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SPATIAL AND TEMPORAL VARIATION OF THE TOTAL SUSPENDED SOLID IN THE SOUTH SULAWESI COASTAL WATERS

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ABSTRACT

Suspended solids are the main ingredients forming precipitates that can inhibit the ability to form organic compounds in coastal and marine waters. This study aims to determine the concentration of Total Suspended Solid (TSS) in coastal and marine waters of the west coast of South Sulawesi collected in different seasons, namely October 2017 (dry season) and March 2018 (rainy season). TSS concentrations generally higher in the rainy season (34-47 ppm) compared to the dry season (10-25 ppm). On location, higher TSS concentrations were obtained in the Tallo river waters, namely 10–47 ppm (28.9 ± 13.4 ppm) compared to locations in Pangkep river waters 14–43 ppm (27.4 ± 11.2 ppm). The results showed that the Total Suspended Solid (TSS) in marine waters and still comply with the limit values set by the Ministry of Environment (MOE).

Keywords: Total Suspended Solid, Spermonde Waters

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1. INTRODUCTION

Suspended solids (Total Suspended Solid) are considered as one of the main pollutants that contribute to the decline in water quality[3,6]. Total suspended solids come from all solids (sand, mud, and clay) or particles suspended in water and can be biotic components such as phytoplankton, zooplankton, bacteria, fungi, or abiotic components such as detritus and inorganic particles [4].

Suspended solids are the place where heterogeneous chemical reactions take place, and as the earliest precipitating material, as a result can inhibit the ability of the production of organic substances in a waters[7,17]. Conditions occur because the penetration of sunlight into the surface and deeper parts is not effective, this is due to being blocked by suspended solids, and photosynthesis cannot proceed perfectly[12]. Distribution of suspended solids in the sea is influenced by the supply of input material coming from the land through river flow or from the air as well as material displacement due to the resuspension of sediment due to erosion (erosion)[9,13,18].

River estuary is one of the diverse and highly productive ecosystems [5,15,19]. River estuary as a semi-enclosed coastal area has a direct relationship with the open sea and receives freshwater input from the land through the river system[2]. River water flows carry a number of dissolved and suspended materials. As an area that becomes a meeting of rivers and seas, the river mouth becomes a very dynamic

region, because it is strongly influenced by environmental factors and human activities[16]. Various sources of pollutant particulates which are common in waters include soil erosion, red sludge from aluminum oxide plants, solids from coal washing, clay holes, landfill dredging activities, washing plants and other activities. Iron salts that turn into hydrated iron in seawater are pollutants from red mud from aluminum oxide plants and distillation of mineral sands[9,11,14]. The purpose of the study is analyzing the total concentration of suspended solids based on the spatial and temporal variation in Spermonde waters, as well as its relation to other water quality parameters such as brightness, temperature, dissolved oxygen levels and salinity.

2. METHOD

Water quality is one of the important indicators to determine the fertility level of waters and as an indicator to measure the level of water pollution. Measurements of water quality parameters carried out include: pH, temperature measured with a Protected Reversing Thermometer, and brightness using a Secchi disk with a diameter of 30 cm. The location of this study was conducted in the waters of Spermonde, South Sulawesi. Sampling was carried out during two sea voyages representing the dry season (October, 2017) and the wet season (March, 2018), on the sediment surface layer (0 m). The ten observation stations were determined using GPS (Geographic Positioning System) (Table 1). Samples were taken in the estuary waters of the major rivers namely the Tallo and Pangkep coasts to some of the outer islands (the estuary of the Tallo river, Barrang Lompo island, Bone Tambung island, Langkai island and Kapoposang island) and the Pangkep coast (Pangkep river mouth, Laiya island, Sarappo Keke island, Kondong Bali island and Kapoposang island). Suspended solids were analyzed by the following procedure: Samples of surface water taken by using a 2 liter water sampler then placed in a polyethylene bottle filtered using filter paper Whatman glass fiber filters (GF/F 0.7 µm pore diameter). Filter paper before use is first heated in an oven at 80 ^{o}C for 24 hours [10], then cooled in a desiccator and weighed to a constant weight. Then filter paper that has been used and contains heated residues as above, and weighed. The difference between the weight of filter paper and the residue on the weight of non-residual filter paper is the total content of suspended solids.

