Analysis of total suspended solids in Lampuuk-Lhoknga Beach Waters, Aceh Besar, Indonesia

Ichsan Setiawan[1*], *Yopi* Ilhamsyah[1], *Vieriz* Andriy Fitrada[1], *Muhammad* Haiqal[1], and *Syarifah* Meurah Yuni[2]

[1]Marine Sciences Department, Faculty of Marine and Fisheries Universitas Syiah Kuala Banda Aceh 23111, Indonesia
[2]Mathematics Department, Faculty of Mathematics and Natural Sciences Universitas Syiah Kuala Banda Aceh 23111, Indonesia

Abstract. Research on total suspended solids in the waters of Lampuuk-Lhoknga Beach, Aceh Besar was conducted on March 16, 2023. Lampuuk-Lhoknga Beach is a beach that has high activity that affects the concentration level of total suspended solids which becomes a problem for waters if the concentration level is high. This study aims to analyze and calculate the concentration of total suspended solids in the waters of Lampuuk-Lhoknga Beach. This study used purposive sampling method by taking beach water samples from several predetermined stations. Water samples that have been taken are analyzed using the gravimetric method. Based on the results of the study, the concentration of total suspended solids at 10 stations (the northernmost, Station 1 to the southernmost, Station 10) ranged from 100 mg/l to 1500 mg/l. The lowest concentration result was found at Station 4 near the cliff, which was 100 mg/l, while the highest result was found at Station 5 near tourism activities, which was 1500 mg/l. The high concentration of total suspended solids is thought to be caused by high human activity in all fields ranging from marine tourism, culinary areas to industrial areas.

1 Introduction

Indonesia is located between two continents and two oceans which makes Indonesia a dynamic country, both economically and politically. Indonesia's geographical location flanked by two continents and two oceans also makes Indonesia a strategic area, especially in marine potential. This can be seen from Indonesia's vast sea area [1]. Indonesia has a vast marine area, almost 70% of Indonesia's territory is oceanic, Indonesia also has abundant biological and non-biological resources. Because of this, Indonesia is given the status of being one of the countries in the world that has high marine biodiversity [2].

Lampuuk-Lhoknga waters as one of the coastal areas is an area filled with various human activities, especially in the field of tourism, the impact of these various activities has a direct effect on water quality on the beach, one of which is the increase in Total Suspended Solids (TSS) content. Coastal areas are dynamic, unique, and vulnerable to environmental change.

*Corresponding author: ichsansetiawan@usk.ac.id

Water quality is essential for all living things [3]. Therefore, water resources must be protected so that they can be utilized by humans and other living things properly. Utilization of water resources for the benefit of all living things must be done wisely for the benefit of current and future generations [4].

TSS is one of the water quality parameters used to measure the concentration of solid particles contained in surface water. TSS concentration can provide important information about water quality and can be an indicator of water pollution. Therefore, TSS analysis is very important in water resources management. TSS is a place where heterogeneous reactions will take place, heterogeneous reactions themselves will serve as the starting material for the formation of sediment and can hinder the ability to produce organic substances in a water body [5]. According to Wirasatriya [6] High TSS can cause other things such as reducing the photosynthetic activity of marine plants, both micro and macro, causing the oxygen content released by marine plants to decrease and causing fish to die. Increased TSS content causes turbidity that can inhibit the entry of sunlight into the water column. The lack of sunlight intensity that enters the water causes the high TSS that occurs in Lampuuk-Lhoknga waters to inhibit phytoplankton growth. TSS concentration can indicate the condition of sedimentation in a water body [7]. Waters that have high TSS concentrations tend to experience high sedimentation as well. TSS is suspended solid material with a diameter of > 1 μm that is retained by a millipore sieve with a pore diameter size of 0.45m. TSS consists of mud and fine sand as well as microorganisms.

