EARTHQUAKE HAZARD PERCEPTION OF THE EDUCATION STAKEHOLDERS IN SUKABUMI REGENCY, WEST JAVA, INDONESIA

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Abstract. The western part of Java is adjacent to the intersection of major tectonic plates between Eurasia and Indo-Australia. This region is often stricken by natural disasters due to its tectonic and geological setting, such as earthquakes, tsunamis, volcanic eruptions, floods, and landslides. West Java Province with more than 40 million inhabitants is the most populous region in Indonesia, where Sukabumi Regency in the southwestern part of this province is known for the frequent location of earthquake. In the southwestern part of Sukabumi Regency, the Ciletuh-Pelabuhan Ratu Geopark has been recognized as one of the newest UNESCO Global Geopark. This study concerns about assignment of Geopark area, which will increase the visit of tourists despite its vulnerable condition to earthquake event. Schools as part of education sector in the study area are functioned as central location for people-based education as well as shelter when disaster happens. This paper is aimed to reveal the perception of earthquake hazard and knowledge among school community as disaster stakeholders. This study is carried out on schools near the vulnerable areas to earthquake events. Several schools had been visited and examined the curriculum, disaster preparedness for earthquake, and mitigation activities. The earthquake brochures and GIS-based vulnerability maps were distributed to students and school’s library. Discussion about the maps with the teachers and students are conducted to examine the understanding of contents as well as to obtain their perception about earthquake. Results showed that earthquake vulnerability map increased the knowledge and gained positive perception on how to respond during earthquake event because initially most of participants were unaware what to do when earthquake happen. This result suggests that dissemination and improvement on perception to respond the earthquake are deeply needed. The school community as disaster stakeholder can play an important role on community-based disaster risk mitigation.

Keywords: Earthquake, hazards, perception, Sukabumi
1. Introduction
The western part of Java is adjacent to the intersection of major tectonic plates between Eurasia and Indo-Australia. This region is often stricken by natural disasters due to its tectonic and geological setting, such as earthquakes, tsunamis, volcanic eruptions, floods, and landslides. Since the aftermath of tsunami and earthquake in Aceh on December 2004, recently the awareness of geological disaster has increased in Indonesia [1].

West Java Province with more than 40 million inhabitants is the most populous region in Indonesia. Sukabumi Regency in the southwestern part of this province is known for the frequent location of earthquake due to the existence of the Cimandiri active fault [2]. The human response on extreme event had been studied for the events of earthquake and tsunami [3] including 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, which includes Sukabumi Regency (see Figure 1).

![Figure 1. Location of Sukabumi Regency in West Java Province, Indonesia](image)

In the southwestern part of Sukabumi Regency, the Ciletuh-Pelabuhan Ratu Geopark has been recognized as one of the newest UNESCO Global Geopark in 2018. This study concerns about the newly assignment of Geopark area, which will increase the visit of tourists despite its vulnerable condition to earthquake event. Schools as part of education sector in the study area are functioned as central location for people-based education as well as shelter when disaster happens. This paper aimed to examine the perception of earthquake hazard and knowledge among school community as disaster stakeholders

2. Materials and Method
Ministry of Education and Culture of the Republic of Indonesia in 2010 circulated a letter of national policy to endorse the subject of disaster risk reduction at school. This letter encouraged Governors, Regents and Mayors throughout the country to implement the disaster management efforts at schools [4]. All stakeholders of disaster in every region including school communities should have sufficient understanding to respond any disasters. In general, school communities have limitation on opportunities and knowledge about disaster education, which could imply to low understanding of disaster awareness [1].

Disaster prevention in Japan had mostly been based on hard engineering solutions before the event Great Hanshin Awaji Earthquake in January 1995 [5]. Following this earthquake, the
importance of people-based approaches and risk communication became widely recognized and considerable efforts were taken in Japan. Disaster education as one of people-based approaches then came to prominence [5].

Unlike the Great Hanshin and Awaji Earthquakes of 1995, in which about 80% of victims suffocated or were crushed to death beneath collapsing structures, more than 90% of the deaths in the 2011 disaster were presumed to be by drowning due to tsunamis [6]. 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 study is carried out on schools near the vulnerable areas to earthquake events. Several schools had been visited and examined the curriculum, disaster preparedness and perception of earthquake as well as mitigation activities. The earthquake brochures and GIS-based vulnerability maps were distributed to students and school’s library. Discussion about the maps with the teachers and students are conducted to examine the understanding of contents as well as to obtain their perception about earthquake.

3. Discussion and Conclusion
The geomorphological condition of Sukabumi Regency is prone to many types of geological hazards that can lead to disaster. Volcanic eruption in the northern part (border with Bogor and Lebak Regencies), landslides and floods in the middle part and earthquake as well as tsunami in the southern to southeastern part of Sukabumi Regency needed a special attention of disaster management for the upcoming unexpected event in the future. The geomorphology of Sukabumi consists of mountainous to hilly area in the northern part, hilly to undulated morphology in the middle part and flat to coastal area in the south, facing to the Pelabuhan Ratu Bay and the Indian Ocean (see Figure 2).

