Original Research Article

WATER QUALITY DISTRIBUTION IN SITU GUNUNG PUTRI BOGOR REGENCY, INDONESIA

ABSTRACT

*The purpose of this study was to determine water quality distribution in Situ Gunung Putri. This research was conducted from February to March 2019, carried out in Situ Gunung Putri and at the Limnology Research Center of the Indonesian Institute of Sciences, both located in Bogor, West Java. The method used was the survey method. The results showed that, at the surface level, the temperature ranged between (28.14±0.52 and 30.61 ±1.76)°C, transparency between(*0.38±0.12 *and 0.65 ± 0.06) m, dissolved oxygen (DO) was between 1.92 ±1.10 and 5.7± 2.55 mg / L, chemical oxygen demand (COD) was between 42.22± 9.86 and 54.09 ± 15.89, nitrate between (0.047 ± 0.009 and 0.05 ± 0.015) mg / L, phosphate of (0.015±0.002 and 0.022± 0.004) mg / L and pH was between 7.11± 0.27 and 7.33 ±0.34. Meanwhile at the Secchi depth values of the temperature ranged between (2.93±0.71 and 29.96 ±1.71)°C, DO was 1.14 ±0.90 and 3.37±1.63 mg / L, nitrate was 0.045 ± 0.008 and 0.056 ± 0.019 mg / L, phosphate was 0.016±0.003 and 0.035± 0.043 mg / L and pH was between 6.68± 0.33 and 7.11 ±0.28. Based on these values water quality parameters except COD in Situ Gunung Putri is still at the optimal range for aquatic organisms.*

Keyword : Water quality, Situ Gunung Putri, Bogor

INTRODUCTION

Situ is a Sundanese for small lake that is formed naturally or artificially, the source of water comes from springs, rainwater or surface runoff. Situ or lake has two main functions, ecological functions and socio-economic-cultural functions. The ecological function of situ as an area of biodiversity conservation, both flora and fauna and as a water regulatory systems, flood control, habitat for wild life or protected species, while the socio-economic-cultural function is to meet the needs of human life, among others as a usable source of water by the community both directly in agriculture, fisheries, industry and household activities (Sittadewi 2008).

Situ Gunung Putri is located in Gunung Putri Village, Gunung Putri District, Bogor Regency, West Java. The location is right by the Jagorawi toll road and is located amongst industrial area, housing area and agricultural area. Situ Gunung Putri was once used as a tourism object around 2010 to 2013, but discontinued since 2014. Since then the location has been used as a fishing area. Activities around Situ Gunung Putri are industries, agriculture and housing. these activities will affected on several water quality, including COD, dissolved oxygen nitrate and phosphate. Changes in the condition of Situ Gunung Putri waters over time due to increased waste originating from industrial, agricultural and household activities. Especially after being used as a water tourism destination, the water quality of Situ Gunung Putri tend to decreased. ~~Changes in the condition of Situ Gunung Putri waters over time due to human activities, both industry, agriculture and households that produce waste, causing water quality~~

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~~in Situ Gunung Putri tend to decrease. Therefore, research is needed to evaluate Situ Gunung Putri waters quality in order to obtain the latest information as a basis for the management of Situ Gunung Putri as an aquatic resource.~~

Water quality characteristics can be distinguished physical and chemical parameters. Physical parameters such as temperature and transparency, chemical parameters such as pH, DO, BOD, and COD. The solubility of gas in water as well as biological activity in waters is strongly influenced by temperature changes. Each increase in temperature of 10^{o}C will cause an increase in metabolic rate of 2-3 times. Increased metabolic rate of organisms will cause oxygen demand to increase, on the other hand increasing temperatures will cause oxygen solubility in water to decrease. This phenomenon will cause water biota to experience difficulty in the process of respiration (Satino 2010). Aquatic organisms can live in ideal conditions in the pH of the waters ranging from weak acids to weak bases or in the range of pH values 6-9. Conditions of waters that are strong acids (less than 6) and strong bases (more than 9) will endanger the survival of the biota in the waters. Therefore, research on the water quality of Situ Gunung Putri is needed in order to obtain better aquatic resources management recommendations.

