MICRO-ZONATION STUDY OF POTENTIAL SEISMIC HAZARDS BASED ON PEAK GROUND ACCELERATION (PGA) VALUE IN THE NORTH KONAWE OFFICE AREA

Prasepvianto Estu Broto, Nidya Lena Fitriah Laksana, Muh. Said L, Hernawati, Sefrilita Risqi Adikaning Rani*

Jurusan Fisika , Fakultas Sains dan Teknologi, Universitas Islam Negeri Alauddin , Jl. H.M. Yasin Limpo No. 36 Romangpolong Kec. Somba Opu, Gowa, 92118, Sulawesi Selatan, Indonesia.

*e-mail: sefrilita.rani@uin-alauddin.ac.id

ABSTRACT

The purpose of this study was to determine the potential for seismic hazard based on the peak ground acceleration value in the North Konawe office area. This study uses the HVSR method to obtain the dominant frequency, amplification factor, dominant period, seismic vulnerability index and Peak Ground Acceleration. The results obtained from the microzonation of the distribution of the dominant frequency value with a high category were found at 5 measurement points, the amplification factor with a low category was found at 1 measurement point, the dominant period with a low category was found at 6 measurement points and the seismic vulnerability index with a low category was found at 5 points. measurement. Overall the research area is included in the level of seismic hazard risk, not high potential but in the low category. While the microzonation of the distribution of PGA values obtained values ranging from 23,2381-23,3231 gal which belong to the low seismic hazard risk level. Where it can be described in this area the earthquake that occurred can be felt by many people but caused damage. The light objects that were hung swayed and the windows shook. So it can be concluded that this research area is included in the category of low seismic hazard level.

Keywords: *Earthquake; Geopsy; HVSR; Microzonation; PGA*

INTRODUCTION

The North Konawe area is one of the regencies in Southeast Sulawesi province consisting of 10 sub-districts, namely Motui, Oheo, Sawa, Wiwirano, Andowia, Asera, Langgikima, Lasolo, Lembo and Molawe which are located in the eastern mandala (East Sulawesi Ophiolit Belt) with a Lith tectonic structure in the form of ophiolite composed of mafic and ultramafic rocks and Triassic Miocene sedimentary rocks. During the Miocene, there was a Compression event. This compression event is caused by the continental collision in the west, making this area prone to earthquakes or seismic disasters. Earthquakes occurred thousands of times in North Konawe in the last 2 years in the range of 2019-2020 with a magnitude of 3.0-5.0 M, mostly due to the activity of the Lawanopo fault. North Konawe Regency is one of the areas traversed by the Lawanopo fault which passes through several Asera and Andowia sub-districts, precisely at the North Konawe Office (Sompotan, 2012).

The North Konawe office is a research area included in the Asera and Andowia sub-districts. The North Konawe office becomes the central point of the North Konawe government because this area is a local resident's facilities and infrastructure. In the design of the North Konawe office building, it must be made in such a way that the building is resistant to natural disasters, one of which is earthquake or seismic. Seismic disasters can be detected using microtremor data and broadly the level of damage caused by an earthquake depends on the strength and quality of the building(Mase et al., 2021) (Mukhopadhyay & Bormann, 2004). Therefore, micro-zonation is needed to identify areas that are prone to earthquake disasters (*PERDA Kab. Konawe Utara No. 6 Tahun 2016 Tentang Rencana Pembangunan Jangka Menengah Daerah Kabupaten Konawe Utara Tahun 2016-2021 [JDIH BPK RI]*, n.d.)

Micro-zonation is the division of areas according to the characteristic parameters considered including amplification factors, dominant periods and ground vibrations in the form of maps that can describe areas that have the potential to be vulnerable to natural disasters. Micro-zonation maps can be combined with microtremor data so that they can describe areas that are prone to disasters and can be taken care of in those areas (Rehman et al., 2021). Micro-zonation maps depicting strong ground vibrations will suffer high damage in areas with high seismic susceptibility (Anggraeni Putri et al., 2016)

Maximum ground vibration movement (PGA) is the peak or largest ground vibration acceleration value in a place due to an earthquake so that ground acceleration becomes a benchmark in calculating earthquake-resistant buildings (Puteri et al., 2019) (Raduan et al., 2018). The greater the PGA value, the greater the vulnerability index of the soil of an area or building to seismic risk. Soil vulnerability index is an index that shows the level of vulnerability of the surface soil layer to earthquakes or seismic events. In determining the soil vulnerability index, local geological factors need to be considered and can be used as a reference (Anindya Putri et al., 2017).

