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Distribution of Springs and Household Clean Water Needs in Bulu District, Rembang Regency

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ABSTRACT

Human life is very dependent on the availability of quality water, obtained from both surface water and groundwater. The need for clean water is increasing along with the increase in population. The potential of springs in each region varies depending on the physical condition of the area. Availability of water greatly affects the fulfillment of household clean water needs. This research aims to analyze the distribution of springs and the household clean water needs. This research was conducted in Bulu District, Rembang Regency. The population consists of the number of the springs and the number of the households in the area. The research sample is determined by purposive sampling. Samples of springs were taken with the condition that the springs are only used for household clean water needs, with total of 10 springs. Household samples were taken under the condition that the households use the springs for their household clean water needs, totaling 106 households. The method used is observation to obtain information about the distribution of springs while interviews are used to obtain data on household clean water needs. There are 10 springs in Bulu District which are used for household clean water needs spread across 7 villages. These springs are able to meet the clean water needs of households both in the rainy and dry seasons in Bulu District, with an average water requirement of 130 liters/person/day.

Keywords: springs, water needs, clean water

INTRODUCTION

The need for clean water continues to increase each year as a result of very rapid population growth, so that humans are trying to find good and guaranteed quality water sources so that they can meet future needs (Wahyuni & Junianto, 2017). Clean water is used by humans for daily needs, such as drinking, bathing, cooking, washing, and other needs (Zulhilmi et al., 2019). The increasing demand for water, both in quantity and quality, from time to time is largely determined by the development of the population and the development of the level of welfare (Hardati, 2015).

Water quality is an important issue to be discussed further. This is because it concerns public health and the environment (Fakhriyah et al., 2021). This is reinforced by the opinion (Saefudin et al., 2019) which states that water resources must be maintained so that they are not polluted and cause disasters that affect the lives of all living things. Regulation of the Minister of Health of the Republic of Indonesia No. 32, (2017) concerning Clean Water Quality Requirements explains that water which meets health requirements must be clear, odorless, tasteless, colorless, and must not contain germs and harmful substances.

Raw water for clean water needs is sourced from groundwater, surface water, rainwater, and springs. Springs are utilized as a supply of clean water, especially in the areas which are not covered by PDAM Kota (Municipal Waterworks of the city) main water network

services (Putra et al., 2020). The availability of water from abundant springs and the ease of getting it are very suitable for today's community needs (Susanto et al., 2022). Communities in rural areas, such as people in Bulu District, use a lot of water which comes from springs for household needs (Maridi, 2015). Springs with relatively low flow rate are generally used by the local community, however, springs with high flow rate are commonly used by the government to provide drinking water or by companies to meet their needs.

Population dynamics have a very important influence on ecosystems, including those related to the availability of clean water (Alihar, 2018). Earth in 2023 is inhabited by a population of up to 8.045 billion (Worldometer, 2023). The country of Indonesia ranks fourth in the world in terms of population. In 2010, the population of Indonesia reached 237.6 million, and in 2015 it has become 255.18 million (Central Agency on Statistics, 2015). In 2020 it has reached 270.2 million, and it is estimated that in 2035 it will reach 308.36 million (Central Agency on Statistics, 2020). The population on Earth will continue to increase from the current number, so that the need for water will also increase, while the availability of water will be limited both in quantity and quality (Hardati, 2015).

Bulu District has a population of 28,146 people with 8,402 households (Central Agency on Statistics of Rembang Regency, 2022). Population growth always increases every year. The higher the population each year, the higher the need for clean water (Suryadi & Gasali, 2019). Most of the residents in Bulu District provide clean water in this area from springs and private wells. The Village Government and its residents have made no effort to utilize surface water sources for household clean water needs, so that during the dry season residents in Bulu District use springs to meet their needs for clean water when private wells run dry.

Springs have very good quality, so they are widely used for the supply of drinking water or raw water for residents in the vicinity or residents in the downstream areas (Sudarmadji et al., 2016). The need for water obtained from springs for continuous human needs must be maintained so that the existence and continuity of the condition, nature, and function of water resources is always available in sufficient quantity and quality to meet the needs of living things such as the population's water needs and irrigation, both for the present and the future time (Agustin et al., 2016).

