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Sustainability of Community-Based Management of Lerak Spring in Semarang City

Cintiya Egi Purwadi[1*], Dhiyanita Shabrina[1], Mahendra Gunawan[1], Mohammad Rifki Trihadianta[1], Lenny Helmalia Mustikawati[1], Abdul Jabbar[1], Trida Ridho Fariz[1], Amnan Haris[1]

[1]Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Indonesia

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*Corresponding author:
Cintiya Egi Purwadi
Universitas Negeri Semarang
E-mail: cintiyaegi@students.unnes.ac.id

Abstract

Along with the increase in the need and use of water, a sustainable water management and distribution system must be implemented. Good management of a water distribution system requires a proper management and distribution system. Gunungpati Subdistrict is one of the areas in Semarang City that still utilizes springs as a source of clean water to meet daily needs. One of the springs utilized to meet the clean water needs of residents is Lerak Spring, located in Muntal Village RT 1 RW 6, Pakintelan Village. This study aimed to determine the management of the spring and its sustainability aspects. Data collection methods used in this study consisted of primary data using qualitative methods in the form of interviews, observations, and laboratory tests related to water quality. The results showed that the management of Lerak Spring has a relatively low level of sustainability in terms of social, economic, environmental, cultural, and technical aspects.

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INTRODUCTION

Water is a basic human need for survival. One of the six Sustainable Development Goals (SDGs) states that one of the goals is to alleviate the problem of access to clean water and sanitation (Pratiwi et al., 2022; Tortajada, 2020: Elysia, 2018). In human life, water plays a role in drinking, bathing and washing, as well as in reducing many people suffer from diseases, especially those related to water (Tiwari et al, 2021; McMichael et al, 2019; Handayani et al, 2019). Water is also essential to meet various needs, including energy production, industry, housing and agriculture, and fisheries (Lomi et al., 2021; Bahri, 2020). However, the need for water is increasing as the population increases, while the availability of clean water decreases, especially during the dry season (Messakh et al., 2015; Mukaromah, 2020; Daniel et al., 2021).

Water resources are water and the water resources included in it (Law of the Republic of Indonesia Number 17 of 2019). Groundwater and surface water are water sources commonly used to fulfill daily needs. One of the water sources utilized by the people of Indonesia is spring water. Naturally, spring water discharges from the aquifer layer and then flows to the top of the earth's surface (Saputro et al., 2022; Toulier et al., 2019). One of the areas in Semarang City that use clean water sources from springs is Gunungpati District, Semarang City (Sidiq et al., 2022). However, population growth in the Gunungpati area is multiplying, considering that it is one of the sub-districts designated by the Semarang City Government as a satellite area to accommodate the housing needs of workers (Sidiq et al., 2022; Anggraini et al., 2022; Dewi & Rudiarto, 2013). In addition, since 1990, Semarang State University has increased the area of its lecture facilities to 120 hectares in Sekaran Village, Gunungpati District. The dynamics of population growth and activities in the Gunungpati area affect the use and availability of clean water, which is increasing (Putri et al., 2023; Ain et al., 2023).

As water use and demand increase, sustainable water distribution and management systems are required. Proper management of the water supply system is needed so that the fulfillment of community water needs can be appropriately met. Therefore, it is necessary to preserve the provision of water sources so that the quality of the raw water supply remains the same as the scientific conditions (Lestari & Suprapto, 2019). Studies related to this are studies on the sustainability of community-based water resource management, such as studies by Andriyanto et al. (2023), Putri et al. (2023), and Wandari et al. (2022). However, studies focusing on springs still need to be made available. This study examines the sustainability management Lerak Spring located in Pakintelan Village, Gunungpati District, which is distributed without fees and management institutions.

METHOD

This study will examine the sustainability of lerak spring management in Pakintelan Village, Gunungpati District (Figure 1). This study looks at the sustainability of lerak spring management in terms of the interrelationship of several aspects, such as social, economic, institutional, environmental, and technological aspects (Trijunianto, 2016; Mukherjee & van Wijk, 2003). These five aspects are interconnected to see which aspects still need to be fulfilled and which should be focused on to be developed (Figure 2).

