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All full paper submissions to the 3rd IGEOS 2019 should only be written in English, and will be sent to at least two reviewers and evaluated based on originality, technical or research content or depth, correctness, relevance to conference, contributions, and readability. the lenght of paper no later than 9 pages. All accepted and selected papers 3rd IGEOS 2019, will be published in Conference Proceeding indexed by: SCOPUS and Google Scholar and also selected Journal.

Abstract Guidelines:

IOP Conference Series: Earth and Environmental Science

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Preface

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Preface

IOP Conf. Series: Earth and Environmental Science **683** (2021) 011001 doi:10.1088/1755-1315/683/1/011001

PREFACE

Globally, geophysical disasters - especially earthquakes - killed more people than any other type of natural hazard in the last 20 years with a cumulative number of around 747,000 fatalities. Natural disasters may manifest themselves with or without warning, while human-induced disasters are tangled with unsustainable anthropogenic activities in the built environment. Disasters take various forms such as earthquake, landslide, rainstorms, volcanic eruption windstorms, floods, ethno-religious crises, wildfires, explosions, terrorist?s attacks etc. The calamitous nature of these disasters therefore calls for their effective management. Extensive disasters were important because they can be used as learning opportunities to face the risk of routine disasters and the importance of continuous disaster learning at all times. The 3rd International Geography Seminar (IGEOS) "Increasing Disaster Literacy towards Resilient Comunities" was appointed to get input from various experts on the characteristics, problems and risk reduction efforts of various types of disasters.

The 3rd International Geography Seminar (IGEOS) is a third international event organized in 2019 by the Department of Geography Education Universitas Sebelas Maret Solo in collaboration with the Department of Geography Education, Faculty of Social Science Education, Universitas Pendidikan Indonesia (UPI).

We proudly announced that this proceeding is the result of discussion from 3rd IGEOS' meeting of leading academic scientists, researchers and scholars on all aspects of geographical studies and practices. It also provides interdisciplinary discourses and the discussion of most recent innovations, trends and concerns as well as practical challenges and solutions adopted within this field.

Praise be to Allah for the opportunity to organize and host this seminar. Furthermore, we would like to thank the the Rector of for their encouragement and support. We would also like to congratulate members of the organizing committee for their endless hard work and dedication as well as perseverance in making sure that this seminar is a success.

The Editors,
Nandi

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Peer review declaration

International Geography Seminar 2019 IOP Publishing
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Peer review declaration

All papers published in this volume of IOP Conference Series: Earth and Environmental Science have been peer reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

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- **Number of submissions received:**
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- **Number of submissions sent for review:**
  224 Abstract
  168 papers

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Analysis of salt water distribution in the borobudur plain

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Analysis of salt water distribution in the borobudur plain

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Abstract. Research objectives: mapping the distribution of salt water and knowing the causes of saltwater in the Borobudur Plain. The research population was in the form of community well water, in 6 villages around the Borobudur plain of Magelang Regency. The research variables included the distribution of well water quality (sodium, acid, chloride, salinity, total dissolve solid/TDS) and impact water quality to the community. The results of the study, the distribution of ground water quality in terms of different physical and chemical properties. Candirejo village from the physical and chemical aspects did not match the quality standard, the content of sodium 353-568 mg/l and strong acid content in the form of chloride ranged from 809.9-1639.5 mg/l, while physically DHL at Candirejo ranged from 1,612-3,546 mhos/cm and TDS 1522-1749 mg/l. The best water quality is found in the village of Bumiharjo in terms of both physical and chemical aspects. The cause of salt water in Borobudur Plain was: ground water dominated by alkalis and strong acids with chemical compounds NaCl type of group sulfate water that taste salty and groundwater is dominated by alkaline earth and weak acids, namely water with type (b) semi bicarbonate type.

1. Introduction

Water is the most fundamental and important component for life. Water is used for various necessities, such as agriculture, industry, and household. Groundwater is colorless, odorless, and tasteless and chemically and biologically, it does not contain dangerous biotic as well as chemical elements [7]. Water is an essential resource in world water supply. The amount of water in the ocean is approximately 97.5%, whereas 1.75% is located in the Polar Regions, and the remaining 0.73% is on land. Water on land consisted 96% groundwater and 4% surface water in reservoir, lake, river and water vapor in air [1]. There are several interrelated processes in a hydrological cycle that reflect water movement including precipitation process, evaporation, transpiration, interception, infiltration, percolation, and a stream called as water availability component [8].

