

# Water quality of the Panasen River in the upstream of the Tondano Watershed in a five-year period (2014-2018)

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## Water quality of the Panasen River in the upstream of the Tondano Watershed in a five-year period (2014-2018)

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**Abstract.** Water quality of the Panasen River in upstream of Tondano's watershed is important to study because the Panasen River crosses residential areas, agriculture, and livestock farms, carrying solid and liquid wastes from these activities, which ultimately leads to Lake Tondano. This waste has the potential to become residue in Lake Tondano. The objective of this research was to study water quality of the Panasen River in the upper of the Tondano watershed throughout a five-year period (2014-2018). Water sampling is done by using *composite sampling* in the one location of Panasen River which become the inlet of Lake Tondano, analyzed using *Colorimetric* method, and compared with the Quality Standard in accordance with the Law of No. 82/2001 Class II about Water Quality Management and Water Pollution Control (KLH, 2001). The results showed that 30 parameters (temperature, pH, TDS, TSS, NH<sub>3</sub>, DO, BOD, COD, chloride, CN, F, NO<sub>3</sub>, NO<sub>2</sub>, sulfate, sulphide, PO<sub>4</sub>, As, B, Ba, Cd, Co, Cu, Fe, Mn, Pb, Se, Zn, Hg, Cr-VI, surfactant (MBAS)) analyzed generally met the Water Quality Standard in accordance with the Law of No. 82/2001, except the chlorine parameter concentrations: Chlorine concentration in 2013 (0,1 mg-0,19 mg/l), 2014 (0,1 mg/l-0,44 mg/l), 2015 (<0,02 mg/l- 0,11 mg/l), 2016 ( 0,05 mg/l – 0,08 mg/l), 2017 (<0,02 mg/l-0,07 mg/l), 2018 (0,03 mg/l-0,06 mg/l). Average chlorine concentrations exceeded Quality Standards according to the Law of No. 82/200101 (Chlorine 0,03 mg/l). The high concentration of chlorine in the Panasen River water bodies is partly due to the application of KCl fertilizers, pesticides to rice fields, horticultural lands, and domestic waste.

### 1. Introduction

The Panasen River is located in the upper Tondano watershed and empties into the southern part of Lake Tondano [1]. Thus, the quality of the Panasen River can affect the water quality of Lake Tondano.

The Indonesian government regulation No. 26/2008 [2]. concerning the National Spatial Plan (RTRWN) stipulated Tondano watershed including Lake Tondano as: 1. National Strategic Area in terms of the importance of environmental functions and carrying capacity, and 2. National Strategic River Area.

National Strategic Areas are seen from the point of view of the importance of environmental functions and carrying capacity determined by the following criteria: (a). as a biodiversity refuge; (b). as a national asset in the form of a protected area designated for the protection of ecosystems, flora and / or fauna that are almost extinct or estimated to be extinct which must be protected and / or conserved; (c). providing protection for the use of water balance, which every year has the opportunity to cause state losses; (d). providing protection for macro-climate balance; (e). demanding high priority



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in improving environmental quality; (f). being prone to natural disasters; or (g). being very decisive in changing natural hues and having a broad impact on the survival of life.

National Strategic River Area is determined by the following criteria: (a). serving national strategic areas, PKN, or mainstay areas; (b). serving at least 1 (one) irrigation area with an area greater than or equal to 10,000 (ten thousand) hectares; and / or (c). having a negative impact due to the destructive force of water on economic growth which results in an economic loss rate of at least 1% (one percent) of the province's gross regional domestic product (GRDP).

Panasen River quality is assessed based on quality standards, namely the size of the limit or the level of living things, substances, energy, or components that exist or must exist and or pollutants tolerated in the water (The Law No. 82/2001 concerning Management of Water Quality and Water Pollution Control). According to the law, the water quality is classified into 4 (four) grades, namely: (a). Grade 1, raw water that can be used for drinking and/or other uses that require the same water quality; (b). Grade 2, water that can be used for water recreation infrastructure/facilities, freshwater fish farming, livestock, irrigation, and / or other uses that require the same water quality; (c). Grade 3, water that can be used for freshwater fish farming, livestock farming, crops irrigation, and or other uses which require the same water quality; (d). Grade 4, water that is designated for irrigating, planting and / or other uses that require the same water quality as that use.

This research aims to assess the quality of the Panasen River water in the upstream of the Tondano watershed within five years (2013-2018).

## 2. Methods

The main equipment used in this study is a water sampling tool: water sampler, ice box, GPS, pH meter, thermometer, and spectrophotometer: Equipment used for water quality parameter concentration analysis (PP No. 82/2001). The research materials were Tondano watershed Map, aquades, tissue, labels to mark the sample, camera and writing instruments.



