Region of springs utilization in Cicurug Village, Majalengka, Sub-District, Majalengka District, West Java

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Abstract. Springs is one of the primary sources of clean water used to fulfil domestic water needs in Cicurug village. Its residents have widely used the springs in Cicurug village, but the spring management is simplistic. Thus, utilization of water resources management practices in Cicurug village should be further developed. This study analyses the spatial pattern of springs utilization based on the potential area, the actual utilization area, and the comparison between the potential and actual utilization areas. The results of this study indicate the springs in Cicurug village are located between the altitude of 165-346 m above the sea level and discharge of 0.158 l/s to 1.935 l/s. The springs utilization's potential areas are located between 135 and 300 m above sea level. The actual area of utilization springs in Cicurug village includes the land use types in villages located between 164 and 275 m above sea level. Comparing the potential areas of utilization of springs with the actual areas shows that the utilized area exceeds the potential areas. There is an actual area of springs utilization that is narrower than potential areas.

1. Introduction
Water is an important environmental component for humans' survival and other living things [1]. In the hierarchy of water utilization, water's main role for life is as a domestic water need (household) [2]. Several water sources exist based on hydrogeology, namely surface water, rainwater, and groundwater [3]. That water source is used to meet various domestic and non-domestic water needs. One of the water sources that the availability of water can use in rural areas is groundwater. Groundwater sometimes comes to the surface as springs. Springs are the point where groundwater appears as surface runoff [4]. Many residents use springs to fulfil their domestic water needs because it is easy to obtain and have good quality.

Based on data from the Ministry of Public Works in the 2015 - 2019 Majalengka Regency Medium-Term Investment Program Plan, the level of clean water services sourced from springs in the Majalengka Regency has a capacity of 7,002 l/s spread over 294 springs [5]. Based on the 26 sub-districts in Majalengka Regency, Majalengka Regency is one of the districts that have good potential for springs in the 3rd place with the highest number of springs after Talaga and Bantarujeg Districts with an average daily discharge of 469 l/s.

Securus Village has the second-highest population density compared to other villages in Majalengka District, 2,559 km² [6]. High population density impacts the increasing need for water sources, while one of the sources used to meet the needs of clean water and raw water is springs. Water sources are important as providers of water needs in the region. Therefore, it requires proper management,
maintenance, and utilization of springs. Its residents have widely used the springs in Cicurug village. However, the spring management is very simplistic, managed independently with traditional techniques such as using a pipe or hose connected. This is why the utilization of springs in Cicurug Village is still not good. Therefore, it is necessary to carry out an analysis to determine how the condition of the spring utilization area's spatial pattern is potentially and actually.

2. Methodology

2.1. Data

The research area is located in Cicurug Village, Majalengka Sub-District, Majalengka District, West Java. The survey in this study was conducted in the dry month, November 2019. The data needed in this study are primary data and secondary data in the form of spatial data and other supporting data obtained from websites, institutions, related institutions, and direct observations in the field. During the research process, the data needed are springs location, springs discharge, elevation, watershed boundaries, distribution system of actual areas, and land-use.

2.2. Method

In this study, the method used is the overlay technique (Overlay Analysis). The overlay is used to process areas of springs utilization and actual areas of springs utilization. Data processing in this study are collected and processed using ArcMAP 10.4 software and Microsoft Excel.

2.2.1. Water availability and water needs

Tabular data processing in this study includes data processing of domestic water availability and water needs. Tabular data processing in this study is as follows. First, water discharge is used to determine the amount of water availability. The total of potential residents who can utilize water from the springs in Cicurug Village will be known.

\[ Q = \frac{V}{t} \]  

Where, \( Q = \) discharge (l/s); \( V = \) water volume (m³); and \( t = \) measurement time (s).

Second, the availability of water. The data used include data on basic water needs for the village's domestic needs for the village as a sum of 82.5 l/capita/day based on the classification [9].

\[ P = \frac{V}{K} \]  

Where \( P = \) People who can take advantage of the springs (soul); \( V = \) The amount of discharge from the springs (l/day); and \( K = \) Assumption of population water needs (l/capita/day).