Several factors influencing groundwater quality [10] include aquifer rocks mineral composition, geohydrology of the area, the working power of groundwater mixing, and influential events in geochemical process, human activities, and aquifer recycle capabilities. Salt water seepage in the fractures of silt stones indicates that the surrounding area in Borobudur Temple once formed a marine environment before the lake environment is formed [4]. Considering the existence of salt water in Borobudur plain, previous research by [5] revealed that Brangkal and Palian villages had a high electrical conductivity (EC) level; thus, it indicated that water in the areas had high salinity. The danger of salinity occurs when salt accumulates in plant root zones and reduces the number of water available for roots. It reduces water availability to the extent that it influences harvest level. The salt often comes from minerals dissolved in irrigation water or high salt water table [9].

The use of SIG in the spatial analysis is useful. SIG application varies and supports resource management, disaster management, planning and development, environmental management, soil and water management, marine research, climate change, and other areas where human exist [2].

Hence, the research aims to: 1) analyze groundwater condition in wells of residents around the Borobudur plain, 2) map the distribution of saltwater in Borobudur plain, and 3) know the causative factors of saltwater in Borobudur plain.

2. Methods

The research population consisted of 9 (nine) groundwater in form of wells in 6 (six) villages in Borobudur plain. A laboratory test was conducted to identify the water content. The research sample was in form of groundwater of the wells. Sampling technique was done using area sampling.

The research variables comprised groundwater condition, groundwater distribution, and causes of salt water. Groundwater condition included physical condition (water physical parameters: TDS (*Total Dissolved Solid*), odor, temperature, and taste) and chemical condition (cation and anion). Cation fasies division covered sodium (Na+K), calcium (Ca), and magnesium (Mg) types. Anion consisted of bicarbonate (HCO3+CO3), sulfate (SO4), chloride (Cl) types. Salt water distribution encompassed groundwater flow and groundwater conductivity value. Salt water causes were observed from the groundwater chemical composition, namely anion/cation in the water.

Data collection technique included water sampling activities, laboratory testing, interview, and document study. Observation method was performed by directly observing the field condition related to well water condition and the use of water by population in Borobudur plain area, Borobudur Sub-district, Magelang Regency. The interview aimed to find out the use of water in the Borobudur plain area and strategies to fulfill water demand for life necessities of communities in the area. The researcher would discover the influence, management, and strategies of water fulfillment among the communities in the Borobudur plain. Documentation was intended to obtain data description in the research location regarding demography, area, and land utilization. The data were obtained from village monograph and spatial planning and territory of Magelang Regency 2010-2030.

The laboratory analysis was performed after the water sampling had completed in 6 (six) villages in Borobudur plain area. The analysis was conducted at the *Balai Besar Teknik Kesehatan Lingkungan Dan Pengendalian Penyakit Yogyakarta* (BBTKLPP) (Yogyakarta Environmental Health and Disease Control Bureau). It aimed to discover the chemical parameters containing in the water.

Data analysis technique was done through comparison and piper diagram. Data comparison analysis was performed to obtain well water quality status. The well water quality suitability was compared to data on the drinking water quality standard according to the Regulation of the Minister of Health of the Republic of Indonesia No 416/1990 and No. 32/2014.

The piper diagram and Kurlov methods were used to analyze water condition and salinity content. Piper diagram [3] is a vital method to study groundwater genetic. The method is very effective in separating data analysis for crisis study, especially on the source of constituent elements dissolved in groundwater, changes or modification in properties of water passing through a certain area and its relationship with geochemical problems.

Salinity level used groundwater classification based on Electrical Conductivity (EC). Kurlov method is a method to find out the composition of groundwater in an area by looking at its chemical compounds that are more than 25% of all chemical compounds for each cation and anion. It uses the following calculation.

