The Fluctuation of Water Quality of Ci Lutung flow areas in Majalengka and Sumedang.

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Abstract. The river is the main source of water in Indonesia, which at the moment, this quality tends to get worse and is no longer worth consuming for various needs. The cause of the pollution is the entry of pollutants both point source (industrial waste) and non-point source (residential and agricultural land). Rainfall can be a non-point source pollutant agent from a watershed to a water body. The impact of rainfall on increasing concentrations of pollutants is very significant, especially the high intensity rainfall that falls after the long dry season. In this study, water quality data is obtained from river outlets located in Damkamun taken every 30 minutes during the rainfall event so that fluctuation in water quality can be seen. Water quality indicators studied in this research are TDS, DHLNitrate, Phosphate and Ph. The author, in analyzing, using rainfall Himawari 8 which is obtained every 10 minutes. The result shows that rainfall is directly related to the water flow and the fluctuation of the discharge affects the water quality. From the calculations, the chemical quality of water is also influenced by the use of land in the watershed. Nitrate value increases when the occurrence of rain occurs in land use while phosphate experiences a high value during the event.

Keywords: **Fluctuation; Water; Waterquality; CiLutung; Majalengka; Sumedang**

1.Introduction

The Watershed is an area used by a separator that serves to drain all the rainwater that falls into the river system to the lake or the sea [1]. The watershed is also a hydrological system in which there are biotic (vegetation and human) parameters and abiotic (physical characteristics) interconnected. According to [2] argues that land use can reduce water quality, increase surface water velocity and speed, increase the frequency of flood waters, increase water flow twice as much as natural forests, cause loss of material and result in decreased groundwater.

Temporarily, the quality of river water is influenced indirectly by rainfall factor. Rainfall is an important factor that can affect the quality of river water, especially in tropical countries where seasonal variations in river water quality are dominated by precipitation. Already many studies have been done in various places in the world that examine the influence of Rainfall on water quality.The process of turning rain into a river is a very complex natural process that is influenced by several factors. According to [3] there are two main factors influencing river flow discharge, climate factor and physiographic factor. Climatic factors concern the relationship between rain and evapotranspiration. Physiographic factors concerning river characteristics and watershed characteristics. The characteristics of the river include the shape and size of the river cross section, the slope of the river, the roughness of the river bed and the length of the river. Watershed characteristics include geometric factors such as watershed morphometry and physical factors such as land cover characteristics, soils and geological conditions.

The quality of the watershed can be determined through several indicators, one of which is river discharge. Assessment of the quality of river flow can be seen from the fluctuation. The fluctuation characteristic of river flow discharge is caused by river hydrological condition. The loss of effective forest vegetation can decrease evapotranspiration, soil moisture, infiltration and increase soil runoff[4].

Rainfall is an important factor that greatly affects the quality of river water, especially in tropical countries because in this tropical country has seasonal variations of river water quality dominated by precipitation. Precipitation itself is the descent of water from the atmosphere to the surface of the earth and the sea in different forms[5].

A study of spatial rainfall on water quality has not been done. Previous studies have not seen spatially, therefore this study aims to examine the

effect of Rainfall on water quality in Cilutung River. This study focuses more on changes in river water quality depending on rainfall events. Analysis of climate change on water quality can be used as a method for analyzing low carbon development by using himawari imagery.

2. Methodology

Study Area

Cilutung river water quality data obtained through direct measurement in the field. Measurement of water quality data is done upstream of Cilutung River located at Kamun Dam located at coordinate 108o10'5"BT, 07o13'13 " (Figure 1).

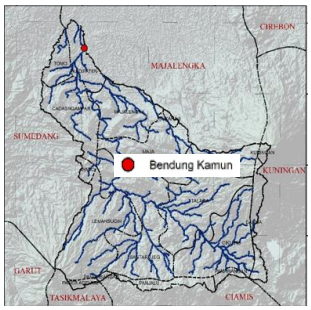

Fig 1. Study Areas(Bendung Kamun)

Field Study

The data processing of the discharge is done directly by looking at the water level at the hydrological station of the kamun dam. To get the discharge data every hour measurements of the water level can be seen on the post of Damkamun. The watched water level data is then converted to discharge data using the formula;

$Q=C \times Beff \times \sqrt{(H^3)}$ (1)

H = Water level(m)
C = 1.64
Beff = Wide of the light

Measurements were carried out for 1 week from April 6, 2018 - April 13, 2018. Water sampling was carried out with a water sampling device with a timer (Figure 1). Water sampling is take every 30 minutes and 15 minutes according to the river water level rise.

