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PROFILE OF COMMUNITY UNDERSTANDING AND LITERACY ABOUT DISASTER RISK MITIGATION: THE RESPONSES OF JAVA SOUTH COAST COMMUNITY AGAINST MEGATHRUST EARTHQUAKE AND TSUNAMI PREDICTION

Iqbal Ainur Rizki[1], Handoko Bintoro[1], Khoirun Nisa'[1], Prima Rahman[2], Arie Realita[1], Utama Alan Deta[1,*]
[1]Department of Physics, Universitas Negeri Surabaya
[2]Department of Geography Education, Universitas Negeri Surabaya
*Email: utamadeta@unesa.ac.id

ABSTRACT

Widiyantoro et al., as Institut Teknologi Bandung (ITB) scientists, predict the worst possibility that in the south of Java Island, a megathrust earthquake with a maximum magnitude of up to 9.1 on the Richter scale and a tsunami of up to 20 meters. So understanding and literacy about mitigation of the megathrust earthquake and tsunami need to be improved so that the South Coast of Java Island (Pansela) community has prepared for these disasters. This study aims to analyze the understanding and literacy of the Pansela community of the earthquake and tsunami disaster against the predictions made by ITB scientists. This study uses a qualitative descriptive method with a total of 57 community respondents living in Pansela. The study results show that most communities believe in this prediction and have fewer mitigation efforts against this disaster. However, the respondents still did not know the specifics of the megathrust earthquake. They considered an earthquake in the south of Java Island related to the megathrust earthquake. Therefore, it is necessary to increase community understanding and literacy regarding mitigation efforts against megathrust earthquakes and tsunami.

Keywords*: Megathrust Earthquake; Tsunami; ITB Scientists; Understanding; Mitigation.*

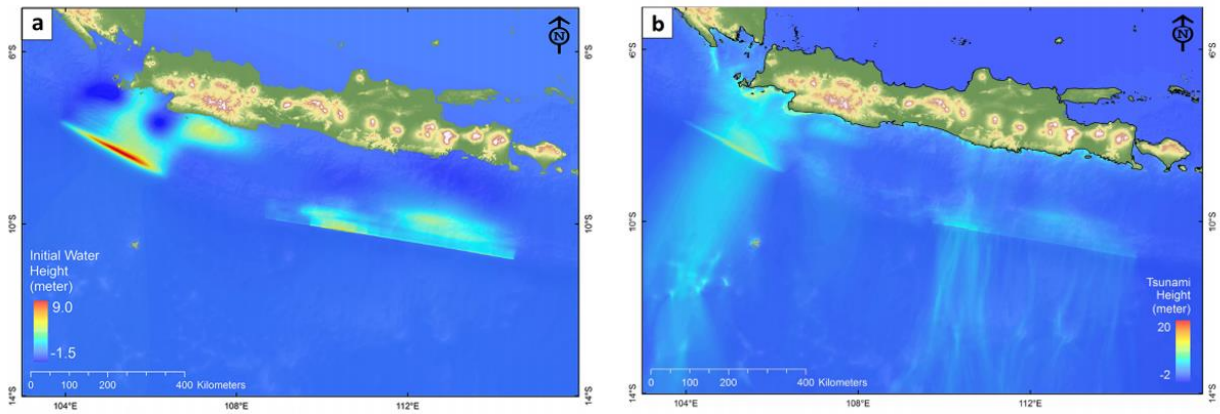
A. INTRODUCTION

Java Island is very vulnerable to earthquakes and tsunamis because about 500 km from the South Coast of Java Island (Pansela) is a megathrust zone formed by the Indian Ocean plate subducting the Asian continent plate (Mulia *et al.*, 2019; Priadi *et al.*, 2020). This causes the occurrence of many earthquakes in the waters south of the island of Java. Based on the catalog of earthquakes and tsunamis by the Meteorology, Climatology and Geophysics Agency (BMKG) was noted that since 1700 the megathrust zone south of Java had occurred several times with *significant earthquakes* and *great earthquakes*. Large earthquakes with a magnitude of 7.0 have appeared eight times (Setiyono *et al.*, 2019). In addition to earthquakes, the BMKG tsunami catalog also notes that tsunamis have occurred six times in the south of Java (Triyono *et al.*, 2019).

