JURNAL PERIKANAN DAN KELAUTAN
Volume 28 No. 3, October 2023: 420-427

e-issn : 2721-8902
p-issn : 0853-7607

Analysis of the Distribution of Suspended Sediments at High and Low Tides in Nambo Coastal Waters, Kendari City

Analisis Distribusi Sedimen Tersuspensi pada Saat Pasang dan Surut di Perairan Pantai Nambo Kota Kendari

Hasmawati[1], Irawati[1*], Syamsul Razak Haraty[1]
[1]*Department of Geophysical Engineering, Faculty of Mathematics and Natural Sciences, Halu Oleo University, Kendari 93232 Indonesia*
**email: irawatigeophysics@uho.ac.id*

Received
12 July 2023

Accepted
25 October 2023

Abstract

This research aims to determine the concentration of TSS distribution water quality characteristics and map the distribution of TSS in the waters of Nambo Beach. Determination of research stations used a purposive sampling method consisting of 7 stations. Water samples were taken at high tide and low tide using sample bottles. The method used in this research is a quantitative method and laboratory analysis to determine the TSS value. The method used to analyze TSS samples is the gravimetric method. The research results show that the distribution of TSS at high tide ranges between 21.80-122.00 mg/L, with the highest TSS value at stations 1-2, while the lowest value is at station 4, namely 21.80 mg/L. The TSS value at low tide ranges from 13.20-19.90 mg/L.

Keywords: Gravimetry, Nambo Beach, Total Suspended Solid

Abstrak

Penelitian ini bertujuan untuk menentukan konsentrasi sebaran TSS, karakteristik kualitas air, serta memetakan sebaran TSS di perairan Pantai Nambo. Penentuan stasiun penelitian menggunakan metode *purposive sampling* yang terdiri dari 7 stasiun. Pengambilan sampel air dilakukan pada saat pasang dan surut air laut dengan menggunakan botol sampel. Metode yang digunakan dalam penelitian ini adalah metode kuantitatif dan analisis laboratorium untuk mengetahui nilai TSS. Metode yang digunakan untuk menganalisis sampel TSS yaitu metode Gravimetri. Hasil penelitian menunjukkan bahwa sebaran TSS pada saat pasang berkisar antara 21,80-122,00 mg/L dengan nilai TSS paling tinggi di stasiun 1-2 Sedangkan nilai terendah berada pada stasiun 4 yaitu 21,80 mg/L. Nilai TSS pada saat surut berkisar antara 13,20-19,90 mg/L.

Kata kunci: Gravimetri, Pantai Nambo, *Total Suspended Solid*

1. Introduction

Total Suspended Solid (TSS) are suspended materials (>1 µm in diameter) retained on a millipore filter with a pore diameter of 0.45 µm. Suspended sediment (TSS) consists of mud, fine sand, and microorganisms, mainly caused by soil erosion or soil erosion carried into water bodies. Water conditions with high turbidity will impact the survival of the aquatic biota that live in it and disrupt marine transportation activities in the surrounding area (Damayanti & Hernawan, 2014).

Based on research conducted by Winnarsih (2016) in the waters of Kendari Bay, it is stated that an increase in suspended sediment will increase turbidity, inhibiting the penetration of sunlight into the water column. The lack of intensity of sunlight entering the waters due to high TSS will inhibit the growth of phytoplankton. This TSS can also hurt aquatic ecosystems, fishermen's catches, and other potential such as fish farming activities (Winnarsih et al., 2016). According to the Decree of the State Minister for the Environment Number 51 of 2004 concerning Sea Water Quality Standards, the maximum TSS level in marine tourism water is 20 mg/L (Kepmen, LH, 2004).

Tides, waves, river flow, wind, and currents along the coast determine the distribution of suspended loads entering the sea (Setyawan, 2016). Tides have an essential influence on sediment transport in waters because they can generate currents, which are the movement of water masses that carry suspended sediment material (Wibowo et al., 2016). Based on research conducted by Setyawan (2016), it is stated that the level of suspended sediment concentration is influenced by current speed and river flow, which is the source of land sediment loads entering the sea (Setyawan, 2016). This research aims to determine the concentration of TSS distribution, determine water quality characteristics, and map TSS in the waters of Nambo Beach.