TDS (Total dissolved solids) and DHL parameters were measured using Hanna HI 98301 (TDS) and Hanna HI 991301 (DHL). Nitrate measurements were measured using Hanna HI 96786, while for measuring phosphate using Hanna C206 Multiparameter Ion Specific Meter.

Post Field Analysis

Rainfall data obtained from the image Himawari 8. Rainfall data obtained every 10 minutes. Rainfall data every 10 minutes is used to view the rainfall temporally and spatially in the upper watershed. Analysis to know how the effect of rainfall that occurred in the upstream is calculated using the formula of Time Of Concertation(2).

Tc= 0.0078 x C 0.77 x S -0.385x 100% (2)
Tc = Time of concentration
L = Long trajectory of water from the furthest point
S = Average slope of the water track area air (m).

3. Disscharge Cilutung

Table 1 . Flood event

Date	Qmin	Qmax	Start Time	End Time	Long incident
6 April 2018	57.4	79.92	13:15	15 :15	2
7 April 2018	31.9	42.4	07 :00	09 :00	2
7 April 2018	39.1	57.4	21 :30	23 :30	2
9 April 2018	66.1	91.7	22:00	24 :00	2

In table 1 can be seen where there are 4 flood events in the period of 1 week during the field. The first flood event occurred on April 6th, where the maximum discharge rate at the following hours reached 79.2 m3 / s. The second rain event occurred on April 7th at 07:00 until 09:00 with a discharge of 42.4 m3 /s. The third occurrence took place on April 7th at 21:30 until 23:30 with a discharge of 57.4 m3 / s.The fourth rain event occured on April 9th, where the maximum discharge rate of 91.7m3/s.
The ups and downs of the discharge on the four events are due to the occurrence of rain that occurs in the upstream. Upstream incidence of rain is viewed based on the 1 hour retreat time in which the figure is obtained based on the formula of time of concentration.

4. Water quality of watershed

The water quality of TDS and DHL has a fairly high correlation value. TDS increases in value so DHL will experience quality improvement and vice versa. The physical quality of Cilutung River waters can be seen in Figure 2.

From the results of field survey data processing on April 6, 2018, can be seen in Figure 2 where the high discharge affect the value of TDS and DHL

concentration. On April 6, 2018 both TDS and DHL values have always increased as the flow of watersheds increases. The quality of the water that was recorded on that date decreased both the nitrate value and the phosphate value.

In the event of the second rain of 7 April 2018 the lowest TDD was recorded at 80 mg / l and the highest was 120 mg / l. While the lowest DHL number recorded at 160 milisiemen / cm and the highest lift was recorded at 240 milisiemen / cm.Pada this rain event again visible where the discharge always affect TDS and DHL figure 2. Graph shows the increase of physical quality of water both TDS and DHL from the lowest discharge until the highest discharge. The value of chemical quality in this second incident tends to be stable both nitrate and phosphate values in the morning. At night the chemical quality of water tends to change more, seen in Figure 2 where the nitrate and phosphate values always decrease.

From the survey data collected dated April 9, 2018 recorded the value of TDS and DHL did not change significantly although the debit has increased quite high. The value of water chemistry quality in this incident tends to be higher than previous rainfall events both nitrate and phosphate. Nitrate and Phosphate values always decrease when the discharge begins to decrease.

