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REVIEW ARTICLE

# Geoinformatics of Spring Water Quality in Smal Village

**Ratna Saraswati, Taqyudin, Fajar Dwi Pamugkas, Adi Wibowo***
Department of Geography, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Indonesia

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**Correspondent email** :
adi.w@sci.ui.ac.id

***Abstract.*** *Geoinformatics is spatial information based on characteristics and analysis regarding spatial data.* Water is the main component of human life with clean water, especially drinking water found from various sources, including spring water. Water quality is a global standard as a chemical, physical, and biological parameter. The study aims to determine the potential spring water based on spatial analysis of water quality standards for potential use. The method used to determine the potential utilization of springs using geographic information system analysis. Data is based on the difference in height, slope, and distance from springs to settlements and discharge. Water quality samples are analyzed using mobile and laboratory tests. The result found that physical parameters from five locations, Sirah Citanggulun, Cikerebek, Cijati, Cijati 2, and Galumpit, have good quality to meet the utilization requirements, especially for water designation class. Chemically parameters, water quality, is relatively good based on several parameters such as pH, Nitrite, dissolved iron, and zinc, which do not exceed the required quality standard threshold. The biological parameters, five samples are contaminated by bacteria *Escherichia coli* and total coliform. Regarding the literature review, this research found that biological contaminants are unsuitable for drinking water, but it is still good to become another used. The research concluded that the spring water in a small village could become potential uses for drinking water based on the parameter of water quality for daily use, especially for drinking water, regarding biological parameters that spring water must be boiled to drink.



## 1. Introduction

Water is the main component of all living things. Human life cannot be separated from the need for clean water, especially drinking water. So far, water needs are met from various sources, including groundwater, river water, rainwater, springs, and seawater. (Amelia et al., 2021; Manune et. al., 2019; Bakti et al. at., 2021). Water quality is a global standard as a chemical, physical, and biological parameter (Chauhan et al., 2020; Thakur et al., 2023). Recently, natural waters, including surface water (freshwater, lakes, and rivers) and ground waters (borehole water and springs), are received many pollutants from biological processes and anthropogenic activities (Al Ameer et al., 2020). Water is good for microorganisms, like groundwater, and surface water may contain bacteria, viruses, fungi, and algae, which makes water objectionable for domestic purposes and health-threatening (Jebreen & Ghanem, 2015). Water is considered pure when colorless and free from turbidity and abnormal taste and smell (Njoyim et al., 2020; Ajith et al., 2023; Patel et al., 2023). Water is polluted when it contains microorganisms of human or animal origin, poisonous chemical substances, industrial or domestic sewage, and organic and inorganic substances (Mitiku, 2020; Al-Taai et al., 2021). Due to industrialization and urbanization, the risk of this polluted water consumption and its sanitation problem is increasing daily in most developing countries (Dehghani and Alizadeh, 2016). Regarding the previous studies, spring water is a polluted contaminant with chemical, physical, and biological exceed a standardized.

Previous research on spring water and its quality has been carried out by Marak et al. (2019) in Waipadda Spring, Sumba Tengah Regency. The research found that water quality at the Waipadda Spring, compared to Class I PP No. 82 of 2001, does not meet the Class I water quality standards. Cause several chemical parameters exceed the threshold, which is unsuitable for drinking water. That water quality meets categorized class II water quality standards, which can be used for water recreation infrastructure/facilities, freshwater fish farming, animal husbandry, and irrigating plants regarding Indonesiaoan regulation. The other research by Abubaker et al. (2019) collected water samples from 10 wells and four springs water during two seasons, autumn and winter 2015, to determine the groundwater and spring water's bacteriological, chemical, and physical quality. That research found that the physicochemical parameters of the water sample were obtained and revealed that most results were within the required levels by WHO. However, the MPN of coliform and fecal coliform were above recommended levels by WHO for all samples. That study provides indicators of bacteria that represent a natural health hazard in water sources in Masa City (Abubaker et al., 2019). Another researcher, Komarawidjaja's in 2011, found that laboratory water quality analysis in the Kanigoro Village still meets the quality standard. This research found that water quality had a concentration of heavy metals, except for some points samplings containing heavy metals Lead (Pb) exceeded the water quality standard of the Minister of Health and Government Regulation Class I (raw water) of PP 82/2001.

Based on the previous study, it was stated that water quality which divided into water quality for drinking water and for other uses. The other use, for example, is a recreational area, fish, and farm area.

In comparison, the density of microbial total coliform and E. coli were detected as abundant compared to the water quality standard of the Minister of Health, mainly for using water as raw or clean water. However, it is possible to utilize water directly for agriculture and fish farming activities and use it for drinking water after being cooked (Chau et al., 2015). Rahardjo (2018) studied water springs in Bali by mapping the spring's location, characteristics, and potency for domestic use. Rahardjo found spring characteristics based on geologic, geomorphologic, and hydrogeologic conditions had potencies based on calculated discharge, and domestic use was determined at 60 l/person/day for rural areas. The other study to analyze the quality of household clean water based on people's perception, by Noeraga et al. (2020), found that the water quality is inadequate for daily needs. Based study of water quality in Alatening Village, Cameroon, the fecal coliforms, as well as specific bacteria such as *Enterobacter, Escherichia coli, Streptococcus, Salmonella*, and *Shigella,* were found in all the water samples, attributable to poor hygiene (Njoyim et al., 2020). Those all-previous studies explained that critical issues in water quality are drinking water as lack of quality caused contaminant chemical, physical and biological exceed as parameter standard quality based on WHO or country regulation.

Geospatial technology has been used for various sectors. One of the most common methods is observation through remote sensing (Njoku & Tenenbaum, 2022; Amliana et al., 2016; Ashok et al., 2021; Avdan & Jovanovska, 2016). Geospatial information has primarily developed within the context of an emerging discipline, named Geoinformatics, Geomatics, or Geographic (sometimes Geospatial) Information Sciences (Chandarasekaran & Arivarignan, 2006). Geomatics is derived from the French word Ge ́ omatique, coined by the French photogrammetric Dubuisson and widely used in North America (Ehler, 2008). Geoinformatics seems popular in Europe, whereas Geographic Information Science usually indicates a Geography background (Goodchild, 1992). Siswantining et al. (2020) made a paper on Geoinformatics for Tuber Colosis (Tb) in Jakarta regarding information and analysis of the distribution characteristicsstic of that disease. In other research, Wibowo (2005) found the environmental threshold as the quality of life using geospatial or geoinformatics analysis. The terminology of geoinformatics was used as specific information regarding a spatial characteristic, and this paper used it for differentiated from the previous study.

