International Journal of Life Science and Agriculture Research
ISSN (Print): 2833-2091, ISSN (Online): 2833-2105
Volume 04 Issue 05 May 2025
DOI: https://doi.org/10.55677/ijlsar/V04I05Y2025-04
Impact Factor: 7.88 , Page No : 308-313

Analysis of Water Quality and Cadmium (Cd) Around the Lantebung Coast of Makassar City, Indonesia

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ABSTRACT
This study aims to determine the water quality and cadmium content around the Lantebung coast, Makassar City. This study is an exploratory study. Water quality measurements were carried out in situ, while seawater cadmium measurements were carried out ex situ. The water quality parameters measured included temperature, pH, and salinity of the waters, while the measurement of cadmium heavy metals refers to the SM APHA 23rd Ed. 3113 B. 2017 method. The data analysis used was descriptive analysis. The results of the study showed that the average water quality such as temperature and salinity of the waters was still classified as good and suitable for the life of aquatic organisms, except that the pH of the waters was still classified as low. Furthermore, the results of cadmium measurements for the three research locations showed that the three locations were not contaminated with the heavy metal cadmium because they had a cadmium value of <0.003 ppm. The water quality on the coast of Lantebung Beach, Makassar City, from the aspect of water quality, namely temperature, pH, and salinity of the water, only the pH of the water is low. Furthermore, from the aspect of cadmium pollution, it is concluded that these waters have not been polluted.

Published Online:
May 12, 2025

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KEYWORDS: water quality, cadmium, coastal area, Lantebung.

INTRODUCTION

Coastal areas are important areas from various planning and management perspectives. The transition between land and sea in coastal areas has formed diverse and highly productive ecosystems and provides extraordinary economic value to humans (Hamuna et al., 2018). Increased activity in coastal and port areas has an impact in the form of pollution of the waters around the area due to the disposal of ship, industrial, and household waste in the coastal areas (Santosa & Sinaga, 2020).

Human activities will have an impact on increasing waste or pollutants in the surrounding waters, thereby potentially causing damage to the aquatic ecosystem (Emilia et al., 2013). The excessive entry of organic and inorganic substances into water bodies has a negative impact on marine waters and causes a decrease in the quality of seawater physically, chemically, and biologically (Hamuna et al., 2018). Any change in a vulnerable ecosystem due to anthropogenic activities that may endanger the habitat of fish and other aquatic organisms (Gholizadeh et al., 2016). Increasing human activity also means increasing the amount of waste produced, which can pollute the environment and cause a decline in the quality of water in the area (Darmawan and Masduqi, 2014). As a result, coastal areas are areas that are prone to declining water quality.

In general, water quality parameters are grouped into two categories, namely primary parameters and secondary parameters. Primary parameters are chemical compounds that enter the waters without any reaction with other compounds in the waters and then cause adverse effects on the waters, Meanwhile, secondary parameters are parameters that are formed due to chemical reactions that change into other compounds, which can have both bad and good impacts on waters (Romimohtarto and Juwana, 2001). Seawater quality is influenced by natural factors and interactions with the land environment. Factors that cause the decline in seawater quality are pollutant waste from land that is not managed properly and occurs continuously over a long period of time until it exceeds the established quality standards, causing marine pollution (Ruslan, 2008). Water quality can also be seen from the level of pollution that occurs in the waters using several methods for determining water quality (Mukamto et al., 2024).

Although the sea has the ability to maintain balance (homeostasis) and is able to purify itself (self-purification) from all pollutants that enter the water body. However, the sea is also the final storage system for all types of waste produced by human activities.

Polluting waste causes a lot of heavy metal content in seawater; this will certainly have a negative impact on marine ecosystems and other living things. Heavy metal content is needed by living things in small amounts, but in general heavy metals have toxic properties for living things (Begum et al., 2009). If the pollution load received by the sea exceeds its carrying capacity, the quality of seawater will decrease (Elyazar et al., 2007).

Pollution does not only come from industry but also from waters adjacent to the port, which is surrounded by several rivers (Noviansyah et al., 2021). In waters, heavy metals are found in dissolved form, and by the adsorption process mechanism, the dissolved phase will be lost from the water column, turning into a particle phase (Fitroh et al., 2019). According to (Afriyansyah et al., 2010), heavy metals in water bind to ligands, suspended particles, organic matter, and components that settle in sediments. The entry of heavy metals into the environment causes metals to accumulate in sediments through 3 processes, namely adsorption, precipitation, and coprecipitation. The influence of weather and the rainy season causes heavy metal levels in water to be lower than in the dry season because in the rainy season metals will dissolve in the water (Kusumadiani et al., 2024).