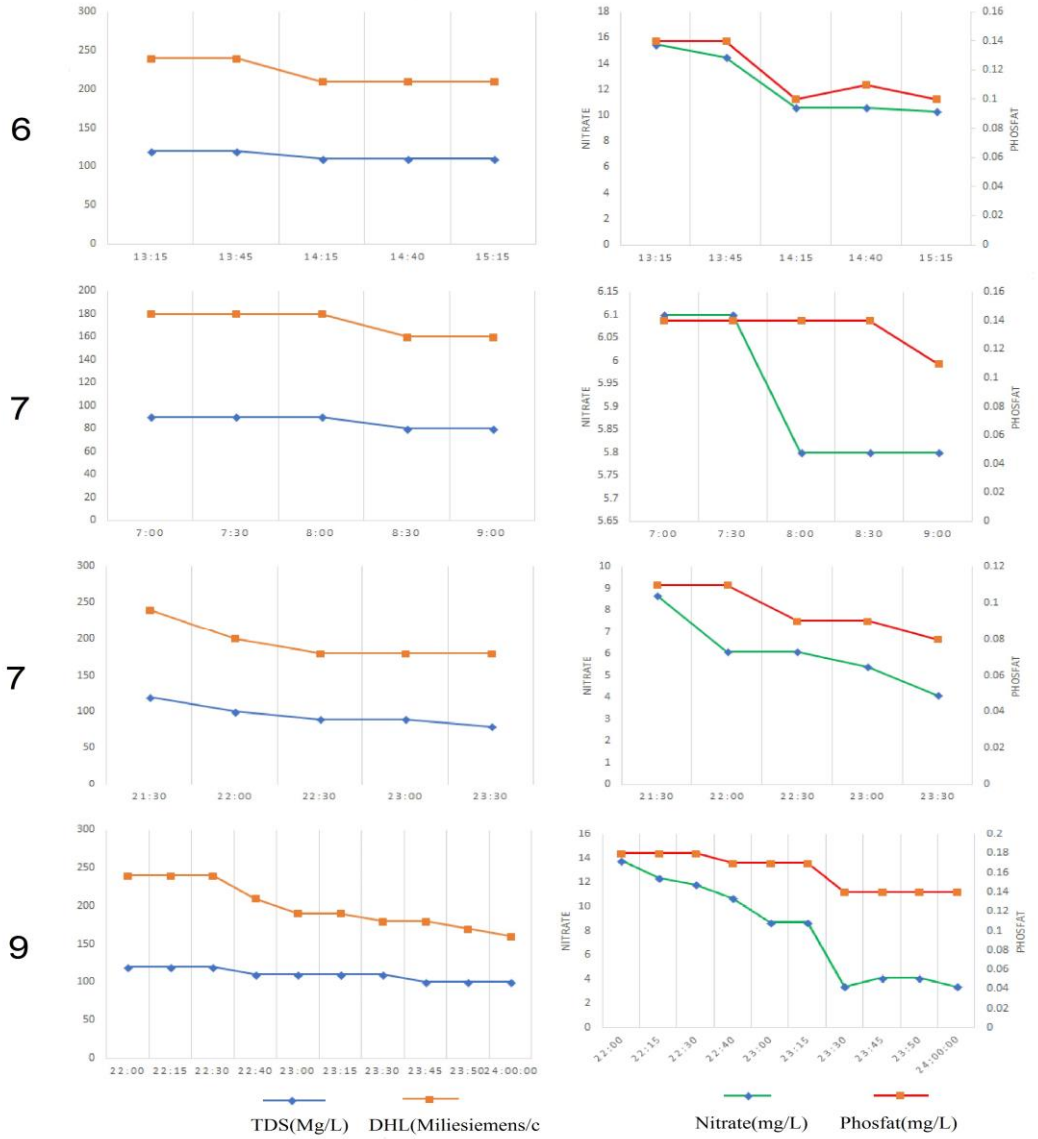

Fig. 3 graph of water quality of cilutung stream area

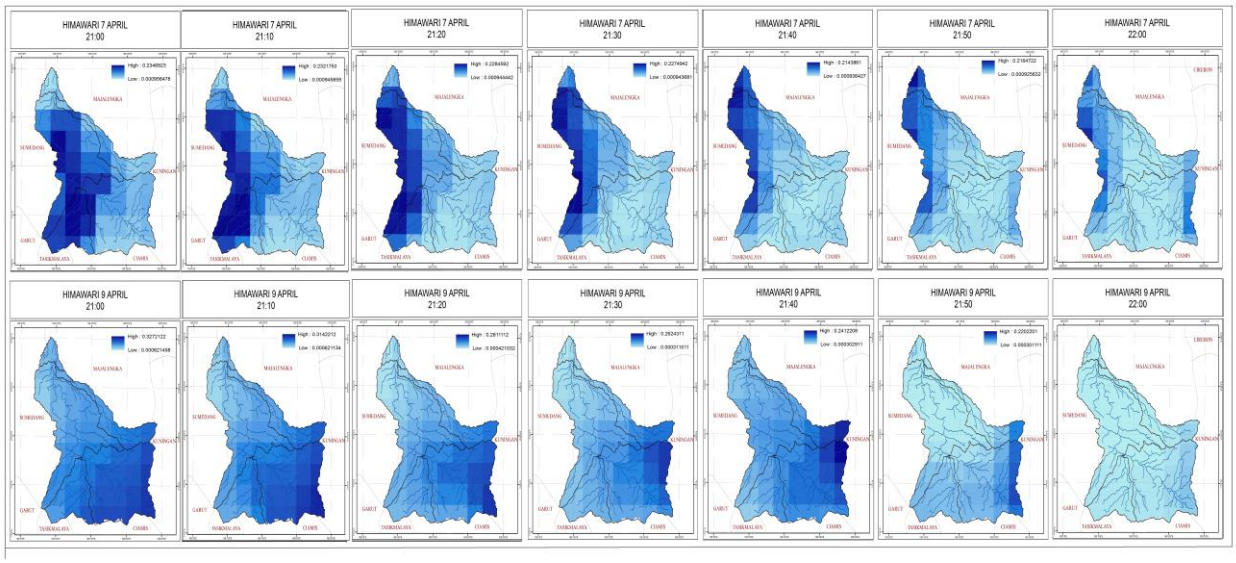

Fig.4 Himawari April 6th dan Himawari April 7th

5. The impact of rainfall on water quality

Water resources can not be separated from watershed (rainwater) and climate issues. Various sources state that the definition of DAS is an area bounded by topographic separators, which receive rain, collect, store, and stream it to the river and so on to the lake or to the sea [6]. Thus the watershed can be described as a model of input output system.

