

## THE ENVIRONMENTAL INFLUENCE IN SELECTING WONOSARI BASIN AS SETTLEMENT IN EARLY HISTORY PERIOD

### PENGARUH LINGKUNGAN DALAM PEMILIHAN CEKUNGAN WONOSARI SEBAGAI HUNIAN PADA MASA AWAL SEJARAH

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#### ABSTRAK

Cekungan Wonosari merupakan bentuk lahan dataran tinggi yang dihuni oleh manusia secara berkelanjutan. Kajian ini bertujuan untuk mengungkap faktor lingkungan yang dipertimbangkan oleh manusia di Cekungan Wonosari pada masa proto-sejarah hingga masa hindu-buddha. Data yang digunakan berupa sebaran situs masa proto-sejarah dan Hindu - Buddha di Cekungan Wonosari. Analisis dilakukan secara spasial dengan cara melakukan *overlay* antara peta sebaran situs dengan variabel lingkungan berupa sumber daya air, lereng, jenis tanah, dan batuan. Hasil dari kajian menggambarkan bahwa Cekungan Wonosari dipilih menjadi lokasi hunian karena memiliki potensi air yang lebih besar dibanding bentuk lahan lain di Kawasan Gunung Sewu. Selain itu, Cekungan Wonosari memiliki area datar yang luas sehingga mempermudah aksesibilitas untuk pemanfaatan sumber daya alam.

**Kata Kunci:** Wonosari; lingkungan; spasial; hunian

#### ABSTRACT

Wonosari Basin is a plateau area and has been inhabited by humans continuously. This research goal is to determine the environmental factors that considered by humans to settle in Wonosari Basin in proto-history until Hindu-Buddhist period. Data used in this study are proto-history and Hindu-Buddhist sites distribution in Wonosari Basin. Analysis is conducted by spatial approach through map overlaying between sites distribution and environmental variable such as water source, slope, soil, and rock formation. This study shows that Wonosari Basin has been selected by human to settle because it has greater water source compared to other landform area in Gunung Sewu. In addition, Wonosari Basin has large flat area which simplify accessibility to utilize natural resource.

**Keywords:** Wonosari; environment; spatial; settlement

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## INTRODUCTION

Wonosari Basin is a plateau formed through the process of lifting and folding during the Middle Pleistocene (Damayanti, 2015). This area is a part of the Gunung Sewu area which has been resided by humans for a long time. The occupancy of the Wonosari Basin began to develop significantly during the proto-historical period. It is shown by the presence of archaeological remains such as megalithic statues and stone graves in several sites, including Sokoliman Site, Gondang Site, Gunungbang Site, and Bleberan Site. The continuity of human living in the Wonosari Basin can be seen from the archaeological remains of the Hindu-Buddhist period, such as temples and inscriptions.

The existence of cultural relics from the proto-historical and the Hindu - Buddhist periods shows the continuity of occupancy as well as cultural changes in the Wonosari Basin. It illustrates the existence of an adaptation process of the humans or communities to the local environment (Haviland, 1993, pp. 250-251). The process of human adaptation to the environment also has an impact on changing cultural systems, especially in the emergence of aspects of community organization and belief systems (Sharer and Ashmore, 2003, p. 82).

Humans, in occupying space, always adapt to the environment where they live. The process of human adaptation to the environment is reflected in the existence of archaeological sites and relics they produced. Archaeological remains are a form or result of human ideas that reflect behavior, adaptation processes, and how humans interact with the environment. The adaptation process carried out by the community in an area also affects the emergence of a distinctive cultural character (Steward, 1955, p. 36).

The Wonosari Basin has unique conditions. As part of the karst area, the Wonosari Basin is distinguished with limited surface water because this area is dominant with subterranean rivers. Now, it appears that the Wonosari Basin has a limited quantity of surface water and is mostly dependent on the wet season (Haryono, 2017, p. 15). It impacts on the water deficiency problems in the Wonosari Basin, especially during the dry season, affecting the run of human life.

There are significant environmental changes in the Wonosari Basin since proto-historic times. The environment in the Wonosari Basin is estimated to use to have a quite large surface water resources compared to the current one. It is supported by the findings of the remains of fauna teeth, namely *hippopotamus sp.* from the excavation conducted by the Gunungkidul Archaeological Research Team, UGM Archeology Department in Song Bentar (Tim PTKA, 2002). The findings indicate the presence of a large quantity of surface water as a habitat for the fauna. The condition of the Wonosari Basin changes over time. The Wonosari Basin is known for water scarcity due to limited surface water resources (Sudarmadji et al., 2011, p. 44).

The decrease in surface water quantity in the Wonosari Basin is along with the changes in forest vegetation types. A research conducted by Lies Rahayu Wijayanti Faida (Faida et al., 2011, pp. 88-89), points out that there have been three changes in ancient forest types since the prehistoric period to the present. The first forest type covering Gunungkidul is a tropical mountain forest that lasted from 16,894±440BP to 9,296±140BP. The second forest type was the wet tropical type which lasted 9,296±140BP to 1,753±90 BP, and the last forest type is the monsoon

forest type which lasts from 1,753±90BP to the present. Those conditions provide an overview of the significant environmental changes in the Wonosari Basin.

At first glance, the cultural dynamic in the Wonosari Basin seems to follow the changing environment. Over a long period, there have been changes in forest vegetation and lessening of surface water resources. Under these conditions, the Wonosari Basin remains attractive as a residential location, and the cultural dynamics occur over a long period. This study is a preliminary study conducted to reveal the dominant environmental factors in the consideration of choosing the Wonosari Basin as a settlement area.

This paper is a literature review that is conducted by synthesizing some of the results of archaeological and environmental research carried out in the Wonosari Basin. The problem discussed in this study is: "What environmental factors were considered by the community from the proto-historic to the Hindu-Buddhist era in choosing the Wonosari Basin as a residential location?" The purpose of this study is to determine the dominant environmental variables considered by the community in the selection of the Wonosari Basin as a resident during the proto-historical period to the Hindu-Buddhist period.

This research reviews various studies that discuss environmental aspects and archaeological remains from the proto-historical period to the Hindu-Buddhist era in the Wonosari Basin. The research reviews research reports, scientific journals, and books. The history of archaeological research in Gunungsewu has been summarized in J.S.E. Yuwono's master thesis (2013). In his thesis, he explained that the first research in Gunungsewu was carried out in Pacitan by P.V. Stein Callenfels in 1927, followed by G.H.R. von Koenigswald and M.W.F. Tweedie (1935), H. de Terra, P. Teilhard de Chardin, and H.L. Movius (1938), Van Heekeren (1972) (Tanudirjo, 1991; Yuwono, 2013).

Tanudirjo (1991) was examining the Boma-Teleng Site in Pacitan, Widiyanto (1983) examined the stone artifacts of Kali Oyo, and Yuwono (2013) revealed information about the character and cultural processes in the central block of Gunungsewu. The results of the excavation and survey from these researches above were then analyzed by many bachelor students and written as their thesis.

Another notable research team which were also focusing in Gunungkidul are: Pusat Penelitian Arkeologi Nasional/ Puslit Arkenas (The National Research Center of Archaeology) and the National d'Histoire Naturelle (MNHN) Museum in 1990 (Forestier, 2007; Yuwono, 2013), Puslit Arkenas from 1997-2000 (Simanjuntak 2002), Balai Arkeologi Provinsi D.I. Yogyakarta (Regional Agency for Archaeological Research in D.I. Yogyakarta Province) in Song Tritis from 2000-2005 by Widiyanto and Handini (2000), exploration and excavation by the PTKA FIB UGM in 1998-2002 in Gunungkidul (Tim PTKA, 2002), Faculty of Geography, Universitas Gadjah Mada (Postgraduate Grant) in 2005-2006 (Sutikno & Tanudirjo 2005; Sutikno & Tanudirjo 2006).

The first research focusing on historical period of the Gunungkidul area was conducted by J.L. Moens in 1934, then continued by van der Hoop in the same year. Several researchers from Indonesia then continued their research. Sumijati Atmosudiro (1980) was researching the distribution of menhir statues in Gunungkidul. Another study regarding the life of megalithic culture in Gunungkidul is a study conducted by Goenadi Nitihaminoto (1989). This study

discusses the pattern of pottery found in Sokoliman's sarcophagus. This study contains the history of research and excavation findings carried out at the Sokoliman Site and the Bleberan Site.

A study on the distribution of Hindu-Buddhist sites was conducted by Sri Secudina Djatiningsih (1997), with the title "*Pola Persebaran Situs-Situs Kepurbakalaan Klasik di Gunung Kidul*" (Distribution Patterns of Classical Archaeological Sites in Gunung Kidul). The result of her research illustrates that the sites of the Hindu-Buddhist era in the Gunungkidul Regency tend to cluster and approach water resources. Another research which was reviewed is the research by Imam Fauzi (2002) entitled "*Kronologi Penghunian Zona Cekungan Wonosari Gunungkidul berdasarkan Kajian Sebaran*" (Occupancy Chronology of the Wonosari Gunungkidul Basin Zone based on the Distribution Study). This research emphasizes the chronology or time context and period of occupation of the Wonosari Basin from the prehistoric to the Islamic-Colonial period.

