Assessing community coping capacity in face of tsunami disaster risk (case study: sumberagung coastal area, banyuwangi, east java)

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Abstract. This research aims to assess community coping capacity especially in implementing post-tsunami disaster mitigation and adaptation in the coastal environment of Sumberagung Village. Sumberagung Village is a vulnerable area exposed to the tsunami. The past tsunami in 1994 has caused many losses to the people at Pancer Beach and Pulau Merah Beach. More than 200 people were dead at Pancer Beach. Data collection techniques on this research could be divided into two; primary data and secondary data. Primary data is obtained by conducting field surveys and in-depth interviews with the local inhabitants. While secondary data is obtained through relevant government agencies such as the Regional Disaster Management Agency (BPBD), Village Monograph Data, and Statistics Agency Bureau (BPS). Data identification was carried out in a qualitative descriptive manner by adjusting the findings of the field with the study of existing theories. The results of the study indicate that in general the appeal for the threat of a tsunami disaster has already existed but has not been comprehensive. On the other hand, not all of the inhabitants have not taken many lessons learned from the 1994 tsunami. Adaptation in the form of shelter that is safe from the threat of a tsunami has not been seen by residents in Pancer Beach. This field condition shows that after the 25 years of the tsunami event, the local residents have not been fully able to implement a mitigation strategy, especially on emergency.

1. Introduction
Coastal areas of Southern Java are highly vulnerable to tsunami. Such a condition is caused by plate tectonics configuration. Indo-Australia and Eurasia plate tectonics subduct intensively 7cm/year to depth 100-200 km in southern offshore of Java Island (Shohaya et al 2013[1]; Sili 2013[2]). The intensive motion of plate tectonics could trigger a submarine earthquake. Submarine earthquake is one of the most dominant factors which triggered tsunami earthquake (Satake et al, 2013[3]).

Data from NGDC showed 1863, 1889, 1921, 1930, 1963, 1982, 1994, and 2006 tsunami in Southern Java are earthquake-triggered (Kumar and Achyuthan 2006[4]; Sunarto and Mardianto 2010[5]). The magnitude of occurred tsunamigenic earthquakes is one of the most dominant factors which triggered tsunami earthquake. Submarine earthquake is one of the most dominant factors which triggered tsunami earthquake (Satake et al, 2013[3]).

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epicentral distance of less than 200 km is potentially forming tsunami wave (Tsuji 1995[8]; Fujii and Satake 2006 [7]). Epicentral dispersion of the 1990—2016 earthquake occurred in Java Waters can be seen in Figure 1.

![Figure 1. Record of Earthquake in Java during 1900-2016 (USGS Earthquake, 2017)](image)

The 1994th tsunami in Banyuwangi Regency, East Java has left serious trauma to local communities, including Sumberagung Village inhabitants. As respondents, the local communities informed: “tsunami wave reached the beach at 02.00 WIB (Western Indonesian Time) after the submarine earthquake in the Indian Ocean”. Its clarified by NEIC-USGS, the 7.6 M earthquake occurred at 01.17 WIB on June 3, 1994, in 10.55˚S 113.0˚E 240 km from the nearest beach (Tsuji et al, 1995[8]). This event mentally impacted to Sumberagung Village community and other communities within a 200 km radius, including Jember, Lumajang, Malang and Negara Regency (Bali Province) (Maramai and Tinti, 1997[10]).

A tsunami could contribute to many negative impacts. Some of the main factors are population growth, migration, poverty and environmental degradation (Kusumasari, 2014[11]). Refer to those factors, the disaster loss could be devastating to the community; great numbers of the dead and injured, damaged buildings and deducted property’s value (Quarantelli, 2001[12]). On account of that, Sumberagung has a high risk of tsunami disaster impact thus it needs to implement comprehensive and progressive phases of a disaster which are mitigation, preparedness, response, and recovery (Cronstedt, M 2002[13]).

The 1994th tsunami gives physical and non-physical impacts in some areas. Physically, Pancer (a hamlet part of Sumberagung) was impacted by 121 fatalities, 223 fatalities, 15 people missing and 789 people injured in Pesanggaran Sub-district (Tsuji, 1995[8]). In the other hand, non-physically, 65% of houses are damaged (648 out of 991 houses) and 340 boats missing (Samsulhadi, 1997[14]). Detailed information about the loss is also helped by adding the tsunami wave height variation as the variable. The tsunami wave, in Pancer Beach, was 11 m in height and reached areas 300 m away from there,
meanwhile in Rajegwesi (Sarongan) was 14 m in height and reached areas within a 150 m radius (Sunarto and Marfai, 2012[6]).