Research conducted by (R.A & Putranto, 2020) concluded that the Banyumudal Groundwater Basin in Kebumen Regency has the potential of 23 springs with moderate to very good quality. Research (Widiyastuti & Widyastuti, 2018) also states that the potential for springs in the Karst Playen area both in the dry season and in the rainy season can meet the community's water needs. Springs are a source of continuous water supply compared to other water sources, so it is necessary to apply clear regulations regarding the use of water from springs for household purposes (Sudarmadji et al., 2016).

There are 10 springs in Bulu District which are used by residents for household clean water needs, spread across seven villages. This spring never runs dry even in the dry season. Water used for each activity is required with different quality standards. Therefore, observations are needed to determine the condition of springs from the aspect of quantity and quality of springs in Bulu District so that they are in accordance with their designation. According to PUPR (The Ministry of Public Works and Housing) Ministerial Regulation No. 29, 2018, water used for sanitary hygiene purposes must meet standard quality parameters, namely not cloudy, tasteless, foamy, colorless and odorless. Springs need to be maintained in terms of quality and quantity because springs are the main source of meeting the clean water needs of households in Bulu District.

MATERIALS & METHODS

The research location was carried out in Bulu District, one of the sub-districts in Rembang Regency, Central Java. Astronomically it is located at 6°48'42" – 6°53'38" South Latitude and 111°17'25" – 111°27'34" East Longitude. Bulu District has an area of 10,239 hectare consisting of 16 villages, with a total of 53 RWs and 186 RTs. This research focuses on several villages with springs used for household needs in Bulu District, namely Mantingan Village, Kadiwono Village, Bulu Village, Pasedan Village, Karangasem Village, Pinggan Village, and Mlatirejo Village. The research location is presented in Figure 1 below. (P.S. RT is a neighborhood unit in Indonesia, while RW is a community unit consists of some RTs)

