E-ISSN-2580-7129
Print- ISSN-1978-6107

TECHNO: JURNAL PENELITIAN
Journal homepage: http://ejournal.unkhair.ac.id/index.php/Techno
Volume 11 Number 02 October 2022 DOI:http://dx.doi.org/10.33387/tjp.v11i 2.5133

Earthquake Disaster Risk Analysis in South Morotai Tourism Area

Risky Nuri Amelia[1]*, Marwis Aswan[2]

[1] *Departement of Geography Education, Universitas Khairun, Indonesia, riskynuri.amelia@unkhair.ac.id*
[2] *Departement of Enviromental Engineering, Universitas Pasifik, Indonesia, marwis.aswan@gmail.com*

Received : 29-09-2022
Accepted : 29-10-2022
Available online : 30-10-2022

ABSTRACT

Morotai is located in the subduction zone of the Philippine Sea Plate and has the potential to be a threat to earthquake disasters. Given that the Morotai region tourism area has the potential to be threatened by earthquakes, it is necessary to prepare a Disaster Risk Assessment (KRB) in the Tourism Area, especially in South Morotai. The purpose of the disaster risk analysis study in the tourism area is to identify potential hazards based on earthquake vulnerability, and prepare a disaster risk assessment in the South Morotai priority tourism area. The risk assessment research conducted uses earthquake hazard information with the maximum ground acceleration value on the surface (PGA) obtained from updated results that have been carried out by PusGEn. The earthquake disaster risk assessment resulting from the analysis of hazard, vulnerability and capacity is obtained in the form of a high disaster risk level. Areas with high disaster risk are Daruba Village (score 11.1) and Darame Village (13.9). However, in terms of the area at high risk, Daruba Village has a large area of 15.1 km2. A planning strategy is needed for the development of disaster resilient tourism destinations by analyzing the 6A factors, namely attractions, accessibility, amenities, available packages, activities, and ancillary services.

Keywords: Risk, Disaster, Earthquake, PGA

ABSTRAK

Morotai terletak di zona subduksi Lempeng Laut Filipina dan berpotensi menjadi ancaman terjadinya bencana gempabumi. Mengingat kawasan pariwisata wilayah Morotai berpotensi mendapat ancaman bencana gempa, maka diperlukan penyusunan Kajian Risiko Bencana (KRB) di Kawasan Pariwisata khususnya di Morotai Selatan. Tujuan kajian analisis risiko bencana di kawasan pariwisata adalah mengidentifikasi potensi bahaya berdasarkan kerentanan gempa, dan menyusun kajian risiko bencana di kawasan pariwisata prioritas Morotai Selatan. Penelitian kajian risiko yang dilakukan menggunakan informasi ancaman bahaya gempabumi dengan nilai percepatan tanah maksimum di permukaan (*PGA*) diperoleh dari hasil terupdate yang telah dilakukan oleh PusGEn. Kajian risiko bencana gempabumi yang dihasilkan dari analisis bahaya, kerentanan, dan kapasitas diperoleh berupa tingkatan risiko bencana tinggi. Daerah yang memiliki risiko bencana tinggi adalah Desa Daruba (skor 11,1) dan Desa Darame (13,9). Namun dilihat dari luas area yang berisiko tinggi, Desa Daruba memiliki daerah yang luas yakni 15,1 km^2. Sangat diperlukan strategi perencanaan untuk pengembangan destinasi pariwisata tangguh bencana dengan melakukan analisis faktor 6A yakni daya tarik *(attractions),* aksesibilitas *(accessibility),* amenitas *(amenities),* ketersediaan paket wisata *(available packages),* aktivitas *(activities),* dan layanan tambahan *(ancillary services).*

Kata kunci: Risiko; Bencana; Gempabumi; PGA

INTRODUCTION

Morotai is included in the tourist destinations of the National Tourism Strategic Areas (KSPN) and Super Priority Areas set by the Central Government. Referring to Presidential Regulation No. 18 2020 concerning the National Medium-Term Development Plan (RPJMN) that the Development of Priority Tourism Destinations is one of the government's major projects until 2024. Tourism is a sector that is experiencing rapid growth and contributes to the economy of the country and region. is the overall activity related to tourism and is multidimensional and multidisciplinary in nature that appears as a manifestation of the needs of each person and country as well as interactions between tourists and local communities, fellow tourists, government, local governments and entrepreneurs (Law No. 10 of 2009). Morotai in this case is in the stage of developing a tourism area, which has different nuances and attractions from other islands. The attraction lies in historical tourism in addition to the advantages of marine tourism with the stunning beauty of the beach and underwater and this is an added value for tourists.

Tectonically, Morotai is one of the areas that has active seismic activity. Earthquakes are vibrations or shocks that happen and are felt on the earth's surface and come from the earth's interior structure. The sudden appearance of seismic wave energy caused by the deformation of tectonic plates in the earth's crust (Murtianto, 2016; Christianto, 2011). This is because there is a subduction zone of the Philippine Sea Plate and has the potential to be a threat to earthquakes in the North Maluku region, especially Morotai. The public must understand the threat of an earthquake in Morotai. The capacity of the community to respond to disasters is still low, this is due to the limited data and information on disaster risk. So that the government cannot use it in development policies. As a result, the use of space and development has not fully considered the disaster risk aspect. The uncertainty of the occurrence of natural events is very significant related to the possibility or potential of loss, harm and injury (Chou & Chiu, 2021).