METHODS

This research was carried out from February to March 2019 at Situ Gunung Putri, Bogor and in the laboratory of the Limnologi Research Center, Indonesian Institute of Sciences, Cibinong, Bogor, West Java.

The method used in this study was a survey method. Samples obtained from five stations that were defined by land use as it can be seen in Figure 1. Sampling was done six times with one week interval . Water quality parameters that were analyzed are temperature, Transparency, DO, COD, Nitrate, Phosphate and pH, both from surface level and secchi depth except tranparency and COD not taken in secchi depth.

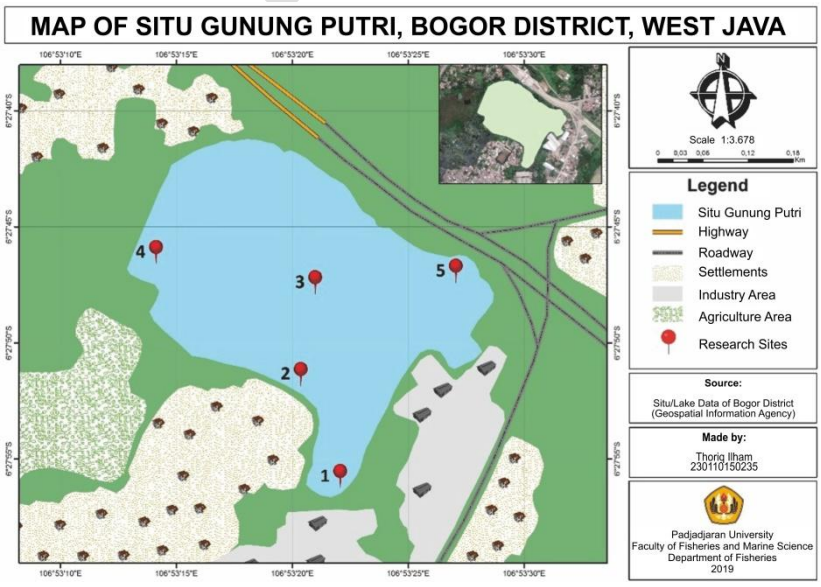

Figure 1. Data Collection Location at Situ Gunung Putri

Temperature, DO, pH measured *in situ* using Horiba Water Quality Checker and transparency measured using the Secchi Disc. measurement of nitrate, phosphate concentrations and COD value was carried out in the laboratory. Measurement of nitrate concentration was carried out

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using the brucine method using a UV-Visible spectrophotometer at a wavelength of 420 nm. Phosphate concentration was measured by ascorbic acid method using a UV-Visible spectrophotometer at a wavelength of 880 nm. Meanwhile COD measurement was carried out in the Environmental Productivity laboratory at Bogor Agriculture University, using the closed reflux method with a spectrophotometer at a wavelength of 600 nm (APHA 2015).

RESULT AND DISCUSSION

Water Quality Parameters

The result of water quality parameters consisted of physical and chemical during observations presented in Table 1.

Table 1. Physical and Chemical Parameters during Study

Parameters/depth	Station				
	1	2	3	4	5
Surface					
Temperature (°C)	30.61±1.76	29.54±1.12	29.73±1.36	28.58±0.77	28.14±0.52
Transparency (m)	0.38±0.12	0.5±0.17	0.53±0.09	0.65±0.06	0.63±0.12
DO (mg/L)	5.7±2.55	2.81±1.38	3.96±3.73	3.06±2.69	1.92±1.10
COD (mg/L)	46.59±10.37	46.89±13.33	54.09±15.89	42.22±9.86	44.59±7.65
Nitrate (mg/L)	0.049±0.006	0.058±0.015	0.05±0.009	0.047±0.009	0.049±0.007
Phosphate (mg/L)	0.018±0.005	0.017±0.003	0.015±0.002	0.022±0.004	0.015±0.003
pH	7.25±0.23	7.11±0.27	7.27±0.10	7.15±0.17	7.33±0.34
Secchi Depth					
Temperature (°C)	29.96±1.71	28.56±0.95	29.03±1.49	28.31±0.64	27.93±0.71
DO (mg/L)	3.37±1.63	1.30±0.94	2.61±5.05	2.07±2.07	1.14±0.90
Nitrate (mg/L)	0.051±0.004	0.046±0.007	0.045±0.008	0.050±0.013	0.056±0.019
Phosphate (mg/L)	0.019±0.001	0.020±0.004	0.035±0.043	0.024±0.004	0.016±0.003
pH	7.11±0.28	6.86±0.33	6.93±0.30	6.90±0.32	7.02±0.27

