

Original Research Article

The analysis of domestic water demand and management in Duren Village, Bandungan, Semarang District

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ARTICLE INFO	ABSTRACT
<i>Keywords:</i> Community Participation Water demands Availability	The demands for and availability of water is one of the main natural factors that can sustain life and means of livelihood. Springs originating from the foot of Mount Ungaran are the main water sources for Duren Village, Bandungan District, Semarang, which play an important role in meeting domestic household water needs. In addition to analyzing various types of techniques and community involvement in managing water supply, this study aims to look at the needs and patterns of water use that are utilized. This research uses a survey method and is descriptive and analytical in nature through field observations and in-depth interviews with local residents using a questionnaire in the data collection process. Statistical analysis used for data analysis is analysis of frequency distribution tables and analysis of various correlations. Based on the study findings, the community views the availability of water as very high due to the abundance of water during the rainy season, the absence of drought during the dry season, and the ease of accessing water due to the direct supply of available water, except during the rainy season when mud or soil debris Landslides enter the water source so that the water becomes cloudy. Springs are used to supply the domestic needs of the population and the quality of the water at the study site is very good or clean. In addition, the results of the analysis at the research location show a very high level of community involvement in the protection and preservation of water sources. This indicates that Duren Village residents consistently participate in efforts to manage water sources by carrying out mutual cooperation activities, slametan traditions, and recitation traditions. However, because there is no specific organization or group that regulates or assists in the management of water sources to become more structured and organized for optimal use therefore the utilization rate of water sources is still below average.

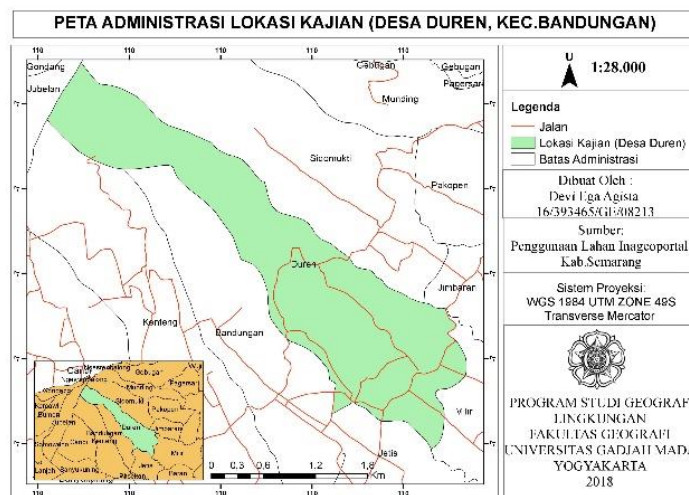
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1. INTRODUCTION

Duren Village is one of the villages in the Bandungan District which has springs to meet domestic water demands. The existence of springs in this highland area has an important role in meeting the community's water needs, considering that only from these sources can surface water be obtained, apart from rainwater. To meet the need for clean water, some people choose to collect water from flowing springs to be used by the surrounding population for bathing, washing and even cooking. The existence of these springs is very important for residents in the vicinity, if observed carefully, residential areas in the highlands, especially the water catchment area on Mount Ungaran are always close to springs. Residents use water from springs to meet their needs for consumption, bathing, washing, sanitation and irrigation of their fields.

The domestic demand for clean water for the people in Duren Village is highly dependent on population growth which continues to increase from year to year, and is influenced by agriculture and animal husbandry. If there is no balance between meteorological water availability and domestic water demand in this study area, it will cause a condition called domestic water crisis. Furthermore, as an effort to meet domestic clean water needs, good management of spring water is needed as local residents do to maintain the balance of the ecosystem of rainwater catchment areas by not exploiting spring water and carrying out traditions so that spring water sources are maintained. and sustainable. On the other hand, simple filtration technology that is easy for the community to use and good institutional structures can protect these water sources so they can survive and be sustainable in the future.



Picture 1. Duren village administration map

According to Sunaryo (2004) various issues regarding water resources related to their quantity and quality make all parties aware that water issues need to be addressed with appropriate actions so as to produce optimal solutions. There is a need for integrated, comprehensive and environmentally sound management of water resources so that water resources can be utilized in a sustainable manner. Management of water resources including springs includes several aspects, namely utilization, preservation and control (Kodoatie and Sugiyanto, 2002).

