

# Differences in the Amount of Karst Groundwater Use Based on Education Level and Availability of Other Water Sources as Well as Seasonal Factors

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## ABSTRACT

Karst underground water is the foundation for meeting water needs for most people in the karst region. Therefore, its sustainability needs to be maintained properly through good management. Management of underground karst water really needs to pay attention to the characteristics of the user and environmental conditions. This study aims to explore differences in the average water use by water users based on education level and availability of other sources as well as seasonal factors. Data obtained through observation and interviews. The analysis was carried out using ANOVA, Student T-test and a graph of the average trend of water use. The test results show that there is a difference in the average amount of water use based on education level and the availability of other water sources. The trend of the graph of water use shows an increase in the amount of use from the rainy season to the dry season.

**Keywords:** Education level, other water sources, season, amount of water use

## 1. INTRODUCTION

Water is a vital resource for human life. Karst underground water is the foundation for meeting water needs for the Gunungsewu karst community, including the Wonosari Ledok area. Domestic water needs include drinking, bathing, and washing purposes [1-3]. Karst groundwater is generally obtained from caves, springs, or dug wells that are still watery. Water is obtained through direct extraction or through a drinking water network managed by the local government. However, not all places have water sources that are easily accessible to residents or there is a drinking water network from the government. Access to water sources in karst areas is generally difficult in line with the nature of the karst landscape itself. Therefore, some people make pumping drilling efforts to fulfil their water needs [4,5].

Efforts to procure water independently by community groups are faced with the problem of water production capacity. Water production is carried out by pumping underground karst water with a limited capacity. This condition has an impact on the amount of water produced in only a limited amount. Therefore, the pattern of water utilization by users must be efficient and effective.

Inefficient utilization results in frequent imbalances between production and water consumed by users. In addition, the water produced is not evenly distributed. Based on this, it is necessary to investigate the pattern of water consumption carried out by the community that uses it.

The level of education has an important meaning for the preservation of karst underground water sources. Findings [2] and [6] shows a significant correlation between education level and participation in conserving karst underground water sources. Conclusion [7] also shows that there is a correlation between community characteristics, one of which is the parameter of education level on the condition of the quantity and quality of the springs. In line with that, [8] states that the lower the level of public education, the lower the optimal utilization and awareness of the importance of the environment.

Spamdus Genjahan is an example of a karst underground water management system carried out by community groups in Genjahan Hamlet, Ponjong district, Gunungkidul Regency. Spamdus Genjahan has similar problems with other community water management systems as described above. Based on this, further

research will be carried out on the Genjahan community who use this Spamdus. This study will explore (1) the difference in average water use based on education level and the use of other water sources, and (2) the number of uses of Spamdus water by the community related to local seasonal conditions. The research findings are expected to be used as considerations in water management.

**2. METHODS**

**A. Population and samples**

The population in this study is the entire community of water users from Spamdus Genjahan. The number of water users is 129 people spread over the hamlets of Genjahan, Ngrombo 2, Silingi, and Jetis. Considering that not all water user communities could be found at the time of the study, 102 respondents were taken as samples. The sample was carried out randomly, with a proportional amount at each administrative location.

**B. Data, variabel, and analysis**

The data taken in this study were the education level of the respondents, the use of other water sources, the amount of water used each month in the last eight months and the average usage. Data on the level of education and utilization of other water sources were taken through direct observation and interviews. Data on the amount of water usage is taken from the record of the amount of water used by each respondent from the Spamdus manager for the last eight months. The average amount of water use is calculated from the average water use of each respondent for eight months. The education level of the respondents is classified into SD, SMP, SMA, and graduate. Meanwhile, the use of water sources that are utilized are classified into “only using Spamdus water” and “using Spamdus water and other sources”.

The variables of education level and the use of other water sources are used to observe the difference in the average amount of water used by respondents which is the first objective of this study. The average difference test of water use based on education level was carried out using Anova single factor. Meanwhile, the different test of mean water usage based on water source was carried out using the Student T-test. The conclusion is based on the calculated p value of each calculation with a significance level of 95%.