So that the island of Java, which incidentally is the island with the highest population density in Indonesia, has a significant threat to earthquake and tsunami disasters, especially the southern

area of Java. This has attracted several researchers to research the potential threat of earthquakes and tsunamis. The results of these studies can be used as a reference in conducting disaster risk mitigation. One of the studies that have attracted the community's attention to viral in the mass media was the research by Widiyantoro *et al.* as scientists from the Institut Teknologi Bandung (ITB) (Widiyantoro *et al.*, 2020).

This research states that the worst-case scenario if megathrust segments along Java rupture simultaneously indicate an earthquake with a maximum potential magnitude of 9.1 and a tsunami with a height of up to 20 meters south coast of West Java and 12 meters south of East Java, as shown in Figure 1. The BMKG monitoring results also show that the megathrust zone south of Java is indeed very active (Setiyono *et al.*, 2019). Several other studies related to the threat of earthquakes and paleotsunami have also confirmed traces of repeated earthquakes and tsunamis in southern Java in the past (Ammon *et al.*, 2006; Soehaimi, 2008; Priyowidodo and Luik, 2013; Stuart, 2018).



(a) (b)

Figure 1. (a) Tsunami modeling results based on scenario 1 (earthquake in West Java segment 8.9 Mw) and scenario 2 (Earthquake in East Java and Central Java segments 8.8 Mw);
(b) Maximum tsunami height modeling results based on results research by (Widiyantoro *et al.*, 2020)

The many phenomena of an earthquake and tsunami on the island of Java and the prediction of megathrust earthquakes must be taken seriously by various parties, especially communities in earthquake potential areas. One way to improve community preparedness is to increase understanding and literacy regarding earthquake and tsunami risk mitigation (Kanbara *et al.*, 2016; Afrian and Islami, 2019; Fadilah *et al.*, 2021). This becomes very important to minimize the loss of property and life. Understanding and literacy about disasters are efforts to raise community awareness in dealing with a disaster. Meanwhile,

information literacy regarding natural disasters involves finding, collecting, and evaluating then using the disaster information to mitigate the disaster (Marlyono, Pasya, and Nandi, 2016).

Mitigation regarding earthquake and tsunami disasters is crucial for the community to understand, especially for the Pansela community, which is predicted to have megathrust earthquakes and large tsunamis. According to a survey on the occurrence of the Hanshin-Awaji earthquake in Japan in 1995, it showed that more than 65% of mitigation efforts survived because of the rescue of self, family, and close relatives (Japan Association for Fire Science and Engineering, 1996). So that knowledge about disaster mitigation is significant for ourselves and close relatives.

Previously, research was done by (Marlyono, Pasya and Nandi, 2016; Marlyono and Nandi, 2018; Muslim *et al.*, 2019; Deta *et al.*, 2020), which discusses the profile of Java's community preparedness for earthquakes just in general. (Hall *et al.*, 2017; Nugroho, 2019) studies the profile of the awareness of the people of the island of Java against tsunamis. These studies are still not up-to-date on earthquake predictions by ITB scientists and do not study based on their location of residence. In fact, the magnitude of the earthquake and tsunami predicted was much greater than the general earthquake, so that the level of preparedness and awareness would be different. In addition, the impact of the earthquake and tsunami will be much greater on the people living on the coast. So that, it needs to analyze specific and actual to find the best solution and action to avoid the risk.

Therefore, this study will discuss the understanding and literacy skills of the Pansela community regarding earthquake and tsunami mitigation risk to respond to the predictions of megathrust earthquakes and tsunamis put forward by ITB scientists. This study aims to analyze the understanding and literacy of the Pansela community of the earthquake and tsunami disaster associated with the predictions made by ITB scientists. By analyzing the Pansela community's understanding and literacy regarding the megathrust earthquake and tsunami, it can be seen what actions can be taken to mitigate the impact of the megathrust earthquake and tsunami as predicted.