1.1 Utilization aspect

Utilization of water resources, including springs, is usually for various purposes, for example for domestic needs, irrigation and agriculture, power generation, river cruises as well as industry and tourism. Usually what comes to human mind is the aspect of this utilization. After an imbalance between needs and what is available, humans begin to be aware of other aspects.

1.2 Preservation aspect

In order for the utilization aspect to be sustainable, water resources need to be preserved both in terms of quantity and quality. Protecting the rain catchment area, keeping water from being polluted by waste is part of management.

1.3 Control aspect

In addition to providing benefits, water also has physical and chemical destructive potential. Therefore, it should not be forgotten is the control of the destructive force in the form of flooding and pollution.

Community participation is an important element in community-based resource management (CBRM). Sajise (1995) defines CBRM as a process in which communities themselves are given the opportunity and/or responsibility to manage their own natural resources to plan, set goals and make decisions.

The aims of this study were to 1) Assess the needs and patterns of domestic water utilization of the community in Duren Village, Bandung District, 2) Analyze the forms of community water management strategies, 3) Analyze community participation in the management of water sources for domestic needs).

2. METHODS

This research is descriptive analytical using survey method with a sample of 92 households. Data collection used questionnaires, in-depth interviews with local communities, and field observations. Data analysis used statistical analysis which was carried out in two stages, namely frequency distribution table analysis and multiple correlation analysis assisted by the SPSS application (Statistical Package for Social Sciences version 23 for Windows).

Domestic water demand in this study uses the assumption that each person uses a requirement of 100 liters/person/day. The formula equation used to calculate domestic water needs is as follows (Martopo, 1987):

$$K_d = n \cdot d \cdot \sum P_d \quad (1)$$

Note :

K_d = domestic water demand (ltr),

n = amount of days in a month

d = assumption of water demand (100 liter)

$\sum P_d$ = total resident

Then, the domestic water demand is projected into population growth by several methods used to project the population:

- Geometrical Increase method:

$$P_n = P_o (1+r)^n \quad (2)$$

where:

P_n = total resident in year – n

P_o = total resident in first year

r = Percentage of population geometric growth each year

n = the time period under review

- Arithmetical Increase method:

$$P_n = P_o + nr$$

$$r = \frac{P_o - P_t}{t} \quad (3)$$

where:

P_n = total resident in year – n

P_o = total resident in first year

P_t = projected year-end population

r = population growth rate/year

n = the time period under review

t = total years prior to analysis

To find out people's perceptions and participation, researchers categorize them into four, namely very low, low, high, and very high. The measurement scale that will be used is the Likert Scale and is analyzed using the quartile method. The community perception variable consists of 3 (three) parts, namely (a) availability of water, (b) level of difficulty in obtaining water and (c) condition of water. In calculating the quartile method, lower limit values (B), upper limit values (A), Q1 values, Q2 values, Q3 values and field survey results will be obtained. To find out the direction of the trend of water resource management, the survey results are matched with the values of Q1, Q2 and Q3 which have been grouped into 4 (four) groups, namely:

Lower limit s/d Q = very low perception

> Q1 s / d < Q2 = low perception

> Q2 s / d < Q3 = high perception

> Q3 = very high perception

To determine the relationship between age, education level and income with the level of community participation using multiple correlation analysis. This analysis aims to find out how much the relationship exists between the variables of community participation simultaneously with the variables of age, education level and income by comparing the R values ranging from 0 to 1, if the value is getting closer to 1 it means the relationship is getting stronger, on the contrary the value is getting The closer to 0 the relationship that occurs is getting weaker. According to Sugiyono (2007) the guidelines for providing an interpretation of the correlation coefficient are as followst:

0,00 - 0,199 = very low

0,20 - 0,399 = low

0,40 - 0,599 = average

0,60 - 0,799 = high

0,80 - 1,000 = very high.

3. RESULTS AND DISCUSSIONS

The results of interviews with 92 respondents, the number of households according to the source of water used is: during the rainy season, as many as 90 households or as much as 97.8% use springs and only a small number of residents use shallow wells, namely as many as two households or 2.2%, while for the dry season the source of water used to meet domestic needs is as many as 90 households or 97.8% use springs and only two households or 2.2% use shallow wells.

