

GROUNDWATER POTENTIAL AND THREATS IN KARST TOPOGRAPHY, PONJONG DISTRICT, GUNUNG KIDUL INDONESIA

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ABSTRACT: Indonesia has many karst landscapes, even reaching an area of 15.4 million hectares spread over the islands of Sumatra, Java, Papua, and other small islands. For the island of Java, the famous karst areas include; Gunung Kidul, which is divided into three zones in terms of physiography and development, namely; the North zone which is in the Batur Agung area; the Central zone is located in the Ledok Wonosari area, and the last is the South zone which is in Gunung Sewu. In general, karst areas have different characteristics from other landscape areas, where karst areas are identical to dry and arid land, as well as hydrology that is underground and there is no surface flow. Water resources are one of the essential elements in the activities of living things. Its existence is expected to support daily human activities. The karst landscape of Gunung Kidul in the province of the Special Region of Yogyakarta is a well-known karst area in Indonesia, one of which is located in the Ponjong sub-district, which is flanked by three development zones. This makes the karst landform in the Ponjong sub-district quite unique because it consists of karst land and non-karst land as well as most of the potential water sources which include; springs, lakes, rivers, and wells that can be used to fulfill the domestic needs of residents around the karst area, as well as the potential for ecotourism. Even so, there is a risk for the Ponjong karst area, namely the vulnerability of groundwater pollution by natural and human activities. This makes the government and the surrounding community require efforts to conserve the Ponjong karst area in utilizing its potential so that there is no excessive damage to the karst area.

Keywords: Karst, Gunung Kidul, Ponjong, characteristics, groundwater, vulnerability.



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1. INTRODUCTION

Indonesia is an archipelago country that has various forms of landscapes, phenomena, and regions, one of which is the karst landscape. Karst is a German term derived from the Slovenian "Kras" which means an arid and rocky area. The term is then indicated in the condition of an area that has easily soluble rocks. In general, karst areas have the characteristics of steep slopes, there are large closed basins, the rock consists of limestone (limestone), there are caves, and underground flow systems [1-4].

Karst landscape is a landscape that occurs due to the process of karstification, which is a process of dissolving carbonate rock (CaCO_3) by rainwater over a long period of time, this phenomenon is what makes the karst area a unique area. Apart from being unique in its arid and dry landforms, karst areas also have various potential resources in them, such as the presence

of underground water flow and the absence of surface runoff. Groundwater is a vital component of life. Groundwater has various important roles such as the main source of freshwater for domestic needs, supporting factors for the fertility of crops, industrial needs, and supporting the needs of other living things in the karst ecosystem. This special feature is known as karst geohydrology. Karst geohydrology has boundaries regarding groundwater availability, namely aquifers, aquifers, and aquitards [5-7].

The rate of development of karst aquifers affects the discharge characteristics of groundwater recharge. A karst aquifer with a high karstification rate will have a fast water discharge system. On the other hand, karst aquifers with a low degree of karstification will be dominated by the type of diffuse flow and slow discharge system. However, recently, karst areas have also often faced threats in the form of damage to their

ecosystems due to management that does not pay attention to environmental sustainability.

The lack of public knowledge or information related to karst areas causes a collision between economic interests and environmental conservation [8-9]. The karst area on the one hand has a diversity of potentials and abundant resources, but on the other hand, it is very vulnerable to the risk of environmental damage.

For example, in Ponjong District, Gunung Kidul Regency, which is one of the famous karst areas in Indonesia, which is located on the island of Java, the province of the Special Region of Yogyakarta. Karst which has developed rapidly in the Ponjong District, Gunung Kidul also has a high risk of threats, such as vulnerability to groundwater pollution. This threat has something to do with the special characteristics that only karst aquifer systems have that can produce a vulnerability status that tends to be high, both in terms of quantity and quality of water. Karst aquifer systems are much more prone to contamination when compared to non-karst aquifer systems. The ease with which contaminants enter and mix into the karst aquifer system is influenced by the permeability of the karst aquifer which tends to be high due to secondary porosity with fracture or diaclose pattern [10-11].

2. RESEARCH METHOD

This study applies the Systematic Literature Review (SLR) method or what is commonly referred to as a literature study. From several research articles, this research is motivated by the potential of groundwater and its threats in the karst topography in Ponjong District, Gunung Kidul. The reviewer suspects that various aspects could trigger this, including the fact that Ponjong District is located in a strategic area flanked by the three development zones. So that the area has a characteristic slice of the three regional zones in the form of a diversity of karst and non-karst morphology, such as dolines, karst hills, caves, and underground rivers. There are several things that must be observed when viewed from the importance of water sources in the area being studied, including finding out the level of sensitivity to the entry of contaminated substances into groundwater which acts as a source of water for the community in the area.

In addition to utilizing the hydrology of the karst area, local residents also take advantage of the potential of the region as a tourist destination. Although the potential for groundwater benefits the community, there are also threats to the karst

topography. To answer the formulation of the problem, the principle of interrelation is used to the potential of groundwater and its threat to karst topography, the problem of vulnerability to contamination of groundwater resources. This is due to the nature of karst aquifers which are much more easily polluted than non-karst aquifers. Determination of the sensitivity level in an area is needed to form guidelines for taking preventive measures to maintain the quality of karst groundwater in Ponjong District.

This article intends to find out the potential of groundwater and its threats in the karst topography in Ponjong District, Gunung Kidul which has the principle of interrelation between groundwater problems and the threat of karst topography.

