Quality of drinking water sources in Sarmi Regency, Papua Province

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Abstract. In general, rivers in Sarmi still in their natural state. Those rivers have considerable discharge during the rainy season and decreased dramatically during the summer. Many rivers are used for domestic purposes such as bathing, washing and other needs in small amounts. Yet there is a river that is used on a large scale as a source of water for industrial activities. Of all the rivers which are the object of monitoring, there is no industry that directly generates large volumes of waste and channeled into the river. In some parts of the river, there are also residential areas, but there is no population growth that causes the expansion of settlements along the banks of these rivers. The sampling method used is grabbed samples. Some things to consider in the course of this sampling include: (1) Water samples taken are representative and reliable; (2) The volume of the sample taken in accordance with the minimum amount required. In general, any method of analysis used chemical parameters has limits specified rate. This is related to the power limitations of each method and measuring equipment used. In that regard, then the chemical analysis is often performed dilution or concentration, with the aim to improve measurement accuracy. The results of the study for water sources used by the community in the sarmi district of Papua Province showed that the values of the measurement results still meet the quality standards for first-class water quality Republic of Indonesia Government Regulation No. 82 of 2001, which is intended for drinking water, water recreation, freshwater fisheries, animal husbandry, and planting. Therefore this quality needs to be maintained by the community by protecting the environment and by the government as a partner by making regulations related to environmental preservation.

Keywords: water quality, drinking water quality, pollution indices, papua

1. Introduction

The water is all the water on above or below ground level, including in this sense the surface water, ground water, rain water, sea water is on land. Water sources can be derived from (i) surface water is the water of rivers and lakes; (ii) Groundwater can be called depending on the depth of shallow groundwater or groundwater; (iii) Air space (atmospheric), the water from the atmosphere, such as rain and snow. The quality of various water sources that vary according to the natural conditions and human activities are nearby. Surface water, either flowing or stagnant part of the component-components of the hydrological cycle, which form the Watershed [1].

The river is a natural waterway flowing into the ocean, lake or sea, or another river. In some cases, a river simply flows seep into the soil before finding other bodies of water. In the historical development of human life, the quantity and quality of water that meets the standards of human life is an important factor that determines the quality of life of human health. The quantity and quality of water are linked to other substances, particularly chemical compounds in the form of organic
compounds, inorganic, also microorganisms that play an important role in determining the chemical composition of water. In nature, water is in the form of surface water and groundwater. Surface water is found in lakes, rivers, and other water sources, while water contained in the soil. Ground water can dissolve mineral material from source rocks in its path. On the other hand, most of the chemicals or microorganisms will be filtered in stages when water enters the soil. Water is an excellent solvent for many materials so that the water be a good medium for the transport of food and waste products/waste generated by the process of life. Because of this, the water found in our environment is never found in a pure state, but there is always mineral or other compounds contained therein. so that the water is a good medium for the transport of food and waste products/waste generated by the process of life. Because of this, the water found in our environment is never found in a pure state, but there is always mineral or other compounds contained therein. so that the water is a good medium for the transport of food and waste products/waste generated by the process of life. Because of this, the water found in our environment is never found in a pure state, but there is always mineral or other compounds contained therein.

In fact, there are very significant differences between surface water and groundwater. This is due to the existence of a variety of materials, both materials are dissolved atauoun suspended in the process of collecting surface water and groundwater. Surface water accumulated in lakes, rivers or other water bodies, contain enough nutrients for the growth of various creatures in it, especially microorganisms, such as algae and others. On the other hand, surface water contains a lot of organic materials that will affect the growth of bacteria and other microorganisms, which in turn will affect the quality of surface water.

In general, the rivers in Sarmi Regency, Papua Province are still in their natural state. These rivers have a fairly large discharge during the rainy season and decrease dramatically during the summer. Various rivers are used for domestic purposes such as bathing, washing, and other purposes in small amounts. There is no river that has been exploited on a large scale as a source of water for industrial activities. Of all the rivers that were the object of monitoring, there is no industry that directly produces large amounts of waste and is channeled to the river. In some parts of the river, there are also settlements, but population growth does not cause expansion of settlements along the banks of the rivers.

By knowing the conditions that exist today and its development in the future, it is necessary to test the quality of water in rivers and streams as well as sources of drinking water for the citizens as well who were in Sarmi. This test is a benchmark for monitoring water quality and expected recommendations of this monitoring can be used as a basis for policy making in this case, the local government. The sampling site is the Tetom River (SKT), Abram River (SE), Sewan River (SS), and Wells (US) which is a source of water for the water business.

2. Experiment

The sampling method used is grabbed samples. Some things to consider in the course of this sampling include: (1) Water samples taken are representative and reliable; (2) The volume of the sample taken in accordance with the minimum amount required. In general, any method of analysis used chemical parameters has limits specified rate. This is related to the power limitations of each method and measuring equipment used. In that regard, then the chemical analysis is often performed dilution or concentration, with the aim to improve measurement accuracy.

