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THE POTENTIAL CIBERANG RIVER ANALYSIS FOR DRINKING WATER SUPPLY DEVELOPMENT OF BANTEN PROVINCE

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ABSTRACT

Aim: This study was aimed to analyze the potential of water sources in the Ciberang River to support drinking water supply system of Banten Province. Methodology and results: The method use to analyze the potential of Ciberang river is a hydrological statistical analysis. The results of the hydrological statistical analysis show that the water resources of the Ciberang River are not sufficient to meet domestic and industrial water needs in Banten Province. Domestic and industrial water demand in Banten Province in 2025 is estimated at 14.64 m³/s and 10.46 m³/s, respectively, while the mainstay discharge with the return period of 10 and 20 year for all durations does not meet these water needs. The mainstay discharge of the Ciberang River with a 10-year return period of 1, 2, 7, 15 and 30 day respectively was 0.08 m^3/s , 0.1 m^3/s , 0.19 m^3/s , 0.36 m^3/s , and 0.87 m³/s. The mainstays of the 20-year return period of 1,2,7,15 and 30 day respectively are 0.04 m³/s, 0.06 m³/s, 0.11 m³/s, 0.23 m³/s and 0.59 m³/s. Conclusion, significance, and impact study: Based on this, it is necessary to conserve water resources to increase the main flow of the Ciberang River. One of the strategic policies to increase the river's mainstay discharge is constructing the reservoir.

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1. INTRODUCTION

The provision of drinking water is one of the community's basic needs and socio-economic rights that the Government must fulfill. The availability of drinking water is one of the determinants of improving people's welfare. It is hoped that the availability of drinking water can enhance public health and encourage an increase in community productivity. There can be an increase in community economic growth. Therefore, the provision of drinking water facilities and infrastructure is one of the keys to regional economic development (Fadhilah, Oginawati dan Romantis, 2018).

Since 1970, the Province of Banten has entered rapid industrialization and urbanization. It was recorded that until 1990 the population growth in the area reached 4% per year and in the period 1990-2000 population growth decreased to 2.4% per year, but the rate of increase in the population remained high. The number of people in 1970 was 8.3 million and increased to 20 million in 2000. Based on this growth trend, by 2025, the population in the region is expected to reach more than 50 million (KOICA, 2006).

Banten Province Region must have a Master Plan for Water Supply System (RISPAM) according to the 2030 SDGs scenario to improve drinking water infrastructure services 18/PRT/M/2007. In line with the RISPAM, the development of Drinking Water Supply System (SPAM) is built to control groundwater exploitation that may resulting in decreasing groundwater level and to ensure the water availability. The climate change, (local, regional, global), land use conversion changed the hydrological regime that lead to extreme rainfall and discharge. There for it is very important to take effort to ensure the sustained water availability (Jayanti *et al.*, n.d.; Marselina *et al.*, 2017; Radhapyari *et al.*, 2021; Wang and Hong, 2021).

There are three main components in the concept of developing a Drinking Water Supply System (SPAM) according to the Government Regulation of the Republic of Indonesia Number 122 of 2015 concerning the Drinking Water Supply System, namely raw water sources; production system; and distribution system. Raw water sources are the main component in developing SPAM, so their availability must be assessed. SPAM aims to serve the community's drinking water needs with guaranteed quality, quantity, continuity, and affordability.

Several areas in Serang Regency, so far, have relied on raw water sources obtained from the Pamarayan irrigation and the Cidurian River, which have limited, both in quantity and quality (polluted by domestic and industrial waste and contaminated with seawater) (Rencana Induk Sistem Penyediaan Air Minum Kabupaten Serang 2019-2038, 2018).

Banten Province Regional SPAM has a development plan with raw water units obtained from the Ciberang River (Rencana Induk Sistem Penyediaan Air Minum Kabupaten Serang 2019-2038, 2018). For this reason, it is necessary to analyze the reliability of the raw water of the Ciberang River.

