



Human and Nature: The Identification of Human Engagement with Karst Topography in Gunungkidul Regency, Yogyakarta's Special Province

Lidya Lestari Sitohang¹, Eko Budiyanto¹, Bambang Hariyanto¹, Aida Kurniawati¹, Wilda Kurnia Fithri¹, Manda Nova-Iza¹, Arra Fadia Putri Ardini¹, Siti Kholifah¹, Hermana Sahara Ardinanta¹

¹ Geography Education, Faculty of Social and Political Sciences
State University of Surabaya, Indonesia
lidyasitohang@unesa.ac.id

Abstract. Landscapes are defined as areas of the Earth's surface that exhibit physical, biological, and cultural characteristics shaped by the interaction of natural factors. One such landform is karst topography, which results from the dissolution of soluble rock. This study employs an empirical approach to examine the relationship between communities and their living spaces in the context of karst landscapes in Gunungkidul Regency, Indonesia. The research methods employed include rapid survey appraisal based on triangulation techniques such as field observation, expert judgement and secondary data collection. The research analysis is carried out as empirical description analysis. The results demonstrate that local communities adapt to the characteristics of the Karst environment and utilise the landform for tourism, agriculture and the fulfilment of living needs. It is estimated that sustainable management is necessary to preserve karst landscapes and improve community welfare.

Keywords: Cultural Landscape, Human Interaction, Solutional Land Form.

1 Introduction

Indonesia is an archipelagic country that was formed through tectonic and volcanic processes over millions of years. Indonesia has a diversity of landscapes both in physical and human aspects [1]. A landscape is an area on the earth's surface that has physical, biological, and cultural characteristics. The formation of this landscape is through a complex interaction process between natural factors. This landscape study covers several aspects, including landscapes and cultural landscapes. Landscapes are part of geomorphological research where the process of forming the landscape itself will produce landforms that have dynamic and varied properties [2]. Landscapes in Indonesia are not a uniform phenomenon but have a variety of formation processes, one of which is the form of land from the solutional process.

The solutional landform process is formed through the process of dissolving rocks by water, both from the surface and below the soil surface so that underground rivers

or caves are formed like in karst topography. Karst topography is a part of the earth's surface made of limestone where karst topographic expressions are often in the form of hills to mountains. Karst areas are known as barren land that experiences water shortages because the potential stored in them is not widely known [3]. Indonesia has many landscapes with karst topography, one of which is in Gunungkidul Regency.

Gunungkidul is one of the districts located in the Special Region Province of Yogyakarta, the administrative area of Gunungkidul is located in the east of Sleman Regency. The area of Gunungkidul $\pm 1,485.36 \text{ km}^2$. Gunungkidul Regency has three development zones, namely the Batur Agung area, the Wonosari Ledok Development area and the Thousand Mountain Development Area [4]. The karst area itself is located in the development area of Gunung Sewu which is found by many underground rivers, areas with karst topography in Gunungkidul district spread across ten sub-districts[5]. This karst area has unique and interesting characteristics to be studied, especially in relation to human interaction in it. In addition to the landscape aspect, the landscape also includes the study of cultural landscapes.

Cultural landscape is a phenomenon that occurs between human activities and the environmental conditions in which they live on the earth's surface. Cultural landscapes can include various elements such as settlements, buildings, roads, natural resource management, ritual activities and so on [6]. Humans with their ability to form a group that occupies the area so that a community is formed, where in the community there is interaction between others that produce activities such as trade, industry, education and others.

Humans adapt and interact with the scope of their residence both in the form of individuals and groups. The scope of their residence is a significant influence on the welfare of the community. Human interaction in the Gunungkidul karst area is different in each region. In the discussion of this article, there are three areas from Gunungkidul Regency that will be studied related to the cultural aspect of the land form of the origin of the solutional process with karst topography, namely Kalisuci, Telaga Karst Seperangan, and Luweng Pego. The research question in this study is how the karst topography shapes the cultural landscape of the people living in the region.