Sumberagung coastal area has been categorized as a highly vulnerable area to disaster for the last 25 years. In Pesanggaran Sub-district, Banyuwangi, the vulnerability is measured in numbers of potential damage and loss based on Disaster Prone Area. The recent condition of vulnerability shows 696 vulnerable population: 204 people vulnerable by age, 194 people vulnerable by the economic situation and 1 person vulnerable by disability; 25,928 million rupiahs potential material loss caused by highly damaged of 6,854 buildings and 19,074 economic facilities (Ina-Risk BNPB, 2017[16]). The fast-growing population and economic activity are holding the key factor of the high risk in the area.

Twenty-five years after the tsunami, the coastal area of Sumberagung has been growing into economic and tourism leading sector in Banyuwangi. The number of a tourism destination is significantly increasing human activities around the coastal area, including in Pulau Merah Beach and Fish Auction Market in Pancerc. As consequences of human increasing activities around the coastal area, the community’s coping capacities towards tsunami risk-reduction are essential to improve. The recent condition shows Sumberagung community’s preparedness and awareness of disaster are categorized as a medium coping capacity. It portrayed by the quantity and quality of the tsunami warning signs at some points of the area. In other words, most of the warning signs are less communicative and unevenly distributed. Both the government and the local community, have a responsibility to provide accessible, readable and comprehensible evacuation routes and warning signs for the community itself and visitor. In fact from the interview, the tsunami’s casualty loss is dominantly visitors and tourists (Nandi and D.S Rohman, 2017[25]).

Knowledge regarding to mitigation strategy and adaptation response to tsunami disaster should be well-understood by communities. Comprehensive knowledge to social and physical environmental conditions is basic knowledge need to the community. Follows by mitigation strategy. Both structurally and non-structurally, mitigation effort could raise people’s awareness in a hope to develop an adaptation culture. Properly-made mitigation plan and adaptation culture are effective and optimal actions for the tsunami disaster risk-reduction for the community.

Assessing community coping capacity in facing of natural disasters can be done by identifying local wisdom. The local wisdom refers to local environmental conditions which based on some assessment parameters. It is also possible to be applied to the community of Sumberagung in the face of tsunami disaster. Local wisdom facing natural disaster can be divided into some components (Westen et al, 2011[17]) namely; 1) knowledge of historical disaster event, and the damages they have caused; 2) knowledge on the elements at risk, and how they value them; 3) knowledge on the factors contributing to vulnerability; 4) knowledge on the coping strategies and capacities to confront disaster; dan 5) knowledge about commuting patterns. Through these identifications, the community coping capacity could be increased. As a result, the casualty loss impacted local communities, visitors and tourists could act the contrary.

The physical condition of an area holds an important factor to determine good disaster management. Places with high vulnerability to a tsunami disaster need proper preparedness and adaptation strategies, counting the coastal area of Sumberagung. In the contrary, proper preparedness and adaptation strategy, especially land use management are not suitable and inappropriate as settlements. This area is thriving across the beach to support the community’s economic sector. As a consequence, the inhabitants are helpless to respond to disasters. Therefore, a continuous local-based education about disaster mitigation, preparedness, responds and adaptation needs to be enforced in order to reduce the tsunami disaster impact and loss.

2. Methods
This research was conducted by qualitative method. The series of techniques for collecting data through the results of documentation, field observation, behavior identification, and in-depth interviews with local communities (Creswell, 2010[18]). The qualitative research approach from
research process is carried out collaboratively with the community, based on solving community social problems, and oriented to community actions (Hamzah, 2019[19]).

Technique of collecting data uses field surveys and in-depth interviews with resource persons to gather information about forms of mitigation and adaptation that are owned by the community. In-depth interviews were conducted with several informants who were considered to have deep knowledge of the environmental conditions of the community. Resource persons selected as key informants so as to be able to provide a reference to the overall information needed. The method in this study can broadly be classified into three, including: 1) field data collection and supporting data, 2) the process of sorting, analyzing, and processing data, and 3) presenting results.

This research was conducted with qualitative methods as a basis for analyzing the results obtained by primary data and secondary data. The primary data collection method is based on the results of the field survey. Survey activities were carried out to obtain data on the distribution and area of the tsunami threat. Surveys were also conducted to obtain information on the existence of evacuation routes. Secondary data collection was carried out by documenting studies from various sources including: Regional Disaster Management Agency (BPBD) about disaster data in Banyuwangi Regency, data on physical environmental and population potential from Statistics Agency Bureau (BPS), and Village Monograph.