Salt water distribution analysis in the research location was conducted using Arc GIS 10.5 Software [9]. The salt water distribution was discovered by mean of interpolation of groundwater conductivity data in the research area; electrical conductivity is a numeric illustration of data on the ability of waters in conducting electricity. Based on the conductivity value, whether or not waters experience salt water infiltration can be recognized. The water conductivity measurement was done using TDS & EC meter to obtain TDS value and water conductivity. Interpolation is a way to identify field condition in the research area based on the conductivity data of the closest neighboring areas; hence, saltwater distribution can be identified. In addition, groundwater flow in the research area could describe the possible direction of the saltwater existence using supporting data in form of groundwater conductivity interpolation.

3. Results and Discussion

According to the physical and chemical properties, water quality varied from one village to another. Of the 6 (six) villages in the research area, Wanurejo Village, Ngargogondo Village, Borobudur Village, and Bumiharjo Village had the water quality in accordance with the drinking water standard with Bumiharjo Village had the best water quality based on the water physical and chemical properties. In Candirejo Village, however, the residents' well water was less suitable for drinking water consumption. According to the physical properties, water in the village had electrical conductivity of (EC) >1000 Mhos/cm and total dissolved solid (TDS) >1000 mg/l, and the water felt brackish. In Kaliduren Village, the water was yellowish.

Table 1. Physical Condition of Well Water

Village	TDS	EC	Temperature	Taste	Color	Odor	Water Quality
Kaliduren	1,749	3547	24	Brackish	Yellowish	No	Unsuitable
Paliyan	1,522	2831	24	Brackish	No	No	Unsuitable
Tingal	139	331	25	No	No	No	Suitable
Ngentak	88	174	28	No	No	No	Suitable
Wagean	136	334	23	No	No	No	Suitable
Mendalan	215	495	28	No	Yellowish	No	Unsuitable
Ngaran	115	225	26	No	No	No	Suitable
Janan	124	261	26	No	No	No	Suitable
Sodongan	84	169	27	No	No	No	Suitable

Source: Research Data, 2018

Based on the chemical properties, water in Candirejo Village had sodium content in the range of 353-568 mg/l, which was beyond the threshold of 200 mg/l and strong acid content in the form of chloride ranged from 809.9 to 1639.5 mg/l. Water quality in Tanjungsari Village did not meet the quality standard since the water was yellowish in color. As for the physical properties, salt water in Borobudur plain was well water that had conductivity value > 1000 mhos/cm (Figure 1).

