MITIGATION OF THE ADVERSE IMPACT OF TSUNAMI HAZARDS ASSISTED BY GEOGRAPHIC INFORMATION SYSTEM: STUDY IN MUNJUNGAN COASTAL-TRENGGALEK - INDONESIA

by Ketut Prasetyo

Submission date: 09-Feb-2023 09:04PM (UTC+0700)
Submission ID: 2010078179
File name: Naskah_di_Sience_Tsunami.pdf (1.47M)
Word count: 5166
Character count: 27006

ISSN 8755-6839

SCIENCE OF TSUNAMI HAZARDS

Journal of Tsunami Society International

Volume 41 Number 2 2022

MITIGATION OF THE ADVERSE IMPACT OF TSUNAMI HAZARDS ASSISTED BY GEOGRAPHIC INFORMATION SYSTEM: STUDY IN MUNJUNGAN COASTAL-TRENGGALEK - INDONESIA

Ketut Prasetyo, Wiwik Sri Utam

Department of Geography Education, Universitaas Negeri Surabaya,
Ketintang Street, Surabaya City, Indonesia
ketutprasetyo@unesa.ac.id

ABSTRACT

Coastal areas of Indonesia that are close to tectonic plates are vulnerable to earthquakes and generated tsunamis. The Munjungan Coast South of East Java-Indonesia is such a vulnerable tsunami area. This coastal area, besides being close to tectonic plate boundaries, has the shape of an open bay which makes it particularly vulnerable to tsunami impacts and, therefore, in need of strict disaster mitigation measures. Assisted Geographic Information System (GIS) applications with map overlay techniques and by the Arc View 3.3 software program can help in the taking of measures that can reduce the impact of tsunami hazards. The processed product of the GIS methodology in the form of a tsunami hazard zoning map, as well as designated evacuation route maps, can be helpful tools in tsunami impact mitigation, when a significant and potentially tsunamigenic earthquake occurs. The present study used a survey method and area sampling to obtain a better understanding of the public's perceptions and attitudes in responding more effectively to the potential of tsunami disasters. Based on the interpretation of the zoning map for the classification of disaster-prone areas and route maps for evacuation, four villages were identified as being more prone to tsunami disasters. The condition of the population in these four disaster-prone villages, despite their higher level of knowledge about tsunamis, was not followed by their perceptions and proper attitudes towards mitigating the potential danger. People on the coast of Munjungan did not appear to be particularly concerned about the tsunami hazard.

Keywords: *mitigation, tsunami hazard, geographic information system*

Vol. 41 No. 2, page 148 (2022)

1. INTRODUCTION

Many kinds of natural disasters occur in Indonesia, so this condition causes some to the country to be named a "supermarket" for natural disasters. Among the natural disasters are earthquakes, tsunamis, volcanic eruptions, floods, and other hydro-meteorological events. Specifically, because of the country's geographical position. extensive coastlines of many of its islands and high tectonic activity earthquake-generated tsunamis in Indonesia have claimed many victims

Geographically, Indonesia is an earthquake-prone area because it has crossed by the meeting point of 3 tectonic plates, the Indo-Australian Plate, the Eurasian plate, and the pacific plate. The path of the meeting of these plates is at sea, so if an earthquake occurs on a large scale and with a shallow depth, it will potentially cause a tsunami. With Indonesia's geographical conditions, coastal areas and islands can experience natural disasters, such as earthquakes, tsunamis, hurricanes, and storms (Rumondor et al., 2019).

Earthquakes due to the movement of tectonic plates can be the source of a tsunami, which cannot have predicted when it will occur (unpredictable), but the location or location where the potential for an earthquake occurs can be known. For coastal areas close to tectonic plate paths, an earthquake will have the potential to cause a tsunami disaster. If the people living in the disaster-prone areas are not aware of the tsunami threat, the risks generated will be severe.