This research was conducted on the Ciberang River, located in the Province Banten. The studies conducted on the Ciberang River include the following: (Arianti, 2015) examined the evaluation of land use to estimate the design flood discharge in the Ciberang watershed, Banten Province; (Wigati *et al.*, 2017) reviewed flood analysis using the HEC-RAS 4.1.0 software (Case Study of the Ciberang Sub-watershed). However, there is no research on a statistical analysis of the reliable discharge of the Ciberang River yet. Statistical analysis to the mainstay discharge of the Ciberang River can see the potential of the Ciberang River in providing raw water (Mayasari, 2017). This information can be used as a basis for planning water structures and water management (Salmani *et al.*, 2013; Sutrisno and Saputra, 2018). Planning for water structures such as dams or reservoirs is one way of watershed conservation to increase the flow of the river's mainstay. Planning for water structures such as dams or reservoirs is one of the Banten Province SPAM (Christopher *et al.*, 2021; Kemenpupr, 2018).

2. RESEARCH METHODOLOGY

2.1 Collecting Data

The study was conducted at the Ciberang watershed, the Ciujung sub-watershed, located in Lebak Regency, Banten Province. Several stages were carried out to research the discharge mainstay of the Ciberang River, the first stage, namely the collection of discharge data. The discharge data used in this study are daily discharge data from discharge measurements at the Sabagi discharge station (Figure 1). The discharge data used is in the range of 2007-2020. Data from the Sabagi station is used because it has a fairly long data range of 14 year.

The Potential Ciberang River Analysis for Drinking Water Supply Development of Banten Province Mulyawati, Sabar, Marselina, Nasir

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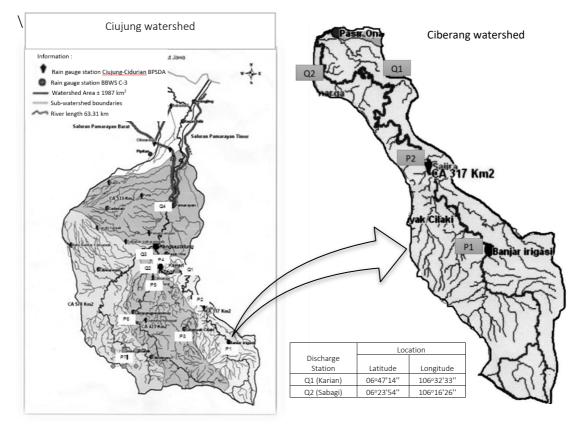


Figure 1 Ciberang Watershed research location Source: Balai Besar Wilayah Sungai Ciujung-Cidurian-Cidanau (BBWS-C3)

After obtaining the discharge data, the next step is data processing. The stages in data processing can be described as follows: a. Determine the Average discharge duration of 1, 2, 7, 15, and 30 day; b. determine the minimum discharge from the average discharge data for the duration of 1, 2, 7, 15, and 30 day; c. selection of probability distributions (Normal, Log-Normal, Gumbel, Log Pearson III) that match the Chi-square Goodness-of-fit Test (Afifah, 2019; Sabar, 2002; Mayasari, 2017; Marselina, 2017); d. calculate the discharge of drinking water for return periods of 5, 10, 20 year with the selected theoretical distribution (Sudinda, 2019); e. create an extreme dry minimum water discharge probability curve; e. Reliability of raw water discharge (river); (Salmani *et al.*, 2013; Sutrisno and Saputra, 2018; Soewarno, 1993). Reliability discharge curve in the dry season using raw water criteria of the Directorate of Public Works Cipta Karya in 1994 is modified by Sabar shown in Table 1 (Afifah, 2019; Sabar, 2002). The range of planned discharge for domestic raw water sources ranges from dry plan water discharge for a 10-year

return period with a duration of 1-7 day until the design dry water discharge 20 year return period.

| River Water Source | Design Criteria for River Raw Water | | | | | | |
|-----------------------------------|-------------------------------------|------------------|--------------|------------------|----------|------------------|--|
| Dry Successive Water Discharge | Domestic | | Irrigation | | Industry | | |
| | Average | Return Period | Average | Return Period | Average | Return Period | |
| | 1-7 day | 10-20 year | 15-30 day | 5 year | 1-2 day | 20 year | |

Table 1 Design criteria for river raw water

Source: Modification of Raw Water Design Criteria MBA Ministry of Public Works (1994), Sabar, 2002; Afifah, 2019

2.2 Statistic Method

Mainstay discharge analysis based on discharge method minimum average of 1, 2, 7, 15, and 30 day, this is because the mainstay discharge must meet the design criteria for raw water sources in order to meet domestic, irrigation and industrial needs (Table 1). The next step is using frequency analysis of minimum discharge average of 1, 2, 7, 15, and 30 day, namely the Gumbel and Log distribution types Pearson Type III, as well as a compatibility test distribution using Chi-Square Method (Afifah, 2019; Sabar, 2002; Sabar, 2006; Marselina, 2017; Mayasari, 2017).