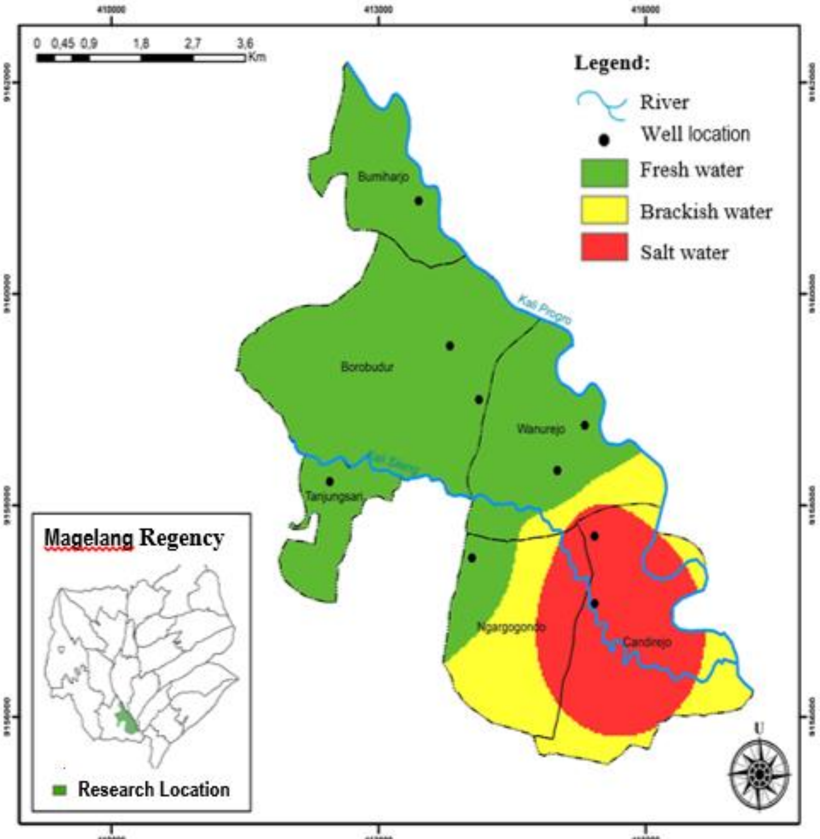

Figure 1. Map of the Distribution of Saltwater in Borobudur Plain

Salt water content mostly found in Candirejo Village and Desa Ngargogondo and in Wanurejo Village in a small portion. In addition, well water in Candirejo Village was salt. In terms of the chemical properties, Candirejo Village was the only village where Cl (Chloride) content was in the range of 809.9-1639.5 mg/l. According to [10] [11], the water was included in brackish water and brackish-salt water.

Based on the groundwater depth (MAT) in Borobudur plain, groundwater flow pattern in the area was flowed from the north, at Bumiharjo Village, to the south in Candirejo Village and west in Ngargogondo Village (Figure 3). Based on the Kurlov method, water composition could be determined according to the value of each ion that had magnitude >25%. Following is the Kurlov's classification in the research location.

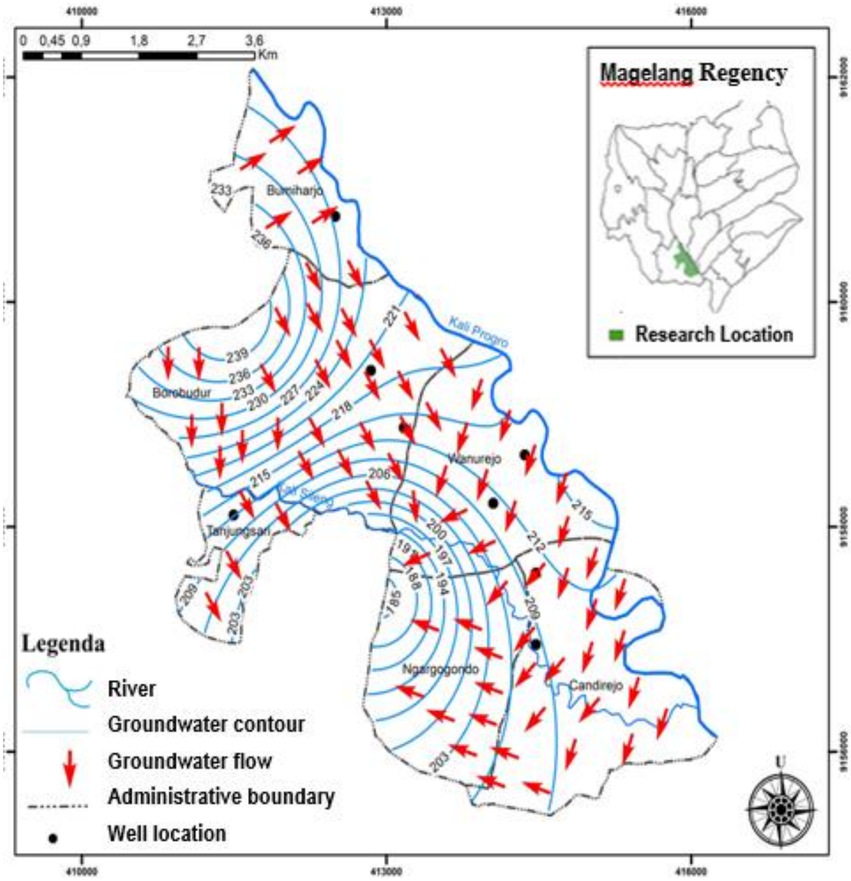

Figure 2. Map of Groundwater Flow in the Borobudur Plain

Table 3 indicated that Candirejo Village had water class of sodium chloride with cation concentration of 51% sodium of 40.04 meq/l and anion concentration of 82% chloride of 68.99 meq/l. Wanurejo Village had water class of calcium-sodium-bicarbonate with cation concentration of 39% calcium of 2.73 meq/lm, 30% sodium of 2.13 meq/l and anion concentration of 80% bicarbonate of 4.69 meq/l.

