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LOCAL WISDOM AND KARST SPRING MANAGEMENT IN PLAYEN DISTRICT, GUNUNGKIDUL REGENCY, INDONESIA

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Abstract

For the population of Playen District, Gunungkidul Regency, karst springs serve as the primary water sources because surface rivers are rare in karst areas and, if present, the quality of their water is reportedly less than that of the springs. In the spring water utilization, local wisdom is incorporated into the management and has so far contributed to sustainability. Since only a few studies have examined local wisdom and its correlation with changes in spring management pattern, this research initiates the provision and dissemination of information on karst spring management that is applicable elsewhere. It was designed to scrutinize the local wisdom and regulatory measures implemented at many springs in Playen District. Detailed data were obtained by in-depth interviews with four key informants responsible for managing springs block 1 (Gedad, Grunggung, and Karangkulon Springs), 2 (Banyusoco and Sungai Oyo), 3 (Dung Poh, Nganding, Umbul, and Jambe), and 4 (Ngrunggo and Ngrasih). Through qualitative descriptive analysis, the research found that the laying of offerings at springs in blocks 1 and 2 during traditional celebratory ceremonies had been abandoned, but cleaning activities at and around these springs as part of the local wisdom sustained. In the context of utilization, the spring management had changed from direct manual withdrawal to indirect systematized one that used pipes with gravitational water flow system (block 1) to distribute spring water to villagers' houses (block 2). On the contrary, local wisdom like offerings and cleaning activities at and around the springs in blocks 3 and 4 was preserved. Their management had changed from manual extraction to gas-fueled water pumping systems, which were later replaced with electricity-powered pumps (block 3), and to indirect withdrawal through pipelines with pump-generated flows (block 4). To manage the springs in all blocks and their sustainable utilization, the people of the district still adopt local wisdom. Besides, they no longer collected water directly at springs but have switched to water distribution technology like pumps and pipelines instead.

Keywords: Karst springs, local wisdom, springs management

A. Introduction

Spring management and utilization differs from one landform to another depending on physical, chemical, and biological characteristics (Adji and Misqi, 2010; Sudarmadji et al., 2011; Wijatna et al., 2013; Sudarmadji, 2013; Eiche et al., 2016; Adji et al., 2016; Sudarmadji et al., 2017) as a result of variations in geological and geomorphological conditions (Kusumayudha, 2009; Verstappen, 1983; Todd and Mays, 2005). For instance, karst landform is defined by dry surface and abundant groundwater quantity (Haryono and Adji, 2004; Ford and Williams, 2007). Consequently, it creates one of the unique spring managements to date.

Rare availability and poor quality of surface water lead karst inhabitants to rely on springs as their primary water resources (Haryono and Day, 2004; Adji, 2011; Adji et al., 2017a, b). Such circumstances are also typical of Playen, a district in Gunungkidul Regency (Widiyastuti and Widyastuti, 2018). Springs are managed differently according to social and physical-physiographic aspects. Socially, community beliefs and myths strongly influence the management (Sudarmadji et al., 2011; Sudarmadji, 2013) because they form traditions with unique purposes in preserving springs (Sumarni, 2014; Sudarmadji et al., 2017).

This research was intended to reveal karst spring management based on local wisdom in Playen District and identify changes in its pattern, particularly from traditional to modern. With the collected information, it partakes in the efforts to fulfill community water demand in Gunungkidul Regency, which is susceptible to drought (Aprian et al., 2014). Also, it is expected to initiate and publish several effective spring management strategies that can be applied to other regions.