The data analysis technique in this study is to measure community adaptation strategies in responding to disasters through risky elements that are tailored to the local knowledge of the community in the field. Parameters of community local knowledge are divided into several components (Westen et al, 2011[17]), videlicet 1) knowledge of historical disaster event, and the damages they have caused; 2) knowledge on the elements at risk, and how they value them; 3) knowledge on the factors contributing to vulnerability; 4) knowledge on the coping strategies and capacities to confront disaster; dan 5) knowledge about commuting patterns. While the risk element as a tsunami risk assessment consists of physical, economic, social, and environmental elements.

3. Results and Discussion
Identification of Tsunami Hazard Location in Sumberagung Village

This research took place at Pancer Bay in Sumberagung, Pesanggaran, Banyuwangi, East Java. Pancer Bay’s characteristics are curved inward, elevated 3.54 m asl. and morphologically homogenous with a total area of 4.6 km². Sumberagung has a flat morphology with a 0-8% slope, the settlements are located 50 m asl. and 300 m from the shoreline. Most of the inhabitants are working in the fisheries and tourism sector. The morphology of the western part of the beach is far less steep than the eastern part due to the existence of Beach Sheoak (Casuarina) in the area. The measurement of the physical oceanography parameter was done in two sites, Mustika Pancer and Pulau Merah Beach. The bay has a fine-shaped light-colored sand beach with 4.049 m long and 26.5 m. The wide of the beach was divided into three segments: the first segment is 17 m long with a 10% slope; the second segment is 5.6 m with a 5% slope; the third segment is 3.9 m long with a 10.5% slope. The sand texture and color are formed as the result of deposited limestone remains. The morphological condition of the research area is shown in Figure 2.
Figure 2. Topographic Map of Pancer and Pulau Merah Beach
Identification of Tsunami Elements of Risk

The identification of tsunami Elements of Risk can be split into four; physical, economic, social, and environmental elements. Each element has different factors to face. The description of every Elements of Risk in Mustika Pancer and Pulau Merah Beach, Banyuwangi depicted in Table 1.

Table 1. Classification of Elements of Risk

| Elements of Risk | Description of Each Variable |
|------------------|-----------------------------|
| Physical Element | 1. Infrastructure: road and man-made wave-breaker  
2. Vital Facility: emergency shelter, school, place of worship  
3. Utility: electricity and water provision  
4. Transportation and communication service  
5. Public service: Village Meeting Hall, Balai Desa, Pancer Beach Fishery Office, Indonesian Navy (TNI AL) Office  
6. “Monument of 1994th Tsunami” historical construction |
| Economic Element | 1. Pulau Merah Beach tourism activity and  
2. Pulau Merah tourism activity and Pancer Fish Auction Market (TPI Pancer)  
3. Access to work (port)  
4. “Corn Field” agricultural land  
5. Impact to job activity (fishery, agriculture and beach tourism) |
| Social Element   | 1. Vulnerable age groups  
2. Low-income groups  
3. People with no land ownership rights  
4. Gender, especially women |
| Environmental Element | 1. Natural resources: air, water, fauna, flora  
2. Biodiversity (beach sheoak, mangrove, and other sea vegetation)  
3. Landscape (Karst Landform, Estuary and Bay) |

Source: Adapted from Westen (2011)

A comprehensive identification aims to find the possible elements of risks in Pancer and Pulau Merah Beach. Infrastructures, buildings/vital facilities, community’s utilities, transportation service, public service’s offices, and historical constructions can be seen as the parameters to determine the physical Elements of Risk in Pancer and Pulau Merah Beach. Counting 4.66 km long and 3.5 m wide main road to connect Pancer and Pulau Merah Beach as an infrastructure at risk. The road only 550 m away from the shoreline, with linear-pattern settlements following. At the northern part of the settlements, river meander creates estuary environment. The distribution of Pancer and Pulau Merah Beach’s physical elements at risks are affecting the high-risk value there.

There are some differences between Pancer and Pulau Merah Beach if looking from their economic Elements of Risk. Pancer Beach’s economic circulation is dominantly driven by fish auction activity. Fishermen are taking the estuary as an advantage to rest and protect their boats from the destructive Southern Sea waves. Also, fisheries lead the economic sector in Sumberagung Village with 721 people working in the sector (BPS, 2018) and 297,112.59 m² of near-coastal settlements. Despite located in the same shoreline with Pancer Beach, fisheries sector is not done much in Pulau Merah Beach. Tourism is more promising in the most-eastern part of Pancer Bay. Pulau Merah Beach has a total area of 3 km² with a 3-5 m wave, suited for surfing and other tourism activities.
The population density of Sumberagung is categorized as medium vulnerability with 1993.7 inhabitants/km². The population is dominated by the elderly above sixty years-old, consists of 964 males out of 7,057 male inhabitants in total and 938 females out of 6,883 female inhabitants in total. Almost all of the inhabitants are not on record due to the absence of land ownership rights. To this present day, the status of Sumberagung Village is still a Reserved Forest Area under the control of State-Owned Forestry Company (Perhutani).

