Analysis of solid oxygen distribution in kakap river, kubu raya district west kalimantan

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Abstract. The people of the Kakap River area live and open businesses along the river while they directly dispose of waste into the river. The people also use the river as a source of clean water to meet their daily needs. The purpose of this study was to determine the condition of the Kakap River water quality against dissolved oxygen with BOD, COD, pH, and DO parameters. This research used purposive sampling, starting from determining the sample point to be selected. The sample points used were three locations along the Kakap River. The results of the water quality analysis of the Kakap River from the first location in the estuary: COD parameter is 5.0 mg/L, the BOD parameter is <1 mg/L, DO parameter is 5.6 mg/L and pH parameter is 6.65. The second point of Pal 9 location: COD is 41 mg/L, the BOD parameter is 13 mg/L, the DO parameter is 4.9 mg/L, and the pH parameter is 7.17. The third location at Punggur Kecil: COD parameter is 210 mg/L, the BOD parameter is 137 mg/L, the DO parameter is 3.9 mg/L, and the pH parameter is 4.86 in the low tide conditions. These results will meet the water quality standards for class IV according to PP RI No. 82 of 2001, in which it can only be utilized for irrigating crops and other uses that require the same water quality. Apart from that, the results indicate that the water quality condition of the Kakap River has been polluted so it is not appropriate for the people to use the river as a clean water source.

1. Introduction
West Kalimantan Province has a special feature that is located on the Equator line and it has the longest river in Indonesia, the Kapuas River, with a length of 1,143 km and it is categorized as the tidal river. Kapuas River becomes the pulse of life of the people in West Kalimantan as a means of transportation, irrigation sources, fisheries sources, and attractions [1]. This research selected one of the tidal rivers in the West Kalimantan Province, specifically in the Kakap River. [2] Tides are under the influence of moonlight and sunlight. The effects of tides can extend to the river that is deep as far as the land has a flat bottom and currents along the river that is under high tidal intervention [3]. Tides experience the phenomenon of rising and falling sea levels with a period of around 12.4 hours or 24.8 hours. Tidal changes are influenced by the shape of the earth and the atmosphere. The types of tides that occur in the study area are the type of Tidal Diurnal where it occurs two high tides during one day and one low tide during 24 hours 50 minutes [4]. The type of tides can be obtained based on the magnitude of the component amplitude that there are semi-diurnal components. A point in the middle between high tide and the low tide has the greatest flow velocity [5]. Tides that occur in Sungai Kakap District are influenced by changes in the flow once, even changes in flow at twice a day intervals. Changes occur due to river hydrodynamic conditions that always change from time to time, such as changes in river flow dynamics that affect water and sediment transport. This river change is also caused by people’s behaviour that does not pay attention to the condition of the river. Currently, the
depth of the tidal river in the Kakap River is around 4 meters for the high tide, and it will less than 4 meters for the low tide. Therefore, the ships that have depths above 4 meters will run aground and if the water recedes, a small boat owned by the people cannot be used because the water is too shallow.

Disposing waste into the tidal river has a negative impact on the environment and public health. The damages that occur are physical, biological, chemical, and ecological. Based on preliminary observations conducted by the researchers, by interviewing several people who live on the banks of the river, people generally think partially and only benefit themselves without thinking about the environment they live in. The composition of various types of household waste is ranging from plastic bottles, glass bottles, cans, residual of plastic, residual of vegetables and fruits, light bulbs and detergents [6]. Based on the observations that the water quality of Kakap River is polluted indicated by changing the colour of the water, and the smell of water caused by the behaviour of people who dispose of waste into the river. The condition of the Kakap River is influenced by the tidal river flow, most of the population live and opening businesses along the river and directly disposing of waste into the river. Normal water has a condition that can be consumed by humans. Normal pH of water is between 6.5-7.5, if the water has a pH above or below that pH, it can be said that the water has been contaminated by pollutants.