Playen is a district of Gunungkidul Regency, the Special Region of Yogyakarta, Indonesia, which lies between the coordinates 110°25'30''- 110°33'0'' E and 7°52'30'' - 8°0'0'' S. It is occupied by 54,299 people, with a population density of 553,86 km/km^2 (BPS, 2017). Based on the national soil classification, the district has *Mediteran* in association with *Grumusol* (Sutaryo, 2014), which are respectively equivalent to Alfisols and Vertisols in the USDA Soil Taxonomy. It receives annual precipitation of 1900-2700 (Brunsch et al., 2011). There are eleven (11) springs distributed from the northern to southern parts of the district (Figures 1 and 2). Geologically, Playen belongs to the formation of tertiary limestones and quaternary carbonate sediments (Kusumayudha et al., 2000). The majority of its area is included in the Panggang Hydrogeological Subsystem (Kusumayudha, 2009).

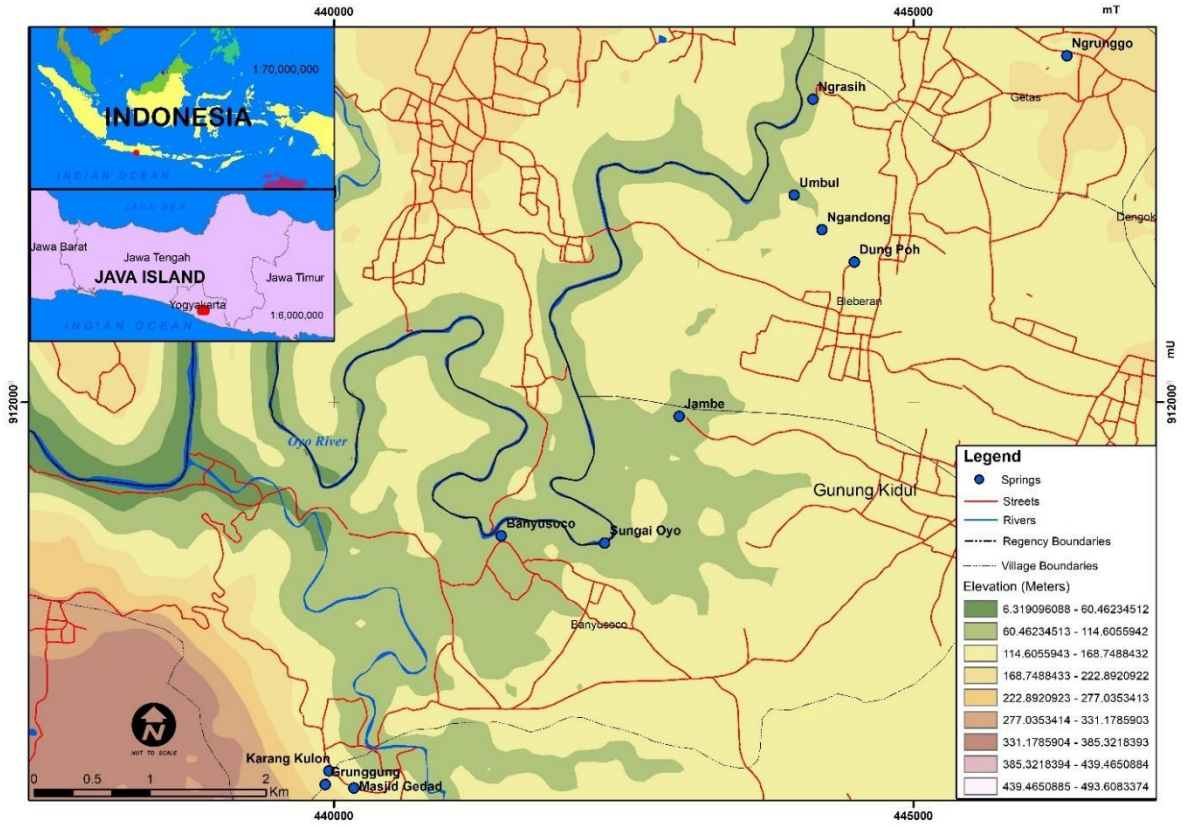

Figure 1. Spring Distribution Map of Playen District, Gunungkidul
(Source: Data Analysis, 2019)

B. Methodology

1. Research Design

The research employed in-depth interviews with several key informants, i.e., persons in charge of managing the springs, to collect detailed and thorough information (Brounéus, 2011). At the time of the research, springs in blocks 1, 2, 3, and 4 were managed by Mr. Iksan, Mr. Damanhadi, Mr. Marjoni, and Mr. Wiyanto, respectively.