Hadmadi's (2012) research on Hindu-Buddhist archaeological remains in the Wonosari Basin is entitled "*Potensi Kepurbakalaan Klasik di Zona Cekungan Wonosari (Tinjauan Atas Kesesuaian Jenis Tanah Berdasarkan Silpasastra dan Silpaprakasa serta Strategi Pengelolaannya)*" (Classic Archaeological Potentials in the Wonosari Basin Zone (Review of the Suitability of Soil Types Based on Silpasastra and Silpaprakasa and Management Strategies)). The objective of this study was to assess the suitability of soil types in the Wonosari Basin with the types of soil required in Manasara Silpasastra and Silpaprakasa. Furthermore, this study discusses the importance and strategy of preserving Hindu-Buddhist sites in the Wonosari Basin. The study indicates that the type of black grumusol soil in the Wonosari Basin did not fill the requirements for selecting the location of the temple building.

Research which was reviewed to reveal environmental developments in the Wonosari Basin is the research of Truman Simanjuntak (2002) in his book "*Gunung Sewu in Prehistoric Times*". This study provides an initial overview of the environment and culture in the Gunung Sewu area. Another study that was reviewed to get an overview of the history of environmental development was conducted by Faida et al. (2011) with the title "*Rekonstruksi Hutan Purba di Kawasan Karst Gunungsewu*" (Reconstruction of Ancient Forests in the Gunungsewu Karst Area). This study provides an overview of the history of forest change in Gunungkidul.

Based on the above literature reviews, this study to find out the dominant environmental variables considered in the selection of the Wonosari Basin as a residential location. The variables tested included soil, slopes, water resources, and rocks. The paper focuses on the proto-historical period to the Hindu - Buddhist period to determine the form of sustainable adaptation carried out by earlier men.

## METHODS

The paper aims to determine the environmental factors of the occupation in the Wonosari Basin. Environmental variables discussed in this study are slopes, water resources, soil, and rocks. The slope variable is related to the ease of accessibility; the water is a basic human need; the soil is linked to the lands' fertility

for agricultural development, and the rock variable is associated with the availability of the rocks to build sacred buildings or make statues as a medium of worship.

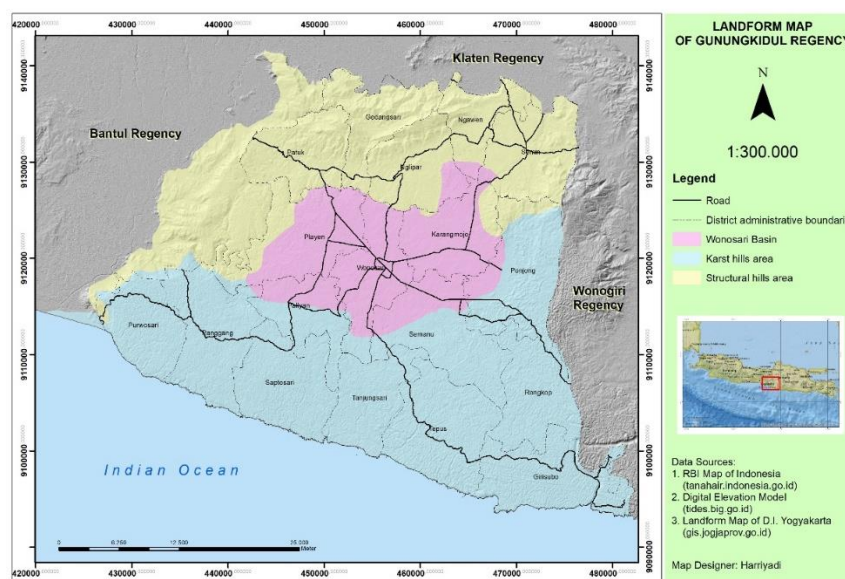
This study approach used is the landscape archaeological approach or researches that emphasizes the relationship between the distribution of archaeological remains landscape and the surrounding environment (Yuwono, 2007, pp. 118-121). The location studied is the Wonosari Basin in Gunungkidul Regency. This study is limited to the proto-historical period marked by sites with megalithic patterns and the Hindu-Buddhist period marked by the presence of temples and inscriptions.

Data were collected and obtained from research reports, site distribution maps, and excavation reports in the Wonosari Basin Area. The site-distribution data were collected to identify the site location in order to facilitate the spatial identification process. Site location data for each period is then discussed in its relationship with environmental variables, namely slopes, water resources, soil, and rocks. The results of the analysis are then elaborated to determine the dominant environmental factors considered by the community in selecting the Wonosari Basin as a residential location.

## RESEARCH RESULTS

### Environmental Conditions in the Wonosari Basin

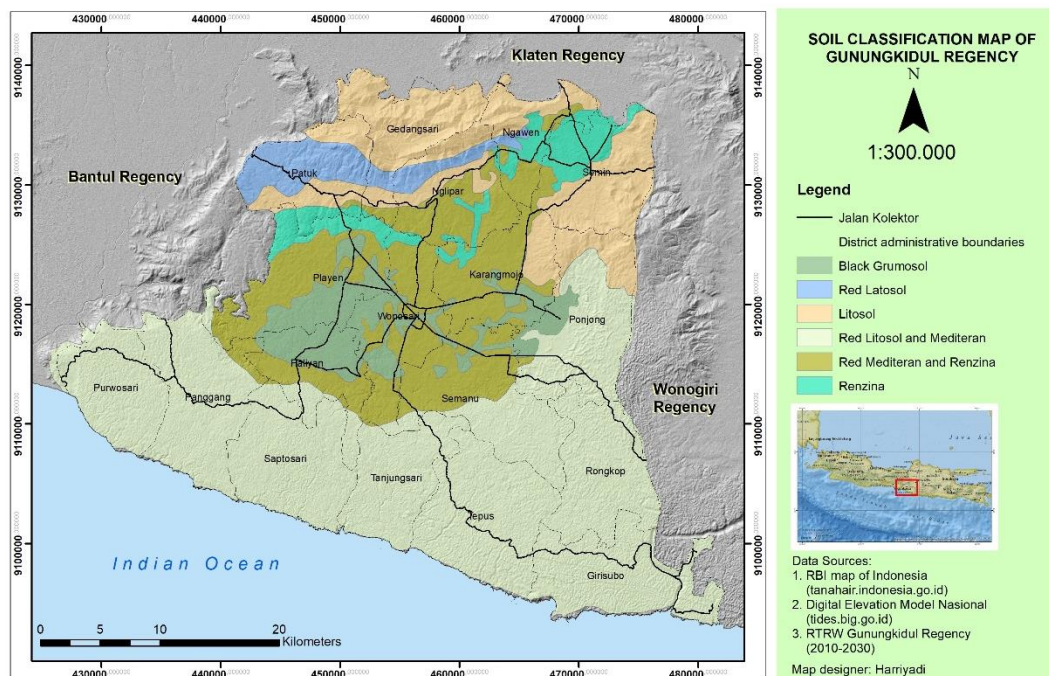
The Basin is located at the Gunungkidul Regency area, D.I. Yogyakarta. The administrative area of the sub-district covers the Districts of Playen, Wonosari, Karangmojo, Semanu, and Ponjong (Pemda Kabupaten Gunungkidul, 2020). This area is one of the areas inhabited by humans for a long time, showing the dynamic culture.



**Figure 1.** Landform Map of Gunungkidul Regency  
(Source: Author's spatial data analysis, 2020)

The Wonosari Basin is surrounded by the Baturagung Hills on the north side and the Gunung Sewu Karst Hills on the south side. The hills of Baturagung have an altitude between 200–700 masl and are dominated by latosol soil. The Karst Hills of Gunung Sewu is conical hills with the basis of their formation being limestone. The Gunung Sewu Karst Hills have an altitude between 0–300 masl and one of its uniqueness is the underground river flow system (Pemda Kabupaten Gunungkidul, 2020). (The official of Gunungkidul Regency, 2020). The Wonosari Basin, which is the focus of the study, is in the middle and has been a residential location until now (Figure 1).

The Wonosari Basin's altitude is between 150–200 masl, with the domination of the association of Mediterranean red soil and rendzina soil, black grumusol, and lithosol (Figure 2). This area is also dominated by limestone as the main material that during the long dry season it can hold water particles. This is evidenced by the existence of a lake in the Wonosari Basin area which is used as a source of water during the dry season. As part of the Karst Area, the Wonosari Basin has surface river flows but it dries up during the dry season. The depth of groundwater in this area reaches 60–120 m (Pemda Kabupaten Gunungkidul, 2020).