There is plenty of research related to the water quality from various regions in Indonesia and other countries. The following are some studies on river water quality problems in Indonesia. In research entitled “Operational Effectiveness of WTU and WWTP Batik in Pekalongan City”, the results of the wastewater test in the WTU outlate with COD parameters show that the water still exceeds the specified quality standards, while there are 6 other parameters namely TSS, BOD, Total Cr, Phenol, pH, and Ammonia, which are still below the specified standards. Meanwhile, the river water test in the Jenggot Village, the COD parameter shows a concentration of 50 ppm and BOD is 17.5 ppm. The results exceed the quality standard of 25 ppm and 3 ppm. 5.2 ppm. BOD concentration in the river water test in Kauman Village is above the 3 ppm quality standard [7]. While researchers with the title of the study is “The Water Quality of Musi River at Palembang City South Sumatra”[8]. The results of this study state that the quality conditions of the Musi river water are not suitable for consumption because they indicate pollutants that polluted from industry and feces as indicated by several values of the test parameters that exceed the allowed threshold for river waters. The parameters tested are several physicals, chemical, and biological parameters in the Musi River Waters. Physical parameters are temperature, TSS, and TDS. Chemical parameters are including pH, COD, BOD, organic matter, and metals. Meanwhile, the biological parameters are total coliform in Amatai.

Conducts a study entitled Water Quality and Pollution Index Study in the Makassar City Coastal Zone. This research is conducted in two seasons, namely dry and rainy seasons [9]. The research location is along the coastal area of Makassar City with water sampling points representing tourism activities, ports, and aquaculture ponds. The results of the study stated that based on environmental parameters that are still appropriate with quality standards for marine biota include DO, pH and Salinity. Meanwhile, parameters that have exceeded the quality standards include BOD, Phosphate (except measurements in the dry season), Phenol, Nitrate, and Sulfide. The high concentration of parameters that exceeded the quality standard is estimated to originate from domestic and industrial waste at the three stations that are quite high. The condition of the water of the City of Makassar based on the results of the calculation of the pollution index is classified as mild pollution. The study from entitled “From Environmental Awareness to Environmental Responsibility: Towards a Stewardship Curriculum in Nigeria” aims to overcome the failure of environmental problems through environmental education. Human perceptions and attitudes direct biocentric management for the environment [10].

Chemical qualities, apart from pH, include dissolved oxygen (DO) levels, organic waste levels measured from the amount of oxygen needed to solve organic waste known as Biological Oxygen Demand (BOD), and organic waste levels measured from the amount of oxygen needed to solving organic waste known as Chemical Oxygen Demand (COD) numbers. If the river contains a lot of organic waste, the amount of oxygen needed by microorganisms to break down the waste will
increase, it means that the BOD will be high. A high BOD number will mean a low DO rate. The amount of oxygen that is used to solve the waste, the oxygen content dissolved in water will decrease, so the COD is low. Rivers that have high BOD will generally cause an unpleasant odour due to low DO and also means that the breakdown of organic waste will take place without oxygen. Disposing waste into the water can change the hydrogen ion (pH) in the water to be more acidic or more alkaline depending on the type of waste and chemicals contained in it.

The objectives to be achieved in this study are to determine the quality of the Kakap River water at low tide, and the impact on the health of the people who live alongside the Kakap River, as well as to describe the behaviour of the people in disposing of waste in the Kakap River.

2. Research Method
The method used in this study was a qualitative research method aiming at obtaining a description of tidal river conditions and the river water quality in Kakap River, Kubu Raya Regency of West Kalimantan since this river is utilized as waste disposal by the society. This study was started from the first site survey then continued by the submission of water quality that included determining the location of sampling. The source of data used in this study were primary and secondary data. Primary data were used for the observation of the research area and the Kakap River pollution from the water test results in the Laboratory. Measurements were taken at low tide only on April 9th, 2019 at 08:45 - 10:00 WIB. Meanwhile, the secondary data consist of the population data and a general description of the case study location. The data collection technique used in this study was a case study by utilizing a variety of sources. The qualitative data analysis technique used triangulation analysis.