2. Material and Method

2.1. Time and Place

This research was conducted in Nambo Beach, Abeli District, Kendari City, Southeast Sulawesi, on July 24, 2022 (Figure 1). Sampling was carried out at seven stations representing the entire research area. The water quality parameters measured include temperature, salinity, pH, brightness, and TSS (Total Suspended Solid). Sample measurements were conducted in situ (directly in the field) and analyzed in the Bimolecular and Environment Laboratory, Faculty of Mathematics and Natural Sciences, Halu Oleo University.

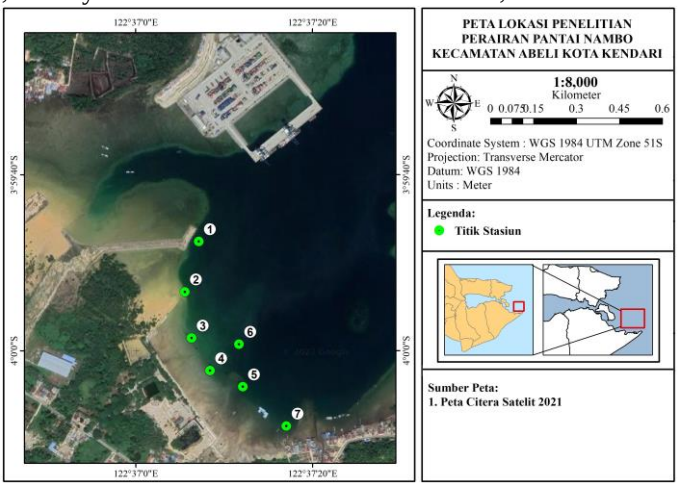

Figure 1. Research location

2.2. Methods

The water samples were then taken to the Biomolecular and Environmental Laboratory, FMIPA, Halu Oleo University for TSS concentration analysis. The sample and equation analysis method follows the Indonesian National Standard (SNI) No. 06-6989.3-2004 concerning how to test total suspended solids gravimetrically.

2.3. Procedure

This Sampling was carried out in the waters of Nambo Beach at seven sampling points. The samples in this study were water samples taken for one day, namely at high tide and low tide, using a bottle by inserting it into the water at a depth of 50 cm with the bottle cap open and then pulling it up with your fingers to close the bottle cap. Hold the water sample taken so that it does not come out. The volume of the water sample taken was 600 mL, then placed in an ice box to maintain the durability of the sample and taken to the laboratory for TSS analysis.

Large particles that float in the sample are separated first. The sample bottle is shaken so that the sample water remains integrated with the solid particles and avoids solid particles sticking to the walls of the sample

bottle. Whatman filter paper is weighed on an analytical scale before the sample is filtered; record the weight of the filter paper. Then, the filter paper is placed on top of the measuring cup, and the filter paper is moistened with a bit of distilled water to mineralize the filter paper before pouring in the sample water slowly pour in the sample water. After the suspended solids are filtered through the Whatman filter paper, the filter paper containing the suspended solids is put into the oven. at a temperature of 103°C to 105°C for 1 hour. After the drying process in the oven is complete, the sample is cooled in a desiccator and then weighed on an analytical balance until a constant weight is obtained or until the weight change is smaller than 4% compared to the previous weighing or smaller than 0.5 mg.

