Spatial Analysis of River Water Quality in Merapi Volcano Watershed
ムラピ火山流域における河川水質の空間分布

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1. Introduction

Merapi Volcano, located in central Java and Yogyakarta province, Indonesia (110°26'30"East and 7°32'30"South) was considered as the most active volcano in the country. Since 1672 until 2010 it had been recorded to erupt for more than 80 times, with rest interval from 1-18 years or 4 years in average. Its last eruption was on October-November 2010. The two months long eruption was estimated to produce approximately 140 million cubic meters volcanic material, made it the greatest eruption of Merapi Volcano's history and created huge damage of wide area around the volcano. Volcanic materials, sands and stones gradually flowed through the rivers originating from Merapi. Merapi watershed was divided into several sub-watershed, some rivers flowed to Yogyakarta province area; Gendol, Boyong-Code and Kuning sub watershed. Land use pattern varied from the upstream to downstream area; forest, paddy field, mixed garden to settlements or household area. Land use pattern was developed by huge amount of volcanic materials for long time. As the land use pattern in Merapi watershed was changed because of 2010 eruption, it was expected that water environment would also change. The objective of this study is to investigate river water quality of NO_3-N and PO_4-P in Merapi watershed associated with the change of land use pattern after 2010 eruption

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2. Method

Water samples were taken from 12 sampling points in Boyong-Code river and Kuning river as parts of Merapi watershed in March 2012. Each sampling points represented possibly different

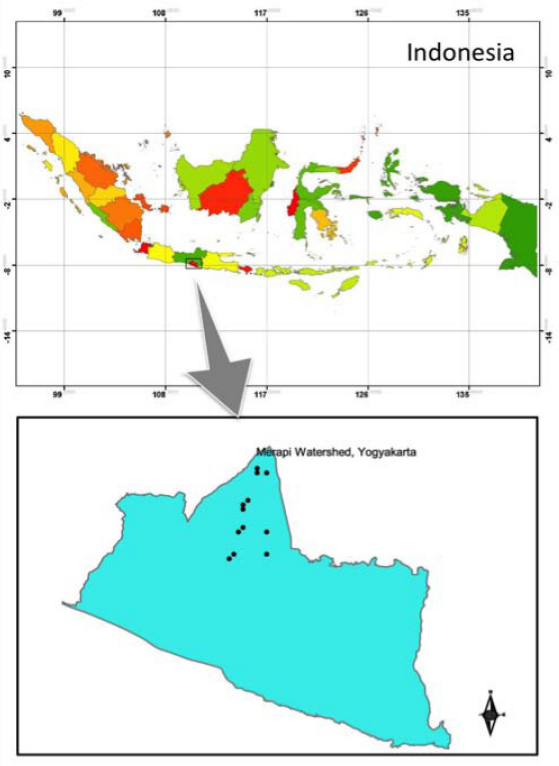

Fig. 1. Study area and monitoring locations

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land use and different impact obtained from Merapi 2010 eruption. These rivers got impact from 2010 Merapi eruption by the amount of volcanic material flown thus several changes were created on the land use pattern along them. Water quality on Electric Conductivity (EC), pH, Temperature, Nitrate-Nitrogen (NO_3-N), Phosphate (PO_4-P), Sulfate (H_2S), Acidic sulfate (SO_4) and COD were analyzed using digital water analyzer. Then, Arc Gis 10 was used to analyze the parameters concentration spatially to understand its relation with land use pattern.

3. Result and Discussion

Lowest NO_3-N concentration was <0.2 mg/L found in point middle 1 Boyong-Code river. While highest concentration was 1.38 mg/L in downstream Boyong-Code river. Lowest PO_4-P concentration was <0.03 mg/L in downstream Boyong-Code river while highest concentration was 0.237 mg/L in downstream Kuning river. Spatial analysis results showed that water quality in the upper stream of Merapi watershed had similar condition with water quality of natural condition. Volcanic materials covered large area of rivers, agricultural lands and settlements, made unable for human activities. Thus the reduced human activities created more natural water quality condition in the rivers of Merapi Volcano. While water quality in the downstream areas of Merapi watershed with land use pattern as settlement areas (cities) tended to show degraded quality of river water such as higher nitrate-nitrogen. This area received little impact of Merapi eruption but large impact of human activities such as house waste thrown to the river. Further investigation is required to completely understand the phenomena on the water quality associated with land use pattern changes by the Merapi eruption 2010.

Table 1. Analysis results of water quality in Merapi watershed

Latitude	Longitude	Point Name	River System	EC (ms/m)	Temp (C)	pH	NO_3-N (mg/l)	PO_4-P (mg/l)	S (H_2S) (mg/l)	SO_4 (mg/l)	COD
S07.46'59.58"	E110.22'15.64"	Code River	Boyong	26,6	27,9	7,55	1,38	<0.03	<0.05	<10	<2
S07.47'22.87"	E110.21'24.8"	Winongo River		14,2	27,9	7,67	1,01	<0.03	0,13	<10	<2
S07.35'42.66"	E110.25'16.44"	Spring Water	Boyong	14,2	23,5	7,08	0,26	0,11	<0.05	<10	<2
S07.36'03.35"	E110.26'09.28"	Kuning River Upstream	Kuning	21,9	21,7	7,6	0,25	0,15	<0.05	<10	<2
S07.43'36.95"	E110.23'26.0"	Boyong Middle 4(3rd)	Boyong	23,3	26,3	7,97	0,27	0,07	0,28	22	2,3
S07.43'26.68"	E110.23'20.84"	Boyong Middle 1(Down)	Boyong	22,9	27,7	7,63	<0.2	0,09	0,08	<10	<2
S07.47'00.20"	E110.26'22.35"	Kuning Downstream	Kuning	29,8	27,2	7,82	1,03	0,24	0,13	<10	<2
S07.39'31.83"	E110.23'47.32"	Boyong Mid 2 (Up)	Boyong	18,6	24,7	7,91	0,37	0,17	<0.05	<10	<2
S07.40'47.28"	E110.23'36.96"	Boyong Mid 3 (2nd up)	Boyong	20,3	25	7,91	0,24	0,1	<0.05	<10	<2
S07.43'31.12"	E110.26'28.13"	Kuning Mid	Kuning	26,4	25,2	7,93	0,93	0,13	<0.05	<10	<2
S07.40'15.05"	E110.23'32.81"	Village(Boyong) Irrigation	Boyong	21	26,4	7,85	0,5	0,04	<0.05	21	<2