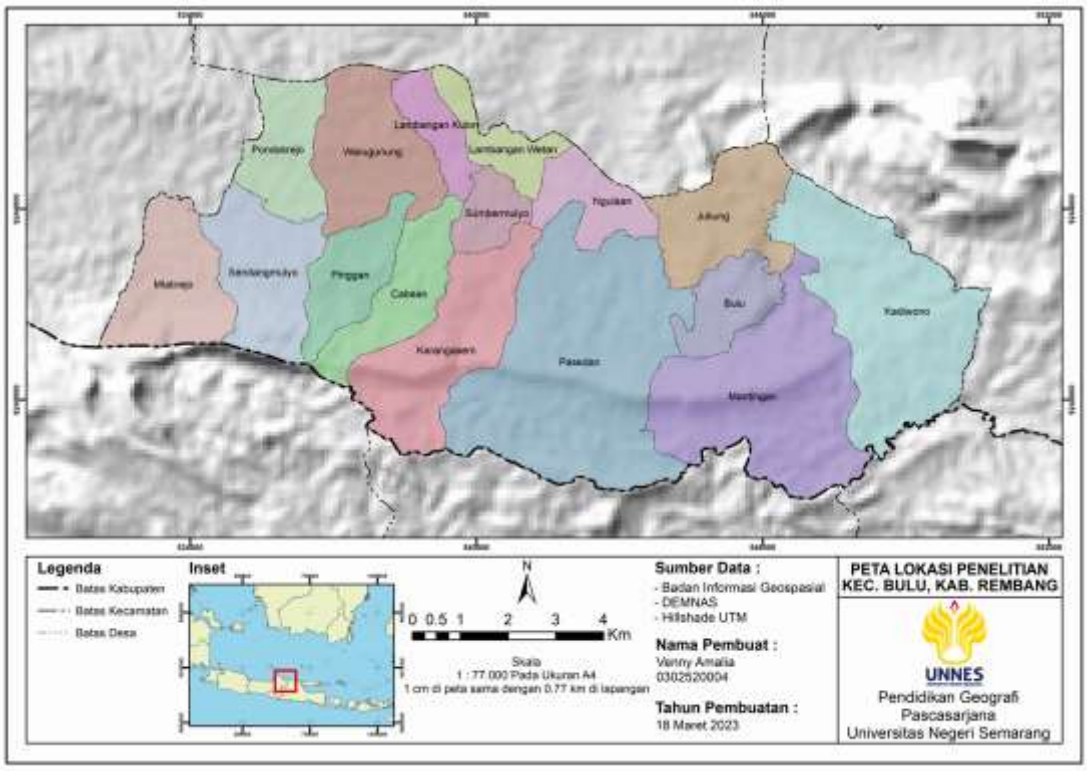

Figure 1 Research Location Map

The population studied consists of 2 types, namely the population of the number of springs and the population of the number of households. The springs in Bulu District which becomes the research sample are the springs used for household clean water needs, totaling 10 springs spread across 7 villages. The household sample was calculated using a purposive sampling technique with some conditions such as that the villages chosen are the the villages which use springs the most for their clean water needs, namely Mantingan Village and Karangasem Village.

The number of households in Karangasem Village which use springs for their clean water needs is spread across parts of RT 07, RT 08, RT 09, RT 10, RT 11, and RT 12 with a total of 281 households. The number of households in Mantingan Village which use springs for their clean water needs are scattered in RT 01, RT 02, and RT 03 (RW 02), RT 01, RT 02, RT 03, and RT 04 (RW 03), RT 01 and RT 02 (RW 04), part of RT 01 and RT 02 (RW 01) with a total of 428 households. The total household population for analyzing household clean water needs in Karangasem Village and Mantingan Village is 709 households. The household sample is taken from 15 percent of the total population (Isu & Lopo, 2021), namely 106 households. The Mantingan Village

household sample is 64 households and the Karangasem Village household sample is 42 households. Calculation of household samples for clean water needs is presented in table 1 as follows. (P.S. RT is a neighborhood unit in Indonesia, while RW is a community unit consists of some RT)

Table 1 Research Population and Sample

Karangasem Village				
Households	Age	Population	Sample	Total
Gen *baby boomer* (1945-1965)	57-77	86	13	42
Gen X (1965-1980)	42-57	95	14	
Gen Y (1980-1995)	27-42	100	15	
Mantingan Village				
Households	Age	Population	Sample	Total
Gen *baby boomer* (1945-1965)	57-77	136	20	64
Gen X (1965-1980)	42-57	156	24	
Gen Y (1980-1995)	27-42	136	20	
Sample Total				106

Source: Monograph Data of The Village

The data needed in this study includes primary data and secondary data. Primary data includes data on household clean water needs and water physical quality. Secondary data includes water quantity or debit data and population data. Data collection techniques used in this research are field observation and interview methods. Field observations are used to obtain information related to the distribution of springs and measurements of the physical quality of water. Interviews were conducted to obtain information related to household clean water needs.

The data analysis method in this study uses spatial analysis, to describe the spatial distribution of springs using a Geographic Information System which is embodied in the form of thematic maps. The need for clean water for households in Bulu District is analyzed by calculating using the following formula.

Qrh = P x q

Qrh : Household clean water needs per day (liter/day)

P : Total Population (Resident)

q : Clean water needs per person (liter/day)

RESULT

Distribution of Springs in Bulu District

Springs in Bulu District are spread over seven villages with a total of 10 springs used for household clean water needs. The distribution of springs includes: 2 springs in Mantingan Village, 2 springs in Bulu Village, 1 spring in Kadiwono Village, 2 springs in Pasedan Village, 1 spring in Karangasem Village, 1 spring in Pinggan Village, and 1 spring in Mlatirejo Village. The table for the distribution of springs in Bulu District can be seen in Table 2 below.

Table 2 Distribution of Springs in Bulu District

No	Springs	Administrative Location
1	Mili Kerep	Kadiwono Village
2	Kebon	Mantingan Village
3	Dokoh	Mantingan Village
4	Taban	Bulu Village
5	Mudal	Bulu Village
6	Sendang Bawang	Pasedan Village
7	Ndilem	Pasedan Village
8	Tlogo	Karangasem Village
9	Sumur Kidul	Pinggan Village
10	Kedung Semar	Mlatirejo Village (Ngiri Forest)

Source: Primary Data 2023

Bulu District has 10 springs with the same characteristics, which the point where the spring appear is dammed with a closed tub directly installed with a pipe with a diameter of ¾-5 inches. The water storage tank functions to collect water from springs so that it can be more easily channeled to people's homes and to protect water from contamination by fallen leaves or other objects entering the springs. The distribution pipes for springs in Bulu District use both open pipe and closed pipe system. The open pipe system drains water at any time, even when the water reservoir is full the water will continue to flow and be wasted into the ditch. A closed pipe system can save more water because the water that comes out can be controlled according to the water needed. Images and distribution of springs are more clearly presented in Figure 2 below.