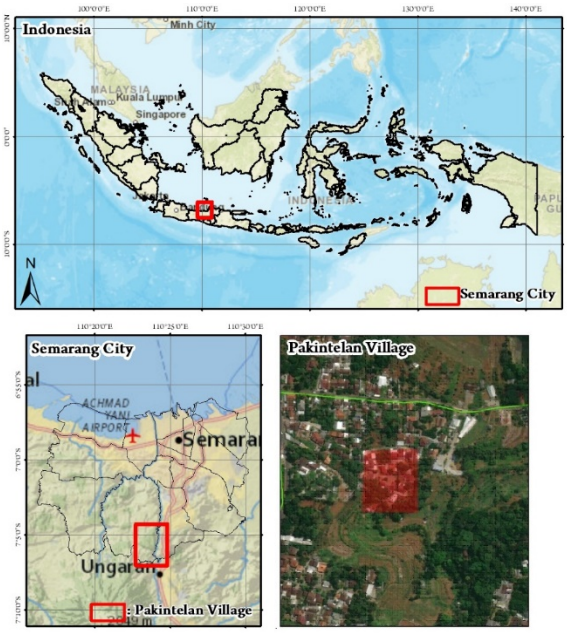

Figure 1. Study area

Data from the environmental aspect is obtained from the water grab sampling method by taking water samples at the spring location. Water samples from Lerak Spring were then tested for water quality, starting from the physical parameters of water in temperature, Electrical Conductivity (EC), and TDS, as well as water chemical parameters consisting of pH, Biological Oxygen demand (BOD), and Chemical Oxygen Demand (COD) tests. The tests were conducted at the Environmental Laboratory of Semarang State University.

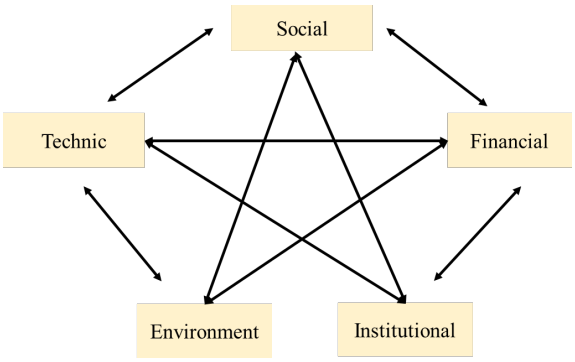

Figure 2. Sustainability Aspects of Clean Water Facilities

Data from social, institutional, and technical aspect were collected using documentation, observation, and interviews. In-depth interviews were conducted with the primary respondent, the Chairman of the neighborhood. Supporting data was obtained from semi-structured interviews conducted with spring-using households. Respondent profiles can be seen in Table 1.

Table 1. Respondent profile of Lerak Springs user

Respondents	Age	Gender
Chairman of the neighborhood	43rd Years	Man
Respondent I	42nd Years	Man
Respondent II	53rd Years	Woman
Respondent III	59th Years	Woman
Respondent IV	27th Years	Man
Respondent V	60th Years	Woman
Respondent VI	25th Years	Man
Respondent VII	62nd Years	Man
Respondent VIII	35th Years	Man
Respondent IX	42nd Years	Man
Respondent X	40th Years	Man

Willingness to Pay is used to assess financial aspects. Willingness to Pay analysis used CVM (Contingent Valuation Method) techniques to determine the community's willingness to pay for a resource and its economic value. The analysis begins by developing a hypothetical market for the conditions and needs of the resource, which can later be used as a reference in providing WTP offers to the community. The offer value is obtained using a closed-question approach that asks respondents about their willingness to pay with a predetermined nominal range (Jabbar et al., 2021; Prasetyanto, 2015). The data obtained is averaged to determine the overall WTP so that the willingness to pay per year is obtained (Nainggolan, 2019; Rosalina et al., 2022).

RESULT AND DISCUSSION

This spring management research was conducted at a spring referred to as Lerak Spring by the community of Muntal Village RT 1 RW 6 Pakintelan Village. This spring is one of 17 springs in Pakintelan Village, located on Jl. Kyai Saleh III, Pakintelan Village, Gunungpati Subdistrict, Semarang City, Central Java. Sixty-one households were registered in RT 1 RW 6 in Muntal Village in 2019. People in Muntal Village use artesian wells with groundwater sources and Lerak Spring to meet their water needs.

