

## Water Quality and Its Appropriate Use for Society in Hargowilis, West Progo

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### ABSTRACT

Hydrochemical survey has been done in Hargowilis Village, West Progo, around Sermo Paunch. This area is located at West Progo Hills physiography which is water ever be important problem because of its lack of water. This research wants to know about water quality in research area and its appropriate use for local people. The survey has been carried out for collecting some data of quality water by geological equipment such as GPS, hammer, compass, loupe, sample bottle and hydrochemical tools like thermometer, pH-meter, as well as TDS- meter. Four samples of water have been taken from stream, lake, spring and dug well and have been tested in chemical laboratory. Result of research shows that water in Hargowilis has pH of 6.1 - 8.4 and TDS of 108-1659 ppm. This water is suitable for clean water, drink water and irrigation (in form of S1C1 and S1C4 types). Although there is dug well found with bad quality water because of its water with very high salinity hazard.

Keyword : water resource, quality, use, physical/chemical properties

### 1. INTRODUCTION

Quality of water is important thing beside its quantity. Therefore, the quality of water is also important to be evaluated for daily living. Assessment of water needs in order to mitigate or remediate of bad quality water, both of surface water and groundwater resources.

Hargowilis Village is one of some villages in West Progo District which is located in hard relief of West Progo Hills. This area is usually also famous as hard water area because water is sometimes difficult to gain in sufficient quantity.

Sermo Paunch is a big reservoir of surface water in West Progo District. This reservoir is located in Hargowilis area. The society strong depends on Sermo Paunch as reservoir for many utilization such as irrigation, drink water, and tourism. Considering the important of water, therefore, the research wants to know about quality water both of surface water and groundwater in research area.

The study area includes in West Progo District, Yogyakarta Special Province (Figure 1). This area mostly located in Hargowilis Village and surrounding area. Astronomically this area is located between 07°47'30" – 07°49'30" south latitude and 110°06'00"- 110°08'00" east longitude coordinates.



Figure 1. Research area is located at Hargowilis Village, West Progo.

## 2. METHODS

The research has been started by field orientation of water resources in study area, include surface and groundwater. The hydrochemical survey has been done and equipped by some tools namely geological equipment (compass, loupe, hammer, GPS) and hydrochemical tool (thermometer, pH meter, TDS meter). Ten locations have been chosen to observe water resources (Figure 2). Then, four of them have been chosen for water sampling, representing spring (S1), dug well (W3), stream (R9) and paunch (L10).

