Toward the Safe Live-able Built Environment around Ciletuh-Palabuhanratu Geopark Area in Sukabumi Regency, Indonesia

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Abstract. The newly appointed UNESCO Global Geopark of Ciletuh-Palabuhanratu is located around the Pelabuhan Ratu Bay in the southwestern part of Sukabumi Regency. There are several geosites in this geopark along the coastline included in 8 districts. This study area is marked by the presence of Cimandiri active fault in the form of river mouth to the bay. The active fault zone is home to several epicentres of shallow earthquakes in the study area. This paper is aimed to highlight the needs of creating disaster resilience community toward the safe live-able environment. Methodology in this study consists of analysing geological hazard potential maps and communities distribution in the built environment related to geotourism. Result of study shows that the geopark assignment has attract more tourists and visitors to this area than before. Some locations of geosites are found vulnerable of geological disaster such as earthquake and tsunami. It is relatively unsafe for the inhabitants and visitors when this geological event occurs. Several communities have attention to build disaster resilience through education stakeholders as well as disaster awareness for the public. It can be concluded that the ideas of disaster resilience for community are already started to be implemented eventhough there is still a lot work to do in supporting the safe live-able environment especially in facing the geotourism development in the study area.

Keywords: Geopark, earthquake, tsunami, urban development, environment, Ciletuh

1. Introduction

The newly appointed UNESCO Global Geopark of Ciletuh-Palabuhanratu is located around the Pelabuhan Ratu Bay in the southwestern part of Sukabumi Regency. There are several geosites in this geopark along the coastline included in 8 districts. Each of geosites is classified into geoarea based on its location. There are 3 geoareas namely Cisolok, Jampang and Ciletuh (see Fig.1). Each of geoarea has its own distinctive characteristics based on geo-diversity, bio-diversity and culture diversity as general guidance in geopark establishment.

The Cisolok geoarea has become main tourist destination since long time ago. It has several geotourism sites such as Cipanas hotspring, Karanghawu beach, Sukawayana beach where a 4 stars hotel had been established since 1960s, Cimaja beach famous for world class surfing, etc. Meanwhile, Jampang and Ciletuh geoareas have only been recently popular to the public due to the improvement of road and infrastructures for easy accessibility. This newly assignment of geopark has attracted more
people to visit due to extensive announcement in the media by the local, provincial and central government. In the long weekend and national holidays, more local and national even global tourists are attracted to visit these two geoareas.

![Figure 1. Location of the study area in Sukabumi Regency, Indonesia](image)

From geological point of view, this study area is marked by the presence of Cimandiri active fault in the form of river mouth to the bay. The active fault zone is home to several epicenters of shallow earthquakes in the study area [1]. The Cimandiri fault coincides with the course of Cimandiri River. This major river is located near the Pelabuhan Ratu Town as the capital of Sukabumi Regency, where the geomorphology consists of flat lowland to hilly area. This town is a major hub of transportation and served as the center of economy for Sukabumi Regency, therefore it is an important area to be safe and live-able city in the future.

Due to the geological condition of this study area, it is important to note that behind the natural beauty there are several potential disasters that might occur in the future. Earthquake and collateral damages such as tsunami, landslide and liquefaction are indispensable for the population and infrastructures. Therefore, disaster mitigation is very important when those geological hazards occur in the study area.

There are many ways to increase disaster mitigation for the community but the most important aspect is education sector [2]. The education stakeholders on disaster mitigation are important actors to support community-based disaster risk mitigation or CBDRM [3]. This paper is aimed to highlight the needs of creating disaster resilience community toward the safe live-able environment.
2. Method
Methodology in this study consists of analyzing geological hazard potential maps and communities distribution in the built environment related to geotourism. Based on the earthquake vulnerability map of Sukabumi Regency, several data of earthquake are observed currently to analyze the potential destructive earthquake as well as collateral disaster that might happen in the study area.

Field visit to Ciletuh and Cisolok geoparas were conducted especially to observe the role of education stakeholders in supporting the creation of disaster resilience community. Schools and education premises were visited while brochures and posters of disaster education were distributed among students, teachers and local population.