3.1. Water demand and utilization pattern

The average water requirement for a family of five people is 600-700 liters per day. The largest use of water is for bathing as much as 60 liters/person/day, while the smallest use is for drinking 3/liter/person/day.

The use of springs in Duren Village is still carried out in a simple way, namely channeling clean water from springs to people's homes using pipes. The community takes advantage of the clean water channel by opening and closing the pipes directly. Some residents have never closed the water pipes because the water sources from the springs in Duren Village are very abundant, even in the dry season. Thus, the pattern of utilization of clean water in Duren village may exceed what has been stated above. If the utilization pattern of the Duren Village community is compared with the standard for domestic rural water needs of the 2004 Directorate General of Water Resources, there is a difference in the amount of water demand, where the standard domestic water requirement is 100 liters/person/day while the average need for the Duren Village community is 128 liters/person/ day. So that the water utilization pattern of the Duren Village community is more or more wasteful than the village standard. This could be due to abundant water sources in the rainy season and never dry up in the dry season, thus making people's consumption behavior wasteful in using water.

Based on the results of interviews conducted in Duren Village, the average need for clean water in the village is 128 liters/person/day. From the number of needs per person obtained, the number of needs per year can be calculated based on the number of people and it can be predicted the need for clean water for domestic needs until 2050. The calculation of the population until 2050 in this study uses the geometric method. One of the calculations is as follows:

Total resident in first year (P_n) = 5371 people (2013)

Total resident in year n (P_o) = 5402 people (2014)

Time period in year (n) = 1

$$r = \left(\frac{p_n}{p_o} \right)^{\frac{1}{n}} - 1$$

$$r = \left(\frac{5402}{5371} \right)^{\frac{1}{1}} - 1 = 0,00577 = 0,57\%$$

From the calculation results, the percentage of population growth in 2013-2014 was 0.57%, the percentage of population growth in 2014-2015 was 0.79%, the percentage of growth in 2015-2016 was 0.95%, the percentage of growth in 2016-2017 was 4.5%, and the percentage growth in 2017-2018 was 3.5%, so that the average population growth in Duren Village each year is 2.082%. Thus, the population of Duren Village in 2050 will be 11,491 people. Furthermore, the increasing population growth will affect the community's need for clean water. The domestic water needs of the people of Duren Village from 2013-2050 are 250,933,120 liters/year - 536,859,520 liters/year.

3.2 Water Resources Management strategy

Management of water resources becomes very important along with population development. In Law number 7 of 2004 concerning Water Resources, it is explained that preservation of water resources is an effort to maintain the existence and sustainability of the condition, nature and function of water resources so that they are always available in sufficient quantity and quality to meet the needs of living things, both at the present time as well as in the future. Management of water sources includes several aspects, namely operational, institutional and community participation aspects.

The operational aspect is carried out by making reservoirs and distribution systems from springs carried out by residents independently. The flow of water from springs to residents' homes is carried

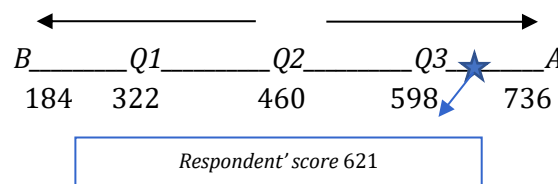
out with a simple system. The springs that appear are then channeled into a permanently closed holding tank to protect it from damage or accumulation of material which can cause the water that comes out to become dirty. The main reservoir is equipped with distribution pipes for distribution to residents' homes. The distribution of water starts from the flow of springs in the northern part of Duren Village, which is a higher elevation than the southern part, to the shared reservoirs located around the plantations and residents' houses. The flow is carried out naturally, namely water from the spring naturally flows into the reservoir by relying on the pressure of the spring discharge and gravity. The distribution was continued from the main reservoir to the shelter in each resident's house.

For the institutional aspect, residents of Duren Village who use water from springs do not have a special organization to manage water. Residents of Duren Village only have a few people as village representatives if deliberations are needed regarding the flow of springs. Even though there is no official organization representing the residents, this does not result in low participation of the residents in managing and preserving the springs. One form of community participation in managing and protecting water sources is by paying contributions for reserve funds if pipe repairs and distribution channels are needed. The amount of money spent on the management of water sources is IDR 30,000 annually. Communication between residents continues to run smoothly even though the residents do not have a special forum to discuss spring management. If mutual cooperation is needed to clean the water canals or there are problems regarding the management of the springs and their distribution system, they will be discussed at the RT meeting or village meeting.