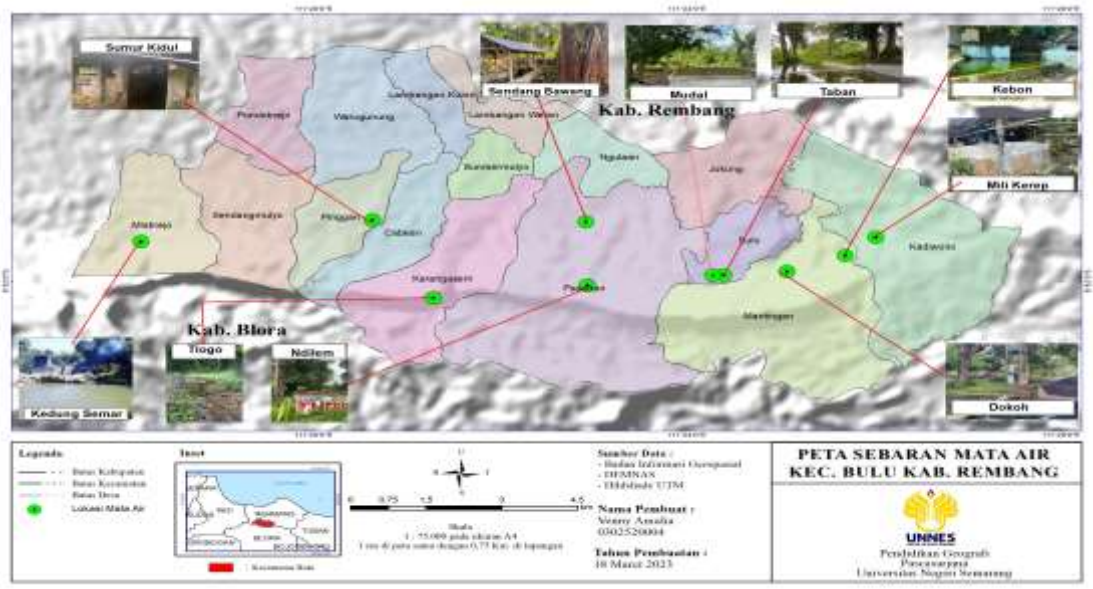

Figure 2 Map of Distribution of Springs in Bulu District

Data documentation study from the Public Works and Spatial Planning Office of Rembang Regency regarding the quantity of springs (Debit) in Bulu District has varying water debits. The debit of springs in Bulu District is able to meet the household's need for clean water which flows continuously throughout the year. The water debit of springs in Bulu District is presented in table 3 below.

Table 3 Distribution of Springs in Bulu District

No	Spring	Debit (liter/second)
1	Mili Kerep	10
2	Kebon	10
3	Dokoh	6
4	Taban	20
5	Mudal	8
6	Sendang Bawang	9
7	Ndilem	15
8	Tlogo	15
9	Sumur Kidul	5
10	Kedung Semar	12

Source: DPUTARU (Department of Public Works and Spatial Planning) of RembangDistrict

The highest spring debit in Bulu District is in the Taban spring with the flow rate of 20 liters/second, while the lowest spring debit is in the Sumur Kidul spring with the flow rate of 5 liters/second. Springs in the District are the type of perennial springs, since the water flow continuously throughout the year. The amount of water distributed to residents' homes between the rainy season and the dry season has differences. In the rainy season the water coming out of the residents' faucets is very large, while in the dry season the water coming out of the faucets decreases even though the water never turns off. Springs are also used by some communities for agricultural irrigation during the dry season, means that the springs is used more during the dry season is.

The water quality data in this study was obtained from direct observations at each

spring location. Water quality is examined based on the clean water standards determined by the Regulation of the Minister of Public Works and Public Housing Number 29/PRT/M/2018 and adapted to the provisions of the Minister of Health Number 32 of 2017 stating that the physical parameters of water quality for clean water needs must meet the requirements such as the level of turbidity, color, taste, foam, and odor. The physical quality of water is presented in the table 4 below.