Perfect filtration takes more than 10 minutes, and the filtration process takes too long; replace the filter paper with a larger diameter or reduce the sample volume. Measure the sample volume, which produces a residue dry weight of 2.5 mg to 200 mg. The filtered volume does not meet the minimum results, so increase the sample volume to 1000 ml. TSS calculations (SNI, 2004) are based on equation (1)

2.3. Data Analysis

The data obtained was tabulated and processed using Microsoft Excel software, then described in tables and graphs, while to obtain a TSS distribution map, it was processed using ArcGIS software and then analyzed descriptively. The TSS value of water can be determined using the gravimetric method. The gravimetric method examines the amount of substance by weighing the results of the precipitation reaction (Fatimah & Wildian, 2014). To calculate Total Suspended Solid (TSS), use a formula based on Indonesian National Standard (SNI) No. 06-6989.3-2004 as follows:

$$\text{TSS (mg/L)} = \frac{(A-B)}{V} \times 1000 \qquad (1)$$

Information:

A = Weight of filter paper+dry residue (mg).
B = Filter paper weight (mg).
V = Test volume (L)

3. Result and Discussion

3.1. Hydro-Oceanographic Condition in Nambo Beach Water

Oceanographic factors influence the condition of the waters at Nambo Beach. Based on the results of in situ and laboratory analysis, oceanographic parameter values were obtained for each station, which can be seen in Table 1 and Table 2

Table 1. Values of physico-chemical parameters of water at tide

station	Temperature (°C)	Salinity (ppt)	Speed. Current (m/s)	Brightness (m)	pH	Light intensity (lux)	TSS (mg/L)
1	28	30	0.055	1.0	8.1	7498	110.00
2	29	30.1	0.070	0.9	8.2	6782	122.00
3	29	30.1	0.091	1.7	8.6	2969	43.15
4	29.6	30.6	0.060	2.5	8.2	4846	21.80
5	29	30	0.044	2.5	8.1	5060	89.70
6	28.3	27	0.055	1.3	8.3	5425	66.80
7	29.3	21	0.075	1.6	8.7	6651	38.70
Average	28.9	28.4	0.064	1.6	8.3	5604	70.3

Table 2.Values of physico-chemical parameters of water at low tide

station	Temperature (°C)	Salinity (ppt)	District Current (m/s)	Brightness (m)	pH	Light intensity (lux)	TSS (mg/L)
1	29.6	23.3	0.11	0.8	8.8	244	19.90
2	30	22.3	0.33	0.8	8.8	330	13.20
3	28.5	26.3	0.14	1.5	8.9	156	15.90
4	28	25	0.16	1.8	8.8	126	16.50
5	29	27	0.18	1,2	8.8	110	18.70
6	27	22.3	0.19	2,2	8.6	96	17.40
7	27	22	0.24	0.8	8.6	80	19.60
Average	28.4	24.0	0.19	1.3	8.8	163	17.3

3.2. Total Suspended Solid (TSS) Value and Distribution

The results of TSS measurements in the waters of Nambo Beach can be seen in Figure 2. Figure 2 shows that the TSS concentration at high tide ranges between 21.80-122.00 mg/L. The TSS value at low tide ranges from 13.20-19.90 mg/L. The distribution of TSS values in the waters of Nambo Beach tends to be higher at high tide (Figure 3) than at low tide (Figure 4). The distribution of TSS at high tide has the highest value at stations 1 and

2 with values of 122.00 mg/L and 110.00 mg/L, while at low tide, it has the highest value at stations 1 and 7, namely around 19.90 mg/L and 19.60 mg/L. The tendency for high suspended sediment at stations 1 and 2 is thought to be due to the station's location being close to land, which is the leading cause because the sediment originating from land enters the sea through the river estuary around the research location. The speed of the current carrying the suspended sediment material can also influence the distribution of suspended sediment. In general, the TSS value at the time of tide has exceeded the quality standard value. Based on the Minister of Environment No. 51 Decree of 2004 concerning seawater quality standards, the maximum level of TSS in water for marine tourism is 20 mg/L.