Tsunamis experienced by coastal areas in Indonesia generally occur less than 30 minutes after an earthquake. This happens because the distance between the subduction zone and the adjacent coastal area is relatively close, while the speed of tsunami waves can reach 600–900 km/hour. Based on the results of a disaster risk study compiled by the Indonesian national disaster management agency in 2015, it can have seen that the most significant number of people exposed to earthquake risk is on java island, with the asset value exposed on java island exceeding rupiah 140 trillion. Then according to BNPB records, the Aceh tsunami disaster was a disaster that claimed many victims. The Aceh tsunami caused the death toll in the entire world region to reach 283,100 people. Meanwhile, the death toll in Indonesia reached 108,100 people, and 127,700 people have lost (Marwanta, 2005)

Noting that coastal areas are prone to tsunami disasters, but on the other hand, coastal areas are areas that are very densely populated, and the world population living in coastal areas ranges from 50-70% of the world population. In Indonesia, 60% of the population lives in coastal areas. Therefore, it is interesting to examine humans' knowledge, perceptions, and attitudes who still survive and live in tsunami-prone areas. Theoretically, if residents know the conditions of their environment correctly, then their perceptions and attitudes are also correct. Likewise, if residents are well aware that their environment has the potential for an earthquake and tsunami disaster to occur, then they will behave and act to be alert and at the same time be able to avoid themselves if the earthquake and tsunami disaster strike their surrounding environment.

Based on the results of Fauzi's research in Wonogiri, it is known that the low level of public knowledge about the meaning of disaster, events that can cause disasters, causes of earthquakes, aftershocks of earthquake disasters, and actions taken in case of earthquake disasters, because people are still ordinary. There is a lack of socialization about earthquake disasters (Rachman, 2018).

The southern coastal environment of Munjungan District, Trenggalek Regency, is one of the coastal areas in Indonesia that is prone to earthquakes and tsunamis. Because this coastal environment is located in the southern part of the island of Java and is directly opposite the Indian Ocean and not too far from the path of subduction of tectonic plates at the bottom of the Indian Ocean, another potential of the Munjungan Coastal area for its vulnerability to tsunamis besides being close to the tectonic plate path is the shape of the coast in the coastal area as an open bay beach and a relatively flat topography. Thus, the giant waves without barriers can directly hit the coastal area if a tsunami occurs.

In addition to the physical condition that shows a high level of hazard vulnerability to the Tsunami disaster in the Munjungan Coast, another thing that is no less important and requires attention is the large number of people who live in the Munjungan coastal area. According to the population records of the Central Statistics Agency, it has known that from 11 villages in Munjungan District, there are seven villages located in the Coastal area and inhabited by a population of 53,521 people (BPS, Munjungan Dalam Angka, 2016). With the condition of the Munjungan coastal environment vulnerable to tsunami disasters and other hands, many people live in the area; therefore, it is necessary to take early mitigation steps to make a zoning map of disaster-prone areas. Besides that, it is also necessary to prepare instructions or guidelines for the direction of the evacuation route.

Geographic Information systems can be applied to assist in making maps and, at the same time, spatial analysis. (Tomaszewski, Judex, Szarzynski, Radestock, & Wirkus, 2015) Therefore, having a GIS device at the Department of Geography Education, State University of Surabaya, can help to create a disaster zoning map and at the same time make a map of evacuation routes to secure a tsunami disaster in the research area. Making a Zoning Map for the level of disaster vulnerability and an Alternative Route Map for Evacuation roads is expected to help identify the spatial and environmental aspects of areas prone to disasters. Because based on the zoning map of disaster vulnerability, it is possible to identify vulnerable areas and areas that are safe from tsunami disasters. Then, based on the Alternative Evacuation Route Map, it is hoped that it can have as a source of information for the Munjungan residents about the route to save themselves if a tsunami disaster occurs in their area.

Making a Map on Zoning of Areas Vulnerable to Tsunami Disasters and Maps of Alternative Evacuation Routes in the form of digital maps that are processed using a Geographical information system, with the background that making maps in digital form can be easily used for inventory, monitoring, and evaluation. By digital map product, if they want to call back or repair/revise data, it can be quickly done at any time. The nature of the product resulting from data processing with a dynamic Geographic Information system is the background behind the application of this information system, which has chosen to assist in analyzing the mitigation of the adverse impact of tsunami hazards. The existence of the tool depends on the person who uses it. Likewise, a disaster mitigation map instrument will function if they pay attention to the people behind the tool. Alternatively, the existence of a tool depends on the human who uses it.