There are four steps in conducting this research, as follows:

- The first stage was determining the problems that occur in the field, and related problems regarding the behaviour of the society in disposing of waste into the river that resulted in a decrease in water quality.
- The second stage was reviewing related theory. The writers examined theories regarding the problems revealed in the field related to water quality.
- The third stage was collecting and analysing the data. The writer collected the data in line with the qualitative research stages of case studies. After the data was collected, the next process was the writers analysed the data that have been obtained by using case study data analysis techniques.
- The fourth stage was drawing a hypothesis after the data were collected and analysed. Then, the results of the analysis were used to reveal the next hypothesis that will be verified.

![Figure 1. Research Step](image)

3. Result and Discussion
The initial condition of Kakap River is a large number of people disposing the waste into the river, and the number of the building located alongside the river not only for the houses but also for the
businesses, such as restaurants, motorcycle wash, chicken slaughterhouse, and markets. Daily activities of the dominant society are on the bank of the Kakap River so that the residual waste of the business is disposed directly into the river without thinking about the health impacts of the people who use the river water as their daily needs, such as washing and bathing. This behaviour has been going on for a long time. People realize that disposing the waste into the river will create a bad impact, but they still do it. Disposing waste into the river is like a tradition that is difficult to be avoided by them. Below is a picture of the Kakap River conditions:

![Kakap River Condition](image1)

**Figure 2.** Example Image Kakap River Condition

![Community Settlements](image2)

**Figure 3.** Example Image Condition of Community Settlements on the Banks of the Kakap River

![Kakap River As A Means of Water Transportation](image3)

**Figure 4.** Example Image Kakap River As A Means of Water Transportation

The unwise behaviour of the society in responding to environmental problems has a negative impact on the environment in which they live and also a negative impact on public health. Kakap River has a very essential role in the life of society. However, the current condition of the Kakap River has begun to experience physical, biological and chemical damage. After the researchers observed and tested the quality of Kakap River water, the water quality results are obtained with parameters of pH,
Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) that are tested in the Health Department for Health Technical Implementation Laboratory on Jalan Dr. Sudarso, Pontianak, West Kalimantan. Below are the results of water quality that have been tested in the laboratory:

**Table 1.** Report on Clean Water Test Results (LHU) Station 1 Estuary Part In 2019

| No | Parameter | Unit | Max Content * | Water Quality Level | Result | Method |
|----|-----------|------|---------------|---------------------|--------|--------|
|    |           |      |               | I  | II  | III | IV |            |        |
| 1  | COD       | Mg/L | -             | 0  | 25  | 50  | 1  | 5.0        | WI-M-L-4-ULK |
| 2  | BOD       | Mg/L | -             | 2  | 3   | 6   | 1  | <1         | BOD meter |
| 3  | DO        | Mg/L | -             | 6  | 4   | 3   | 0  | 5.6        | DO meter |
| 4  | pH        |       | 6.5-9.0       | 6- | 6-9 | 6-9 | 9-9 | 6.65       | SNI-06-6989.11-2004 |

Source: Unit Health Laboratory, 2019

Based on table 1 above, it can be viewed that the condition of water quality at the Station I of the Kakap estuary river from four parameters COD, BOD, DO, and pH. From the first sampling at the Kakap estuary river, the concentration of the COD parameter is 5.0 mg/L, BOD parameter concentration is <1 mg/L, DO parameter concentration is 5.6 mg/L, and the pH parameter concentration is 6.65. It meets the water quality standards for class I according to PP RI No. 82 of 2001. This water class quality can be utilised for drinking water and other purposes.