Pancer and Pulau Merah Beach have flora biodiversities, such as Beach Sheoak (Casuarina) and Katang-katang (Ipomoea pescaprae). Not only diverse in flora, Pancer and Pulau Merah Beach but also diverse in landforms. There are fluvial, karst, and marine landform in this area.

a. Agung River’s estuary is one of the units of fluvial landform. The 16 km river has been significantly creating a dynamic at Pancer Beach coastal environment. Before the estuary, Agung River’s meander is another unit of the fluvial landform located in the northern part of human settlements, separating it with the karst mountains.

b. Karst landform can be identified by the presence of Batuampar Formation in a form of karst mountains in the north. Batuampar Formation consists of volcanic tuff, tuff, sandstone, andesite lava, and limestone.

c. Pancer Beach has a pocket beach marine landform. The pocket beach is a bay surrounded by structural mountains. The sand material of Pancer Beach created as the result of deposited headlands eroded materials.
Forms of Structural and Non-structural Mitigation to Face Tsunami Hazard

Pancer and Pulau Merah Beach are represented as strategic development areas due to these because of their flat topography. The area is located in a bay that has an inlet thus the topography is relatively flatter than the surrounding karst mountains. The advantage of the morphological condition is being taken by the local community to grow settlements nearby the beach ridge within a 500 m radius from the shoreline. Such a condition is highly vulnerable to a tsunami exposure which can cause a devastating impact. Its physical condition is as disastrous as its non-physical condition. The inward-curved bay accumulates the sea wave due to its flat topography. Therefore, a structural and non-structural mitigation strategy is needed to face a tsunami disaster.

Structural mitigation effort can be done by building a wave-breaker. In Pancer Beach where there are dense human activities, two wave-breaker had been built. The first and second wave-breaker has 321 m and 206 m in length to prevent destructive wave to hit boats and surrounding buildings. After the 1994th tsunami, the local community and government agreed to construct an Indonesian Navy (TNI AL) Observation Post for an effective coordination while a disaster happens in Pancer Hamlet. Planting Beach Seaoak (*Casuarina*) and Coconut (*Cocos nucifera*) trees lengthwise the shoreline, right ahead of the settlements, are another effort to restrain the sea wave.

![Figure 6. Jetty](source: Author Documentation)

![Figure 7. Marine Vegetation](source: Author Documentation)

Structural mitigation efforts also need to be supported with the non-structural mitigation efforts in order to run optimally. Non-structurally, disaster training and education hold the crucial key in strengthening people’s understanding of disasters. The community needs to be fully aware of their local hazardous area to disasters with a planned, integrated and comprehensive effort.

The non-structural mitigation effort plays an important role in the risk-reduction strategy because of the social element’s high involvement condition between local communities, stakeholders and/or government agencies. The contribution of the local government was started with the establishment of the Banyuwangi Local Disaster Management Agency (BPBD) in 2012 which soon gives significant impacts on accommodating disaster education at all education levels.

Disaster Investigation Team is also authorized by a Regental Decree (Surat Keputusan Bupati) No.188.184/Kep/429.012/2008 as an act of disaster management. They have important tasks (Sunarto and Marfai, 2012[6]) to; (1) collecting disaster reports from the impacted area, (2) doing ground check/collect casualty loss, rehabilitation and restoration need data with related technical teams, (3) giving support, rehabilitate and/or reconstruct settlements, social and public facilities in the area, (4) accepting and distributing support to people directly affected, (5) doing other tasks given by Regent in order to create an optimal governmental and development situation and condition, (6) taking responsibility and report their tasks to Disaster Management in Banyuwangi.

Community Adaptation in Facing a Tsunami Disaster

An ability to adapt with disaster hazards is crucial to community coping capacity responding its environment. The strategies are started with an identification of a local community’s knowledge,
perception, participation, and adaptation. Adaptation behavior is essential to reduce the physical and social vulnerability. Vulnerability needs to be put on a spotlight because it has a capability to create a defenseless community facing sudden (shock) and continual (stress) threatening situations and conditions (Hizbaron, 2008[21]). This is based on the fact that after disaster has the potential to cause high losses and damage (Hizbaron, 2014[22]).