The water quality is crucial due to human life supporting daily activity, especially the population near the spring water (Chen et al., 2020; Folke et al., 2021). Chen (2020) explained a traditional village in the Huizhou region, China, and how the locals have responded to water pollution to achieve landscape sustainability. The previous study chose the small Village to underline the spring water potential area and water quality assessment. Sumedang Regency is a unique area caused the topographic and the new toll road are ready for connecting to New Airport in Indonesia, especially in West Java. One of the districts in Sumedang Regency is Jatinanggor District, a studentification area that has three universities IPDN, University Padjajaran, Intitutute Technolgy Bandung, and a lot of university non-government had homebase or campuses in this area. Jatiroke Village, one of Jatinangor District, Sumedang Regemcy, West Java Province. Jatiroke villages are located at the foot of Mount Geulis with an altitude ranging from 600-1,200 meters above sea level and have a slope of 15-25% (Jatiroke Village Data, (2021); Khadijah & Praphesti, (2020); Sobari et al., 2016). The study area's one of the villages near the toll road and mountain has six springs of water, and the people in the Village use the spring water for drinking water. This study aims to assess spring water quality by determining physio-chemical parameters and microbial of water as Geoinformatics Spring Water Quality. In this study, the point determinants of water quality are the physical requirements of water, the chemical properties of water, and the biological conditions of the water to analyze the characteristic and pollution in spring water in the village area using combined with laboratory analysis and mobile data tester. This method is new compared with the previous study that only used a mobile tester or laboratory analysis.

## 2. Methods

Indonesia has many big islands, and Java Island is one of the major islands. Due to transportation connections, the Sumedang Regency is one of the new toll roads connected from Jakarta City to the new West Java International Airport in Majalengka Regency. The study area is in Jatiroke Village in Sumedang Regency. The Village in Sumedang is preparing to become a tourism area or business district. The map of Jatiroke Village saw in Figure 1.

This research uses a direct survey method and laboratory analysis, and the map is made with a geographic information system or geoinformatics. The potential area is regarding from quality of spring water and the characteristic of the spring water location. The potential area for the springs is obtained using the overlay technique at the springs. The variables used are the buffer distance of the springs, land use, and elevation. The potential area explains three classification areas suitable for supported drinking water. The classification is highest, medium, and low potential. The distance from the springs to the area served is obtained from the discharge of each spring. Spring potential areas have a lower elevation than the location of the springs, with a minimum height difference of 10 m - 30 m below the springs and less than 0.2 km from the spring. The potential area of a spring is limited by the watershed area of the spring than 1 km from the springs for medium systems. The low potential is more than the height and medium classification. The distance from the springs to the area served is obtained from the discharge of each spring. In this study, the potential spring area is based on the topography conditions in altitude areas regarding the Department of Public Works in 2020. Existing watersheds in the research area limit it. In addition, spring discharge is also considered in determining potential areas utilization of springs regarding the Meinzer discharge classification. Region potential springs with a discharge of $0.1 \leq x < 1$ l/s are limited to a distance of less than <1 km and have a height difference of ≤10 – 30 m. The potential area of springs with a discharge of $1 \leq x < 10$ l/s is limited to a distance <3 Km has a height difference of >30 m from the source water. There are six springs water around Jatiroke village. According to the nature of the flow, springs are divided into perennial springs that release water throughout the year and are not affected by rainfall, seasonal springs (intermittent springs), springs that release water at certain seasons and are highly

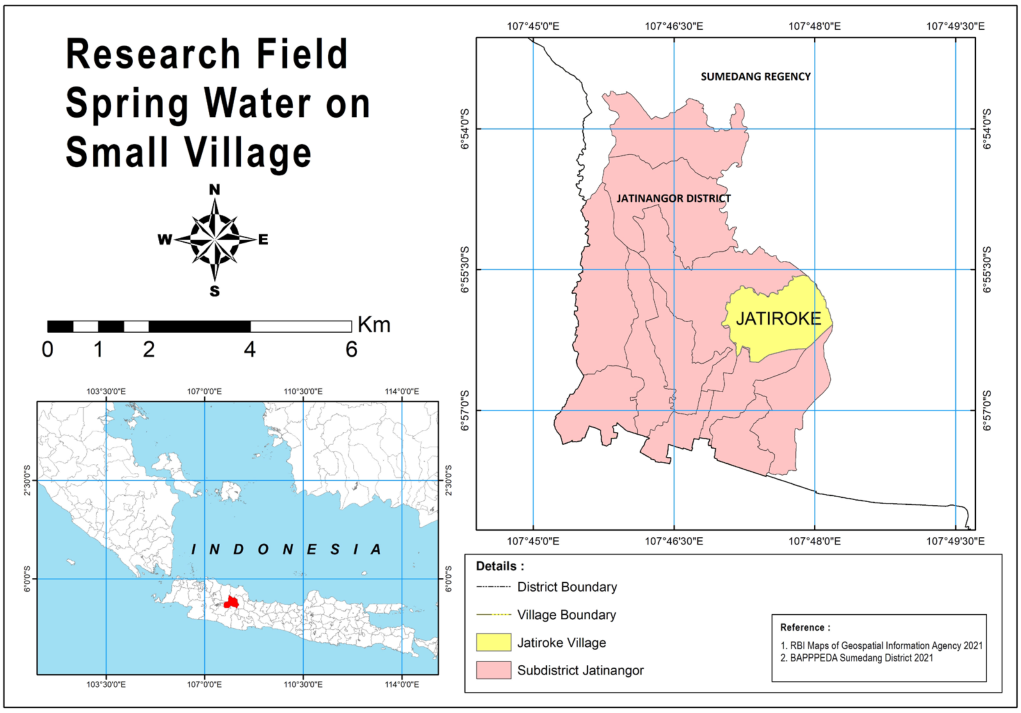


Figure 1. Jatiroke Village, Jatinangor District, Sumedang Regncy

Table 2. Parameter Standard of Water Quality

| Chemical Parameter | Unit | QS Menkes No. 32/2017 | QS PP No. 82/2001 |
|---|---|---|---|
| Dissolve Iron | mg/L | 1 | 0.3 |
| Dissolve Zinc | mg/L | 15 | 0.05 |
| Nitrit ($NO_2$-N) | mg/L | 1 | 0.6 |
| pH | mg/L | 5-9 | 6-9 |
| Physical Parameter | Unit | QS Menkes No. 32/2017 | QS PP No. 82/2001 |
| Total Dissolve Solid (TDS) | mg/L | 1000 | 1000 |
| Electrical Conductivity (EC) | | | |
| Temperature | ($^oC$) | Deviation 3$^oC$ | Deviation 3$^oC$ |
| Biological Parameter | Unit | QS Menkes No. 32/2017 | QS PP No. 82/2001 |
| *Escherichia coli* | CFU/100 mL | 0 | 100 |
| Coliform Total (MPN) | CFU/100 mL | 50 | 1000 |
| Total Pesticide | mg/L | 0.1 | 0.002 |

dependent on rainfall and periodic springs, that release their water at specific periods caused by reduced evapotranspiration at night, changes in air pressure, tides, and water heating by rocks. The survey was conducted in July 2021, during drought season, to ensure the perennial and intermittent spring water. The spring water in the Village has an altitude of lowest than 900 meters above sea level.