**Table 2.** Report on Clean Water Test Results (LHU) Station II Middle Part In 2019

| No | Parameter | Unit | Max Content * | Water Quality Level | Result | Method |
|----|-----------|------|---------------|---------------------|--------|--------|
|    |           |      |               | I  | II  | III | IV |            |        |
| 1  | COD       | Mg/L | -             | 10 | 25  | 50  | 100 | 41         | WI-M-L-4-ULK |
| 2  | BOD       | Mg/L | -             | 2  | 3   | 6   | 12  | 13         | BOD meter |
| 3  | DO        | Mg/L | -             | 6  | 4   | 3   | 0   | 4.9        | DO meter |
| 4  | pH        |       | 6.5-9.0       | 6-9| 6-9 | 6-9 | 9-9 | 7.1        | SNI-06-6989.11-2004 |

Source: Unit Health Laboratory, 2019

Based on table 2 above, it can be seen the report on the clean water test results at Station II in the middle, specifically in the area of Pal 9 Sungai Kakap District, Kubu Raya Regency of West Kalimantan Province. The concentration of COD parameters is 41 mg/L, BOD parameters concentration is 13 mg/L, DO parameters concentration is 4.9, and pH parameters concentration is 7.17. These results meet water quality standards for class III based on PP RI No. 82 of 2001, dated 14 December 2001. A class III water quality standard can be used for fish farming, animal husbandry, and crops irrigating.
### Table 3. Report on Clean Water Test Results (LHU) Station III Limits of Kakap River In 2019

| No | Parameter | Unit | Max Content* | Water Quality Level | Result | Method |
|----|-----------|------|--------------|---------------------|--------|--------|
| 1  | COD       | Mg/L | -            | I II III IV         | 210    | WI-M-L-4-ULK |
|    |           |      | 0 5          |                     |        |         |
| 2  | BOD       | Mg/L | -            | 2 3 6 12            | 137    | BOD meter |
| 3  | DO        | Mg/L | -            | 6 4 3 0             | 3,9    | DO meter |
| 4  | pH        | -    | 6.5-9.0      | 6-9 6-9 6.0-9 9.0   | 4.86   | SNI-06-6989.11-2004 |

Based on table 3 above, the report on clean water test results at station III that is located along the Kakap River, specifically in Punggur Village, Sungai Kakap District, Kubu Raya Regency of West Kalimantan Province. In table 3 above, the parameters do not change. The parameters in Table 3 are the same as in table I and table 2 except the difference in the results of the tests and the location of water sampling. The clean water test results at the Station III: the first parameter of COD concentration is 210 mg/L. It exceeds the water quality class standards specified in PP RI No. 82 of 2001, dated 14 December 2001. The BOD parameters concentration is 137 mg/L. It exceeds the water quality class standards specified in PP RI No. 82 of 2001, dated 14 December 2001. DO parameter concentration is 3.9, which means DO parameters meet class II water quality standards. It can be used for water recreation infrastructure/facilities, cultivation of fish farming, livestock, and crops irrigating as stated in Government Regulation No. 82 of 2001, December 14, 2001. The pH parameter concentration is 4.86. This pH results only meets the class IV water quality standards. This water can be utilised for irrigating crops and/or other purposes that require the same water quality as in PP RI No. 82 of 2001, dated December 14, 2001.

Based on the research that has been conducted and the results obtained, the river has been polluted so it is not appropriate for the people to use it as a clean water source. There is a relationship between the parameter values of BOD, COD, DO, and pH in low tide conditions. BOD (Biochemical Oxygen Demand) is one of the most important parameters to determine water quality or an important parameter to determine how the river or water is polluted, especially the pollution of inorganic waste material that is not easily decomposed. The amount of oxygen needed by bacteria to decompose pollutants is known as BOD (Biochemical Oxygen Demand). Whereas DO (Dissolved Oxygen) is the amount of oxygen contained in the water needed by all living bodies for breathing. Oxygen requires organic and inorganic materials in the aerobic process. However, if the BOD content is higher than the DO content, then oxygen is decreased. Parameters pH is only to reveal the level of acidity in water.

### 4. Conclusions
Based on the results of the analysis, it shows that the condition of Kakap River water quality in Kakap River sub-district, Kubu Raya Regency, West Kalimantan Province has experienced mild pollution so that it is not suitable for the surrounding community as clean water and negative impacts on the health of the people who use Kakap River water which is a skin disease caused by Kakap River water. BOD (Biochemical Oxygen Demand) is one of the parameters that is very important to determine water quality or important parameters to determine how the river or water is polluted, especially inorganic material pollution which is not easily decomposed.

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