The use of microtremor data has also been carried out by Amaliyah (2017) in Alla District, Enrekang Regency by conducting research on the level of earthquake risk based on analysis of micro seismic measurements in order to obtain data to analyze the effect of PGA values on earthquake intensity. It is known that the distribution of PGA values is usually in the low to moderate category, namely in the range of 0.8501 to 31.7304 gal. The range of ground vibration acceleration scale values is between <2.9 - 88 gal. The geological conditions of the local area affect the PGA value obtained and the distance from the seismic source which is used as a seismic reference to the measurement location (Amaliyah, 2017)

The North Konawe office was used as the study area because of the different geological conditions, which are prone to disasters. So that in this study, the analysis of the level of disaster risk in the area will be discussed using microtremor data. The microtremor data was then analyzed using the Peak Ground Acceleration value to determine the analysis of the level of earthquake risk in the North Konawe office area.

METHODS

The research area is located in the North Konawe district, Southeast Sulawesi province with an astronomical location at 3° 30’ 37”-3° 31” 2,5” LS and 122° 6’ 25”-122° 6’ 55” BT (fig.1). This study uses Geopsy software, google earth software, Microsoft excel software, arcgis software 3.16.8 and surfer 15 software. The secondary data used in this study are microtremor data and earthquake data for 2000-2020 from the BMKG. The stages in this research include literature study, making survey design, data collection and data processing. At the data processing stage, namely changing the data that has been collected in the form of a trace format starting from the measurement points K1 to K9, then changing the trace format data to minisheed format, processing data that has been in minisheed format with Geopsy software, processing data from Geopsy software using the Geopsy software method. HVSR so that the dominant frequency value (f_0) and amplification factor (A_0) (ie the peak/maximum amplitude value) are obtained, calculate the dominant period value (T_0) and the seismic vulnerability index value (Kg) by entering the values (f_0) and (A_0) which have been obtained, calculate the value of ground vibration acceleration / PGA after obtaining the dominant period value (T_0), create a distribution contour using the obtained values, namely the dominant frequency value (f_0), dominant period (T_0), amplification factor (A_0), seismic susceptibility index (Kg) and PGA values as well as create a micro zonation map of the area by entering the contours of the distribution of the values of each parameter with a geological map.gi that has been digitized previously in ArcGis 10.3 software, Interprets the distribution of values for each parameter by adjusting the geological and soil conditions of the area around the measurement point

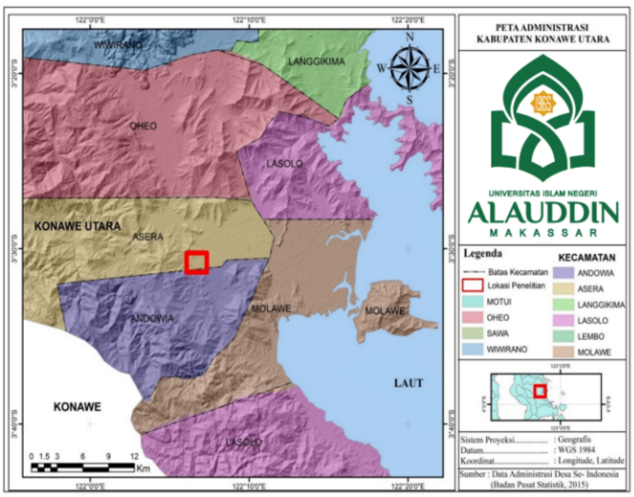

Figure 1. Research site map

RESULT AND DISCUSSION

Parameters to analyze the level of seismic hazard risk include dominant frequency (f_0), amplification (A_0), dominant period (T_0), seismic vulnerability index (Kg) and Peak Ground Acceleration (PGA). The results of the analysis of some of these parameters can be observed as follows:

a. Dominant frequency (f_0)