B. MATERIALS AND METHODS

The research method used is a written interview method by distributing the instrument in the form of a questionnaire. The questionnaire contains

five questions that represent the understanding and preparedness of the community in responding to disaster predictions by ITB scientists. The process of preparing the questionnaire is based on a grid of questionnaires made by arranging items through the description of the variables and indicators used, then written into questionnaire questions as shown in Table 1. The data obtained is qualitative, so it does not require the validity and reliability of the questionnaire instrument (Deta *et al.*, 2021). So those qualitative methods are used to build an understanding of the disaster literacy of the South Coast of Java community well.

Table 1. Variables, indicators, and question formulations used in this research

No	Variables	Indicators	Formulation of the Question
1	Literacy	Respondents' literacy regarding the information on the megathrust earthquake and tsunami circulating in the mass media in terms of information literacy	Do you know information that scientists from ITB predict a megathrust earthquake and tsunami as high as 20 meters that will occur on the south coast of Java?
		Respondents' literacy regarding the circulated information about megathrust earthquake and tsunami from a scientific point of view	How do you respond to these predictions or expressions?
2	Understanding	Respondents' understanding of the megathrust earthquake and tsunami	What do you know about the megathrust earthquake and tsunami?
		Respondents' understanding of the megathrust and tsunami mitigation efforts	What mitigation or prevention efforts will you take to deal with these predictions?
		Respondents' understanding of the relationship between earthquakes that have occurred and the predicted megathrust earthquake	On October 25 and 26, 2020, an earthquake occurred in the southern part of West Java with a 5,9 and 4.5 magnitude (strength) with an epicenter, as shown in Figure 7.
			Based on that earthquakes, what is your opinion regarding the relationship between that earthquake and the megathrust earthquake predicted by ITB scientists?

The distribution of the questionnaire was carried out online on October 31 - December 6, 2020, targeting the community of the South Coast of Java Island. The coastal areas of the island of Java include the Regencies/Cities of Pandeglang, Lebak, Sukabumi, Cianjur, Garut, Tasikmalaya, Ciamis, Pangandaran, Cilacap, Kebumen, Purworejo, Kulonprogo, Bantul, Gunungkidul, Wonogiri, Pacitan, Malang, Tulungagung, Blitar, Lumajang, Jember, Malang, and Trenggalek. The research sample obtained was 99 community consisting of 57 community respondents living in the South Coast area and 42 respondents living in non-South Coast areas.

The data analysis technique in this research is descriptive qualitative data analysis. This analysis was carried out by analyzing, describing, and summarizing various situations and conditions from multiple data collected from the results of Pansela community interviews regarding the problems studied (Tuerah, 2014; Suprapto *et al.*, 2018). There were 57 respondents from several areas that became the focus of this research.

C. RESULTS AND DISCUSSION

Based on the results of the data sorting that has been carried out, several groupings of respondents were obtained. It was found that respondents are dominated by high school graduates as much as 56%, student status 63%, and living in the lowlands 44%. This is because the distribution of the questionnaire is done online so that the young community dominates the respondents because they are more familiar with gadgets (Emanuel, 2013).

The first question is about community knowledge regarding the information on potential megathrust earthquakes and tsunamis in Pansela. The answers from the respondents can be seen in Figure 2. The graph shows that most communities already know the information about the predictions that ITB scientists have made. This is in line with Priyowidodo's research that the Pansela community already knows the natural characteristics of a tsunami, originating from their ancestors from generation to generation (Afrian and Islami, 2019).

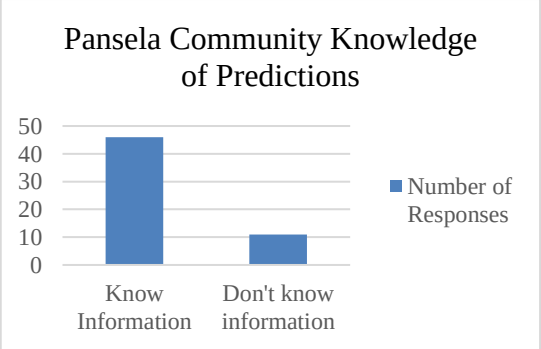


Figure 2. A bar chart of the knowledge of the Pansela Java community towards the predictions made by ITB scientists.