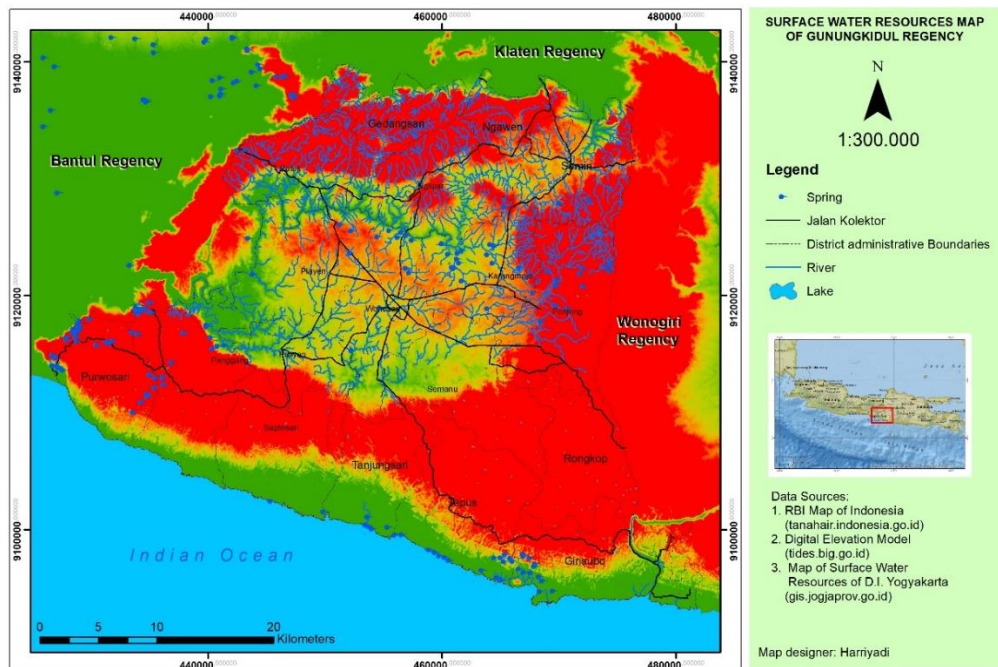
**Figure 2.** Soil Classification Map of Gunungkidul  
(Source: Author's spatial data analysis, 2020)

The existence of water is important for people living in karst environments. Water in the karst area moves through a system of fractures or cave gaps which then forms underground river flow, while several other areas move through the pores between the grains and flow on the ground. The hydrological character of water in the karst area has an impact on more underground river systems and at

least surface rivers (Rahmadi, 2018, pp. 8-9). The lack of surface runoff has an impact on the environment in the karst area which appears to be dry.

The Wonosari Basin is an area that has considerable water potential, compared to the Gunung Sewu Karst Hills and Baturagung Hills. The Wonosari Basin is an area with potential groundwater accumulation. Based on the results of research by Sudarmadji (Sudarmadji et al, 2011, pp. 46-47), the concentration of springs in the Wonosari Basin is on the north side. This is due to the abundant groundwater concentration in the valley area and shallow groundwater level. In contrast, in the southern part of the Wonosari Basin is a sharp drop in the groundwater level, so that springs are rarely found, causing water scarcity problems.

The main surface water resources in the Wonosari Basin are springs, lakes, and seasonal rivers (Figure 3). The Wonosari Basin is a place that has considerable groundwater potential so that many springs are found. The results of the spring survey show that there were 78 springs in Karangmojo District with 46 springs, Ponjong for 19 springs, Paliyan with three springs, and Wonosari for 10 springs. The highest concentration of spring presents is in Karangmojo District and the average spring discharge ranges from 95-1,532,650 m<sup>3</sup>/year (Sudarmadji et al, 2011, pp. 46-47).

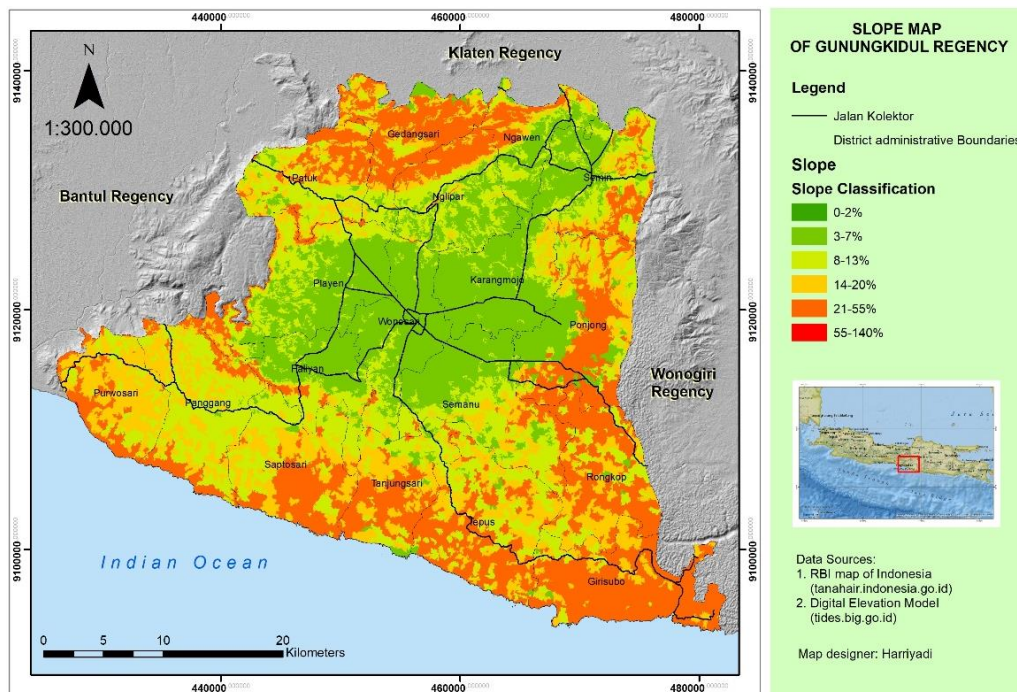


**Figure 3.** Surface Water Resources Map of Gunungkidul  
(Source: Author's spatial data analysis, 2020)

The Wonosari Basin has two river basins (DAS), namely the Opak-Oyo Watershed and the Dengkeng Watershed. The Oyo River and the Beton River have a constant flow throughout the year even though there is a dry season. Other surface water resources that can be utilized as water catchment areas during the rainy season are ponds (Pokja Sanitasi Kabupaten Gunungkidul, 2010, pp. 1-2).

Surface water in the Wonosari Basin, which is the main source for the community today, most likely occurred in the past.

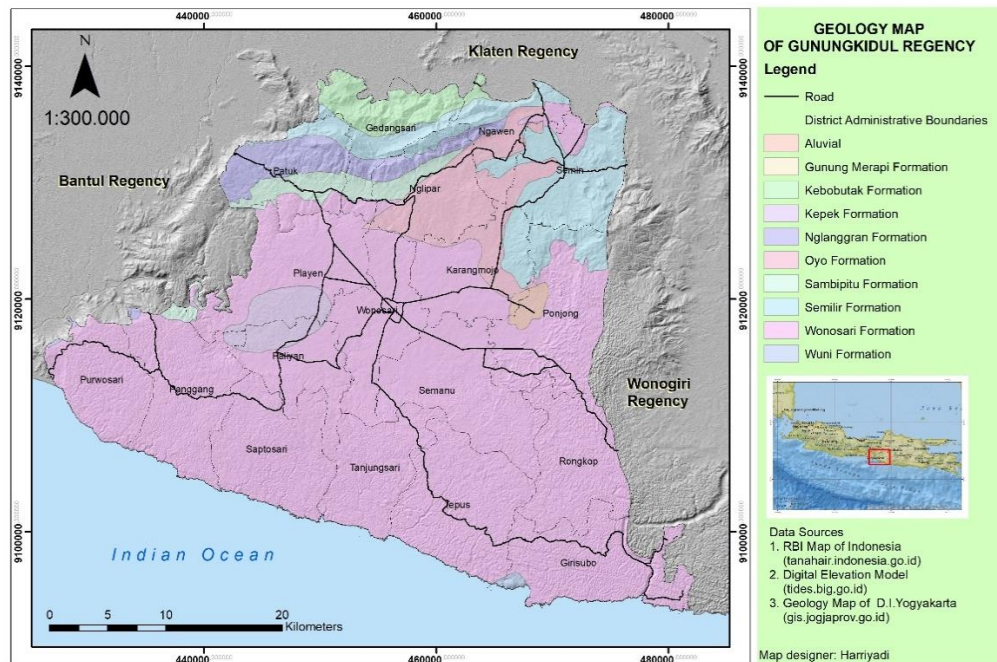
Accessibility in the Wonosari Basin can be said to be slenderer than the Baturagung Hills and Gunung Sewu Karst Hills. The Wonosari Basin has slopes with a slope of between 0–8% (Figure 4) (Pokja Sanitasi Kabupaten Gunungkidul, 2010, pp. 2-3). In the Van Zuidam classification (1985), slopes 0-2% are included in the flat category and 2-7% are included in the gentle slope class. Slopes are certainly an important part of human life in terms of accessibility for movement and utilization of natural resources. The existence of a relatively flat slope facilitates community exploration of the natural resources around it.