Earthquake events are a major problem that will have a major impact on regional development. If the disaster has the potential to cause damage to infrastructure, it can even cause casualties (Kusmajaya & Wulandari, 2019). Tourists and the community must obtain protection from the threat of disaster by the government and related stakeholders. The most important thing to do is to raise public awareness and ability to protect themselves from threats and disaster risks (Sugianto, 2021). The threat of disaster can hinder the development of infrastructure, supporting facilities, and withdrawal of investment in the Development of Tourism Areas. If the development of tourism areas is not managed properly, it can increase the risk of disaster. So it needs special handling related to disasters in tourism areas, especially priority tourism.

Natural disaster management, especially earthquakes, is expected to provide information, communication, and emergency accommodation for tourists. This needs to be done because tourism development and sustainable strategies after disasters are usually rare (Chan *et al.*, 2020). In addition, governments and stakeholders should seriously adhere to modules in disaster management to deal with more challenging situations after disasters, risks and crises, and marketing strategies for sustainable tourism development (Ghimire, 2015). Although the Tourism Village managers are responsible for maintaining safety, security, and crisis management in the case of a tragedy, it is typically unclear what is being done about it (Adeyinka-Ojo *et al.*, 2014).

Research on disaster risk studies has been carried out by several previous researchers (Kasman & Triokmen, 2021; Kusmajaya & Wulandari, 2019; Melianita *et al.*, 2021). The research to be carried out has some similarities in terms of themes with previous research, but there are differences in terms of objectives, methods of analysis, approaches, and objects of study. Kasman & Triokmen (2021) conducted a research on Tsunami disaster risk analysis in the South Coast of Java, precisely in Garut Regency to determine the level of tsunami disaster risk in the coastal villages of Garut Regency. There are several analytical methods used, namely the calculation of factor values with the Davidson standardization model and the map superimpose method with a scoring technique whose process is processed with Geographic Information System (GIS) software. To determine the priority value for the tsunami disaster risk, the weighting is carried out using the Analytical Hierarchy Process (AHP) method.

Sumardani *et al*. (2019) have conducted a research study on earthquake risk in Cianjur Regency to determine the potential hazard, level of vulnerability, exposure and earthquake risk. The hazard analysis was carried out by combining bedrock shock intensity data and Ground Amplication Factor (GAF) data. Vulnerability analysis is carried out by combining physical, economic and social components. Exposure analysis is done by combining the components of distance from the center of government and the distribution of settlements. Then a risk analysis is carried out by combining the components of hazard, vulnerability, and exposure. Melianita *et al* (2021) have conducted research on the analysis of Potential Vulnerability and Disaster Risk in the Tanggamus Regency to produce a natural disaster risk map prepared by assessing the level of threat, vulnerability, and regional capacity in dealing with disasters based on Geographic Information Systems. (GIS). In this study, delineation of areas that have a level of threat, vulnerability, capacity and risk of natural disasters such as landslides, floods and earthquakes is divided into 3 class classifications, namely low, medium and high.

The risk assessment research conducted by previous researchers to calculate the risk of earthquake hazards only uses the existing maximum ground acceleration value (PGA) data and does not use geophysical methods. The next disaster risk study uses information on the threat of earthquake hazards with the maximum ground acceleration value (PGA) obtained from the updated results that have been carried out by PusGEN. Previous research did not carry out the object of research in the tourism area. And for the calculation of earthquake risk in this study using the AHP (Analitycal Hierarchy Process) analysis method and the delineation method. For the analysis of disaster risk mapping using GIS techniques.

Considering that the tourism area of the Morotai area has the potential to be threatened by an earthquake, it is necessary to prepare a Disaster Risk Study (KRB) in the Tourism Area, especially in South Morotai. This is a form of disaster mitigation efforts. The purpose of the study of disaster risk analysis in tourism areas is to identify potential hazards based on earthquake vulnerability, and to compile a disaster risk study in the priority tourism area of South Morotai. It is hoped that this earthquake and tsunami risk analysis study will become important information in planning and implementing disaster management in tourism areas. And this information will help the government in determining policies related to disaster mitigation.

METHODOLOGY

The disaster risk study was conducted using an exploratory survey method. The exploratory method is used in accordance with the research objectives, namely in the object of this research there are several clues that indicate problems and the need for further investigation. The survey method shows the way of implementation, data is collected at the same time. Data collection is done by using a sample that is expected to represent the population under study. The components for obtaining the level of disaster risk consist of threats, vulnerabilities and capacities. The tools used in this study consisted of field measurement tools and laboratory equipment. Field measurement tools include: GPS for determining coordinates and altitude, digital camera for taking pictures, and stationery and checklists for field measurement guidelines. The laboratory tools include: a set of computers for image interpretation and QGIS for GIS analysis, plotters to convert analog data of RBI maps into digital data, printers to print research results. The materials used in this study include (1) Geological Maps, (2) Indonesian Topographic Maps, and (3) Morotai Landsat Imagery.

Data collection techniques by observation, documentation, interpretation of image data, literature study, interviews, and questionnaires (questionnaires). The data analysis method used qualitative risk analysis and the weighting of the preparation factors using the AHP (Analitycal Hierarchy Process) method of calculation. As for the analysis of disaster risk mapping using GIS techniques. The index calculation method uses the general basic formula for risk analysis proposed in the Guidelines for Disaster Risk Mitigation Planning, which has been prepared by the Indonesian National Disaster Management Agency (Regulation of the Head of BNPB Number 4 of 2008) as follows:

$$R \approx H * \frac{V}{C} \tag{1}$$

where: R : Disaster Risk, H : Danger: The frequency (probability) of a certain disaster tends to occur with a certain intensity at a certain location, V : Vulnerability: The expected loss (impact) in a certain area in the case of a certain disaster occurring with a certain intensity. The calculation of this variable is usually defined as the exposure (population, assets, etc.) times the sensitivity for the specific intensity of the disaster, C : Adaptive capacity: The capacity available in the area to recover from a particular disaster. The research flow can be seen in Figure 1.