2 Methods

2.1 Research Location Selection

This research was conducted in Gunungkidul Regency, Special Region of Yogyakarta, because it has a large and unique karst area formed through a solutional process, which offers many geomorphological features such as caves, underground rivers, and limestone hills that are interesting to research. Gunungsewu is a karst landscape that is inhabited by many humans as a place to live. Gunungsewu is an active karst area which is characterized by many underground river flows and has been declared a geological reserve area by world agencies or the Indonesian government itself [7]

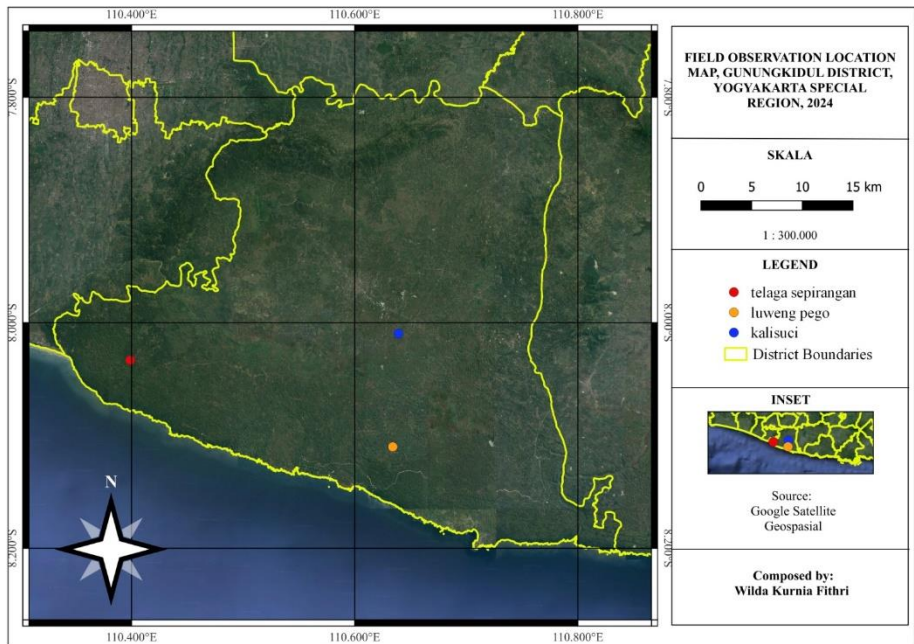


Fig. 1. Map of the Research Location

2.1 Data Collection

The three stages of data collection in this study include pre-field, field and post-field. In the pre-field, the author introduced the region both through face-to-face lectures and the preparation of research instruments. During the field, the author conducts field checks by implementing an integrated survey. Meanwhile, after the field, the author analyzed the data based on the theme of the analysis.

The identification of the sustainability of cultural landscape diversity from the form of marine and aeoline land was carried out through an integrated rapid survey appraisal method [11]. This method applies the principle of data collection triangulation which includes direct observation, interviews, and the use of secondary data (see Fig.2.). This survey is applied in field work lecture activities. The purpose of the fieldwork in this study is to provide direct experience and comprehensive understanding of human interaction with the karst environment in the Kalisuci area, Seperangan Karst Lake, and Luweng Pego in Gunungkidul Regency, Special Region of Yogyakarta [8].

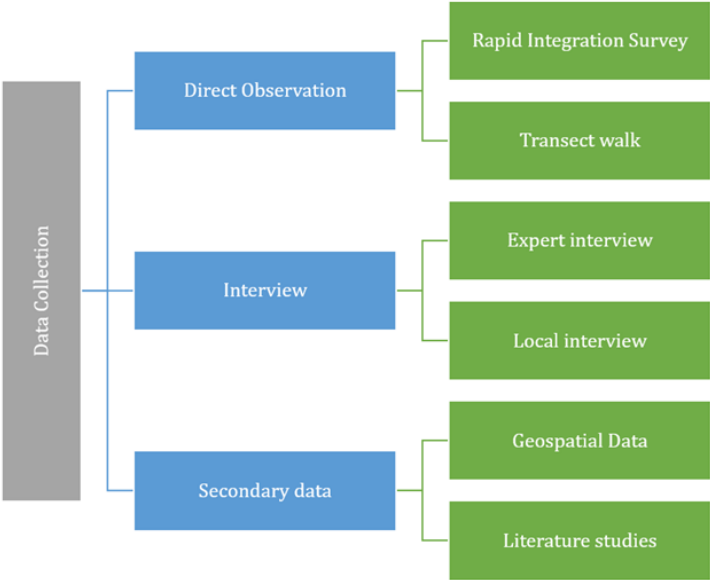


Fig.2. Data collection during fieldwork

Observation is one of the data collection techniques that has specific characteristics when compared to other data collection techniques[9]. Observation is an activity that involves all the powers of the senses such as hearing, sight, taste, touch, and taste based on the facts of empirical events[10]. The observation was made on the indicators of the cultural landscape components as in **Fig. 3**.