Based on the time survey explained in the previous paragraph, Data collection of chemical parameters of springs, Fe (dissolve iron), Zn (dissolve zinc), and Nitrite was analyzed in Environmental Services laboratories in Bekasi. The Potential Hydrogen (pH) data of the spring water was taken from a field survey by measuring using the previously calibrated ATC Pen Type PH-009 water pH meter. The spring water stored in separate glass bottles is poured into a cup to measure its pH. Data physical parameters of springs included temperature, TDS (Total Dissolve Solid), EC (electrical conductivity), and discharge. Water temperature, pH and, conductivity, TDS were measured with the help of a thermometer, pH meter, conductivity meter, and TDS meter, respectively (Abdulrazzak et al., 2020; Chauhan et al., 2020). Data on a microbiological parameter of water springs included *Escherichia coli* and Total coliform, analyzed in laboratories. In this research, pesticide parameters have also been analyzed. The results of laboratory examinations on water quality in the study area, suitable water quality parameters physical, chemical, physical, pesticide, and microbial parameters reviewed based on water quality standards, either Government Regulation (PP) No. 82 the Year 2001 and Regulation of the Minister of Health No. 32 the Year 2017. The parameter and the standard are explained in Table 1.

Meanwhile, spring water discharge data is obtained from the measurement results using the volumetric method and the formula 1 (Chauhan et al., 2020)

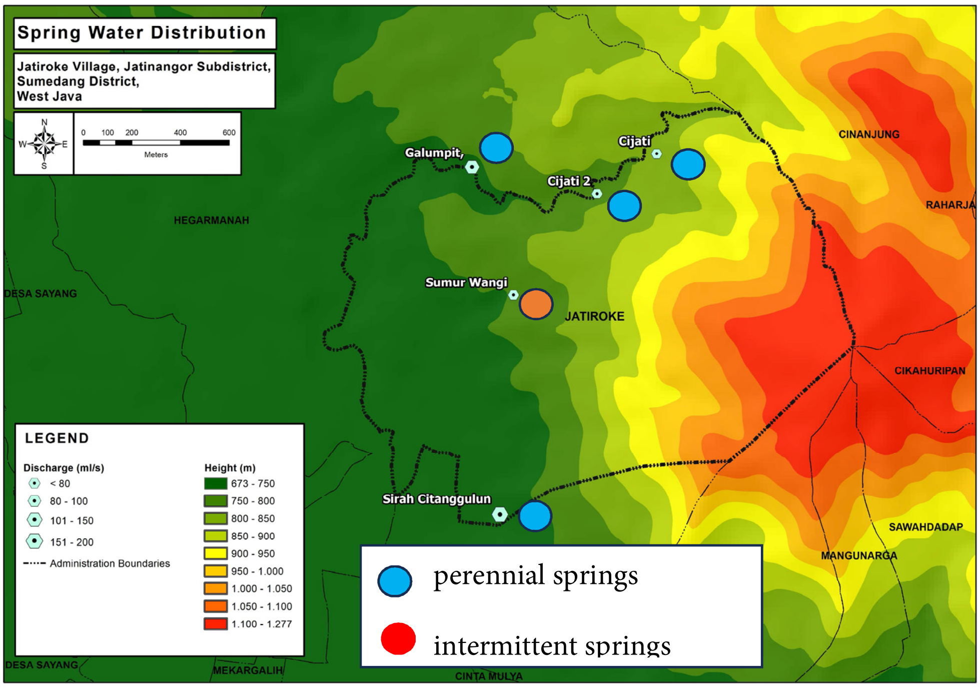


Figure 2. Spring Water Distribution in Jatiroke Village

$$Q = V/t \quad (1)$$

description:
Q = spring discharge (L/second)
V = volume of the vessel (L)
t = time (seconds)
Spring discharge is measured through a faucet or shower at the spring's location.

## 3. Result and Discussion

Based on Jatiroke Village Data (2021), Khadijah & Praphesti (2020), and Sobari et al. (2016), Jatiroke Village general information is that the geological conditions are classified as lava and Limestone from Quaternary Volcano, and Limestone is formed by organisms, resistant to waves, and has a topographic relief above the surrounding sediments; The young lava flow is molten rock (magma) that flows out of the earth through volcanic craters or fissures (faults) and freezes into the igneous rock of various shapes, sourced from two mountains, namely Mount Geulis and Mount Tampomas, and this young lava flow is composed of basaltic and scoria; Hydrogeological conditions which have a depth of the groundwater table tends to follow the region's topography, within a north-eastern part is relatively higher, and also, the water level on the ground is relatively high as well; The population in 2019 was 7,129 people, meanwhile, in 2015 were 6,741 people, with a population growth rate of 1.4% per year.

Based on the narrative of the village head, spring water in Jatiroke Village has six, and one is dry. Most people fulfill their daily needs of bathing, washing, and defecating, already available in every house with water facilities from pumps and PDAM. Figure 2 describes the distribution of water springs in Jatiroke village. There are six spring water Sirah Citanggulun, Cikrebek, Cijati, Cijati 2, Galumpit, and Sumur Wangi. Sumur Wangi is dry in the dry season, but the five springs water have water every season.

Land use in Jatiroke Village consists of paddy fields 32 ha, dry land 78,508 ha, plantation 74 ha, settlement and public facilities 15.575 ha, forest (Mount Geulis area) 55 ha, and cemetery 2 ha (Figure 3). Based on Figure 3, Jatiroke Village has land use as settlements scattered along the road. The settlement area is west of Mt. Geulis, and three springs were located around the settlement. The Dryland and Plantation were dominant land uses in the Jatiroke village. The water quality used for drinking should not have substances and bacteria that can harm the human body. To monitor water sources from springs in the Village, Jatiroke used a combination of parameters physics, chemistry, and biology. Indarto (2010) suggests that spring water is groundwater that comes out with itself to the ground, and spring water comes from groundwater in relatively shallow water resistance (perched water tables). According to Suripin (2002), water quality states the degree of suitability of water to specific uses in fulfilling the necessities of human life, starting from water to meet immediate needs, namely water drinking, bathing, and washing, irrigation water or agriculture, animal husbandry, fishing, recreation, and transportation. Various factors can influence groundwater quality.

