

Water Quality Assessment of Cimanuk River in West Java Using Pollution Index

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Abstract. Cimanuk river is one of the seven rivers in West Java. Cimanuk river pollution is indicated to have suffered as a result of the activity of domestic waste, industrial and agricultural uncontrolled in the riparian area of Cimanuk river. This research aims to analyze water quality of Cimanuk river based on water quality standard on Government Regulation of Republic of Indonesia (IDN), Regulation of the Governor of West Java (WJ), World Health Organization (WHO), Environmental Standard of United Kingdom (UK), Environmental Protection Agency (EPA), Environmental Quality Standard (EQS), and Department of Environment (DOE). This research used pollution index method. The result is water quality of Cimanuk river not meet water quality standard where the TSS (94.85±84.60 mg/L), BOD (9.61±3.16 mg/L), COD (37.69±14.01 mg/L), DO (5.12±1.22 mg/L), NH₃N (0.25±0.24 mg/L). Degradation of water quality of Cimanuk river from upstream to downstream marked by increased pollution index value annually. Pollution index of Cimanuk river ranging from 1.25 to 20.31. Water quality status of Cimanuk river has been from lightly polluted to heavily polluted.

1 Introduction

River is a water resources which is utilized for the life of humans and other living beings [1]. Therefore, river is unseparated from community activities in the riparian area. Community activities in the riparian area as domestic, agriculture, and industry will improve solid and liquid waste disposal. The waste disposal activities uncontrolled properly will have a negative impact on the water quality of river, resulting in water pollution of river.

Cimanuk river is one of the seven rivers in West Java. Some of rivers in West Java like Citarum river [2,3], Cilamaya river [3], Cileungsi river [3,4] has been polluted. Whereas, the rivers in West Java is widely used as a water source for the raw material Regional Drinking Water Company (PDAM) and the public.

Water pollution of river is an important issue that needs serious attention from various parties, including academics, community and stakeholders [5]. Based on the problems,

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2 Materials and Methods

This research aims to analyze Cimanuk river water quality and assessment of water quality status of the river Cimanuk use pollution index method

2.1 Sampling Site of Riverwater

Water sampling sites of Cimanuk river in Bayongbong (107°49'33.6"E,07°15'56.1"S), Sukaregang(33.3"E,07°11'39.4"S), Tomo (108°08'03.1"E,06°45'43.1" S) and Jatibarang (108° 17' 45.6" E, 06° 28'07.0"S) in West Java (Fig 1). Analysis of water quality of Cimanuk river by compared water quality test results with water quality standard (Table 1).

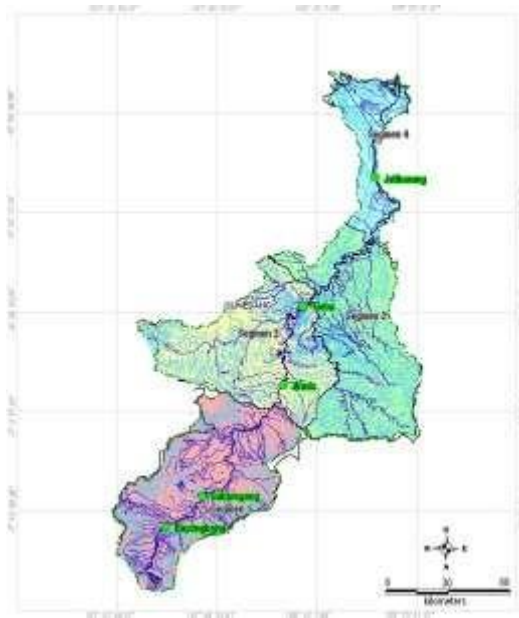


Fig. 1. Map of Sampling Site in Cimanuk River, West Java Province

2.2 Pollution Index

Water quality status was assessed by water pollution index method based on the Minister of Environment Decree Number 115/2003 on Guidelines for Determination of Water Quality Status. Water pollution index was calculated by the following measures.

$$PI_j = \sqrt{\frac{(C_i/L_{ij})_M^2 + (C_i/L_{ij})_R^2}{2}} \quad (1)$$

Where PI_j is pollution index for a specified water quality purpose (j), L_{ij} is standard water quality parameter for each parameter at specified water quality purpose (j), C_i is measured water quality parameters, $(C_i/L_{ij})_M$ is C_i/L_{ij} maximum and $(C_i/L_{ij})_R$ is C_i/L_{ij} average. PI_j was then compared with the criteria shown at Table 1.