2.2.1 Normal Probability Distribution

The mainstay discharge analysis based on the Normal probability distribution is carried out with the following equation (Kamiana, 2011):

 $X_T = \overline{X} + K_T S$

Description:

(1)

 X_{Ta} = discharge with a return period of T year

- X = The average value of the discharge data (X) m³/s.
- S = Standard deviation of the discharge data (X) m^3/s .
- KT = Frequency factor, the value depends on T (Gauss Reduction Variable)

2.2.2 Gumbel's Probability Distribution

The mainstay discharge analysis based on the Gumbel probability distribution is carried out using the following equation (Kamiana, 2011):

$$X_T = X + K S \tag{2}$$

Description:

- XT = Discharge with a return period of T year
- X = The average value of the discharge data (X) m^3/s
- S = Standard deviation of the discharge data (X) m^3/s
- K = Gumbel frequency factor
- Yt = Reduced variate
- Sn = Reduced standard deviation
- Yn = Reduced mean

2.2.3 Log-Normal Distribution

The mainstay discharge analysis based on the Log-Normal probability distribution is carried out with the following equation (Kamiana, 2011):

$$Log X_T = \overline{LogX} + K_T x S Log X \tag{3}$$

Description:

 $Log X_T$ = Logarithmic value of discharges with a return period of T year.

 \overline{LogX} = Average value of Log X

S Log X = Standard deviation of Log X

 K_T = Frequency factor, the value depends on T

2.2.4 Log Pearson III Distribution

The mainstay discharge analysis based on the Log Pearson III probability distribution is carried out using the following equation (Kamiana, 2011):

$$Log X_T = \overline{LogX} + K_T x S Log X \tag{4}$$

Description:

 $Log X_T$ = Logarithmic value of discharges with a return period of T year

 \overline{LogX} = Average value of Log X

S Log X = Standard deviation of Log X

 K_T = Standard variable, the magnitude of which depends on the coefficient to the check (Cs or G)

2.2.5 Chi-Square Method (χ2) Probability Distribution Test

The probability distribution test is intended to determine the probability distribution equation chosen to represent the statistical distribution of the analyzed data sample. The equations used in the calculation of the Chi-Square method are as follows:

$$\chi^2 = \sum_{i=1}^n \frac{(OF - EF)^2}{EF} \tag{5}$$

Description:

- χ 2 = Calculation of Chi-Square Parameters
- EF = The expected frequency is according to the class division
- OF = frequency observed in the same class.
- n = Number of subgroups

The degree of a real or certain degree of confidence (α) often taken is 5%. The formula calculates the degree of freedom (DK):

$$Dk = K - (p+1) \tag{6}$$

$$K = 1 + 3.3 \log n \tag{7}$$

Description:

- Dk = Degrees of Freedom
- P = The Number of parameters for the Chi-Square test is two
- K = Number of distribution classes
- n = Amount of data

Furthermore, the probability distribution used to determine the planned rainfall is a probability distribution that has the smallest maximum deviation and is smaller than the critical deviation, or is formulated as follows:

$$\chi^2 < \chi^2_{cr} \tag{8}$$

Description:

 χ^2 = Calculated Chi-Square parameter

 χ^2_{cr} = Critical Chi-Square parameter

3. RESULTS AND DISCUSSION

The discharge data used in this study is daily discharge data from discharge measurements at the Sabagi discharge station. The discharge data used is in the range of 2007-2020. Data from the Sabagi station is used because it has a long data range, namely 14 year and with the latest data in 2020. The discharge date is then averaged with a discharge duration of 1, 2, 7, 15, and 30 day, then the minimum discharge is determined from discharge data average duration 1, 2, 7,15, and 30 day Table 2.