2. *Instruments*

The research tools included GPS (to pinpoint the location of the springs), tape recorder (to record all interview activities), camera (to document field survey), ArcGIS program (to map the distribution of the springs), and books and scientific journals as reference materials.

Figure 2. Springs in Playen District: A (Banyusoco), B (Grunggung), C (Umbul), D (Ngandong), E (Gedad), F (Dung Poh), G (Jambe), H (Karangkulon), I (Ngrunggo), J (Ngrasih), and K (Sungai Oyo) (Source: Field Survey, 2018).

3. *Technique of Data Analysis*

The results of the in-depth interviews were analyzed by a qualitative descriptive approach and then supported by a literature study that reviewed scientific publications. The analysis was focused on changes in spring management from traditional to modern and the existence of local wisdom at every block of spring. Furthermore, the physical conditions of the springs were examined qualitatively from the results of the in-depth interview.

C. Findings and Discussion

1. Findings

Playen District has eleven (11) springs with four (4) different blocks of management systems (Table 1). Block 1, which is in the south, consists of Gedad, Grunggung, and Karangkulon Springs. Block 2 includes Banyusoco and Sungai Oyo Springs, while Block 3 is composed of Dung Poh, Nganding, Umbul, and Jambe Springs. In the north, Block 4 encompasses Ngrunggo and Ngrasih Springs. Measurement in the field revealed that in the dry season, Sungai Oyo Spring produced the highest discharge, 163.90 L/s, whereas Ngandong had the lowest, 1.50 L/s. Meanwhile, in the rainy season, Grunggung released the highest water quantity, 415.1 L/s, and Dung Poh had the lowest, 6.5 L/s (Table 1). Based on the classification introduced by Todd and Mays (2005), eight of the eleven gravity springs are solution tubular, which is the result of the solution process taking place in limestones, and the other three are contact springs formed in the transition between Gunungsewu karst hills and Wonosari Basin. The solution tubular springs are Banyusoco, Grunggung, Gedad, Dung Poh, Karangkulon, Ngrunggo, Ngrasih, and Sungai Oyo Springs, while the contact springs include Umbul, Ngandong, and Jambe.

Gedad and Grunggung Springs (block 1) are murky during the rainy season because they are connected to ponors. The level of turbidity in Grunggung Spring is consistent with the Total Dissolved Solids (TDS), which increases as water level rises (Widyastuti et al., 2017). The connection between both springs and a ponor is based on the information provided by residents who conducted a tracer test using rice husks and tried to block the ponor, causing both springs to dry up. Meanwhile, Karangkulon Spring is not turbid during rain events because it is not connected to ponors. Despite the low resurgence in dry seasons, Gedad, Grunggung, and Karangkulon Springs can still meet the water needs of the local people. The interview results showed that the quality and quantity of the three springs were reliable and consistent because their natural physical conditions were preserved.