Table 1. Pollution index and water quality status criteria

Pollution Index	Water Quality Status
$0 \leq P_{ij} \leq 1.0$	Meet quality standards
$1.0 \leq P_{ij} \leq 5.0$	Lightly polluted
$5.0 \leq P_{ij} \leq 10.0$	Moderately polluted
$P_{ij} \geq 10.0$	Heavily polluted

3 Results and Discussions

Cimanuk river is one of the seven rivers in West Java with rainfall 1500-3000 mm/year and 347 697 ha watershed area. Cimanuk watershed is divided into three (3) sub-basins, namely: upstream has an extensive Cimanuk 145.677 ha are in Garut and Sumedang. Cimanuk the center has an area of 114.477 ha in the area of Sumedang and Majalengka. Cimanuk downstream has an area of 81.299 ha in the area of Indramayu. Water quality of Cimanuk river to have declined over the last 5 years (2013-2017). Water quality of Cimanuk river showed in Table 2.

Based on Table 3. Parameters Temperature and pH meet water quality standard (Table 1) where Temperature (from 22.00 to 31.70 °C) and pH (from 7 to 9). Parameter sun met water quality standard where TSS (from 18.00 to 307.33 mg/L), BOD (from 6.67 to 16.67 mg/L), COD (from 26.00 to 71.00 mg/L), DO (from 2.13 to 6.98 mg/L), NH₃N (from 0.06 to 0.87 mg/L). Degradation of water quality of Cimanuk river based on physicochemical parameters is identified cause domestic waste, agriculture, hospitals and industries uncontrolled at the riparian area of Cimanuk river.

Table 1. Water quality standards for river.

Parameters	Unit	IDN	WJP	WHO	UK	EPA	EQS	DOE
Physical								
Temperature	°C	25	25	25	25	25	25	25
Total Suspended Solid (TSS)	mg/L	50	50	50	50	50	25	25
Chemical								
pH	-	6-9	6-9	6.5-8.5	6.5-8.5	5.5-8.5	6.5-8.5	6.5-8.5
Biological Oxygen Demand (BOD)	mg/L	2	2	4	3	5	1	1
Chemical Oxygen Demand (COD)	mg/L	10	10	10	4	25	10	10
Dissolves Oxygen (DO)	mg/L	6	6	6	7	8.5	7.5	7
Ammonia (NH ₃ -N)	mg/L	0.5	0.1	0.01	0.2	0.2	0.2	0.5

Where: Government Regulation of Republic of Indonesia Number 82/2001 on Water Quality and Water Pollution Control (IDN) [3,6,7,8,9], Regulation of the Governor of West Java Number 1/2012 on Water Pollution Control (WJ), World Health Organization (WHO) [10,11], Environmental Standard of United Kingdom (UK), Environmental Protection Agency (EPA) [12], Environmental Quality Standard (EQS), Department of Environment (DOE) [13,14]

Based on Figure 2. Pollution index of Cimanuk river increased from upstream to downstream annually (2013-2015). Where pollution index of Cimanuk river on IDN (from 1.71 to 4.53), WJ (from 1.89 to 5.52), WHO (from 2.55 to 20.31), UK (from 2.26 to 6.51), EPA (from 1.25 to 3.51), EQS (from 2.25 to 7.51) and DOE (from 2.42 to 7.39).

The highest of pollution index of Cimanuk river is 20.31 in Sukaregang site has been heavily polluted. This results support previous level research stating that Cimanuk river has been polluted [3,4]. Water pollution of river occurs is influenced by various factors, such as: population growth, changes in land use, waste disposal into the river uncontrolled, and community activity in the riparian area [15]. Water quality assessment of Cimanuk river is carried out as an effort to water quality management and water pollution control Cimanuk river. Cimanuk river so that can be harnessed and used according to their distribution.

