Preparedness community and potential of liquefaction due to earthquake occurred in the village baturetno sub-district banguntapan yogyakarta regency

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Abstract. Baturetno village was one of the areas affected by the Yogyakarta earthquake on May 27, 2006 which left thousands dead, seriously injured, and destroyed buildings on the ground. The condition of the Bantul Regency area with hilly nature which has a labile soil structure causes the soil to become unstable and to see the geological conditions, Baturetno Village, Banguntapan District, Bantul Regency has the potential to be threatened by liquefaction caused by the earthquake. The purpose of this study was to identify: (1) the level of knowledge of the people in Baturetno Village regarding liquefaction and earthquakes and (2) the level of community preparedness in Baturetno Village regarding liquefaction and earthquakes. The research method used is a quantitative method with a descriptive approach. The population in this study were all people in Baturetno Village as many as 14,345 people, while the study sample was 99 residents with sampling techniques using systematic stratified sampling techniques. Based on the results of the study it can be concluded that: (1) the level of knowledge of the Baturetno Village community regarding liquefaction and earthquakes is less readily available for total realty with an index value of 40-50, which means that the attitude is not ready and the percentage 57%. Meanwhile, (2) the level of community preparedness is known to be ready to face liquefaction due to earthquakes and mobilization from the community stating that they are prepared in terms of preparedness of 70%, which means that the community is responsive and alert to natural disasters. In accordance with what has been described above, the need for efforts to increase the level of knowledge and preparedness in the face of liquefaction and earthquakes.

1. Introduction
Indonesia lies between the meeting of three earth crust plates, namely Indo-Australia, Eurasia, and the Pacific. The Indonesian archipelago is an area that is at a meeting between two major earthquake lines, namely the Mediterranean earthquake line and the Pacific Circum earthquake pathway, so that Indonesia has the potential for an earthquake. Bantul Regency is an area directly adjacent to the Indian Ocean and is the closest area to the Indo-Australian and Eurasian plate subduction zones. The Yogyakarta earthquake that occurred on May 27, 2006 caused thousands of deaths and suffered severe injuries and buildings were destroyed on the ground.

The impact of the disaster is very varied, ranging from damage, losses, and can even cause casualties. Based on the Indonesian Disaster Information Data (DIBI) during January to April 2019, there were 1,586 disasters that caused 325 deaths, 113 people were lost, 1439 people were injured, 996,143 people were displaced and affected, 22,253 houses were damaged. More than 98% of
disasters that occur are hydrometeorological disasters, while 2% are geological disasters. Judging from
these figures, the incidence of natural disasters in Indonesia is increasing and often occurs.

The occurrence of earthquakes in Indonesia between 2004-2006 became an important event to be
recorded as history in this modern century and has been felt by the wider community as a natural
disaster. In general, large intensity earthquakes followed by tsunami waves have resulted in fatalities,
for example, which have occurred in Banda Aceh, Padang, Pamong, and Cilacap, to the south of
Yogyakarta. Earthquakes occur almost every time in Indonesia and from all earthquakes that occur in
the world, about ten percent are concentrated in Indonesia each year, both with very little power and
only recorded by large earthquake recording instruments that can be damaged and felt by humans [1].
Earthquakes are natural disasters that occur below the surface of the soil which can cause damage to
the soil structure. Damage to the soil is caused by the amount of energy released by the epicenter
(hypocenter) in the form of vibrations that propagate on the surface of the earth. One of the impacts is
damage to the soil structure caused by earthquakes and often referred to as liquefaction.

Bantul Regency is one of the five regencies or cities in the Special Province of Yogyakarta (DIY).
The area of Bantul Regency is located between 110 ° 12'34" to 110 ° 31'08" East Longitude and
between 7 ° 44'04" to 8 ° 00'27" South Latitude. The condition of the Bantul Regency area with hilly
nature which has an unstable soil structure causes vulnerability to landslides and flash floods with high
rainfall intensity. In addition, Bantul Regency is also located at the meeting of the Eurasian plate with
Indo-Australia. Geologically, on the south there is the South Coast and is closely related to volcanoes
in Sleman Regency, so it is very prone to earthquakes followed by tsunamis.