Furthermore, the aspect of community participation in the management of springs can be seen from some of the activities that they routinely carry out, including: mutual cooperation, the slametan tradition, the tradition of recitation.

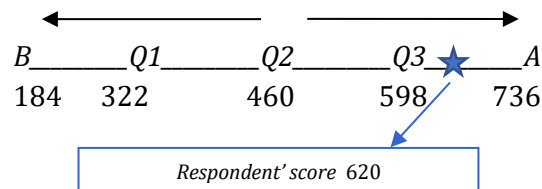
3.3 Community Perceptions of Water Sources

Community perceptions of water availability are inseparable from the influence of seasonal indicators in the study area. This is because the community directly feels the availability of water in the rainy season and dry season. Furthermore, both indicators were measured using a Likerts scale and then analyzed using the quartile (Q) method. From the two indicators, the lower limit value (B) is 184, the upper limit value (A) is 736, the Q1 value is 322, the Q2 value is 460 and the Q3 value is 598 and the survey results obtained from respondents is 621. The calculation results show the value of the field survey results is $> Q3$. This means that the direction of the tendency for people's perception of water availability in Duren Village is classified as very high.



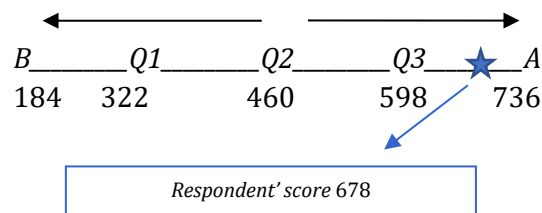
Picture 2 Community Perceptions of Water Availability

Furthermore, the community's perception of access to water is also inseparable from the influence of seasonal indicators in the study area. This is because the community directly feels the need to get water in the rainy season and dry season. The values obtained from the two indicators are the lower limit value (B) of 184, the upper limit value (A) of 736, the Q1 value of 322, the Q2 value of 460 and the Q3 value of 598 and the value of the survey results obtained from respondents is 620. The calculation results show that the field survey results are at $> Q3$. This means that the direction of the community's perception of obtaining water in Duren Village is classified as very high.



Picture 3 Community Perceptions of the Level of Difficulty in Obtaining Water

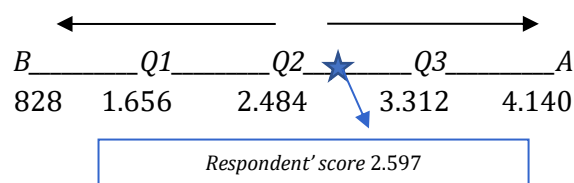
Furthermore, people's perception of water conditions is also inseparable from the influence of seasonal indicators in the study area. This is because the community directly experiences the condition of water in the rainy season and dry season. Furthermore, both indicators were measured using a Likerts scale and then analyzed using the quartile (Q) method. From the two indicators, the lower limit value (B) is 184, the upper limit value (A) is 736, the Q1 value is 322, the Q2 value is 460 and the Q3 value is 598 and the survey results obtained from respondents is 678. The calculation results show the value of the field survey results is $> Q3$. This means that the direction of community perception of water conditions in Duren Village is classified as very high.



Picture 4 Community Perceptions of Water Conditions

3.4 Community Participation in Water Resources Management

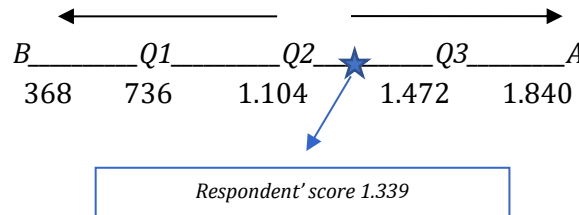
Community participation in the protection of water sources consisting of nine indicators, including (1) securing water sources independently, (2) checking water quality, (3) counseling on water management, (4) establishing clean water independent villages, (5) making tubs containers, (6) sacred water sources, (7) prohibition of throwing garbage around water sources, (8) use of water directly from springs and (9) prohibition of using detergents around springs. The nine indicators of community participation in protecting water sources are measured using the Likert scale method and analyzed using the quartile (Q) method. From the nine indicators, the lower limit value (B) is 828, the upper limit value (A) is 4140, the Q1 value is 1,656, the Q2 value is 2,484 and the Q3 value is 3,312 and the survey results obtained from respondents are 2597. The calculation results show the value of the field survey results are in Q2 and Q3. This means that the direction of community participation in protecting water sources in Duren Village is relatively high.