The main cause of TSS in waters is soil erosion or soil erosion that is carried into water bodies [8]. To measure the amount and distribution of suspended matter in water bodies, TSS analysis is used. The range of TSS can indicate whether there is sedimentation in the water [7]. Waters with high TSS concentrations often have high sedimentation rates. Siswanto [9] claims that areas with significant sedimentation rates are areas such as estuaries and coastlines that have high amounts of TSS. The pattern of sedimentation that takes place is influenced by current patterns in coastal waters and estuaries [10]. The distribution of TSS can be significantly influenced by the tidal range [11]. The distribution of TSS can be used to evaluate the degree of sedimentation in an area.

Lampuuk-Lhoknga Beach is a tourist beach that is one of the factors in the movement of the regional economy. Good beach tourism is good tourism in all respects ranging from management, access, cleanliness, and others. Water quality is included in beach cleanliness. Water quality management and water pollution control which includes chemical parameters (temperature and TSS), and microbiological parameters (total coliform bacteria). Determination of water quality status using the pollution index method compared to PP No. 822/2001 water quality standards.

This study aims to analyze and determine the concentration of TSS in the surface waters of Lampuuk-Lhoknga beach. Later the results of this study are expected to provide information that can be used as a basic source and input material for further research and can determine the quality of water in the Lampuuk-Lhoknga Waters which affects the water so that it inhibits living conditions in the waters will be disrupted.

2 Research methods

This research was conducted in the waters of the Lampuuk Beach and Lhoknga Beach tourist areas, Lhoknga District, Aceh Besar Regency, Aceh Province.

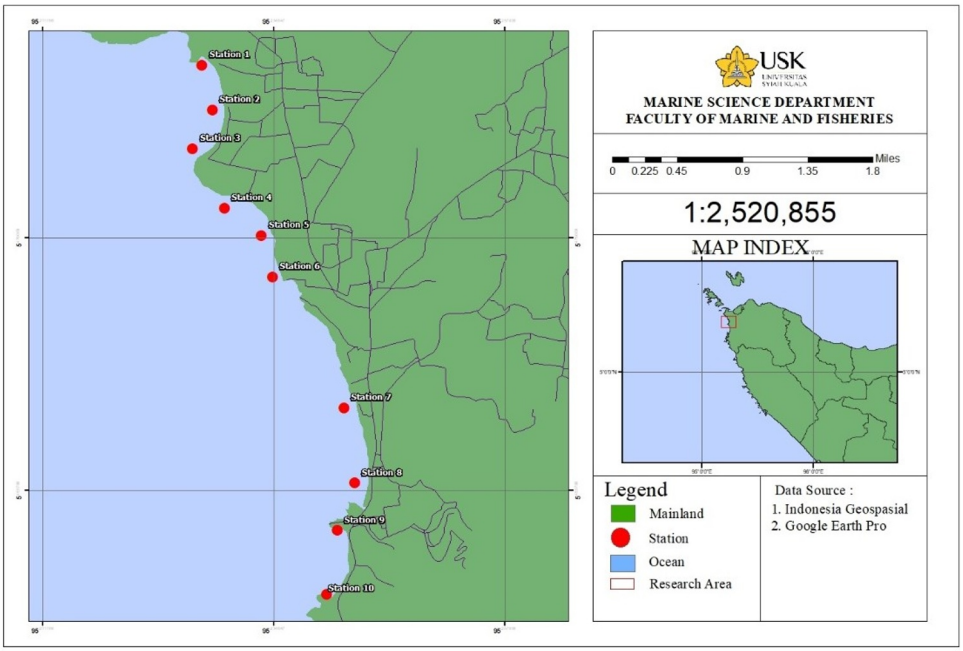

Fig. 1. Research Location Map.

2.1 Location point determination

Determination of sampling station points in the Lampuuk-Lhoknga Beach Waters area (Figure 1). Determined as many as 10 research stations taken along the coastline of Lampuuk Beach and Lhoknga Beach. Determination of the research location point is based on differences in beach management, the number of tourist visit to the beach, and uniqueness of different locations.