Regarding the target of disaster mitigation, humans or residents who live in disaster-prone areas, the research conducted will also reveal residents' level of knowledge, perceptions, and attitudes towards disasters that constantly threaten their living environment. Because revealing and knowing the level of knowledge, perceptions, and attitudes of the population towards disasters that constantly threaten their environment can sharpen the analysis of research results. Thus, it has hoped that the research results can provide more operational input in avoiding or saving the population or community in the research area from the danger of a tsunami hazard.

2. METHODS

The method used in this research is a survey with quantitative descriptive. The object and location of this research are residents in Munjungan district, Trenggalek Regency, east java province, Indonesia. The reason for choosing this area to be researched is because this area has a high vulnerability to earthquake and tsunami disasters, but the population in this area is relatively large.

2.1. Collection Techniques, and Data Sources

In this study, the collected data have been into two groups. The first group is the data used for making maps and the second group is the data to find out the knowledge-perception and attitude of the population towards the existence of the tsunami disaster. Data for making maps related to the physical condition of the area (height, beach shape, coastal slope, coastal roughness, and land use) has to collect through observation and documentation. The altitude data have sourced from a Topography Map scale of 1: 50,000 with an interval of 12.5 meters, while data related to the knowledge-perception and attitude of the population towards the tsunami were collected through interviews and Focus Discussion Groups (FGD) with respondents.

2.2. Population and Sample

The research population is the head of the family who lives in a tsunami-prone area. Data related to the physical condition of the research area as a whole becomes the object of research, while to obtain data related to the knowledge-perception and attitude of the population about the tsunami, the data acquisition have based on the sample.

The sampling method has chosen promotional area random sampling. Based on the mapping done, there are four villages prone to tsunami disasters, namely Craken, Masaran, Munjungan, and Tawing villages. The four villages became the area sample frame. The random sampling area has based on the Tsunami Hazard Level map made with the GIS Program. The number of households living in these four villages in 6260 households. Referring determination of the number of samples from Isaac and Michael with a significance level of 90%, from a population of 6260 households, the minimum sample in the study was 163 households. In this study, a sample of 254 households has taken. Sampling was carried out randomly, according to the number of households in each village.

2.3. Data analysis technique

Data related to the level of vulnerability to tsunamis will be analyzed using a Geographic Information System (GIS), namely the map overlay technique using the Arc View 3.3 software program. The overlay technique is carried out and followed by a query. The overlaid maps are land use maps, coastal shape maps, coastal slope maps, coastal roughness maps, and elevation maps. The level of vulnerability to the tsunami to described with the query process. The next step is that the tsunami-prone zoning map overlaid with administrative maps and land use maps. Based on the results of this overlay, the level of vulnerability of each village in Munjungan District to the tsunami disaster can have mapped. Then, the data related to the knowledge perceptions and attitudes of the population regarding the earthquake and tsunami were analyzed

descriptively, namely with percentages equipped with qualitative explanations. Data related to the level of vulnerability to tsunamis will be analyzed using a Geographic Information System (GIS), namely the map overlay technique using the Arc View 3.3 software program. The compile a zoning map of the level of vulnerability to tsunami disasters, the overlay technique is carried out and followed by a query. The overlaid maps are land use maps, coastal shape maps, coastal slope maps, coastal roughness maps, and elevation maps. The level of vulnerability to the tsunami disaster to describe with the query process. The next step is that the tsunami-prone zoning map overlaps with administrative and land use maps. The results of this overlay, the level of vulnerability of each village in Munjungan District to the tsunami disaster mapped. Then, the data related to the knowledge perceptions and attitudes of the population regarding the earthquake and tsunami were analyzed descriptively quantitatively, namely with percentages equipped with quantitative explanations.