Changes in rainfall as one of the climatic elements and is the only input in a watershed

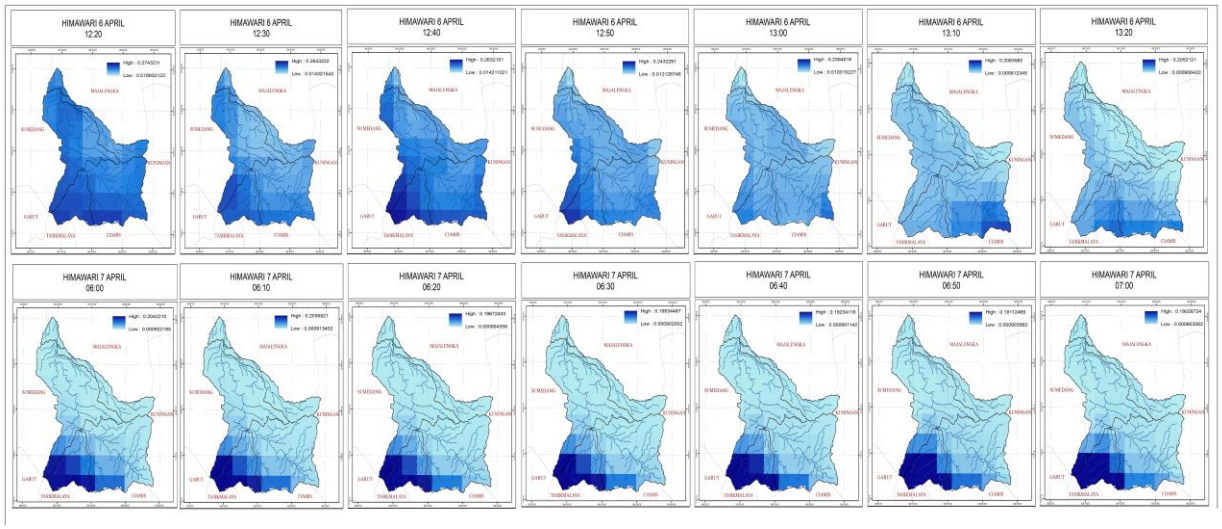

Fig. 5 Himawari April 7th and Himawari April 9th

system, will certainly have an impact on river flow discharge. Rain is a major cause of variability in the balance of the amount of water in the earth's surface in the scale of space and time so that rainfall has an important impact on hydrology and water resources [7].

