

# Analysis Of Water Quality Of The Sario River

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**Abstract**— The city of Manado is fed by at least 5 large rivers and several other small rivers. The problem that is often faced by the community and the government in particular is that if rainfall is high, the body of water is unable to accommodate and drain water towards the upstream and result in flooding.. Sampling is carried out at the top of the water flow or area before the *Pinasungkulan market*, the middle that passes through *Pinasungkulan market*, and the location of the flow of water flowing under the *Pinasungkulan market*. Variables to be measured for determining water quality is physical quality, chemistry, microbiology. From the results of the analysis that has been done, it can be concluded that: for Physical Water Quality which includes temperature, turbidity, color and total suspended solid (TSS), the resulting value is still below the threshold so that for third class water allocation can be done, for Chemical Water Quality which includes examination of acidity (pH), BOD, and COD, the resulting value is still below the threshold so that for the allocation of third class water can be done, For Biological Water Quality which includes fecal coliform and total coliform examinations, the resulting value is well above the threshold so that for third class water allocation cannot be done. This value shows that the awareness of people who live around the riverbank still uses the river flow as a place to dispose of garbage and human waste.

**Keywords**—*Rainfall, water quality analysis, flooding, physical quality, chemical, biological quality*

## I. Introduction

Manado city located at the end of the Sulawesi peninsula, as the capital of North Sulawesi Province which has a geographical location between 1°25'88"-1°39'50" LU and 124°47'00"-124°56'00" East Longitude (Takaendengan et al, 2017).

The city of Manado is fed by at least 5 large rivers and several other small rivers. The problem that is often faced by the community and the government in particular is that if rainfall is high, then the water will

overflow, the body of water is unable to accommodate and drain water towards the upstream and result in flooding.

The root of this problem is the behavior of people who are not yet fully aware of the existence of rivers that can be used for the public interest. There are still many waste wastes, both liquid and solid waste. The use of river borders that result in erosion and narrowing of the river.

The direct disposal of liquid waste into this body of water also greatly affects the quality of river water.

It is known that the flow of this river passes through the facilities and infrastructure of the Manado *Pinasungkulan Market*. Disposal of liquid waste from the surrounding community is also very influential, especially in terms of biology (fecal coliform).

Water pollution is a global problem faced by many developing countries that require evaluation and revision of policies regarding water resources at all levels of policy makers (Parker, 2012).

Manado city government program, especially in the field of Water Resources and Environment has a research road map related to the need for clean water for the community and other living things. The initial research is to identify the morphology of the river and then analyze the quality of the river water and will continue with efforts to improve the economy of the community around the river and tourism.

For this reason, this study was conducted to get preliminary data on the quality of river water physically, chemically and biologically.

### A. Research objectives

The goals to be achieved in this study are: Getting physical water quality value, Getting water quality value chemically, Getting water quality value biologically

### B. Scope

The scope of the study was limited to: Sario river water flow, Physical water quality measurement (pH, turbidity, TSS), Chemical water quality measurement (BOD, COD), Biological water quality measurement (fecal coliform, Total coliform).

## II. LITERATURE REVIEW

Manado city is one of the cities in North Sulawesi Province, which is also the capital of North Sulawesi province. According to the book "Manado City In Numbers 2020", Manado City is directly adjacent to the northern part with North Minahasa district, in the eastern part with North Minahasa and South Minahasa, in the southern part with Minahasa Regency, and in the western part with the Sulawesi Sea. Manado city has 11 subdistricts as well as 87 villages and townships. The city of Manado has a landscape in the form of land and hills, so the city of Manado has many rivers and empties into the coast of Manado bay.

The area of Manado city is traversed by 5 major rivers that divide the city of Manado, namely: Tondano River, Tikala River, Sario River, Bailang River and Malalayang River (Wuisang and Rondonuwu, 2015).

Sario River is one of the rivers that divide the city of Manado sourced from the Mahawu mountain area located in The City of Tomohon (Suadnya, et al, 2017). This river passes through the elite Housing Area citraland, Karombasan (around the market Pinasungkulan Karombasan), Ranotana, Tanjung Batu, and empties around the beach Sario.

