RJC

RASĀYAN *J. Chem.*
Vol. 14 | No. 1 |454-459| January - March | 2021
ISSN: 0974-1496 | e-ISSN: 0976-0083 | CODEN: RJCABP
http://www.rasayanjournal.com
http://www.rasayanjournal.co.in

THE INFLUENCE OF SOIL CHEMICAL CONTENT FACTOR ON RUSWERI RIVER WATER QUALITY IN SUPIORI REGENCY, PROVINCE OF PAPUA, INDONESIA

J. V. Morin[1,✉], B. Mansoben[2], M. Infaindan[2], F.L. Ayer[2], Marty[2], L. L. Mandosir[2], J.O. Ughude[2], D. Awendu[2], R. Yarangga[2], P. Patulak[2], P. Noya[2], and D. Santi[1,3]

[1]Chemistry Department, Faculty of Mathematics and Nature Sciences Papua University, Papua Barat, Indonesia

[2] Department of Environment Agency, Supiori District, Papua, Indonesia

✉Corresponding Author: jecko_morin@yahoo.com

ABSTRACT

Research on the effect of chemicals on the water quality of the Rusweri river in Supiori Regency has been conducted. The inventory plan of the river as a provider of raw water in Supiori Regency will begin in 2020, and the Rusweri river is one of the candidates to be used, it will be seen using its green water for microbiological assistance that can be researched the Rusweri river. This study uses a descriptive method that explains the water quality of the Rusweri river with physical and chemical monitoring parameter methods for each place in the Rusweri river. The results of this study contain several chemical and physical parameters that exceed the quality standard threshold. Increased concentrations of parameters PO_4^{-}, Fe, F^{-}, COD, and BOD from upstream to downstream due to the river bed structure that already contains particular metal contents and also the influence of organic and microbiological concentrations that enter through the addition of secondary rivers on the body Rusweri river. Calculation of river pollution index results in an average of mildly polluted status, which is dominated by phosphate parameters.

Keywords: Soil quality, Water quality, Rusweri, Papua

RASĀYAN *J. Chem.*, Vol. 14, No.1, 2021

INTRODUCTION

Water quality an essential role for all living things. Surface water quality in an area is governed by both natural processes such as rainfall levels, weathering and soil erosion processes and anthropogenic effects such as urban, industrial and agricultural activities and human exploitation of water resources. Groundwater quality has become an important water resource problem due to rapid population growth, rapid industrialization, unplanned urbanization, pollution from highlands to lowlands, and overuse of fertilizers, pesticides in agriculture[1,2].

Based on the Republic of Indonesia Government Regulations (quality standard) (PP RI) No. 82 of 2001 concerning Management of Water Quality and Control of Water Pollution (river/surface water) and PERMENKES No. 7 of 2019 concerning hospital environmental health, water and soil quality monitoring needs to be done in each District/City through a process of observation and field measurements and laboratory testing to obtain predetermined data parameters which are then used as a basis for preparing river and groundwater quality status reports body in the Supiori district of Papua Province. Rusweri River is one of the largest rivers in Supiori Regency which has a river width of 90 m. Although this river is not a river intended for drinking water in Rusweri village, it is essential for the continuity of coastal habitats and ecosystems because the Rusweri river empties into the ocean. Upstream activities according to local community information contain local mines and do not use hazardous chemicals as an aid in obtaining gold, but the potential pressure of water resources can lead to inadequate water supply, deteriorating water quality, and low surface water flow[3]. The physical condition contains high dissolved solids originating from the river headwaters so that the water and river water quality monitoring activities are carried out on the Rusweri river in Supiori Regency, Papua Province.

http://dx.doi.org/10.31788/ RJC.2021.1416111

EXPERIMENTAL

The research site is the headwaters of the river up to the downstream of the Rusweri river, Supiori district, Papua Province. This research approach uses a qualitative approach. The method used in this study is a combination of quantitative. Quantitative methods, among others, compare the results of measurement parameters in situ and laboratory and compare the data with water quality standards. The quantitative data will be calculated using the Pollution Index method. Another quantitative method used in determining the status of water quality using the Pollution Index method[4]. Considerations using the Pollution Index method because there are no differences between the types of physical, chemical and biological contaminants. Pollution Index based on the Decree of the State Minister for the Environment No. 115 of 2003 concerning Guidelines for Determination of Water Quality Status. The Pollution Index for the allotment (j), which is a function of Ci / Lij can be determined by equation (1).

$$x = \frac{\sqrt{\left(\frac{Cij}{Lij}\right)M^2+\left(\frac{Ci}{Lij}\right)R^2}}{2} \quad (1)$$

Where, Ci = Concentration of water quality parameters (i); Lij = Concentration of water quality parameters on water designation standards (j); PIj = Pollution Index / Pollution Index for designation (j); (Ci / Lij) M = (Ci / Lij) maximum; (Ci / Lij) R = (Ci / Lij) average; Evaluate the value of PI (Pollution Index); 0 ≤ PIj ≤ 1.0 Meet quality standards (good condition); 1.0 <PIj ≤ 5.0 Light pollution; 5.0 ≤ PIj ≤ 10 Medium polluted; PI> 10 Severe pollutants.