3. RESULTS

3.1 Mapping of Tsunami Hazard Areas

Based on observations, it has known that several variables that are estimated to affect the level of tsunami susceptibility, namely the shape of the coast, the roughness of the coast, and the level of the slope of the coast associated with the residences of the population (villages) are relatively the same. The beach is U-shaped, sloping, and the beach is smooth (sand), and between the coastline and the settlements, the separation is mainly sand, rice fields, and gardens; this shows that the coastal area of Munjungan District has a high level of vulnerability to tsunami disasters (Fig. 1).

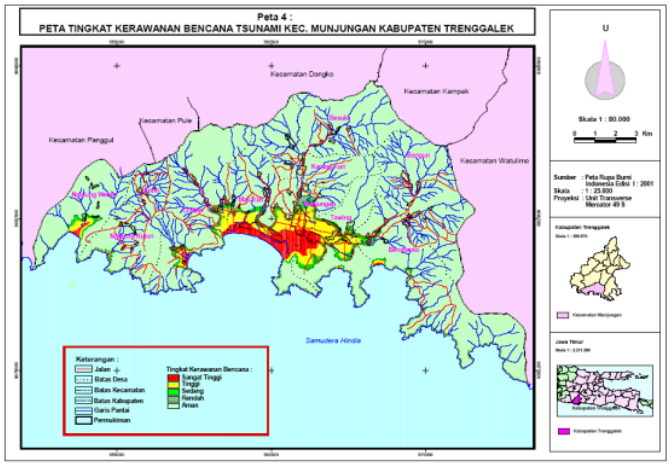

Fig. 1. Tsunami Hazard Level

Therefore, the variables vary from one place to another are the height and distance between the coast and the mainland. Referring to the zoning of tsunami-prone areas from Bakosurtanal, namely that up to a height of 20 meters above sea level, it is still a tsunami-prone area and taking

into account the distance between the coastline to the mainland, a map of the level of vulnerability to tsunami disasters can be made. In measurements, the furthest distance from the shoreline to the mainland with an altitude below 20 meters is less than 4 km.

Theoretically, with conditions like those in Munjungan, with a run-up level as high as 10 meters, tsunami waves can reach the mainland with a distance of more than 4 km. Therefore, based on this distance variable, all areas with a height of fewer than 20 meters are still reachable if a tsunami occurs. Map of the level of vulnerability to a tsunami can be made based on altitude with the criteria mentioned above.

This study has successfully mapped; namely, there are four villages included in the tsunami-prone area, but there is no early warning tool for tsunami disasters in these areas so far. In the four villages, most residents do not understand the tsunami. The public's lack of understanding about the tsunami resulted in the community has been easily deceived by not sourced information. After the Jogya earthquake in 2006, rumors circulated in this area that there would be two tsunamis, and the police even participated in warning the public that a tsunami would occur, even though previously there had been no earthquake or signs of a tsunami distance of more than 4 km. The mapping of the zoning of disaster-prone areas has presented as follows in figure 1 above.

3.2 Mapping Of Alternative Evacuation Routes

In the research conducted to create a map of alternative evacuation routes that are safe against tsunamis, the method used has based on a map of the tsunami hazard level by tracing the route selection with the considerations mentioned above. Choosing route alternative for evacuating based on factors: reached distances, avoid the cross river, near the street, and the route is good. The results of alternative mapping routes in a Tsunami has presented in the following figure 2.