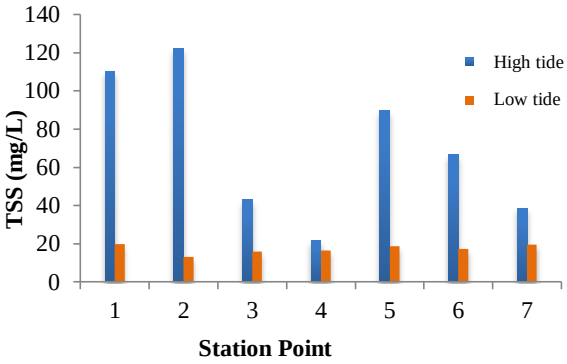

Figure 2. TSS graph at high and low tide

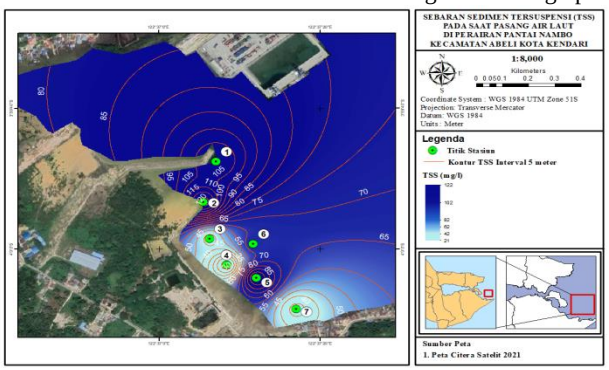

Figure 3. Distribution of suspended sediment at high tide

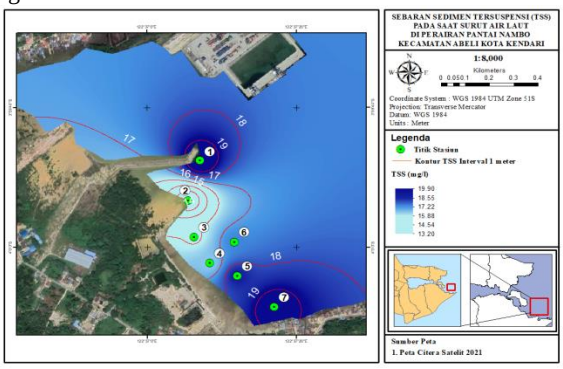

Figure 4. Distribution of suspended sediment at low tide

3.3. Water Quality Parameters

Water parameters are factors that influence the quality of water. The following are the physico-chemical water parameters measured in the waters of Nambo Beach:

3.3.1. Temperature

Water temperature is a significant factor in the life of organisms in water (Hamuna et al., 2018). Many factors, including solar radiation, geographic location of waters, current circulation, sea depth, and wind, influence the condition of seawater temperature in waters (Prakoso, 2016). The results of temperature measurements in the waters of Nambo Beach can be seen in Figure 5.

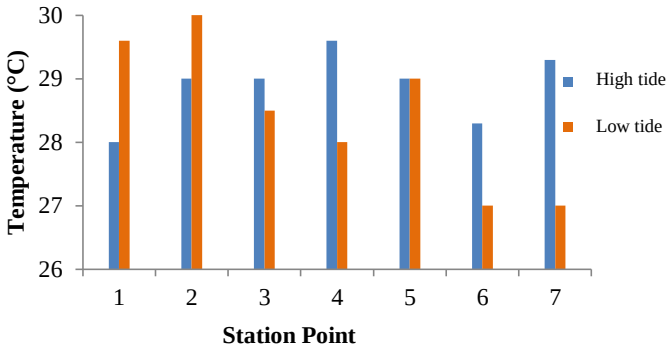

Figure 5. Temperature graph at high and low tide

Based on Figure 5, the temperature value at high tide ranges between 28- 29.6°C with the highest value at station 4, namely 29.6°C and the lowest at station 1, namely 28°C. At low tide, the temperature value ranges

between 27-30°C with the highest value being at station 1, namely 29.6°C and the lowest at stations 6 and 7, namely 27°C. The temperature quality standards in waters have been determined by KEPMENLH No. 51 of 2004 for marine tourism is 20°C.

The high-temperature value in the research area occurred because the measurements were carried out during the day, so there was the influence of solar radiation. The temperature in these waters is almost the same because the temperature at the sea surface is homogeneous. The decrease in temperature is directly proportional to the increase in depth and salinity. This is called the thermocline layer in areas where the temperature decreases rapidly. In general, the formation of the thermocline layer is due to the absorption of sunlight during the day by the sea surface. The heat at the surface of the seawater is distributed to the interior to a depth of 100-200 m (called the mixed layer) so that the temperature in this zone is relatively homogeneous. The thermocline layer is a layer in the water column in the sea where this layer experiences drastic temperature changes with the layers located below the thermocline layer (Iskandarsyah, 2011).

