | 33.1 |
| Salinity | ppt | - | 20.9 | 14.52 | 29.9 |
| pH | - | 6.5 - 9.0 | 7.92 | 7.57 | 9.03 |
| Turbidity | NTU | - | 245 | 16.5 | 416 |
| Dissolved Oxygen | mg/l | > 3.0 | 10.88 | 3.64 | 3.76 |
| Ammonia | µg/l | 320.0 | 173 | 840 | 1197 |
| Nitrate | µg/l | 700.0 | 10 | 10 | 10 |
| Phosphate | µg/l | 670.0 | 3090 | 820 | 1700 |
| Total Suspended Solid | mg/l | 100.0 | 380 | 94 | 94 |
| Faecal Coliform | Cfu/100ml | 70.0 | 380 | 7200 | 510 |

Based on the recorded data shown in Table 2, there have several parameters that exceed the MMWQS limits across the three selected study locations. The highest turbidity (416 NTU) that was recorded at Redang Beach and reading for pH (9.03) slightly exceed from the standard limits, while Tanjung Harapan shown the most severe contamination especially in terms of parameter faecal coliform (7200 Cfu/100ml) and ammonia (840 µg/l) which is exceeded the standard limits that possibility to indicating the presence of sewage pollution. Bagan Lalang Beach showed the highest phosphate concentration with the reading 3090 µg/l and total suspended solid (380 mg/l), likely occure because of agricultural runoff or coastal development. For dissolved oxygen level at all study location indicate that have acceptable reading which is above 3.0 mg/l.

In general, Tanjung Harapan has the poorest marine water quality due to the excessive ammonia concentration and microbial contamination. Even though Redang Beach data showed high turbidity and slightly alkaline pH reading, it had relatively lower microbial pollution. While having a high concentration of phosphate and suspended solids at Bagan Lalang Beach, the reading of dissolved oxygen levels is maintained in the standard limit. These findings highlight that

further investigation is required to identify the potential of contamination sources particularly in Tanjung Harapan and mitigation methods to improve the marine water quality.

MMWQI can be determined by calculated the values of some parameter like dissolved oxygen, faecal coliform, ammonia, nitrate, phosphate and total suspended solid based on the marine water quality data from Table 2. The Malaysian Marine Water Quality Index (MMWQI) was calculated using Equation (1).

$$MMWQI^* = q_{iDO}^{0.18} \times q_{iFC}^{0.19} \times q_{uNH3}^{0.15} \times q_{iNO3}^{0.16} \times q_{iPO4}^{0.17} \times q_{iTSS}^{0.15} \quad (1)$$

Table 3 - MMWQI of The Study Location

| Location | MMWQI | Class |
|---|---|---|
| Bagan Lalang Beach | 21 | Poor |
| Tanjung Harapan | 22 | Poor |
| Redang Beach | 16 | Poor |

Based on Table 3 showed that Redang Beach is the location with the lowest class of MMWQI. The MMWQI for this study location is 16 which is the lowest values compare to another two study location which is Bagan Lalang Beach and Tanjung Harapan with values 21 and 22, respectively.

### 3.1 Classification of Anthropogenic and Human Activities

This assessment categorizes several type of anthropogenic and human activities at all study location within 3 km radius.

Table 4 - Anthropogenic and human activities at study location

| Category | Activity | Environmental Impact | Type of Pollutant |
|---|---|---|---|
| Tourism and recreation | Hotel and resort | Wastewater discharge, littering and coastal erosion | Faecal coliform |
| Coastal erosion | Natural erosion | Habitat degradation due to sediment runoff that can affect the aquatic plants. | Turbidity (TSS) |
| Industrial and shipping | Port operation, factories | Oil Spillage and Inorganic accumulation from industrial discharge | Oil and grease, heavy metal, ammonia |
| Residential and commercial area | Domestic waste disposal and sewage discharge | Dissolved oxygen depletion from organic matter accumulation, bacterial pollution due to uncontrolled sewage discharge | Fecal Coliform, ammonia, phosphate, nitrate |
| Fishing industry and jetties | Boat navigation, seafood processing | Wastewater discharge from seafood market | Ammonia, phosphate |
| Agricultural | Large scale of paddy field | Chemical fertilizer and pesticide runoff, soil erosion | Ammonia, nitrate, phosphate, TSS |
| Coastal settlement | Domestic waste disposal and sewage discharge | Bacterial contamination, dissolved oxygen level depleted due to organic contamination | Ammonia, faecal coliform, nitrate, phosphate |

Based on Table 4, this classification of anthropogenic and human activities at all study location provides insight of the potential sources of marine pollution which influence the quality of the marine water. At Bagan Lalang Beach, the tourism related activities and agricultural runoff has contributed to high concentration of phosphate (3090 µg/L) and TSS levels, which likely cause by fertilizer runoff and sediment erosion due to coastal development. According to [10], high concentration of phosphate also depends amount of phosphate in freshwater that mixed with the seawater. This can related with the nearby estuaries of Sepang River.

Tanjung Harapan which is consist many industrial and shipping activities that potentially led to severe pollution with faecal coliform (7200 cfu/100mL) and ammonia (840 µg/L) exceeding the standard limits. Ports can be the sources of human interference in the ocean and marine ecosystem [1]. The factor of the violation occur because of the organic pollution from wastewater discharge that come from the residential and commercial areas. As an example, seafood restaurant near to the coastal location may directly discharge their waste into the sea. However, quality of marine water at Redang Beach impacted by fishing activities, seafood processing and agricultural runoff. This finding indicated that the violation of parameter ammonia (1197 µg/L) and phosphate (1700 µg/L) cause by high amount of nutrient loading from fertilizer and pesticides used in paddy field. A study by [8] have shown that nutrient input into the environment due fertilization was more than twice that of natural processes. These classification was shown the relationship between land use activities influence the degradation of marine water quality.

## 4. Conclusion

This assessment successfully achieved its objective of evaluating marine water quality along the Selangor coastline and determining its compliance with the Malaysian Marine Water Quality Standards (MMWQS). The results showed that several water quality parameters exceeded the permissible limits. According to Table 2, Bagan Lalang Beach recorded the highest phosphate concentration (3090 µg/L) and total suspended solids (380 mg/L), Tanjung Harapan recorded the highest faecal coliform concentration (7200 CFU/100 mL) and elevated ammonia concentration (840 µg/L), while Redang Beach recorded the highest turbidity (416 NTU), highest ammonia concentration (1197 µg/L), and slightly exceeded the pH limit (9.03). Although dissolved oxygen concentrations at all locations remained above the minimum standard of 3.0 mtableg/L, the overall water quality was still classified as poor. The calculated MMWQI values were 21 for Bagan Lalang Beach, 22 for Tanjung Harapan, and 16 for Redang Beach, indicating that all three locations fall under the Poor water quality category. These findings demonstrate that tourism, industrial activities, agriculture, fisheries, and domestic wastewater significantly influence marine water quality along the Selangor coastline. Therefore, continuous monitoring, stricter pollution control measures, and sustainable coastal management are essential to protect the marine ecosystem and ensure long-term environmental sustainability.

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