

CHAPTER II

LITERATURE REVIEW

A. Karst

The term "Karst" refers to a distinctive type of area that had developed from the dissolving action of water on soluble bedrock, primary limestone, and marble but also dolostone, gypsum and halite. Karst landscapes are characterized by fluted and pitted rock surface, shafts, sinkholes, sinking streams, spring, subsurface drainage systems, and caves. The unique features and three-dimensional nature of karst landscapes are the results of complex interplay between geology, climate, topography, hydrology, and biological factors over long time scale. Globally, examples of karst topography can be found at all latitudes and elevations, with rock types potentially containing karst covering approximately 20% of earth's land surface.¹

Karst zone is an area that has characteristic typical relief and drainage, especially caused by intensive rocks dissolving. Limestone is a rock that often to the occurrence of karst, karst landscape has sinkholes, sinking streams, caves, and spring. The term "karst" is derived from a Slavic word that means barren, stony ground. It is also the name of a region in Slovenia near the border with Italy that is well known for its sinkholes and spring. Geologist has adopted karst as the term for all such

¹ Tim Stokes, Paul Griffiths and Carol Ramsey, 2010, "Karst Geomorphology, Hydrology, and Management", https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/Lmh66/Lmh66_ch11.pdf, Accessed on November-12-2015 at 6.55 AM.

terrain. The term "karst" refers to the whole landscape, not a single or spring. Karst landscape most commonly developed on limestone, but can develop into several other types of rocks, such as dolostone (Magnesium carbonate or the mineral dolomite) gypsum, and salt. Precipitation infiltrates into the soil and flows into the subsurface from higher elevation generally toward a lower elevation. Weak acid found naturally in rain and soil water slowly dissolve the tiny fractures in the soluble bedrock, enlarging the joint and bedding planes.² Karst zone is the natural reservation area and has a potential as unrenewable natural resources and also has the unique natural phenomena and rare, thus the utilization of natural resources space for construction or mining must be carefully done to protect the environment and not causes some damage.³

The karst region—landscape of the carbonate rocks (limestone and dolomite) which shows the morphological form of karst hills, valleys, dolina and cave—has quantitative economic values that derived from direct benefits, such as recreation activities, and from indirect benefits, such as the ecosystem services of water preservation, erosion control, biodiversity conservation, an agent of controlling the climate change.⁴ Besides of that karst zones also have various potential resources for

² Kentucky Geological Survey, 2012, "Introduction to Karst Ground Water", https://www.uky.edu/KGS/water/general/karst/karst_landscape.htm Accessed on November-11-2015 at 10.00 AM

³ Hatma Suryatmojo, 2002, "Konservasi tanah di kawasan karst Gunungkidul", http://www.mayong.staff.ugm.ac.id/artikel_pdf/konservasi%20tanah%20di%20kawasan%20karst%20gunung%20kidul.pdf Accessed November-11-2015 at 12.55 AM

⁴ Brinkman, R., Garren, S., J., 2011. *Karst and Sustainability. Karst Management*. DOI : 10.1007/978-94-007-1207-2_16.

development such as land, biological resources, and landscape either at surface or subsurface.⁵

The karst zone is very unfavorable to mostly plants as seen from the land condition, limited nutrient and water, and too hot weather especially during dry season. Plants that live in this area will undergo an adaptation on the environment. Here are the multi-functions of karst;

1. Water Resources

Without a doubt, water is the most commonly used resources in karst zones. Although the lack of surface water is commonly characteristic of karst zones, they also contain some of the largest water producing wells and springs in the world. Until the development of well-drilling technologies, communities generally inhabit along the margins of karst zones, down stream from large springs that provided water for drinking, agriculture, and other uses. The cavernous nature of karst aquifer allows considerable volumes of water to be stored underground. This is especially valuable in arid climates where evaporation is high.