The second question regarding their responses is related to the predictions made by ITB scientists. Opinions from respondents will be implicitly grouped into respondents' beliefs about these predictions, as shown in Figure 3. The diagram indicates that most communities believe in these predictions. However, some respondents still do not believe the scientific information. When viewed from the educational background, almost all respondents who do not believe the information have a high school education. This shows that the education level relatively does not affect a person's trust in scientifically proven information.

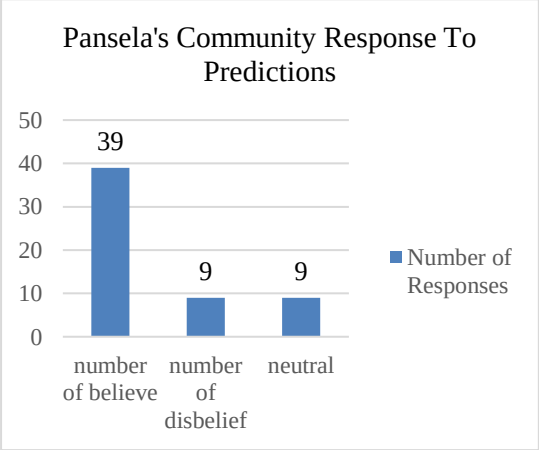


Figure 3. Bar chart regarding the response of the Pansela Java community to the predictions made by ITB scientists.

In this second question, most communities who believe in these predictions have anxiety but are still accompanied by vigilance and mitigation efforts. One of their answers was as follows:

"*At first I must have been afraid because the area where I live is only about 5km from the sea. However, I tried to use this information to urge people around me not to panic and stay alert and as much as possible avoid the beach area first.*" *-LRPI*

Based on the response above, it appears that the respondents believed the prediction of the megathrust earthquake and tsunami and tried to appeal to the community around them. However, the argument's weakness is not supported by a theoretical basis regarding the megathrust earthquake or tsunami itself. One opinion that is equipped with data or theoretical basis is as follows:

"Basically, Indonesia is a country located in the Pacific ring of fire which makes Indonesia a country that is prone to earthquakes and volcanic eruptions which in the future can also cause a tsunami. Regarding these predictions, we should increase our maximum preparedness to face whatever things will happen in the future."

In addition to answers that represent the respondents' agreement with the predictions made by ITB scientists, some answers represent disagreement with a unique response. One opinion that does not believe in the prediction is as follows.

"*I can't believe it, because as far as I know, there is still no tool to detect earthquakes accurately until now.*" *- The SA*

The response above is quite unique because the argument is equipped with facts: no technology or equipment cannot detect earthquakes. BMKG often uses this fact to avoid fake news circulated in the community regarding earthquake predictions (Rachmawati, Kurniawan, and Mawaddah, 2020). According to the answers above, the misconception that occurs is that the earthquake prediction published by ITB scientists is the worst-case scenario of a megathrust earthquake and tsunami in Indonesia at an unknown time. Meanwhile, fake news (*hoaxes*) regarding earthquake predictions that circulate are usually accompanied by the time of the earthquake. In fact, until now, the time of the earthquake can't be predicted (Malau and Sitepu, 2016; Senthilkumar *et al.*, 2020). This is presumably due to several factors: respondents who have not read the news about the full megathrust earthquake prediction or news publications in the mass media that do not write complete information (Kwanda and Lin, 2020).

The third question is about the community's understanding of the megathrust earthquake and tsunami. This question aims to determine the community's understanding of the megathrust earthquake and tsunami besfore they understand the mitigation efforts that must be carried out. The answers to this question will be grouped into several categories, namely: very understanding, quite understanding, less understanding, and not understanding.