![Morphologic Map derived from DEM/SRTM in Sukabumi Regency](image)

**Fig. 2.** Morphologic Map derived from DEM/SRTM in Sukabumi Regency

From the morphologic map on Figure 2, it can be seen that adjacent to this bay there is a distinctive line of major fault, trending east-west direction as the location of the Cimandiri River. This Cimandiri fault is considered active fault zone [2]. From geological point of view, the existence of this active fault zone coincides with the possible occurrence of epicenters for shallow and major earthquake.
According to the Ministry of Education and Culture, disaster prevention curricula covers issues of earthquake, tsunami, volcanic eruption, floods, droughts, and fires as learning materials in schools [4]. Those natural disasters are included in several subjects of schools’ curriculum such as natural science, social studies, geography, and even religion. Therefore, in the school visit there is no specific subject named as disaster education or disaster prevention, even for local content of curriculum.

Education for disaster prevention in school is implemented by curricular and non-curricular activities. This implementation is intended as one method to enhance disaster awareness among its community as well as its supported population around the school premise [1] (see Figure 3). For the extra-curricular activities in the school, the role of Boy Scout movement (Gerakan Pramuka) has high possibility to be applied for disaster awareness campaign. These activities support the efforts on disaster risk reduction in the school as well to enhance good practice and perception during earthquake hazard [7].

Figure 3. Classroom interaction during school visit to obtain student’s perception on earthquake and tsunami hazards in their areas.

It can be concluded that appropriate disaster education related to earthquake in school is an important factor to support a safe school. In a school community with limited disaster knowledge and experience, disaster education and training for students & teachers may increase the level of disaster awareness [8]. This will lead to increase a better perception on how to manage disaster in community. A combination of GIS-based vulnerability maps of earthquake and interactive brochures are thought to be an effective way to increase earthquake hazard awareness as well as to encourage school community to create its own disaster management plan in the study area. The result suggests that dissemination of knowledge on earthquake preparedness is deeply needed. The school community as one of disaster stakeholders can play an important role on community-based disaster risk mitigation in the study area.

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References
[1] Muslim D, Haerani E, Shibayama M, Ueshima M, Kagawa N (2015) Disaster Awareness Education in Schools around Geological Hazards Prone Areas in Indonesia, in Lollino et al., (Ed) Engineering Geology for Society and Territory, Vol. 6, Springer Publ. Co., Switzerland, pp 107-112.

[2] Marliyani, G. I., Arrowsmith J.R., and Whipple K.X.(2016), Characterization of slow slip rate faults in humid areas: Cimandiri fault zone, Indonesia, Journal Geophysical Research: Earth Surface, Vol. 121, pp.2287-2308, doi:10.1002/2016JF003846

[3] Bird D.K., Chagué-Goff C and Gero A. (2011) Human Response to Extreme Events: a review of three post-tsunami disaster case studies, Australian Geographer, Vol.42, No.3, pp 225-239

[4] Amri A. (2017) Disaster Resilience Education, Ministry of Education and Culture of the Republic of Indonesia (Book in Indonesian Language), 79p.

[5] Iwahori T, Yamori K., Miyamoto T., Shirosita H., Iio Y (2017) Disaster Education Based on Legitimate Peripheral Participation Theory: A New Model of Disaster Science Communication, Journal of Natural Disaster Science, Vol.38, No.1, pp 01-15.

[6] Tamura M, Tabayashi Y, Ling F H, Ajima K, Mimura N, and Yasuhara K (2014) Analysis of Tsunami Evacuation Caused By The Great East Japan Earthquake: A Case Study of Ibaraki Prefecture, Journal of Japan Association for Earthquake Engineering, Vol.14, No.3, pp 1-20.

[7] Muslim G.O., Muslim F.N, Haerani E, Muslim D and Sophian R.I (2017) Disaster Awareness Campaign of Indonesian Boy Scout Gerakan Pramuka for Students in Bandung, West Java, Indonesia, Proceeding of the 2nd Join Conference of Utsunomiya University, Japan and Universitas Padjadjaran, Indonesia, pp 42-47 (http://pisces.lib.utsunomiya-u.ac.jp/dspace/bitstream/10241/10881/1/paper_07.pdf)

[8] Shibayama M, Kagawa N, Ueshima M, Muslim D (2012) Earthquake and Tsunami Disaster Prevention Education for Children in Indonesia, Abstract and Technical Program of the 34th International Geological Congress (IGC), Brisbane, Australia, p. 103, Paper #1560, Session of Geoscience Education