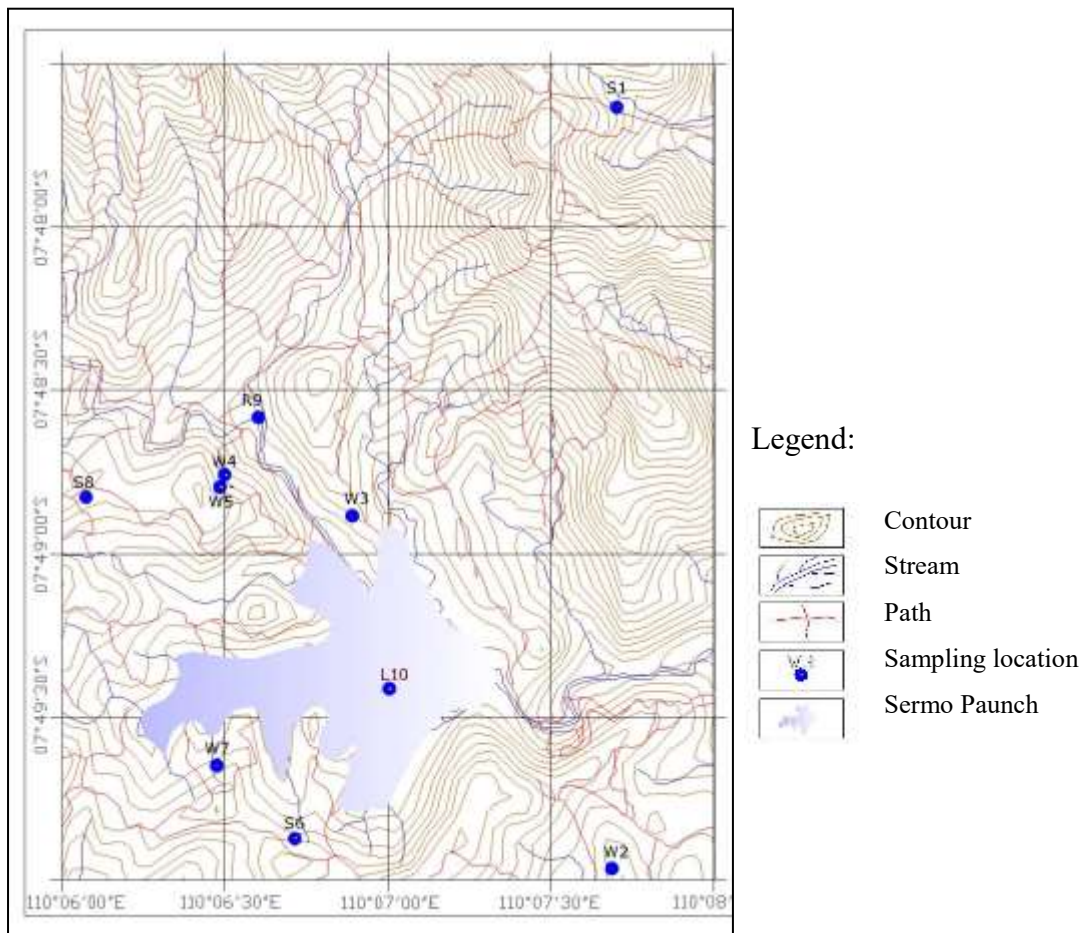


Figure 2. Observed location of study.

## 3. RESULT AND DISCUSSION

### 3.1. Geological Review

Research area belongs to West Progo Dome Physiography [1], located at south eastern part of it. Rocks which consist this area include tuff and andesite breccia of Old Andesite Formation, and andesite lava or autoclastic breccia and sandstone of Nanggulan Formation [2]. All rocks in the research area may be aquifers but their characteristics usually low – moderate potential. The higher potential can be gained because of more intensive cracks or joints. For examples, tuff which is outcropped at western part of Sermo Paunch (Figure 3) may potentially be aquifer by intergranular and crack porosity, although its permeability still low – medium.

Geomorphological feature of study area seems as hard relief in higher elevation of West Progo Hills. Small streams flow direct to Sermo Paunch through narrow, deep valley. The topography usually shows strong dissected feature.



Figure 3. Bedded tuff outcropped at southwestern side of Sermo Paunch that may be act as aquifer in study area.

One of water samples has been taken from Sermo Paunch (Figure 4). This paunch is the important reservoir in West Progo which gets water from surrounding area through many steams and run off. Water from this paunch mainly used for irrigation of cultivation area surrounding it.



Figure 4. Appearance of Sermo Paunch in the centre of research area.

### 3.2. Hydrochemical Characteristics

Water usually shows transparent, no color, no odor, and clear. Water in field shows pH value as much as 6.1 – 8.4 while TDS as much as 108 – 660 ppm (Table 1). Whereas, laboratory data show pH of 6.4 – 7.3 and TDS of 127-1659 ppm (Table 2).

Table 1. Field data of water quality at selected locations of research area.

Loc.	Water table	pH	TDS	T	Color	Taste	Odor	Turbidity
S1	422	7.9	125	27	Transparent	No	No	Clear
W2	162.6	7.3	116	28	Transparent	No	No	Clear
W3	220	7.60	660	29	Transparent	No	No	Clear
W4	226	8.20	128	28	Transparent	No	No	Clear
W5	237	7.60	168	29	Transparent	No	No	Clear
S6	227	8.40	260	30	Transparent	No	No	Clear
W7	155	8.20	227	30	Transparent	No	No	Clear
S8	237	8.27	247	30	Transparent	No	No	Clear
R9	140	6.1	122	25.2	Transparent	No	No	Clear
L10	135	7	108	25.2	Transparent	No	No	Almost clear

Water types of water in research area usually develop as Ca,Na - bicarbonate; Ca,Mg - bicarbonate; Ca,Na,Mg - bicarbonate water. But, one sample from dug well (W3) shows sulfate type. The water from this dug well also refers different characteristics with low pH, high TDS, very hard of hardness (Sawyer & McCarty, 1967, in [3]). The dominant bicarbonate ions sometimes related with the neutral pH of water [4].

Table 2. Laboratory data of water samples.