### The Potential Spring Area in Jatiroke Village

Spring water with potential areas is high, which has a lower elevation than the location of the springs, with a minimum height difference of 10 m – 30 m below the springs and less than 0.2 km from the spring. The potential area of a spring is limited by the watershed area of the spring than 1 km from the springs for medium systems (Figure 4). The small system has a height difference of less than 10 m below the spring and less than 0.2 km from the spring. The potential area of a spring is limited by the watershed area of the spring. The research analysis of the potential use of springs is as follow Galumpit (11.43 hectare), Cikrebek (8.89 hectares), Cijati 2 (8.31 hectare), Cijati (8.14 hectare), and Sirah Citanggulun (2.08 hectare).

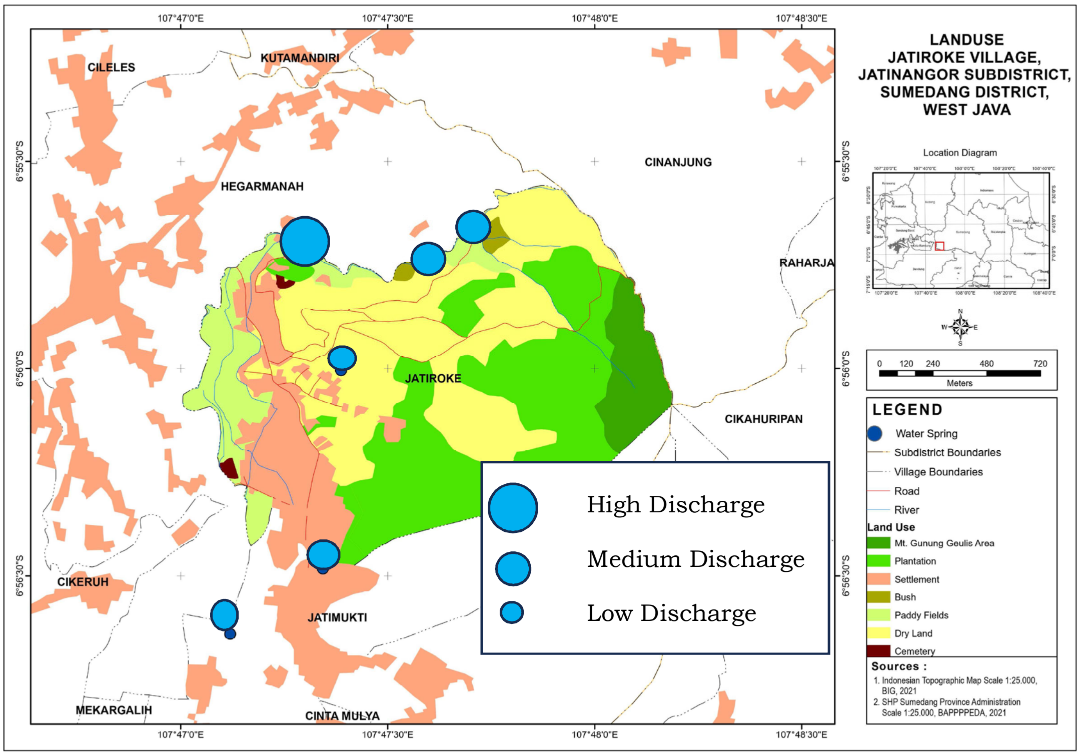


Figure 3. Land Use Jatiroke Village

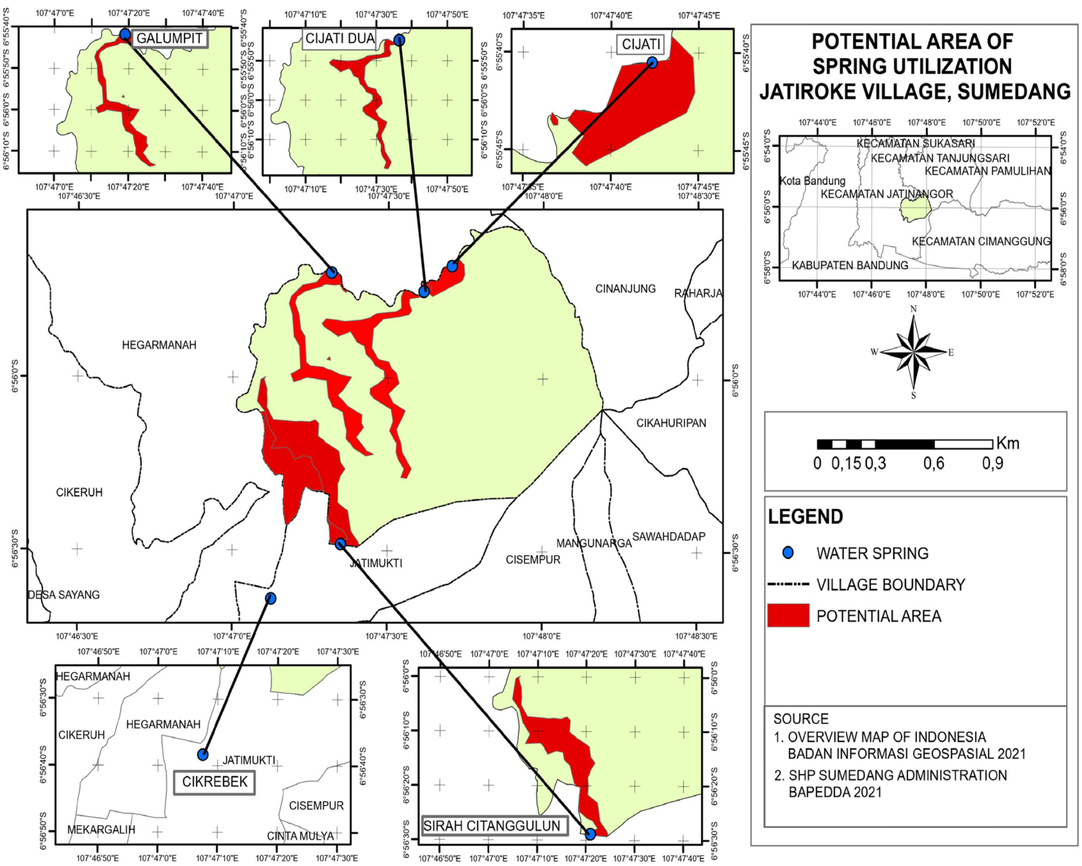


Figure 4. Potential Spring Area in Jatiroke Village

## (A) *Sirah Citanggulun spring water*

Sirah Citanggulun spring water is located at RT 004/05. This spring is open spring water; many bamboo leaves fall into it. The water flow is 0.2 l/second. Land status is private property. Landowners do not allow spring water to be drawn into the house by pipes; only the mosque can drain by a pipe. The land use upstream of the spring is settlements (40 houses), wood and bamboo gardens, a fishpond, and a cemetery. (See Figure 4 and Figure 5). Sirah Citanggulun spring water is used for washing baths for men and women of residents, meanwhile during the long dry season from other villagers, and for ablution water. Sirah Citanggulun springs, when viewed based on the discharge, are classified as springs with a medium system located at an altitude of 700 meters above sea level. This spring had a potential area of 2.08 hectares, which is located 30 meters lower than the location of the water source, which is at an altitude below 670 meters above sea level, is less than 1 km from the water source, and is in the same watershed. The potential area is categories high.

### (B) Cikrebek Spring Water

Cikrebek spring water is at an altitude of 689 meters above sea level. This Cikarebek Spring is an open spring covered by Apu-apu (Pistia Stratiotes). Pistia stratiotes is a small, evergreen perennial plant with feathery roots and free-floating in lakes or ponds. The plant is sometimes used locally for food, but only usually where nothing better is available. It has a range of medicinal applications and is also used as a source of organic matter and to remove toxins from polluted water. It is sometimes grown as an ornamental in the tropics and as an indoor aquatic ornamental in temperate regions. The land belongs to Cikrebek spring water and is private property.

This spring is used for agriculture, hydroponic, and fishpond. The water flow is 0.1 l/second and is classified as a spring with a medium system. Land use around Cikrebek Spring is a settlement, dry land, paddy field, and plantation. The spring is located outside the village boundary to the South. This spring is included in the potential area of 8.89 hectares, which is located 30 meters lower than the location of the water source, which is at an altitude below 650 meters above sea level and is less than 1 km from the water source and is in the same watershed. (Figure 4 and Figure 6). The potential area is categories high.

### (C) Cijati and Cijati 2 Spring Water

Cijati and Cijati 2 spring water is close together but different in height and located on the border of a village in the North. Cijati is located at an altitude of 813 meters above sea level. This Cijati and Cijati 2 is an open spring, which covers Apu-apu (Pistia Stratiotes). and bamboo leaves. The water flow is 0.08 l/second, included in the small system. Land use around Cijati spring water is a settlement, dry land, paddy field, and bush. The potential area of Cijati Spring is located 10 meters above sea level than the location of the water source, which is an altitude below 800 meters above sea level and is less than 0.2 km from the water source (See Figure 7). Cijati 2 spring is located at 782 meters. This Cijati 2 is a closed spring surrounded by concrete and covered with zinc. The surrounding of Cijati 2 is dry land, plantation, and settlement. This spring is included in the potential area, which is located 30 meters lower than the location of the water source, which is at an altitude below 650 meters above sea level and is less than 1 km from the water source. (See Figure 4, Figure 7, and Figure 8).

