Assessment for Seismic Activities in Pesisir Selatan West Sumatra in 2018

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Abstract. The tendency of the recurring earthquake phenomenon in the same place in an area with a high seismic level has triggered an increase in earthquake activity in the region. Kabupaten Pesisir Selatan, which is located in West Sumatra Province, is a coastal area that is very close to the waters of the Sumatran sea as well as a source of destructive earthquakes that hit Sumatra. To anticipate the risk of future earthquakes and as an effort to increase public awareness and preparedness in the South Coast, in particular, it is necessary to provide understanding and knowledge of the seismic activities that have occurred there. The research method was carried out by collecting earthquake event data in the South Coast region for the period of January - December 2018 from the United States Geological Survey (USGS) data. The results of the analysis concluded, that in the Pesisir Selatan District there were frequent tectonic earthquakes, and also followed by landslides due to the contours of many hilly areas.

1. Introduction

West Sumatra Province is a region with a very high seismic level because it is on the path of a large world plate such as Eurasia, the Philippines, and the Indo-Australia. The source of the earthquake that most affected the area of West Sumatra was the Mentawai Megathrust line in the subduction zone, the Mentawai Fault and the Sumatra Fault [1].

One area in West Sumatra with a high seismic level is the area in Pesisir Selatan District. Kabupaten Pesisir Selatan is in the South of West Sumatra Province which is close to the sea in the western of the island of Sumatra. The western part is bordered by the Indonesian Ocean, the eastern part is bordered by Kabupaten Solok, Solok Selatan and Kerinci, the northern part borders with Padang City and the southern part borders on Kabupaten Muko Muko in Bengkulu Province [2].

Based on geographical location, it can be ascertained that Pesisir Selatan district is very vulnerable to earthquake and tsunami disasters because it is flanked by three earthquake zone sources as described above. The earthquake that occurred on December 2, 2018, at magnitude 4.6 and the earthquake on December 14, 2018, at 4.1 magnitudes was sufficient to prove that earthquake events in Pesisir Selatan district were quite frequent with adjacent times [3], [4].
2. Theory
2.1. Earthquake
Scientifically, earthquakes are physical phenomena, in which the sudden release of energy originates from the bedrock in the earth, which causes energy waves to reach the surface of the earth. These energy waves are also known as earthquake waves and turn into vibrations in the form of acceleration of the surface of the land so that it can affect everything above the surface of the land.

According to Wikipedia [5], earthquakes are vibrations that occur on the surface of the earth due to the sudden release of energy that creates seismic waves. The earthquake waves that occur are caused by the continuous movement of the earth's crust (the earth plate) so that the rocks collide with each other and interlock until the accumulation of energy until the time is released in the form of earthquake energy.

2.2. Significant West Sumatra Earthquake
West Sumatra Province is a region with a high seismic level. History records, destructive and significant earthquakes that have hit West Sumatra such as the earthquake in 1822, 1835, 1981, 1991, 2005 and 2009 in Padang, 1926 and 1943 in Singkarak, 1977 in Pasaman, 2003 in Agam, and 2007 in Bukittinggi. Then the earthquake that followed the tsunami disaster in 1861 and 2010 in Mentawai and 1904 in Sori-sori [1].

Figure 1. Damage due to earthquake [1].
2.3. Source of Earthquakes in Kabupaten Pesisir Selatan

Pesisir Selatan District is located at coordinates 0.983 - 2.317 LS and 100.316 - 101.305 BT [2]. Geologically, Kabupaten Pesisir Selatan is in the west of Sumatran seas which is close to the Mentawai subduction zone and Megathrust. In addition, the existence of a large Sumatran fault in the mainland of the island of Sumatra has also caused this area to be in a very high threat of seismicity.

Generally, the source of the earthquake that often affects daerah Pesisir Selatan comes from the subduction zone in the sea and the Sumatra Fault located on the mainland of Sumatra. Subduction zones in the western part of Sumatra island are formed from the Indo-Australian plate which dips below the Eurasian plate as far as 40° slope at 52 mm / year in the north and 60 mm / year in the south [7].

The last earthquake in Pesisir Selatan in 2018 was the earthquake on December 12, 2018, with magnitude 4.6 SR, the effect of which was felt up to Padang and its surroundings on a scale II MMI with the source of the depth of the earthquake 32 km. Based on BMKG [8], this earthquake is a shallow earthquake with a mechanism of upward fault.

In addition to the subduction zone, another source of the earthquake that often disrupts Kabupaten Pesisir Selatan is the Mentawai Fault which is parallel to the Sumatra fault, with a movement of 5 mm/year [9].

Figure 2. Pesisir Selatan Region [6].
3. Methodology
This research is a study with literature study, where the data obtained are secondary data in the form of seismic historical data obtained from the United States Geological Survey (USGS) [10] with time from 1 January 2018 to 31 December 2018, from magnitude 2.5 to 9.0 Mw, which had happened in the area of Kabupaten Pesisir Selatan and its surroundings.

4. Discussion and Result
This research was conducted to find out and identify how high the seismicity that occurred in the study area during 2018. From the research that has been done, the seismic level in Kabupaten Pesisir Selatan based on USGS occurred eight times with a maximum magnitude of up to 4.9 MW. This earthquake includes a medium earthquake, and on average it occurs mostly in the sea, namely in the subduction zone.

Figure 3. Center for earthquakes in subduction zones that affect in Pesisir Selatan on August 1, 2018 [9].
Figure 4. Determining the coordinates of the study area on Pesisir Selatan (usgs.gov) [10].

Table 1. Seismic data during 2018 on the South Coast according to USGS [10].

| No | Time      | Mag. | Depth (km) |
|----|-----------|------|------------|
| 1  | 2018-01-04| 4.3  | 149.8      |
| 2  | 2018-02-12| 4.6  | 68.2       |
| 3  | 2018-02-19| 4.4  | 76.4       |
| 4  | 2018-06-03| 4.3  | 70.2       |
| 5  | 2018-06-26| 4.6  | 55.1       |
| 6  | 2018-07-28| 4.5  | 64.5       |
| 7  | 2018-07-31| 4.9  | 55.4       |
| 8  | 2018-09-09| 4.3  | 55.8       |
| 9  | 2018-12-14| 4.1  | 36.1       |

Figure 5. Distribution of seismic activity in Pesisir Selatan during 2018 with Satellite photos [10].
5. Conclusions
The conclusions of this study are:
1. The earthquake data used is seismic data in Pesisir Selatan during 2018 from USGS
2. During 2018 there were 8 earthquakes of up to 4.9 MW in Pesisir Selatan.
3. The earthquakes that have occurred in Kabupaten Pesisir Selatan during 2018 generally come from earthquakes in the subduction zone.

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