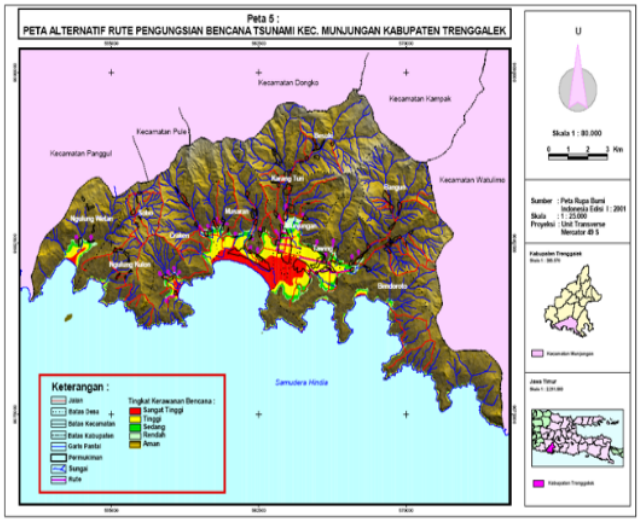

Figure 2. Mapping Mapping Of Alternative Evacuation Routes

3.2.1 Disaster Knowledge of People in Munjungan

All respondents (100%) stated that earthquakes often occur but have never been accompanied by a tsunami in the area where they live. The earthquakes in their area have not been strong enough to cause significant damage. According to most respondents (78.35%), the impact caused by the earthquake was the collapse of houses, while respondents who stated that the earthquake caused the tsunami took the second-largest number, namely 14.57%. Regarding knowledge about tsunamis, most of the respondents (93.39%) have heard of the term. Only a few respondents stated that they had never heard of the term tsunami, namely 6.61%. As a source of knowledge about the tsunami, most respondents came from TV media (71.79%). In more detail, the sources of information regarding the tsunami have to see in the Table.1.

Table : 1. Information Sources of Tsunami

Information Sources	Number of respondents	(%)
Apparatus	18	6,43
Televission	101	71,79
News Paper	6	2,14
Other person	37	13,12
Radio	8	2,85
Scholl	6	2,14
Police	2	0,71
Internet	1	0,36
Book	1	0,36
Total	280	100

Sources : Primer data

This study has successfully mapped this area. Namely, there are four villages included in the tsunami-prone area, but there is no early warning tool for tsunami disasters in these areas so far. In the four villages, most residents do not understand the tsunami. The public's lack of understanding about the tsunami resulted in the community has easily deceived by not sourced information. After the Jogya earthquake in 2006, rumors circulated in this area that there would be a tsunami twice, even the police took part in warning the public of a tsunami, even though previously there was no earthquake or signs of a tsunami coming.

3.2.2 Tsunami Disaster Perception of People Munjungan

Although all of the respondents in this study live in disaster-prone areas, most of the respondents (88.58%) have the perception that their place of residence is safe from the threat of disasters. Respondents who stated that their area was prone to earthquakes and tsunamis were 18.51%, while those who said they did not know were 1.57%. Account 82.76% of respondents perceive that their area is safe. The reason is that there has never been a tsunami in their area. In detail, the reasons for respondents who perceive their homes to be safe from tsunamis have seen in the following table 2.

Table: 2. People's Perception Is Safe for Tsunami

People's Perception	%
There has never been a tsunami in the village	88.58
The village environment is protected by the hills	1.97
The village environment is quite high	6.40
Guarded by "Nyi Roro Kidul (Fiction Figur)	0.99
There is a key to the antidote to disaster	0.49
No response	1.57
Total	100.00

Sources : Primer Data

Respondents who perceive that their place of residence is safe from the threat of a tsunami disaster do not/do not know what actions they will have in the event of a tsunami disaster. To is natural because they believe that a tsunami disaster will not occur in their area. Although the percentage is small, it is interesting that the community still has a strong perception of a disaster due to religious and supernatural factors surrounding the population's beliefs in the research area

3.2.3 Attitude to Disaster from Munjungan People

For respondents who perceive that their area is prone to tsunami disaster (15.51%), most of them already have an attitude in anticipating the possibility of a disaster and tsunami in their area. Most of the respondents (44.68%) stated that if there were a relatively strong earthquake, they would immediately run to find a high place. In detail, the respondent's attitude to anticipate the possibility of an earthquake resulting in a tsunami disaster has seen in Table 3.

The attitude of the community in the event of a disaster has known that most of the population (44.68%) will run to find a safe place, then some of the community (36.19) will save themselves if there are signs/warnings, and there are some people (19,15). %) who stay at home. The Munjungan people, the potential tsunami disaster in their neighborhood, do not pay much attention to the safety of their lives.

