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Analysis of Pollution on Physical-Chemical Parameters and Waters Environmental Quality Index Using Storet Index in Natural Tourism Park at Youtefa Bay, Jayapura, Indonesia

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ABSTRACT

This study aimed to analyze the quality of water in the Natural Tourism Park, Youtefa bay and analyze water quality in the Youtefa bay using STORET method. The results showed that the existing condition parameters have exceeded the quality standard in the Natural Tourism Park, Youtefa bay is TSS, NH_3, NO_3, PO_4, with value, respectively: 196-528 mg/L, 1.3-1.8 mg/L, 11-17.4 mg/L and 0.95-1.57 mg/L, all the parameters have exceeded the quality standard that is permitted by the decision of the Minister of Environment No. 51 of 2004 on water quality standards of sea waters. Bodies of water quality status of Natural Tourism Park, Youtefa bay has been heavily polluted or bad value with STORET value (-99). So that the necessary enforcement of the regulations and supervision of waste disposal on activities in upstream and downstream activities such as agricultural waste, erosion, sedimentation, industrial waste, residential waste, shopping sewage and waste of manufactures.

Keywords: Water quality, STORET method, sedimentation, Youtefa bay, Jayapura

INTRODUCTION

One of the very important environmental problems in the present and future is water pollution treatment. Water pollution is a very important issue because water is a substance that is needed in human life and environment. Surface water and groundwater were contaminated in accordance with the hydrological cycle will lead to sea past the rivers and creeks either on the surface or in the ground. The contaminated water reached the sea continuously, will be the cause of the pollution of sea water. Marine pollution is the introduction of living creatures, substances, energy, and/or other components into the marine environment by human activities so that quality decreases to a certain level which causes the marine environment no longer in line with quality standards and/or functions (Government Regulation No. 19 of 1999).

Youtefa bay is located in neighborhood Yos Sudarso bay, includes several villages (traditional villages) that Tobati, Enggros, and Nafri village. All villages had an alliance of indigenous cultures are closely however, administratively separate. Youtefa bay extent of 1,675 hectares. Potential pollution in Youtefa bay thought to be high, high levels of pollution in the Youtefa bay caused by the high potential pollutants entering the waste of land around the bay that would add to the burden of pollution from year to year. The level of pollution of the sea will continue to rise because it is still in the trust that the view that the function of coastal waters and oceans as a waste disposal site of various human activities for approximately 60-85% of pollutant sources of coastal and marine waters from various activities on the mainland while the rest of the activities in the sea own.

According Manalu (2012) Youtefa bay waters have been polluted by the parameters of TSS, NO_3, and P-PO_4 where nitrate levels in waters of Youtefa bay ranged from 0.7 mg/L-2.6 mg/L (the quality standard of 0.008 mg/L), phosphate (P-PO_4) ranging from 0.03 mg/l-0.75 mg/L (the quality standard of 0.015 mg/L), and the total value of water suspended solids (TSS) in the waters of the Youtefa bay ranges between 71-306 mg/L (the quality standard of 20 mg/L).

One of the causes of high pollution caused by increased land conversion and industrial development around the Youtefa bay. Mangrove forests in the region Youtefa bay, largely converted into residential and industrial areas, with an average rate of degradation is 6.14 hectares/year. Other than that caused by sedimentation, increased pollutant, increased waste that goes into the bay due to poor land management. Based on the above reasoning, the study was conducted with the aim of: (1) Analyzed of water quality of Youtefa bay, (2) Analyzing the status of water quality in the bay Youtefa using STORET method.

The study on the water quality of the bay is in line with previous research [1-5], which suggests that the quality of the waters of the Gulf coast in good condition are calculated based on the parameters Si, N and P, where the Si concentration is higher than the N and P (mg/L). Studies on the contamination of the bay are in line with several studies before [2-6].