The dominant frequency is the frequency of rock layers in an area that describes the type and characteristics of the rock. In the micro-zonation of the distribution of the dominant frequency values in the measurement area, there are three frequency categories. For frequencies with low categories, there are two measurement points. For frequencies with moderate categories, there are two measurement points. As for the frequency with the high category, there are five measurement points. Areas with low category frequency values are indicated as areas of high seismic hazard risk. Areas that are vulnerable to seismic hazard risk are at the measurement points K4 and K7. The following are the results of the micro-zonation of the dominant frequency value distribution (A_0):

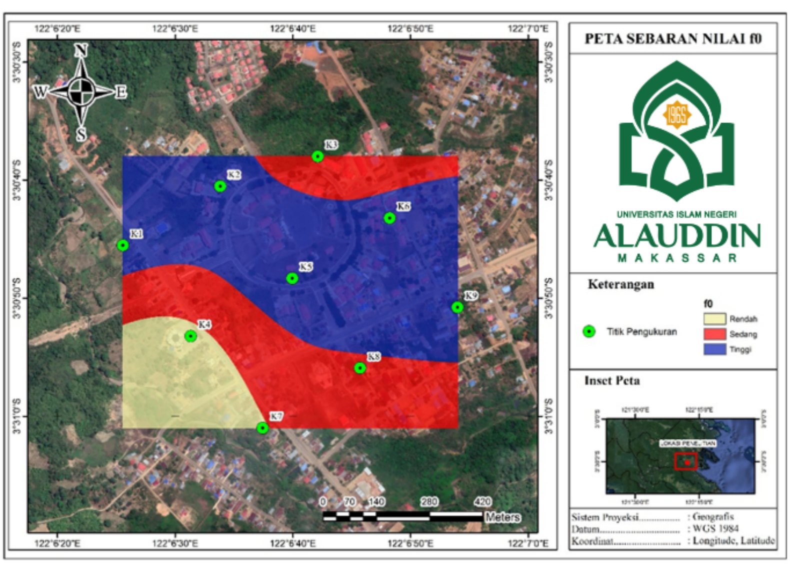

Figure 2. Dominant frequency value distribution map of micro-zonation (f_0)

Figure 2 states that the research area is dominated by measurement points with a high dominant frequency value. There are five measurement points. So that this research area is included in the level of low seismic hazard risk.

b. Dominant Period (T_0)

The dominant period is the time it takes for the wave to propagate through the sediment layer that bounces once to the surface in the reflecting plane. In micro-zoning the distribution of dominant period values, it can be seen that there are three categories, namely high, medium and low. In the dominant period with the high category there is one measurement point. In the dominant period with the medium category there are two measurement points. Meanwhile, for the dominant period in the low category, there are six measurement points. Areas with high period values are indicated as areas of high seismic hazard risk. Areas that are vulnerable to seismic hazard risk are K4 measurement points. Figure 3 is the result of the micro-zonation of the dominant period value distribution.

Figure 3 depicts the research area dominated by measurement points with the value of the low category dominant period being found at five measurement points. So that this research area is included in the level of low seismic hazard risk.

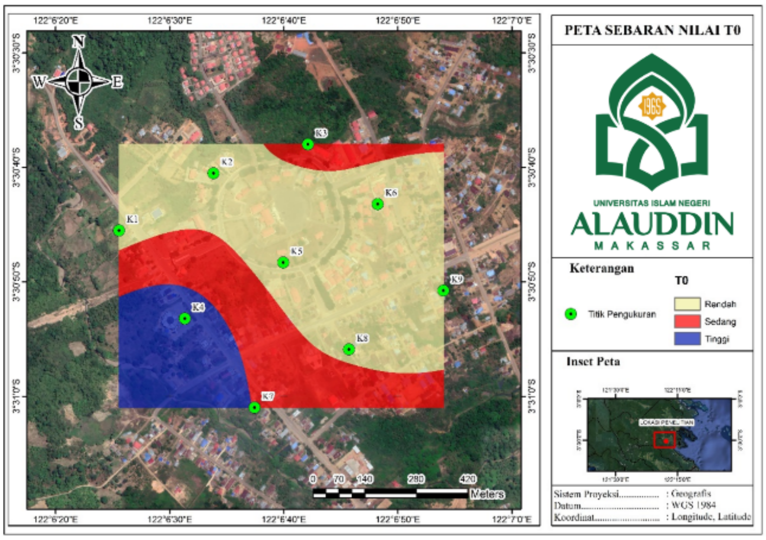

Figure 3. Dominant period value distribution map (T_0)

c. Amplification Factor (A_0)