4. DISCUSSION

4.1 Results of Mapping of Tsunami Vulnerability Zoning and Tsunami Disaster Evacuation Routes for Early Mitigation

Geographical Information System applications for various mapping purposes have been carried out extensively. The following is an example of the application of GIS to map the Tsunami disaster zoning in Pariaman-West Sumatra. (Hadi & Astrid, 2017). Thus, the results of this study have strengthened the concepts and theories in the use of Geographic Information Systems for the creation of Zoning Hazard Level Maps and, at the same time, mapping evacuation routes. Referring to the Geospatial Information Agency classification, the use of a scale of 1:50,000 to 1:100,000 is said to be more of a division at the landscape level, which only reflects the influence of endogenous processes. On a 1:50,000 scale map, spatial information presented at a macro level can be recognized (Brahmantyo & Salim, 2018). Thus, related to the source of the base map used in this study is a topographic map with a scale of 1: 50,000, the resulting map derivatives have not been able to describe in detail the actual morphology of the earth's surface. However, as a material or tool or initial mitigation medium in a relatively broad environmental coverage such as the research area, the map produced from the research conducted is sufficient to be used as a source of macro-spatial information.

Based in reference to Dwi Jokowinarno's opinion, at least six steps are needed to mitigate the tsunami disaster. The first policy protects life, infrastructure, and the coastal environment. The development of an early warning system and the construction of protective buildings are examples of protection measures developed. (Jokowinarno, 2011). The first step proposed by Dwi Jokowinarno was based on the results of research conducted in a hazard zoning map and an evacuation route map. Utilization of data processing and data analysis with GIS has the following advantages: input processed data can be sourced from various spatial and non-spatial data, and are easy to update, to store, and to retrieve. This GIS's characteristics can also be used as a tool for inventory, monitoring, evaluation, and planning to be carried out for overall disaster mitigation starting from the pre-disaster stage, during the disaster, and post-disaster stage

Regarding the dynamics of changes in physical data, it is slower than socio-economic data. Therefore, considering the input data processed by GIS in this study in the form of physical data, the existence of the data in the form of a spatial map of the zoning of the tsunami hazard level and the Tsunami route map is relatively longer used in the research area.

4.2 Knowledge-Perception and Attitude of Tsunami Hazard for Early Mitigation

The knowledge of the Munjungan community as a research location about the earthquake and tsunami disaster in its environment is sufficient. However, perceptions and attitudes towards constantly threatened disasters have been adequately owned by the research area's people. The knowledge of the Munjungan Community about the Tsunami Earthquake has expected to be their essential capital to avoid the victims of the earthquake

and tsunami disaster. The experience of earthquake that hit West Sumatra in September 2009 killed 1,195 people, allegedly due to a lack of knowledge and community preparedness in anticipating disasters in East Java-Indonesia(Simandalahi, Apriyeni, & Pardede, 2019). Because the people of Munjungan have a higher knowledge of the tsunami danger, this higher level of knowledge will become their capital to save themselves if a tsunami hits the environment they lived in.

Their high knowledge of disasters in their environment seems to have still interference with local wisdom about "superstitious" beliefs. Another strength to avoid disasters seems to be an integral part of the coastal communities of South-Java Island, including in the research area. (Handoko, Hariyono, & Pujimahanani, 2018). Communities around the southern coast of Java Island, including Munjungan, have confidence in the coastal authorities in their environment. Apart from all that, almost every country has its own legend stories that will enrich the country's cultural treasures. Whether it is true or not, please hold fast to each other's beliefs and respect them (Yuri Rahayu, 2016). Myths or local wisdom like this affect people's knowledge, perceptions, and attitudes in some research areas.

The experience of the Palu Tsunami disaster psychologically seems to have traumatized the local population. Those whom a Tsunami has never hit in their lives, but the tsunami in 2020 can change the local community's perception regarding the existence of their place of residence where the disaster has occurred (Margaretha, 2021). This condition may need to be owned by the people of the Munjungan area always to be ready for disasters that continue to threaten their environment. The study results showed that the community's perception in the coastal area of Munjungan said that their place of residence was safe from the threat of a tsunami disaster, so this situation was concerning. Because even though they know about the danger of a tsunami that constantly threatens their environment, they have never experienced a tsunami disaster, this condition causes their perception that the area is safe from tsunamis, and they choose to stay in the risk area. The theory of environmental adaptation stated that the population could overcome the stressor in the threat of a tsunami disaster. (Eka B. Z. Pamekas.et al, 2019). According to Bell, in the theory of environmental psychology, the Munjungan population is already in a home-statistical condition. The tsunami stressor that threatens the environment has been reduced by the knowledge, perception, and behavior of the people of Munjungan that they have never experienced a tsunami.