MATERIAL AND METHODS

This research was conducted for 3 months (January to March 2016) at Youtefa bay in Jayapura, Papua-Indonesia. Sampling of water using motor boats. Parameters measured include the physical and chemical parameters. Water sampling is done by using a sample bottle in four areas of Youtefa bay (Figure 1), namely Entrop, Abe Coastal, Abe Nafri Coastal, with samples of the mixture (composite sample).

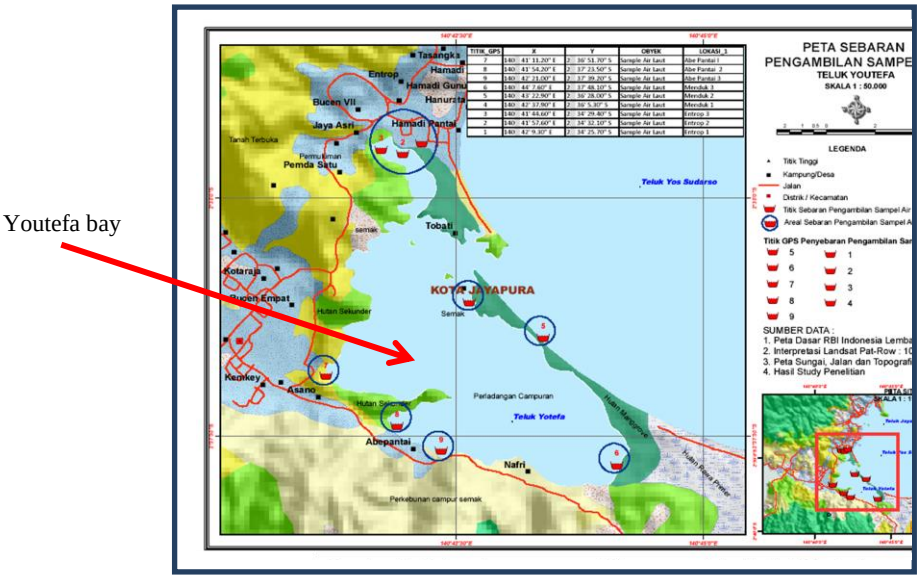

Figure 1: Map of the natural tourism park, Youtefa bay, Jayapura Indonesia

Analyzing the quality status of Youtefa bay waters

To determine the quality status of the Youtefa bay waters used STORET method. According to Djoko Setiyanto and Hardjono and the Minister of Environment Decree No. 115 of 2003, STORET method is one method for determining water quality status that is commonly used. With this known method STORET classification levels of quality parameters that have met or exceeded the water quality standard. Determination of water quality status STORET with system is intended as a reference in monitoring the quality of groundwater in order to determine the quality of an aquatic system. Determination of the status of water quality is based on the analysis of parameters of physics, chemistry, and biology. Good water quality will be in accordance with government-issued regulations at the levels (concentration) of the maximum allowed. As for knowing how far the water sample is called good or not assessed with STORET system. The results of chemical analysis of the sample of water are then compared to the quality standards appropriate to the use of water. Water quality is assessed based on the provisions STORET system that issued by the EPA (Environmental Protection Agency), which classifies water quality into four classes, namely:

(1) Class A: Very well, score=0 fulfills standard quality.
(2) Class B: Good, score=-1 s/d -10 lightly polluted.
(3) Class C: Medium, score=-11 s/d -30 medium contaminated.
(4) Class D: Bad, score ≥ -31 heavily contaminated.

Determination of the status of water quality by using STORET is done by the steps of: (a) Comparing the measured data of each parameter with a value of water quality standards in accordance with the class of water; (B) If the measurement results meet the standard value of quality (measurement results <standard quality) then given a score of 0, (c) If the measurement results do not meet water quality standards (the measurement results >quality standard) then given a score (Table 1), and (d) The number of negatives from all the parameters are calculated and determined its quality status of the number of scores obtained by using a system of values.