**Figure 4.** Zuidam's Slope Categorization in Gunungkidul  
(Source: Author's spatial data analysis, 2020)

Rock resources in the Wonosari Basin cannot be separated from the process of forming an area. The Wonosari Basin is an area formed through a process of lifting and folding (Damayanti, 2015). Most of the Wonosari Basin is dominated by limestone rocks that were formed during the Middle Miocene – Late Miocene (Figure 5) (Surono, 2009, p. 217).





**Figure 5.** Geology Map of Gunungkidul  
(Source: Author's spatial data analysis, 2020)

### ***Archaeological Heritage from the Proto-History to Hindu-Buddhist Period in the Wonosari Basin***

Cultural dynamics in the Wonosari Basin are marked by the emergence of megalithic culture. Several sites have megalithic cultural heritage features in the Wonosari Basin, namely: Sokoliman Site, Gondang Site, Gunungbang Site, and Bleberan Site (Figure 6). Research on megalithic culture in the Wonosari Basin was first carried out by JL Moens in 1934 and continued by Van Der Hoop in 1934. This research excavated stone graves and found 35 human individuals who were buried on top with grave provisions in the form of iron tools. Other artifacts found in the excavation were bronze rings and terracotta bowls (Soejono, 1984; Nitihaminoto, 1989, p. 62).

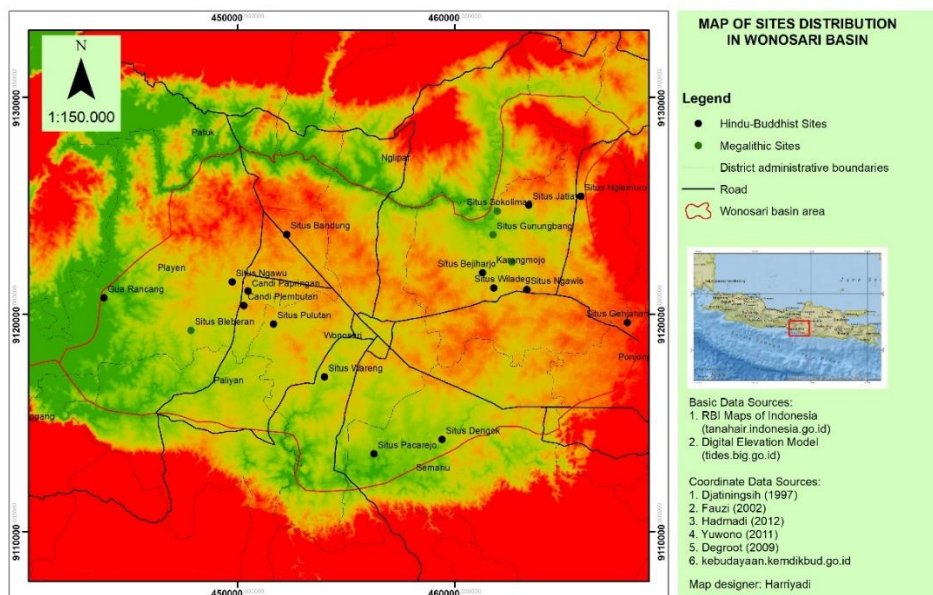
The Bleberan is a site with an excavated megalithic cultural style. The excavation research found three human skeletons in a stacked position, an iron object on top of the frame's chest, copper, iron knives, and beads scattered between the frames (Soejono, 1984; Nitihaminoto, 1989, p. 62). Research on megalithic culture continued to the Archaeological Center's research in 1985 in Sokoliman which found nine human individuals, animal bones consisting of a bull (*Bos*), deer (*Cervus*), and pig (*Sus*), bronze and iron fragments, beads, and pottery fragments (Goenadi dan Sukendar, 1986; Nitihaminoto, 1989, p. 63).

Several menhir statues in Karangmojo and Playen Districts contributes to the development of the megalithic culture in the Wonosari Basin. The first research on menhir statues in Karangmojo found to inventory three statues, one at the Gondang Site and two in Sokoliman. Playen has a number of findings. In the early period of the study, 4 megalithic statues were found. Then, from 1968 to 1980, 11 menhir statues had been found which were then put together at the Sokoliman Site and the Gondang Site (Sukendar, 1971, p. 23; Atmosudiro, 1980, p. 27).

The Wonosari Basin was also a residence during the Hindu - Buddhist era, especially during the Ancient Mataram period. There are several relics from the Hindu - Buddhist era, namely inscriptions, statues, and temples. Inscriptions found in Gunungkidul Regency are the Kandangan Inscription, the Wuatan Tija Inscription found in Nglipar, Wonosari Regency, and the two other inscriptions are without year numbers, namely the Nganjatan I Inscription and the Nganjatan II Inscription.

Broadly speaking, the inscriptions found in Gunungkidul contain the liberation of several villages to become Sima. Several specific things are told, namely: the Wuatan Tija inscription (880 AD) tells of a person, Dyah Bhumiwijaya, who fled to the south, to the sea, and arrived at Wuatan Tija Village. Wuatan Tija village officials then rescued him and escorted him to the king of Bhumi Mataram (Christie, 1999, p. 153; Sarkar, 1971, pp. 250-261), The Kandangan inscription (906 AD) presents Rakryan Wungkal Wirakrama who changed a village to Sima; the building maintenance and the sacredness were done by the community service (Christie, 1999, p. 249). The Nganjatan inscription describes community service due to strong winds that damaged rice fields (Setianingsih, 1996, p. 86).

Archaeological remains of the Hindu-Buddhist era in the form of temples are also found in the Wonosari Basin. The research conducted by Sri Secudina Djatiningsih (1997) identified findings scattered in the Wonosari Basin, namely: Playen District, there are two temples, namely Candi Plembutan and Candi Papringan; Wonosari District, there are two sites, namely the Ngawu and Pulutan Site in the form of ruins; Paliyan District there is a site in Giring Village; Semanu District, there are temple ruins and there are components of Nandi's temple and statue in Pacarejo Village; Karangmojo District, there are temple ruins in Ngawis; Ngawen District has two sites in Watusigar Village and Kampung Village, Semin District there is Candirejo site; Ponjong District has sites in Gejahan Village (Figure 6) (Djatiningsih, 1997, pp. 33-40; Putranto, 2003, p. 226-227).



**Figure 6.** Map of Wonosari Basin  
(Source: Author's spatial data analysis, 2020)

## DISCUSSION

### **The Relationship between the Sites and the Environmental Variables in the Wonosari Basin**

In placing themselves in space, humans consider various environmental variables around them. The consideration intends to facilitate the use of natural resources to support their needs. Nature is a provider of various goods and materials for daily life, so it has a significant share in the consideration of choosing a residential location.

The existence of a site in one space represents the existence of housing and the community. The distribution of sites in an area forms some patterns that can be interpreted as the result of human adaptation. Settlement patterns are the manifestation of the human's understanding of space and their efforts to take advantage of the physical environment following their views and knowledge (Ahimsa-Putra, 1995, p. 10). The site-distributions in an area have a certain pattern and is not random. This means that humans, in choosing a residential location, paid attention to certain environmental factors and general rules that apply in society (Mundardjito, 1995, p. 27).

Humans consider the environment to facilitate the use of resources. In the cultural ecology approach, several environmental factors considered as the most dominant in choosing a settlement location are distance to water, distance to ecotone, elevation, and level of slope (Thomas, 1973, p. 301; Ahimsa-Putra, 1995, p. 15). Those are dominant aspects considered in choosing a residential location. It is believed that these variables were also considered by humans in choosing the Wonosari Basin as a residential location.

The Wonosari Basin as part of a karst area has distinctive environmental characters. The specificity of character environmental appears on the hydrologic system and the process of its formation. The Wonosari Basin is an area that has been used for activities and culture over a long period. Environmental factors in choosing a residential location must be considered by humans from each cultural period. Environmental variables tested in this paper include site location on water resources, slopes, soil types, and rocks. The following are the results of an analysis of the mentioned factors.

### **Water Variables in Proto-Historical and Hindu-Buddhist Periods**

As water is a basic human need, the selection of residential locations always pays attention to the ease of access to water resources. It means that water resources such as springs and rivers should be accessible from the residential area (site). Tests were carried out through spatial measurements by measuring the distance between the site and water resources. Distances are divided into three classes, namely short distances 0-4 km, moderate distances 4-7 km, and long distances >7 km.