Table 2 Average minimum discharge of the Ciberang Riverfor the duration of 1, 2, 7, 15, and 30 day

з.

| Year | Q Average (m ³ /s) | | | | | |
|------|-------------------------------|-------|-------|--------|--------|--|
| | 1-Day | 2-Day | 7-Day | 15-Day | 30-Day | |
| 2007 | 0.01 | 0.03 | 0.07 | 0.17 | 0.88 | |
| 2008 | 0.29 | 0.31 | 0.46 | 1.04 | 3.70 | |
| 2009 | 1.49 | 1.82 | 3.60 | 6.32 | 9.11 | |
| 2010 | 4.07 | 4.59 | 6.13 | 6.75 | 8.96 | |
| 2011 | 0.39 | 0.41 | 0.77 | 0.82 | 1.29 | |
| 2012 | 0.56 | 0.56 | 0.76 | 1.45 | 1.68 | |
| 2013 | 3.96 | 4.13 | 4.83 | 7.26 | 9.79 | |
| 2014 | 0.20 | 0.30 | 0.52 | 0.91 | 2.00 | |
| 2015 | 0.06 | 0.06 | 0.09 | 0.19 | 0.39 | |
| 2016 | 2.02 | 2.49 | 3.51 | 5.58 | 7.57 | |
| 2017 | 1.33 | 1.58 | 2.31 | 2.51 | 3.98 | |
| 2018 | 1.72 | 1.77 | 2.31 | 2.64 | 17.10 | |
| 2019 | 1.01 | 1.14 | 1.50 | 1.73 | 2.47 | |
| 2020 | 4.82 | 5.04 | 5.70 | 6.51 | 7.51 | |

In addition to the discharge data, data on the water demand rate for the Banten Province Table 3. The data on the water demand rate will be compared with the discharge data of the mainstay of the Ciberang River. The information is to determine the reliability of the Ciberang River in meeting water needs in the Banten Province Region.

| Area | Water Allocatio n | Water Demand Projection (m ³ /s) | | | Water Supply | Water Demand (m ³ /s) | | |
|-----------|-------------------------|---|------|------|--------------|----------------------------------|------|-----------|
| | | 2005 | 2012 | 2025 | 2005 | 2005 | 2012 | 2025 |
| Tangerang | Domestic | 5.2 | 9.1 | 16 | 4.51 | 0.69 | 4.59 | 11.4 9 |
| | Industry | 2.1 | 3.6 | 6.3 | 0.07 | 2.03 | 3.53 | 6.23 |
| | Total | 7.3 | 12.7 | 22.3 | 4.58 | 2.72 | 8.12 | 17.7 2 |
| Serang | Domestic | 2 | 2.6 | 3.4 | 0.25 | 1.75 n | 2.35 | 3.15 |
| | Industry | 2.6 | 3.2 | 4.3 | 0.07 | 2.53 | 3.13 | 4.23 |
| | Total | 4.6 | 5.8 | 7.7 | 0.32 | 4.28 | 5.48 | 7.38 |
| Total | | 11.9 | 18.5 | 30 | 4.90 | 7.00 | 13.6 | 25.1 |

Table 3 Water demand projection for Tangerang and Serang, Banten Province

Source: KOICA, 2006

The next step in the mainstay discharge analysis is the analysis of the theoretical distribution (Normal, Log-Normal, Gumbel, Log Pearson III) for each duration. The analysis results based on each type of distribution are represented by a 7-day average discharge analysis, Table 4.

Table 4 Distribution analysis of the log-normal Q average 7 day

| Year | Qmin (m ³ /s) | Log Qi (m³/s) | Log Qi-Log Q Avg (m ³ /s) | (Log Qi-Log Q Avg) ² (m ³ /s) |
|---------|--------------------------|---------------|--------------------------------------|---|
| 2007 | 0.07 | -1.16 | -1.25 | 1.55 |
| 2008 | 0.46 | -0.34 | -0.42 | 0.17 |
| 2009 | 3.60 | 0.56 | 0.47 | 0.22 |
| 2010 | 6.13 | 0.79 | 0.70 | 0.50 |
| 2011 | 0.77 | -0.11 | -0.19 | 0.04 |
| 2012 | 0.76 | -0.12 | -0.20 | 0.04 |
| 2013 | 4.83 | 0.68 | 0.60 | 0.36 |
| 2014 | 0.52 | -0.29 | -0.37 | 0.14 |
| 2015 | 0.09 | -1.06 | -1.14 | 1.31 |
| 2016 | 3.51 | 0.55 | 0.46 | 0.21 |
| 2017 | 2.31 | 0.36 | 0.28 | 0.08 |
| 2018 | 2.31 | 0.36 | 0.28 | 0.08 |
| 2019 | 1.50 | 0.18 | 0.09 | 0.01 |
| 2020 | 5.70 | 0.76 | 0.67 | 0.45 |
| Sum | 32.56 | | | |
| Average | 2.33 | 0.08 | | |
| SD | 2.10 | 0.63 | | |