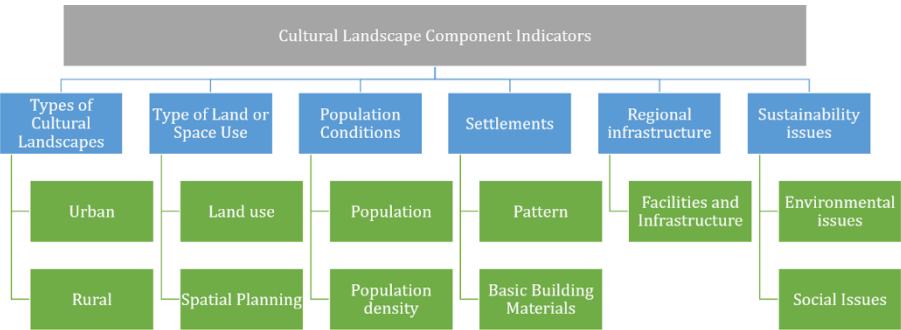


Fig.3. Key indicators of the cultural landscape
Source: (Santosa and Muta’ali, 2014 with adaptation)[11]

2.2 Qualitative Analysis

The analysis in this paper is a qualitative empirical description based on the theme of analysis. The theme of analysis emphasizes on meaning and generalization [12] and

broad insights from researchers [13]. Data triangulation is carried out to ensure the validity and reliability of the findings, comparing results from various data sources. This qualitative analysis provides comprehensive insights into the experiences, perspectives, and practices of local communities, which are essential for formulating relevant and effective management policies and practices. Qualitative analysis is carried out with characteristics that describe facts or an actual situation, but the report made must pay attention to scientific interpretation in order to have good results [14]. The qualitative analysis in this research is conducted by experts with a background in human geography, Karst expert and environmental science, who describe the characteristics of a given situation. The resulting report is then created through a process of scientific interpretation, which represents the expert's expertise.

3 Results and Discussions

The way people interact with their living environment, specifically in areas with karst topography like Kalisuci, Telaga Seperangan, and Luweng Pego in Gunungkidul Regency, involves several important aspects that should be taken into account or considered. The influence of karst topography in the three locations has a considerable influence that can affect the activities of the people living in the area. The research findings yielded three key themes, each pertaining to an environmental service. These themes were identified as tourism services, domestic services and clean water sources.

3.1 Tourism Services in Kalisuci

Kali Suci is an underground river flow that can be found in the Jonge area, Pacarejo, Semanu District. Kali Suci comes from a solutional process, namely from the dissolution of karst rocks by rainwater containing carbonic acid. This process occurs over a very long period of time and takes up to thousands of years. From this process are created crevices, passages, caves in limestone and underground rivers that flow through the existing series of caves. Underground rivers occur due to the infiltration of water into limestone through rock cracks. In the formation of underground rivers, there is a dissolution of limestone or the like in the soil by the presence of absorption or infiltration, as a result of which there are cracks or cracks filled with water in the karst layer. If the water in these cracks or cracks is combined, small waterways will arise. Water from these small channels combines to form a large volume of water [15].

The uniqueness of Kali Suci lies in the karst sugar system which is interconnected by underground river flows. With this uniqueness, the community uses Kali Suci as a sustainable tourism place that offers a unique experience by going down underground rivers and natural caves formed in the karst area of Gunungkidul. The potential for tourism developed by the community can be a source of income for the surrounding community.