Based on the community's attitude if there will be an earthquake and tsunami, it seems that it is also in line with their perception. The community's attitude that some will run to protect themselves (44.68%) in the event of a disaster, then the condition of the community like this is encouraging. However, if we look at when the population flees from the disaster, the condition is very worrying. Because people who behave will run away to save from disaster if they have received information (36.19%), it is even more tragic if we know the attitude of 19.15% of the people in the research area will still choose to stay at home even though there has been a disaster in their environment.

Thus, in the coastal area of Munjungan, where this research concetrated, it can be seen that people's knowledge about their environment that is vulnerable to earthquake and tsunami disasters, but this knowledge does not reflect their perceptions and attitudes to avoid themselves or save themselves from the threat of the earthquake and tsunami.

Homeostatic conditions in the Munjungan coastal community at the research location are based on the perception of safety from earthquake and tsunami disasters because the people in the area have never experienced such a disaster. This perception is suspected of having more victims if a disaster and tsunami occurs in this area of research. Based on the still strong opinion of the people of Munjungan that their area is safe from tsunami disasters, it is necessary to take more intensive steps to prevent future losses of lives and property.

5. CONCLUSIONS

The Geographic Information System produces a zoning map for tsunami-prone areas and a map of alternative evacuation routes. Based on the Tsunami Hazard Zoning Map, it has been concluded that four villages have been included in the tsunami-prone zone. Based on the results of a survey of four tsunami-prone villages, it is concluded that the residents in these villages have never experienced a tsunami disaster, so they have an erroneous perception of safety from tsunamis, and have the attitude of continuing to live in their present potentially dangerous coastal areas.

REFERENSES

Brahmantyo, B., & Salim, B. (2018). *Klasifikasi Bentuk Muka Bumi (Landform) untuk Pemetaan Geomorfologi pada Skala 1:25.000 dan Aplikasinya untuk Penataan Ruang*. *1*, 71–78. https://doi.org/10.31227/osf.io/8ah6v

Eka B. Z. Pamekas.et al. (2019). Adaptasi Masyarakat Bantaran Sungai Terhadap Banjir Di Kelurahan Pakowa Kota Manado. *Spasial*, *6*(2), 482–492.

Hadi, F., & Astrid, D. (2017). Aplikasi SIG Untuk Pemetaan Zona Keterpaparan Permukiman Terhadap Tsunami Studi Kasus : Kota Pariaman , Sumatera Barat. *Seminar Nasional Geomatika*, 317–324.

Handoko, P., Hariyono, H., & Pujimahanani, C. (2018). *Local Wisdom of Religious Tourism in East Java*. *165*(Iccsr), 456–459. https://doi.org/10.2991/iccsr-18.2018.101

Jokowinarno, D. (2011). Mitigasi Bencana Tsunami. *Universitas*, *15*(1), 13–20. Retrieved from d.jokowinarno@gmail.com

Margaretha, F. (2021). STUDI PERSEPSI MASYARAKAT SETEMPAT TERHADAP DAYA DUKUNG HABITUASI KOTA PALU PASCA BENCANA TAHUN 2018. *Jurnal Perencanaan Wilayah Dan Kota*, *8*(3), 488–500.