3.3.2. Salinity

Salinity is the overall concentration of salt solutions contained in water. According to Sumarno (2013), water salinity values are greatly influenced by the supply of fresh water to seawater, rainfall, seasons, topography, and evaporation. If the salinity level in a body of water is higher, the osmotic pressure will also be more significant. Differences in water salinity values can occur due to several factors, one of which is due to differences in evaporation and precipitation (Ambarwati, 2020). The results of measuring salinity values at field data station points can be seen in Figure 6.

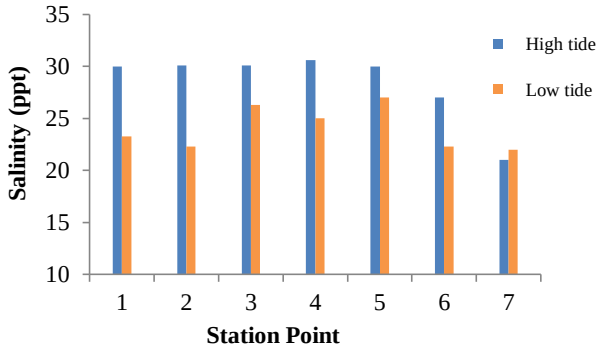

Figure 6. Salinity graph at high and low tide

Figure 6 shows that the salinity value at high tide ranges between 21 - 30.6 ppt, with the highest salinity at station 4, namely 30.6 ppt, and the lowest at station 7, namely 21 ppt. At low tide, the seawater value ranges between 22-27 ppt, with the highest salinity value at station 5, namely 27 ppt, and the lowest at station 7, namely 22 ppt. The low salinity value is caused by influences from land, such as the mixing of freshwater carried by river flows. Meanwhile, the increase in salinity is due to the reduced influence of freshwater input from land (Patty et al., 2018). The sea's salinity distribution is influenced by various factors, such as water circulation patterns, evaporation, rainfall, and river flow (Patty et al., 2019).

3.3.3. Current Speed

Currents are the movement of a mass of water from one place to another in every ocean. Wind gusts and differences in density influence this movement. Several factors can influence ocean currents, including wind, water pressure differences, water density, upwelling, and down welling (Irawan et al., 2018). Many factors influence the state of the aquatic environment, one of which is current speed. The results of measuring the current speed in the waters of Nambo Beach can be seen in Figure 7.

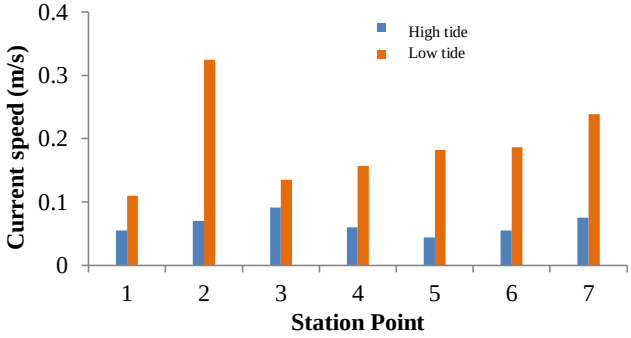

Figure 7. Graph of current speed at high tide and low tide

Based on Figure 7, the results of measuring current speed values at field data station points, we obtained varying current speed values at each station. The current speed value at high tide ranges from 0.044 m/s to 0.091 m/s, with the highest value at station 3, 0.091 m/s, and the lowest at station 5, 0.044 m/s. When sea water recedes, the current speed value ranges from 0.110 to 0.325 m/s, with the highest value at station 2, 0.325 m/s, while the lowest is at station 1, 0.110 m/s. High current speeds can cause high TSS concentrations. The speed of the current can affect TSS because the current can cause sediment to stir at the bottom of the water so that the sediment particles are suspended in the water. Also, the current will carry suspended solids, making the suspended solids load high (Akhrianti et al., 2014).