Picture 5 Community Participation in Protection

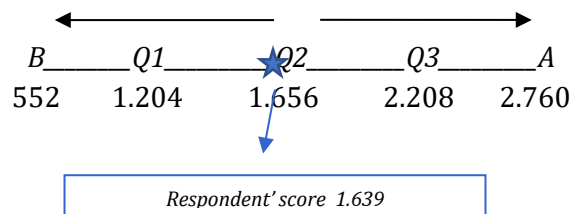
Then, community participation in the preservation of water sources which consists of four indicators including (1) planting trees around springs, (2) cleaning up trash in the spring area, (3) forest management with the government and (4) community service for keep water. The four indicators of community participation in the preservation of water sources are measured using the Likert scale method and analyzed using the quartile (Q) method. Of the four indicators, the lower limit value (B) was

368, the upper limit value (A) was 1840, the Q1 value was 736, the Q2 value was 1,104 and the Q3 value was 1,472 and the survey results obtained from respondents were 1,339. The calculation results show that the field survey results are in Q2 and Q3. This means that the direction of community participation in preserving water sources in Duren Village is relatively high.



Picture 6 Community Participation in preservation

Furthermore, community participation in the utilization of water sources consists of six indicators, including (1) use of water for domestic needs, (2) use of water for PDAM, (3) use of water for animal husbandry, (4) use of water for home industry, (5) use of water for fishery (cultivation) and (6) use of water for agriculture. The six indicators of community participation in the utilization of water sources are measured using the Likert scale method and analyzed using the quartile (Q) method. From the nine indicators, the lower limit value (B) is 552, the upper limit value (A) is 2,760, the Q1 value is 1,104, the Q2 value is 1,656 and the Q3 value is 2,208 and the survey results obtained from respondents are 1,639. The calculation results show the results of the field survey are in Q1 and Q2. This means that the direction of community participation in water utilization in Duren Village is low.



Picture 7 Community Participation in Utilization

3.5 Analysis of Factors Associated with Level of Community Participation in Water Resources Management

The purpose of this analysis is to find out what factors are related to the level of community participation in the management of water sources at the research location. The factors to be analyzed include age, education level and income.

Table 1 Age Factor Frequency Distribution, Education Level and Income

No	Factor	Σ	%
A	Age		
1	< 40 years old	13	14,1
2	40 – 65 years old	64	69,5
3	> 65 years old	15	16,3
B	Education level		
1	Didn't finish el.	37	40,2
2	school	44	47,8
3	El. school	6	6,5
4	Middle school	5	5,4
	High school		
C	income		
1	< Rp. 1000.000	43	46,7
2	Rp. 1000.000 –	34	36,9
3	Rp. 2000.000	15	16,3
	> Rp. 2000.000		

(Source: analysis, 2019)

3.5.1 Relationship between Age, Education and Income Factors with the Level of Community Participation in Water Source Protection

Based on the relationship between the age factor and the level of community participation in protecting water sources, Table 5.32 shows that there is a moderate relationship with an R number of 0.538. Furthermore, the R Square figure was obtained at 0.314 or 31.4%, this shows that the percentage of contribution to the influence of the participation (protection) variable on the age variable is 31.4%.

Based on the relationship between the level of education and the level of community participation in protecting water sources, Table 5.33 shows that there is a moderate relationship with an R number of 0.446. Furthermore, the R Square obtained is 0.261 or 26.1%, this shows that the percentage of contribution to the influence of the participation (protection) variable on the education level variable is 26.1%.

Table 2 Relationship Level of Public Participation in Protection

No.	Factor	r	r ²
1	Age	0,538	0,314
2	Education	0,446	0,261
3	Income	0,383	0,234

(Source: Analysis, 2019)

Based on the relationship between the income factor and the level of community participation in protecting water sources, Table 5.34 shows that there is a low relationship with an R number of 0.383. Furthermore, the R Square obtained is 0.234 or 23.4%, this shows that the percentage of contribution to the influence of the participation (protection) variable on the education level variable is 23.4%.