Table 1. Observation Station

Water Location Coastal and Sea	Latitude	Longitude
Coastal		
Tallo Makassar estuary (MT)	05.05.42,3	119.26.34,5
The sea		
Barrang Lompo Island (BL)	05.03.32,3	119.21.18,3
Bone Tambung Island (BT)	05.02.16,4	119.17.16,8
Langkai Island (LK)	05.01.44,4	119.06.19,1
Lanyukang Island (LYK)	04.58.44,3	119.05.07,1
Coastal		
Pangkep estuary (MP)	04.49.47,3	119.29.23,5
The sea		
Laiya Island (LY)	04.48.31,9	119.24.30,4
Sarappo Keke Island (SK)	04.48.20,8	119.13.31,2
Kondong Bali Island (KB)	04.43.24,0	119.02.34,4
Kapoposang Island (KPPS)	04.41.13,6	118.57.09,5

3. RESULT AND DISCUSSION 3.1

3.1. Condition of Hydrography Waters

Hydrography conditions (temperature, pH and brightness) in different seasons based on the results of the analysis obtained did not show significant

differences (**Figure** 1). The temperature on the water surface in both seasons is relatively the same as the mean (± standard deviation) of 30.4 ± 0.27 °C in the dry season and 30.3 ± 0.24 °C in the wet season. The average temperature in these waters is optimum because this temperature is good for the growth of phytoplankton and other marine biota. The average pH in the dry and rainy seasons was 7.24 ± 0.2, 7.59 ± 0.3 (**Figure** 2). Based on the results shows the pH value water at sampling area is alkaline. The water pH is tends to be stable and relatively in accordance with the specified quality standards. Significant changes in pH can adversely affect the lives of marine biota. The brightness or transparency of the waters was determined visually using a disc (Secchi disk) averaging 34.65 ± 7.4% in the dry season and 73.56 ± 4.1% in the rainy season (**Figure** 3). The brightness value is strongly influenced by weather conditions, measurement time, turbidity and suspended solids. Based on the results of measurements of hydrography conditions in the estuary waters of the Tallo, Pangkep and marine waters, in general water quality shows the quality or condition of the water that is associated with a particular activity or need.