The Rusweri river water sampling location consists of 4 (four) locations along the river body. The location code and sample coordinates are as follows:

Table-1: Location Codes and Sampling Coordinates

No	Location Codes	Coordinates
1	S1	0040’26.94”S 135032’09.76”E
2	S2	0040’32.03”S 135032’12.21”E
3	S3	0040’36.62”S 135032’09.97”E
4	S4	0040’40.91”S 135032’07.79”E

RESULTS AND DISCUSSION

Measurement of Rusweri river samples carried out in the laboratory is shown in Figs-2 to10. The analysis conducted obtained results that refer to quality standards based on PP No. 82 of 2001. Discussion of parameters of river water quality parameters that exceed water quality standards and are shown in Figs.-1 to 7.

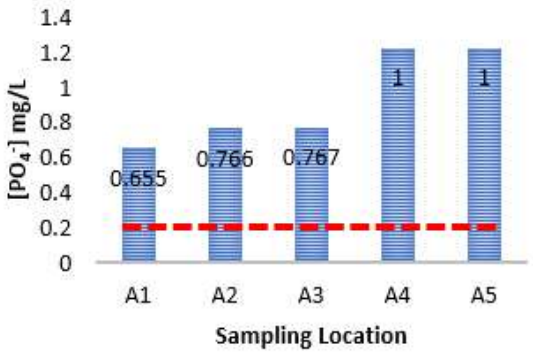

Fig.-1: Test Results for Phosphate Levels in the Rusweri River

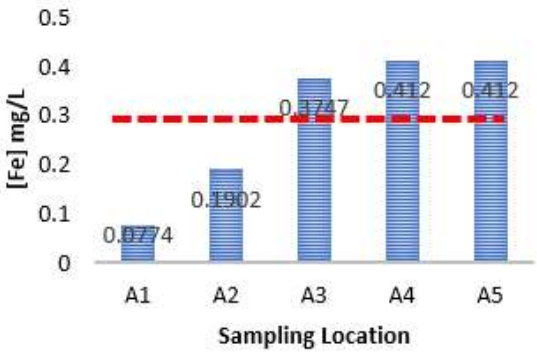

Fig.-2: Test Content of Iron Content (Fe) in the Rusweri River

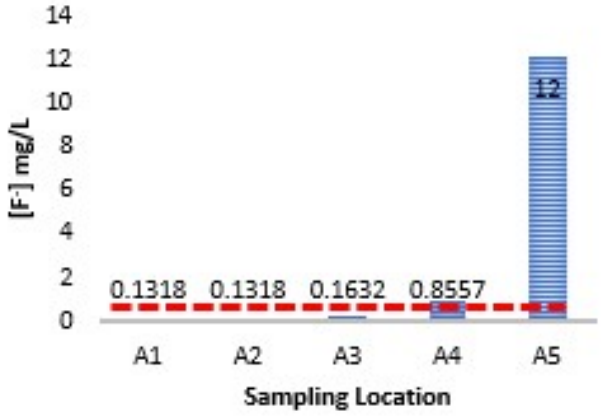

Fig.-3: Fluoride Test Results in the Rusweri River

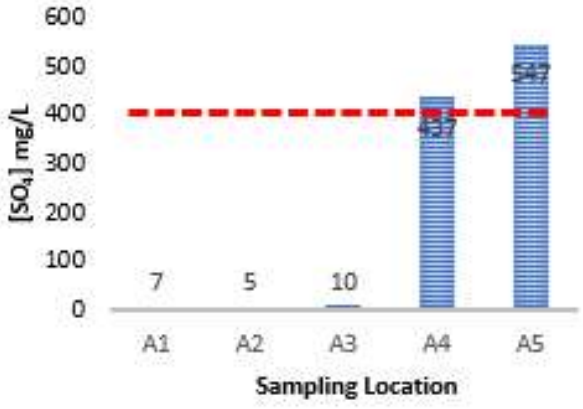

Fig.-4: Sulphate (SO_4^{2-}) Test Results in the Rusweri River

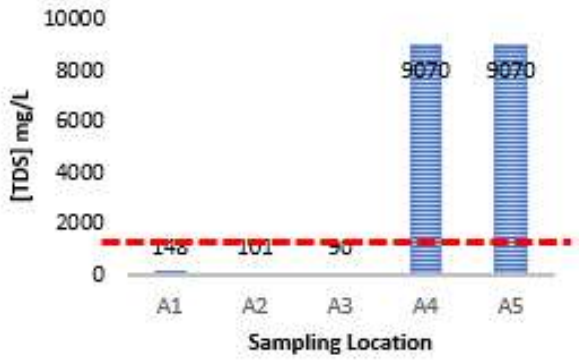

Fig.-5: TDS Test Results in the Rusweri River

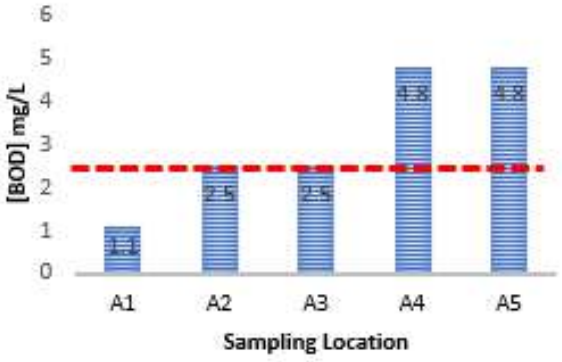

Fig.-6: BOD Test Results in the Rusweri River

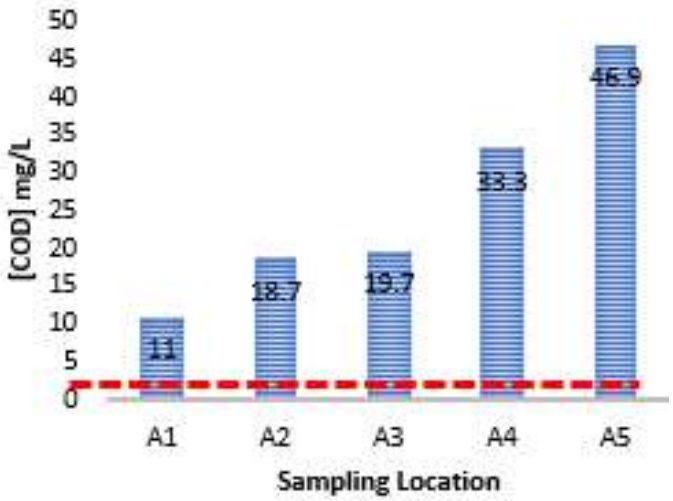

Fig.-7: COD Test Results in the Rusweri River

The test results show that of all parameters measured based on PP No. 82 of 2001, there were several chemical parameters that exceeded the established water quality standard, including Total Phospate location

A1 = 0.655 mg/L, A2 mg/L = 0.766 mg/L, A3 = 0.767 mg/L, A4 = 1 mg/L, A5 = 1 mg/L while PO_4^- = 0.2 mg/L quality standard; iron content (Fe) at location A3 = 0.3747 mg/L, A4 = 0.412 mg/L, A5 = 0.412 mg/L while the quality standard is 0.3 mg / L; Fluoride at location A4 = 0.8557 mg / L, A5 = 12 mg / L while the standard quality is 0.5 mg/L; Sulfate levels (SO4) at location A4 = 487 mg/L and A5 = 547 mg/L the quality standard is 400 mg/L; COD levels at locations A1 = 11 mg/L, A2 = 18.7 mg/L, A3 = 19.7 mg/L, A4 = 33.3 mg/L, A5 = 46.9 mg/L the quality standard is 0,2 mg/L; TDS levels for location A4 = 9.070 mg/L and A5 = 9.070 mg/L while the standard quality is 1,000 mg/L. Sulfur or sulfur is a chemical element with an atomic number of 16 