The results of the analysis show that three proto-historical sites are nearby and one site is in the medium distance. Measurements were also made between the site and the river, which shows that all proto-historical sites were close to water resources (Tables 1 and 2). The results of the spatial analysis show that the

distribution of megalithic sites in the Wonosari Basin is clustered and approaches water resources.

The results of measuring the distance between Hindu-Buddhist sites and water resources (springs and rivers) show similar things. The measurement results between the distance between the site and the spring show that 13 sites are close to the springs and two are in the moderate distance. The results of measuring the distance between Hindu-Buddhist sites and the river show that all of the sites are in the class of proximity (short distance) to the river (Tables 1 and 2).

**Table 1.** Sites Placement to the Water Resources

No.	Period	Near (0-4 km)	Intermediate (5-7 km)	Far (>7)
1.	<i>Proto-history</i>	Gunugbang Site Sokoliman Site Gondang Site	Bleberan Site	-
2.	<i>Hindu-Buddhist</i>	Ngawu Site Pulutan Site Wareng Temple Plembutan Temple Papripangan Temple Rancang Cave Genjahan Site Bandung Site Ngawis Site Bejiharjo Site Wiladeg Site Jatiayu Site Nglemuru Site	Dengok Site Pacarejo Site	

Source: Author's spatial data analysis, 2020

The result of the analysis above shows that surface water resources affect the choice of a residential location. Similar studies conducted on Hindu-Buddhist sites in Gunungkidul tend to cluster and close to water resources, to fulfill the requirements for selecting the location of a temple (Djatiningasih, 1997). This condition illustrates that the consideration of the ease of accessing water resources from the proto-historical period to the Hindu - Buddhist period, showing sustainability.

**Table 2.** Sites Placement Related to the Water Resources (rivers)

No.	Period	Near (0-4 km)	Intermediate (5-7 km)	Far (>7)
1.	<i>Proto-history</i>	Gunugbang Site Sokoliman Site Gondang Site Bleberan Site		-
2.	<i>Hindu-Buddha</i>	Ngawu Site Pulutan Site Wareng Temple Plembutan Temple Papripangan Temple Rancang Cave Genjahan Site Bandung Site Ngawis Site Bejiharjo Site		

Wiladeg Site  
 Jatiayu Site  
 Nglemuru Site  
 Dengok Site  
 Pacarejo Site

Source: Author's spatial data analysis, 2020

Relatively the sites are partly scattered in the northern part of the Wonosari Basin, where the area has many springs and a network of rivers. It is related to the character of the surface water in the Wonosari Basin, where the northern area of the groundwater level is shallower than the southern part (Sudarmadji et al, 2011, pp. 46-47). The shallow groundwater level affects the number of springs to form river flow which then attracts human attention to inhabit the area. This can be seen from the number of findings in Karangmojo, which is in the northern part of the Wonosari Basin (Figure 7).

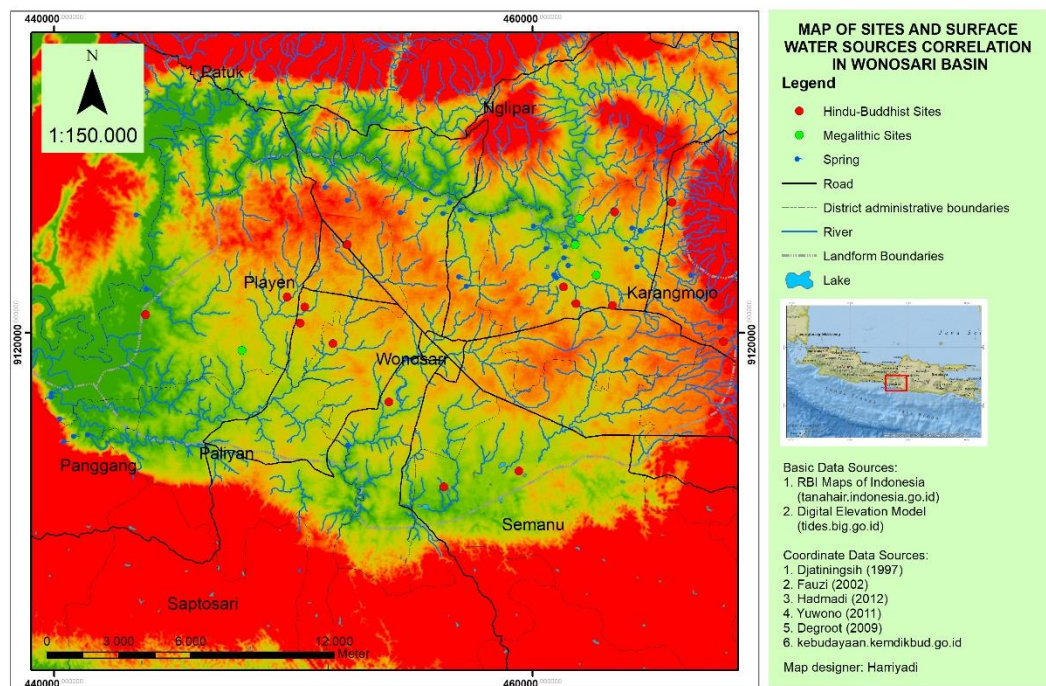


Figure 7. Map of Sites and Water Sources Correlation in Wonosari Basin  
 (Source: Author's spatial data analysis, 2020)

### The Variable of Types of Soil in Proto-History and Hindu-Buddhist Periods

The soil type variables relate to the consideration of whether an area is fertile if it is developed to become a location for agriculture, rice fields, and/or agriculture. Land cultivation products can be used by humans to meet their daily needs. The fertility of the soil is known through the type of soil.

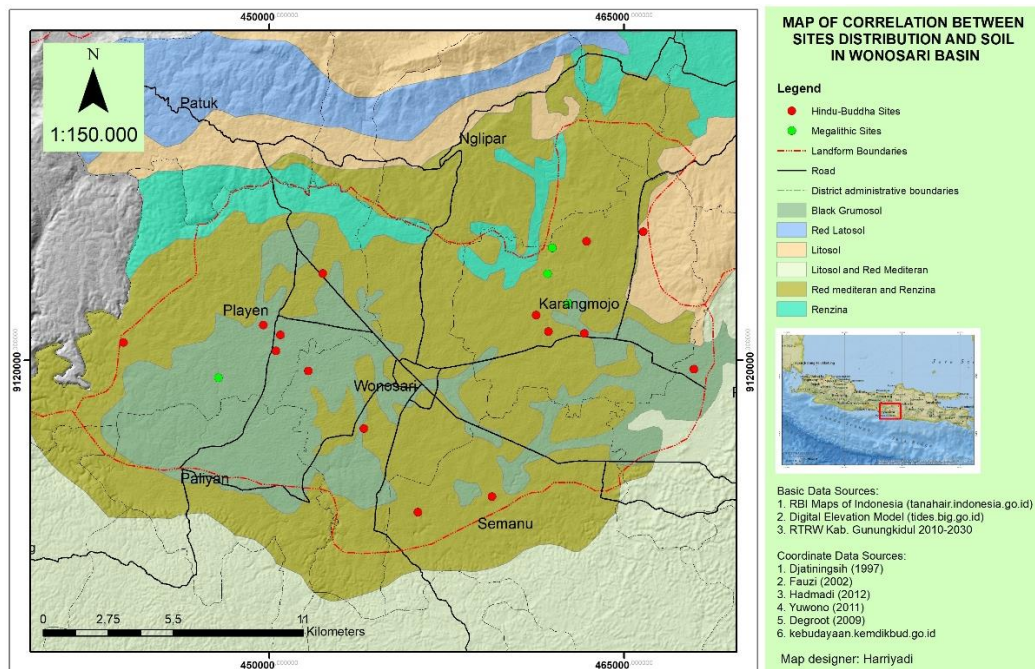
Each type of soil has different characters and levels of fertility. The Wonosari Basin has three types of soil, namely black grumusol, lithosol, and the association of red soil and renzina Mediterranean soil. Based on the overlay between the site distribution map and the soil type map, it shows that sites from the proto-historical and Hindu-Buddhist periods are mostly scattered on soils with

black grumusol types and associations of red and rendzina Mediterranean (Table 3 and Figure 8).