Based on these conditions, Bantul Regency allows the occurrence of a disaster, both caused by
natural factors, non-natural factors, and human factors that can cause human casualties, environmental
damage, property losses, and psychological impacts that in certain circumstances can hinder regional
development [2]. Facts have proven that earthquakes have occurred in Bantul Regency during the first
(first) quarter period of 2016. Bantul Regency has geological character around the subduction zone,
this zone is about 00-250 Km from the southern coastline of Java and potentially cause an earthquake.
The earthquake that took place in Bantul district on May 27, 2016 had a shock strength of 5.9 ritcher
scale to shake the Yogyakarta and surrounding areas including Bantul, Kulonprogo, Gunung Kidul,
Sleman, Solo, Karanganyar, Klaten, and Prambanan. The source of the earthquake centered on 37 Km
of coastline with the epicenter at the base of the Indian Ocean at the 8,26˚ LS 10.31˚ BT coordinate
has caused around 500 fatalities. Earthquake activity has triggered cesarean movements in the Bantul
region and its surroundings. The active fault is identified as forming a straight line starting from the
epicenter towards the northeast to Prambanan.

The southern part of Central Java Province, including the city of Yogyakarta and its surroundings,
is one of the earthquake prone areas. On May 27, 2006 there was an earthquake in the Yogyakarta
region to the districts of Bantul, Klaten, Gunung Kidul, and Kulonprogo. The United State Geological
Survey (USGS) recorded an earthquake occurred at 05:53:58 WIB with the position of the epicenter
7.97˚ South Latitude and 110.44, East Longitude, with a depth of 10 Km, and a moment magnitude of
6.3 scale ritcher. (http://earthquake.usgs.gov/). As an earthquake-prone area, these areas are dominated
by quarterly deposits and are still loose or not yet solid, especially late holocene deposits. Meanwhile,
these loose sediments generally originate from swamp deposits and alluvial fan deposits. Quaternary
sediment itself occupies around 35% of the entire land area of Indonesia, where the development of
development tends to be concentrated in this region. The unbroken deposition is a fragile area due to
liquefaction processes, where liquefaction is one of the main factors causing damage to buildings from
an earthquake event [3].

The threat of geological hazards, especially the event of liquefaction when a large earthquake in a
seismic zone or earthquake path is something that can occur and can cause extensive damage to
buildings and infrastructure facilities in urban areas in Indonesia. Liquefaction events can cause
subsidence, collapse, tilting in buildings, soil cracks, landslides and others. Likuifaksi is a solid phase
change event into a liquid phase caused by an increase in pore water pressure in the soil cavity [4].
The impact of an increase in pore water pressure, the soil will lose the shear strength drastically due to
the decrease in the effective stress of soil pore[5]. This event is mainly related to the condition of saturated soil that has a loose or medium density. Some examples of liquefaction events that have occurred in Indonesia were damage caused by earthquakes in Bengkulu in 2000 and 2007, the Aceh earthquake in 2005, and the Yogyakarta earthquake in 2006 [9].

Liquidation research in several countries shows that liquefaction events and distribution of liquefaction damage generally only occur in areas formed by a layer of granular sediment that saturates water with a low density and the possibility of movement on the surface exceeds a certain threshold value [7]. Liquidation often occurs in sandy soil loose and saturated when an earthquake occurs. The threat of geological hazards, especially liquefaction events when an earthquake is something that can occur and can cause extensive damage to buildings and infrastructure facilities in urban areas.

Zoning of earthquake areas is usually based on microzonation work on acceleration of seismic soil surface or rock layers [8]. Liquefaction events are more widely known to evaluate the potential for infrastructure damage. This liquefaction will cause damage to the building above it [9]. Greater earthquake magnitude and acceleration cause many layers of soil to experience liquefaction and trigger damage at the ground surface, liquefaction potential, and land subsidence are affected not only by seismic parameters, but also by soil lithology [10, 11].