Respondents are considered very understanding if they can explain in detail about the megathrust earthquake and tsunami well. One response was as follows:

"*Megathrust earthquake is an event that occurs in a subduction zone at a destructive convergent plate boundary, where one tectonic plate is under pressure from another. This earthquake is the most powerful interplate earthquake on the planet, with a moment magnitude (Mw) that can exceed 9.0. Since 1900, earthquakes of magnitude 9.0 or greater are considered high-magnitude earthquakes. While a tsunami is a series of large waves caused by an earthquake on the seabed*." -YB

Respondents are considered quite understanding if they can explain earthquakes and tsunamis in general. One response was as follows:

"*A large earthquake that causes a fault in the earth's crustal plate in the sea, so that water enters the gap suddenly and forms a large sea wave."* -FAS

Respondents are considered less understanding if they understand little information about the earthquake and

tsunami. Some of the responses were as follows:

"*A large earthquake that triggered a tsunami as high as 20 m."* -DK
"*Large-scale earthquake while the tsunami rose sea levels due to a great earthquake.*" -II

Respondents are considered not to understand if they explicitly do not know about the megathrust earthquake and tsunami. Some of the responses are as follows:

"*Don't know it*" -AM
"*Secret of nature*" -US
"*Don't know more yet*" -EDS

Based on all respondents' answers, most of them fall into the category of quite understanding. However, respondents still do not know the specifics of megathrust earthquakes and mostly describe "*huge earthquakes*". Whereas according to (Faizah *et al*., 2019), megathrust earthquakes are destructive earthquakes caused by the movement of intercontinental plates colliding with each other, causing a powerful earthquake with a magnitude of up to 9.0 SR. While the tsunami is a tidal wave with a height of 8 m and can reach 30 m when approaching the port or land area (Nur, 2010). This finding is also similar to the research by Priyowidodo that the community, especially the Pacitan area, is quite aware of the tsunami itself (Priyowidodo and Luik, 2013).

The fourth question is, "*What mitigation or prevention efforts will you take to deal with these predictions*?". This question aims to see the extent of community mitigation efforts regarding the predictions made by ITB scientists. Respondents' opinions on this question will be grouped into four levels with the results as shown in Figure 4. Based on the graph, it can see that the community at most less knowledge about the mitigation efforts that will be carried out when the megathrust earthquake and tsunami happen. Similar to the research of Putri *et al*. (2018), which shows that the understanding of tsunami disaster risk mitigation for the community of Karanggadung Village, Kebumen Regency, is still less than 50% from pre-disaster to post-disaster.

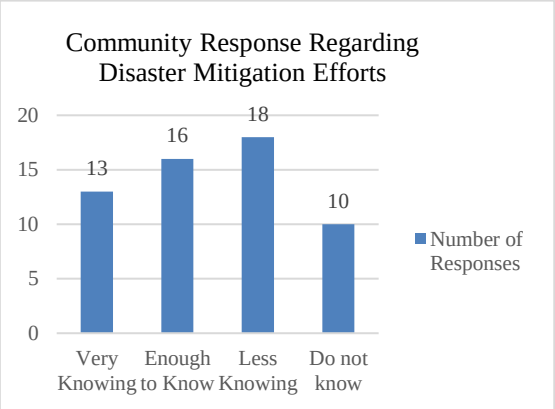


Figure 4. Bar chart of Java Island's Pansela community's mitigation efforts against predictions made by ITB scientists

Respondents were considered very knowledgeable when they mentioned three or more efforts to be made. One of the responses that categorized knowing very well was as follows:

"*Calm down and don't panic, prepare for maximum preparedness such as starting to reactivate one of the previous habits, namely kentongan as a source of disaster information, providing education to families and people around about this so that can be prepared at any time when this happens."* -YB

Respondents are considered to know enough if they mention two efforts that must be made. Some responses that indicate this category are as follows:

"*Before a disaster occurs I must know the route to a safe place. Prepare important files and necessities in one bag.*" -SA

"*Pay attention to earthquake warnings or anticipate when an earthquake occurs by evacuating themselves to a higher place*." -DR