3. RESULT AND DISCUSSION

3.1. Karst in Gunung Kidul

Gunung Kidul Regency is one of many regencies in Indonesia which is famous for its many karst areas, even 60% of its area is dominated by karst landscapes. Based on the topography of Gunung Kidul Regency, it is divided into three zones that are specifically developed, namely the North Zone called the Batur Agung area with an altitude of 200-700 meters above sea level and the condition of the area is hilly, as well as the presence of groundwater flows that intensity approximately 6m-12m from ground level. Its territory includes districts Ngawen, Nglipar, Gedangsari, Semin, Patuk, and northern districts of Ponjong.



Fig 1. Nglaggeran Volcano in Batur Agung

The Central Zone is called the Ledok Wonosari area, which has an altitude of approximately 150-200 meters above sea level which is marked as a transitional location between the Wonosari Ledok (basin) and the karst hills area. And most of the area is also filled with red mediterranean soil and black grumosols, so that when a long dry season arrives, the

existing water element can survive. This middle zone area includes Wonosari, Playen, Karangmojo, and Ponjong Tengah sub-districts.

Then the last is the Southern zone called Gunung Sewu, the karst area of Mount Sewu has a unique landscape, characterized by the presence of phenomena on the surface (exokarst) and subsurface phenomena (endokarst). The exokarst phenomenon is indicated by the presence of conical hills that have an area elevation of 0-300 meters above sea level and dolines. An example of an exokarst is Baked karst. And examples of endokarst include a variety of underground rivers, the southern region includes the districts of Purwosari, Paliyan, Tanjungsari, Panggang and South Ponjong.

3.2. Karst in Ponjong sub-district

Ponjong Sub-District is located in a strategic area flanked by three development zones. So that the area has a characteristic of the three regional zones in the form of a diversity of karst and non-karst morphology, such as dolines, karst hills, caves, and underground rivers.

In Ponjong sub-district there is also a polje which is manifested by fault movements, and this results in variations in the appearance of water due to the presence of an underground river on the slopes of the karst hills. And also in this area has a potential groundwater aquifer pattern. Aquifer karst is the best spring in most countries in the world, Aquifer karst is very essential in an area that has limited spring resources for a certain time [5].

Based on the location of the area and the varying morphological conditions, Karst Ponjong is divided into four regions, namely the northern, eastern, central, and southern parts. These four parts of the area are used to facilitate the identification of characteristics and potentials in Ponjong District to be developed. Judging from the physical potential in terms of geomorphology and hydrology, the northern part of Ponjong is characterized by an area that acts as a permanent groundwater storage area in the form of lakes, underground lakes, or underground rivers that are useful for meeting human needs.

While in the Central part of Ponjong, it is characterized by a karst landscape consisting of Polje and small hills, also a rainwater catchment area. For the eastern region, it is characterized by hilly terrain with a dome type and a lake with a bowl type. From the different characteristics in each part of the sub-district, there is one thing in common, namely the existence of a karst lake and

a karst hydrological area. Groundwater in the lake or above the surface can be used by Local residents in various fields, including the domestic (local) sector, such as drinking water, bathing, washing, latrines, (MCK), irrigation for irrigating agricultural land, and used for fish ponds, and used by several small industries.

In addition to utilizing the hydrology of the karst area, local residents also take advantage of the potential of their region as a tourist destination, as is the case with people living in the northern, eastern and southern regions, which tend to be traditional and have a lot of historical value.

3.3. Threats in Karst Ponjong

However, there is one thing that poses a threat to the surrounding community in utilizing karst groundwater in Ponjong District, namely the problem of vulnerability to contamination of groundwater resources. This is due to the nature of karst aquifers which are much more easily polluted than non-karst aquifers. Contaminants from the surface can enter in a simple way into karst groundwater due to the high permeability of the karst aquifer due to the secondary porosity process in the form of cracks, then surface water seeps into the soil and rock through cracks, joints and cavities that dissolve and dissolve. often accelerated by the media of lakes or dolines and valleys, which in some areas of Ponjong District only have a very thin layer of soil cover, moreover almost none. As a result, there is a decomposition of contaminants that have been carried out by microorganisms through chemical and physical processes, which usually occur efficiently in the soil zone which makes the soil very weak in the karst region [12].

The level of vulnerability of karst groundwater is also closely related to the conservation of water catchment areas. Determination of the direction of conservation of the catchment area can also be based on signs of vulnerability to pollution located in the area. Variations in land use in an area can be one of the elements determining the level of sensitivity or vulnerability.

Therefore, determining the level of vulnerability to an area is fundamental to be realized as a guide in carrying out preventive efforts to maintain the resilience of karst groundwater quality in Ponjong District. This groundwater vulnerability study contains advice and information in determining policies and regulations regarding the protection of

groundwater and surface water sources in the Ponjong karst area, especially in planning for disaster mitigation caused by the contamination of groundwater flows in this area.

Based on the results of a study [12] using a groundwater sensitivity map can accommodate local governments in an area to plan appropriate effective actions and to determine rational land use planning in an area. This groundwater vulnerability map is the main basis and benchmark in preparing for sustainable development that reduces the potential for groundwater contamination by human activities and by nature itself.

4. CONCLUSION

There are many types of karst areas in the Gunung Kidul area, one of which is in Ponjong District. The karst landscape in the Ponjong area is quite unique, this is because Ponjong District is located between the three physiographic and development zones in Gunung Kidul, causing the Ponjong karst area to have various potentials. The main characteristics of this karst area are the many reliefs and karst hydrological systems that facilitate the life of the local community. And this makes the Karst Ponjong area a tourist destination by the local community. However, apart from having great potential to be managed, the Ponjong Karst area also has a large risk threat in the form of vulnerability to groundwater pollution. Therefore, caution is needed in its use and cooperation from various parties is needed to maintain its sustainability.

5. REFERENCES

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