represented by sulfur. In general, most of the sulfur contained in the water is in the form of sulfate ions (SO_4^{2-}). Sulfur (S) is in organic and inorganic form. Inorganic sulfur is mainly present in the form of sulfate (SO_4^{2-}), which is the main form of sulfur in waters and soils[5]. Sulfates that bind with hydrogen form sulfuric acid, and sulfates that bind to alkali metals are the most common form of sulfur found in lakes and rivers[6] Chemically sulfate is an inorganic form of sulfide in an aerobic environment. Scientifically, sulfate is derived from dissolving sulfur-containing minerals, for example, $CaSO_4 \cdot 2H_2O$ or casts and calcium sulfate anhydrous ($CaSO_4$). WHO recommends that sulfate levels be permitted in drinking water around 400 mg/L and hydrogen sulfide levels around 0.05 mg/L[7]. The sulfate ion is a type of solid ion with the empirical formula SO_4^{2-} with a molecular mass of 96.06 atomic mass units. Sulfates consist of a central sulfur atom surrounded by four oxygen atoms in a negatively charged two-sulfur tetrahedron arrangement[8]. The maximum limit of sulfate in water is around 250 mg/L for water consumed by humans[9]. The addition of Sulfate ions from brackish water makes it possible to increase the number of sulfate parameters at locations A3 and A4. The flow velocity of water around 0.2 m/s strongly supports the entry of a certain amount of water from the sea during high tide conditions increasing SO_4^{2-} levels at points A3 and A4. COD and BOD concentrations from upstream to downstream exceed the river water quality standard, and this data is strongly supported by the amount of oxygen dissolved in Rusweri river water (A1 = 6 mg/L, A2 = 5.3 mg/L, A3 = 4.3 mg/L, A4 = 4 mg/L and A5 = 3 mg/L) while the minimum standard quality is 6 mg / L. High phosphate levels in rivers can cause high levels in the sea if the river empties into the sea[10], the source of phosphate in marine waters in coastal areas is rivers. The high levels of COD and BOD in the Rusweri river, when viewed from upstream to downstream, are caused by the decomposition of large amounts of organic matter in the waters which will absorb oxygen in the water thereby reducing the amount of dissolved oxygen (DO)[11]. The relationship between decreased DO levels with BOD and COD is shown in Figure 8.