3.3.4. Brightness

Brightness is a measure of the clarity of water; low water brightness can reduce the photosynthetic ability of plants and affect the physiology of biota (Hasim et al., 2015), but in marine tourism activities, brightness is also a parameter that can determine the value of a tourism's feasibility. Based on the Decree of the State Minister for the Environment No. 51 of 2004, the quality standard value set for marine tourism purposes is >6 m (Kepmen LH, 2004). From the research results, the maximum brightness value obtained was 2.5 m, which is different from the Decree of the Minister of Environment No. 51 2004 standards. The presence of high levels of TSS and turbidity causes this low brightness value. The results of brightness measurements in Nambo coastal waters can be seen in Figure 8.

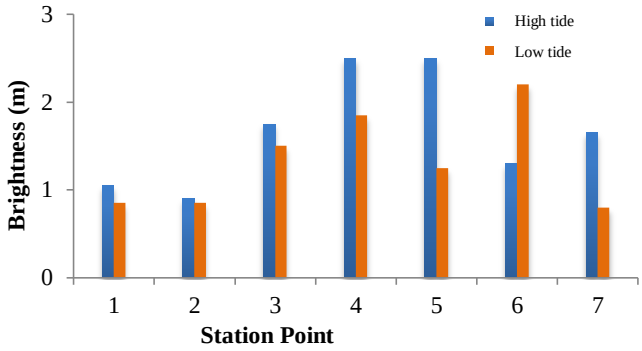

Figure 8. Brightness graph at high and low tide

Figure 8 shows that the brightness value at high tide ranges between 0.9-2.5 m, with the highest value at stations 4 and 5, namely 2.5 m, while the lowest is at stations 2, namely 0.9 m. The brightness value at low tide ranges between 0.8-2.2 m, where the highest brightness value is at station point 6, namely 2.2 m, while the lowest value is at station points 1, 2, and 7, namely 0.8 m. The brightness of the waters is influenced by fine materials floating in the waters, both in the form of organic and inorganic materials. The high brightness value at the research location was caused by very bright conditions at the measurement time. According to Nybakken (2000), the higher the brightness, the greater the intensity of light entering the water (Purba et al., 2018).

3.3.5. Light intensity

Sunlight has a huge role in water quality because light penetration can influence reactions in water (Zahara & Fuadiyah, 2021). The results of measuring the intensity of sunlight in the waters of Nambo Beach can be seen in Figure 9.

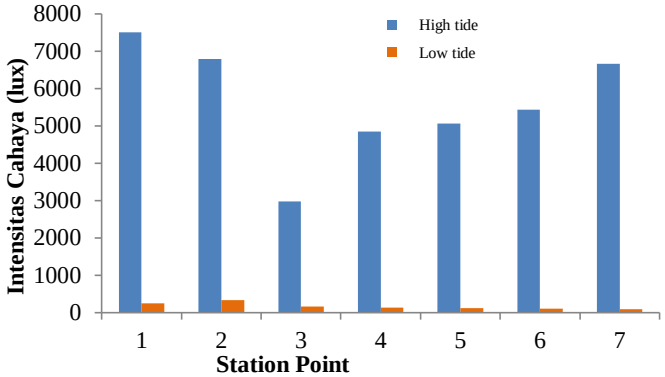

Figure 9. Graph of light intensity at high tide and low tide

Based on Figure 9. It can be seen that the value of sunlight intensity at high tide ranges from 2969-7498 lux, with the highest value being at station 1, namely 7498, while the lowest is at station 3, namely 2969 lux. At low tide, the light intensity value ranges from 80-330 lux, with the highest value at station 2, namely 330, and the

lowest at station 7, namely 80 lux. The high light intensity value at high tide at the research location is because measurements were carried out during the day with sunny weather conditions, while at low tide, the light intensity value was relatively low; because the measurements were carried out in the afternoon. The effect of light intensity during high and low tide can vary depending on geographical location, weather conditions, and other factors related to water level changes (Effendi, 2003).