Responses are considered less aware if they only mention one effort and are at least alert to mitigate earthquake and tsunami disasters, according to the predictions of ITB scientists. Some of the responses that indicate this category are as follows:

"*We still have to be vigilant and don't panic.*" -MI

"*Pray and keep looking for information.*" -ARJ

Respondents were considered not knowing if they answered that they did not know what to do. Some responses that indicate this category are as follows:

"*Nothing, still relaxed.*" -HH

"*I do not know what will be done to deal with these predictions.*" -AL

In the fifth question, the respondent responded regarding the earthquake's relationship on October 25 and 26, 2020, in the southern part of West Java with the megathrust earthquake predicted by ITB scientists. Almost all respondents believe that this earthquake is related to the megathrust earthquake predicted by ITB scientists. However, compared to the prediction map in Figure 1, the earthquake location has a difference. Megathrust earthquakes occur in the megathrust zone or subduction zone depicted in the red line in Figure 5 (Madden *et al.*, 2021). While the epicenter of the earthquake that occurred on October 25 and 26 is still far from the megathrust zone. So there is no connection between the two earthquakes. Some of the opinions of respondents who believe that there is a link are as follows:

"*It is possible that the earthquake that occurred on October 25 and 26 was an earthquake caused by plate activity around the south coast of Java. If the predictions regarding the megathrust earthquake are correct, it is possible that the earthquake that occurred on October 25 and 26 was the beginning of the earthquake, so there may be aftershocks before the megathrust earthquake actually occurs." -FDN*

"It is related where the prediction by the ITB scientists stated that a megathrust earthquake would occur in the south of West Java or East Java with several scenarios that have been explained very clearly by the ITB scientists themselves." -YB

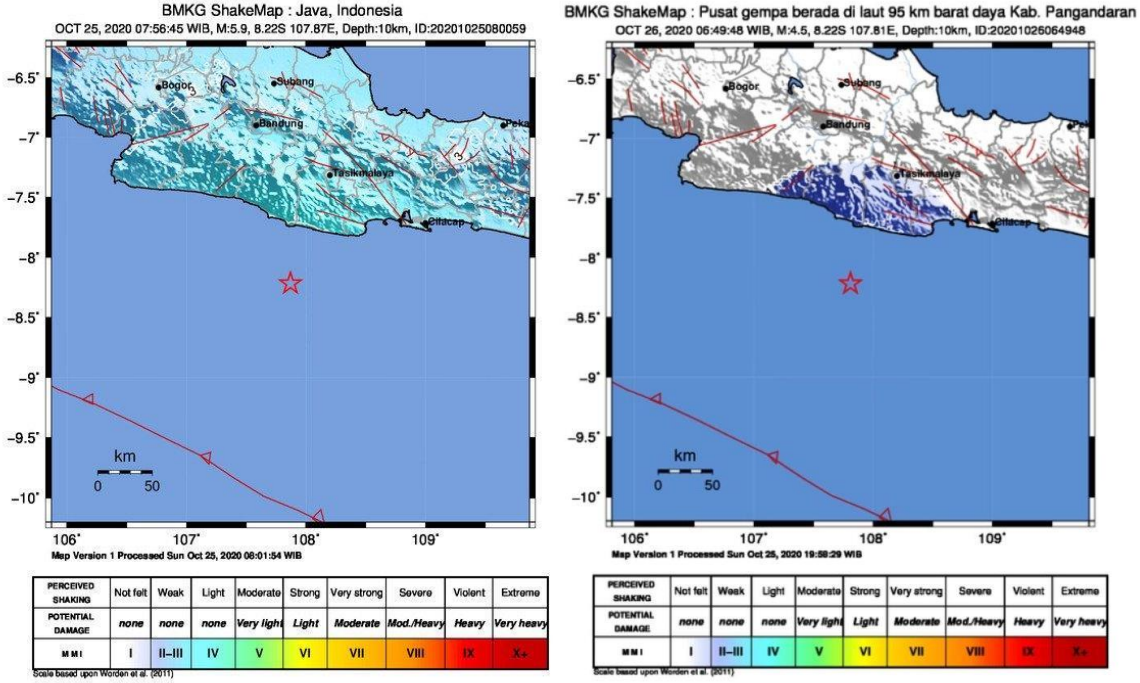


Figure 5. Two earthquakes occurred in the South of Java Island on October 25 and 26, 2020. These two earthquakes were included in the fifth question (Badan Meteorologi Klimatologi dan Geofisika, 2020).

