Mapping of Karangsambung - Karangbolong Geopark, as an Effort to Manage Geoheritage in Kebumen Regency

C. Ansori¹, P. D. Raharjo¹, and M. A. Fariji²

¹Research Centre for Geotechnology, Indonesian Institute of Science
²Jurusan Teknik Geologi, Institute Teknologi Nasional

Email: chus001@lipi.go.id

Abstract. Kebumen is the most underdeveloped district in Central Java Province. The area covers the mountains in the north to the coast in the south. Kebumen has a unique geological diversity, exciting and international scientific value so that it is widely used as a natural laboratory for conservation, education, and research purposes. Minister of Energy and Mineral Resources Decree No. 2817 K/40/MEM/2006 has designated 21,150 hectares in Karangsambung as the first geological heritage in Indonesia. At the height of Karangbolong in the southern part, there are limestones. An area of 4,089 hectares has been designated through the Decree of the Minister of Energy and Mineral Resources Number: 3873 K/40/MEM/2014 as a Kars Landscape Area, which has a protected function. Geopark is a concept of sustainable development in a single area with a geoheritage for conservation, education, and sustainable economic development of local communities. A place of 543,599 km² covering 12 sub-districts and 118 villages stretching from the Karangsambung geoheritage to the Karangbolong geoheritage has been designated as the Karangsambung Karangbolong National Geopark since 2018. This geopark is planned to be upgraded to a UNESCO global geopark. This study aims to see whether the management of the two geoheritages with the geopark concept is the right choice. The research was conducted through literature studies, field research, comparative studies on geoparks in other places, and qualitative data analysis.

Keywords: Geopark, Geoheritage, Karangsambung-Karangbolong, Kebumen

1. Introduction

Kebumen Regency location between 7°27′–7°50′ latitude and 109°22′ – 109°50′ east longitude, consisting of 26 sub-districts, 460 villages with an area of 1,281.12 Km². The topography of Kebumen consists of structural mountains in the north, karst hills in the southwest, and alluvial plains in the south-central part. Kebumen’s 2019 PAD 409.163 billion, 1.35 million population with a poor population reaching 17.59% spread over the mountainous areas in the north and south of Kebumen [1]. Kebumen is the district with the highest number of poor people (17.59%) and the highest poverty severity index (0.55) in Central Java [2]. Kebumen is also an agriculture-based district with diverse mining potential. Kebumen mine potential includes metallic minerals in iron sand, manganese, and gold, while the coal group is in the form of bitumen shale; nonmetallic groups include kaolin, Ca-bentonite, guano phosphate, trass, feldspar, asbestos, and talc. Rock groups include limestone, clay, andesite, diabase, gabbro, basalt, marble, sand sediment, and red soil, primarily located in the Karangsambung Geoheritage area and the Karst Landscape Area [3]. The existence of mining materials in geological protected areas certainly cannot be mined according to legislation. This is certainly an obstacle in the utilization of existing resources. For this reason, it is necessary to conduct a study using the two geoheritages to support the welfare of the population.

Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education, and sustainable development. Their bottom-up approach of combining conservation with sustainable development while involving local communities is becoming increasingly popular [4]. Geoparks must have geological, biological, and cultural diversity [5]. According to Presidential Regulation Number 9 of 2019 [6], a geopark is a single or combined geographic area with a geological heritage site (geosite) and valuable landscapes related to geoheritage, geodiversity, biodiversity, and cultural aspects diversity. It is managed for conservation, education, and sustainable economic development with the active involvement of the community and local government so that it can be used to foster public understanding and concern for the
earth and the surrounding environment. The main elements include geological, biological, and cultural diversity to protect the geodiversity, environmental conservation, and broader earth science education. Geological diversity is in the form of the diversity of rocks, minerals and fossils, landforms, topography and processes, soils, hydrology, and structures’ influence on the landscape [7]. Geodiversity is a description of the uniqueness of geological components such as minerals, rocks, fossils, geological structures, and landscapes that are the essential wealth of an area and their existence, distribution wealth, and conditions that can represent a description of the geological evolution process of the site [6]. The geological diversity in an area can be designated as geoheritage if it has more value as a legacy because it is a record that has or is happening on earth. Geoheritage is geological diversity that has more value as a heritage because it is a record that is happening on earth. Because of its high scientific value, it is rare, unique, and beautiful, so that it can be used for research and earth education purposes.