Description:

Qmin : Minimum discharge

Qi : Discharge unit i

- Q Avg : Average discharge
- SD : Standard Deviation

The next stage in this research is the Goodness-of-fit Test. The Goodness-of-fit test used in this mainstay discharge analysis is Chi-Square. In this test, the calculated Chi-Square test parameters are sought. Furthermore, the probability distribution used to determine the reliable discharge is the probability distribution with the smallest maximum deviation and smaller than the critical deviation, Table 5. Table Based on the test results obtained for determining the mainstay discharge for a minimum discharge duration of 1 and 2 day, namely the Log-Normal distribution, the minimum duration discharge of 7 day, namely Normal distribution, and minimum discharge duration of 15, 30 day, two distributions were selected, namely Log-Normal and Log Pearson III.

| Qmin (MA) | Probability Distribution | ($\chi 2$) Count | ($\chi 2$) Critical | Hypothesis |
|-----------|--------------------------|--------------------|-----------------------|------------|
| 1-day | Normal | 1.67 | 5.991 | Accepted |
| | Log-Normal | 0.67 | | Accepted |
| | Gumbel | 4.67 | | Accepted |
| | Log Pearson III | 2.67 | | Accepted |
| 2-day | Normal | 4.67 | | Accepted |
| | Log-Normal | 0.67 | | Accepted |
| | Gumbel | 6.67 | | Accepted |
| | Log Pearson III | 6.00 | | Rejected |
| 7-day | Normal | 0.67 | | Accepted |
| | Log-Normal | 2.00 | | Accepted |
| | Gumbel | 5.67 | | Accepted |
| | Log Pearson III | 3.33 | | Accepted |
| 15-day | Normal | 5.00 | | Accepted |
| | Log-Normal | 2.00 | | Accepted |
| | Gumbel | 9.33 | | Rejected |
| | Log Pearson III | 2.00 | | Accepted |
| 30-day | Normal | 5.00 | | Accepted |
| | Log-Normal | 1.00 | | Accepted |
| | Gumbel | 8.00 | | Rejected |
| | Log Pearson III | 1.00 | | Accepted |

Table 5 The results of the match between the Chi-Squared ($\chi 2$) probability distribution count and critical

After knowing the distribution that best fits the Chi-Square compatibility test, then the reliable discharge values are calculated for the 50%, 80%, 90%, 95% probability which is analogous to the discharge with return periods of 2, 5, 10, and 20 year (Kamiana, 2011). Calculations are carried out for all minimum discharge durations of averages 1, 2, 7, 15, and 30 Day, Figure 2.

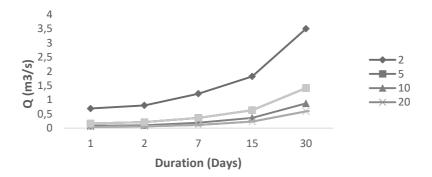


Figure 2 Shows the mainstay discharge of the Ciberang River for each average duration and returns period

The mainstay discharge of the Ciberang River, the calculation results are compared with the demand for raw water for Banten Province. The result is that the mainstay discharge of the Ciberang River cannot meet the demand for raw water needs for Banten Province, both for domestic and industrial needs, Table 6. For mainstay discharge for drinking water based on discharges Average 1 and 7 day with a probability of 90% (10 year return period) and 95% (20 year return period), (Afifah, 2019; Sabar, 2002).The mainstays of the 1 and, 7 day averages with 90% probability are 0.08 m³/s and 0.19 m³/s, for 95% probability are 0.04 and 0.11 m³/s. The mainstay discharge cannot meet the rate of domestic water demand for the Serang and Tangerang areas in 2025 of 3.15 m³/s and 11.49 m³/s.