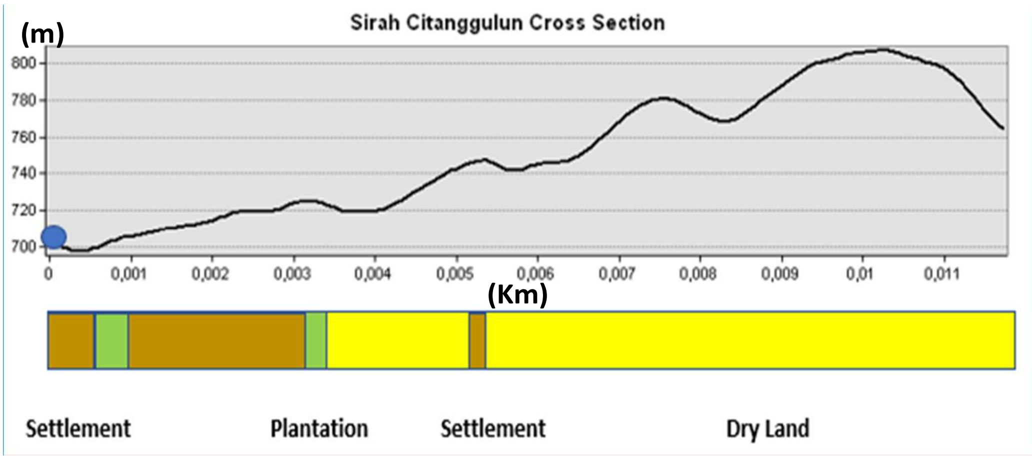


Figure 5. Sirah Citanggulun Crross Section

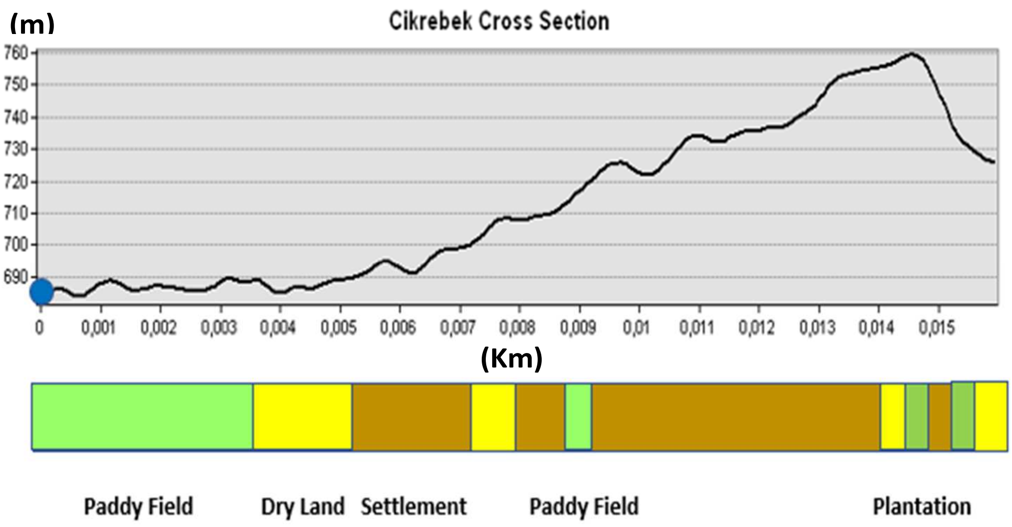


Figure 5. Cikarebek Cross Section

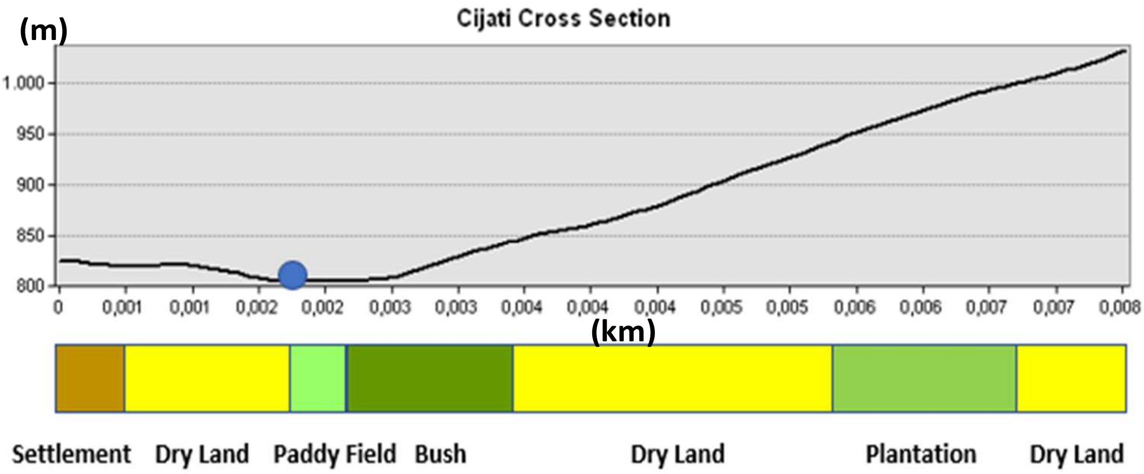


Figure 7. Cijati Cross Section

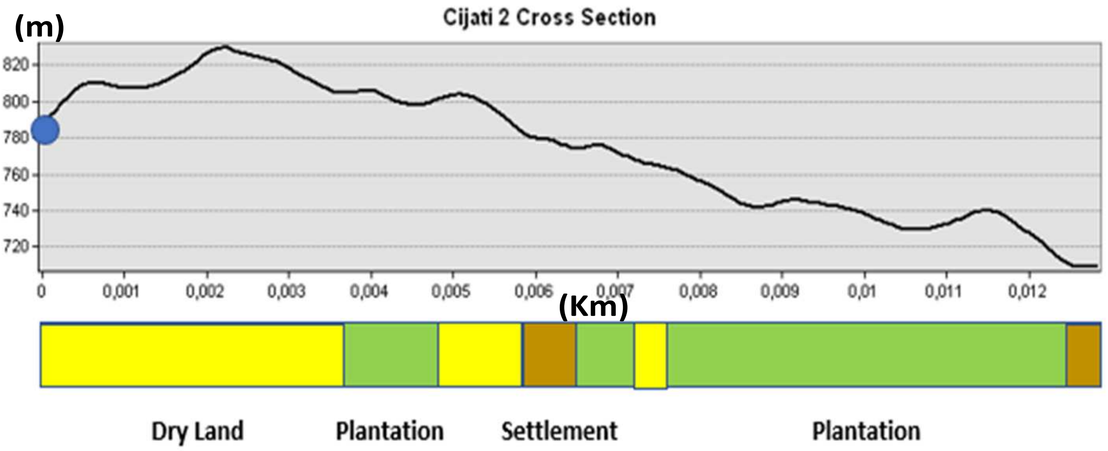


Figure 8. Cijati 2 Cross Section

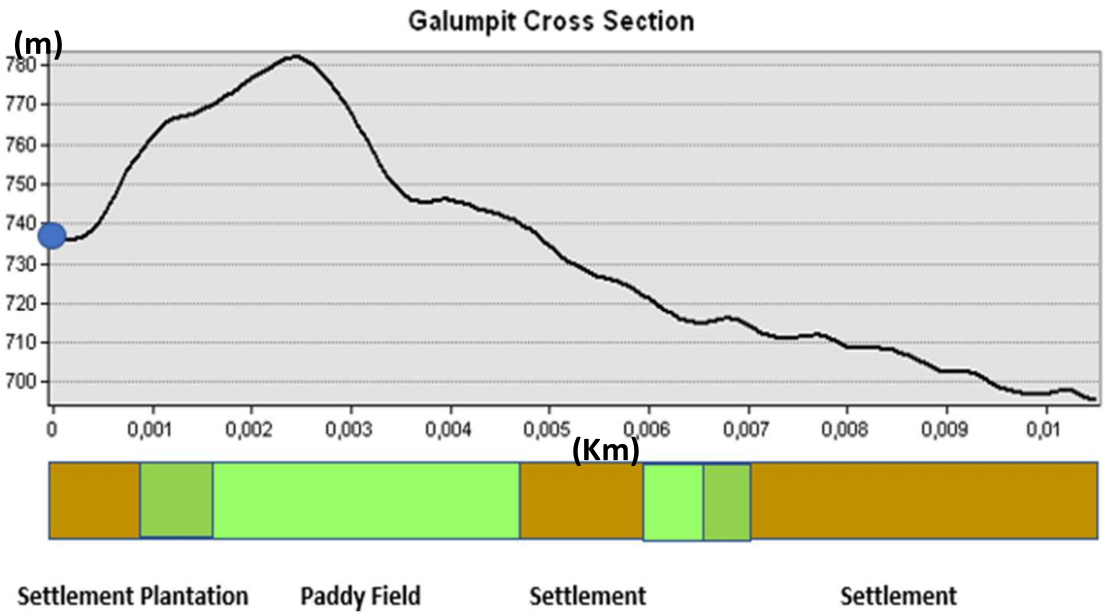


Figure 9. Galumpit Cross Section

## *(D) Galumpit Spring Water*

Galumpit Spring water is located at a height of 734 meters. The land use around the spring is a bamboo forest upstream and a settlement downstream. The water flow is 0.15 l/second. Galumpit is also an open spring, where many bamboos leave fall. Residents around the spring use it for bathing. This spring is included in the potential area, which is located 30 meters lower than the location of the water source, which is at an altitude below 700 meters above sea level and is less than 1 km from the water source. (Figure 9).