In addition, there are several correct answers that there is no relation between the earthquake sources. They are as follows:

"There is no response to the relationship above. But basically Indonesia is in the ring of fire area, the earth plate under Indonesia is also very active. The Indonesian people should be more aware of the potential disasters that will arise. Understand and prepare for disaster mitigation calmly and maturely. When a disaster occurs, the community is ready to face it." -SA

"There is no relation between the previous earthquake and the future one." -KK

Overall, the community's understanding of megathrust earthquakes is still lacking. Therefore, further efforts are needed to improve knowledge of disaster mitigation to the community, especially the Pansela area regarding the megathrust earthquake and tsunami. Some things that can be done are to include disaster mitigation knowledge in the school curriculum, direct socialization to the community, make strategic policies by the government, provide mitigation guidelines to the community, and collaborate with various parties (Roskusumah, 2013; Bilal Habibie and Sjafei, 2017; Hariyono *et al.*, 2018; Kastolani and Mainaki, 2018; Isna *et al.*, 2019; Tamuntuan *et al.*, 2019; Dian Agustina, Sunandi and Nugroho, 2020; Yousuf *et al.*, 2020). So that they understand disaster mitigation, have vigilance, don't panic, and understand what to do when a disaster happened. Moreover, several city centers on the coast, such as Cilacap and Pacitan Regencies, are prone to casualties and material casualties (Probosiwi, 2013; Khasanah, Suwarsito and Sarjanti, 2014).

Nevertheless, it is necessary to appreciate the community mitigation efforts that will be carried out following the predictions of this ITB scientist. The survey results shown in Figure 6 show that some communities already understand the efforts to mitigate the megathrust earthquake and tsunami. The community is expected to understand the appropriate mitigation measures to minimize the impacts caused by the earthquake and tsunami disaster as predicted.

Research on disaster mitigation is significant because it is part of disaster risk management and control (Scolobig *et al.*, 2015). Disaster management can be calculated through three components, namely, the risk of danger *(hazard),* vulnerability *(vulnerability),* and capability *(capability)* (Rafiq and Blaschke, 2012). Each of these components has characteristics and uses that are mutually sustainable to measure and determine disaster risk in an area. The factor of understanding and information literacy of the community is one part of the capability or ability to cope with disasters both materially and non-materially (Shohaya *et al.*, 2013; Ali *et al.*, 2019). Therefore, it is necessary to improve the quality of human resources in terms of knowledge and skills about disaster mitigation to minimize the risks posed by disasters.

This study has limitations, there are including connection between respondents and study criteria (only Pansela society), difficulty in conducting publications and

inviting respondents to fill out forms, long process to gain more information from respondents using interview method, classify best answer of respondents fill form.

So there are recommendations, including: (1) Increase the number of respondents evenly for all areas of the island of Java; (2) Involving various parties to publish the questionnaire; and (3) Conduct additional interviews with respondents.

There is also a development from this research, namely: increasing the understanding and literacy of the Pansela community through various efforts according to research. After that, a post-test was conducted to understand the megathrust earthquake and tsunami as predicted by ITB scientists.

D. CONCLUSIONS

The Pansela community's understanding and literacy of earthquake and tsunami disaster information on the megathrust earthquake prediction by ITB scientists are lacking. Most communities believe in these predictions, but less knowledge about the mitigation efforts must do when the megathrust earthquake and tsunami happen. They still do not know the specifics of the megathrust earthquake and tsunami impact for them. This information is very important for people who live there and it needs to be spread up through direct socialization, infographic poster, and other methods that they can understand. Nevertheless, it is necessary to appreciate the community's trust in predicting the megathrust earthquake and its mitigation efforts that will or have been carried out.

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