On April 6th can be seen where the water level rises at 13:15 and decreases until 15:15. Based on the satellite image data (fig 3), the rainfall that has the value of water quality is in the sub watershed 3 and the DAS 4. Sub watersheds 3 and 4 are dominated by wetland use. When viewed from the

physical quality value of the Cilutung flow area seen every 30 minutes the incidence always decreases the value of TDS and so does the DH in every kejadiaanya. This is related to [8] which in theory states the discharge will increase the natural materials dissolved exponentially.

Physical quality of water always decreases when rainfall decreases. DHL values be affected due to dilution of dissolved sediment and mineral

materials [8]. Chemical quality when viewed is influenced by land use where the incident rain occurred. In the first case if you see the figure 3 then nitrate will increase when rainfall occurs sub watershed dominated by the use of rice fields and plantations.

Figure 3 shows that the events of rain that occurred on April 6 and April 7 were both affected by rainfall events in the sub-watershed 4. The quality of the nitrate recorded on April 6 was greater than on April 7, due to the influence of rain itensity that happened. The incidence of rain on 6 April was recorded higher than on April 7 (figure 3), which is why the difference in nitrate quality is higher on April 6th. In addition, the incidence of rain on 6 April is not only influenced by land use in sub-watershed 4 but also influenced by land use in sub watershed 3 (figure 3).

On the occurrence of the third rain on 7th at 21: 30-23: 30 April, it is seen that the rain happened in sub DAS 3 (fig 4). Sub DAS 3 is dominated by the use of plantation and paddy fields. If you look at the value of water quality on the dated rain event (fig 2) then the nitrate value on this occurrence is higher than 07: 00-09: 00. High nitrate values are influenced by rainfall events in sub-DAS 3, this is what causes the difference in nitrate value. While the impact on phosphate values at 21: 30-23: 30 incidents tend to be lower.

In the event of the fourth rain of the 9 April study can be seen where the water level rises at 22:00 and decreases until 24:00. Based on the satellite image data (fig 4), the rainfall that shows the value of the sample point is located in the sub DAS 5. If the view of the land use, sub-watershed 5 consists of 3 types of land use consisting of rice fields, moor and bush . According to the recording of himawari's image, the rainfall effect on the physical quality of the cilutung stream area where the value of TDS and DHL increases as the image looks rain and decreases every hour. The chemical quality of the fourth occurrence is quite high at nitrate and phosphate values at 22:00, this is due to the use of land that is plagued by rainfall on the use of agricultural land and plantations, sub watershed 5 gives a considerable influence on water quality. Phosphate values are also high in the event of rain. High nitrate and phosphate values come from plantation land use.

6. Conclusion

From the results of research on the effect of rainfall on water quality in the Cilutung basin can be concluded that the large amount of rainfall affects the value of the discharge. From the results of data processing, when the high rainfall is also increased. High and low discharge also affect the fluctuation of physical quality of Cilutung river flow area but does not affect the chemical quality. The quality of the water chemistry is influenced by the use of the land where the substances contained therein are carried by the rain and laid down into the Cilutung stream. The quality of nitrate is strongly influenced by the use of land of persawa-han and plantation whereas phosphate is highly influenced by settlement. It is seen when the rainfall occurring in sub DAS 3 dominated by plantation and rice field shows the highest nitrate value whereas when the incident rain occurred at sub DAS 4 nitrate values do not show a high enough number. the use of agricultural land around the watershed causes thousands of hectares of land to be in critical condition which causes a decrease in river water quality. Agricultural land use causes the value of carbon emissions released into the atmosphere to be high so that it affects the rainfall that is brought to the cilutung flow area.