The Yogyakarta Special Region (DIY) did not escape the effects of seas from the sea due to a system of subduction zone activities from collisions between the Indo-Australian oceanic plate and the Eurasian continental plate and on land due to the movement of the active fault system [12]. History records that earthquakes began on 10-6-1867 which caused damage to buildings in Yogyakarta, Klaten to Surakarta. These frequent earthquakes have triggered liquefaction events in the Bantul area. This is caused by the geological environmental conditions of some alluvium deposits in the condition of the groundwater, active opaque fault zone pathways and in the Bantul grip [13]. By looking at such geological conditions, Baturetno Village, Banguntapan District, Bantul Regency has the potential to be threatened by liquefaction. The potential for liquefaction in the study sites is potentially medium and the direction of the opaque fault (east) has a higher potential.

Potential threats that can threaten the region can affect the people in the Bantul area. Therefore, the community needs to know about preparedness regarding the threat of liquefaction and mitigate it with the aim of reducing the risk of liquefaction. This study aims to identify the level of preparedness and to know the level of public knowledge about liquefaction in Banguntapan Village. The results of this study are expected to be useful as input for information to enrich the knowledge repertoire and as a material for consideration in determining better policy steps in the future and an overview of the level of preparedness and level of knowledge of the community regarding liquefaction in Baturetno Village, Banguntapan District, Bantul Regency.

Figure 1. Map of Location of Liquidation Events in the Yogyakarta-Klaten Area during the Yogyakarta Earthquake (Geotechnology Research Center-LIPI)
2. Methods
The research location was carried out in Baturetno Village, Banguntapan Sub-District, Bantul Regency. This research was conducted using survey methods and data analysis techniques used were descriptive data analysis techniques with correlation data analysis. This research was conducted with descriptive quantitative research. In this research phase, the population of all communities in Baturetno village was determined by using a stratified systematic sample technique, the variable used to determine preparedness refers to the Indonesian Institute of Sciences (LIPI), which is about knowledge and attitudes, policies and guidelines, emergency response plans, disaster warning and mobilization systems, and community preparedness in the face of earthquake and liquefaction disasters.

Data collection techniques in this study used instruments in the form of questionnaires and structured interviews. The questionnaire was used to determine the level of knowledge of the community, structured interviews were used to determine the level of preparedness and knowledge. Descriptive data analysis was used in this study, namely descriptive statistics by describing the collected data. Presentation of descriptive statistical data through tables, graphs, circumference diagrams, and percentages.

2.1 Knowledge Analysis
The index of public knowledge on disasters of earthquake disaster preparedness and preparedness is sought by using a questionnaire with 40 questions that must be answered, with choices "YES", "NO", and "DO NOT KNOW". The answer "YES" has a value of 1, the answer "NO" and "DO NOT KNOW" has a value of 0. The public knowledge index regarding knowledge of earthquake disaster preparedness and preparedness uses the following formula:

\[
\text{Maximum Value} = \frac{\text{number of questions} \times \text{number of respondents}}{\text{real value/\text{max value}}} \times 100\%
\]

2.2 Scale of Community Knowledge Assessment
The scale of the average assessment of people's understanding of knowledge of disasters of liquefaction and earthquakes is divided into five categories: very ready, ready, almost ready, less prepared, and not ready.

3. Results and Discussion
3.1 Overview of Research Sites
Baturetno Village, Banguntapan Subdistrict is in a low area, the capital of the sub-district is at an altitude of 100 meters above sea level. The distance from the subdistrict capital to the Bantul district government center is 15 Km. The landscape in Baturetno Village, Banguntapan District is 100% in the form of flat to choppy areas. Baturetno village has a climate like a low-lying area in the tropics with hot weather as its trademark. The highest temperature recorded in Banguntapan District is 37°C with the lowest temperature of 24°C. The administrative area of Banguntapan District is in the northeast of the capital of Bantul Regency. The area of Banguntapan District is 2,865.9537 Ha. The administrative area of Banguntapan District consists of eight villages, one of which is Baturetno Village which is the location of the study.
3.1.1 Level of Community Knowledge of Earthquake and Liquidity Disaster Preparation and Liquidation