In the northern part of Kebumen, the Karangsambung geoheritage area is the first Geological heritage area in Indonesia due to the uniqueness of rocks and fossils that need to be protected [8]. Meanwhile, the southern part is a geoheritage area with exokarstic phenomena in the form of cockpit karst morphology and caves and underground rivers that need to be conserved to support the karst ecosystem [9]. This study aims to determine whether geopark in Kebumen as a concept in regional development and management of geological protected areas is appropriate.

2. Data and Methods

The research was conducted through an in-depth literature review of research results and references to existing regulations. After that, field observations to see the condition of community activities in the geoheritage area. A comparative study based on data on implementing the geopark concept in sustainable development in other geoparks. The analysis was carried out qualitatively on the data obtained to determine whether the management of the geoheritage area was appropriate using the geopark concept. Map drawing using Arc-Gis.

3. Results and Discussion

3.1 Karangsambung Geoheritage

Karangsambung Geoheritage area of 21,150 hectares, including the Regencies of Kebumen, Banjarnegara, and Wonosobo, is a protected geological area. The existence of this area is essential for science, education, and tourism because of the uniqueness of rocks and fossils, the diversity of rocks that reflects a unique geological process in the form of subduction of the Eurasian continental plate with the Indian Ocean plate at 121-55 million years ago. There are 30 geological protected sites in the area. In contrast, outside areas are for settlements, forests, gardens, rice fields, and other production activities that do not damage geological sites [8]. Potential industrial minerals found in the area include Sand-rock sediment, Diabase, Serpentinite, Marble, Kaolin, Clay, Limestone, Feldspar, Precious Stones/Ornaments, Basalt, and Gabbro (Figure 1).

a. Sand sediment, found in an area of 151.77 hectares along S. Luk Ulo. Most miners use suction machines, so they tend to damage the environment. Mining causes former deep mining pits, changes in the direction of river currents, landslides on riverbanks, and damage to roads.

b. Diabase is found in the reserve area of 210,648 Ha, so that the estimated reserves are about 6,31944 million m³. Based on the compressive strength analysis data, the quality is below andesite. Mt Parang Diabase location at the core of the reserve, so it must be free from mining activities.

c. Serpentinite, spread over an area of 215,687 Ha, estimated reserves of about 4,31374 million m³. Serpentinite can be used as a refractory material such as brick and refractory furnaces. Serpentine minerals found in ultramafic rock complexes have an excellent opportunity to be processed into alkaline forsterite-type refractories.

d. Marble is an industrial mineral for building ornaments in the form of dimensional stone. The distribution area reaches 4.95 ha, with an estimated reserve of around 1,237,500 m³. The compressive strength is poor (class IV), while the wear resistance is excellent (class I). Based on its physical properties, it is suitable for making small-sized handicrafts.

e. Kaolin found in Kalisana and Totogan Village with an area of 5.93 Ha, estimated reserves of 74.175 m³. High Fe₂O₃ content ranging from 4.35 to 7.22% and montmorillonite clay, so the quality is not good.

f. Clay found in Peniron has a distribution area of about 12,706 ha, with an estimated reserve of around 444.71 thousand m³. Epigenetic clay occurs due to the weathering process of tuff, tuffaceous sandstone, or claystone from the Halang Formation. It can be used as tile and brick material.

g. Limestone found on the Jatibungkus hill covering 13 ha, estimated reserves of about 2.176 million m³. The quality is good for quicklime or cement materials, including protected sites.
h. Feldspar, found with a distribution area of about 5.903 Ha, estimated reserves of 590.3 thousand m³, as a mixture of cement and ceramics.

i. Precious stones, found in the Melange complex area as veins and boulders along the river.