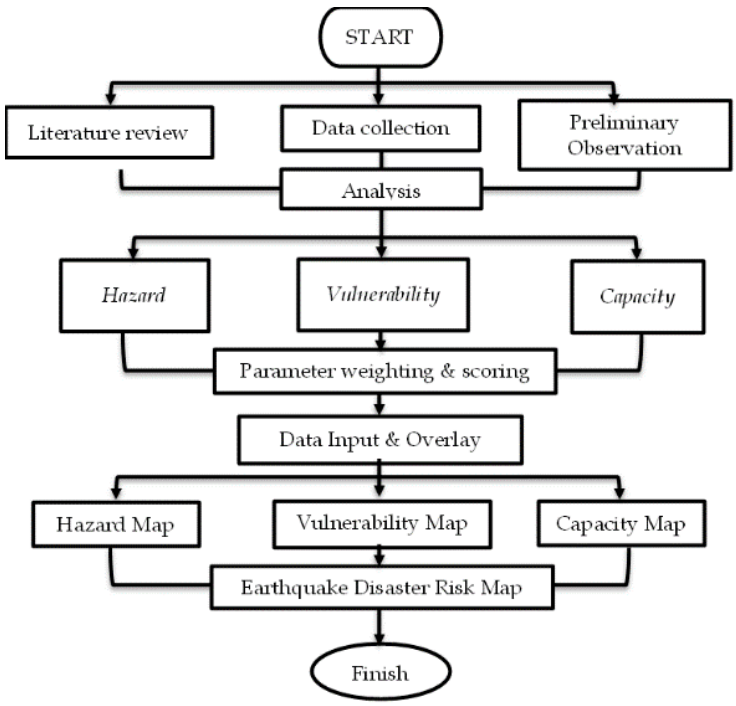

Figure 1. Research flowchart

RESULTS AND DISCUSSION

Overview of South Morotai Tourism Area

The tectonic order of the Morotai Island plate is influenced by the activity of the main plate and small plates that form the subduction zone, namely the Pacific plate, the Philippine plate, the Sangihe plate, and the Maluku sea plate. The administrative center of Morotai Island is located in South Morotai with topographic conditions in the form of land on the coast with an area of 363.1 km2. Based on the geographical location of South Morotai, it is limited to the north of East Morotai, to the south of the Morotai Strait, to the east of South West Morotai, and to the west of the Morotai Strait. South Morotai is divided into 25 with a population of 28,579 people (BPS South Morotai District in Figures, 2021).

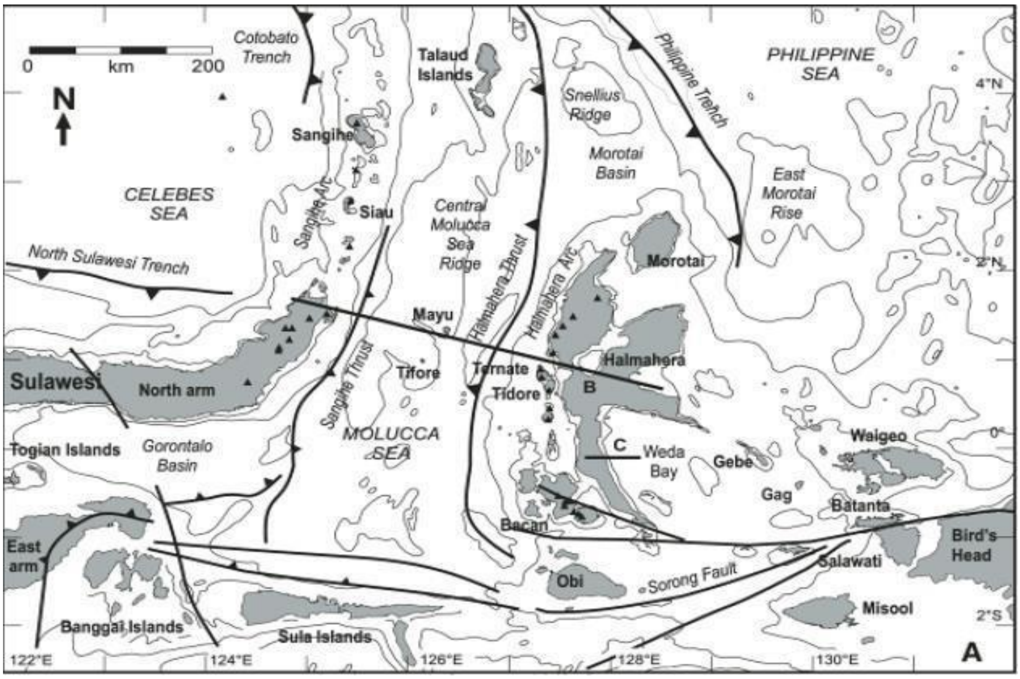

Figure 2. Tectonic Overview of Halmahera and its surroundings
(Source: Waltham, Hall, Smyth, and Ebinger, 2008)