Research on the level of liquefaction knowledge on earthquake disaster preparedness includes one village with 99 supporters obtaining data with a total sample of 99 families. To describe the community preparedness level index using the following formula: $\text{indeks} = \frac{\text{real value}}{\text{max value}} \times 100\%$. Based on the data obtained, the results can be included in the level of preparedness which is classified into five categories, namely as follows:

| Level of Preparedness | Index Results |
|-----------------------|---------------|
| Very Ready            | 80 – 100      |
| Ready                 | 65-79         |
| Almost Ready          | 55-64         |
| Less Ready            | 40-54         |
| Not Ready             | < 40          |

Source: Community Preparedness Study in Anticipating Natural Disasters, LIPI (2006 and 2007)

So, after the management of the results of data analysis using the formula above the total acquisition for natural disaster preparedness in Baturetno Village, Banguntapan Subdistrict, the first analysis revealed that the percentage of knowledge about liquefaction from the Baturetno Village community was not ready to receive knowledge about the earthquake and more importantly the community does not understand the liquefaction disaster. Thus, the community does not understand what should be done when a disaster occurs, both in terms of saving themselves, handling casualties and injured victims.
3.1.2 Attitudes in Facing Liquidation Disasters due to Earthquakes The second analysis showed that the percentage of attitudes in the face of disasters from the people of Baturetno Village, Banguntapan Subdistrict, partly stated that they were unprepared, although some family members stated they were ready, but the analysis stated that most of them stated that they were not ready to face the earthquake. Based on the analysis test, determining the percentage of the whole sample obtained low scores compared to other analyzes, namely by the percentage of 57%, so that the community does not understand the planning of what must be done before the disaster occurs, both in handling fatalities, building houses, and so on.

3.1.3 Mobilization The results of the third analysis on the percentage of mobilization from the community of Baturetno Village, Banguntapan District are ready. Based on the analysis test, community mobilization has been declared ready in earthquake preparedness, so that responsiveness will emerge when the disaster occurs, even though the knowledge and planning of the community is still lacking, but this is covered by community mobility in the face of earthquake disasters.

3.1.4 Community Preparedness in the Face of Earthquakes The results of the latest analysis show that the percentage of community preparedness in the face of liquefaction due to earthquakes or other natural disasters from the people of Baturetno Village, Banguntapan District is ready. Community preparedness in the face of liquefaction and other natural disasters is very swift, this can not be separated from the results obtained, namely with a percentage of 70% of the community responsive and alert to the earthquake that hit the people of Baturetno Village, Banguntapan District.

![Community Preparedness Diagram](image-url)
4. Conclusion
The level of public knowledge of earthquake disaster preparedness and liquefaction and liquefaction, which includes villages with 99 supporters, obtained data with a total sample of 99KK, so the percentage or analysis results showed that the percentage of knowledge about liquefaction from Baturetno villagers was not ready to accept knowledge of earthquake disasters and more importantly the community does not understand the disaster of liquefaction. The attitude in dealing with liquefaction disasters due to the Earthquake is known that the percentage of the attitude in facing disasters from the Baturetno Village community stated that they were not ready to face the earthquake which caused liquefaction disasters which could come at any time with a percentage of 57% so that the community did not understand what planning should done before a disaster occurs.

The results of the subsequent analysis were about Mobilization of the Baturetno Village community in Banguntapan District in the ready category. Community mobilization has been declared ready in earthquake preparedness and liquefaction so that the response will occur when disaster occurs. The percentage of community preparedness in the face of liquefaction due to earthquakes or other natural disasters from the baturetno village community in Banguntapan sub-district is ready with the results of 70% of the community responsive and alert to the earthquake and liquefaction that befell the people of Baturetno Village, Banguntapan District.

Acknowledgements
Thank you to the executive team of IGEOS-UNS (International Geography Seminar 2019), Sebelas Maret University, to Mr. Drs. Suharjo, M.S as the research supervisor and my colleagues who have helped in this research, and finally I would like to thank RISTEKDIKTI for providing funding to carry out this research until the publication process.

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