No	Parameter	S1	W3	R9	L10
PHYSICAL					
1	Color	Colorless	Colorless	Colorless	Colorless
2	Odor	no	no	no	no
3	Taste	no	no	no	no
4	Turbidity (NTU)	5	3	5	2
5	Temperature (°C)	29.1	27.1	25.2	25.2
CHEMICAL					
1	Hardness*)	122.374	827.161	156.815	87.903
2	TDS (mg/l)	156	1659	139	127
3	pH	7.3	6.4	6.6	6.6
4	Ion content (mg/l)				
	Cation				
	a Ca	24.12	223.51	42.8	25.6
	b Na	52	37	21	20
	c K	7	2	4	3
	d Mg	15.14	65.46	12.15	5.83
	e Fe	0.0506	0.0162	0.0221	<0.0162
	f Mn	0.0101	0.0101	<0.0101	<0.0101
	g Zn	0.0083	0.0083	<0.0083	<0.0083
	Anion				
	a NO <sub>3</sub>	4.16	3.58	5.33	1.33
	b HCO <sub>3</sub>	114.2	186.3	126.2	108.2
	c SO <sub>4</sub>	1	1297	6	5
	d Cl	7.5	12.6	4.5	2
	e SiO <sub>2</sub>	35.221	17.783	17.212	15.543
	Chemical type	Ca,Na,Mg - bicarbonate	Ca, Mg - sulfate	Ca, Mg - bicarbonate	Ca, Na - bicarbonate

### 3.3. Appropriate Use of Water

Based on field and laboratory data, all kind of water are usually suitable for drinking and clean water (Table 3-4). Surface water from stream and paunch, as well as spring water can be utilized for daily life. Unfortunately, groundwater sample from dug well W3 is too acid, brackish water of TDS (Carroll, 1962, in [3]), very hard of hardness (Sawyer & McCarty, 1967, in [3]). This characteristic of water is not suitable for both of clean and drinking water.

Some parameters are need to assess water that can meet water requirement of irrigation, such as %Na, SAR (sodium adsorption ratio) and RSC (Residual Sodium Carbonate). All samples are also appropriate for irrigation except water from dug well W3. Groundwater from W3 is very hard so that its salinity hazard become very high, although sodium hazard is still low, low SAR and safe RSC [5] (Table 5; Figure 5). Different with other samples (S1, R9, L10) which refer S1C1 type, water from dug well (W3) shows the irrigation class of S1C4 (Figure 6).

Table 3. Field data of physical/chemical characteristics and their comparison to standard.

No	Parameter	S1	W2	W3	W4	W5	S6	W7	S8	R9	L10	Drinking Water (MHIR, 2010) [6]	Clean Water (MHIR, 2017) [7]
1	pH	7.9	7.3	7.60	8.20	7.60	8.40	8.20	8.27	6.1	7	6.5 - 8.5	6.5 - 8.5
2	Turbidity (NTU)	no	no	no	no	no	no	no	no	no	no	5	25
3	Taste	no	no	no	no	no	no	no	no	no	no	tb	tb
4	Odor	no	no	no	no	no	no	no	no	no	no	tb	tb
5	Temperature (°C)	27.1	25.2	29	25.2	26.5	25.2	27.1	25.2	25.2	25.2	Air temp. ±3	Air temp. ± 3
6	TDS (mg/l)	125	116	660	128	168	260	227	247	122	108	500	1000
7	Color (TCU)	no	no	no	no	no	no	no	no	no	no	15	50

Table 5. Data of water parameters for irrigation requirement in research area and their appropriate use.

Loc.	Hardness		SAR		Explanation	%Na		RSC		EC	Sodium (alkali) Hazard	Salinity Hazard	Irrigation Water Class
	Value	Class	Value	Class		Value	Class	Value	Explanation	(µS/cm)			
S1	122.37	Almost hard	1.2	Low	No or less Na nor alkali hazard	40	Good	0.578	Safe to use	243.36	Low	Low	S1C1
W3	827.16	Very hard	0.33	Low	No or less Na nor alkali hazard	5.88	Excellent	13.49	Safe to use	2588	Low	Very high	S1C4
R9	156.82	Hard	0.43	Low	No or less Na nor alkali hazard	18.5	Excellent	1.067	Safe to use	216.84	Low	Low	S1C1
L10	87.90	Almost hard	0.55	Low	No or less Na nor alkali hazard	26.8	Good	0.016	Safe to use	198.12	Low	Low	S1C1