Temperature

The highest temperature was found on the surface of the water at the station 1 which reaches 30.61^{o}C. The lowest temperature on the water surface was 28.14 ^{o}C at station 5 is also still within the ideal temperature limit for the survival of aquatic organisms. Average tempature during study can be seen in Figure 2

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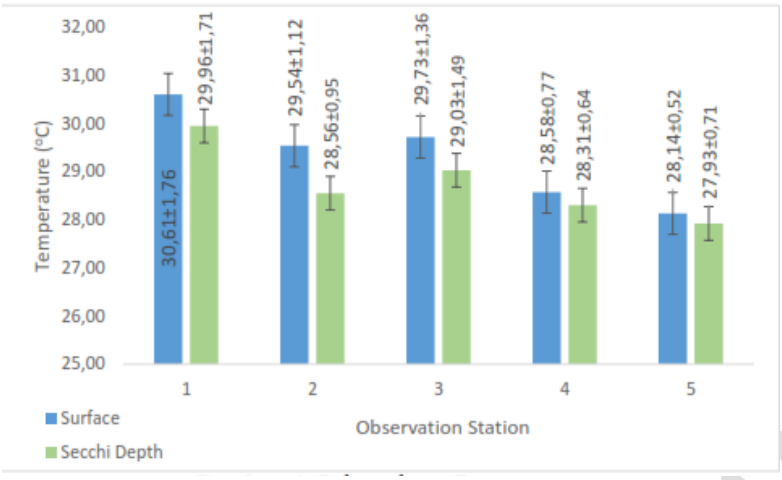

Figure 2. Temperature during observation

The temperature in the secchi depth was also measured to determine the effect on the transparency of sunlight. According to Effendi (2003) sunlight entering the waters will be absorbed and change into heat energy. In the surface layers waters will have a higher temperature and lower density than in the lower layers.

The highest temperature at secchi depth was obtained at station 1 reaching 29.96^{o}C. The lowest temperature measured in secchi depth was at station 5 of 27.93 ^{o}C. The difference between the temperature on the surface with secchi depth was not too significant at all stations. This is in line with the findings of Adiwilaga *et al.*, (2009) that the temperature obtained at each depth is not much different especially between surface layers and secchi depth. Overall, temperature value di Situ Gunung Putri still in tolerable range for aquatic organisms as stated in the Republic of Indonesia Government Regulation No. 82 of 2001 for class III (suitable for aquatic organisms to live in, deviation 3 ^{o}C from normal temperature)

Transparency

The value of light penetration or transparency as measured by secchi disc is strongly influenced by the intensity of sunlight at the surface water, turbidity and the density of plankton in a waters column. Light penetration is a limiting factor for photosynthetic organisms (phytoplankton) and also causes death in certain organisms (Barus 2004). Figure 3 showed transparency during study