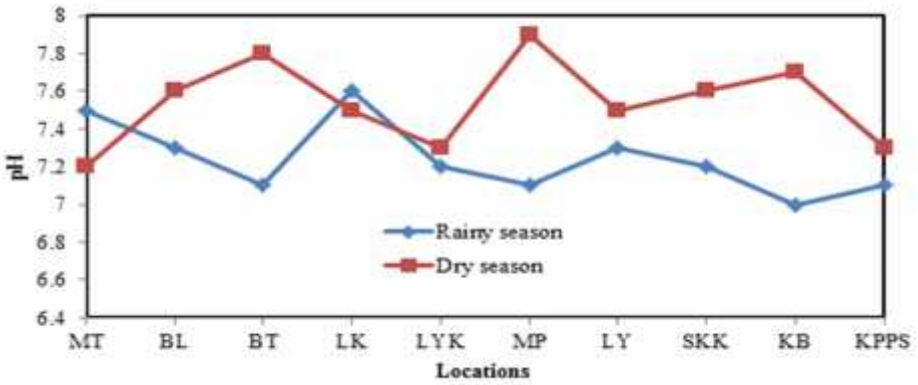

Figure 2 pH of water on the different location

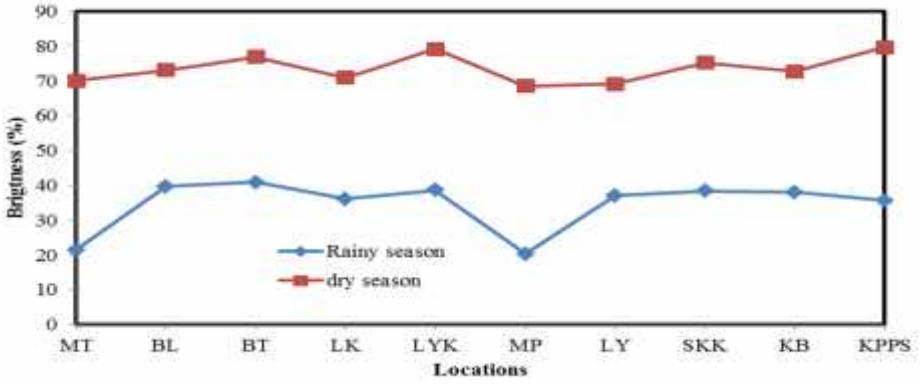

Figure 3. Brightness of Water on the different

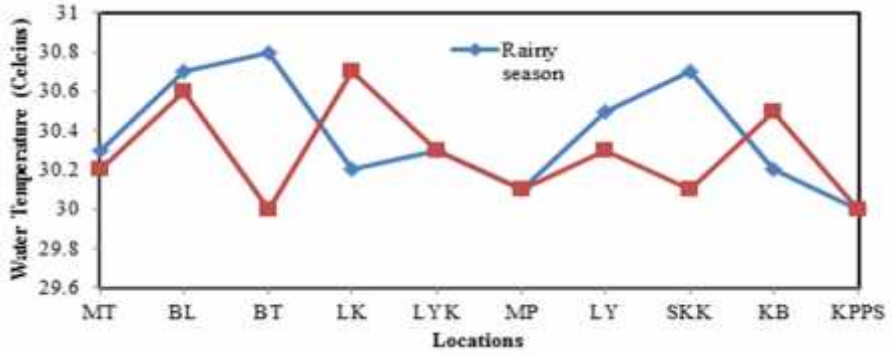

Figure 1. Water temperature on the different

(27.4 ± 11.2 ppm) respectively.

3.2 Total Suspended Solid Concentration

The results of measurements of the total concentration of suspended solids in coastal waters of South Sulawesi are presented in **Figure 3**. The concentration of suspended solids obtained varies between seasons and locations. In all of the two data collection seasons, TSS concentrations in the rainy season (March 2018) were much higher than in the dry season (October 2017). In the rainy season TSS concentrations ranged from 34–47 ppm (39.3 ± 3.7 ppm). Whereas, in the dry season the TSS concentrations ranged is 10-25 ppm (17 ± 4.3 ppm). Furthermore, by location, TSS concentrations in the waters of Makassar and Pangkep to some of the outer islands ranged between 10–47 ppm (28.9 ± 13.4 ppm) and 14–43 ppm

The influence of the seasonal factors and the location of the variation in TSS concentration were quite significant. The role of the season in the distribution of TSS in the waters is quite large, where the greatest concentration of TSS in the waters occurs in the rainy season, this condition occurs because rainwater brings waste and organic waste into the river estuaries of Makassar and Pangkep. This event causes the addition of suspended materials that occur along the river flow.

TSS concentration is inversely proportional to the level of water brightness, the lower the level of suspended solids the higher the level of brightness of the waters. The relationship between TSS and brightness will show a