3.5.2 Relationship between Age, Education and Income Factors with the Level of Community Participation in Resource Preservation

Table 3 Relationship Level of Community Participation in Preservation

No.	Factor	r	r ²
1	Age	0,428	0,252
2	Education	0,443	0,259
3	Income	0,293	0,237

(Source: analysis, 2019)

Based on the relationship between the age factor and the level of community participation in preserving water sources, Table 5.35 shows that there is a moderate relationship with an R number of 0.428. Furthermore, the R Square figure is obtained at 0.252 or 25.2%, this indicates that the percentage of contribution to the influence of the participation variable (preservation) on the age variable is 25.2%.

Based on the relationship between the level of education and the level of community participation in conserving water sources, Table 5.36 shows that there is a moderate relationship with an R number of 0.443. Furthermore, the R Square obtained is 0.259 or 25.9%, this shows that the percentage of contribution to the influence of the participation (preservation) variable on the education level variable is 25.9%.

Based on the relationship between the income factor and the level of community participation in preserving water sources, Table 5.37 shows that there is a low relationship with an R number of 0.293. Furthermore, the R Square obtained is 0.237 or 23.7%, this shows that the percentage of contribution to the influence of the participation variable (preservation) on the education level variable is 23.7%.

3.5.3 Relationship between Age, Education and Income Factors with the Level of Community Participation in the Utilization of Water Sources

Tabel 4 Relationship Level of Community Participation in Utilization

No.	Factor	r	r ²
1	Age	0,489	0,283
2	Education	0,670	0,421
3	Income	0,449	0,262

(Source: Analysis, 2019)

Based on the relationship between the age factor and the level of community participation in the utilization of water sources, Table 5.38 shows that there is a moderate relationship with an R number of 0.489. Furthermore, the R Square figure was obtained at 0.283 or 28.3%, this shows that the percentage of contribution to the influence of the participation (utilization) variable on the age variable is 28.3%.

Based on the relationship between the level of education and the level of community participation in the utilization of water sources, Table 5.39 shows that there is a strong relationship with an R number of 0.670. Furthermore, the R Square obtained is 0.421 or 42.1%, this shows that the percentage of contribution to the influence of the participation (preservation) variable on the education level variable is 25.9%.

Based on the relationship between the income factor and the level of community participation in the utilization of water sources, Table 5.40 shows that there is a moderate relationship with an R number of 0.449. Furthermore, the R Square obtained is 0.262 or 26.2%, this shows that the percentage of contribution to the influence of the participation (preservation) variable on the education level variable is 26.2%.

4. CONCLUSION

The form of the wisdom of the Duren Village community in preserving and managing springs is in the form of mutual cooperation, the tradition of slametans and traditions of recitation, as well as local prohibitions. The wisdom of the Duren Village community regarding the existence of a spring is an effort to conserve water resources in the village. The form of the management strategy for the management of water resources in Duren Village consists of three aspects, namely operational aspects, institutional aspects and community participation aspects. For the operational aspect, the people of Duren Village built a reservoir and distribution system from the springs which were carried out by the residents independently. The flow of water from springs to residents' homes is carried out using a simple system through the main reservoir equipped with distribution pipes for distribution to residents' homes. For the institutional aspect, residents of Duren Village who use water from springs do not have a special organization to manage water but only village representatives if deliberations are needed regarding the flow of springs. Even though there is no official organization representing the residents, this does not result in low participation of the residents in managing and preserving the springs. Furthermore, the aspect of the participation of the Duren Village community in the management of the spring can be seen from the several activities that they routinely carry out, including mutual cooperation, the slametan tradition and the tradition of recitation.

The level of community participation in the management of water sources in Duren Village consists of three components, namely protection, preservation and utilization. For community participation in the protection of water sources, the results of the analysis at the research location show that the level of community participation in the protection and preservation of water sources is very high, which

means that the people of Duren Village always participate in efforts to manage water sources by carrying out mutual cooperation activities, traditions slametans and recitation traditions. However, the level of utilization of water sources in Duren Village is still low because the management of water sources is still carried out independently without any special organization or group that organizes or assists the management of water sources to become more structured or organized so that they can be utilized optimally.

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