Morotai Island is designated as one of the Government's Strategic Priority Tourism Destinations (Major Projects) set out in the 2020-2024 National Medium-Term Development Plan (RPJMN). In addition, based on Government Regulation Number 26 of 2008, concerning the Determination of National Strategic Areas, Morotai Island is designated as one of the National Strategic Areas. This is focused on accelerating economic development on Morotai Island. South Morotai is one of the areas on Morotai Island that has a number of superior potential in terms of tourism destinations. The tourism products in South Morotai are divided into 3, namely nature tourism, cultural tourism, and man-made tourism. Among them are Dodola Island, Metita Island, Kolorai Island, Kokoya Island, Galo-Galo Island, Kapa-kapa Island. Sagolo Beach, Ngele-ngele Island, Tabailenge Island, Cape America, Cape Gorango, Nunuhu Beach, Gorua Beach, Bere-bere Waterfall, Nakamura Waterfall, Tanjung Pinang, Tanjung Liku, World War II Morotai Museum and Trikora, Zum Island- Zum, Glass Water, Ancient Caves, Plane Wrecks at Sea, Amphibious Tanks, Nakamura's hideout, World War II Museum, Millenial Exsail, Water Front City, Armi Dok Park, Morotai Grand Mosque, Oukumene Building, Soekarno-Hatta Statue Tourism Area, and City Park. Although the South Morotai area is an area with a high potential for earthquake disasters, in terms of tourism destinations, it is very interesting to visit. This is the reason for the need for a disaster risk study, especially the earthquake disaster in theSouth Morotai tourism area.

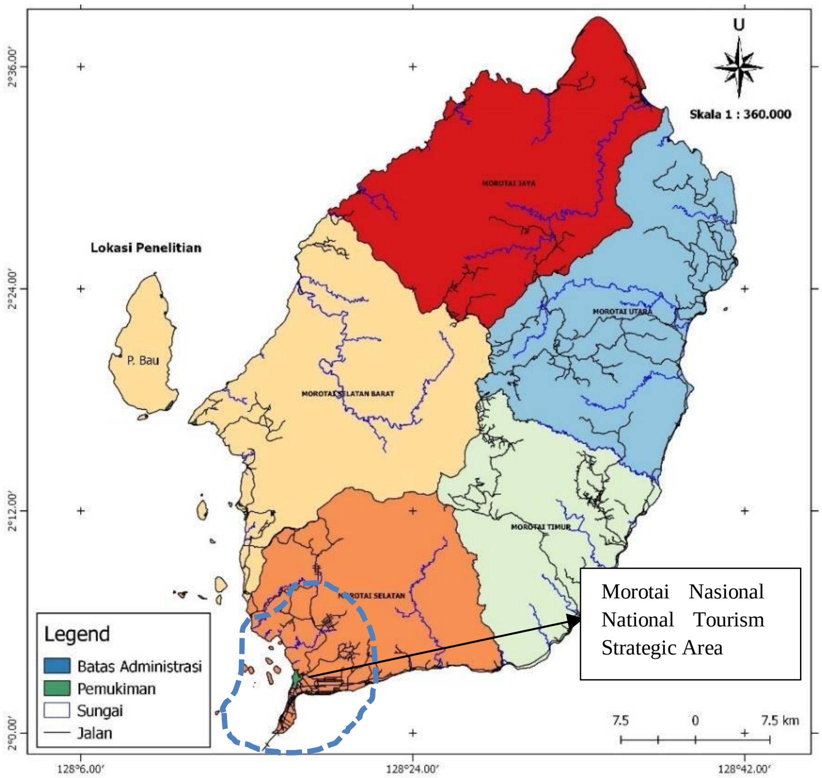

Figure 3. South Morotai tourism area

Tourism areas are very vulnerable and affected by disaster events, especially earthquakes. Theimpact of the earthquake in tourism areas can cause physical and non-physical losses, decline in tourists, and even fatalities. This will affect the tourism economy which ultimately causes material losses.

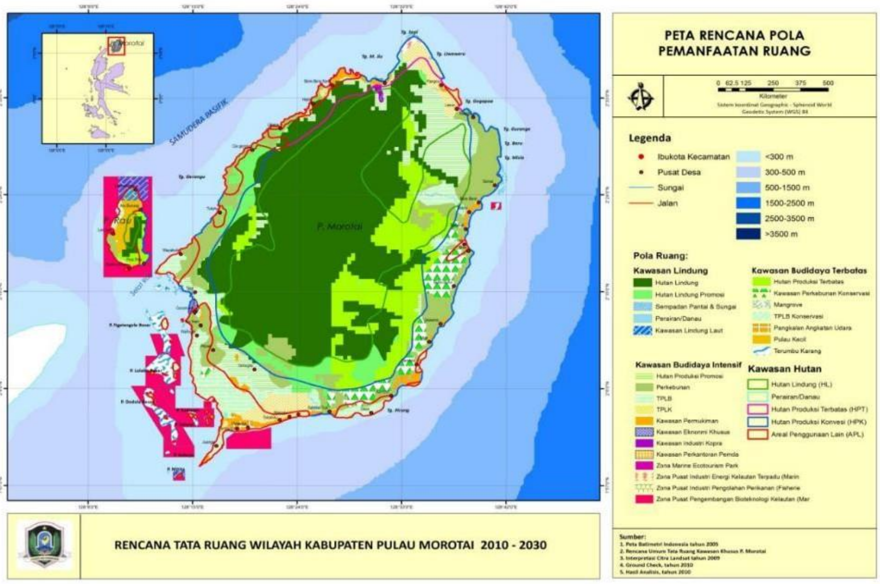

Figure 4. Map of spatial utilization patterns

Earthquake Hazard Mapping Analysis

Data needs for hazard studies are taken from data for preparing hazard studies such as earthquake hazard maps sourced from the North Maluku Earthquake Hazard Map made by Ningrum, et al., 2020 and the 2017 Indonesia Earthquake Source and Hazard Map made by the National Earthquake Study Center. (Pusgen). Based on tectonic activity, it can be concluded thatMorotai Island has a high potential for earthquake hazard. This can also be seen from the earthquake hazard map for Morotai Island that has been carried out by (Ningrum, et al., 2020) and is shown in Figure 5. The highest Peak Ground Acceleration (PGA) value for Morotai Island is 3.8 gal, this is influenced by by the source of the subduction earthquake from the Philippine plate, the Maluku Sea and the Sangihe Sea. Meanwhile, the PGA value of Morotai Island sourcedfrom the 2017 Indonesia Earthquake Source and Hazard Map made by the National EarthquakeStudy Center (Pusgen) is > 3.0 gal and can be seen in Figure 6**.**