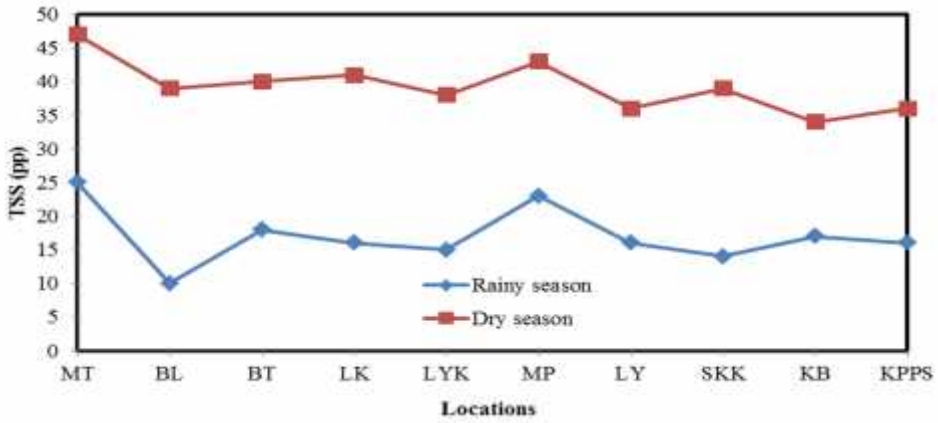

Figure 4. TSS of Water on the different

relationship that is inversely proportional. TSS values are generally lower towards the sea[1]. The level of water brightness can provide clues as to how far the penetration of sunlight penetrates the water column. The high concentration of suspended solids (TSS) in the river mouth indirectly limits the productivity of waters due to particles floating in the water blocking the penetration of sunlight into the water body, so that the heat received by surface sea water is not effective enough for the process photosynthesis[8]. However, it seems the concentration of suspended solids in the waters of Makassar and Pangkep and some of the outer islands have not caused the obstruction of the transfer of energy from the sun to the sea surface so that the solar energy received by sea water is still able to carry out photosynthesis.

TSS concentration in these waters is still in accordance with the threshold value set by the Environment Ministry of Indonesia, namely the quality standard for marine biota such as mangroves, algae and sea grasses. Moreover, it condition is still in accordance with the standard for fisheries and marine park conservation <80 ppm and tourism <23 ppm. The existence of suspended solids can still have a positive impact if it does not exceed the tolerance of the distribution of suspension of water quality standards set by Environment Ministry of Indonesia No. 51 year 2004.

Table 2. Classification of Degrees of Pollution Based on TSS Levels

No.	Total Suspended Solid (mg/L)	Aquatic Status
1.	< 20	not polluted
2.	20-49	light polluted
3.	50-100	medium polluted
4.	> 100	highly polluted

TSS is suspended material or material that is positively correlated with turbidity and is one of the factors causing a decrease in water quality. Classification of water pollution levels based on the content of TSS concentration is presented in Table 2. One of the sources of TSS is input from land and rivers. In the waters of Makassar and Pangkep, the value of TSS measured at the river mouth is higher because it is closer to the mainland. The large number of industrial factories that can dispose of industrial waste at the river at any time becomes a factor in the high concentration of TSS. The concentration of TSS from the estuary to some of the outer islands is decreasing as the distance from the estuary increases towards the sea. However, the concentration of suspended solids in these waters to some of the outer islands seems to have not caused the low level of brightness of sea water. Turbidity in the river is caused by larger suspended materials in the form of a surface layer of soil carried by the flow of water when it rains. In addition, it is also influenced by the stirring of waves to sediments, because the waters of Makassar and Pangkep are estuary waters which contain several rivers that flow into these waters.

4. CONCLUSIONS

This study shows that the parameters of temperature and pH in river and sea estuary waters are relatively normal, not experiencing significant differences. The difference in concentration of Total Suspended Solid (TSS) between Makassar and Pangkep waters is more influenced by the season factor. The highest TSS concentrations were found in the rainy season caused by rainwater carrying waste

and organic waste into the river estuaries of Makassar and Pangkep. The concentration of suspended solids in the Makassar river estuary and Pangkep river estuary is still in accordance with the threshold value set by Environtmetal Ministri of Indonesia, in this case for the benefit of fisheries and conservation marine parks. The influence of river flow is relatively large in these waters as a result of sedimentation of material carried by river flow.

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REFERENCES

[1] Arsen, A., Cretaux, J.-F., Berge-Nguyen, M., Abarca del Rio, R., 2014. Remote sensing-derived bathymetry of Lake Poopo. Remote Sens. 12 (4): 407-420. https://doi.org/103390/rs6010407.

[2] Aufdenkampe, A.K., Mayorga, E., Raymond, P.A., Melack, J.M., Doney, S.C., Alin, S.R., et al., 2011. Riverine coupling of biogeochemical cycles between land, oceans, and atmosphere. Front. Ecol. Environ. 9, 53–60.