The coastal area of Lantebung, Makassar City, is a coastal area that is quite susceptible to declining water quality and heavy metal pollution such as cadmium (Cd). This condition is possible because of the increasing activities of the community in this area, both as fishermen and other household activities, which sooner or later will also affect the decline in water quality in this area, although we know that in this area there are still many mangrove forests. That is why research was conducted related to water quality and lead content of seawater in this coastal area.

MATERIAL AND METHOD

This research was conducted in April to May 2024 by taking the research location in the coastal area or mangrove area of Lantebung, Makassar City. This research uses a descriptive exploratory method. Data collection was carried out at 3 observation stations (ST), namely station 1 (ST 1), located in the southern part of the ecotourism area, where facilities such as toilets and tourist spots are available at this station, and currently many new mangroves have been planted as a result of collaboration between students and local residents. Station 2 (ST 2) is located in the northern part of the Lantebung mangrove ecotourism area and is the main spot for tourism because the area is larger than the spot area at station 1. Station 3 (ST 3) is located on the outside of the Lantebung Mangrove Ecotourism, which is the main road to access tourist spots, and along this station it is very common to see the activities of local residents, especially in the morning and evening when residents who work as fishermen are doing a lot of activities.

Measurement of seawater quality such as temperature, pH, and salinity, was carried out in situ at each station and repeated 3 times. Temperature measurement using a thermometer, water pH measurement using a pH meter, and water salinity measurement using a hand refractometer. Meanwhile, for seawater sampling that requires laboratory analysis, namely the lead content of seawater at the research location, this is done by putting seawater samples into sample bottles and storing them in a coolbox for analysis in the laboratory. Analysis of Cd metal in water samples refers to the SM APHA 23rd Ed. 3113 B. 2017 method. Analysis of in-situ measurement data and laboratory analysis results of cadmium (Cd) parameters was carried out descriptively.

RESULTS AND DISCUSSION

Water Temperature (ºC)

Figure 1 shows that the average water temperature at the research location was highest at ST 3 and lowest at ST 1. However, this water temperature is still considered suitable for both the life of aquatic organisms and its relation to temperature as a trigger for water pollution levels.

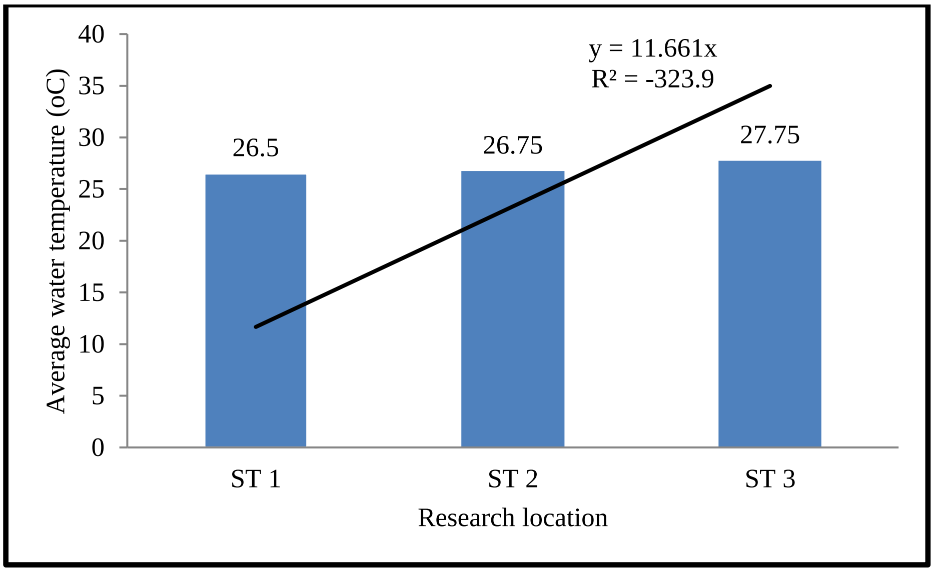

Figure 1. Average water temperature at the research location

Temperature is one of the important parameters of water quality because it is abiotic in the aquatic environment because, on average, aquatic biota are poikilothermic or cannot regulate their body temperature (Levinton, 1982), so they are very dependent on the temperature conditions of the waters where the biota lives. If the temperature conditions do not match the tolerance that can be accepted by the biota, it can cause death (Hutagalung, 1988). In general, the surface temperature of the waters ranges from 28–31 °C (Nonji, 2005). According to (Prihati et al., 2020), the standard temperature range for marine biota is 28–32 °C. Changes in temperature have an impact on metal levels in the waters. An increase in water temperature will result in higher heavy metal toxicity in the waters (Kusumadiani et al., 2024). The level of heavy metal accumulation is getting bigger. Temperature is an important parameter in waters because temperature can affect the growth of aquatic organisms (Hariyanti et al., 2021). On the other hand, the temperature indicated based on the research results of (Wulandari et al., 2015) ranges from 28–30 °C. The water temperature is relatively stable with an increase that is not too drastic (Putriningtias et al., 2021). Temperature plays a role in the reaction of the formation of heavy metal ions; the higher the temperature in the water, the faster the reaction of the formation of these ions (Rezki et al., 2013).