Besides, domestic water needs to be calculated based on population and water consumption per capita per day.

\[ Q = P \times q \]  

Where \( Q = \) water needs (l/day); \( P = \) assumption of population water needs per day (l/capita/day); and \( q = \) the total of souls to be served according to the planning year (soul). Furthermore, water losses are calculated based on the same calculation method as the water needs calculation method, assuming a water loss of 24 l/capita/day [9,10].

3. Results and discussion

3.1. Distribution of springs and hydrological characteristics

Based on the results of the field survey and information from the Village Officer, there are nine springs in the village of Cicurug, which are used to meet the community's domestic water needs. They are located at an altitude of 165 - 346 m above sea level, namely Gajah, Lolojog, Kahuripan, Kedok, Kopo
springs. Nyimplung, Panjang, Pasir Muncang, and Situ. The highest springs are at an altitude of 346 m above sea level at the Pasir Muncang spring, and the lowest is at an altitude of 165, which is at the Kopo springs. The map of the distribution of springs is presented in figure 1.

**Figure 1.** Map of the distribution of springs in Cicurug Village.

Based on the discharge measurements carried out in the dry month of November 2019 at the spring location, the results of the calculations are shown in table 1. The largest spring discharge is found in the Pasir Muncang spring with a discharge of 1,935 l/s or 167.184 l/day, while for eye discharge, the smallest water is found in Nyimplung spring, which is 0.158 l/s or 13.651 l/day. Based on the discharge class, according to Meinzer, the springs in Cicurug Village are classified as class V springs with a discharge of 1 to 10 l/s and class VI with a discharge of 0.1 to 1 l/s. Water discharge from springs is used to calculate water availability, where water availability is used to describe each spring's potential to serve the water needs of the residents of Cicurug Village. The following is a table of information on the discharge of springs and the potential of the population served by the springs in Cicurug Village.

**Table 1.** The total population is potentially served by the springs of Cicurug Village.

| No | Springs      | Discharge | Total Population Potentially Served (Soul) |
|----|--------------|-----------|------------------------------------------|
| 1  | Gajah        | 0.419     | 36.202                                    | 439           |
| 2  | Lolojog      | 1         | 86.400                                    | 1,047         |
| 3  | Kahuripan    | 0.187     | 16.157                                    | 196           |
| 4  | Kedok        | 0.329     | 28.426                                    | 345           |
| 5  | Kopo         | 0.339     | 29.290                                    | 355           |
| 6  | Nyimplung    | 0.158     | 13.651                                    | 165           |
| 7  | Panjang      | 0.309     | 26.698                                    | 324           |
| 8  | Pasir Muncang| 1.935     | 167.184                                   | 2,026         |
| 9  | Situ         | 0.29      | 25.056                                    | 304           |

Apart from calculating water availability, domestic water needs from springs in the service area can be obtained by calculating the debit based on the population of the area and the water needs per capita. It is also necessary to calculate water losses, which cannot be separated from water needs. Calculation of water availability, demand, and loss in Cicurug Village can be seen in tables 2 and 3.
The availability of water from springs in Cicurug Village is used to fulfill the population's domestic water needs. The following is a comparison table between the availability and water needs in Cicurug Village.

### Table 2. Domestic water needs and loss in Cicurug Village.

| The Total of Villagers (Soul) | Domestic Water Needs (l/capita/day) | Water Needs (l/day) | Losing Water (l/day) | Total (l/day) |
|------------------------------|-------------------------------------|---------------------|---------------------|--------------|
| 6,495                        |                                     | 535.838             | 155.880             | 691.718      |

The availability of water from springs in Cicurug Village is used to fulfill the population's domestic water needs. The following is a comparison table between the availability and water needs in Cicurug Village.

### Table 3. Domestic water needs and availability in Cicurug Village.

| The Total of Villagers (Soul) | Availability l/s | Domestic Water Needs (l/day) | Info |
|------------------------------|-------------------|-------------------------------|------|
| 6,495                        | 5                 | 432.000                       |      |
|                              |                   | 535.838                       |      |
|                              |                   | 155.880                       |      |
|                              |                   | 691.718                       | D    |

D: Deficit

If seen in table 3, based on the total population of Cicurug Village, the available water availability is less than the need, namely having water availability from springs of 432.000 l/day. In comparison, the water needs of the population, which are also calculated as water loss, are 691.718 l/day, thus experiencing a water deficit. According to the informant (Village Officer), Cicurug Village residents have never experienced water shortages. This is because residents do not only use springs but use other water sources such as shallow groundwater or river water.