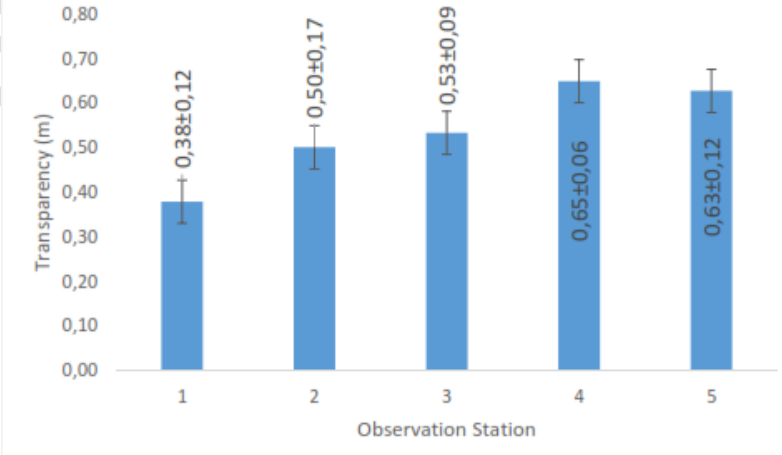

Figure 3. Water Transparency during Study

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The lowest transparency value at station 1 was 0.38 ± 0.12 m and the highest transparency at station 4 was 0.65 ± 0.06 m. The transparency value according to Boyd (2000) was still within normal limits because the transparency of light is good for plankton growth optimally which is 30 cm (0.30 m) to 50 cm (0.50 m). Further stated that phytoplankton growth at euphotic zone that can be estimated with multiplying secchi depth visibility by 2

Dissolved Oxygen

There was a difference in dissolved oxygen concentration between the surface water and the secchi depth of each station caused by differences in sunlight penetration. The highest DO obtained at station 1 and the lowest one at station 5 both in surface water and secchi depth. In surface water the highest average value was 5.70 ±2.55, mg/L and at secchi depth the value was 3.37 ±1.63 ,g/L. meanwhile lowest value was 1.92 ±1.1 mg/L and at secchi depth was 1.14±0.90 mg/L

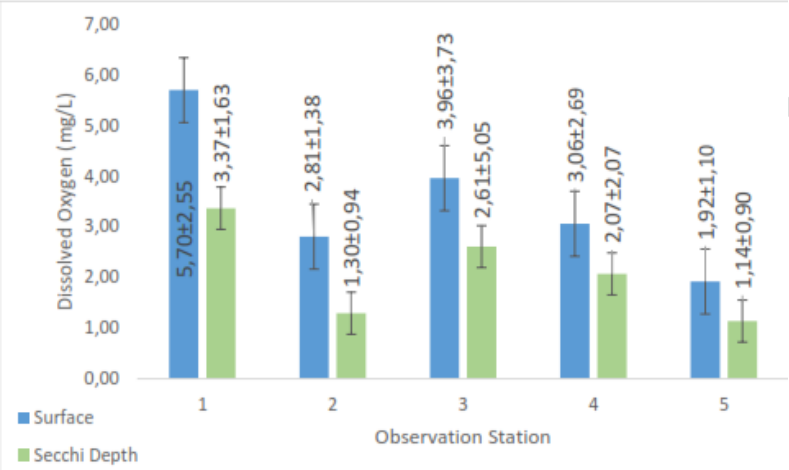

Figure 4. Dissolved Oxygen during Study

According to Reebs (2009) DO concentrations which have decreased as depth increase due to photosynthesis activities is higher in the surface waters level than in deeper waters level . In addition, at the bottom layer of waters decomposition of organic matter that utilize oxygen occur more (Lukman and Ridwansyah 2010). Based on figure 4, dissolved oxygen in station 2 and 5 under the quality standard for class III according to Republic of Indonesia Government Regulation No. 82 of 2001 both at surface and secchi depth, meanwhile in stasion 1 the concentration suitable with standard both in two layer. On the other hand, in others two station DO concentration at surface layer suitable with the standard but not in the secchi depth. Bhatnagar and Devi (2013) stated that minimun concentration of 1.0 mg/L is essensial to sustain fish for long period, and 5.0 mg/L are adequate for fish growth

Acidity/alkalinity (pH)

The highest average pH value in surface obtained at station 5 with a value of 7.33 ± 0.34 and the lowest was found at station 2 with a value of 7.11±0.27. Whereas the highest value in secchi depth occured at station 1 with a value of 7.11±0.28 and the lowest ones at station 2 with a value of 6.86 ±0.33. The difference in pH between surface and secchi depth is normal condition. according to Araoye (2009) statement, that the decrease in pH at the deeper waters level occurs due to an increase in microbial activity to decompose organic matter so that O_2 decreases and CO_2 increases. which will cause the waters to become more acidic . Overall, pH value di Situ Gunung Putri still in tolerable range for aquatic organisms as stated in the