Table 1: Determination of the value system to determine the status of water quality

Total sample	Value	Parameter		
		Physics	Chemical	Biology
<10	Maximum	-1	-2	-3
	Minimum	-1	-2	-3
	Average	-3	-6	-9
≥10	Maximum	-2	-4	-6
	Minimum	-2	-4	-6
	Average	-6	-12	-18

RESULTS AND DISCUSSION

The results of the pollution analysis of physical parameters

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) is suspended materials (diameter >1 µm). TSS consists of mud, organic and inorganic materials, fine sand as well as the bodies of microorganisms, which is mainly caused by scraping the soil or soil erosion that washed into water bodies. Field results indicate that the value of total suspended solids in the water of Youtefa bay waters ranged from 196-528 mg/L with an overall average score was 285 mg/L. The value has exceeded the sea water quality standard for marine life, where quality standards are allowed 20-80 mg/L. This means it can cause a reduction in the rate of photosynthesis of phytoplankton, which could cause primary production dropping waters. The high pollution of TSS levels in the Youtefa bay due to the abundance of suspended particles composed of sand, silt, fine sand and microorganisms mainly due to piling up due to erosion or carried into water bodies through several rivers that empty into the of Youtefa bay. The results are consistent with research [7] which suggests that TSS is become contamination in Egyptian Mediterranean coastal waters with a range of values 77.9 ± 76.71 mg (Figure 2).

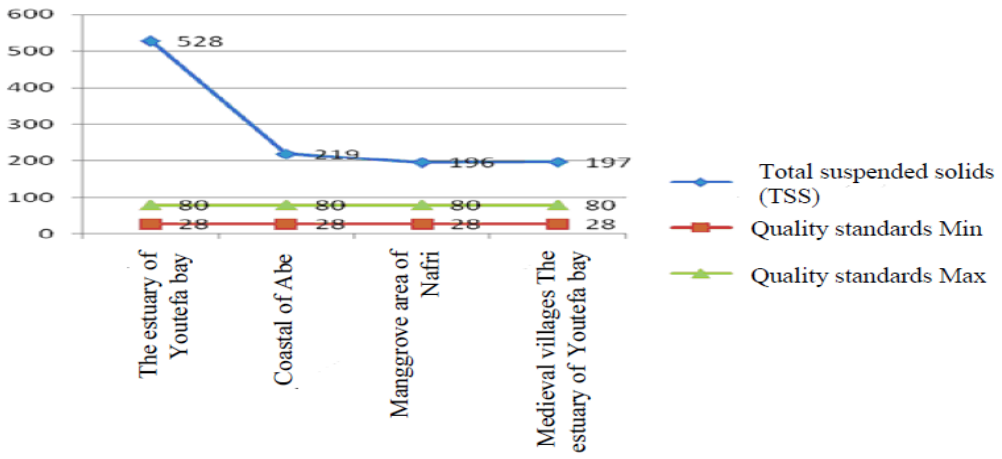

Figure 2: Water quality parameters of TSS

The results of the analysis of chemical pollution parameters

Nitrate

Nitrate is the main form of nitrogen in natural waters and is a major nutrient for plant growth. Nitrate is produced from the oxidation of nitrogen compounds in the water. Sewage typically contains nitrate in large quantities. The results showed that the nitrate levels in Youtefa bay waters ranged from 1.3-1.8 mg/L. The highest value of nitrate found in the river Youtefa (1.8 mg/L) and the lowest in the Tobati [1,8,9] with an overall average of 1.58 mg/L. The value has exceeded the sea water quality standard for marine life, where quality standards are allowed NO_3 is 0,008 mg/L. Results of a study in line with the previous research [7,10,11] which states that the bay pollution caused by eutrophication parameters nitrite (NO_2), nitrate (NO_3), which respectively gained 1.2 ± 3.2, and 5.04 ± 5.02 µM (Figure 3).