pH of Water

Figure 2 shows that the average pH of the waters at the research location was highest at ST 2 and the lowest at ST 1. The average pH of the waters at the research location was relatively low for all research locations, and this range of water pH is usually not good for the life of aquatic organisms because it is classified as acidic. The low pH content of the water at the research location is thought to be caused by the proximity of the research location to a small river that usually has a low pH.

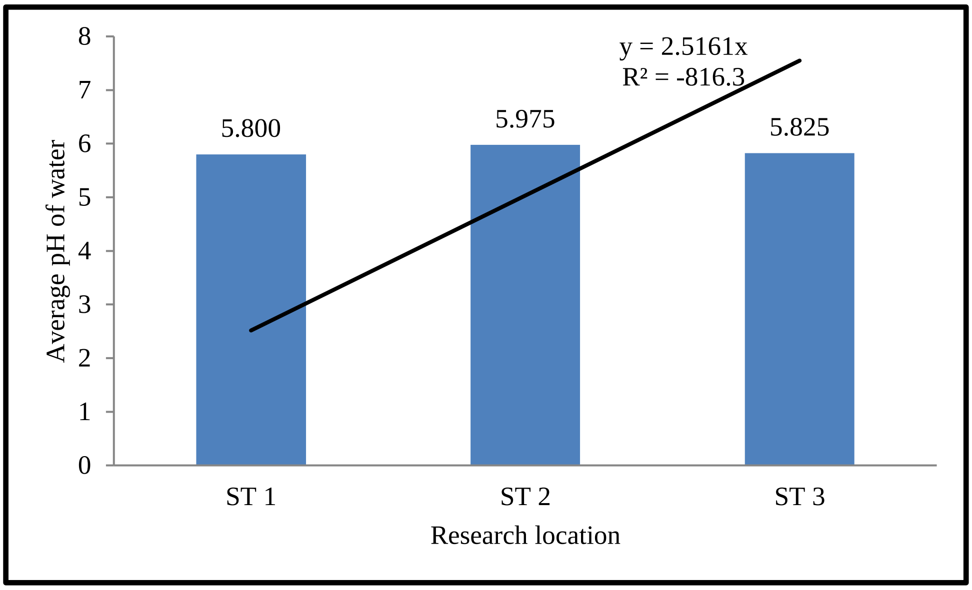

Figure 2. Average pH of water at the research location

Seawater has a very large buffering capacity to prevent pH changes. A slight change in pH from the natural pH will indicate disruption of the buffer system (Putriningtias et al., 2021). The pH of water is one of the chemical parameters that is quite important in monitoring water stability (Simanjuntak, 2009). According to (Wulandari et al., 2015), every marine biota requires certain pH conditions for its survival, without exception. According to (Dojlido and Best, 1993), the pH of seawater is relatively more stable and is usually in the range of 7.5–8.4, except near the coast. Odum (1971) stated that the pH value between 6.5–8.0 is the safe limit of water pH for the life of biota in it. The ideal pH value for water is 7–8.5. Water conditions that are very alkaline or very acidic will endanger the survival of organisms because they will interfere with the metabolism and respiration processes (Hamuna et al., 2018). A slight change in pH from the natural pH will indicate disruption of the buffer system (Putriningtias et al., 2021). This can cause changes and imbalances in CO_2 levels that can endanger the lives of marine biota (Amiluddin, 2007). In addition, the high pH value greatly determines the dominance of phytoplankton, which affects the level of primary productivity of a body of water where the presence of phytoplankton is supported by the availability of nutrients in seawater (Megawati et al., 2014). The high and low pH values in seawater affect the concentration of heavy metals. This is reinforced by (Juharna et al., 2022), who stated that pH conditions in waters affect the solubility of metals in water. The low pH value in waters causes the solubility of heavy metals to increase, thus increasing toxicity (Kusumadiani et al., 2024). Which forms bonds with particles in the water body until they precipitate (Rezki et al., 2013). Cd absorption is influenced by pH and the strength of ions and cations that can change (Bradl, 2005).