Table 1. Spring Discharge and Location in Playen District, Gunungkidul Regency

No.	Springs	Sub-villages	Villages	Subtypes of Gravity Springs	Measured Discharge (dry season, in L/s)	Measured Discharge (rainy season, in L/s)
1	Banyusoco	Banyusoco	Banyusoco	Solution Tubular	70.7	193.2
2	Sungai Oyo	Kentangi	Banyusoco	Solution Tubular	163.09	-
3	Grunggung	Gedad	Banyusoco	Solution Tubular	15.7	415.1
4	Karangkulon	Klepu	Banyusoco	Solution Tubular	20.42	-
5	Masjid Gedad	Gedad	Banyusoco	Solution Tubular	-	-
6	Ngrasih	Gubukrubuh	Getas	Solution Tubular	12.8	57.7
7	Ngrunggo	Ngrunggo	Getas	Solution Tubular	-	-
8	Jambe	Menggoran 1	Bleberan	Contact	49.4	197.2
9	Umbul	Menggoran 2	Bleberan	Contact	74	-
10	Ngandong	Menggoran 2	Bleberan	Contact	1.50	50.6
11	Dung Poh	Menggoran 2	Bleberan	Solution Tubular	4.7	6.5

Source: Field survey and Widiyastuti and Widyastuti (2018) with modifications

Gedad and Grunggung Springs (block 1) are murky during the rainy season because they are connected to ponors. The level of turbidity in Grunggung Spring is consistent with the Total Dissolved Solids (TDS), which increases as water level rises (Widyastuti et al., 2017). The connection between both springs and a ponor is based on the information provided by residents who conducted a tracer test using rice husks and tried to block the ponor, causing both springs to dry up. Meanwhile, Karangkulon Spring is not turbid during rain events because it is not connected to ponors. Despite the low resurgence in dry seasons, Gedad, Grunggung, and Karangkulon Springs can still meet the water needs of the local people. The interview results showed that the quality and quantity of the three springs were reliable and consistent because their natural physical conditions were preserved.

The local people believe that Grunggung Spring emerged when a person with divine power used a simple tool to dig stones until the water appeared. Grunggung was found because there were sounds of rapid water flows coming from inside the rock after heavy rain or called *ngrunggung*, from which the name of this spring was derived. Meanwhile, Gedad is believed as a naturally appearing spring. The local community still believes in the message left by the ancestors, that is, not to usurp the use of both springs. Current spring management has been somewhat modernized using pipelines that connect 100 households, which deliver their financial contributions only when the equipment is damaged and needs reparation. Instead of a pumping system, water distribution from springs in block 1 relies on gravity. The tradition of laying offerings at this block has been abandoned, and the remaining local wisdom is a custom to clean the village, including the springs, together as part of mutual aids.

Physically, Banyusoco and Sungai Oyo (block 2) appear to be murky during rainfall because these springs are connected to swallow holes. This connection was found during a simple tracer test that the villagers had carried out, in which rice husks were poured into the swallow hole and reportedly appeared at suspected springs. Based on the interview results, the discharge of Banyusoco and Sungai Oyo Springs in dry seasons can still meet the need of the surrounding population. Also, their water quality and quantity are still reliable and have no significant seasonal changes because their natural conditions are well maintained.

The local community applies a modernized technique of water utilization at Banyusoco and Sungai Oyo Springs. There are community groups responsible for managing the distribution of water from the two sources to residential areas using pumps and pipelines. Initially, 13 houses participated in the installation in 2006, and today, this number has grown to 323 houses (Figure 3). The installation costs IDR 1,200,000, and the residents are obligated to pay IDR 2,500/m^3

per month (maximum daily extraction= 10 m^3) for the amount of water they have used. This financial contribution is deemed lower than the cost of a jerry can or tank of water.