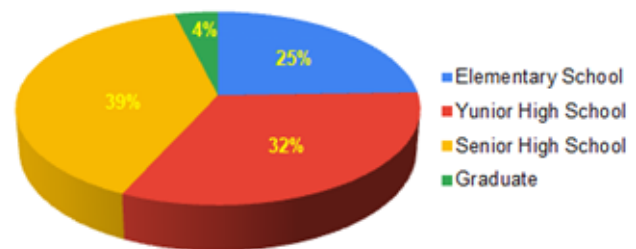
The second objective is observed through the variable amount of water usage per month. Trends in the amount of water use are observed through graphs of data on the average water usage of all respondents per month. Based on the available rainfall data, it is known that the high average rainfall occurs around January, while the low average rainfall occurs around August. Based on the distribution of the average rainfall, the calculation of water use is carried out continuously from January to

August. The calculation result in January is a representation of the use of Spamdus water in the rainy season. The calculation result in August is the representation of water use in the dry season. The amount of Spamdus water utilization from each respondent is averaged and then manifested in the form of a line graph. A trend line is formed based on the distribution of data on the chart. The analysis is carried out by describing the graph line of the average amount of water use and the trend line formed on the graph.

**3. RESULTS AND DISCUSSION**

**A. Water utilization based on education level**

Based on the results of the interview, it is known that the education level of the people who use Spamdus Genjahan water varies from elementary to undergraduate. The highest percentage of respondents' education level is at the high school level, which is 39.2 percent. The next percentage in a row is for junior high school as much as 32.4 percent, elementary school as much as 24 percent, and undergraduate as much as 3.9 percent. This condition is illustrated in Figure 1 below.

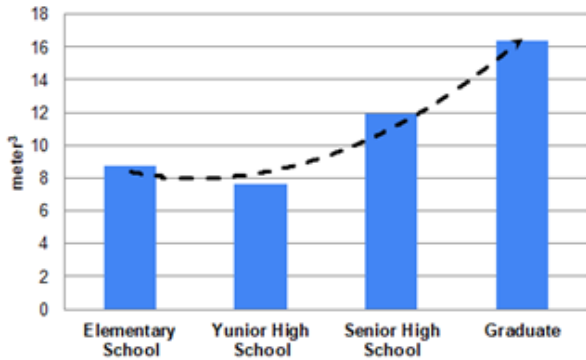


**Figure. 1.** Percentage of respondent’s education level

Figure 1 shows that the average education level of the people who use Spamdus Genjahan water is at the lower middle level. These conditions are often found in other locations in the Ledok Wonosari area or the Gunungsewu karst [9,10]. Finding [2] shows that most of the public education levels in Saptosari district are at a low level. The difference in the average level of education is made possible by differences in research locations, where the research location of [2] is in the Gunungsewu karst area which has more difficult accessibility than this research area. The research area is located in the Wonosari Ledok area which has better and easier access.

The results of the different test on the average water use of each respondent based on their education level showed a significant difference. The results of the ANOVA test on the variable level of education and the average amount of water use show a p value of 0.0397. This means that the calculated p value is less than 0.05 so it can be concluded that there is a significant difference from each level of education to the average use of Spamdus water. The average water use based on

education level can be seen graphically in the following figure.



**Figure. 2.** Average amount of water use by education level

The graph shows an increase in the average amount of water use from a low level of education to a higher level of education. Respondents who have a higher education level tend to use water in greater quantities than respondents with secondary and low education. Based on the graph, the average amount of water used by respondents with a higher education level is twice the average amount of water used by respondents with low education. Respondents with a high level of education tend to have more diverse activities in water use. Utilization is not only for basic needs, but extends to use for small-scale agriculture. Respondents with elementary education level tend to use water only for basic needs such as drinking water, bathing, and washing. This finding is in line with the findings of [11] that the higher the level of education, the greater the use of water. These findings indicate that the higher the level of education there is an increase in the variety of water use, so that the demand for water increases. Variations in water use are triggered by the increasing number of types of activities carried out by people with higher education levels.

**B. Utilization of other water sources**

Based on the results of interviews and observations, it is known that some of the people of Genjahan hamlet have water sources in the form of dug wells. The number of wells in the research area is not large considering that not every place can be dug wells that will discharge water. Water from existing wells is used individually or collectively. In line with the characteristics of the karst area, not all wells have a large discharge even though they are in close proximity. This well water is also very volatile due to the rain that occurs in the study area. Most of the existing wells will dry up during the dry season and some will remain watery with very small discharges.

Studying the data, it is known that some people use both water sources from wells and Spamdus, and others only use water from this Genjahan Spamdus. The following table shows the number and percentage of

respondents who only use Spamdus water and use other water sources.

**Table 1.** Use of water sources

water sources	sum	average (m³)
Only from Spamdus	40 persons	13.5
Using both	62 persons	8.3

Table 1 shows that most of the respondents have other water sources that are used to fulfil their water needs. The number of respondents is as many as 62 people or by 60.8 percent. Meanwhile, people who only use water from Spamdus are 40 people or 39.2 percent. The results of interviews with respondents who have other water sources indicate that the use of water from Spamdus Genjahan is used as a reserve during the dry season. During the dry season, most of the wells in the study area are dry. Therefore, the fulfilment of water needs is then added from water originating from Spamdus Genjahan. Respondents who have other sources tend to use other sources as long as their debits are still high.