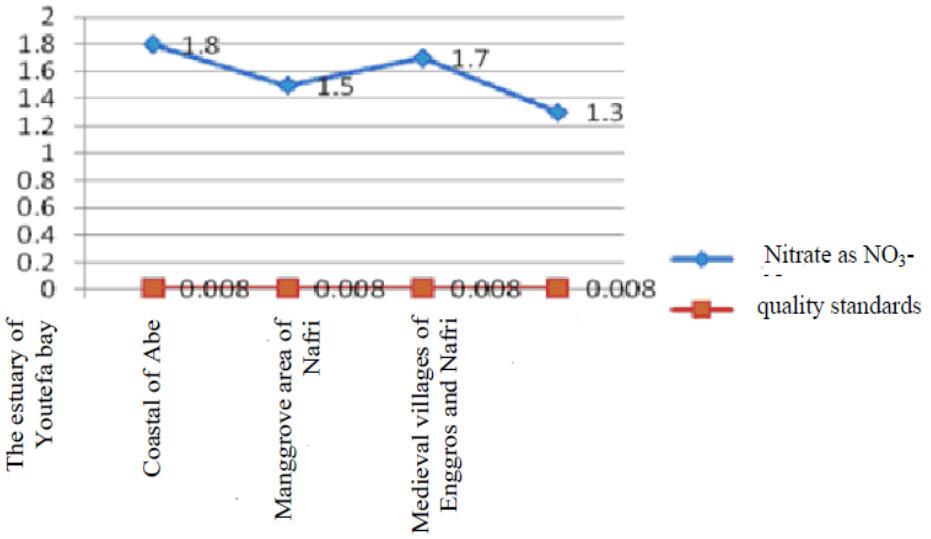

Figure 3: The water quality parameters of NO_3

Ammonia

The results of field research shows that ammonia levels Youtefa bay waters ranging from 11-17.4 mg/L, with an average value of 15.4 mg/L. Highest values are in the Nafri village (17.4 mg/L), the lowest value contained in Tobati 1 (11 mg/L). In general, the levels of ammonia in waters of Youtefa bay have exceeded the value of the quality standards that require maximum ammonia value of 0.3 mg/L. So, we can conclude that the waters of Youtefa bay has happened pollution by ammonia. The results are consistent with studies [7,10,11] which states that the pollutant parameters are parameters eutrophication of coastal waters ammonia (NH_3) with a value of 9.61 ± 12:28 μM (Figure 4).

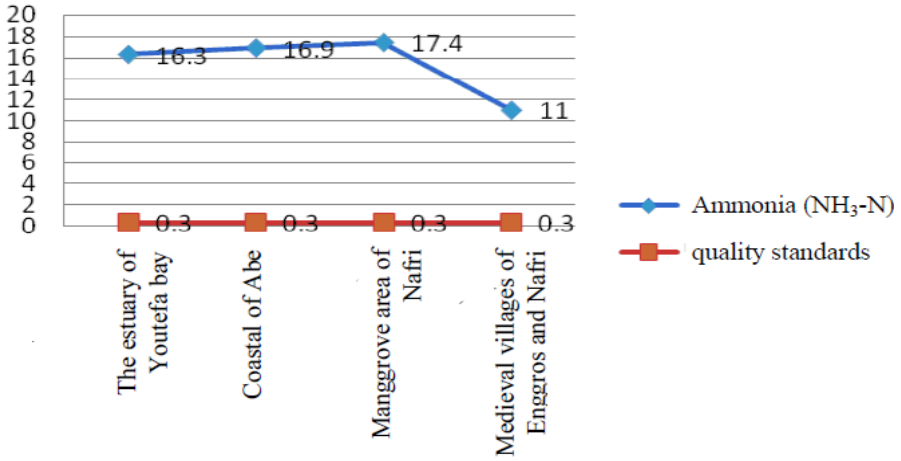

Figure 4: Water quality parameters of NH_3

Phosphate levels

The results of field research showed that the levels of phosphate (P-PO_4) in waters of Youtefa bay ranging from 0.95-1.57 mg/L, with an overall average value of 1.33 mg/L. Based on marine water quality standard for marine life that require maximum phosphate concentration of 0.015, it can be concluded that P-PO_4 at Youtefa bay waters do not fulfills standard quality. Source P-PO_4 in waters of Youtefa bay allegedly sourced from domestic waste, especially detergents and human waste and agricultural waste. The results support the studies [3-4,10-11] and that the pollution in bay caused by activities around the coast, marine hydrodynamics factors and anthropogenic influences (Figure 5).