2. Mineral Resources

Prehistoric people found shelter and mineral resources in caves for flint (also known as chert) to make stone tools and for sulfate minerals and clays for medicines and paint pigment. In Europe, a soft speleothem known as moonmilk was used as poultice,

⁵ Suryatmojo, 2006. "Strategi Pengelolaan Ekosistem Karst di Kabupaten Gunungkidul." *Seminar Nasional Strategi Rehabilitasi Kawasan Konservasi di Daerah Padat Penduduk*. Fakultas Kehutanan UGM

an antacid, to induce mother milk, and to remedy other medical woes. The most common mineral resources extracted from karst zones is the quarried rock itself. Limestone, dolomite, marble, gypsum, travertine, and salt are all mined in large quantities throughout the world.

3. Earth History

Karst has an important role in increasing our understanding of the history of past climates and environments on earth. Sediments and speleothem or mineral deposit in caves are among the richest sources of paleoclimate information, providing a detailed record of fluctuations in regional temperature, atmospheric gasses, rainfall, ice ages, sea level changes, and plants and animals that once inhabited the areas during the past several hundred thousand years.

4. Ecology

Many species of bats, including those that form some of the world largest colonies, hang in the caves. Nectar-feeding bats are important pollinators, and a number of economical and ecologically important plants might not survive without them. Insectivorous bats makes up the largest known colonies of mammals in the world. Population from some of these colonies may far less complex than those on the surface, biologist study these animals for insights into evolution and ecosystem development.

5. Archaeology and Culture

From early times in human development, caves have served first as shelters, and later, as resources reservoirs and religious sites. Many of the world's greatest archaeological sites have been found in caves, where fragile materials that would easily be destroyed in other setting have been preserved.

6. Recreation

Karst zones provide three main types of recreational setting: commercial caves, wild caves, and scenic areas. For many people, their only exposure to the karst environment occurs when they visit commercial caves. There, they can view delicate and grand mineral displays, valuated chambers, hidden rivers, and other underground wonders.⁶

B. Conservation

The main focus in the protection of natural areas across the globe has been in the context of preserving landscape beauty, natural heritage, unique biological habitat. More recently, geology has emerged at the forefront of interest for many protected areas (Eder and Patzak).⁷ According to law No 4 of 1982, natural resource conservation is the management natural resources to ensure its use wisely and for renewable continuity of the stock

⁶ American Geological Institute, 2001, "Living With Karst", <http://www.agiweb.org/environment/publications/karst.pdf> accessed November-11-2015 at 5.23 PM

⁷ Eder, F.W., and Patzak, M., 2004. Geoparks Geological Attractions: A Tool for Public Education, Recreation and sustainable Economic Development, Episodes, 27, No.3., p.162-164

and to improve the quality of values and diversity.⁸ Conservation also can be viewed from economical aspect and ecological where conservation from economical aspect means as that tempt to allocate natural resources. In term of ecology, conservation is the allocation of natural resources for now and future. Conservation also can be interpreted as the action to keep the existence of something which is available in continuously sustainable either quality and quantity.⁹

In Indonesia, conservation activities should have been held in coordination with the government and society, including the communities, private organization or NGO, University, and others parties. Conservation national strategy was formulated into three implementation schemes;

1. The protection of life supporting system,
2. Preserving the diversity of plant species and animal and their ecosystem,
3. The use of sustainable organic resources and their ecosystem.

Conservation is regulating the use of the biosphere by human beings in order to obtain results that are sustainable for the present generation as well as to preserve the potential for the needs of future generations.¹⁰

⁸ Law no 4 of 1984 Article 1 Paragraph 4, concerning on The Principal Management of Environment.