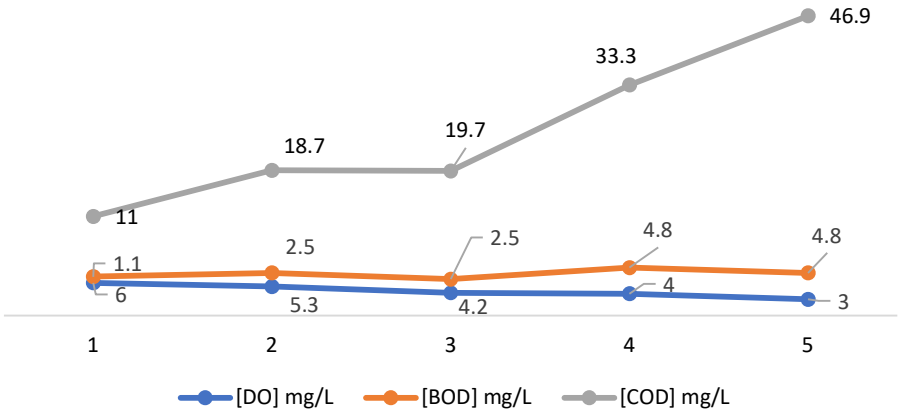

Fig.-8: Relationship between Parameters [BOD] mg/L River Water, [COD] mg/L soil and [DO] mg/L

Iron (Fe) content in water at location A3 = 0.3747 mg/L, A4 = 0.412 mg/L, A5 = 0.412 mg/L while the standard quality of Fe in river water is 0.3 mg/L. The chemical condition of the soil around the river is a factor that affects Fe levels in water and the number of dissolved solids (TDS) in water[12] as illustrated in Fig.-9.

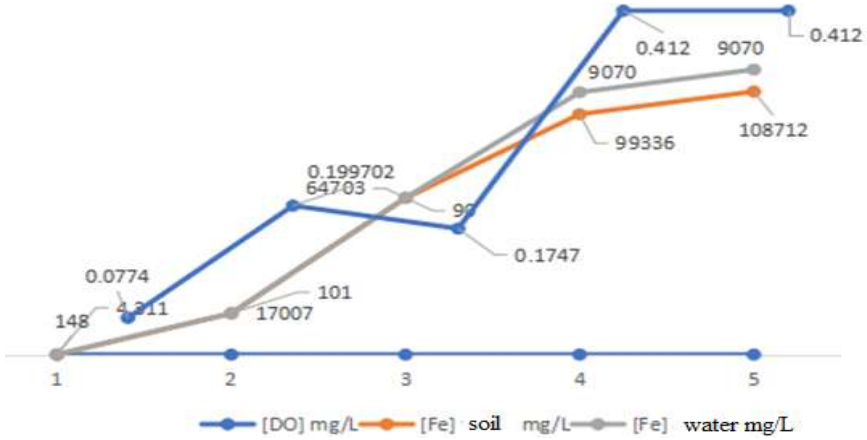

Fig.-9: Relationship between Parameters [Fe] mg/L River Water, [Fe] mg/Kg Soil and [TDS] mg/L

Rusweri river water quality status after being processed using the formula PIj (Pollution Index). Based on the calculation of the pollution index is shown in Table-2.