Figure 1. Mining potential map in the Karangsambung Geoheritage Area

There are still many mining activities around the Karangsambung area (Figure 2), mainly sand and rock mining. Tourist sites managed by the community (Pokdarwis) have developed and provided economic benefits to the surrounding community. Several tourist villages that contain tourism objects include Cangkring Village, Seboro Village, Karangsambung Village, and Peniron Village.

Figure 2. Mining activities of sand sediments and placer gold are still commonly found in the Karangsambung Geological Reserve area along the middle to the upper Luk Ulo river (a to f). Activities and tourism objects managed by the developing community include: Embung Cangkring (g, h), Selo Asri in Seboro (i, j), Pentulu Indah tourism in Karangsambung Village (k, l), and Brujul tourism object in Peniron Village (m, n).

3.2 Karangbolong Geoheritage

Potential mining materials in the Karangbolong area include; Andesite, Limestone, Phosphate, Bentonite, Kaolin, Trass, Manganese, Gold, and Bitumen Shale with an even distribution throughout the area.

a. Andesite, found in the villages of Manguwini, Candienggo, Kalipoh, Srati, Jintung and Adiwarmo. The total reserves are around 106,130,975 m³, large-scale mining found in Manguwini, Candienggo and Jintung. Good quality, location is not in the karst area.

b. Limestone contains more than 90% CaCO₃, CaO 54.38 – 55.50%, MgO 0.2746 – 0.49%, so the quality is very good for cement. Other uses are acid neutralizer, quicklime, extinguished lime, and building...
material. Mining found in Jatijajar Village, Redisari Village, Kalisari Village, and Banyumudal Village, generally used for quicklime. The area is about 5083.5 Ha, with estimated reserves of 389,250,000 metric tons, at an altitude above 150 m.

c. Phosphate, in the form of guano in Golek Cave, Mangunwenti Village, Kampret Cave, Banyumudal Village; Sriwulung Cave, Buayan Village; Sekayu Village Bull Cave, and several other caves. The P\textsubscript{2}O\textsubscript{5} content generally varies more than 30% so that it meets the requirements for industrial use.

d. Bentonite, found west of the Argopeni village road, is an alteration zone with high sulfur content, potential reserves of up to 100,000 m\textsuperscript{3}. Chemical analysis of bentonite showed that the content of CaO + MgO = 3.17%, meanwhile Na\textsubscript{2}O = 0.39%, so it includes calcium - magnesium bentonite.

e. Trass, found in Jintung Village, is brittle due to weathering of volcanic rocks (andesite breccia) that contain a lot of feldspar and silica. The content of Si\textsubscript{O}\textsubscript{2}: 45.96%, Al\textsubscript{2}O\textsubscript{3}: 14.96%, CaO:15.00% so that it is possible to manufacture pozzolan cement.

f. Kaolin, found in Lemah Putih, Jintung Village, Ayah sub-district, resulted from changes in volcanic material due to the influence of hydrothermal alteration. High Fe\textsubscript{2}O\textsubscript{3} content ranges from 4.35 to 7.22%, so it is not suitable for ceramics.

g. Manganese, several locations that have been mined are in Candirenggo Village, Mangunwenti, Srati and Pasir, Ayah sub-district; Wanadadi and Rangkah village, Buayan sub-district.

h. Gold, found in the Lodeng River. Produced from alteration and mineralization of intrusive bodies of Mt. Arjuna and Poleng.

i. Bitumen shale is shale/clay rock that contains much organic material and has undergone physical and chemical changes, also known as lignite. The thickness is between 0.30 m – 4 m. It can even reach a thickness of 5 m, so the bitumen reserves are 7,264,176.20 tons of rock.