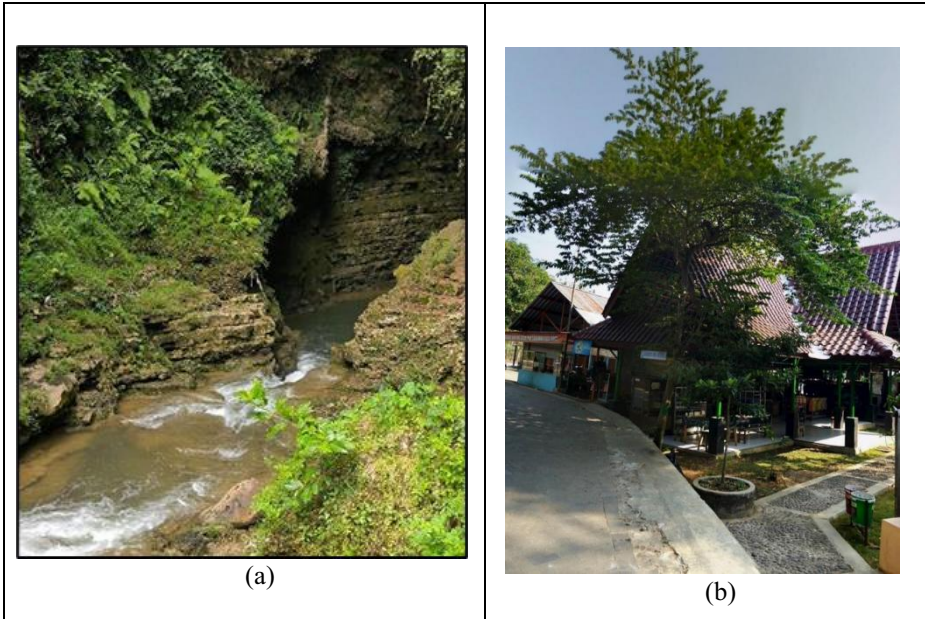


Fig. 4. (a) Kalisuci Cave (b) Small stalls and float rentals

Based on the res field observations, the cultural landscapes in Kalisuci is dominated by the tourism sector such as the opening of parking lots and small stalls. Along the road to Kalisuci, there are land uses such as fields, settlements and areas for places of worship. The development of Kalisuci tourist attractions provides additional income for the district and village areas in the form of levies. Following the development of the Kalisuci tourism object, the local community has initiated a number of economic activities. These include the opening of small stalls and the renting of buoys and tyres for use as cave tubing tourism facilities. In addition, Kalisuci tourism is also used as a place for education and learning about the relationship between environmental conditions and humans.

The development of the tourism in Kalisuci also has a social impact on the community. One aspect is the improvement of knowledge and skills. Homestay management training which includes cooking training has begun to be held by the village government since the beginning of the development of tourist attractions as an effort to increase human resources from Pacarejo Village is still being carried out even though it does not have a fixed agenda or schedule but the village government will continue to organize [16]. This is done as an effort to increase human resources from Pacarejo Village. Homestay is expected to be the main source of income for the surrounding community. So that the community is required to remain creative and develop in managing every update of an object so that there is still a special interest from tourists who continue to visit.

3.2 Domestic Services by Seperangan Karst Lake

One of the hallmarks of karst landscapes is that each slope usually ends in a closed depression with no outlet for water. A doline or sinkhole is a rounded concave or closed depression on the surface, which is shaped like a bowl, with a center line ranging from a few meters to 1000 m. The depth of a dolina can range from very shallow (less than 1 m), to hundreds of meters. Doline can also be defined as a morphological form in karst areas in the form of basins such as bowls, cones or tubes that can be formed by water power that can dissolve limestone or subsidence underground. If most of the dolina is coated with impermeable sediment, this basin will fill in and form a *lokva* (Karst Lake water). *Lokva* in Gunungsewu is better known by locals as a lake [17].



Fig. 5. (a) Seperangan lake (b) Built-wall along Seperangan lake

Seperangan karst lake is a lake located in Karangnongko, Giripurwo Village, Purwosari District. The Seperangan Karst Lake is located close to residential areas. Seperangan Lake was formed due to the deposition process of sedimentary rocks. sediment that undergoes a sedimentation process. This is because the morphology of Gunungkidul Regency consists of Karst or Karate arrangements. This sedimentary or limestone rocks undergo a dissolution process due to the climatic conditions in the area. The dissolved limestone then undergoes precipitation and forms like a pond that traps water in it. So that a karst lake was formed. The lake has a closed ponor hole. This resulted in the flow of water in the lake being obstructed.

Based on observations, Seperangan Lake in the past was widely used by the community in every daily activity and became a source of life for local residents. This lake is used as a place for washing, a place to bathe livestock and also a bathing place for local residents. This activity can be proven by the wall buildings made by the surrounding community along the edge of the lake. In this lake area, a path was also built that functions to facilitate access for local residents to go down to the lake.