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Republic of Indonesia Government Regulation No. 82 of 2001 for class III with value range between 6-9

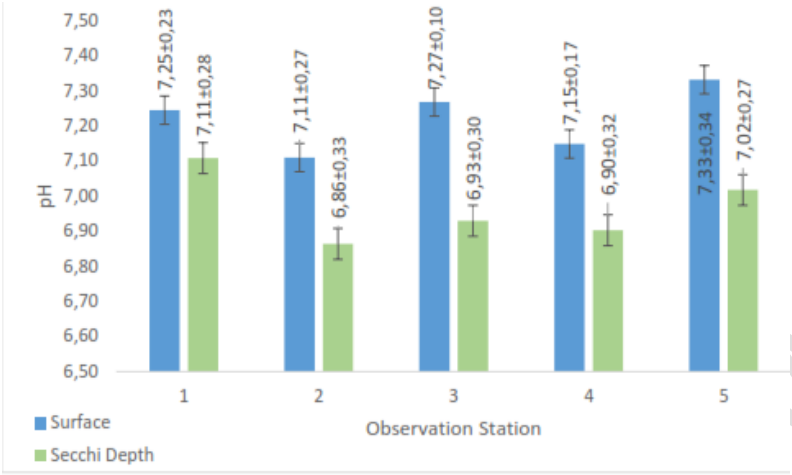

Figure 5. pH during Observation

COD

The highest average COD (Chemical Oxygen Demand) value was found at station 3 with an average value of 54.09 ± 15.89 mg / L while the lowest COD concentration was at station 4 with an average value of 42.22 ± 9.86 mg / L. Based on Indonesian Government regulation Number 82 of 2001. Those values were still below the treshold limit for class III of 50 mg/L (suitable for aquaculture activities, and aquatic organisms), but its very close to border and need to get serious attention. COD distribution during study are showed in Figure 6.

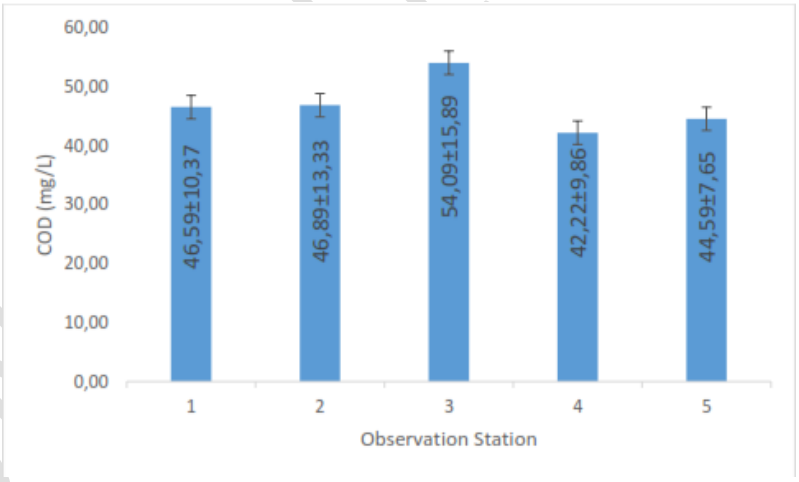

Figure 6. COD ~~Concentration~~ value during Observation

Nitrate

Based on the results as shown in Figure 7, the highest average value of nitrate concentration in surface layer was found at station 2 at 0.058 ± 0.015 mg / L and the lowest one was obtained at stasion 4 of 0.047± 0.009 mg / L. On the other hand the highest average nitrate concentration in secchi depth found at station 5 of 0.056 ± 0.019 mg / L and the lowest occured at station 3 with a value of 0.045 ± 0.008 mg / L .