Tabel 4 Spring Water Quality in Bulu District

No	Springs	Parameter				
		Turbidity	Color	Taste	Foam	Odor
1	Mili Kerep	A little cloudy	No color	Tasteless	No foam	Odorless
2	Kebon	Not cloudy	No color	Tasteless	No foam	Odorless
3	Dokoh	Not cloudy	No color	Tasteless	No foam	Odorless
4	Taban	Not cloudy	No color	Tasteless	No foam	Odorless
5	Mudal	Not cloudy	No color	Tasteless	No foam	Odorless
6	Sendang Bawang	Not cloudy	No color	Tasteless	No foam	Odorless
7	Ndilem	Not cloudy	No color	Tasteless	No foam	Odorless
8	Tlogo	Not cloudy	No color	Tasteless	No foam	Odorless
9	Sumur Kidul	Not cloudy	No color	Tasteless	No foam	A little smelly
10	Kedung Semar	Not cloudy	No color	Tasteless	No foam	Odorless

Source: Primary Data 2023

Based on the observations of the physical quality of the water springs in Bulu District, it shows that the color, taste, and foam parameters of all springs are in good condition. The water quality for the turbidity parameters in the Milli Kerep springs results in a little turbidity and in the Sumur Kidul spring the odor parameter results in a slightly odorous water quality. Water turbidity can be caused by the presence of organic and inorganic materials such as silt and sewage. Water that has turbid quality requires filtering before being processed for clean water sources. The smell of water in the Well Kidul spring is caused by foreign objects which may have entered the water, such as animal carcasses or animal dung. Since the location of this spring is in a dry field, many birds or other animals nest near the spring. The existence of a spring that is quite far from the resident's house causes the spring to not be kept clean. This spring is still used for household needs even though its use is very small compared to other springs, but for drinking water the community uses other water sources.

The springs in Bulu District are of good quality and the data shows that water debit is quite high so the water does not dry up during the dry season and is abundant during the rainy season so that the household's clean water needs can be fulfilled. Springs in Bulu District can be managed optimally by making larger reservoirs and greater pump capacity. Water monitoring needs to be done periodically on the quality and quantity of water from springs. The distribution system also needs to be further evaluated so that water can be distributed better, either in the form of pipelines such as PDAM or by building new storage tanks at points with shortage of clean water condition. Construction of facilities at springs will facilitate the distribution of water needed by local residents.

Household Clean Water Needs

Household water demand is the volume of water needed to meet daily needs. Daily water needs included in household needs include: water needs for bathing, washing (clothes and dishes), cooking and drinking (Maulana & Sudarmadji, 2016). The need for clean water for households in each region varies, this is influenced by various factors, including the number of members in the family, income, household activities, and climate. Household water needs in this study are divided into seven main activities, namely bathing, washing clothes, washing

dishes, toilet, cooking and drinking, watering plants, and washing vehicles. The use of water for household purposes is calculated from the total population in urban and rural areas in a location. The population of a small town like Bulu District with a population of 28,146 people requires approximately 90-110 liters of water/person/day (National Standardization Agency, 2015). The need for clean water for households in Bulu District based on needs is presented in table 5 below.

Table 5 Clean Water Needs Based on Activities

No	Activities	Water Needs (liter/person/day)
1	Bathing	50,77
2	Washing Clothes	11,64
3	Washing Dishes	6,41
4	Toilets	22,17
5	Cooking and Drinking	5,05
6	Watering Plants	0,88
7	Watering Vehicles	3,07
	Jumlah	130

Source: Primary Data 2023

The total need for clean water for households in Bulu District is 130 liters/person/day. Household activities that require the most to the least amount of water are the needs of water for bathing, toilets, washing clothes, washing dishes, cooking and drinking, washing vehicles and watering plants. The need for bathing water reaches 50.77% of the total water need for household activities. The minimum water requirement is the need to water the plants, only 0.88% of the total water requirement. The total need for clean water for households in Bulu District, the total calculation results between the amount of clean water needed for each person per day is 130 liters/person/day with a population of 28,146 people in Bulu District, the result is 3,658,980 liters/day. The need for clean water for households in Bulu District is greater than the standards issued by the 2015 National Standards Agency, which is only 90-110 liters/person/day.