For sampling and analysis of reference samples used on the Minister of the Environment Number 37 in 2003 about Water Quality Analysis Method of Surface and Surface Water Sampling[4].

2.1. The level of sampling for inspection

Setting the sampling tool adapted to the situation (location) of water sampling. Flushing the appliance where the sample (container) with a water source to be sampled. Take samples in accordance with their needs, then save it in a temporary container after mixing evenly. When a sample
is taken from a number of points, then the volume of the sample taken from any point must be the same.

2.2. Tests carried out in the field

Examination of the elements that can change rapidly, must be conducted in the field directly. These elements include pH, temperature, conductivity, Total Dissolved Suspended (TDS), temperature, salinity, and dissolved oxygen. All test results are recorded in a journal in the field, which includes the identity of the point of sampling, date of sampling, time sampling, the weather, preservatives are used. Materials and methods section describes materials used in research and steps followed in the execution of the study. A brief justification for the method used is also stated so the readers can evaluate the appropriateness of the method, reliability, and validity of the results. Interventionary studies involving animals or humans, and other studies require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

3. Result and Discussion

Analysis of water quality criteria for using Mold Class I water the Indonesian Government Regulation No. 82 of 2001, which are intended for drinking water, recreational water, fresh water fisheries, livestock, and crops. The quality of public drinking water sources in Sarmi seen from the levels of heavy metal ions such as copper, manganese, iron, and some parameters. The results of the analysis are presented in the table below

| Parameter  | Unit  | Locations | Quality standard |
|------------|-------|-----------|------------------|
|            |       | SKT  | SE   | SS   | US   |       |
| Temperature| °C    | 31,2 | 27,7 | 29,8 | 27,1 | -     |
| pH         | -     | 7,7  | 8,0  | 7,9  | 7,8  | 6-9   |
| EC         | μS/cm | 0,418| 0,293| 0,37 | 0,549| -     |
| TDS        | mg/L  | 320  | 240  | 290  | 400  | 1000  |
| DO         | mg/L  | 7,6  | 7,9  | 5,6  | 7,8  | 6 (min)|
| Mn         | mg/L  | 0,714| 0,524| 0,238| 0,095| 0,1   |
| Cu         | mg/L  | 0,0174| 0,0124| 0,0124| 0,0074| 0,02 |
| Fe         | mg/L  | 0,524| 0,73 | 0,667| 0,079| 0,3   |

The present study was to obtain preliminary data on the water quality of the water used for the needs of society in Sarmi Papua. Several chemical and physical parameters measured for water quality. Standards used in the exposure data based on Republik Indonesian Government Regulation No. 82 of 2001 on water quality management and water pollution control.

3.1. Temperature

The increase of temperature may lead to increased concentrations of dissolved substances, increasing the chemical reaction rate, evaporation, and volatilization, which also causes a decrease in gas solubility in water. In addition, the increase in temperature can also cause an increase in metabolic rate and respiration of aquatic organisms, and subsequently result in oxygen consumption[5].

The results of temperature measurements carried out show at all points of the temperature range are between 27.1 - 31,2°C. The temperature range is still within the limits of fair and good for a body of water. This is supported by the environmental temperature at the time of measurement in the range of 26.2 - 32,9°C. Therein lies the justification, because fresh water can not withstand heat, so generally the temperature difference between the land and freshwater slightly higher when compared to
seawater. The reason is the salt contained in sea water can act as a heat barrier so that sea water is generally warmer than in fresh water.

![Graph of temperature monitoring results](image)

**Figure 1.** Graph of temperature monitoring results

### 3.2. Total Dissolved Solid (TDS)

TDS is generally caused by substances in the form of inorganic ions commonly found in the waters. The TDS value of the water is strongly influenced by the weathering of rocks and anthropogenic influences (such as domestic and industrial waste). Substances dissolved in water are not toxic, but if excessive may increase the turbidity. In addition, the materials are suspended in water is not toxic, but if excessive may increase the turbidity, which will further inhibit the penetration of sunlight into the water column and eventually have an effect on the process of photosynthesis in the ocean. Total solid is a combination of TDS and TSS. The observations in this study show TDS levels ranged from 240-400 mg/L.

### 3.3. Electric Conductivity (EC)

Conductivity or electric conductivity (EC) is the ability of water to pass an electric current. This is due to the presence of minerals that are dissolved in the ionized water. Ions are able to conduct electricity. The higher the capability electric current, which means that more ions present in the water. The objective was to determine the conductivity of the ions dissolved in water or dissolved minerals. The water conductivity data were useful for predicting or evaluating water quality or type of water (surface water, ground water, brackish water or seawater). Data is often associated with high levels of conductivity, dissolved substances (TDS = Total Dissolved Solid) in the water. The river water quality standards which were in 2250 μS/cm, and the measurement results at each study site to provide data at the lower 0.37 μS/cm and the highest 0.549 μS/cm.