Figure 3. Lerak Springs

There are currently 11 households registered by the RT head as users of Lerak spring water independently using a water pump. The springs flow together to form a 3x3 meter spring. Residents have utilized Lerak Spring since the late 90s, using simple buckets and ropes as water collection tools. The villagers chose the word Lerak itself because there is a lerak tree (*Sapindus rarak*) near the spring as a canopy cover. At the beginning of the spring's utilization, the Lerak fruit that often falls around the spring was widely used by residents as a natural detergent. Nevertheless, over time, resident began to switch to using conventional detergents on the market.

Sustainability of Water Management and Supply

Based on its quality and quantity, Lerak Spring is still maintained and able to meet the needs of its users. Water quality measurements were tested at the Environmental Laboratory of Semarang State University using water samples taken directly from Lerak Spring. Table 2 presents the physical and chemical parameters showing the water quality testing results.

Government Regulation No. 82/2001 on Water Quality Management and Water Pollution Control is the quality standard applied in Indonesia. Lerak spring water meets the requirements of class I water use or drinking water, both temperature, pH, and BOD levels, according to the quality norms of PP No. 82 of 2001—water intended for irrigating crops or other purposes that require the same. Water quality meets the criteria for class IV water quality of a chemical nature in the form of COD. By Minister of Health Regulation No. 492/Menkes/Per/IV/2010, TDS and EC meet the drinking water quality criteria regarding physical characteristics.

Based on information from residents around the spring, the discharge produced by Lerak Spring reaches 9 m^3hour. With a reasonably high discharge for a spring and low usage by residents, Lerak Spring is also occasionally used as a source of irrigation water for nearby farms. However, from 2010 to 2015, the water discharge declined to 3.6 m^3. This was due to the erratic dry season, changes in land cover, and the replacement of water collection equipment with water pumping machines. Since 2010, several villagers have connected piped water pumps to the Lerak Spring. Since then, Lerak spring water has been used not only for bathing, washing, and cooking needs but also by some residents as a source of irrigation for aquaculture. The research area has already accommodated a water supply service as a privately owned artesian well with a Rp 3,000/m^3 fee.

From the beginning of spring utilization until now, there has been no spring management institution or costs incurred by residents as operational or maintenance costs. The community use he spring water with its pump, piping, and electricity without additional costs. Due to the absence of an official management institution, the utilization of Lerak Spring often causes problems between residents. The existence of jet pump machines owned by catfish farmers is considered to take large amounts of water and cause the water discharge in the spring to recede. Currently, some residents only carry out maintenance in the form of cleaning moss on the edge of the spring.

Table 1. Measurement values of physical and chemical parameters of Lerak Springs

Physics Parameters					
Temperature		**EC (Electrical Conductivity)**		**TDS**	
Tested	Quality Standards	Tested	Quality Standards	Tested	Quality Standards
27,6 °C	26-29 °C	745 µS/cm	20 - 1500 µS/cm	130 mg/l	500 mg/l
Chemical Parameters					
pH		**BOD**		**COD**	
Tested	Quality Standards	Tested	Quality Standards	Tested	Quality Standards
7	6-9	0,13	2-12	66 mg/l	10-100 mg/l

Willingness to Pay for the Utilization of Lerak Spring

The utilization of Lerak Spring as a water source is currently still community-based and free of charge. Respondents said that they only need to install pipes and water pumps in their homes to access clean water from the spring. According to residents, the cost of pipe installation per house reaches 1 million rupiah, but this also depends on the distance of the house to the spring. Based on interviews, respondents said they are willing to pay if an institution manages the Lerak Spring, but they object if the fees charged are higher or equivalent to PDAM services or private water sources.

From the Willingness to Pay analysis using the survey-based CVM (Contingent Valuation Method) (Hasiani, 2013), in this study, the market price agreed upon by respondents was Rp 500,000 - Rp 1,000,000. The middle value was taken from the agreed market price of Rp 725,000 per year or Rp 2000/m3. People are only willing to pay low prices because the spring is already free, and they have been using it for decades. The absence of a management institution is one indicator of the low price given because residents feel that they can install the water privately at a high price.