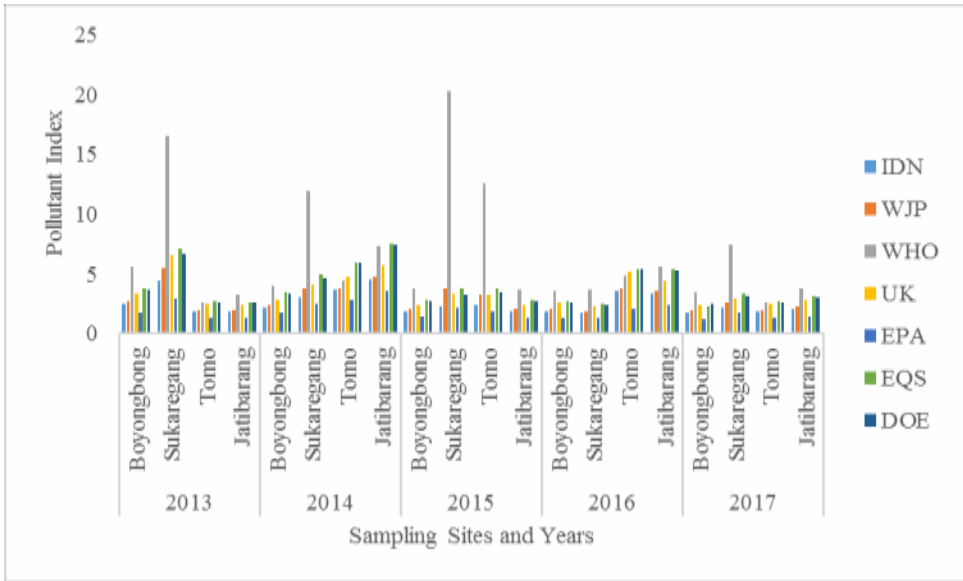


Fig. 2. Pollution index of Cimanuk river.

Table 3. Water quality of Cimanuk river.

Years	Samplin g Sites	Parameter s						
		Temp. °C	TSS mg/L	pH	BOD mg/L	COD mg/L	DO mg/L	NH3-N mg/L
2017	Boyongbong	23.25	33.00	7.75	7.25	28.75	5.40	0.11
	Sukaregang	23.75	98.25	7.75	8.50	30.25	4.85	0.26
	Tomo	26.25	40.25	8.00	6.75	26.50	6.98	0.08
	Jatibarang	28.75	39.75	8.00	7.00	27.25	6.20	0.12
2016	Boyongbong	22.00	29.67	7.60	9.00	38.00	5.90	0.13
	Sukaregang	23.67	45.00	7.87	7.33	28.33	5.20	0.16
	Tomo	26.33	73.33	7.91	14.33	58.00	5.50	0.12
	Jatibarang	27.00	224.67	7.83	1.33	48.33	5.80	0.12
2015	Boyongbong	23.00	48.00	8.67	8.33	26.00	4.67	0.15
	Sukaregang	24.67	26.00	7.67	9.00	27.67	4.33	0.72
	Tomo	27.00	35.67	7.40	9.00	29.33	4.67	0.70
	Jatibarang	30.67	18.00	6.93	8.33	27.00	4.33	0.15
2014	Boyongbong	24.43	116.00	7.93	6.67	27.00	5.17	0.17
	Sukaregang	25.87	171.67	8.12	8.00	33.00	5.17	0.44
	Tomo	29.17	272.00	8.18	13.67	58.67	2.40	0.06
	Jatibarang	30.00	307.33	7.77	15.33	62.00	2.13	0.14
2013	Boyongbong	24.40	96.33	7.99	9.33	40.33	6.76	0.24
	Sukaregang	25.00	10.00	7.81	1.67	71.00	6.30	0.87
	Tomo	28.37	65.67	8.22	7.33	32.33	5.46	0.08
	Jatibarang	31.70	51.33	8.23	7.00	34.00	5.26	0.09

4 Conclusion

Water quality of Cimanuk river unmeeted water quality standard on Government Regulation of Republic of Indonesia (IDN), Regulation of the Governor of West Java (WJ), World Health Organization (WHO), Enviromental Standard of United Kingdom (UK), Environmental Protection Agency (EPA), Enviromental Quality Standard (EQS), and Department of Environment (DOE). Pollution index of Cimanuk river ranging from 1,25 to 20,31. Water quality status of Cimanuk river has been from lightly polluted to heavilypolluted.

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