**Table 3.** Sites Placement to the Soil

No.	Period	Black Grumusol	Red Mediteran Associated and Renzina	Latosol
1.	<i>Proto-history</i>	Gondang Site Bleberan Site	Gunugbang Site Sokoliman Site	-
2.	<i>Hindu - Buddha</i>	Rancang Cave Bandung Site Bejiharjo Site Wiladeg Site Jatiayu Site Dengok Site Pacarejo Site	Plembutan Site Papringan Site Ngawu Site Pulutan Site Wareng Site Genjahan Site Ngawis Site	Nglemuru Site

(Source: Author's spatial data analysis, 2020)



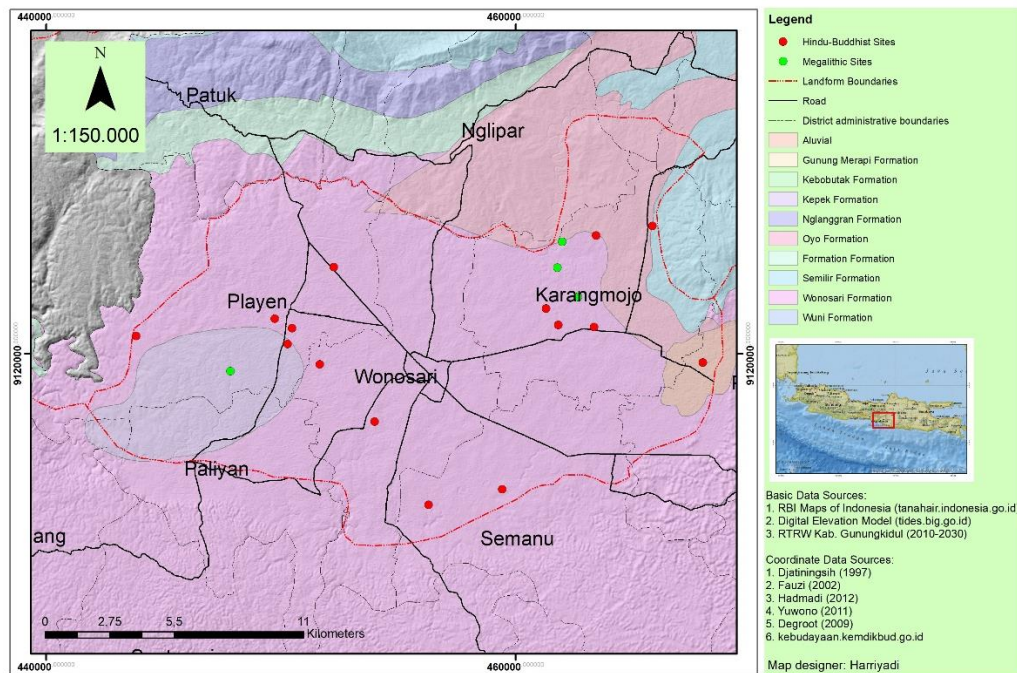
**Figure 8.** Map of Sites and Soil Correlation in Wonosari Basin  
(Source: Author's spatial data analysis, 2020)

Wonosari Basin has mostly black grumusol soil and the association of the red Mediterranean and rendzina. Black grumusol soil is characterized by a lump of clay to heavy clay texture, slow permeability, poor drainage, and low chemical fertility. The fertility rate is not good since it contains clay, so the permeability of the black grumusol tends to be slow. The area containing ground black grumusol can only produce crops with moderate levels, when done processing and fertilizer intensive (Mundardjito, 1993, p. 113) while Land Mediterranean red-productivity which is medium and high so it is suitable for use in developing wet agriculture, rice fields and moor (Hadmadi, 2012, p. 34).

The distribution of sites from the results of the analysis shows that there is even distribution, this indicates that the site location selection does not consider aspects of soil type. This is supported by research conducted by Hadmadi (2012) who concludes that the soil selection followed the *Manasara Silpasastra* and *Silpaprakasa* which require Mediterranean and litosol land. The black grumusol soil where most of the sites are located in infertile land which is not suitable for building temples.

### Rock Variables from the Proto-History and Hindu-Buddhist Periods

Rock resources have been used as hunting tools since prehistoric times, evidenced by the existence of paleolithic and Mesolithic stone as tools. The rocks utilized were derived from the area around the community (Nurani, 2017, p. 14). It seems to have developed until the Hindu-Buddhist era in the Wonosari Basin, seen from the distribution of sites in the Wonosari formation (Table 4 and Figure 9).



**Figure 9.** Map of Sites and Geology Formation Correlation in Wonosari Basin  
(Source: Author's spatial data analysis, 2020)

**Table 4.** Sites Placement Related to the Rock Resources

No.	Period	Kepek Formation	Semilir Formation	Wonosari Formation	Alluvium
1.	Proto-history	Gondang Site		Gunugbang Site Sokoliman Site Bleberan Site	
2.	Hindu-Buddhist	Plembutan Temple	Nglemuru Site	Papringan Temple Ngawu Site Pulutan Site Wareng Site Ngawis Site Rancang Cave Bandung Site	Genjahan Site

Bejiharjo Site  
 Wiladeg Site  
 Jatiayu Site  
 Dengok Site  
 Pacarejo Site

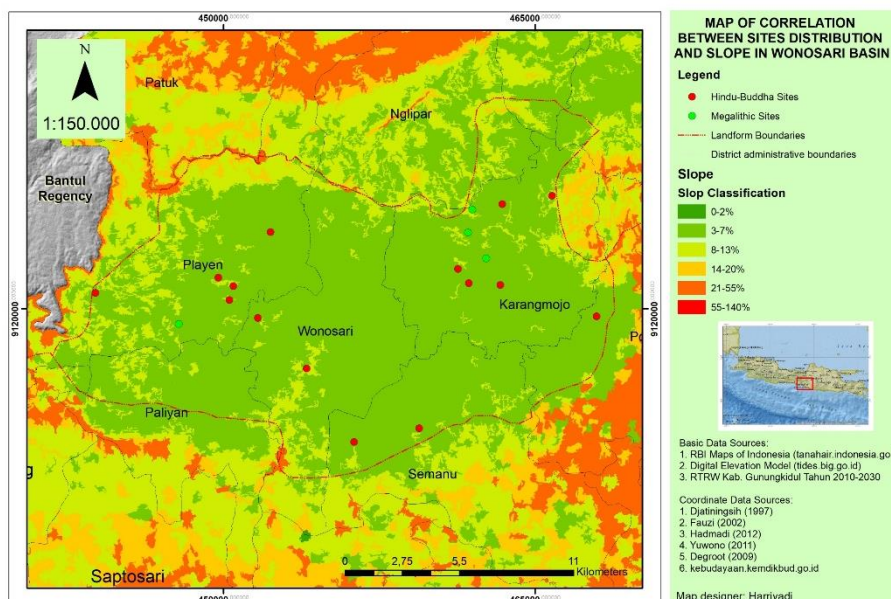
(Source: Author's spatial data analysis, 2020)

The Wonosari Formation is a formation composed of layered limestone (Suroño, 2009, p. 217). Evidence of the use of limestone is seen in the findings of menhir statues, temple components, and statues of gods. The use of limestone is a form of adaptation and utilization of local natural resources by humans in the Wonosari Basin. The use of limestone is a cultural character that appears in the artifacts in the Wonosari Basin.

### Slope Variables of Proto-History and Hindu-Buddhist Periods

The slope variables in the environment relate to the availability of flat land and accessibility for resource exploration and use. The slope variable testing was performed by overlaying the site distribution map with a slope map, made using the Digital Elevation Model (DEM). The results of DEM data processing are then divided into slope classes based on the classification by Van Zuidam (1985). The results show that the Wonosari Basin has three classes, namely the flat category (0-2%), gentle slope (3-7%), and wavy slope (8-13%). Based on the overlay between the site-distribution and the slope map, it shows that all proto-historical sites are on the flat category and Hindu-Buddhist sites. There are 12 sites on the flat category and two others are on wavy slopes (Table 5 and Figure 10).

The results demonstrate that the slope is considerably influential in the selection of residential location. Flat slopes provide easy access. Moreover, the availability of flat land can be used for the exploration of other natural resources in the Wonosari Basin.



**Figure 10.** Map of Sites Distribution and Slope Correlation in Wonosari Basin  
 (Source: Author's spatial data analysis, 2020)



**Table 5. Sites Placement Related to Their Slope**

No.	Period	Flat (0-2%)	Gentle Slope (3-7%)	Wavy Slope (8-13%)
1.	<i>Proto-history</i>	Gondang Site Gunugbang Site Sokoliman Site Bleberan Site		
2.	<i>Hindu - Buddhist</i>	Plembutan Temple Ngawu Site Pulutan Site Ngawis Site Rancang Cave Bandung Site Bejiharjo Site Wiladeg Site Jatiayu Site Dengok Site Pacarejo Site Nglemuru Site		Papringan Temple Wareng Site

(Source: Author's spatial data analysis, 2020)

### **Environmental Influence in Choosing the Wonosari Basin as a Settlement Location**

The local environment where humans live greatly influences the community's cultural characters and characteristics. Cultural characters emerge due to the adaptation process in the local environment, which has various characters and features (Steward, 1955, p. 36). The form of adaptation is seen in the selection of residents, which is represented by the distribution of site distribution.

The spatial analysis was carried out by overlaying the site distribution map with water resources, soil types, slopes, and rocks. The result shows that three of the four environmental variables are considered influential in selecting locations, namely water resources, rocks, and slopes. The soil type factor is not taken into consideration as the sites are evenly spread out without showing any classification. The three environmental variables in choosing a residential location in the Wonosari Basin appear to have continued from the proto-history to the Hindu-Buddhist period.