Comparative Analysis of Sustainability Aspects of Water Management and Supply

The results of the analysis of several groupings of aspects of the sustainability of the Lerak Spring on Kyai Saleh III are presented in Table 4. Table 4 shows that the social aspect, namely community participation in managing and maintaining the spring as a source of clean water, still needs to be higher. This is because the awareness to maintain the spring is only owned by users who live next to the spring, while users

who are located further away do not contribute anything. If there is damage to the pipeline, residents tend to immediately switch to using other sources of clean water. There has been a decrease in the number of customers who have access to clean water services due to piping damage caused by the burning of several pipes due to jet pumps used by resident owners who cultivate catfish. Previously, there were 15-17 households registered as users of Lerak Spring, but when researchers observed the situation in the field, only 11 households remained who were still actively using Lerak Spring. Users who switched to using private artesian wells admitted that they were reluctant to repair the burnt pipes and did not want conflicts between users, so they preferred to remain silent and switch to other clean water source services.

Based on the analysis results, the existence of operational fees and the willingness of residents to pay could be much higher. While residents have been using Lerak Spring for about 20 years, no management organization has been established, so no operational fees have been charged. Lerak Spring has only undergone a one-time construction in the form of a roof from the Semarang City Water Agency. Based on the interviews and the Willingness to Pay analysis, it was also found that the willingness to pay for spring services was low.

Table 3. Aspect of Sustainability of Water Management and Supply

Sustainability Aspects	Description
Social aspects	
Community participation	Community participation in spring maintenance is growing but unevenly distributed
Access to clean water services	Declining
Financial aspects	
Maintenance operating costs	Not applicable
Willingness to pay	Low
Environmental aspects	
Water quantity	Meet the needs of the community
Water quality	Good
Institutional aspects	
Management organization	None
Rules and norms	None and not applicable
Technical aspects	
Production unit condition	The condition of the spring is quite good

In terms of water quality and quantity based on measurements of pH, temperature, TDS, EC, COD, and BOD, Lerak spring water meets the quality criteria set by legislation based on its utilization. In terms of water quantity based on the discharge produced, Lerak Spring has a high enough discharge that it can be said to be able to meet the needs of its users. In this sense, Lerak Spring fulfills the environmental component of sustainability. The aspect of sustainability that needs to be improved in the management of Lerak Spring is the institutional aspect. This includes the management organization and any relevant policies or guidelines. From the beginning of using the spring as a source of clean water services until now, no management organization has been established, and no rules have been set as a basis for residents using the spring. Residents need a definitive license to use Lerak Spring as a clean water source. The technical aspect considered in this study is the condition of the spring reservoir. Technically, the structure's condition is quite good, with a canopy cover and cement around the spring. However, because no management organization cares for the spring area, moss is often found growing at the bottom and around the spring. This moss affects the smell and taste of Lerak spring water. The piping unit itself is privately organized and managed by the spring users.

The existence of management institutions can overcome the sustainability problems found (Sinrahoy et al., 2019). The utilization and maintenance of springs need to be improved through management institutions so that the spring maintenance process can be carried out and the sustainability of springs can be better maintained despite threats such as climate change (Kohlitz et al., 2020). In addition, spring user fees should be introduced so that water use rates can be measured and the system's sustainability can be assured (Cronk & Bartram, 2017; Daniel et al., 2023). Of course, this type of management is costly in terms of network installation to the houses and the construction of water towers to temporarily store the water before it is distributed to the houses. However, the design of spring management is essential if the spring is to continue to be utilized.

This research needs to be expanded in the future due to its many limitations. This study's WTP assessment was based only on a market price survey, so the relationship between residents' backgrounds and the agreed market value needs to be sufficiently visible. In-depth analysis using a dynamic systems approach is needed to evaluate the sustainability of water supply systems influenced by several interconnected elements (Daniel et al., 2021). Similarly, the utilization of springs also needs to be done to improve spring management and access to clean water for the community.

CONCLUSION

Using clean water through Lerak Spring in Muntal Village RT 1 RW 6 Pakintelan Village, Gunungpati Subdistrict, Semarang City, has a low sustainability score. An examination of each aspect of sustainability, including social, financial, institutional, environmental, and technological components, was used to illustrate this. The sustainability of Lerak Spring only meets the assessment of the environmental aspect, while all five aspects of sustainability are related to each other. The water supply of Lerak Spring has low sustainability value.

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