2.2 Water sampling and analysis

Water sampling was carried out using a 1 liter sample bottle with a depth of ± 1 meter from the water surface. Furthermore, the filled sample bottle is inserted into the coolbox [2]. Analysis of TSS samples using the Gravimetric method, where samples are filtered using filter paper. The filter paper used is Whatmann filter size 1.25µm, before use the filter paper must first be weighed to get its weight, the water sample must first be homogenized before filtering, the volume of sample water tested is 500 ml at each station. Filter paper that has been used to filter 500 ml of sample water is then heated using an oven at 105°C for 1 hour, then the filter paper is cooled in a desiccator then weighed and recorded the results. To determine the distribution of TSS values, the samples obtained were analyzed using the formula according to the Badan Standarisasi Nasional (2004) SNI 06-6989.3-2004 [12]:

$$TSS\ \left(\frac{mg}{l}\right) = \frac{(A-B)x1000}{v}$$

Description:
TSS = Total Suspended Solids (mg/l)
A = weight of filter paper + dry residue (mg)
B = weight of filter paper (mg)
V = sample volume (ml)

3 Results and discussions

TSS is the residue of total solids retained in the filter with a particle size of no more than 2µm. Materials such as bacteria, fungi, algae, clay, mud, sulfides, and metal oxides are materials included in TSS. These materials, which function as the earliest sediment-forming materials that can hinder the ability to produce organic substances in a water body, make these materials a place where heterogeneous reactions take place. The increase in TSS is caused by several things such as mangrove logging activities, sand mining, high wave phenomena, tides, industrial waste, and all other human activities.

The amount of TSS concentration in the waters also shows the sedimentation conditions in the waters. Usually, flocculation and filtration lead to TSS removal. TSS contributes to turbidity reduction by increasing light penetration for photosynthesis and air visibility. This means that turbidity values cannot be converted into TSS values. Turbidity is the shape change required to display light. Instead, scattering is produced using suspended particles found within the sample. Turbidity is an optically murky concept. Due to changes in the size and shape of particles and materials, the color and intensity will change. TSS is always measured as dry weight and the drying procedure must be observed to avoid errors caused by retained moisture. This makes TSS one of the most important physical indicators in determining or seeing the condition of waters and coastal environments. In addition, TSS is often used as an early indicator to determine the physical changes that occur in an environment.

Measurement of TSS concentration levels can be done directly or indirectly. Direct measurements are measurements using the gravimetric method or measurement of water content, this method is the most common method used to measure the concentration of TSS. While indirect measurements can be used through worldview 3 satellite imagery or other remote sensing.

The principle of TSS analysis is as follows:

The homogeneous test sample is filtered with filter paper measuring 0.7µm-1.5µm in accordance with the National Standardization Agency, then the residue retained on the filter paper is dried at 103°C to 105°C using an oven for 1 hour, the increase in the weight of the filter paper is the TSS residue in the test volume. In this trial, the author used 500 ml of seawater from each station as the test volume.

Table 1. TSS results.

No	Research Station	TSS Concentration (mg/l)
1	Station 1	280
2	Station 2	600
3	Station 3	500
4	Station 4	100
5	Station 5	1500
6	Station 6	1240
7	Station 7	360
8	Station 8	280
9	Station 9	280
10	Station 10	840

TSS concentration levels at 10 stations are very high values in Table 1, because according to Ministerial Decree. No.51/MENKLH/2004 [13], the quality standard TSS value set for marine tourism is 20 mg/l. At Stations 1, 2, 3, which are located in the Lampuuk beach tourism area ranging from 280 mg/l to 500 mg/l, the thing that causes TSS levels at the