Illegal mining activities are also still found around the Karangbolong area, mainly limestone and andesite mining which has been carried out many years to meet the needs of building materials. However, community-based tourism activities have been developed and managed by Tourism Awareness Groups (Pokdarwis). Some of the tourism objects driven by the community include Wanalela Hill, Menganti Beach, Lampon Beach, Surumanis Beach, Watu Bale, Hud Hill (Figure 3).

Figure 3. The appearance of Karangbolong karst geoheritage (a,b), illegal mining activities on limestone (c,d), andesite mining (e), metallic minerals (f). Tourism objects managed by the community include; west cave (g), Wanalela hill (h), Sawangan beach (i), Menganti beach (j), Surumanis beach (k), and Lampon beach (i)

4. Discussion

Conservation is the care and protection of these resources so that they can persist for future generations. It includes maintaining the diversity of species, genes, ecosystems, and environment functions, such as nutrient cycling. Conservation is similar to the preservation, but while both relate to protecting nature, they strive to accomplish this task differently. Conservation seeks humans' sustainable use of wildlife for hunting, logging, or mining activities, while preservation means protecting nature from human use [10]. Conservation is generally held to include managing human use of natural resources for current public benefit and sustainable social and economic utilization. A natural resource is the physical supply of something in nature, such as soil, water, air, plants, animals, and energy [11].

Based on [12], the conservation of natural resources is the management of natural resources whose utilization is carried out wisely to ensure the continuity of their supply while maintaining and improving the quality of their diversity and value. Conservation is the use of natural resources to meet human needs in large quantities over a long period (American Dictionary). Conservation is the management of air, water, soil, minerals, and living organisms, including humans, to achieve an improved quality of human life [13]. Geological Protected Area is an area designated with the primary function of protecting environmental sustainability, which includes natural resources, artificial resources, and historical and cultural values of
the nation in the interest of sustainable development. Geological protected areas consist of Geological Nature Reserve Areas, geological disaster-prone regions, and regions that protect groundwater [14].

Geological Protected Area is an area designated with the primary function to protect the Geological heritage. Geological Protected Area is a geological object formed naturally and, because of its uniqueness, requires protection. The Geological Protected Area includes the uniqueness of rocks and fossils, the area of the essence of the karst landscape, and the uniqueness of geological processes [15].

Presidential Decree No. 32/1990 on Management of Protected Areas, Article 37 regarding control of protected areas, includes; in protected areas it is prohibited to carry out cultivation activities, except those that do not interfere with the protected function; In nature reserves and cultural conservation areas, it is not permitted to carry out any cultivation activities, except activities related to their roles and do not change the landscape, land use conditions, and existing natural ecosystems. Cultivation activities in protected areas that have an essential impact on the environment are carried out by the environment analysis. People who violate the management of protected areas can be subject to administrative and criminal sanctions.

Unesco does not define a geopark as a protected area but as a single geographic area with a geological heritage as a protected geological area and in Presidential Decree 9/2019. Establishing a geopark aims to explore, develop, and celebrate the relationship between geological heritage and all aspects of protected areas, culture, and intangible heritage. Geoparks contain not only geological heritage but also cultural, archaeological, and biodiversity heritage. Geopark is a concept of sustainable regional development that integrates all-natural components for conservation, education, and growth of local economic value [16].

The Global Geopark Network (GGN) defines geoparks as areas with clear boundaries that enable sustainable local development in social, economic, cultural, and environmental aspects. The concept of development area is carried out by managing various stakeholders to provide a significant regional impact for conservation, education, and improving the welfare of the surrounding community based on green tourism activities.

Based on [4,6,8,9,12,14] and expert opinion, geopark is a single geographic area with geological, biological, and cultural diversity with its main functions for conservation, education, and economic local development purposes. Geopark must have a geological heritage, where the geological heritage is a protected geological area. In the laws and regulations concerning protected areas, cultivation activities are prohibited except those that do not interfere with the protected function. The geopark concept is combines protected areas and cultivated areas with a single geographic boundary and a holistic concept for the welfare of its citizens where nature is preserved. The Unesco Global Network is getting more and more members; at present, there are 169 UNESCO Global Geoparks in 44 countries, in Indonesia, there are 6 UGG (http://www.unesco.org).