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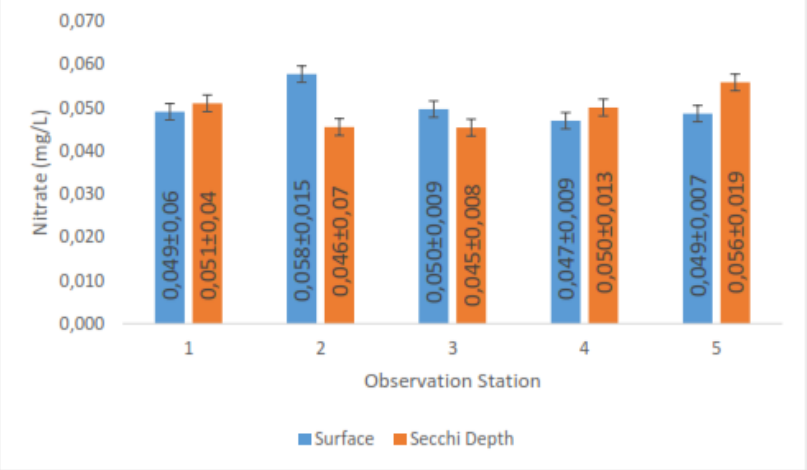

Figure 7. Nitrate Concentration during Study

Concentration of nitrate in waters are influenced by several parameters such as dissolved oxygen and organic matter content. According to Zahidah (2017), if dissolved oxygen concentration is low, the activity of microorganisms in decomposting of organic matter and nitrification process will be affected. This result is similar to Yuliana *et al*., (2012) findings in Jakarta Bay, who found that there is relationship between nitrate concentrations with oxic condition. In Figure 7 it can be seen that there is no significant difference between surface level and secchi depth in nitrate concentration. Compare to Kumar, Grover and Wats (2018) that conducted research Haryana Lakes, India found nitrate concentration range between 26.1-47.67 mg/l, nitrate concentration in Situ Gunung Putri were very low.

Phosphate

Phosphate concentration can be seen in Figure 8. The highest average phosphate concentration in surface level was at station 4 with a value of 0.022 ± 0.004 mg / L and the lowest occured at station 3 with a value of 0.015 ± 0.002 mg / L. Meanwhile the highest phosphate concentration in secchi depth was at station 3 with a value of 0.035 ± 0.0043 mg / L and the lowest is at station 3 with a value of 0.016 ± 0.003 mg / L.

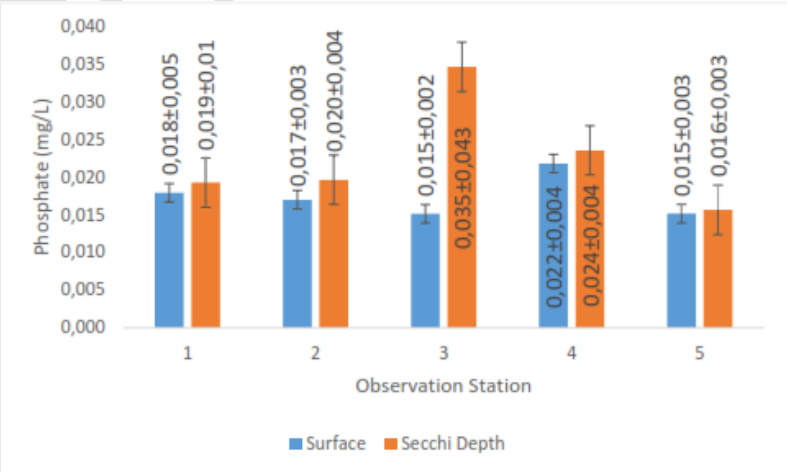

Figure 8. Phosphate Concentration during Observation

Phosphates are needed in small amounts, as a transfer of energy from the outside into cells of the organism (Effendi, 2003). According to Indonesian Government regulation Number 82 of

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2001, phosphate concentration in all of the station was still far below the threshold of phosphate concentration for aquaculture and aquatic organisms (class III), which was less than 1 mg / L. From Figure 8 it can be seen that there is no significance difference between surface layer and secchi depth in phosphate concentration. Low concentration of phosphate also found in Naivasha Lake, Kenya as stated by Ndungu (2014) that range between 0.001-0.079 mg/L

CONCLUSIONS

Based on this research, it can be concluded that water quality in Situ Gunung Putri is still at the optimal range according to Indonesian Government regulation Number 82 of 2001, except for Chemical Oxygen Demand and Dissolved Oxygen at stasion 2 and 5 which is very close to threshold value

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