Table-2: Pollution Index Table based on Parameters in the Rusweri River Body

Parameter	Pollution Index	Status
PO_4^{-}	5.417	Medium polluted
Fe	1.191	Mild polluted
F^{-}	17.381	Heavily polluted
SO_4^{2-}	1.03	Mild polluted
TDS	6.925	Medium polluted
BOD	2.027	Mild polluted
COD	0.378	According to quality standards

Rusweri river water pollution index based on the calculation of PIj (pollution index) shown in Table-2, then the mild pollution status is more dominant, as shown in Fig.-10.

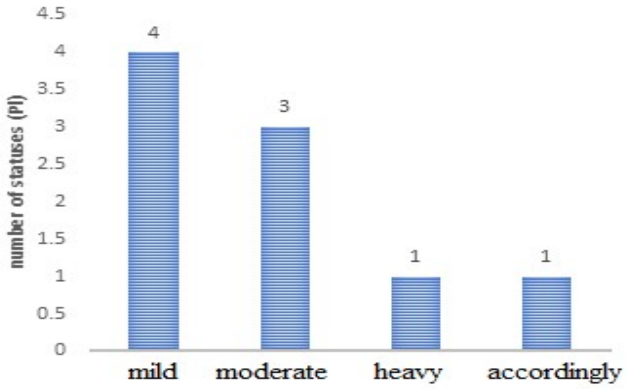

Fig.-10: Pollution Index based on number of PI status

CONCLUSION

This study concludes that the Rusweri river in Supiori Regency, Papua Province, is still considered suitable for the development of ecosystems that exist in and around the river, but it is not recommended as a source of drinking water for the local community because some important parameters have exceeded the water quality standard. Urgently Rusweri river water can be consumed as raw water for drinking water but needs further processing.

ACKNOWLEDGMENT

The author would like to thank the Department of Chemistry, Gadjah Mada University, and Indonesia Endowment Fund for Education (LPDP-BUDIDN), for providing funds and facilities for this research.

REFERENCES

1. A.H. Mahvi, J. Nouri, A.A. Babaei, R. Nabizadeh, *International Journal of Environmental Science and Technology*, **2**, 41(2005), **DOI:**10.3389/fpubh.2019.00174
2. Y. Teng, J. Yang, R. Zuo, J. Wang, *Journal of Earth Science*, **22**, 658 (2011), **DOI:**10.1007/s12583-011-0217-2
3. I.S. Saimy, N.A.M. Yusof, *Procedia - Social and Behavioral Sciences* **81**, 371(2013), **DOI:**10.1016/j.sbspro.2013.06.445
4. D. Janardhana Rao, A.V.V.S. Swami, K. Raghu Babu, B. Hari Babu, *Rasayan Journal of Chemistry*, **9(3)**, 444 (2016).
5. Y. Chen, L. Shen, T. Huang, Z. Chu, Z. Xie, *Science of the Total Environment*, **703**, 135591(2020), **DOI:**10.1016/j.scitotenv.2019.135591
6. J.L. Duan, J.W. Sun, M.M. Ji, Y. Ma, Z.T. Cui, R.K. Tian, P.C. Xu, W.L. Sun, X.Z. Yuan, *Microbiological Research*, **236**, 126453(2020), **DOI:**10.1016/j.micres.2020.126453
7. W.A.M. Fernando, I.M.S.K. Ilankoon, T.H. Syed, *Minerals Engineering* **117,** 74(2018), **DOI:**10.1016/j.mineng.2017.12.004
8. A.S. Thangiah, *Rasayan Journal of Chemistry*, **12**, 1503(2019), **DOI:**10.31788/RJC.2019.1235201
9. Y. Meride, B. Ayenew, *Environmental Systems Research*, **5(1)**, 1 (2016), **DOI:**10.1186/s40068-016-0053-6
10. A. Santhy, R. Rejithamol, *Rasayan Journal of Chemistry*, **11(3)**, 1067(2018), **DOI:**10.31788/RJC.2018.1131978
11. Y.M. Yustiani, S. Wahyuni, M.R. Alfian, *Rasayan Journal of Chemistry*, **11(2)**, 475(2018), **DOI:**10.7324/RJC.2018.1121892
12. D. Kumar, V. Kumar, S. Kumari, *Rasayan Journal of Chemistry* **11(3)**, 1477(2018), **DOI:**10.31788/RJC.2018.1143075

[RJC-6111/2020]