The development of geoparks in several countries has proven to positively contribute to sustainable tourism and local revenue (Table 1). In Indonesia, we can see the positive benefits of Gunung Sewu Geopark in increasing PAD, increasing tourism investment, and reducing poverty in Gunungkidul. Regional Original Income (PAD) in the three districts that are the location of the Gunung Sewu Geopark, namely Gunung Kidul Regency, Wonogiri Regency, and Pacitan Regency, has increased by almost 50%. In Gunungkidul Regency, from IDR 6.118 billion in 2013 to IDR 26.92 billion in 2019 (Figure 4).

| No | Destination Type | Indonesia | South Korea | Malaysia |
|----|------------------|-----------|-------------|----------|
| 1  | Management       | Badan Pengelola Geopark        | Jeju UNESCO Global Geopark | Langkawi UNESCO Global Geopark |
| 2  | Foreign Tourist  | Gunungsewu UNESCO Global Geopark | Jeju UNESCO Global Geopark | Langkawi UNESCO Global Geopark |
| 3  | Highlights       | 5.5 Millions | 7.7 Millions | 3.6 Millions |
| 4  | Amenity           | Hotels, restaurants, public transportation, shops, culinary | TIC, museum, hotel, money changer, public transportation, restaurant, etc. | TIC, hotel, villa, money changer, public transportation, rental, cable car, sky bridge, restaurant, etc. |
| 5  | Internasional Event | Gunung Sewu UGG Festival | Jeju International Wind Ensemble Festival | Langkawi International Water Festival |
| 6  | Management       | Gunungsewu | Jeju Province Management Committee for UNESCO | Langkawi Development Authority (LADA) |
Figure 4. Graph of the target and realization of Gunung Kidul Local Revenue (PAD) from the Tourism sector, in 2013 it became a national geopark, in 2015 it became a Unesco global geopark [2].

Kebumen Regency, since 2018 has had the Karangsambung – Karangbolong National Geopark (GNKK), which covers an area of 543,599 Km² in 12 Districts and 118 Villages. There are two geological protected areas within the GNKK area, Karangsambung geoheritage and the karst landscape area (Figure 5). Referring to the existing laws and regulations, in the protected geological area, cultivation activities (mainly mining) that damage the protected function cannot be carried out. Based on field observations, it turns out that in the two geological protected areas, there are still many illegal mining activities that should not be allowed because they have the potential to damage the protected function. The process of changing professions has begun to be seen with the emergence of community-managed tourism objects that provide significant financial benefits to the manager and the community around the tourism destination. The emergence of village-based tourism objects is an excellent opportunity to change the community's perspective on mining activities.

Kebumen Regency, the poorest district in Central Java, will develop this national geopark into a Unesco global geopark. In the Kebumen Regency Development Planning (RPJMD 2021-2025), the geopark is one of Kebumen's flagship programs, which is expected to be the locomotive of the Kebumen economy. In a geopark, there must be a geological heritage (geosite) which is a protected area. However, a geopark is not the same as a secure area because not all geopark areas are included in a protected area. Geoparks must also prosper the community so that cultivation activities must be carried out. The selection of the two geological protected areas in the geopark is the right choice in developing protected areas through the geopark concept. In geoheritage areas, cultivation activities still are carried out through sustainable economic development such as geotourism, plantation, and agricultural activities. It is hoped that the process of professional transfer in the community will be more and more in line with the development of geotourism in the geopark area. The existence of a geosite in a protected area should be managed by the village community to benefit economic improvement. However, the presence of the site is maintained well. The development of tourism villages around geosites driven by the community will provide significant benefits in geopark management. The purpose of geoparks is to natural protection and make its citizens prosperous.
5. Conclusion