[3] Bianchia, T.S., Allison, M.A., 2009. Large-river delta-front estuaries as natural ‘recorders’ of global environmental change. PNAS 106, 8085-8092.

[4] Bilotta, G.S., Brazier, R.E., 2008. Understanding the influence of suspended solids on water quality and aquatic biota. Water Res. 42 (3), 2849-2861.

[5] Cloern, J.E., Foster, S.Q., Kleckner, A.E., 2014. Phytoplankton primary production in the world's estuarine-coastal ecosystems. Biogeosciences 11, 2477-2501.

[6] Doxaran, D., Froidefond, J.M., Castaing, P.., Babin, M., 2009. Dynamics of the turbidity max-imum zone in a macrotidal estuary (the Gironde, France): observations from field and MODIS satellite data. Estuary.coast. shelf Sci. 81, 321-332.

[7] Faburé, J., Dufour, M., Autret, A., Uher, E., Fechner, L.C. (2015). Impact of an urban multimetal contamination gradient: Metal bioaccumulation and tolerance of river biofilms collected in different seasons, Aquatic Toxicology, 159, 276-289.

[8] French, S.K., Ackerman, J.D., 2014. Responses of newly settled juvenile mussels to bed shear stress: implications for dispersal. Freshw. Sci. 33:46-55. http://dx.doi.org/10.1086/674983.

[9] Garcia, M.H. (ED.), 2008. Sedimentatioan engineering: processes, measurements, modelling, and practice. Manual 110. American Society of Civil Engineering (ASCE), USA, 1150 Reston, VA.

[10] Gascho Landis, A.M., Haag, W.R., Stoeckel, J.A., 2013. High suspended solids as a factor in reproductive failure of a freshwater mussel. Freshw. Sci. 32:70-81. http://dx.doi.org/ 10.1899/12-093.1.

[11] GU, Z., Akahori, R., Ikeda, S., 2011. Study on the transport of suspended sediment in an open channel flow

with permeable spur dikes. Int. J. Sediment Res. 26, 96-111.

[12] Hancke, TB, Olsen, LM, Johnsen, G, Glud, RN. Temperature effects on microalgal photosynthesis-light response measured by O_2 production, pulse-amplitude modulated fluorescence, and 14C assimilation. Journal of Phycology, 2008, 44: 501-514.

[13] Huang, S.L., Jia, Y., Wang, S.S.Y., 2006. Numerical modelling of suspended sediment transport in channel bends. J. Hydro D., Ser. B. 18, 411-417.

[14] Jha, S.K., Bombardelli, F.A., 2011. Theoretical/numerical model for the transport of non-uniform suspended sediment in open channels. J. Acv. Water Resour. 34, 577-591.

[15] Maher, D.T., Eyre, B.D., 2012. Carbon budget for three autrotrophic Australian estuaries: Implications for global estimates of the coastal air-water CO_2 flux. Glob. Biogeochem. Cy 26, GB1032. http://dx.doi.org/10.1029 /2011GB004075.

[16] Nagano, T., Yanase, N., Tsuduki, K., Nagao, S., 2003. Particulate and dissolved elemental loads in the Kuji River related to discharge related to discharge rate. Environment International 28, 649-658.

[17] Nasrabadi, T. (2015) An index approach to metallic pollution in river waters, Int. J. Environ. Res., 9(1):385-394.

[18] Rodrigues, S., Breheret, J.G., Macaire, J.J., Moatar, F., Nistoran, D., Juge, P., 2006. Flow and sediment dynamics in the vegetated secondary channels of an anabranching river: the Loire River (France). Sediment. Geol. 186, 89-109.

[19] Sri Adiyanti., Bradley D. Eyre., Damien T. Maher., Isaac Santos., Lindsay Golsby-Smith., Perrine Mangion., Matthew R. Hipsey., 2016. Stable isotopes reduce uncertainty of an estuarine carbon cycling model. Environmental Modelling & Software 79, 233-255.