### 3.2. Potential areas for domestic utilization of springs

A potential spring area is an area located in an area with an altitude lower than the spring location, with a minimum height difference of ≤10 m - 30 m below the spring and less than 1 km from the spring for small systems. The large systems have an altitude difference of more than 30 m below the spring and less than 3 km from the spring, and both are bounded by the watershed area the spring is located (DA Cideres).

Based on the discharge, Gajah Spring is classified as a spring with a small system located at 174 m above sea level. Those included in the potential area of Gajah springs are located from 10 m - 30 m lower than the spring location, namely at an altitude of 144 - 164 m asl and less than 1 km from the spring for the same watershed. The same applies to the Nyimplung, Kedok, Kahuripan, Kopo, Situ, Panjang springs, whose discharge is included in the Small system. While the Muncang Sand Springs, if viewed based on the discharge, are classified as springs with an extensive system located at an altitude of 346 m above sea level. Included in the Pasir Muncang spring's potential area is located from 315 m above sea level and onwards and is less than 3 km from the spring. The same applies to the Lolojog spring to obtain a potential water use area based on its physical condition. Furthermore, both are bounded by the watershed area the spring is located (DA Cideres). Figure 1 shows the map of data processing results to form a Potential Area Map for Domestic Use of Springs in Cicurug Village.

When viewed on the map (figure 2), the potential area for water use in Cicurug Village forms an area following the shape of a watershed extending from South to North. The potential area formed covers all hamlets of Desa Cicurug but does not cover all parts of the village. The village group that can be served by springs is located at an altitude of 135-295 m asl. The area of potential and potential settlements served by springs in Cicurug Village is presented in table 4.

### Table 4. Area of potential springs in Cicurug Village.

| No. | Springs | Potential (ha) | % | Potential settlement (ha) | % |
|-----|---------|----------------|---|----------------------------|---|
| 1   | Gajah   | 29,2           | 9,7| 10,6                       | 18,5|
| 2   | Kahuripan | 5,4           | 1,8| 0                           | 0 |
| No. | Springs  | Potential (ha) | %   | Potential settlement (ha) | %   |
|-----|----------|----------------|------|--------------------------|------|
| 3   | Kedok    | 62.8           | 20.8 | 20.6                     | 36.1 |
| 4   | Kopo     | 3.1            | 1    | 0.6                      | 1    |
| 5   | Lolojog  | 183.4          | 60.9 | 46.9                     | 82   |
| 6   | Nyimplung| 18             | 6    | 1.6                      | 2.8  |
| 7   | Panjang  | 65.1           | 21.6 | 22.5                     | 39.5 |
| 8   | Pasir Muncang | 163.6 | 54.3 | 26.7                     | 46.8 |
| 9   | Situ     | 10.3           | 3.4  | 3.5                      | 6.1  |

The potential area with the largest area is the Lolojog spring area with an area of 183.4 ha or 60.9%, and the potential area of the Lolojog spring has the largest potential served area of the village, namely 46.9 ha (82%). The potential area with the smallest area is the potential area of the Kopo spring with an area of 3.1 ha or 1%, and the potential area of the Kopo spring has a potential village area of only 0.6 ha (1%). The smallest potential village area is in the Kahuripan spring, which has no area in it or with a value of 0 ha (0%).

The potential area for domestic water utilization in Cicurug Village is divided into three classifications: high, medium, and low-level classifications. The high-level classification is predominantly located in the northern part of the village, to be precise in the southwest part of Kp Rebo, part north, part south, and part northwest Kp Monday Babakan Koda. This area is included in the high level because it can be served by 5-6 springs. Furthermore, the medium-level utilization potential area is located in the North and South of the Village. This area is included in the medium level because it can be served by 3-4 springs. Besides, Low-level potential utilization areas are located in the Northeast and part of the South of the Village. This area is included in the low level because it can be served by only 1-2 springs in Cicurug Village. The map of the potential level of spring utilization in Cicurug Village can be seen in figure 3.
3.3 Actual areas of springs utilization

The actual area for utilizing springs is formed from villages through which a spring distribution channel is called a service area. Based on data collection and processing results, a map of the actual area of spring utilization in Cicurug Village is produced and is presented in figure 6.