In Kebumen Regency, there are 2 (two) geological protected areas are the Karangsambung geoheritage and the Karangbolong karst landscape, which are included in the Karangsambung Karangbolong Geopark Area. The two protected areas are many mineral potentials. Those are sand sediment, diabase, serpentinite, asbestos, marble, kaolin, clay, limestone, feldspar, precious stones, andesite, phosphate, bentonite, trass, manganese, gold, and bitumen shale. Illegal mining activities that have the potential to damage the environment are still around the area. Several geosites and other areas included in the geopark have developed into community-managed tourist villages, giving rise to local economic activities and alternative community profession transfers. The development of the Karangsambung Karangbolong Geopark is the right choice in the management of geological protected areas because it is in line with the goal of the geopark to prosper its citizens with a protected environment. With the development of the Nasional Geopark towards the Unesco Global Geopark, it is hoped that it can provide economic benefits to the community through sustainable tourism activities, but its natural preservation is maintained.

6. Acknowledgments

Thanks to the Karangsambung Karangbolong Geopark Management Agency and the Head of the Karangsambung Conservation and Information Center, LIPI, for the opportunity and support.

7. References

[1] Badan Pusat Statistik Kabupaten Kebumen 2021 Kabupaten Kebumen dalam Angka 2021
[2] Dinas Pariwisata Kabupaten Gunung Kidul 2017 Laporan Tahunan Pemerintah Daerah Kabupaten Gunung Kidul
[3] Ansori C and Hastria D 2012 Potensi Bahan Tambang, Penataan Wilayah Usaha Pertambangan (WUP) dan Wilayah Pertambangan Rakyat (WPR) di Kebumen J. Teknol. Miner. dan Batubara 8 107–18
[4] UNESCO 2021 UNESCO Global Geoparks (UGGp)
[5] Ansori C 2018 Geosite identification in Karangbolong High to support the development of
Karangsambung-Karangbolong Geopark candidate, Central Java *IOP Conference Series: Earth and Environmental Science* vol 118p 12014

[6] Presiden Republik Indonesia 2019 Peraturan Presiden Indonesia Nomor 9 Tahun 2019 tentang Pengembangan Taman Bumi

[7] Gray M 2004 *Geodiversity: valuing and conserving abiotic nature* (John Wiley & Sons)

[8] Menteri Energi dan Sumber Daya Mineral 2006 Keputusan Menteri Energi dan Sumber Daya Mineral Nomor 2817 K/40/MEM/2006 tentang Penetapan Kawasan Cagar Alam Geologi Karangsambung

[9] Menteri Energi dan Sumber Daya Mineral 2014 Keputusan Menteri Energi dan Sumber Daya Mineral Nomor 3873 K/40/MEM/2014 tentang Perubahan Atas Keputusan Menteri Energi dan Sumber Daya Mineral Nomor 3043K/40/MEM/2014 tentang Penetapan Kawasan Bentang Alam Karst Gombong

[10] National Geographic 2021 Conservation

[11] USDA 2014 What does conservation mean?

[12] Presiden Republik Indonesia 1990 Undang-Undang Republik Indonesia Nomor 5 Tahun 1990 tentang Konservasi Sumber Daya Alam Hayati dan Ekosistemnya

[13] IUCN 1968 *Proceeding of The Latin American Conference on The Conservation of Renewable Natural Resources*

[14] Presiden Republik Indonesia 1990 Keputusan Presiden Republik Indonesia Nomor 32 Tahun 1990 tentang Pengelolaan Kawasan Lindung

[15] Menteri Energi dan Sumber Daya Mineral 2016 Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 32 Tahun 2016 tentang Pedoman Penetapan Kawasan Cagar Alam Geologi Karst Gombong

[16] Samodra H 2016 *Pedoman membangun dan mengembangkan geopark*

[17] Menteri Pariwisata dan Ekonomi Kreatif 2020 Kebijakan Pengembangan Geopark di Indonesia