Amplification factor is a magnification factor in seismic waves that occurs due to large changes between layers from a hard medium to a softer medium. Unlike the case with the dominant frequency value, the value of this amplification factor is directly proportional to the dominant period. A high dominant period value indicates the tendency of an area to experience a high amplification factor so that it is vulnerable to seismic hazard risk. In the micro-zonation of the distribution of amplification values, it can be seen that there are three categories, namely very high, medium and low. In the low category, there is one measurement point for the amplification factor. On the medium amplification factor there are seven measurement points. While the amplification factor in the very high category has one measurement point. Areas with high amplification factor values are indicated as areas of high seismic hazard risk. Areas that are low in seismic hazard risk are K3 measurement points. Figure 4 illustrates the results of the micro-zonation of the amplification factor value distribution.

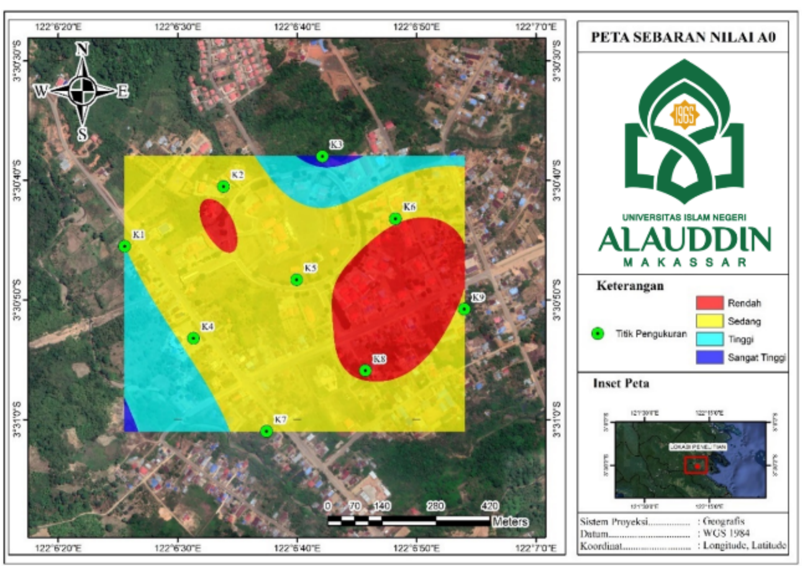

Figure 4. Micro-zonation map of the distribution of amplification factor values (A_0)

Figure 4 depicts the research area dominated by measurement points with the dominant period value being in the medium category at seven measurement points. So that this research area is included in the level of moderate seismic hazard risk.

d. Seismic vulnerability index (Kg)

Seismic vulnerability index (Kg) is an index that shows the level of vulnerability to seismic. The seismic vulnerability index aims to detect areas that are included in the weak zone during an earthquake. In the micro-zonation of the distribution of seismic vulnerability index values based on the classification of seismic vulnerability index values by Refrizon, it can be seen that the high category is at the K3, K4 and K7 measurement points. The value of the seismic vulnerability index in the medium category is at the K1 measurement point. Meanwhile, the value of the low category seismic vulnerability index is found at the measurement points K2, K5, K6, K8 and K9. Figure 5 is the result of microzoning the distribution of the seismic vulnerability index value.

Figure 5 shows that the research area is dominated by measurement points with the value of the low category dominant period being found at five measurement points. So that this research area is included in the level of low seismic hazard risk.