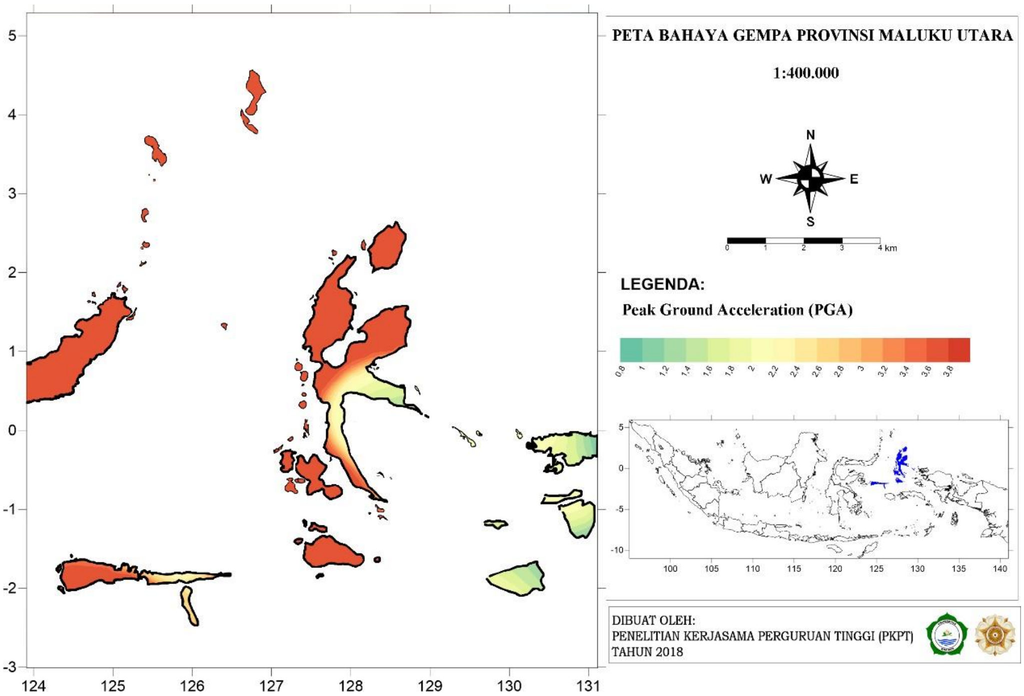

Figure 5. North Maluku earthquake hazard map (Ningrum, et al., 2020)

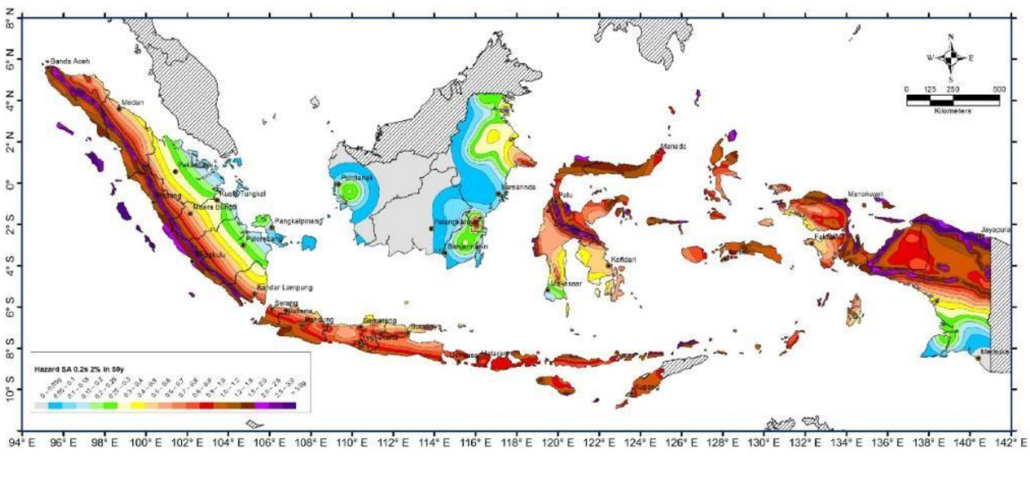

Figure 6. Indonesia earthquake hazard map 2017 (Pusgen, 2017)

Earthquake Vulnerability Analysis

Vulnerability is a condition in which a group/community becomes incapacitated when experiencing various damaging impacts from hazards (Rif'an and Tyawati, 2020). The data needed for the study of earthquake vulnerability analysis is population data (number per village, population based on age, gender, poor and diabetic), distribution and number of house buildings per village, land use, distribution and number of public facilities and critical facilities, and the area of tourism. The study of earthquake vulnerability analysis in this study is limited to discussing social, economic, physical, and environmental vulnerabilities.

Social Vulnerability

The data parameters used for social vulnerability are limited to population data (number of residents per village and gender) of villages that have tourism potential. The results of the scoring carried out for social vulnerability are shown in Table 1.