DISCUSSION

Bulu District has 10 springs which are used for clean water needs spread across 7 villages. The springs are very abundant during the rainy season and do not dry up during the dry season, only the amount of water decreases. The data of springs water quantity in Bulu District was obtained from the Public Works Department to find out the availability of clean water produced. The amount of spring debit in Bulu District varies, ranging from 5 liters/second to 20 liters/second. Spring water debit is influenced by several factors, such as climate processes, topography, aquifer characteristics, and geological structure (Noperissa & Waspodo, 2018). The water debit during the rainy season is higher, since the water supply in the catchment area to fill groundwater is greater than the dry season (Setyowati, 2014)

The physical quality of the water in the springs in Bulu District is reviewed from each parameter such as color, smell, taste, turbidity and foam. The springs in Bulu District indicating that their quality is slightly disturbed are the Milli Kerep spring and the Sumur Kidul spring due to the turbidity and odor of the water. Changes in water quality such as turbidity are caused by the presence of suspended and dissolved organic and inorganic materials (Sawitri & Takandjandji, 2019). The level of turbidity in the dry season is lower than in the rainy season, during the dry season it looks clearer and sunlight penetrates to the bottom of the waters, while during the rainy season there is a little substance suspended in the waters, although not at high intensity (Simanjuntak et al., 2020) . Other water quality parameters, such as the smell of the springs in Bulu District, shows that they are polluted due to animal activity around the springs. Manune et al. (2019) stated that water pollution does not only occur due to human factors, but other living things are also influental. Good water quality will be safe if consumed by local residents, therefore it is necessary to take care of the springs so that they can meet the needs of clean water in a sustainable manner.

Household clean water needs are influenced by several factors such as income level, city size, and climatic conditions (Putra et al.,

2020). The need for water is greater for households with better socioeconomic conditions (Zulhilmi et al., 2019). The level of household water use is also influenced by climatic conditions in an area. Residents in hot areas need more water than residents in cold areas, moreover, during the dry season the need for water becomes higher than rainy season (Fakhriyah et al., 2021). The example of activity which uses less water during the rainy season and more water during the dry season is the need to water the plants, since the plants are only watered when they are not exposed to rain. Households' need for clean water for bathing purposes in Bulu District is more than 50% of the total water use of each resident. The lowest use of water is the need for watering plants, which is no more than 1% of the total use of clean water for household needs. The average daily water consumption of the people of Bulu District is 130 liters/person/day, 20 liters more than the standard set by the government. This relatively large water demand is influenced by the availability of water resources, this will not happen if water resources are limited in an area (Hanafi et al., 2019).

The high demand for clean water for households in Bulu District requires maintenance and protection of springs. Protection of springs is needed to protect springs so that the continuity, capacity and quality of clean water can be maintained properly. Spring protection is needed based on both technical and non-technical aspects (Tiaraputri & Diana, 2017). From a technical point of view, protection of springs is needed so that the location where water comes out of the spring is maintained and its extraction is measurable. Non-technical aspects are needed in the operation and maintenance of springs so that the springs are not damaged and the local wisdom is maintained. Protection of springs has not been developed optimally in Bulu District even though the surrounding community has utilized its water, especially in the dry season, therefore, efforts to protect springs are needed both independently from the community and from related agencies (Ismawati et al., 2020). The spring management group stated that they have not been able to make full use of the potential of the existing springs due to limited funds, limited tools, and limited electric power to pump water. The increasing of this pumping debit must of course be followed by the periodic control of the spring water debit, especially during long dry seasons (Widiyastuti & Widyastuti, 2018).

CONCLUSION

The springs in Bulu District are spread across seven villages, with a total of ten springs used by the community for household clean water needs. The quality of the springs in Bulu District studied is of good quality, out of ten springs there are only two springs of slightly less quality, namely the Mili Kerep spring and the Sumur Kidul spring. The poor-quality parameters are in the level of turbidity and odor of the water, however, these conditions do not have a major effect on the use of water from the two springs, hence it can be stated that the springs in Bulu District can be used as clean water sources and are suitable for meeting household needs. The quantity (debit) of springs in Bulu District has various water flows, namely 5-20 liters/second. The water produced with a sufficiently high debit condition can properly meet the households' clean water needs. Clean water from springs needs to be protected to maintain its quantity and quality, considering the importance of springs for the lives of the surrounding population.

Declaration by Authors

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