3. Result
Result of study shows that the geopark assignment has attracted more tourists and visitors to this area than before. They are attracted by the beauty of nature especially in the Ciletuh geoarea, where amphitheater, waterfalls, sandy beaches and turtle conservation in the front face of Indian Ocean are located. These geotourism locations are also inhabited by local communities, where cultural attractions such as art performances, local food and culinary are provided for the tourists. The geotourism site is generally located in a village where schools are central point of activity for the local people. This condition has made up the geosites as central of activity for people during weekdays, weekend and even holidays.

Based on the record of earthquake data, some locations of geosites are found vulnerable of geological disaster, including collateral damages such as tsunami, landslide, liquefactions, etc. Scenarios for disaster management are extremely important to face the unexpected geological events when there are crowd of people. When it happens, the emergency response phase could be more difficult if the people are not well prepared.

The human response on extreme natural event had been studied for the events of earthquake and tsunami [4]. Their study included a major earthquake on 17 July 2006 in Indian Ocean, which was followed by tsunami in Pangandaran beach of West Java Province. This tsunami claimed more than 600 casualties and destroyed hundreds of houses and infrastructures. This event had alerted the danger of southern coastline of West Java, which includes Sukabumi Regency. Potential disaster in the study area is increasing very recently due to higher concentration of people and infrastructures because of geopark assignment.

Figure 2. Earthquake vulnerability map of Sukabumi Regency containing Ciletuh-Palabuhanratu Geopark area. Note that the high vulnerability zone next to the bay is Cimandiri River.
Figure 3. A big earthquake (Magnitude of 6 in Richter Scale) was happened off the Pelabuhan Ratu Bay on January 2018. No tsunami alert was announced but damages of buildings and infrastructures were frequently reported.

Figure 4. Record of shallow earthquake events for the month of July, 2018 in and around the study area. BMKG recorded about 1287 earthquake events for this area.

4. Discussion
From the result above, currently it is relatively unsafe for the inhabitants and visitors when this geological event occurs in the study area. While humans can do nothing to avoid or diminished this event, the best practice is to reduce the risk of disaster.
Based on extensive study in Japan [5] it is stated that before the Great Hanshin-Awaji Earthquake of 1995 in Kobe City, disaster prevention had mostly been based on hard engineering solutions in Japan. Following this earthquake, the importance of people-based approaches and risk communication then became widely recognized throughout the country. There are many actions were taken in that area. Disaster education is one of people-based approaches in the areas that came to prominence.

From the lesson learned of Sendai earthquake in 2011 [6] it was mentioned that in the Great Hanshin-Awaji Earthquakes of 1995, about 80% of victims suffocated or were crushed to death beneath collapsing buildings or structures. While more than 90% of the deaths in the 2011 disaster were presumed to be by drowning because of tsunamis. Furthermore, with 65% of the identified victims aged 60 years and older, it is clear that many elderly people were unable to escape from tsunamis. This lesson learned is extremely helpful information to be communicated to the people in the study area through CBDRM activities.

Several communities have attention to build disaster resilience through education stakeholders as well as disaster awareness for the public. Disaster awareness education is one of the best choices to implement CBDRM in the study area. It is affordable and manageable to be conducted in such rural and remote area, where facilities of communication and health and infrastructures are still less developed [3].

Meanwhile, [7] it was reported the study on the disaster awareness campaign for students in the school based on the activities of boy-scout. This extra-curricular activity is mandatory in each school especially in elementary school level in Indonesia. It involves not only the students and teachers but also the parent-teacher association. For the study area, this kind of activity is very important and gained interest among participants.

In comparison of disaster education between Japan and Indonesia [8], appropriate disaster education related to earthquake appears to be essential ingredients in providing a prepared and safe school. In a school community where previous disaster response experience is limited, appropriate disaster education and training for students & teachers may increase the level of disaster awareness along with local people around the school premises.

The readiness to face potential disaster for local inhabitants is necessary in terms of escaping from tsunami or collapsed buildings, finding safe assembly points, determining safe evacuation routes and communicating the emergency to authority for quick response actions. The local people should be prepared and knowledgeable since their locations are visited by many tourists who do not know the local terrain condition.

Figure 5. Disaster awareness campaign for foreign students in the Summer Camp Program of Universitas Padjadjaran conducted in the office of Geopark Research Center in Ciletuh (left). Disaster
education for schools conducted by NERI from Japan while distributing the brochures of tsunami (right).

5. Conclusion

It can be concluded that the ideas of disaster resilience for community are already started to be implemented eventhough there is still a lot work to do in supporting the safe live-able environment especially in facing the geotourism development in the study area..

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