Salinity of Waters (ppt)

Figure 3 shows that the seawater salinity at the research location was highest at ST 3 and lowest at ST 2. The average salinity at the research location was still considered suitable for the life of aquatic organisms, namely in the salinity range of 32.25–34.25 ppt.

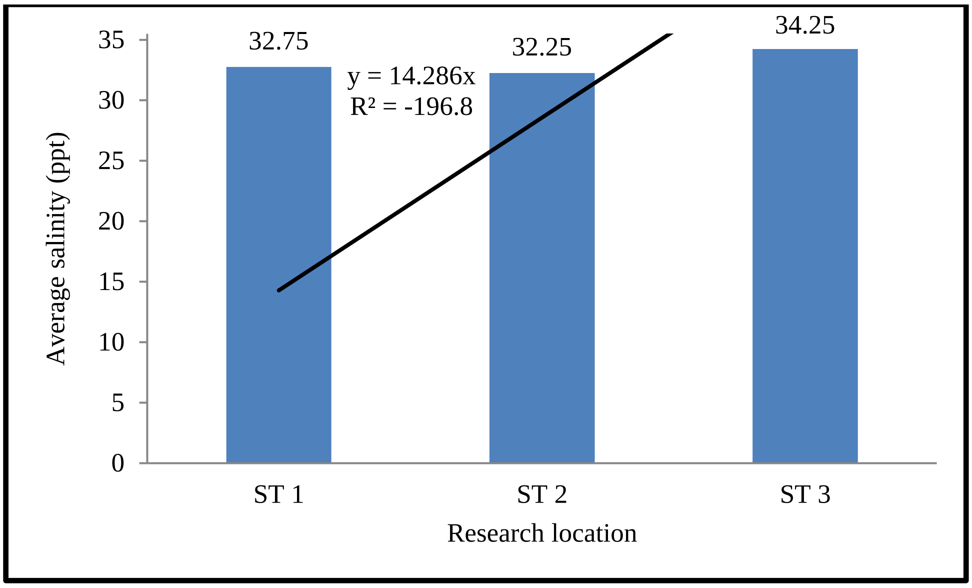

Figure 3. Average salinity of waters at the research location

Hutabarat and Evans (1984) stated that the estuary area is an area where the salinity level decreases due to the influence of incoming fresh water and also due to the occurrence of ebb and flow in the area. The diversity of salinity in seawater will affect aquatic organisms based on the ability to control specific gravity and diversity of osmotic pressure. In addition, each marine biota has a different tolerance range for salinity, so salinity is one of the important factors that influences the survival and growth of biota (Putriningtias et al., 2021). According to Kadi and Atmadja (2006), a good salinity range for marine biota in tropical areas is in the range of 32–34 ppt water salinity. In general, the average surface waters of Indonesia range from 32–34 ppt (Dahuri et al., 1996).

Cadmium (Cd) content of sea water

The cadmium content of the research location can be seen in Table 1. Table 1 shows that the cadmium content at the research location for all research locations is <0.003 ppm.

Table 1. Cadmium (Cd) content of sea water at the research location

Research Location	Parameter	Unit	Test Results	Method specifications
ST 1	Cadmium (Cd)	ppm	< 0.003	SM APHA 23rd Ed. 3113 B. 2017
ST 2	Cadmium (Cd)	ppm	< 0.003	SM APHA 23rd Ed. 3113 B. 2017
ST 3	Cadmium (Cd)	ppm	< 0.003	SM APHA 23rd Ed. 3113 B. 2017

For the three research locations, all are still in the good category and have not been contaminated by the heavy metal cadmium (Cd). Polapa et al. (2022) explained that heavy metals in the aquatic environment can come from natural sources and anthropogenic activities. Natural sources are produced from direct atmospheric input and geological weathering, while anthropogenic activities are produced from agricultural, residential, municipal, and industrial waste products. Based on the research results of (Dewi et al., 2018), the levels of cadmium metal found in river estuaries can be caused by mining activities, ports, and ship activities around river estuaries. However, this study shows that the research location has not been contaminated with cadmium metal even though it is located around tourism, near residential areas, and there are small rivers around it.

CONCLUSION

The water quality measured during the study showed that the average water quality such as the temperature and salinity of the waters was still classified as good and suitable for the life of aquatic organisms, except that the pH of the waters was still classified as low due to the measurement being carried out during the rainy season. Furthermore, the results of cadmium measurements for the three research locations showed that the three locations were not contaminated with the heavy metal cadmium.

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