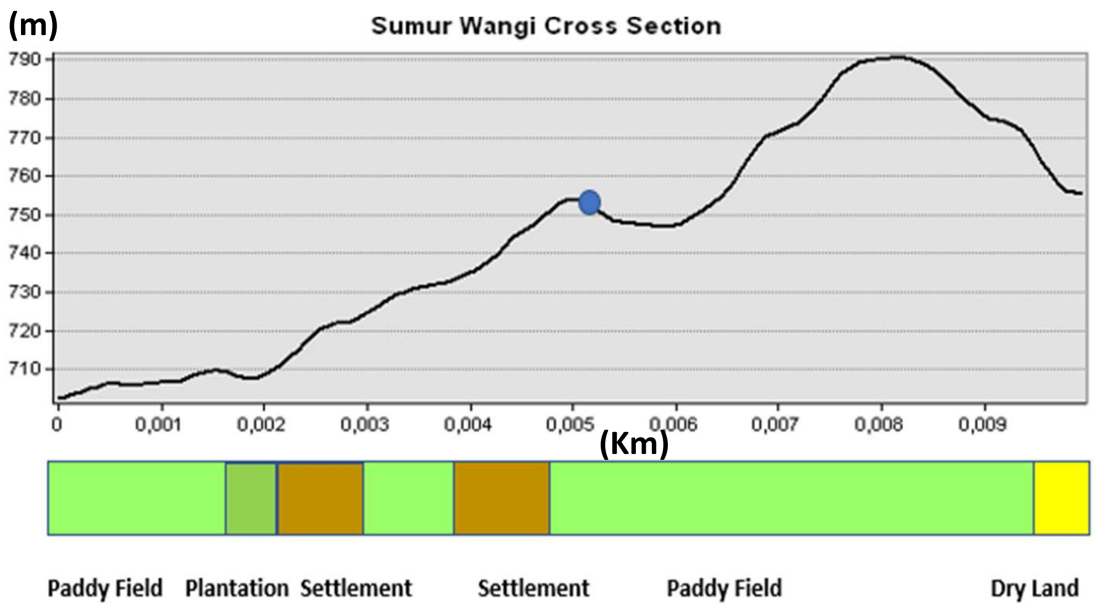


Figure 10. Sumur Wangi Cross Section

### (E) Sumur Wangi Spring Water

Sumur Wangi spring water is located at a height of 756 meters msl. At the time of the survey in July, the conditions were dry. Residents around the spring use it only during the rainy season because the land above it is already open for dry land, bamboo, and a rare big tree. (See Figure 10).

## Water Quality Spring Water in Jatiroke Village

### Chemical Parameter

Based on the results of the analysis of the water quality test in the Jatiroke Village spring, the dissolved iron value is 0.0616 mg/L, while the water quality standard criteria for Government Regulation number 82 of 2001 class I is 0.3 mg/L and according to Minister of Health number 32/2017 is 1. This water quality test means that the five springs in Jatiroke Village, regarding iron parameters, it is suitable for drinking water. (See Table 2).

The use of excess on agricultural land will lead to land pollution and then enter the waters or water flow. However, in this study, the five springs in Jatiroke Village were still below the threshold standard criteria for Government Regulation 82 of 2001 class I, according to Minister of Health number 32/2017, due to the standardized zinc parameter being suitable for drinking water. The presence of Nitrite illustrates the ongoing biological process of reshuffling organic matter with deficient dissolved oxygen. Nitrite's source includes industrial and domestic waste and nitrogen fertilizers (Effendi, 2003; Kumala et al., 2019). The results of the measurement of nitrite levels in springs in Jatiroke village showed the nitrite value is < 0.010 mg/L for Sirah Citanggulun, Cijati, Cijati 2, and Galumpit, Cikerebek, 0.026 mg/L. This nitrite value indicates that the five spring water sources are safe and have not been contaminated by industrial or domestic waste. The daily use of nitrogen fertilizers in agricultural activities on surrounding community water sources is still well controlled. The standard criteria for water quality standards PP number 82 of 2001 class I are 0.06 mg/L (Table 1). Nitrite levels in Jatiroke Springs meet the quality criteria PP 82/2001 and quality standard criteria from the Minister of Health 32/2017. This quality standard is used because the pollutant that enters the water body is still classified as low.

The value of the degree of acidity (pH) expresses the intensity of acidity or alkalinity of a liquid dilute and represents the concentration of the hydrogen ion. If the pH is less than 6.5 or greater than 9.2, it will corrode the water pipes and can convert some chemical compounds into toxins that are harmful to the health of humans (Marak et al., 2019). The low pH value of the Cikrebek spring is suspected of having Apu plants, while in Sirah Citanggulun, there are activities for bathing and washing. Based on the results of the analysis of the water quality test at the Jatiroke spring, the pH value is below 7, while the standard criteria for water quality standards PP number 82 of 2001 class I are 6-9. (Table 1 and Table 3). Jatiroke Springs meets the quality standard criteria.

### Physical Parameter

The cause of high Total Dissolve Solid (TDS) in water is caused by wastewater that often contains soaps, detergents, and water-soluble surfactants originating from household waste and natural sources such as leaves and mud. The data in Table 3 shows substance measurement results of TDS in spring water in Jatiroke Village. The highest Cikerebek spring is 163 mg/L compared to the TDS value of the Galumpit spring is 101 mg/L. High TDS value at source Cikerebek springs allegedly other than affected by leaves or litter is also affected by residual soap and waste materials detergent because people are more do many activities like bathing and washing in spring water. The high value of TDS in springs is suspected to cause the ingredient's inorganic in the form of ions in the waters. Galumpit's spring has a value of TDS as the lowest of the five springs is 101 mg/L, even though this spring is in the open state. It is because the spring and the place for bathing and washing are different. In general, the average value of TDS on the five springs is still below the threshold on the maximum limit allowed according to Quality Standard Water Class 1 PP No 82 of 2001, 1000mg/L. Therefore, the five spring water sources of the springs of Sirah Citanggulun, Cikerebek, Cijati, Cijati 2, and Galumpit are categorized as a decent source of water and safe for consumption or appropriate with Water Quality Standard Class 1 (Table 3).