The mainstay discharge for the industry is based on average 1 and 2-day with a probability of 90% and 95% (Afifah, 2019; Sabar, 2002). The mainstay of 1 and 2-day averages with 90% probability respectively are 0.08 m³/s and 0.10 m³/s, for 95% probability are 0.04 m³/s and 0.06 m³/s. The mainstay discharge cannot meet the rate of industrial water demand for the Serang and Tangerang areas in 2025 of 4.23 m³/s and 6.23 m³/s.

| Probability | Return Period (Year) | Q Supply | Sungai Ci | berang (n | Q Demand in 2025 (m ³ /s) | | | |
|-------------|----------------------------|----------|-----------|-----------|--------------------------------------|--------|------------|------------|
| | | 1-day | 2-day | 7-day | 15-day | 30-day | Q Domestic | Q Industry |
| 50% | 2 | 0.69 | 0.8 | 1.21 | 1.82 | 3.5 | 14.64 | 10.46 |
| 80% | 5 | 0.16 | 0.21 | 0.36 | 0.63 | 1.41 | | |
| 90% | 10 | 0.08 | 0.1 | 0.19 | 0.36 | 0.87 | | |
| 95% | 20 | 0.04 | 0.06 | 0.11 | 0.23 | 0.59 | | |

Table 6 Comparison of mainstay discharge with the rate of water demand in Banten Province

The results showed that the mainstay discharge of the Ciberang River could not meet the water demand rate in Banten Province; therefore, a watershed conservation strategy was needed. One of the watershed conservation strategies is to build water infrastructure such as reservoirs, dams, etc. Reservoirs or dams can accommodate water from a watershed, especially during the rainy season. They can be used during the dry season to increase the reliability of the Ciberang River water.

4. CONCLUSION

The mainstay of the Ciberang River water discharge for each duration of the average of 1, 2, 7, 15, and 30 day on return periods 10 and 20 year cannot meet the water demand of Banten Province. The mainstays for drinking water based on of the 1 and, 7 day averages with 10 year return period are 0.08 m³/s and 0.19 m³/s, for 20 year return period are 0.04 m³/s and 0.11 m³/s. The mainstay discharge cannot meet the rate of domestic water demand for the Serang and Tangerang areas in 2025 of 3.15 m³/s and 11.49 m³/s. The mainstay discharge for the industry based on 1 and 2-day averages 10 year return period, respectively, are 0.08 m³/s and 0.10 m³/s, for 10 year return period are 0.04 m³/s and 0.06 m³/s. The mainstay discharge cannot meet the rate of and 0.06 m³/s. The mainstay discharge cannot meet the rate of 0.06 m³/s. The mainstay discharge cannot meet the rate 0.04 m³/s and 0.20 m³/s. The mainstay discharge for the industry based on 1 and 2-day averages 10 year return period, respectively, are 0.08 m³/s and 0.10 m³/s, for 10 year return period are 0.04 m³/s and 0.06 m³/s. The mainstay discharge cannot meet the rate of industrial water demand for the Serang and Tangerang areas in 2025 of 4.23 m³/s and 6.23 m³/s.

REFERENCES

Afifah, E., Sabar, A., Wulandari, S, Marselina, M. 2019. The Reliability Study of Raw Water Sources in the Development of Potable Water Supply Systems in Indonesia. *International Journal of Geomate*. 16(54): 209-2016. Doi: <u>https://doi.org/10.21660/2019.54.75034</u>. Arianti, D *et al.*, 2015. Perencanaan Penggunaan Lahan untuk Debit Rancangan Bendungan Karian di DAS Ciberang Kabupaten Lebak Provinsi Banten http://repository.ipb.ac.id/handle/123456789/76726. [12 December 2021].

Balai Besar Wilayah Sungai Ciujung-Cidurian-Cidanau (BBWS-C3), Data Hidrologi, 2021.