sampling location point at this station is high is tourist activities such as culinary areas, restaurant waste, and pollution from motorized vehicles such as boats, jetski, and others. At Stations 5, 6, which are located in the bathing area and the Lhoknga culinary area, are the location points with the highest TSS content values in the range of 1500 mg/l to 1240 mg/l, apart from the high human activity at this location, the flow of the Krueng Raba tributary which empties into the Lhoknga beach which can carry mud, sand and other materials from the mainland to the coastal waters, especially in seasons with high rainfall. At Stations 8 and 9 are the closest collection location points to the industrial area has a concentration of 280 mg / l, this is a high level for industrial areas, because according to the Ministerial Decree. No P.16 / MENLHK / SETJEN / KUM. 1/4/2019 [13] the wastewater quality standard is 50 mg/l. While the lowest TSS levels are found at the point of Station 4 collection location with a TSS concentration of 100 mg/l, this is because at the point of Station 4 collection location is a location that is minimal with human activity because the location is far from the rural road to the beach is the thing that causes this location to be minimal activity. However, the level or concentration of TSS at the Station 4 collection point is still very high from the quality standard set by Ministerial Decree.No.51/MENKLH/2004 which is 20 mg/l, this is because at this location there is still a flow from the river mouth which causes sediment or other materials to be carried into coastal waters.

There are other things that cause high TSS concentration levels such as particles suspended in water, these particles can be inorganic particles such as detritus and organic particles such as living components such as phytoplankton, zooplankton, bacteria, fungi, benthos, and others. Apart from being influenced by materials originating from land, the concentration of TSS in marine waters also comes from air and displacement of suspended sediment from erosion.

The high concentration of TSS in the waters along the Lampuuk-Lhoknga coastline indicates that the water quality in the area is poor. Due to the production of organic compounds in water may be inhibited by suspended particles, which are the first materials to form deposits and the site of heterogeneous chemical reactions. Therefore, the higher the content of TSS in the water, it will block the entry of sunlight into the water, so that it will interfere with the photosynthesis process or photosynthesis does not take place perfectly which will cause a decrease in dissolved oxygen levels released into the water. If dissolved oxygen levels in a body of water are low, it causes many negative impacts on the waters, one of which is that aquatic biota cannot respire so that it can cause death. Ecosystem balance will be disrupted if there is mass death in aquatic biota. Low dissolved oxygen levels will also cause a foul odor in a body of water.

Therefore, the less content of TSS in a water body will have a good impact on the life of the surrounding ecosystem. Not only does it have an impact on the disturbance of marine biota life, increasing high levels of TSS on an ongoing basis also has a direct effect on changing the depth of a body of water for a long time. In addition, the rapid distribution of TSS will continue to have an impact on changes in suspended sediment deposition along the coast, as it will lead to constant sedimentation and land development of land areas resulting from high levels of sedimentation. Based on the results obtained, the high level of TSS concentration in the waters of Lampuuk-Lhoknga Beach makes these waters polluted, this is supported by previous research by Khairunna et al. [14] where TSS shows that the value obtained does not exceed the specified threshold with a range of values of 4 mg/l to 14 mg/l, so this value does not exceed the threshold determined by KEPMEN LH 51 of 2004 with a value of 80 mg/l. The BOD_5 value obtained did not exceed the KEPMEN LH 51 Year 2004 threshold and the range of values obtained from this study from the lowest to the highest was 0.8 mg/l to 2.3 mg/l. While the range of TSS concentrations in the waters of Lampuuk-Lhoknga Beach exceeds the established limit.

4 Conclusion

The concentration of TSS levels at the 10 stations ranged from 100-1500 mg/l with a test volume of 500 ml of water. The lowest concentration result is found at Station 4 which is 100 mg/l, while the highest result is found at Station 5 which is 1500 mg/l. The results of TSS concentration levels at 10 stations are high levels because the value of 10 stations that have exceeded the TSS quality standard based on Kepmen. No.51/MENKLH/2004 which is 20 mg/l for marine tourism and Kepmen. No. P.16/MENLHK/SETJEN/KUM. 1/4/2019 for waste.

Acknowledgments

Authors express gratitude to the Research and Community Service Institute of Universitas Syiah Kuala for financial assistance under Grants for *Lektor Kepala* in 2023, with contract number: 145/UN11.2.1/PT.01.03/PNBP/2023.

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