Marwanta, B. (2005). Tsunami Di Indonesia Dan Upaya Mitigasinya. *Alami: Jurnal Teknologi Reduksi Risiko Bencana*, *10*(2). Retrieved from ejurnal.bppt.go.id

Rachman, F. F. (2018). Bank Bukopin Permak Laporan Keuangan, Ini Kata BI dan OJK. Retrieved April 16, 2020, from Detik Finance website: https://finance.detik.com/moneter/d-3994551/bank-bukopin-permak-laporan-keuangan-ini-kata-bi-dan-ojk

Rumondor, A. G., Sentinuwo, S. R., Sambul, A. M., Elektro, T., Sam, U., & Manado, J. K. B. (2019). Perancangan Jalur Terpendek Evakuasi Bencana di Kawasan Boulevard Manado Menggunakan Algoritma Dijkstra. *Jurnal Teknik Informatika*, *14*(2), 261–268. https://doi.org/10.35793/jti.14.2.2019.24002

Simandalahi, T., Apriyeni, E., & Pardede, R. (2019). Pengaruh Pendidikan Kesehatan Terhadap Pengetahuan Siswa Tentang Kesiapsiagaan Bencana Gempa Bumi. *Jurnal Kesehatan Medika Saintika*, *10*(1), 107. https://doi.org/10.30633/jkms.v10i1.314

Tomaszewski, B., Judex, M., Szarzynski, J., Radestock, C., & Wirkus, L. (2015). Geographic Information Systems for Disaster Response: A Review. *Journal of Homeland Security and Emergency Management*, *12*(3), 571–602. https://doi.org/10.1515/jhsem-2014-0082

Yuri Rahayu. (2016). *Alami: Jurnal Teknologi Reduksi Risiko Bencana (Alami)*. *14*(November), 483–491.

MITIGATION OF THE ADVERSE IMPACT OF TSUNAMI HAZARDS ASSISTED BY GEOGRAPHIC INFORMATION SYSTEM: STUDY IN MUNJUNGAN COASTAL-TRENGGALEK - INDONESIA

ORIGINALITY REPORT

9%	8%	5%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ejournal.unwaha.ac.id Internet Source	1%
2	ojs.unanda.ac.id Internet Source	1%
3	journal.unesa.ac.id Internet Source	1%
4	www.degruyter.com Internet Source	1%
5	ejournal.unsrat.ac.id Internet Source	1%
6	Enik Ernawati, Slamet Widodo. "Comparative Study of Internal Force between Dynamic Method and Equivalent Static Methods in Lecture Buildings in Yogyakarta Based on Earthquake Indonesian National Standard (SNI 1726-2019)", IOP Conference Series: Earth and Environmental Science, 2021 Publication	1%

7	repository.unsoed.ac.id Internet Source	<1 %
8	www.researchgate.net Internet Source	<1 %
9	iopscience.iop.org Internet Source	<1 %
10	Submitted to MAHSA University Student Paper	<1 %
11	Nelly Florida Riama, Riri Fitri Sari, Henita Rahmayanti, Widada Sulistya, Mohamad Husein Nurrahmat. "The Level of Public Acceptance to the Development of a Coastal Flooding Early Warning System in Jakarta", Sustainability, 2021 Publication	<1 %
12	Submitted to Oregon State University Student Paper	<1 %
13	Apriani Apriani, Sandi Justitia Putra, Ismarmiaty Ismarmiaty, Ni Gusti Ayu Dasriani. "E-Alert Application In Facing Earthquake Disaster", MATRIK : Jurnal Manajemen, Teknik Informatika dan Rekayasa Komputer, 2020 Publication	<1 %
14	www.atlantis-press.com Internet Source	<1 %

15	Submitted to Universitas Negeri Surabaya The State University of Surabaya Student Paper	<1 %
16	K.K. Bedi, A.R. Hakeem, R. Dave, A. Lewington, H. Sanfey, N. Ahmad. "Survey of the Knowledge, Perception, and Attitude of Medical Students at the University of Leeds Toward Organ Donation and Transplantation", Transplantation Proceedings, 2015 Publication	<1 %
17	Mohammad Ridwan Lessy, Mesrawaty Sabar. "Mapping Tsunami Vulnerability Area for Bacan Sub-District and Its Surroundings – North Maluku Province", E3S Web of Conferences, 2021 Publication	<1 %
18	fdocuments.in Internet Source	<1 %
19	Submitted to University of Glasgow Student Paper	<1 %
20	Submitted to Universitas Pertamina Student Paper	<1 %
21	fliphtml5.com Internet Source	<1 %
22	repository.uin-malang.ac.id Internet Source	<1 %

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		