3.3.6. Degree of Acidity (pH)

The pH value of a body of water is one of the chemical parameters that is quite important in monitoring water stability (Hamuna et al., 2018). Based on the Decree of the State Minister for the Environment No. 51 of 2004, the pH quality standard for marine tourism is 7 - 8.5 (Kepmen LH, 2004).

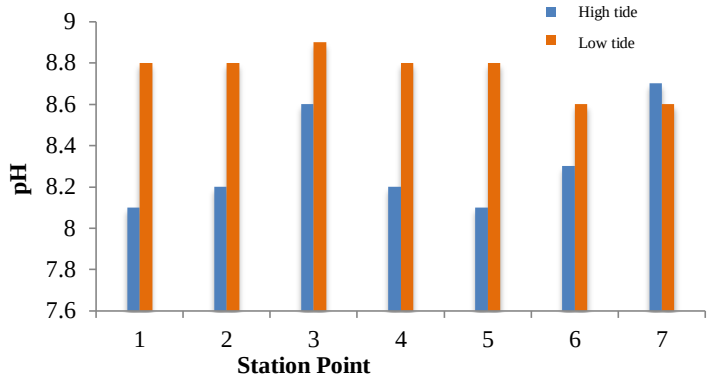

Figure 10. pH graph at high and low tide

One factor influencing water quality is pH or the reaction of acids and bases. Acid and base reactions are one of the parameters for determining water quality. Based on the results of measuring pH values at field data measurement points, pH values showed almost the same trend at each station. The brightness value at high tide ranges from 8.1 to 8.7, while at low tide, it ranges from 8.6 to 8.9. The highest pH value at high tide is at the 7th station point, which is around 8.7, while at low tide; the highest pH value is at the 3rd station point, with a value of 8.9 as in the picture above (Figure 10). In general, the pH of the water in the waters of Nambo Beach is relatively high, so it is alkaline.

4. Conclusions

Based on the objectives of this research, it can be concluded that the distribution concentration of TSS in the waters of Nambo Beach at high tide ranges between 21.80-122.00 mg/L, while at low tide, it ranges from 13.20-19.90 mg/L. Based on the results of in situ analysis obtained, the water quality characteristics of Nambo Beach waters at high tide and low tide vary greatly, including temperatures ranging from27°C-30°C, salinity values ranging from 21 ppt-30.6 ppt, current speed values ranging from 0.044-0.325 m/s, pH values range from 8.1-8.9, and brightness range from 0.8-2.5m. Distribution of TSS in the waters of Nambo Beach tends to be higher at high tide than at low tide.

5. Suggestion

This research is descriptive quantitative research. It is suggested that more research stations are needed to produce better data, and further research is hoped to use additional 3D modeling.

6. References

Akhrianti, I., Bengen, D.G., Setyobudiandi, I. (2014). Distribusi Spasial dan Preferensi Habitat Bivalvia di Pesisir Perairan Kecamatan Simpang Pesak Kabupaten Belitung Timur. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, 6(1): 171-185.

Ambarwati, R. (2020). *Parameter Fisik Kualitas Perairan serta Desa Wates Kecamatan Lekok Pasuruan Jawa Timur*. Program Studi Ilmu Kelautan Fakultas Sains dan Teknologi Universitas Islam Negeri Sunan Ampel. Surabaya.

Damayanti, H.O., Hernawan, U. (2014). Pola Penyebaran Sedimen Tersuspensi Berdasarkan Analisis Debit Maksimum dan Minimum di Muara Sungai Porong, Kabupaten Pasuruan. *Widyariset*, 17(2): 291–302.

Effendi, H. (2003). *Telaah Kualitas Air*. Jurusan Managemen Sumberdaya Perairan. Fakultas Perairan dan Ilmu Kelautan. IPB: Bogor

Fatimah, A., Wildian, H. (2014). Perancangan Alat Ukur TSS (Total Suspended Solid) Air Menggunakan Sensor Serat Optik secara Real Time. *Jurnal Ilmu Fisika (JIF)*, 6(2): 68–73.