Along with the increasing population, economic activities become more diverse, so the need for water resources becomes very important because its existence is very volatile (Sutriati, 2011).

River water quality is greatly influenced by the water supply that comes from the catchment area, and the water supply that comes from the catchment area is influenced by the activities of people who live in the catchment area. (Asrini et al, 2017)

### A. RIVER

The definition of a river is a natural and/or artificial water channel or container in the form of a water drainage network and the water in it, starting from the upstream to the estuary, with right and left borders by border lines (Government Regulation No. 38/2011).

The riverbank is part of the river system holistically, where the existence of the upstream part will affect the central and downstream parts that generally divide the city area (Wuisang and Rondonuwu, 2015).

According to Ali, et al (2018) stated that the river is the union of water on the earth's surface as a result of excess rainfall and groundwater flowing into the valley and forming grooves naturally.

### B. River Water Quality

Natural water has never been found in its pure state, since water condenses into the air, and then falls, it has been affected by particles contained in the air. Water flowing on the surface of the soil has been contaminated due to the soluble of various types of rocks and other organic substances (Sutriati, 2011)

Water quality is defined as the chemical, physical and biological characteristics of water, usually with respect to its suitability for prescribed use. Bodies of water can be used as a means of recreation, drinking water, fisheries, agriculture or industry (Ritabrata, 2018). According to Goi (2020), the term water quality is used to express the suitability of water for the sustainability of various uses or processes. Quality river water is also very impactful on human life.

In Thailand, The raw water from groundwater system showed 100% limits exceeded in biological characteristics. These results indicated the groundwater resource is contaminated by human or animal because of the presence of Total coliform and fecal coliform (Soticha et al, 2014).

In Malaysia, the effects of urbanization and modernization result in the most severe problems faced by Malaysia and adversely affect the sustainability of water resources. To that end, the Malaysian Environment Ministry has classified the water quality index based on 5 classifications (Goi, 2020).

In Malaysia, research from Camara et al (2019) stated that 87% of the studies reviewed showed urban land use as the main source of water pollution, while 82% showed agricultural land use, 77% showed forest land use, and 44% showed other land use.

In Indonesia, the Government has issued Government Regulation of the Republic of Indonesia no. 82 of 2001 on water quality management and water pollution control then equipped with the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia no. P.68 / Menlhk / Setjen / Kum.1 / 8/2016 on domestic wastewater quality standards.

Classification of water quality based on PP No. 82 of 2011, set to 4 (four) classes:

First class, water whose designation can be used for drinking water, and or other designations that require the same water quality as such uses

Second class, water whose designation can be used for infrastructure / facilities of water recreation, cultivation of freshwater fish, livestock, water to irrigate the land,

and or other purposes that require the same water quality with these uses

Third class, water whose designation can be used for the cultivation of freshwater fish, livestock, water to irrigate the land, and or other designations that require the same water as such uses

Fourth class, water whose designation can be used for irrigating, farming and or other designations that require the same water quality as such uses.

### III. RESEARCH METHODOLOGY

The methodology used in this study is the observation research method (Asrini et al, 2017). Technical implementation of this observation method is to conduct reviews, measurements on the ground, take water samples and conduct testing in the laboratory.

Water sampling is determined at the first point at the location at the top of the water flow that will pass through the facilities and infrastructure of Karombasan Pinasungkulan Market. The second point at the location of the middle of the water flow that passes through pinasungkulan market and the third point is the bottom point of the water flow that has passed through pinasungkulan market.

Variables that will be measured to determine water quality are:

#### A. Physical Quality:

Water temperature  
 Turbidity  
 Color  
 TSS (Total Solid Suspended)

#### B. Chemistry

pH: using litmus paper  
 BOD<sub>(5)</sub>  
 COD

#### C. Microbiology

Fecal Coliform  
 Total Coliform

For comparison, the terms and threshold values can be seen in the following table:

TABLE 1. Parameter threshold conditions and values

Parameter	Unit	Class				Remark
		I	II	III	IV	
<b>PHYSICS</b>						
Temperature	°C	Deviasi 3	Deviasi 3	Deviasi 3	Deviasi 5	
Suspended residue	Mg/L	50	50	400	400	*
<b>ORGANIC CHEMISTRY</b>						
pH		6 – 9	6 – 9	6 – 9	5 – 9	**
BOD	Mg/L	2	3	6	12	
COD	Mg/L	10	25	50	100	
<b>Microbiology</b>						
Fecal Coliform	Q'ty/100ml	100	1000	2000	2000	***
Total Coliform	Q'ty/100ml	1000	500	10000	10000	