⁹ Mochamad Hadi, "Konservasi Sumberdaya Alam dan Lingkungan", <http://core.ac.uk/download/pdf/11702495.pdf> Accessed on November-11-2015 at 2.02 PM

¹⁰ Ajie Rocan, 2014, "Pengertian konservasi", <http://birocan.dephut.go.id/ikk/webrocan/index.php/informasi/berita/42-pengertian-konservasi> Accessed on November-11-2015 at 1.53 AM

C. Geoconservation

Geoconservation, now a growing activity, is defined by Prosser (2013) as “action taken with the intent of conserving and enhancing geological, geomorphological and soil features, processes, sites and specimens, including associated promotional and awareness-raising activities, and the recording and rescue of data or specimens from features and sites threatened with loss or damage”.¹¹Conserving geodiversity is part of the core business of nature conservation (understood as the protection, preservation, management or enchantment and the improvement of understanding and appreciation of flora, fauna, and geological and geomorphological features. Geodiversity is essentially the abiotic part of the natural world; it is intimately linked with biodiversity and is the physical setting for life itself. It may be defined as the natural range or diversity of geological features (Rock, mineral, fossil, structures), geomorphological features (landforms and process), soil and water that compose and shape the physical landscaping, concrete, or other human landform and products.

Earth heritage resources have been exploited by humans for thousand of years, but the integrity and accessibility of these resources may be threatened in various ways. The principal threats can be summarized as:

1. Loss of geological exposures and/or information,
2. Damage to the physical area and its geomorphological features and process,

¹¹ Prosser, C.D., 2013. Our rich and varied geoconservation portfolio: the foundation for the future. *Proceedings of the Geologists' Association* 124, 568–580.

3. Damage to soil features and process,
4. Damage to groundwater and surface water,
5. Lack of public understanding about geodiversity, and why it is valuable to society for its contribution to economic life, science, wildlife, leisure, and recreation.¹²

D. Mining

Mining could be interpreted as an activity, technology and business related to the mining industry ranging from prospecting, exploration, evaluation, mining, processing, refining, transportation to marketing. The mining business is a mineral or coal exploitation business covering some or all phases of activities in general inspection, exploration, feasibility study, construction, mining, processing and purification, transportation and sales as well as post-mining.¹³ The legal basis on the mining sector is the 1945 constitutions article 33 paragraph 3 which stipulates that earth and water and natural resources are controlled by the state and used for the greatest prosperity of the people.¹⁴

According to Law No. 11 of 1967, mining materials are classified into three types; Group A (the so-called strategic materials), Group B (vital ingredient), and Group C (material does not strategic and vital). Group A materials are goods that are essential for the defense, security and strategic to ensure the country's economy and mostly only allowed to be owned by

¹² Tim Holt Wilson, 2015, "Introducing Geoconservation", <http://www.ukwildlife.com/index.php/conserving-geodiversity/introducing-geoconservation/> accessed November-11-2015 at 6.20 PM

¹³ Article 1, Mineral and Coal Mining Act 2009

¹⁴ 1945 Constitution Art. 33 paragraph 3

the government, such as oil, uranium, and plutonium. Meanwhile, the Class B material can guarantee the life of many people, for example, gold, silver, iron and copper. Group C materials are materials that do not belong to Group A and B¹⁵.

Mineral mining is the mining of mineral groups in the form of ore or rocks outside geothermal, oil and gas as well as ground water.¹⁶ There are four types of mineral mining groups, namely:

- a. Radioactive mineral mining
- b. Metal mineral mining
- c. Non-metal mineral mining
- d. Rock mining

The mining licensing system was regulated in Article 35 of Mineral and Coal Mining Act 2009. It is mentioned that there are three kinds of permit/licence in the mining business,¹⁷ namely:

- a. *Izin Usaha Pertambangan* or Mining Business Permit hereinafter referred to as IUP, is a permit to carry on a mining business.
- b. *Izin Pertambangan Rakyat* or Smallholder mining permit hereinafter referred to as IPR, is a permit to carry on a mining business in the smallholder mining area with limited area and investment.

¹⁵ Law no. 11 of 1967 on The Principal of Mining, section 3.

¹⁶ Gatot Supramono, 2012, *Hukum Pertambangan Mineral dan Batubara di Indonesia*, Jakarta, PT. Rineka Cipta, p.16

¹⁷ Article 35, Mineral and Coal Mining Act 2009

c. *Izin Usaha Pertambangan Khusus* or Special Mining Business Permit hereinafter referred to as IUPK, is business permit to carry on a mining business in the special mining business area.