Hamuna, B., Tanjung, R.H.R., Maury, H.K., Suwito, S., Alianto, A. (2018). Kajian Kualitas Air Laut dan Indeks Pencemaran Berdasarkan Parameter Fisika-Kimia di Perairan Distrik Depapre, Jayapura. *Jurnal Ilmu Lingkungan*, 16(1): 35–43.

Hasim, H., Koniyo,Y., Kasim, F. (2015). Parameter Fisik Kimia Perairan Danau Limboto sebagai dasar Pengembangan Perikanan Budidaya Air Tawar. *Jurnal Ilmiah Perikanan dan Kelautan*, 3(4): 130-136.

Irawan, S., Fahmi, R., Roziqin, A. (2018). Kondisi Hidro-Oseanografi (Pasang Surut, Arus Laut, dan Gelombang) Perairan Nongsa Bata., *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, 11(1): 56.

Iskandarsyah, M. (2011). *Pemetaan Shadow Zone Akustik dengan Metode Parabolic Equation di Wilayah Perairan Selat Lombok.* Departemen Ilmu dan Teknologi Kelautan Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor. Bogor.

Kepmen LH. (2004). Keputusan Menteri Negara Lingkungan Hidup Nomor 51 Tahun 2004.

Nybakken, J.W. (2000). *Biologi Laut Suatu Pendekatan Ekologi*. PT. Gramedia, Jakarta.

Patty, S.I., Akbar, N. (2018). Kondisi Suhu, Salinitas, pH dan Oksigen Terlarut di Perairan Terumbu Karang Ternate, Tidore dan Sekitarnya. *Jurnal Ilmu Kelautan Kepulauan*, 1(2): 1-10.

Patty, S.I., Rizki, M.P., Rifai, H., Akbar, N. (2019). Kajian Kualitas Air dan Indeks Pencemaran Perairan Laut di Teluk Manado ditinjau dari Parameter Fisika-Kimia Air Laut. *Jurnal Ilmu Kelautan Kepulauan*, 2(2): 1–13.

Prakoso, F.D. (2016). Studi Pola Sebaran Salinitas, Temperatur, dan Arus Perairan Estuari Sungai Wonokromo Surabaya. Jurusan Teknik Kelautan Fakultas Teknologi Kelautan Institut Teknologi Sepuluh Nopember. Surabaya.

Purba, R.H., Mubarak, M., Galib, M. (2018). Sebaran Total Suspended Solid (TSS) di kawasan Muara Sungai Kampar Kabupaten Pelalawan Provinsi Riau. *Jurnal Perikanan dan Kelautan*, 23(1): 21–30.

Setyawan, W.B. (2016). Muatan Sedimen Tersuspensi dan Kualitas Lingkungan Perairan Kendari, Sulawesi Tenggara. *Ilmu Kelautan*, 495–501.

Sumarno, D., Rudi, A. (2013). Kadar Salinitas di Beberapa Sungai yang Bermuara di Teluk Cempi Kabupaten Dompu-Provinsi Nusa Tenggara Barat. *Jurnal Biology Teaching and Learning (BTL)*, 11(2): 75-81.

Wibowo, Y.S.A., Hariadi, H., Marwoto, J. (2016). Pengaruh Arus Laut dan Pasang Surut Terhadap Distribusi Sedimen Tersuspensi di Perairan Muara Sungai Sembilangan Kaliprau Pemalang. *Journal of Oceanography*, 5(4): 490–497.

Winnarsih, W., Emiyarti, E., Afu, L.O.A. (2016). Distribusi Total Suspended Solid Permukaan di Perairan Teluk Kendari. *Jurnal Sapa Laut*, 1(2): 54–59.

Zahara, F., Fuadiyah, S. (2021). Pengaruh Cahaya Matahari terhadap proses Fotosintesis. Prosiding Seminar Nasional Biologi. 1(1) : 1-4.