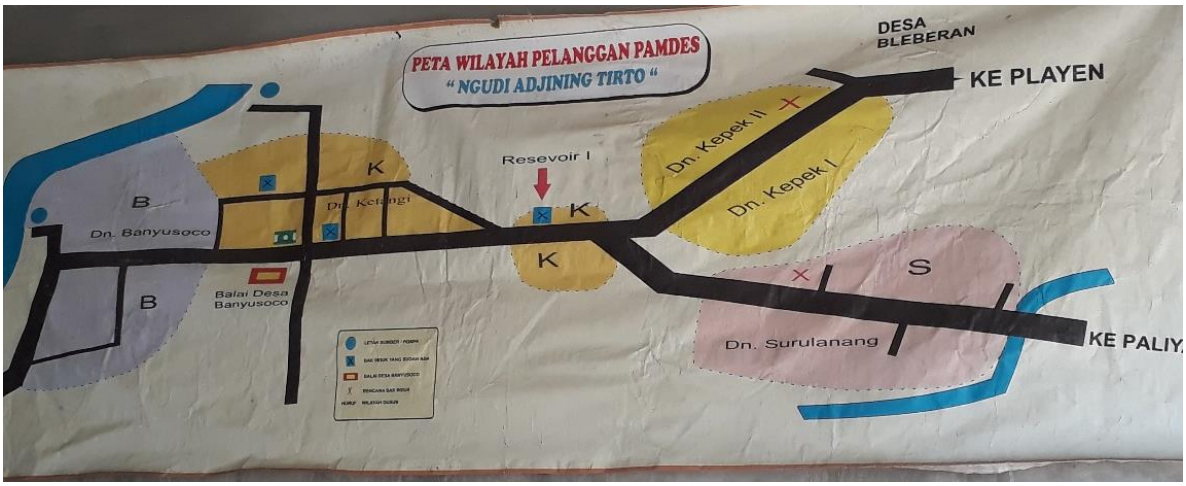

Figure 3. Water Pipelines Map from Springs in Block 1

This contemporary water distribution management does not instantaneously change the local belief in long-standing myths, for example, placing offerings on the edge of the river at certain times or restrictions on activities at and around Banyusoco Spring. The local people have started to abandon some of the myths because, nowadays, they rarely come directly to springs or rivers to meet their water demands. In the past, offerings consisting of raw eggs, cooked eggs, and rice were placed during special celebratory occasions. Moreover, certain types of swamp eels were not to be disturbed or consumed because they were considered as the incarnation of supernatural beings that dwelt in the springs. There was also an old belief that mythical red dogs guarded the springs. At Banyusoco and Sungai Oyo, there are myths that people are prohibited from uttering profanity, bathing naked, and taking or picking banyan branches and leaves. With the existence of these myths, waste disposal to the springs and careless tree logging are forbidden, leading to maintained cleanliness and sustainability.

Physically, rainfall does not cause Umbul, Ngandong, Dung Poh, and Jambe Springs (block 3) muddy because they are not connected to swallow holes. Even in dry seasons, these springs can still provide a sufficient amount of water to the surrounding communities. The interview results showed that their water quality and quantity were reliable and consistent because their natural physical conditions were well maintained.

In 1992, spring management and spring water distribution program using diesel-powered pumps were initiated to facilitate the community that had to walk as far as 1-1.5 km to fetch water (Figure 4). At first, water was collected manually with jerry cans. When electricity was introduced to the village in 2001, water was no longer extracted manually but with an oil-fueled engine and water pump. The four springs can currently supply water for 415 houses, as well as agricultural practices. The water distribution installation is estimated at IDR 1,000,000, and the cost incurred per cubic meter of water is IDR 2,500.

Figure 4. Interviews in Block 3 (left) and the Office of Water Management in Block 3 (right)

Legends surrounding the emergence of springs were originated in the arrival of several people with divine power who asked for water but were given used one instead because freshwater was scarce. Afterward, they prayed that drought would strike the village and that no water sources would be available for its residents. Until now, water is rarely found in this village (part of Wonosari Basin and the undeveloped karst area). The story continued to the neighboring village, where the people believed to have divine power asked for water, and despite the drought, the villagers gave them a fresh one. Then, they prayed that the villagers would be blessed with water sources, and almost immediately, many springs emerged. Today, these springs are found abundantly in parts of Gunungsewu karst hills, especially Goa Rancang—i.e., one of the sources of the spring water.