The selection strategy was predicted continuous, for the character of the physical environment of the sites were not different. This is confirmed by the results of research by Faida (Faida et al, 2011) which illustrates that from the proto-historical period to the Hindu-Buddhist era 4,000-450 BP (2,050BC-1500AD), the Gunungsewu area in Gunungkidul was mostly tropical forests. The similarity in the physical environment, from the proto-historical period to the Hindu - Buddhist period, may cause the similarity of variables in the choice of residential location.

The slope variable with 0-2% defines as the flat category. Slopes with this class provide easy accessibility for exploration and utilization of natural resources. The ease of accessibility facilitates the use of limestone as a material for making menhir statues and components of temple buildings as well as the utilization of surface water resources.

The cultural character that can be seen from the human adaptation process to the local environment in the Wonosari Basin is the use of limestone as a basic material for making media and buildings of worship. The use of limestone seems to continue from the proto-historical period to the Hindu-Buddhist period. The environment in the Wonosari Basin is dominated by limestone from the Wonosari formation (Surono, 2009, p. 217).

The use of limestone as an artifact material is a characteristic of the culture in the Wonosari Basin. These cultural characteristics are the result of human adaptation to the local environment. This form of adaptation can be seen if a comparison is made with other areas, namely the temples in Prambanan and Borobudur. The rock components in the temple building use mostly andesite from volcanoes.

The dominant and sustainable environmental variable from the proto-history to the Hindu-Buddhist era seen is the water resources. The pattern of placement of sites in the Wonosari Basin appears to be clustered and close to water resources in the form of springs and rivers. The spatial distribution shows that most of the sites are in the northern part of the Wonosari Basin, namely the Karangmojo area which has more springs and river flows than the southern area of the Basin. The number of springs and rivers in the northern part associates with the shallow groundwater level (Sudarmadji et al, 2011, pp. 46-47). This is then used by humans as a residential location.

The analysis of the soil types results illustrates that soil was not an important consideration during the proto-historical to Hindu-Buddhist periods. Examined further, during the Hindu-Buddhist period, the soil variable was important because soil fertility was one of the conditions for selecting the location of sacred buildings mentioned in the *Manasara Silpasastra* and *Silpaprakasa* (Kramrisch, 1946, pp. 12-13). Technically, the fertile land around the temple can be used as a location for agriculture/rice fields, which products later used to finance the maintenance of sacred buildings. This financing concept is called the *Sima Punpunan*, which is a tax-free plot of lands, of which proceeds are allocated to finance sacred buildings (Dharmosoetopo, 2003).

Meanwhile, the distribution of Hindu-Buddhist sites in the Wonosari Basin shows that the land factor was not considered in the choice of location. Based on research conducted by Hadmadi (2012), several sites in the Wonosari Basin are scattered on grumusol land, which is not supporting the guidelines for building temples in the *Manasara Silpasastra* and *the Silpaprakasa*. The mismatch is caused by the character of the grumusol soil, with low permeability, and tends to be loamy leading it not to become fertile.

The Wonosari Basin is limited in natural resources when compared to natural resources in the alluvial flats in Yogyakarta. The distribution of sites of the Hindu - Buddhist period in the Wonosari Basin unmatched the rules for the construction of the temple shows that the other factors were considered in the selection of the Wonosari Basin as a residence during the Hindu-Buddhist period.

The lack of natural resources also is mentioned by Mundardjito (1993) who exflats that several sites in the Baturagung Hills are in locations with limited environmental resources. The existence of sites in the Baturagung hills was then reviewed by Pradnyawan (2000) who exflated that the symbolic factor in the form

of a high location as a representation of the point of contact between the human world and the world of maturity became the background for the location of the site in the Baturagung Hills.

The distribution of sites in the Wonosari Basin tends to be flat that have different characteristics from the environment in the Baturagung Hills. This requires further study to reveal the factors behind the occupancy of the Wonosari Basin during the Hindu-Buddhist era in terms of disaster safety or security from potential conflicts.

The selection of the Wonosari Basin as a residence during the Hindu-Buddhist period indicates that it relates to security factors. They are presumably disasters in the form of natural disasters, volcanic eruptions, and conflicts/wars that occurred in the area of ancient Mataram civilization on the alluvial flat in Yogyakarta.

The safety factor from volcanic eruptions can be seen from the eruption of Mount Merapi which buried several ancient Mataram temples such as Sambisari Temple, Kentuk Temple, Palgading Temple, Kedulan Temple, Kadisoka Temple. The temples that were buried under the eruption of Mount Merapi are located at the foot of Mount Merapi. This illustrates that during the Hindu - Buddhist period there was a natural disaster that buried the ancient Mataram civilization (Boechari, 1976, p. 15). The Wonosari Basin as part of the karst certainly provides security from volcanic eruptions because of its location far from Mount Merapi.

Another factor that is thought to have been inhabited by this area during the Hindu-Buddhist era is security from conflicts and wars. This is evidenced by the Wuatan Tija Inscription (880 AD) which describes this area as an escape area. The Wonosari Basin is an area that is relatively far from the center of government during the ancient Mataram era around Kedu and the Prambanan Alluvial Flat (Andreastuti et al, 2006, p. 207). Its location, which is far from the center of government certainly, makes this location safe from potential conflicts that occurred at that time.

## CONCLUSION

The environment is a dominant factor in the consideration of selecting a residential location. Humans always place themselves in a space that provides various items and materials to support their life. The Wonosari Basin is an area inhabited by humans for a long period. This long-term settlement shows the continuity of the idea in selecting the Wonosari Basin as a residential location.

The Wonosari Basin is a plateau surrounded by two hills, namely the Baturagung Hills and Gunungsewu Hills. This area is the center of potential groundwater accumulation. The existence of a surface water resource factor, that is greater than the surrounding hills is the dominant factor of the area being inhabited by humans. This is confirmed by the results of studies that show that the presence of sites in the Wonosari Basin is close to surface water resources in the form of rivers, springs, and lakes.

Environmental variables that appear to be important are slopes and rocks. The Wonosari Basin has slopes with flat classes, providing easy accessibility and availability for many activities. The ease of accessibility encourages the use of local

natural resources, i.e. rocks to be processed into artifacts or religious building components.

Soil type is the environmental variable that is not taken into account in the selection of the Wonosari Basin as a residential location. This is evidenced by the seemingly random and unclassified distribution of sites on soil types with fertile characters. During Hindu-Buddhist times, the type of fertile soil was an important requirement in considering the placement of sacred buildings. The discrepancy between the placement requirements and the distribution of sites in the Wonosari Basin needs to be studied further using another approach to reveal the occupancy of the Wonosari Basin during the Hindu - Buddhist period.

## BIBLIOGRAPHY

- Ahimsa-Putra, H. S. (1995). Arkeologi Pemukiman: Titik Strategis dan Beberapa Paradigma. *Berkala Arkeologi, Edisi khusus tahun XV*, pp. 10-23.
- Andreastuti, Supriati Dwi, Chris Newhall, dan Joko Dwiyanto (2006). Menelusuri Kebenaran Letusan Gunung Merapi 1006. *Jurnal Geologi Indonesia, Vol 1 . No. 4*, pp. 201-207.
- Atmosudiro, S. (1980). Tinjauan Sementara Tentang Arca Menhir Gunung Kidul. *Berkala Arkeologi, Th. 1 No.1*, pp. 25-41.
- Badan Informasi Spasial. (2020). Peta Rupa Bumi Indonesia. Diunduh dari <https://tanahair.indonesia.go.id/portal-web>
- Badan Informasi Spasial. (2020). Seamless Digital Elevation Model (DEM) dan Batimetri Nasional. Diunduh dari <http://tides.big.go.id/DEMNAS/index.html>
- Balai Arkeologi Yogyakarta. (1986). *Laporan Ekskavasi Sokoliman*. Yogyakarta, Indonesia: Goenadi, N. dan Haris Sukendar.
- Boechari. (1976). Some Consideration of the Problem of the Shift of Mataram's Center of Government From Central to East Java in the 10th Century A.D. *Bulletin of the Research Centre of Archaeology, No. 10*, pp. 1-27.
- Christie, J. W. (1999). *Register of The Inscription of Java 732 - 1060 A.D. Unpublished*.
- Damayanti, S. (2015). *Kajian Morfologi Karst di Ledok Wonosari Kabupaten Gunungkidul Daerah Istimewa Yogyakarta (Skripsi)*. Yogyakarta: Fakultas Geografi Universitas Gadjah Mada.
- Dharmosoetopo, R. (2003). *Sima dan Bangunan Keagamaan di Jawa Pada Abad IX-X TU*. Yogyakarta: Prana Pena.
- Djatiningsih, S. S. (1997). *Pola Persebaran Situs - Situs Kepurbakalaan Klasik di Gunung Kidul (Skripsi)*. Yogyakarta: Fakultas Ilmu Budaya Universitas Gadjah Mada.
- Faida, Lies Rahayu Wijayanti, Sutikno, Chadif Fandeli, dan Sunarto (2011). Rekonstruksi Hutan Purba di Kawasan Karst Gunungsewu dalam Periode Sejarah Manusia. *Jurnal Ilmu Kehutanan, Vol. V No.2*, pp. 79-90.
- Fauzi, I. (2002). *Kronologi Penghunian Zona Cekungan Wonosari Gunungkidul berdasarkan Kajian Sebaran (Skripsi)*. Yogyakarta: Fakultas Ilmu Budaya, Universitas Gadjah Mada.
- Geoportal DIY. (2020). Katalog data dan Informasi Geospasial dalam Bentuk Layer Peta dan Dokumen. Diunduh dari <http://gis.jogjapro.go.id/>
- Hadmadi, A. S. (2012). *Potensi Kepurbakalaan Klasik di Zona Cekungan Wonosari (Tinjauan Atas Kesesuaian Jenis Tanah Berdasarkan Silpasastra dan Silpaprakarsa serta Strategi Pengelolaannya) (Skripsi)*. Yogyakarta: Fakultas Ilmu Budaya, Universitas Gadjah Mada.