\* For conventional drinking water treatment, suspended residue ≤ 5000 mg/L

\*\* if naturally outside the range, then it is determined based on natural conditions

\*\*\* For conventional drinking water treatment, fecal Coliform ≤2000 Q'ty/100ml and total Coliform ≤10000 Q'ty/100ml

### IV. RESULT AND DISCUSSIONS

This assessment is carried out by comparing the value of the water quality parameter measured with the water quality standard according to its designation in force in Indonesia.

Government Regulation of the Republic of Indonesia no. 82 of 2001 on water quality management and water pollution control concerning the management of water quality and control of water pollution stipulates the class for the use of water. The third class is a class where the designation can be used for freshwater fish cultivation, animal husbandry, water for irrigating crops and or other uses that require the same water as that use.

Based on the results of water sampling and analysis carried out in the Manado WLN laboratory, where the parameters observed were temperature, turbidity, color, TSS, pH, BOD, COD, Fecal Coliform and total Coliform in the Sario river flow.

#### A. Physical Quality

The results of the analysis of physical water quality in the Sario river water flow are:

##### 1). Temperature

The results of the analysis of water temperature measurements are 26.5°C to 26.8°C, based on these results, the value is still within the normal range and can still be tolerated by freshwater biota.

### 2). Turbidity

From the results of the analysis conducted at the WLN Laboratory, the turbidity value of the four (4) sampling locations was 4.2 NTU. This value is still within normal limits.

### 3). Color

From the results of field observations, the color of the water looks clear for the four research locations

### 4). Total Suspended Solid (TSS)

From the results of the analysis, the TSS value is < 1, this value is far below the value set by the Government has issued Government Regulation of the Republic of Indonesia no. 82 of 2001 for class 3 of 400 mg/L

## B. Chemical water quality analysis results

### 1). Degree of Acidity (pH)

The results of research and analysis of the degree of acidity (pH) in the Sario river flow at four different points/locations. For location/point 1 pH = 8.12, location/point 2 pH = 8.01, point/location 3 pH = 7.75, and location/point 4 pH = 7.68.

The value of the degree of acidity (pH) is still within the tolerance value as stipulated in the Government has issued Government Regulation of the Republic of Indonesia no. 82 of 2001.

### 2). BOD

The results of the analysis of BOD values for the four observation points are:

Point/location 1 = < 2  
Point/location 2 = < 2  
Point/location 3 = < 2  
Point/location 4 = 6

The BOD value in the Government Regulation of the Republic of Indonesia no. 82 of 2001 is 6, so it can be said that the BOD value in the Sario river flow is still within the threshold.

### 3). COD

The results of the analysis that have been carried out at the Manado WLN Laboratory, show the results for the four observation points/locations are:

Point/location 1 = < 10  
Point/location 2 = < 10  
Point/location 3 = < 10  
Point/location 4 = 11

The COD value in Government Regulation of the Republic of Indonesia no. 82 of 2001 is 50, so it can be said that the COD value in the Sario river flow is still within the threshold.

## C. Results of Biological Water Quality Analysis

### 1). Fecal Coliform

According to Government Regulation of the Republic of Indonesia no. 82 of 2001, the threshold value of Fecal Coliform for class 3 designation is 2000 jml/100 ml.

The results of the analysis that has been carried out at the Manado WLN Laboratory for the four observation points/locations are:

Point/location 1 = 160,000  
Point/location 2 = 54,000  
Point/location 3 = > 160,000  
Point/location 4 = 160,000

The value of the analysis results higher than the predetermined threshold indicates that the water quality of the Sario river around the Pinsungkulan Karombasan market is very poor. This value shows that the awareness of the people who live around the riverbanks still use the river flow as a place to dispose of human waste.

### 2). Total Coliform

According to Government Regulation of the Republic of Indonesia no. 82 of 2001, the threshold value of Fecal Coliform for class 3 designation is 10,000 jml/100 ml.