Figure 1. Water Sampling Location

Primary data was obtained by taking data directly in the field *in situ*: pH, temperature and analysis in the laboratory, namely to obtain water quality data (The Law No. 82/2001). Water sampling refers to Hadi [3]. Water sampling was carried out using the composite sampling method in one location

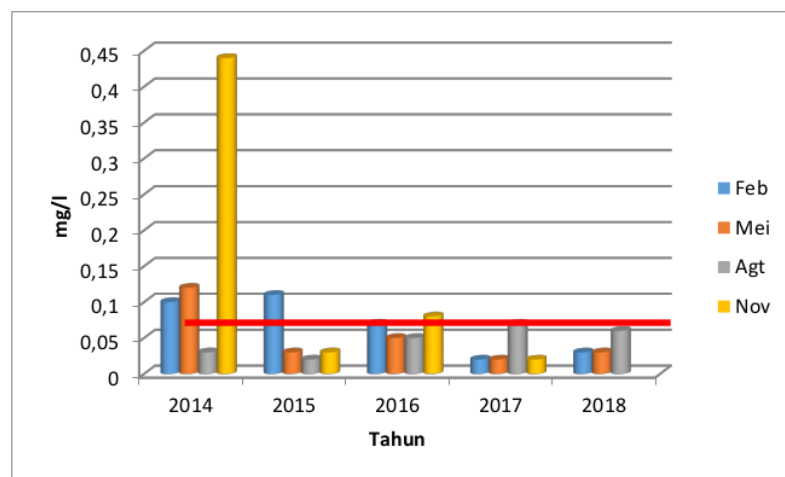
(Figure 1), which were the inlets of Lake Tondano. Stages of water sampling began with preparation of tools and materials, preparing samples in the field and analyzing them in the laboratory.

Data was analyzed using the Colorimetry method and compared with Quality Standards according to the Law No. 82/2001 Class II concerning Management of Water Quality and Water Pollution Control [4]. Class II is water whose designation can be used for water recreation, infrastructure/facilities, freshwater fish farming, livestock farming, crops irrigation, and/or other uses that require the same water quality.

### 3. Results and Discussion

The results of the Panasen River water quality research conducted over a period of five years (2014-2018) show that the 30 parameters (temperature, pH, TDS, TSS, NH<sub>3</sub>, DO, BOD, COD, chloride, CN, F, NO<sub>3</sub>, NO<sub>2</sub>, sulfate, sulphide, PO<sub>4</sub>, As, B, Ba, Cd, Co, Cu, Fe, Mn, Pb, Se, Zn, Hg, Cr-VI, surfactants (MBAS)) which are analyzed generally meet the water quality standards according with the Law No. 82 of 2001, except chlorine parameter concentrations.

The result of the chlorine analysis on PP Quality Standard 82 of 2001 Class II is graphically shown in Figure 2.



**Figure 2.** Chlorine Concentration in the Upper Panasen River of the Tondano Watershed for the 2014-2018 Period

Figure 2 shows the chlorine concentration that fluctuates for each month in each year, the highest value was in November 2014 of 0.44 mg / l (Quality standard for chlorine concentration is 0.03 mg / l). Besides that, measured chlorine levels that exceed quality standards occurred in February 2015, February and November 2016, August 2017, and August 2018. The trend that occurred in the last three years shows that chlorine levels is above the quality standard in August. Climate data shows that rainfall is low in August.

The high chlorine concentration in the Panasen River water is partly due to the application of KCl fertilizer, pesticides on rice fields, and horticultural land. The southern region of Lake Tondano is dominated by wetland agriculture with a vast rice field area of about 2924 ha [1]. Chloride inputs to watersheds are most often from atmospheric deposition, road salt, or agricultural fertilizer [5]. Some specific pollutants such as chlorinated hydrocarbons general municipal and industrial waste [6]. Waste containing household effluent and human wastes are discharged directly to a natural drain or water body and open agriculture land [7]. Deterioration of water quality in rivers are decrease in water

quality from nutrient leaching [8]. Legal, cultural, technical operational aspects determine environmental conservation [9]. Also, the current conditions of domestic waste contain many chlorine- containing products such as household appliances, medical devices, paper, drugs and pharmaceutical products, refrigerants, cleaning sprays, solvents and various other products [10]. Burning waste or solid waste containing chlorinated hydrocarbon compounds can cause the formation of harmful organochlorine compounds such as dioxin. Water supplies management sector is responsible to resolve this problem by complete monitoring and using enough chlorine so that no more water shall remain harmful for the health of citizens [11].

#### 4. Conclusion

Thirty water quality parameters (temperature, pH, TDS, TSS, NH<sub>3</sub>, DO, BOD, COD, chloride, CN, F, NO<sub>3</sub>, NO<sub>2</sub>, sulfate, sulphide, PO<sub>4</sub>, As, B, Ba, Cd, Co, Cu, Fe, Mn, Pb, Se, Zn, Hg, Cr-VI, surfactants (MBAS)) fulfilled the requirements according to the Law No. 82/2001. Chlorine levels in the Panasen River upstream of the Tondano watershed exceed the quality standards required in the Law No. 82/2001. Chlorine concentration tended to be the highest in August.

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