Table 1. Results of social vulnerability analysis in South Morotai tourism area

Village	Population Density (people/km^2)	Male	Women	Gender ratio	Social Vulnerability Index	Score	Class
Juanga	1261	679	582	116,7	47,3	1,5	Medium
Pandanga	1260	646	614	105,2	42,8	1,6	Medium
Daruba	3031	1552	1479	104,9	42,6	1,5	Medium
Koloray	565	307	258	119,0	48,3	1,5	Medium
Galo-galo	562	309	253	122,1	49,6	1,6	Medium
Darame	2440	1274	1166	109,3	44,4	1,5	Medium
Gotalamo	3661	1835	1826	100,5	41,0	1,6	Medium
Wawama	1875	935	940	99,5	40,4	1,5	Medium
Totodoku	837	427	410	104,1	42,3	1,5	Medium
Joubela	1159	591	568	104,0	42,2	1,5	Medium
Falila	310	156	154	101,3	41,1	1,5	Medium
Nakamura	612	330	282	117,0	47,4	1,5	Medium

(Source: BPS, 2021)

It is known from the results of the analysis that villages in the South Morotai tourism area have an average social vulnerability parameter of medium class.

Economic Vulnerability

Parameters of economic vulnerability are limited to the area of productive land obtained from land use maps and converted into rupiah, and Gross Regional Domestic Product (GRDP). The results of weighting the value of economic vulnerability obtained low, medium, and high categories. For the value of economic vulnerability with the lowest category is in Falila Village. It can be seen from the land use map that Falila Village does not have productive land and has a low Gross Regional Domestic Product (GRDP). The value of economic vulnerability with the highest category is in Juanga Village, Pandanga Village, and Daruba Village.

Physical Vulnerability

Physical vulnerability uses parameters from the density of houses or buildings, the availability of buildings/ public and critical facilities and the road network. The parameters used were analyzed using weighting and resulted in a score in the form of a class. Data on the number of houses or buildings and the road network were obtained from the basic map information from Bakosurtanal. From the results of the physical vulnerability analysis carried out, the physical vulnerability values obtained with class categories from medium to high. The value of physicalvulnerability is in Falila Village and Nakamura Village. Meanwhile, the highest physical vulnerability values were in the villages of Juanga, Pandanga, Daruba, Kolorai, Galo-galo, Darame, Gothalamo, Wawama, Totodoku, and Joubela. An area with high vulnerability if it has a high number of buildings or a high percentage of built area.

Environmental Vulnerability

Parameters used in the vulnerability of the land cover environment (protected forests, naturalforests, mangroves/mangroves, swamps and shrubs). The results of the weighting analysis obtained the value of environmental vulnerability in the medium category for the 12 villages studied. This means that the level of productivity in the 12 villages is moderate.

Analysis of Community Capacity Level in dealing with earthquake disasters

Coping capacity is the ability of communities, organizations and systems to face and cope withvarious conditions, emergency situations or disasters by using the capacity they have or resources that are dangerous (Rif'an and Tyawati, 2020). The assessment of community capacity is very complex compared to other parameters, which are obtained based on the level of resilience of an area. The level of community capacity was obtained using data from a questionnaire based on indicators in the Hyogo Framework for Actions with the GUTTMAN Scale.

Table 2. Results of capacity analysis of the south Morotai community in facing earthquake disasters

Village	Score	Class
Juanga	0,25	Low
Pandanga	0,56	Medium
Daruba	0,14	Low
Koloray	0,28	Low
Galo-galo	0,22	Low
Darame	0,11	Low
Gotalamo	0,36	Medium
Wawama	0,28	Low
Totodoku	0,25	Low
Joubela	0,25	Low
Falila	0,14	Low
Nakamura	0,22	Low

Based on the results of the analysis of the level of community capacity in dealing with earthquake disasters in the South Morotai tourism area, that shows a low, and medium level. The level of capacity is moderate in Gothalamo and Pandanga Villages, this is influenced by the lack of coordination from local organizations or governments in earthquake disaster management in these villages. The low capacity levels are in Juanga Village, Daruba Village, Koloray Village, Galo-galo Village, Darame Village, Wawama Village, Totodoku Village, Joubela Village, Falila Village, and Nakamura Village, so capacity building is still very much needed. With a high level of danger, the community should feel the need for disaster management actions through increasing public awareness, evacuation training, and providingevacuation instructions.

Earthquake Disaster Risk Assessment

According to the regulation of the head of the National Disaster Management Agency No. 2 of 2012, it states that a disaster risk assessment is an approach to show the potential negative impacts that may arise due to the potential disaster that strikes. Disaster risk assessment is todetermine the three components of disaster risk, namely hazard, vulnerability and capacity. The three components obtained are used to produce a disaster risk map in an area. Disaster risk maps are the result of overlaying hazard, vulnerability, and capacity maps that are displayed in the form of spatial maps. Disaster risk maps can be used as the basis for government policies in disaster management, especially earthquake disasters in the South Morotai tourism area.

The study of earthquake disaster risk resulting from the analysis of hazard, vulnerability, and capacity was obtained in the form of level of disaster risk. The distribution of earthquake disaster risk areas is shown in Figure 7. The areas with high disaster risk are Daruba Village (score 11.1) and Darame Village (13.9). However, judging from the high-risk area, Daruba Village has a large area of 15.1 km^2. This can be used as a foundation by government partners to implement technical assistance and intervention initiatives in vulnerable communities to reduce disaster risk. For disaster management to be effective, partners' assistance and interventions must be coordinated and synchronized with government programs. And the general public can use it as a basis to create concrete preparedness actions, such as making evacuation plans and routes, choosing residential areas, and so on (Ningrum et al., 2021).