The results of the analysis that has been carried out at the Manado WLN Laboratory for the four observation points/locations are:

Point/location 1 = > 160,000  
Point/location 2 = > 160,000  
Point/location 3 = > 160,000  
Point/location 4 = > 160,000

The value of the analysis results higher than the predetermined threshold indicates that the water quality of the Sario river around the Pinsungkulan Karombasan market is very poor. This value indicates that the awareness of the people who live around the riverbanks still uses the river flow as a place to dispose of human waste

## V. CONCLUSIONS

From the results of the analysis that has been carried out, it can be concluded that:

A. For Physical Water Quality which includes checking temperature, turbidity (turbidity), color and total suspended solid (TSS), the resulting value is still below the threshold so that class 3 water designation can be carried out

B. For Chemical Water Quality which includes checking the degree of Acidity (pH), BOD, and COD, the resulting value is still below the threshold so that class 3 water designation can be carried out.

C. For Biological Water Quality which includes examination of Fecal Coliform and Total Coliform, the resulting value is far above the threshold so that class 3 water designation cannot be carried out.

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## REFERENCES

[1] Asrini, Ni Ketut, I Wayan Sandi Adnyana, I Nyoman Rai, Analysis of Water Quality in the Pakerisan River Basin, Bali Province, ECOTROPHIC Journal of Environmental Science DOI: 10.24843/EJES.2017.v11.i02.p01

[2] BPS Manado City, 2020, Manado in Figures 2020, <https://manadokota.bps.go.id/publication>

[3] Goi, Chai Lee, 2020, The River Water Quality Before and During The Movement Control Order (MCO) in Malaysia, Journal Case Studies in Chemical and Environmental Engineering, Elsevier.

[4] Manado City, [https://id.wikipedia.org/wiki/Kota\\_Manado](https://id.wikipedia.org/wiki/Kota_Manado), downloaded on 21 April 2021 at 12.01

[5] Soewarno, 1991, Hydrology: Measurement and treatment of river flows, Nova Textbook, Bandung

[6] Parker, Chloe, 2021, Water Pollution, environmental expert article, IWA Publishing, <https://www.environmental-expert.com/articles/water-pollution-307136>

[7] Regulation of the Minister of Environment and Forestry of the Republic of Indonesia number:

P.68/Menlhk/Setjen/Kum.1/8/2016, Regarding Domestic Wastewater Quality Standards

[8] Government Regulation of the Republic of Indonesia number 82 of 2001, Concerning Water Quality Management and Water Pollution Control

[9] Government Regulation of the Republic of Indonesia No. 38 of 2011, About the River

[10] Ritabrata, Roy, 2018, An Introduction to Water Quality Analysis, International Journal for Environmental Rehabilitation and Conservation, ISSN: 0975-6272

[11] Suadnya, Dewi Purwati, Sumarauw, JSF, Mananoma, Tiny, 2017, Analysis of Flood Discharge and Flood Water Level of the Sario River at the Citraland Point, Journal of Static Civil Vol.5 no. 3 May 2017.

[12] Sutriati, Armaita, 2011, Assessment of River Quality and Potential Utilization Case study: S. Cimanuk, Journal of Water Resources, Vol. 7 No. May 1, 2011

[13] Takaendengan, T., Padmi, T., Sembiring, E., Damanhuri, E., 2017, Scenario Optimization of the Integrated Waste Transportation System in the Regional Final Processing Site (TPA) (Case Study of Manado City), ITB Environmental Engineering Dissertation,

[14] Wuisang, Cynthia, E.V., Rondonuwu, Dwight M, 2015, Greenbelt Planning in Urban Riverbank Landscapes, Proceedings of the IPLBI Scientific Meeting

[15] Moriken Camara,, Nor Rohaizah Jamil , Ahmad Fikri Bin Abdullah, Impact of land uses on water quality in Malaysia: a review, Ecological Processes 2019, **8**: 1

[16] K. Soticha, Y. Jareeya, K. Sudjit, and P. Prapat, Assessing Water Quality of Rural Water Supply in Thailand, Journal of Clean Energy Technologies, Vol. 2, No. 3, July 2014