Refrence

1. Seyhan, E., 1990. Dasar-dasar Hidrologi (terjemahan Fundamental of Hydrology oleh sentot subagya) Gadjah Mada University Press, Yogyakarta
2. Pennsylvania, L.E., 2006. Land Use and Water Quality
3. Sudibyakto. 1990. Model Infiltrasi DAS , Suatu Tinjauan Perbandingan Metodologi. Dari http://i-lib.ugm.ac.id/jurnal/download.php?dataId= 2362. 25 Januari 2013
4. Lisa Tanika, Subekti Rahayu, Ni'matul Khasanah dan Sonya Dewi. Fungsi Hidrologi Pada daerah ALiran Sungai.Bogor: World Agroforestry Centre (ICRAF).
5. Endar Budi Sasongko, Endang Widyastuti, dan Rawuh Edy Priyono, Oktober 2014, "Kajian Kualitas Air dan penggunaan sumur gali oleh masyarakat disekitar sungai Kaliyasa Kabupaten". Jurnal Ilmu Lingkungan. Volume 12 Issue 2: 72-82 (2014).
6. Suripin. 2004. Sistem Drainase Perkotaan yang Berkelanjutan. ANDI Offset Yogyakarta.
7. Novotny, Eric V dan Stefan, Heinz G, 2007, Stream flow in Minnesota: Indikator of climate change, Journal of Hydrology 2007, Elsevier.
8. Effendi, H. (2003). Telaah Kualitas Air Bagi Pengelolaan Sumber Daya dan Lingkungan Perairan. Yogyakarta : Kanisius.
9. Araya, P. R., Agostinho, A. A., and Bechara, J. A. (2005). "The influence of dam construction on a population of Leporinus obtusidens (Valenciennes, 1847) (Pisces, Anostomidae) in the Yacyret´a Reservoir (Argentina)." Fish. Res., Vol. 74, Nos. 1-3, pp. 198-209.'