Electrical conductivity (EC) measures the ions in water but does not tell us what specific ions are present. This property

Table 2. Chemical Water Quality No. 258/Lab. DLH

| Parameters | Unit | Result | Threshold | Methode |
|---|---|---|---|---|
| Dissolved Iron | mg/L | < 0.0616 | 1 | SNI 6989.4.2009 |
| Zink | mg/L | < 0.0221 | 15 | SNI 6989.7.200 |
| Nitrite ($NO_2$-N) | mg/L | < 0.010 | 1 | SNI 06-6989.9:2004 |
| E.Coli | CFU/100 mL | 8 | 0 | APHA 9222 A-2017 |
| Totoal Coliform | CFU/100 mL | >800 | 50 | APHA 9222 A-2017 |
| Pestiside | Mg/L | < 0.005 | 0.1 | 18-GC-1/MU/SMM-AAS (GC-MS) |

Source: Data Analysis

Table 3. Water Quality

| Spring Water | pH | TDS | EC | Temp. (°C) |
|---|---|---|---|---|
| 1. Sirah Citanggulun | 7 | 112 | 200 | 28.2 |
| 2. Cikrebek | 6.6 | 163 | 330 | 27.2 |
| 3. Cijati | 6.6 | 113 | 226 | 26.2 |
| 4. *Cijati* 2 | 6.8 | 110 | 221 | 29.7 |
| 5. *Galumpit* | 6.9 | 101 | 203 | 27.4 |
| 6. Sirah Wangi | - | - | - | - |

Source: Data Analysis

helps determine the number of treatment chemicals that could be added to a water sample (Bakti et al., 2021; Al-Ameer et al., 2020). No threshold value was found for EC (Table 1). The results showed that high EC was found in Cikerebek Spring; that area is subjected to contaminants due to the disposal of domestic wastewater and the use of fertilizers for agriculture. The value of TDS in the waters will affect the value of EC. The ability of deep water to conduct electricity depends on the presence of ions and the total ion concentration. The more dissolved salts that can be ionized, the higher the EC value. Conversely, the higher the dissolved solids in organic matter (sucrose and benzene), which cannot dissociate, the lower the value of EC (Ramadhawati, 2021).

The temperature in the water is influenced by various factors such as sun intensity and heat exchange between water and the surrounding air. The results of the water temperature test in Jatiroke Village showed that the springs varied from 26.2°C-29.7°C. Environmental and location factors affect the higher temperature in the Cijati 2 spring water. It is an open area exposed to direct sun, so light penetration directly interacts with springs. Exposed springs of light can raise the water temperature. This statement is supported by the opinion of Odum (1971) that high and low water temperatures are related to high and low-intensity sunlight. When the intensity large light, then the water temperature will be increase. Cijati's springs have the lowest temperature of the three sources springs, which is 26.2°C. This condition is presumably due to the location of Cijati Springs having dense tree vegetation, thus preventing the penetration of sunlight to the waters so that the temperature value in the spring Cijati is not too high. This spring water temperature meets the quality standards according to PP number 82 of 2001 class I is a deviation of 3. This quality is because the trees around the spring's body do not cover the body of Jatiroke springs so that the light absorption process can occur correctly.

### Microbiological Parameter

*Escherichia coli* is a commensal bacterium in the human intestine and is generally not a disease-causing pathogen. If *Escherichia coli* is detected in the water, which is fecal, if consumed continuously in the long term, it will impact the incidence of diseases such as colitis, diarrhea, infections of the urinary tract, and bile ducts. This presence in drinking water indicates that it has been contaminated with human feces and may contain intestinal pathogens, making it unfit. Therefore, drinking water standards require *Escherichia coli* to be 0 in 100 ml. (Sari et al., 2020). If a sample contains bacteria, the tested water has been contaminated with feces. The presence of these microorganisms in water proves that populated by the feces of humans and warm-blooded animals. This population allows various pathogenic microorganisms periodically in the digestive tract to enter the water (Sulistyorini et al., 2016). This microorganism in water comes from various sources such as soil, garbage, mud, live plants, or other sources dead, live or dead animals (carcasses), excrement humans or animals, and so on. A lot of waste material indicates that coliform bacteria will breed. The results from the laboratory, all five springs contained *Escherichia coli*. The higher is in the Galumpit spring, and the lowest is in Cijati 2 spring. (Table 3).

Total coliform bacteria are coliform bacteria originating from environmental pollution by organic matter. Total coliform is an indicator, The first bacteria used to determine whether the water is safe for consumption. From the result testing in the laboratory, water samples from Jatiroke Village District showed the total number of coliforms contained in 100 ml of water each > 800 individuals, while the water samples from Sirah Citanggulun, Cijati, Cijati 2, and Galumpit spring. Meanwhile, Cikerebek Spring contains total coliform is 220 individuals/ 100 ml of water. Amount total coliform bacteria in water samples originating from five springs caused by environmental conditions. Total coliform in all springs is higher than the water quality standard based on PP number

82 of 2001 class I for drinking water and based on Minister of Health number 32/2017. If residents in Jatiroke Village want to use water sourced from springs for domestic needs, especially cooking, and drinking, right now, it would be safer if water cooks until it boils to remove the bacteria in the water which will be used.

Pesticide is a mixture of chemicals used to prevent, eradicate, and control nuisance animals and or nuisance plants with the aim of human welfare. Pesticide content in water can occur because of the activity's development using pesticides. The display worried that if it enters or dissolves in the body, water will be absorbed by other organisms, such as aquatic plants and animals, which, in the end, are utilized by humans. However, even though the activities of agricultural cultivation in Jatiroke Village and other villages very intensively use pesticides, laboratory analysis results show that the pesticide content in the water sample is not detected (0.005 mg/L), as presented in Table 2. The result does not show a concentration that exceeds pesticide parameter quality standards even though Jatiroke village and its surroundings are an agricultural area, such as horticultural crops and annual crops, which are regularly fertilized and pest prevention with pesticides. The water spring location, regarding elevation, was highest than the agricultural area, which proves that the pesticide in the laboratory analysis is lowest than the threshold. The result saw that the Jatiroke spring water could become water resources and drinking water.

The six springs do not reach all settlements in Jatiroke Village because the spring discharge is classified as medium and small. Spring potential areas have a lower elevation than the location of the springs, with a minimum height difference of 10 m – 30 m below the springs and less than 1 km from the springs for medium systems. The small system has a height difference of less than 10 m below the spring and less than 0.2 km from the spring. The potential area of a spring is limited by the watershed area of the spring.

## 4. Conclusion

The six springs in the Jatiroke Village, Sirah Citanggulun, Cikerebek, Cijati, Cijati 2, Galumpit, and Sumur Wangi springs, with four springs are included in the medium system, and one spring is a small system (Cijati 2). At the same time, one only has water during the rainy season (Sumur Wangi). The most comprehensive utilization of spring potential is in Galumpit, and the smallest is in Sirah Citagulun. Physically parameters with Total Dissolve Solid (TDS), Electrical conductivity (EC), and temperature parameters originating from five locations have good quality to meet the utilization requirements, especially for the water designation class, class I. Chemically, the water quality is relatively good based on several parameters such as pH, Nitrite, dissolved iron, and zinc, which do not exceed the required quality standard threshold. The biological parameters show that the water from the five locations is contaminated by bacteria E. coliform and total coliform but without pesticide contamination. The coliform bacterium in the water exceeds the required quality standard threshold, so when used as drinking water, it must still go through water treatment and be heated to a specific boiling point because it contains bacteria that may be harmful to humans.

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