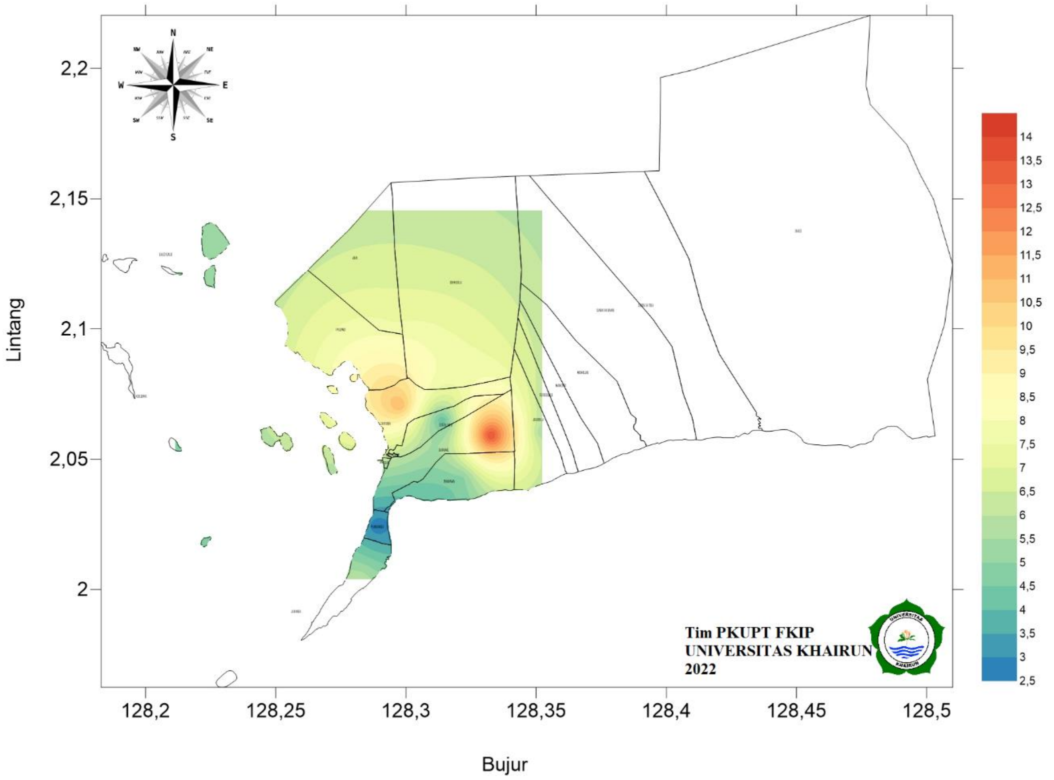

Figure 7. Earthquake disaster risk map in South Morotai tourism area

Disaster Resilient Tourism Destination Development Planning Strategy

Based on the earthquake risk analysis, it can be seen that the areas at moderate to high risk are in the South Morotai tourism area. So that it can be used as a reference for the development of tourism areas based on the known level of earthquake disaster risk. An earthquake risk analysis in the South Morotai tourism area was carried out in order to provide direction for tourism development as a form of disaster mitigation. The main goal is to make the South Morotai tourism area safe for visiting tourists.

The disaster risk in South Morotai is very threatening to tourism, especially in coastal areas, itis necessary to implement mitigation to minimize the consequences of the occurrence of disasters. Tourism in South Morotai has attractive tourism potential, but there is also a threat in the form of an earthquake, if the management of tourism is not optimal, so that it can increase the risk of a disaster (Pahleviannur et al., 2019). Planning strategies for the developmentof disaster-resilient tourism destinations need to analyze the 6A factors, namely attractions, accessibility, amenities, availability of tour packages, activities, and ancillary services.

The results of the 6A analysis can be used in planning the development of disaster-resilient tourism. The lack of availability of evacuation route signs, gathering points, and early warning systems, resulted in the absence of structural mitigation in the South Morotai tourism area. Structural mitigation needs to exist to minimize the impact of disasters and create disaster- resilient tourism. Disaster mitigation efforts in the South Morotai tourism area have shown the seriousness of the local government, there are several villages that have signs and evacuation routes, namely Juanga Village, Pandanga Village, Daruba Village, Darame Village, and Joubela Village. The new natural disaster early warning system is located in Juanga Village, Pandanga Village, Kolorai Village, Galo-galo Village, Totodoku Village, Falila Village, and Nakamura Village.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that areas with high disaster risk are Daruba Village (score 11.1) and Darame Village (score 13.9). However, judging from the area of high risk, Daruba Village has a large area of 15.1 km2 compared to Darame Village. Solutions for planning strategies for the development of disaster-resilient tourism destinations need to analyze the 6A factors, namely attractions, accessibility, amenities, availability of tour packages, activities, and additional services. ancillary services).

ACKNOWLEDGEMENTS

Thanks are conveyed by the Chairperson of the Institute for Research and Community Service who has funded this activity through Competitive Research for Higher Education Excellence at the Faculty Level 2022 with Research Implementation Agreement Number: 009/PEN- PKUPT/PG.12/2022.