However, nowadays, the lake is no longer used by the surrounding residents. This is because the water in this lake is polluted and untreated. The reason for its lack of

maintenance is because access to clean water in this area has begun to run smoothly and is also adequate for use in daily life.

3.3 Clean Water Services in Luweng Pego

In Giripurwo Village, Purwosari District, there is a collapse depression under which through a narrow gap and stepped underground river flow. Groundwater is important in karst topographic areas; the groundwater can be used by the local community as drinking water and household water [18]. The surrounding community calls the underground river Luweng Pego. Pego is a Javanese word that means smoke or steam because in the morning from a distance there is smoke (water vapor) that rises from the luweng [19]. Luweng pego is a vertical hole that is formed due to a solutional process. As a result of the karst rock process that constitutes the weathered landscape by water that lasts for a long time, an underground channel in the form of a luweng is created.

Based on the results of field observations that have been carried out, Toyo Kendi Pego or commonly called Luweng Pego is partially used by the surrounding community to meet their daily clean water needs. The use of water from Luweng Peda is distributed through water pipes that are directly connected to the surrounding residential areas. The land around Luweng Pego is used by the surrounding community as agricultural land and plantations, generally the plants planted on the land are in the form of vegetables and fruits such as chili, tomatoes, pumpkins and bananas.

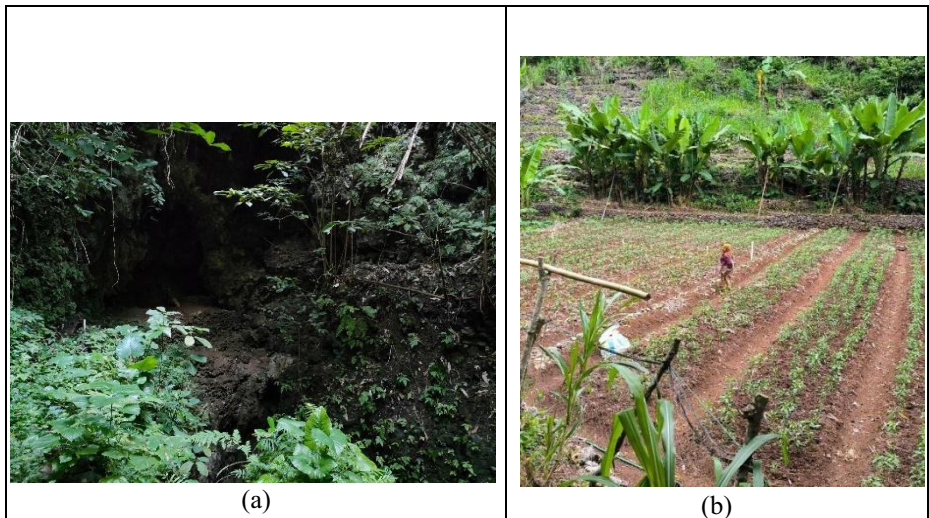


Fig. 6. (a) Luweng (hole) cave (b) Agricultural land around Luweng.

4 Conclusions

The Gunungkidul Regency is notable for its extensive karst topography, which is characterised by a variety of distinctive geological formations, including dolines, ponors, underground rivers, and caves. This landscape encompasses a number of areas, including Kalisuci, Seperangan Karst Lake, and Luweng Pego. The study reveals a significant human interaction with these karst landscapes, which highlights their crucial role in providing environmental services.

Local communities have adapted to these environments, fostering cultural practices such as the management of Kalisuci as a tourist destination, which has stimulated economic activities. In contrast, the Seperangan Karst Lake, which was previously an important source of water for daily activities such as bathing and washing, has suffered from the effects of pollution. Conversely, the Luweng Pego area has capitalised on its karst features to provide clean water through interconnected systems, which benefit nearby settlements.