Table 2. Water Composition in Candirejo Village

Village	Ion concentration (% meq/l)								Type of Water
	K	Na	Ca	Mg	SO4	CO	Cl	HCO	
Candirejo	1,59	51,84	22,33	24,22	0,86	0	82,87	16,26	Sodium Chloride
Wanurejo	6,26	30,61	39,25	23,86	10,67	0	9,13	80,18	Calcium Sodium Bicarbonate
Borobudur	3,72	34,72	36,83	24,71	7,07	0	18,18	74,73	Calcium Sodium Bicarbonate
Bumiharjo	3,26	31,35	43,04	22,34	8,18	0	8,3	83,51	Calcium Sodium Bicarbonate
Ngargondo	3,04	29,92	44,92	22,11	4,05	0	12,53	83,41	Calcium Sodium Bicarbonate
Tanjungsari	3,71	40,92	24,86	30,49	3,3	0	22,6	74,08	Magnesium Sodium Bicarbonate

Source: Research Data, 2018

Borobudur Village had water class of calcium-sodium-bicarbonate with cation concentration of 36% calcium of 2.53 meq/l, 34% sodium of 2.39 meq/l and anion concentration of 74% bicarbonate of 4.4 meq/l. Bumiharjo Village had water composition of calcium-sodium-bicarbonate with ion concentration of 43% calcium of 1.01 meq/l, 31% sodium of 0.73 meq/l, and 83% bicarbonate of 1.7 meq/l. Ngargogondo Village had water class of calcium-sodium-bicarbonate with ion concentration of 44% calcium of 1.89 meq/l, 29% sodium of 1.26 meq/l, and 83% bicarbonate of 3 meq/l. In addition, Tanjungsari Village had water class of magnesium-sodium-bicarbonate with ion concentration of 30% magnesium of 2.10 meq/l, 40% sodium of 2.82 meq/l, and 74% bicarbonate of 4.2 meq/l.

Based on the piper diagram (Figure 4), there were two types of water quality in Borobudur plain. As indicated by water composition in Candirejo Village, groundwater was dominated by alkali and strong acids; thus, it included in Group IV in the form of sulfate water. It was due to the occurrence of chemical compound reduction with organic materials of swamp plants in the past, non-carbonate hardness of chloride content in the area was more than 80%.

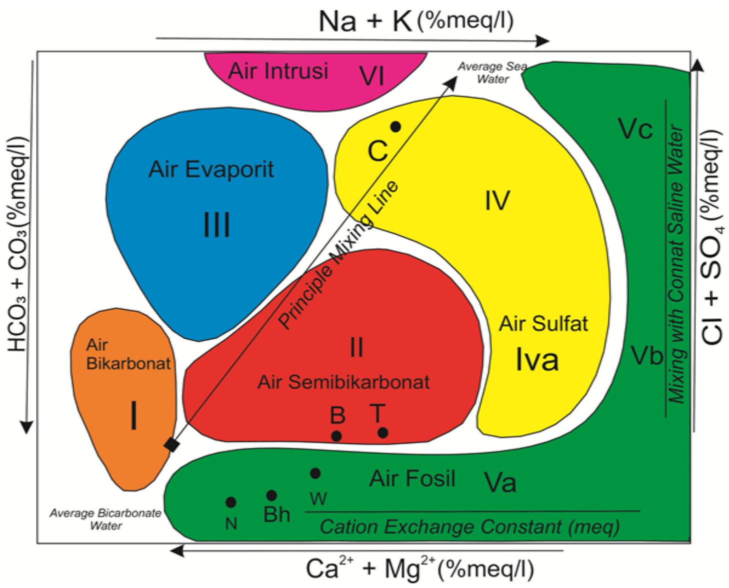

Figure 3. Piper Diagram [6], Source: Research, 2018

Other 5 (five) villages, however, was dominated by weak acids. The water type in Wanurejo Village, Bumiharjo Village, and Ngargogondo Village was fossil water (connate water) of Group Va. Water in the areas was tasteless. Fossil water occurs due to a hydro chemical process in the form of cation exchange and fossil mixing. The water was, generally, salt, brackish, and tasteless. Borobudur and Tanjungsari Villages had type of water of semi-bicarbonate water of group (II) and its groundwater composition was tasteless and it was suitable for human consumption. Ca (calcium) ion, however, had not dominated the groundwater chemical composition in this group. It indicated that the groundwater was not completely stable.