- Haryono, E. dkk. (2017). *Petunjuk Kegiatan Lapangan Hidrogeologi Kawasan Karst Gunungsewu*. Yogyakarta: Fakultas Geografi, Universitas Gadjah Mada.
- Haviland, W. A. (1993). *Antropologi*. Jakarta: Erlangga.
- Jurusan Arkeologi, Fakultas Ilmu Budaya, UGM. (2002). *Laporan Ekskavasi dan Analisis Pendahuluan Situs Song Bentar Dusun Bentar, Desa Kenteng, Kecamatan Ponjong*. Yogyakarta, Indonesia: Tim Penelitian Terpadu Kawasan Arkeologi Gunungkidul.
- Kramrisch, S. (1946). *The Hindu Temple* (Volume I). Calcutta: University of Calcutta.
- Mundardjito. (1993). *Pertimbangan Ekologis Situs Masa Hindu-Buda di Daerah Yogyakarta: Kajian Arkeologi Ruang Semi-Mikro* (Disertasi). Depok: Fakultas Ilmu Pengetahuan Budaya, Universitas Indonesia.
- Mundardjito. (1995). Kajian Kawasan: Pendekatan Strategis dalam Penelitian Arkeologi di Indonesia Dewasa ini. *Berkala Arkeologi Edisi Khusus tahun XV*, pp. 24-28.
- Nawawi, H. dan Mimi Martini (1996). *Penelitian Terapan*. Yogyakarta: Gadjah Mada University Press.
- Nitihaminoto, G. (1989). Bentuk-Bentuk Gerabah Kubur Peti Batu Sokoliman: Hubungan dengan Tahap Penguburan. *Berkala Arkeologi, Vol. X No.2*, pp. 62-72.
- Nurani, I. A. (2017). Sistem Setting Okupasi Manusia Kala Pleistosen - Awal Holosen di Kawasan Gunungkidul. *Naditira Widya, Vol. 11 No1*, pp. 1-16.
- Pemda Kabupaten Gunungkidul. (2020). Profil Daerah Kabupaten Gunungkidul. Diunduh dari <https://gunungkidulkab.go.id/pustaka/D-74db63a914e6fb0f4445120c6fa44e6a-NR-100-0.html>
- Pokja Sanitasi kabupaten Gunungkidul. (2010). *Buku Putih Sanitasi kabupaten Gunungkidul*. Gunungkidul: Pemerintah Kabupaten Gunungkidul.
- Pradnyawan, D. (2000). *Latar Belakang Pemilihan Situs-Situs Di Pegunungan Seribu, Prambanan, Daerah Istimewa Yogyakarta* (Skripsi). Yogyakarta: Fakultas Ilmu Budaya, Universitas Gadjah Mada.
- Putranto, A. (2003). Pandangan Masyarakat Gunung Kidul Terhadap Pelarian Majapahit Sebagai Leluhurnya (Kajian Atas Data Arkeologi dan Antropologi). *Humaniora, Vol. XV No. 2*, pp. 224-233.
- Rahmadi, Cahyo, Sigit Wiantoro, dan Hari Nugroho (2018). *Sejarah Alam Gunung Sewu*. Jakarta: LIPI Press.
- Sarkar, H. B. (1971). *Corpus of the Inscription of Java (Corpus Inscriptionum Javanicarum) up to 928 A.D.* (Vol. 1). Calcutta: Firma K. L. Mukhopadhyay.
- Setianingsih, R. M. (1996). Bencana Alam dan Kerja Bakti masa Jawa Kuna serta Catatan Lain tentang Prasasti Nganjatan. *Berkala Arkeologi, Th. XVI No. 2*.

- Sharer, R. J. and W. A. (2003). *Archaeology; Discovering Our Past*. Boston: McGraw-Hill Higher Education.
- Simanjuntak, T. (1996). Cave Habitation During the Holocene Period in Gunung Sewu. *Aspects of Indonesian Archaeology, Vo.18*, pp. 1-28.
- Simanjuntak, T. (2002). *Gunung Sewu in Prehistoric Times* (T. Simanjuntak, Ed.). Yogyakarta: Gadjah Mada University Press.
- Soejono, R. (1984). Jaman Prasejarah di Indonesia. In Marwati Djoened Poesponegoro dan Nugroho Notosusanto (Ed.), *Sejarah Nasional Indonesia I*. Jakarta: Balai Pustaka.
- Steward, J. H. (1955). *The Theory of Culture Change*. Urbana and Chicago: University of Illinois Press.
- Sudarmadji, Slamet Suprayogi, M. Widyastuti, dan Rika Harini (2011). Konservasi Mata Air Berbasis Masyarakat di Unit Fisiografi Pegunungan Baturagung, Ledok Wonosari, dan Perbukitan Gunung Sewu, Kabupaten Gunungkidul. *Jurnal Teknosains, Vol.1 No.1*, pp. 42-53.
- Sukendar, H. (1971). *Penyelidikan Megalit di Daerah Wonosari (Gunungkidul)* (Skripsi). Yogyakarta, Fakultas Ilmu Budaya, Universitas Gadjah Mada.
- Surono. (2009). Litostratigrafi Pegunungan Selatan Bagian Timur Daerah Istimewa Yogyakarta dan Jawa Tengah. *Geo-Sciences, Vol.19 No.3*, pp. 209-221.
- Sutikno & DA Tanudirjo. (2005). *Kajian Geoarkeologi Kawasan Gunungsewu sebagai Dasar Pengembangan Model Pelestarian Lingkungan Karst*. Laporan Penelitian. Yogyakarta: Dirjen Dikti, Depdiknas-UGM.
- Sutikno & DA Tanudirjo. (2006). *Kajian Geoarkeologi Kawasan Gunungsewu sebagai Dasar Pengembangan Model Pelestarian Lingkungan Karst*. Laporan Penelitian. Yogyakarta: Dirjen Dikti, Depdiknas-UGM.
- Tanudirjo, D. A (1991). *Some Behavioral Aspects of Bomo Teleng Stone Adze Workshop Site in East Java*. Thesis. Australian National University.
- Thomas, D. (1973). An Empirical Test for Steward's Model of Great Basin Settlement Patterns. *American Antiquity, 38*, pp. 155-176.
- Tim PTKA. (2001). *Laporan Hasil Ekskavasi Gua Sengok Desa Getas, Kecamatan Playen, Kabupaten Gunungkidul*. Laporan Penelitian. Yogyakarta: The Toyota Foundation.
- van Zuidam, R. (1985). *Aerial Photo-Interpretation in Terrain Analysis and Geomorphologic Mapping*. Enschede: ITC, Smith Publication.
- Widianto, H. (1983). *Paleolitik Kali Oyo dalam Kronologi Pertanggalan Plestosen*. Skripsi. Yogyakarta: Departemen Arkeologi FIB Universitas Gadjah Mada.
- Widianto, H. & R. H. (2000). *Penelitian Song Tritis: Eksistensi dan Posisinya dalam Kerangka Situs Hunian Gua Prasejarah*. Yogyakarta: Departemen Arkeologi FIB Universitas Gadjah Mada

- Yuwono, J. S. E. (2007). Kontribusi Sistem Informasi Geografis dalam Berbagai Skala Kajian Arkeologi Lansekap. *Berkala Arkeologi, Th XXVII No 2*, pp. 81-102.
- Yuwono, J. S. E. (2013). *Karakter Geoarkeologis Dan Proses Budaya Prasejarah Zona Poros Ponjong - Rongkop Di Blok Tengah Gunungsewu*. Thesis. Program Pascasarjana Fakultas Geografi Universitas Gadjah Mada.