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References

- [1] G. Perak, G. Bromo, D. A. N. Pantai, S. N. Safira, A. I. Yulianti, and N. Y. Triwigati, "11378-769-24607-1-10-20190621," pp. 1–25.
- [2] S. Hidayat and U. M. Lumbanatu, "Analisis Bentang Alam Kuarter," *Jurnal Geologi dan Sumberdaya Mineral*, vol. 20, no. 6, pp. 293–303, 2010, [Online]. Available: <https://jgsm.geologi.esdm.go.id/index.php/JGSM/article/view/180>
- [3] E. Saputra and R. H. Jatmiko, "Aplikasi Teknik Penginderaan Jauh untuk Identifikasi Mulut Gua dan Sebarannya Di Kawasan Karst Daerah Semanu, Gunungkidul, Yogyakarta," *Jurnal Bumi Indonesia*, vol. 3, no. 2, pp. 1–7, 2014.
- [4] E. Masduqi, A. H.T., and A. Agung N, "Analisis Data Kelautan Dan Perikanan Pemetaan Lahan Potensi Budidaya Perikanan," *Jurnal Rekayasa Lingkungan*, vol. 18, no. 1, pp. 1–16, 2020, doi: 10.37412/jrl.v18i1.22.
- [5] A. Kurniawan and M. I. Sadali, *Keistimewaan Lingkungan Daerah Istimewa Yogyakarta*. Yogyakarta: Gadjah Mada University Press, 2014.
- [6] I. Hidayati, "Bentang Lahan Jawa Bagian Tengah," *Jurnal Geografi*, vol. XVIII, pp. 145–164, 2020.

- [7] E. Budiyo, "EVALUASI LAJU DESERTIFIKASI BATUAN PADA BENTANG LAHAN KARST GUNUNGSEWU MELALUI PENGINDERAAN JAUH," *Prosiding Pertemuan Ilmiah Tahunan (PIT). Ikatan Geograf Indonesia*, 2014.
- [8] L. L. Sitohang, B. Hariyanto, A. Kurniawati, S. P. Prasetya, E. Budiyo, and N. H. Purnomo, "Head to the field: Fieldwork as a direct experience learning tool in the integrated geography course," *Technium Social Sciences Journal*, vol. 50, pp. 71–78, Nov. 2023, doi: 10.47577/tssj.v50i1.9869.
- [9] D. Hardani, S.Pd., M.Si Nur Hikmatul Auliya, *Metode Penelitian Kualitatif dan Kuantitatif*, no. January. 2020.
- [10] A. Anggito and J. Setiawan, *Metodologi Penelitian Kualitatif*, 1st ed. Sukabumi: CV Jejak, 2018.
- [11] L. W. Santosa and L. Muta'ali, *Bentang Alam dan Bentang Budaya, Panduan Kuliah Kerja Lapangan Pengenalan Bentanglahan*. Yogyakarta: Badan Penderbit Fakultas Geografi (BPFGE) UGM, 2014.
- [12] Sugiyono, *METODE PENELITIAN KUANTITATIF, KUALITATIF, DAN R&D*, 2nd ed. Bandung: ALFABETA, 2021.
- [13] S. H. SAHIR, "Metodologi Penelitian," Bantul: KBM INDONESIA , 2021. [Online]. Available: www.penerbitbukumurah.com
- [14] M. Rijal Fadli, "Memahami desain metode penelitian kualitatif," vol. 21, no. 1, pp. 33–54, 2021, doi: 10.21831/hum.v21i1.
- [15] P. Purwanto, N. Haryanti, and S. A. S. Raharja, "Bauran Pemasaran dan Perilaku Pengunjung Wisata Minat Khusus di Objek Wisata Kali Suci Caving dan Tubing," *Jurnal Ilmu Lingkungan*, vol. 18, no. 3, pp. 467–475, 2020, doi: 10.14710/jil.18.3.467-475.
- [16] A. Purwandari, "DAMPAK KEGIATAN PARIWISATA DI KALISUCI CAVE TUBING DESA PACAREJO KECAMATAN SEMANU KABUPATEN GUNUNG KIDUL TERHADAP SOSIAL EKONOMI MASYARAKAT SEKITAR," 2018.
- [17] R. Y. Lesmana, "Identifikasi Pengaruh Kondisi Lingkungan Fisik terhadap Kuantitas Air Telaga Palgading di," 2016.
- [18] S. Azharia Sabitah, "Jurnal Geografi," *Jurnal Geografi*, vol. XIX, pp. 35–48, 2021.
- [19] H. Pramono, "FISIOGRAFI PARANGTRITIS DAN SEKITARNYA," *Geomedia* , vol. 5, pp. 66–78, 2007.

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