### 3.4. pH

The acidity of the water will affect the solubility of chemicals are available. pH can trigger the explosion solubility so that the water will be accumulated certain material, which is likely to endanger the life of aquatic biota [6]. As a measure of acidity and alkalinity of the nature of water, extracted pH is defined as minus the price of the logarithm of the hydrogen ion concentration. pH affects the toxicity of a chemical compound. In the atmosphere of alkaline (high pH) are more common and non-ionized ammonia, which is toxic. Some types of metal will also be poison in low pH conditions. From the analysis of pH, obtained a pH range between 7.7 to 8.0. PH is still in the normal pH range limits, ie between 6-9.

### 3.5. Dissolved Oxygen (DO)

Dissolved Oxygen(DO) or dissolved oxygen in the water is the concentration of oxygen dissolved in the water that comes from the process of photosynthesis by phytoplankton or other aquatic plants in
the euphotic zone, as well as the diffusion of air. The solubility of oxygen in water is determined by temperature, salinity, water turbulence, and air pressure. In situations where an increase in temperature, there will be a decrease in the solubility of oxygen in the water. The level of oxygen in fresh water at 25°C temperature range of 8 mg / L. The source of dissolved oxygen can be derived from the diffusion of oxygen in the atmosphere (about 30%) as well as aquatic plants and phytoplankton activity. Diffusion of oxygen from the atmosphere can occur directly on the water when stationary (stagnant), in addition to the water mass agitation process will also speed up the process of diffusion. In the process of water mass unrest, there will be a process of water oxidation by oxygen in the air. The oxygen content in the water generally has an effect on the solubility of chemicals in the water.

Dissolved oxygen is the most important substance in the waters of life, in this case, it played a role in the metabolism of macro and microorganisms that utilize organic matter derived from photosynthesis. It also has an important role in rendering organic materials by various types of aerobic microorganisms [7] so if there is not enough oxygen availability will result in an aquatic environment and aquatic life to be disrupted, and will reduce water quality. The vertical distribution of oxygen in water decreases with increasing depth. The oxygen concentration decreases with increasing depth, even had expired before reaching the ground. Further removal of oxygen in the bottom waters caused more decomposition process of organic matter that requires oxygen [8]. The results of the analysis of samples that have to be obtained by the dissolved oxygen content of 5.6 to 7.8 mg / L. The analysis in the study area iron content between 0.007 to 0.73 mg / L. From locations, wells used for drinking water to meet the needs of first-class quality standards, at 0.3 mg / L.[9]

3.6. Iron

The concentration of iron ions in water that exceeds ± 2 mg / L will cause stains on the equipment and materials that are white. The presence of these elements can also cause odor and color of water and color colloids in water. In addition, a greater concentration of 1 mg / L can cause water reddish color, gives a bad taste to the drink, can form deposits on metal pipe [10].

The solubility of iron in water is strongly influenced by the concentration of oxygen. Iron content in the water that contains enough oxygen generally ranges from 0.3 to 0.4 mg / L. The presence of iron in waters other than natural factors, can also be used to see if there are mining activities, particularly mining of minerals by open pit mining system.

![Graph of metal (Mn, Cu, and Fe) monitoring result](image)

3.7. Copper

Copper (Cu) is an important and useful element for the metabolism in small quantities. The metal is absorbed by the animal body of water, mostly in the form of ions. In the animal body, the metal binds to the protein and if the excess will be removed[3], Cu 2+ ions required for the formation of blood
cells (hemoglobin), but in large amounts can cause a bad taste in the tongue, in addition to causing damage to the liver, even neutropenia (neuromuscular disorders). The threshold set for water class 1 is 0.02 mg/L. The measurement results of samples showed copper levels ranging from 0.0074 to 0.0174 mg/L and meet the quality standards set.

3.8. Manganese

Manganese is an essential nutrient for plants and animals. Manganese is found in all body tissues, and the highest level was found in the liver, kidney, and pancreas [11]. The concentration of manganese in the body is controlled by the regulation of hepatic excretion into bile. In addition, liver function in the absorption of chemical compounds and other toxic substances that enter the body. Increasing water content in the body can take is caused by mineral mining activities C. Thresholds classes I take in water is 0.1 mg/L. At concentrations higher than this threshold manganese ions cause undesirable taste in the drinking water and cause stains on plumbing and clothing[6], The analysis showed manganese levels ranging from 0.095 to 0.714 mg/L. Only one location that meets the KMA class I wells downtown.

4. Conclusion

Based on the results of the research and the results of the tests that have been carried out, the conclusions are:

- The results of this study can be used to shawl initial data for the analysis of water quality in Sarmi Papua.
- The results show the quality of the water used as a source of water for the needs of people in Sarmi still suits the water quality standards in accordance with Government Regulation No. 82 of 2001 on water quality management and water pollution control.
- Keep working on the prevention and control of pollution in the waters of lakes and rivers that flow into waters in Sarmi, either by technical or local government policy. This section is not mandatory but can be added to the manuscript if the discussion is unusually long or complex.

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