- Christopher, Cleon, Doddi Yudianto, and Albert Wicaksono. 2021. Studi Kelayakan Waduk Cikawari 2a Dan 5a dalam Rangka Pemenuhan Kebutuhan Air Kota Bandung. *Jurnal Teknik Hidraulik*. 12(1): 53-64. DOI: 10.32679/JTH.V12I1.654.
- Fadhilah, R., Oginawati, K., Romantis, N.A.Y. 2018. The Pollution Profile of Citarik, Cimande, and Cikijing Rivers in Rancaekek District, West Java, Indonesia. Indonesian Journal of Urban and Environmental Technology. 2(1): 14-26. <u>https://trijurnal.lemlit.trisakti.ac.id/index.php/urbanenvirotech/article/view/3551/pdf</u>
- Jayanti, M., Hadihardadja, I. K., Dwi Ariesyady, H., and Messakh, J. J. (n.d). 2020. Climate Change Impacts on Hydrology Regime and Water Resources Sustainability in Cimanuk Watershed, West Java, Indonesia. International Journal of Geomate. 19(71): 90-97. Doi: 10.21660/2020.71.9215.
- Kemenpupr. 2018. Modul 2 Kebijakan dalam Pengembangan Bendungan. <u>https://bpsdm.pu.go.id/</u>. [20 December 2021].
- KOICA, Karian Multi Porpose Dam Report. KOICA Inc, 2011.
- Kamiana, I., M., Teknik Perhitungan Debit Rencana Bangunan, Edisi 1, Air Graha Ilmu. Yogyakarta, 2011, p. 14-43.
- Mayasari, D. 2017. Analisa Statistik Debit Banjir dan Debit Andalan Sungai Komering Sumatera Selatan. *Forum Mekanika*. 6(2): 88-98. Doi: 10.33322.
- Marselina, M., Sabar, A., Rachmatiah, I., Salami, S., Marganingrum, D. 2017. Primary Pollutant Selection and Determination of Water Quality Index in Class Discharge Division Based on Three Class Markov Model. *International Journal of Geomate*. 13(38). Doi: http://dx.doi.org/10.21660/2017.38.402807.
- Marselina, M., Sabar, A., Rachmatiah, I., Salami, S., Marganingrum, D., Teoretis, J. 2017. Model Prakiraan Debit Air dalam Rangka Optimalisasi Pengelolaan Waduk Saguling-Kaskade Citarum. *Jurnal Teknik Sipil.* 24(1). Doi: 10.5614/2017.24.1.12.
- Radhapyari, K., Datta, S., Dutta, S., and Barman, R. 2021. Impacts of Global Climate Change on Water Quality and its Assessment. Water Conservation in the Era of Global Climate Change, pp. 229-275. Doi: 10.1016/B978-0-12-820200-5.00011-7
- Rencana Induk Sistem Penyediaan Air Minum Kabupaten Serang 2019-2038. 2018. Executive Summary Rencana Induk Sistem Penyediaan Air Minum Kabupaten Serang 2019-2038. https://siska.serangkab.go.id/file/Kajian Tahun 2018/. [20 December 2021].

- Sabar, A. Tren Global Pembangunan Infrastruktur Sumber Daya Air yang Berkelanjutan dalam Rangka Diskusi Pakar Perumusan Kebijakan *Eco-Efficient Water Infrastructure* Indonesia, Direktorat Pengairan dan Irigasi-Bappenas, 2002.
- Salmani , Razi, F., and Wahyudi, M. 2013. Analisa Ketersediaan Air Daerah Aliran Sungai Barito Hulu dengan Menggunakan Debit Hasil Perhitungan Metode Nreca. *Jurnal INTEKNA : Informasi Teknik dan Niaga*: 13(2). Doi: 10.31961/intekna.v21i2.
- Soewarno, Aplikasi Metode Statitistik untuk Analisa Data Hidrologi, Jilid II, Nova, Bandung, 1993, p-22-25.
- Sudinda, T. W. 2019. Penentuan Debit Andalan dengan Metoda FJ Mock di Daerah Aliran Sungai Cisadane (Determination of Mainstay Discharge using the FJ Mock Method in the Cisadane River Basin. *Jurnal Air Indonesia*. 11(1). Doi: <u>https://doi.org/10.29122/jai.v11i1.3933</u>.
- Sutrisno, S., and Ferdhy Setiawan Saputra. 2018. Studi Penerapan Metode Mock dan Statistik untuk Menghitung Debit Andalan PLTA Bakaru Kabupaten Pinrang. *Teknik Hidro*. 11(2): 38-47. Doi: 10.26618/TH.V11I2.2445.
- Wang, J., and Hong, B. 2021. Threat Posed by the Future Sea-Level Rise to Freshwater Resources in the Upper Pearl River Estuary. *Journal of Marine Science and Engineering*. 9(3). Doi: 10.3390/jmse9030291.
- Wigati, R., Maddeppungeng, A., and Pratiwi, B. D. 2017. Kajian Alternatif Penanggulangan Banjir (Studi Kasus DAS Ciujung Bagian Hulu, Banten). *Konstruksia.* 8(2). 9-22. Doi: 10.24853/JK.8.2.9-22.