10. Asdak Chay, 2010, Hidrologi dan Pengelolaan Daerah Aliran Sungai, Cetakan ke 5, Gadjah Mada University Press, Yogyakarta
11. Chow, Ven Te. 1985. Hidrolika Saluran Terbuka. Jakarta: ERLANGGA
12. Chow, Ven Te, Phd., Hidrolika Saluran Terbuka. Penerbit Erlangga, Jakarta, 1992.
13. Chu H.-J., Liu C.-Y., Wang C.-K. Identifying the relationships between water quality and land cover changes in the tseng-wen reservoir watershed of Taiwan. Int. J. Environ. Res. Public Health. 2013;10:478–489. doi: 10.3390/ijerph10020478
14. E. Ngoye and J. F. Machiwa, "The influence of land-use patterns in the Ruvu river watershed on water quality in the river system," Physics and Chemistry of the Earth A, B, C, vol. 29, no. 15–18, pp. 1161–1166, 2004.
15. Guhathakurta P., Sreejith O., Menon P. Impact of climate change on extreme rainfall events and flood risk in India. J. Earth Syst. Sci. 2011;120:359–373. doi: 10.1007/s12040-011-0082-5.
16. Hadisusanto, N. 2011. Aplikasi Hidrologi. Malang: Jogja Mediautama
17. Haridjaja, O., K. Murtilaksono, Soedarmo, dan L.M. Rachman. 1991. Hidrologi Pertanian. Jurusan Tanah. Fakultas Pertanian. Institut Pertanian Bogor. Bogor.
18. Hun-Kyun Bae, Changes of River's Water Quality Responded to Rainfall Events: Environment and Ecology Research 1(1): 21-25, 2013
19. Indarto, (2012). Hidrologi metode analisis dan Tool untuk interpretasi Hidrograf Aliran Sungai : Bumi Aksara
20. Kwang-Seuk Jeong, Dong-Kyun Kim, Hyun-Suk Shin, Ju-Duk Yoon, Hyun-Woo Kim, dan Gea-Jae Joo. 2010. Impact of Summer Rainfall on the Seasonal Water Quality Variation (Chlorophyll a) in the Regulated Nakdong River: Journal of Civil Engineering (2011) 15(6):983-994 DOI 10.1007/s12205-011-1052-9.
21. Linsley, R.K., Franzini, J.B., 1996, Teknik Sumberdaya Air Jilid 2, Erlangga, Jakarta.
22. L. Sliva and D. D. Williams, "Buffer zone versus whole catchment approaches to studying land use impact on river water quality," Water Research, vol. 35, no. 14, pp. 3462–3472, 2001.
23. Narulita, Ida. 2016. Distribusi Spasial dan Temporal Curah Hujan di DAS Cerucuk, Pulau Belitung. Jurnal RISET Geologi dan Pertambangan, Vol.26, No.2, Desember 2016, 141 – 154.
24. Nugraha, S. 2006. Potensi dan Tingkat Kerusakan Sumberdaya Lahan di Daerah Aliran Sungai Samin Kabupaten Karanganyar dan Sukoharjo Propinsi Jawa Tengah Tahun 2006. Laporan Penelitian. LPPM UNS. Surakarta.
25. Palma P., Ledo L., Soares S., Barbosa I., Alvarenga P. Spatial and temporal variability of the water and sediments quality in the alqueva reservoir (Guadiana basin; southern Portugal) Sci. Total Environ. 2014;470:780–790. doi: 10.1016/j.scitotenv.2013.10.035.
26. Reichwaldt E.S., Ghadouani A. Effects of rainfall patterns on toxic cyanobacterial blooms in a changing climate: Between simplistic scenarios and complex dynamics. Water Res. 2012;46:1372–1393. doi: 10.1016/j.watres.2011.11.052
27. Ruhiat, (2012) Kajian Hidrologis DAS Cimanuk-Leuwidaun Kabupaten Garut. Tugas Akhir: Program Studi Teknik Sipil Sekolah Tinggi Teknologi Garut.
28. Sheila F Murphy, JeffreyHWriter, R Blaine McCleskey dan DeborahAMartin. 2015. The role of precipitation type, intensity, and spatial distribution in source water quality after wildfire: Environ. Res. Lett. 10 (2015) 084007
29. Sosrodarsono, Suyono. 2002. Bendungan Type Urugan. Pradnya Paramita, Jakarta.
30. Sri Harto., 1993, Analisis Hidrologi, Gramedia Pustaka Utama, Jakarta
31. S. T. Y. Yong and W. Chen, "Modeling the relationship between land use and surface water quality," Journal of Environmental Management, vol. 66, no. 4, pp. 377–393, 2002.
32. Subarkah, Imam. 1978. Hidrologi untuk Perencanaan Bangunan Air. Bandung: Idea Dharma.
33. Teck-Yee Ling1, Chen-Lin Soo1, Jing-Jing Liew, Lee Nyanti, Siong-Fong Sim, Jongkar Grinang. 2017.Influence of Rainfall on the Physicochemical Characteristics of a Tropical River in Sarawak, Malaysia : Pol. J. Environ. Stud. Vol. 26, No. 5 (2017), 2053-2065
34. Tivianton, T. A. 2008. Analisis Hidrograf Banjir Rancangan Terhadap Perubahan Penggunaanlahan Dalam Berbagai Kala Ulang Metode Hujan-Limpasan Dengan HEC-GeoHMS dan HEC-HMS (Studi Kasus: Daerah Aliran Sungai Garang, Provinsi Jawa Tengah). Tesis. Yogyakarta: Program Studi Geografi Magister Perencanaan Pengelolaan Pesisir dan Daerah Aliran Sungai (MPPDAS) Fakultas Geografi, Universitas Gadjah Mada

35. Triatmodjo, Bambang. 1998. Penyusunan Skala Prioritas Pengendalian Banjir Sungai-sungai di Jawa Tengah Selatan. Forum Teknik Jilid 22, No. 3, November 1998.
36. Ward, R.C. 1967. Principles of Hydrology, McGraw-Hill (Limited), London.
37. Xuan Li, Tinglin Huang, Weixing Ma, Xin Sun, Haihan Zhang. 2015. Effects of rainfall patterns onwater quality in a stratified reservoir subject to eutrophication: Implications for management: Science of the Total Environment 521–522 (2015) 27–36