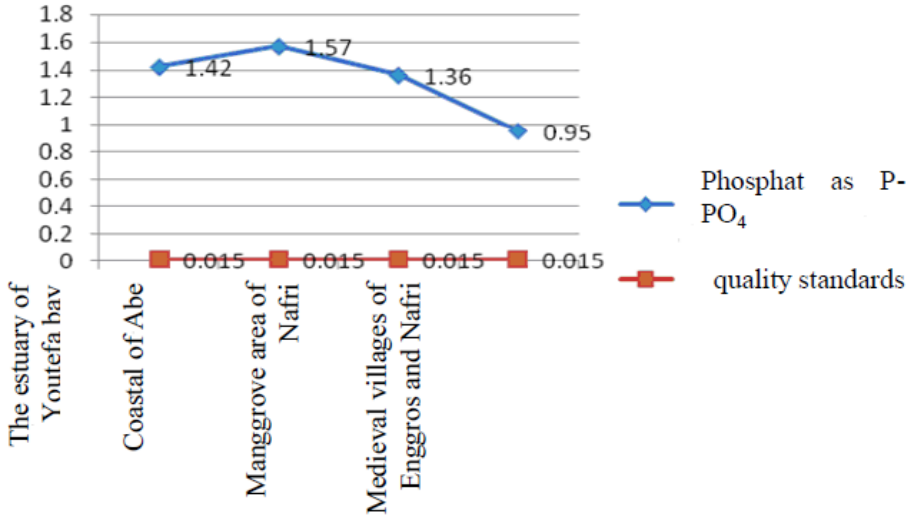

Figure 5: Water quality parameters of PO_4

The results of the analysis of the status of water quality in the Youtefa bay

The approach uses STORET index method used to analyze the actual status of pollution that has occurred in the Youtefa bay. The results of the evaluation of water quality based Youtefa bay Storet index values obtained (-99), it indicates that the Natural Tourism Park badly polluted or heavily polluted. This condition should be the concern of all parties bay users to be more careful exploits marine resources in it. The fall of the status of water quality caused by physical and chemical pollution parameters, this is in line with previous studies [1-11]. The high space utilization bay waters, erosion, sedimentation, settlement controlled, high domestic waste, uncontrolled waste disposal, waste industrial and business sector constitutes the main factor Youtefa bay pollution. Conditions and reality like this, spur all parties to seriously seek to handle the institutional approach and appropriate technologies for handling pollution problems. The results are consistent with research [7] which suggests bahwasumber because major polluters in the study area are industrial waste, agricultural and domestic. Average index of water quality is increasing every year at locations Burullus, West El-Nobareya Drain and Damietta; this is caused by lack of law enforcement in the Egyptian environment.

Also in line with the study [2] which examines marine pollution index of Sungai Kilim based on the concentration of heavy metals such as Cd, Co, Pb, and Zn. The study results [2] show the highest concentration of Cd metal followed by Zn and Co. Cd pollution index in the medium category [12].

So that needs handling of the sources of pollution by anthropogenic activities such as household waste, water activities and tourism activities in the Kilim river and strengthening the regulation and need advanced monitoring in these waters, this is in line with previous research [2,9].

CONCLUSION

1. Existing condition parameters have exceeded the quality standard in the Natural Tourism Park Youtefa bay is TSS, NH_3, NO_3, PO_4, all the parameters must need serious treatment by the relevant institutions.
2. Status of water quality in the waters of the Natural Tourism Park on Youtefa bay has been heavily polluted or bad with STORET value (-99).

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