4. Conclusion

Of 6 (six) villages in Borobudur plain, Candirejo Village had water quality that was not in accordance with the quality standard based on the physical as well as chemical aspects with sodium content of 353-568 mg/l and strong acid of chloride in the range of 809.9-1639.5 mg/l. Physically, DHL in Candirejo was ranged from 1.612 to 3.546 Mhos/cm and TDS of 1522-1749 mg/l. The best water quality was in Bumiharjo Village based on both in physical and chemical aspects.

According to the groundwater physical properties, it could be observed that salt water in Borobudur plain was well water that had conductivity value >1000 mhos/cm and it mostly found in Candirejo and

Ngargogondo Villages and in a small portion in Wanurejo Village. As indicated by the groundwater flow pattern in the research location it could be assumed that salt water was only found in residents' wells in Candirejo Village and Ngargogondo Village, whereas in Wanurejo Village the salt water was found in a small portion. It was due to that almost all groundwater flow pattern headed to Candirejo Village and Ngargogondo Village.

The causes of salt water in Borobudur plain were identified based on the piper diagram. The diagram pointed out that there were two types of water quality in Borobudur plain. The first type was groundwater dominated by alkali and strong acids with chemical compound of NaCl from sulfate water of group (IV) that was salty and found in Candirejo Village. The second type was ground water dominated by earth alkali and weak acids of semi-bicarbonate water of group (II) in Tanjungsari Village and Borobudur Village, and fossil water (connate water) of group (Va) in Wanurejo Village, Ngargogondo Village, and Bumiharjo Village.

References

[1] Bouwer H, Rice R C, Lance J C and Gilbert R G 1980 Rapid-infiltration research at flushing meadows project, Arizona. Journal (Water Pollution Control Federation), pp.2457-2470.
[2] Gnanachandrasamy G, Ramkumar T, Venkatramanan S, Vasudevan S, Chung S Y and Bagyaraj M 2015 Accessing groundwater quality in lower part of Nagapattinam district, Southern India: using hydrogeochemistry and GIS interpolation techniques. Applied water science, 5(1), pp.39-55.
[3] Laitupa K 2017 Interpretasi Lapisan Akuifer Air Tanah Menggunakan Metode Geolistrik Di Kampung Horna Baru Dan Kampung Muturi Distrik Manimeri Kabupaten Teluk Bintuni Provinsi Papua Barat. ReTII.
[4] Murwanto H, Purwoarminta A and Siregar D A 2014 Pengaruh tektonik dan longsor lahan terhadap perubahan bentuklahan di bagian selatan Danau Purba Borobudur. Jurnal Lingkungan dan Bencana Geologi, 5(2), pp.143-158.
[5] Prabowo I A 2003 Kualitas air tanah di dataran Borobudur kabupaten Magelang propinsi Jawa Tengah (Doctoral dissertation, Universitas Gadjah Mada).
[6] Schutte M F, Treffers P E, Kloosterman G J and Soepatmi S 1983 Management of premature rupture of membranes: the risk of vaginal examination to the infant. *American journal of obstetrics and gynecology*, *146*(4), pp.395-400.
[7] Setyaningsih, W 2010 Model Pergerakan Bahan Pencemar Minyak Disel Padaakuifer Batupasir Formasi Volkanik Merapi Muda. Jurnal Geografi: Media Informasi Pengembangan dan Profesi Kegeografian, 7(2).
[8] Setyowati D L 2009 Pemodelan Ketersediaan Air untuk Perencanaan Pengendalian Banjir Kali Blorong Kabupaten Kendal. Jurnal Teknik Sipil dan Perencanaan, 10(2), pp.127-138.
[9] Simsek C and Gunduz O 2007 IWQ index: a GIS-integrated technique to assess irrigation water quality. Environmental Monitoring and Assessment, 128(1-3), pp.277-300.
[10] Wanielista M, Kersten R and Eaglin R 1997 Hydrology: Water quantity and quality control. John Wiley and Sons.
[11] Widada S 2007 Gejala Intrusi Air Laut di Daerah Pantai Kota Pekalongan. ILMU KELAUTAN: Indonesian Journal of Marine Sciences, 12(1), pp.45-52.