The results of the average water use test on the respondents show that there is a significant difference. This is indicated by the calculated P value of 0.0004. This calculated P value is less than 0.05. This value indicates that there is a significant difference from the average amount of water used by the two groups of respondents. The average amount of water used by respondents who only use Spamdus Genjahan water is 13.5 cubic meters per month. Meanwhile, the average amount used by respondents who use other water sources is 8.3 cubic meters per month. This figure clearly shows that respondents who have other sources have not used water from Spamdus Gejahan as a source of basic water fulfilment in their daily lives. The use of various water sources as done by the community in this study is mostly carried out in the community in the Gunungsewu karst area. Reference [3] and [12] describes several other alternative water sources that are often used by the Gunungsewu karst community, such as the use of PAH and water from karst lakes.

**C. Water use related to local season**

Rainfall that occurs in the research area has an influence on the population's well water discharge. Groundwater level fluctuations in each well vary spatially. High rainfall in the rainy season adds to well water reserves at an unequal rate. This condition is in line with the characteristics of the karst region that underlies the research area. The limestone underlying this research area has irregular fracture and joint grooves, so that not all wells have the same fill volume.

In line with the findings in this study above, it is known that some respondents use other water sources to

meet their water needs during the rainy season. The use of water from Spamdus increases in line with the changing seasons towards the dry season. This finding shows that there is a relationship between season and the amount of Spamdus water utilization. The results of the calculation of the average use of Spamdus water from each respondent shows in the following graph.

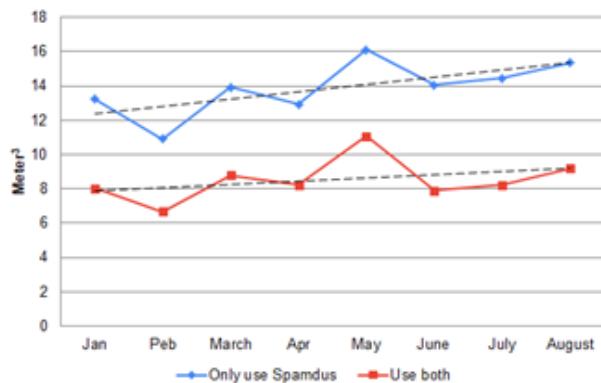


Figure 3. Graph of average water usage per month

Figure 3 shows a graph of the average monthly use of Spamdus Genjahan by respondents. The graph line on the top is a graph of the average water utilization of respondents who only use Spamdus water. The bottom line of the graph is a graph of the average amount of water used by respondents who use other water sources. The average amount of water usage fluctuates, especially during the rainy season. The graph shows the similarity of fluctuations in the amount of water use of the two groups of respondents using water. The average amount of water usage from the group that only uses Spamdus is more than the group that uses other water sources.

The average amount of water usage from the group that only uses Spamdus ranges from about 11 cubic meters to around 16 cubic meters. Meanwhile, the average amount of water used by groups using other sources ranges from about 7 cubic meters to about 11 cubic meters. The difference in the average utilization of the two groups of respondents is about 5 to 6 cubic meters per month. Fluctuations up and down occur in January to June. The lowest average number of uses of the two groups occurred in February 2021 and the highest occurred in May 2021.

The trend of the average use of water by the two groups of respondents seems to have increased from January to August. This trend line shows an increase in the amount of water used from Spamdus Genjahan in line with a decrease in rainfall. August is the driest month in the study area. Low rainfall triggers a decrease in water discharge in wells in this region. As a result, residents take water from other sources, one of which is Spamdus Genjahan. Some have completely switched to using this water source from Spamdus because other sources have completely dried up. This condition is in line with the facts in other places as conveyed by [1, 2, and 4].

#### 4. CONCLUSION

Based on the results and discussion above, it can be concluded as follows.

- The majority of the education level of Spamdus Genjahan water users are at the secondary education level. The test results show a significant difference in the mean amount of water use based on education level.
- Most of the people who use Spamdus Genjahan water still use other water sources to fulfill their needs. There is a significant difference in the mean amount of water use between groups of people who only use Spamdus Genjahan water and groups that use other water sources. The average water uses by residents who only use Spamdus Genjahan water is higher than residents who use other water sources.
- There was an increase in the average amount of water use in the months in the rainy season to the months in the dry season. The increase occurred in community groups who only used Spamdus Genjahan water or who used other water sources.

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