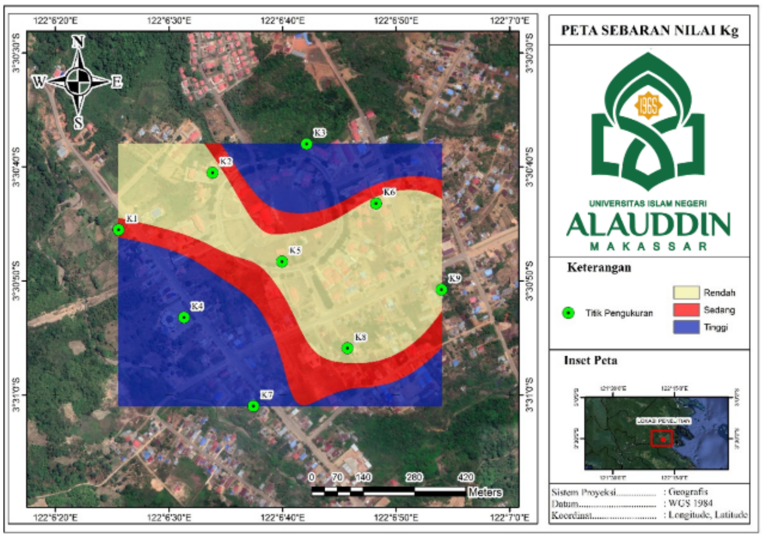

Figure 5. Micro-zonation map of the distribution of seismic vulnerability index values (Kg)

e. Peak Ground Acceleration (PGA)

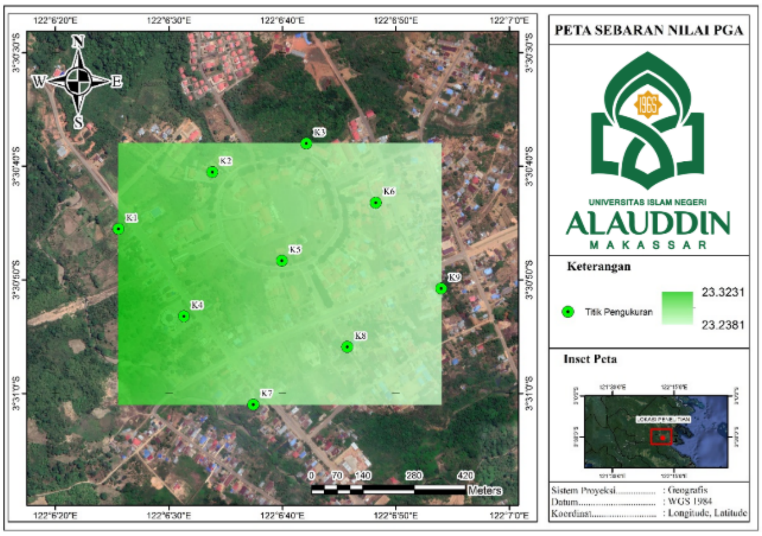

Figure 6. Peak Ground Acceleration (PGA) distribution micro-zonation map

Maximum ground vibration acceleration (PGA) is the peak ground acceleration value caused by earthquake waves. Based on the earthquake intensity scale, there are 5 scales, namely scale I is not felt with a PGA value less than 2.9gal, scale II is felt with a PGA value of 2.9-88gal, scale III is mild damage with a PGA value of 89-167 gal, and scale III is mild damage with a PGA value of 89-167 gal. IV moderate damage with a value of 168-564 gal and V scale severe damage with a PGA value > 564 gal. Judging from the level of damage, scale IV has the potential to pose a seismic hazard. The research area is included in the scale II, which is felt by many people but does not cause damage. The light objects that were hung swayed and the windows shook. Figure 6 shows the results of ground vibration acceleration (PGA) micro-zonation.

Figure 6 shows the measurement points in the research area as a whole are at the measurement point with a low category PGA value with values ranging from 23.2381 to 23.3231 gal. Where it can be described in this area the earthquake that occurred can be felt by many people but caused damage. The light objects that were hung swayed and the windows shook. So that this research area is included in the level of low seismic hazard risk.

CONCLUSION

Based on the results of data processing, it can be concluded that the results of the study are as follows: Microzonation of seismic hazard potential based on the PGA value in the North Konawe region, which is at a PGA value of 2.8-88 gal which is included in scale II, which is a low category which explains that if an earthquake occurs the area this was felt by the crowd but caused no damage except that the light objects that were hanging swayed and the windows vibrated. So that the North Konawe office area has a low seismic hazard potential. The Microzonation method by looking at the PGA value is very beneficial in interpreting data on potential areas with certain seismic hazards.

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