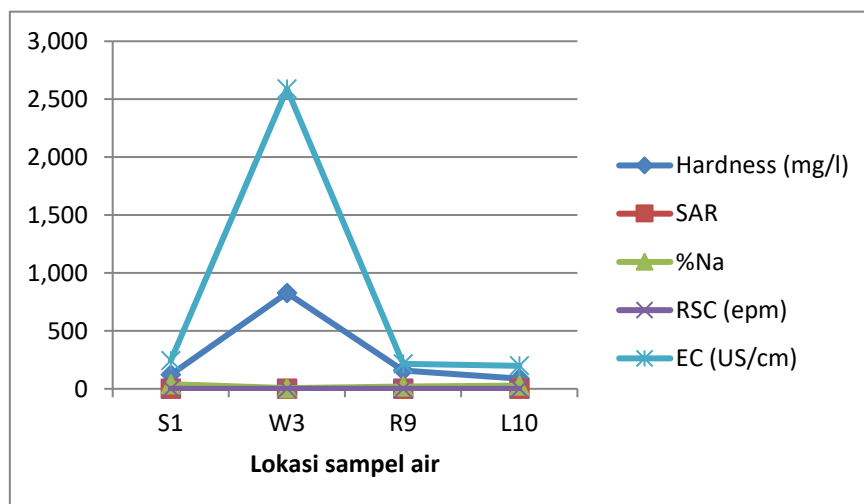


Figure 5. Some irrigation parameters of water samples.

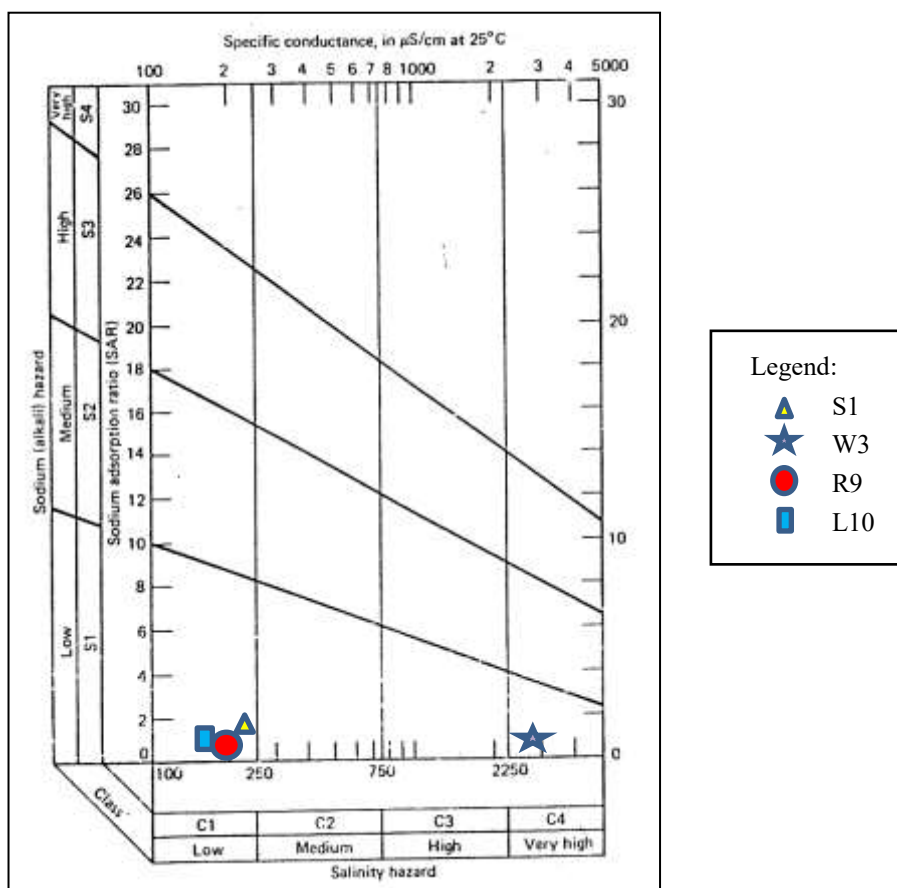


Figure 6. Plot of water samples in classification diagram of irrigation water (Richards, 1954, in [3]).

#### 4. CONCLUSION

Hargowilis Village is one of areas in West Progo Hills which has potential both of surface water and groundwater. The area is located at high elevation and dissected topography, but still has water resource as surface water in the form of stream and paunch and groundwater from spring and dug well. The quality of water is usually good enough and suitable for clean and drinking water, with pH of 6.1 - 8.4 and TDS of 108-1659 ppm. All water can be used for clean, drinking and irrigation water, except water from dug well (W3). Water usually includes in S1C1 irrigation class, except water from W3 whose water refers S1C4 type with very high salinity hazard.

#### ACKNOWLEDGMENT

The authors would like to thank STTNAS for funding the research. The authors also would like to thank the management of P3M STTNAS for providing technical support.

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