Based on interviews with Cicurug Village Officers, Gajah, Kedok, Kopo, Kahuripan, Lolojog, Nyimplung, Panjang, Pasir Muncang, and Situ Springs were fully utilized to meet the domestic water needs of residents in the village. The spring used to drain the agricultural flow is Buyut's spring. So, in general, the use of springs in Cicurug Village is prioritized to meet the population's domestic water needs.

Based on the field findings, the water distribution network system from springs at the research location uses a branching system and a single lane system. However, the one-lane system is mostly used in the research area because according to the Cicurug Village Officer, the one-lane system is more straightforward than the one-lane system. Branch off. The branching system is only used in the Gajah and Panjang springs. This branching network system exists due to requests from fish livestock owners to the Head of Cicurug Village and Cicurug Village officials' requests.

Based on data processing results, not all utilization areas formed are by following under their potential areas. The actual utilization of domestic springs in Cicurug Village is located at an altitude of 164-275 m asl. Comparing the actual and potential area of use of springs in Cicurug Village, which is mainly by potential areas that exceed the actual area of use of each spring, different things occur in the actual areas of use of Gajah, Kahuripan, Kopo, and Situ Springs springs. Beyond its potential boundaries. This happens because the spring discharge from Gajah, Kahuripan, Kopo and Situ springs in actual conditions can still be used to meet the village's domestic water needs with a distance of more than 1 km. Another factor that affects the utilization of using a mediator in the form of pipes/hoses is that water does not run over much and can be utilized in a wider area. The comparative data can be seen in table 9.

The Kahuripan spring, when viewed based on its potential area, is categorized as non-potential, where it has a value of 0 ha in the potential village. However, in the actual area, its use extends to the north with an area of 0.47 ha. The actual area of use for the Kopo and Situ springs also exceeds the potential area boundaries, namely, the actual area of the Kopo spring area is 3.75 ha, while the potential village area is 0.6 ha. The Situ Spring has an area of 3.5 ha for its potential village, and the actual settlement is 9.23 ha. Mata Air Gajah has a larger potential settlement area of 10.6 ha and an actual settlement area of 12.54 ha.

If seen in table 9 and figure 4 in general, apart from the Gajah, Kahuripan, Kopo and Situ springs, the actual use of the springs in Cicurug Village is much smaller than the potential area. This indicates that not all residents are close to the area of potential springs in Cicurug Village. So, according to their potential areas to meet the domestic water needs of Cicurug Village residents.

| No. | Springs       | Discharge (l/s) | Potential settlement (ha) | Actual settlement (ha) |
|-----|---------------|-----------------|---------------------------|------------------------|
| 1   | Gajah         | 0.419           | 10.6                      | 12.54                  |
| 2   | Kahuripan     | 0.187           | 0                         | 0.47                   |
| 3   | Kedok         | 0.329           | 20.6                      | 6.02                   |
| 4   | Kopo          | 0.339           | 0.6                       | 3.75                   |
| 5   | Lolojog       | 1               | 46.9                      | 4.03                   |
| 6   | Nyimplung     | 0.158           | 1.6                       | 0.40                   |
| 7   | Panjang       | 0.309           | 22.5                      | 11.41                  |
| 8   | Pasir Muncang | 1.935           | 26.7                      | 6.85                   |
| 9   | Situ          | 0.3             | 3.5                       | 9.23                   |
4. Conclusion

The spring in Cicurug Village is located at an altitude of 165-346 m above sea level with a discharge of 0.158 l/s to 1,935 l/s. The potential springs formed in Cicurug Village form an area extending from upstream to downstream of DA Cideres following the boundaries of the ridge, located at an altitude of 135 - 300 m asl with varying areas scattered in the villages in Margaluyu, Margarahayu, and Margaraharja hamlets. The actual use of springs in Cicurug Village includes land use types in the form of villages located at an altitude of 164 - 275 m asl. The comparison between the area of potential utilization of domestic springs does not match actual use. There is an actual area of use that exceeds its potential area, and there is an actual area of use of springs that is narrower than the potential area. This is because the actual area depends on the distance between the spring and the village's location, where the villagers will make more use of the springs that are nearby.

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