The local people still maintain the tradition as an expression of their gratitude for the existence of springs as a source of water that they can withdraw every day by, for example, praying and cleaning the environment together as a community even though these practices are not carried out routinely with a fixed schedule. Offerings were found occasionally long before the machinery technology to extract the spring water was adopted. Several myths that prohibit polluting springs and cutting down trees carelessly persist; however, not for their sanctity but capacity to help preserve the springs instead.

Ngrasih and Ngeleng Springs (block 4) have different physical characteristics. Ngrasih can be utilized in rainy seasons because it is not connected to swallow holes and, therefore, the water is clear. As for the water at Ngeleng, it can only be used in dry seasons because this spring is connected to swallow holes, due to which the water is murky after rain events. The interview results showed that their water quality and quantity were reliable and consistent even during dry seasons because their natural physical conditions were well kept (Figure 5). In block 4, a pumping system is used to extract spring water and distribute it to 728 households. The water distribution installation costs IDR 1,000,000, with varying monthly levies starting from IDR 2,500 (1-10 m^3), IDR 3,000 (11-20 m^3), and up to IDR 3,500 (21-30 m^3).

The adoption of pumps for water extraction does not necessarily mean the disappearance of local beliefs and traditions, such as *kenduren* (a banquet for expressing gratitude and requesting blessing), restrictions in cutting down banyan trees and capturing fish carelessly, and offerings placed at Ngeleng Spring. *Kenduren* is even carried out every year on a particular day or month determined according to the local calendar calculation. At the same time, offerings are generally placed on roadsides during celebratory ceremonies as an attempt to deflect any disturbances. On the contrary, the local people around Ngrasih Spring have abandoned some of the particular restrictions and rituals found at Ngeleng. There used to be a tradition of making offerings during a celebratory event in the village and a myth that cutting down banyan trees around this spring would anger its supernatural guardians. Nowadays, the local people still believe that polluting the spring can lead to possession by its guardians and that, for Ngeleng and Ngrasih Springs, placing offerings during *rasul* (cleaning activities in the village) is necessary. These springs are deemed connected to the Majapahit Kingdom and were inherited from the ancient guardians.

Figure 5. Interviews in Block 4

2. Discussion

There are similarities between the local wisdom patterns in Playen District (Gunungkidul Regency) and Kulon Progo Regency, i.e., celebratory ceremonies to express gratitude and cleaning activities at and around the springs, which are potentially the leading cause of these springs' sustainability (Sudarmadji et al., 2017). Furthermore, the spring management pattern in Playen is similar to other districts in Gunungkidul Regency—especially in three physiographic units: Baturagung, Wonosari Basin, and Karst Hills—in a way that the management task is assigned to a community group for an effective and well-structured operation (Sudarmadji et al., 2011). Through this system, karst spring management has exhibited significant improvements from only one individual who mobilized her/his surroundings to a group of people creating innovations to alleviate local water scarcity issues. This type of mobilization is common in rural communities: if one person proves that a strategy is effective or successful, then the others will follow (Xu et al., 2017). Local wisdom can make people comply with applicable regulations because it also includes consequences to disobedience (Sumarni, 2014). An example includes preserving springs by not contaminating them, cutting down the surrounding trees, and cleaning them together as a community due to fears of possible ramifications. Another purpose of local wisdom is to conserve the environment because it is the product of local observation of specific natural phenomena that has been translated into rules or prohibitions (Retnowati et al., 2014). Accordingly, Playen District has jointly incorporated local wisdom and technology into its spring management. This process has a substantial impact on the population of a region (Dahliani et al., 2015). In the district, significant progress is marked by the higher number of households that withdraw water from the piping system and the disuse of direct manual water extraction at the springs. Besides, water management is highly reliable in that the entire community can now access water easily and fulfill their needs even during dry seasons.

D. Conclusion

The population of Playen District still relies on local wisdom to manage its springs. Nevertheless, the local wisdom-based spring management has been integrated with water distribution technology, that is, pumping systems. Such a combination significantly contributes to not only the availability of a sufficient amount of water during dry seasons but also drought prevention.

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