REFERENCES

Adeyinka-Ojo, S. F., Khoo-Lattimore, C., & Nair, V. (2014). A Framework for Rural Tourism Destination Management and Marketing Organisations. *Procedia-Social and Behavioral Sciences*, *144*, 151-163. https://doi.org/10.1016/j.sbspro.2014.07.284

BNPB. (2008). *Pedoman Penyusunan Rencana Penanggulangan Bencana*. *Peraturan Kepala Badan Nasional Penanggulangan Bencana Nomor*, *4*. Jakarta: Badan Nasional Penanggulangan Bencana

BNPB. (2012). *Peraturan Kepala Badan Nasional Penanggulangan Bencana No.02 Tahun 2012 tentang Pedoman Umum Pengkajian Risiko Bencana*. Jakarta: Badan Nasional Penanggulangan Bencana

BNPB. (2015). *Petunjuk Teknis Penyusunan Rencana Penanggulangan Bencana Daerah Tingkat Kabupaten/Kota*. Jakarta: Badan Nasional Penanggulangan Bencana

BPS. (2022). *Kecamatan Morotai Selatan Dalam Angka 2021*. Badan Pusat Statistik

Chou, J. S., & Chiu, Y. C. (2021). Identifying Critical Risk Factors and Responses of River Dredging Projects for Knowledge Management Within Organisation. *Journal of Flood Risk Management*, *14*(1), e12690. https://doi.org/10.1111/jfr3.12690

Chan, C. S., Nozu, K., & Cheung, T. O. L. (2020). Tourism and Natural Disaster Management Process: Perception of Tourism Stakeholders in The Case of Kumamoto Earthquake in Japan. *Current Issues in Tourism*, *23*(15), 1864-1885. https://doi.org/10.1080/13683500.2019.1666809

Ghimire, H. L. (2015). Disaster Management and Post-Quake Impact on Tourism in Nepal. *The Gaze: Journal of Tourism and Hospitality*, *7*, 37-57. https://doi.org/10.3126/gaze.v7i0.15119

Kasman, K., & Triokmen, E. (2021). Analisis Risiko Bencana Tsunami di Pesisir Selatan Jawa Studi Kasus: Kabupaten Garut. *Jurnal Kelautan Tropis*, *24*(2), 265-274. https://doi.org/10.14710/jkt.v24i2.10271

Kusmajaya, S., & Wulandari, R. (2019). Kajian Risiko Bencana Gempabumi di Kabupaten Cianjur. *Jurnal Dialog dan Penanggulangan Bencana*, *10*(1), 39-51.

Melianita, R., Putra, A. D., & Syah, A. (2021). Analisis Potensi Kerentanan dan Risiko Bencana di Wilayah Kabupaten Tanggamus. *Jurnal Rekayasa Sipil dan Desain*, *9*(3), 437-448.

Ningrum, R. W., Suryanto, W., Fauzi, H., & Mei, E. T. W. (2020). Mapping of PGA Value Using PSHA Method in West Halmahera North Maluku. *Jurnal Teknosains*, *9*(2), 116-126. https://doi.org/10.22146/teknosains.41483

Ningrum, R. W., Amelia, R. N., Hasmawati, H., Aswan, M., & Saprudin, S. (2021). Earthquake Disaster Risk Assessment Analysis in Jailolo Coastal Region. *Techno: Jurnal Penelitian*, *10*(2), 152-163. http://dx.doi.org/10.33387/tjp.v10i2.3523

Pahleviannur, M. R., Wulandari, D. A., Sochiba, S. L., & Santoso, R. R. (2020). Strategi Perencanaan Pengembangan Pariwisata untuk Mewujudkan Destinasi Tangguh Bencana di Wilayah Kepesisiran Drini Gunungkidul. *Jurnal Pendidikan Ilmu Sosial*, *29*(2), 116-126.

Presiden Republik Indonesia. (2020). *Perpres Nomor 18 Tahun 2020 Tentang Rencana Pembangunan Jangka Menengah Nasional 2020-2024*. Jakarta: Presiden RI

Presiden Republik Indonesia. (2020). *Perpres Nomor 18 Tahun 2020 Tentang Rencana Pembangunan Jangka Menengah Nasional 2020-2024*. Jakarta: Presiden RI

Purwanto, N. I., Poluan, R. J., & Takumansang, E. D. (2017). Perencanaan Wilayah Pesisir Berbasis Mitigasi Bencana di Kecamatan Sanana Kabupaten Kepulauan Sula Provinsi Maluku Utara. *Spasial*, *4*(3), 1-8. https://doi.org/10.35793/sp.v4i3.17295

PuSGeN. (2017). *Peta Sumber dan Bahaya Gempa Indonesia Tahun 2017 (1st ed).* Bandung: Puslitbang Perumahan dan Pemukiman

Rif'an, A. A., & Tyawati, A. W. (2020). Penilaian Risiko Bencana Kawasan Pariwisata Pantai Sayung, Kabupaten Demak. *Pringgitan*, *1*(2), 135-150. http://dx.doi.org/10.47256/prg.v1i2.118

Sugianto, M. A. (2021). The Role of Disaster-Resilient Villages Supporting Tourism in Badung District. *Jurnal Sains dan Teknologi Mitigasi Bencana*, *16*(1), 23-29. https://doi.org/10.29122/jstmb.v16i1.4797

Sunarto, Marfai, M. A., Djati, M. (2010). *Penaksiran Resiko Multi Bencana di Wilayah Kepesisiran Parangtritis, Suatu Analisis Serbacakup Untuk Membangun Kepedulian Masyarakat Terhadap Berbagai Kejadian Bencana*. Yogyakarta: Gadjah Mada University Press.

Thywissen, K. (2006). *Component of Risk: A Comparative Glossary*. Bonn: UNU Institute for Environmentand Human Security

Undang Undang tentang Kepariwisataan, UU No. 10 Tahun 2009. Jakarta: Direktorat Jenderal Hukum dan HAM

Undang-Undang No. 24 Tahun 2007 tentang Penanggulangan Bencana. Jakarta.

Waltham, D., Hall, R., Smyth, H. R., & Ebinger, C. J. (2008). Basin Formation by Volcanic Arc Loading. *Formation and Applications of the Sedimentary Record in Arc Collision Zones*, *436*, 11.