Identifying local wisdom about local environmental conditions acts as the main stage to achieve well-adapted to disaster community. The local wisdom to face natural disaster can be divided into some components (Westen et al, 2011[17]) namely; 1) knowledge of historical disaster event, and the damages they have caused; 2) knowledge on the elements at risk, and how they value them; 3) knowledge on the factors contributing to vulnerability; 4) knowledge on the coping strategies and capacities to confront disaster; dan 5) knowledge about commuting patterns.

The Pancer and Pulau Merah near-shore community already have a good local environmental knowledge. This parameter is concluded by the result of interview about the tsunami disaster 25 year ago. Informed by one of Sumberagung Village’s public figures, Sumberagung also crowned as a Well-Prepared to Tsunami Disaster Village for four years now by Banyuwangi Regency BPBD. The priority is to set a convergence plan focused on a prone and vulnerable to tsunami area, although with a low intensity. In-depth interview with the local community can be use as a parameter to assess their local knowledge, which includes:

1) Knowledge of historical disaster event, and the damages they have caused

The tsunami disaster occurred at 02.00 WIB on June 3, 1994. Average tsunami wave height in Pancer reached 9.4 m above sea level with a maximum height at Pancer Fish Auction (TPI Pancer) reaching 11 meters. This tsunami disaster was triggered by an earthquake on the ocean floor of the Indian Ocean with a force of around 6 SR. Post-disaster losses include property and death. Damage to property, namely houses that are only 500 meters from the coastline as a whole, 600 houses were more destroyed by the tsunami. Information about the tsunami victims affected by more than 200 people as a whole was marked by the presence of a tsunami monument in near of the Pancer Hamlet Office.

2) Knowledge on the elements at risk, and how they value them

Many houses in the Pancer have a high potential for being exposed to the tsunami disaster. This location that extends along the road that is parallel to the coastline. The distance between a house and a coastline is only 300 - 500 meters. In addition, there are also fish auctions (TPI Pancer), TNI AL offices, schools, and hamlet offices that are adjacent to the homes and they have the same risk. The location of the fisherman activities is that the center is in Pancer, directly and undirectly will be have high potential damaged with the tsunami wave. The contribution of the community activities from fisheries is fairly developed tourism activity in Sumberagung. If exposed to the tsunami, it will not only threaten the local people but also all of tourists who visit on Mustika Pancer Beach and Pulau Merah Beach.

3) Knowledge on the factors contributing to vulnerability

Very high tsunami threats are triggered by various factors such as seismic tendencies, topography, and conditions of population. The strength of the seafloor earthquake during the 1994 tsunami event ranged from 6 SR, so it is likely that if the earthquake strength is more than that it will potentially trigger a larger tsunami wave. The form of the beach form the bay, also triggers high vulnerability in the tsunami because it tends to be a place for accumulated water. In addition, the coastal highs included in the flat category are 0-3 m from the coastline so that the wave height is difficult to breakable. The contribution of population density is also a major factor in the high vulnerability of the tsunami disaster. This can be seen from the total population density of more than 1900 people / km². This population density is quite high risk because the number of toddlers and seniors is quite large. The environmental characteristics of the coastal village of Sumberagung actually have a natural barrier, namely Tumpang Pitu hills, but their use which is currently a mining location can also have a negative impact on the long term because it can cause greater losses from tsunami exposure.

4) Knowledge on the coping strategies and capacities to confront disaster
In 2011, people of Sumberagung began to initiate a disaster-resilient village by forming disaster response volunteers. Planning disaster response volunteers are under the coordination of the Government of Pesanggrahan District which is based on awareness to the potential for disasters that are quite diverse ranging from tsunamis, floods, and landslides. Resilient village planning is then officially realized by BPBD Kab. Banyuwangi was divided into 4 hamlets in Sumberagung with the priority of tsunami disaster preparedness studies. Enhancing community capacity in responding to the tsunami disaster was also followed by community-based disaster simulation training and training. This simulation activity was followed by residents who worked with the district BPBD and other relevant agencies. One of the concerns of this simulation and training was to establish an evacuation route from the tsunami disaster which up to now consists of 4 evacuation routes. At present the development of the monitoring of potential tsunami triggered by the earthquake can be immediately known by citizens through the guideway network on smartphones. This monitoring activity is also equipped with an early warning system around the ponds installed by the Geological Energy and Mineral Resources Agency and automatically connected to the BPBD of the Regency. Banyuwangi. At least a monitoring tool that is installed around the farm is checked every 1 month to ensure that the tsunami warning device is still functioning properly.

5) Knowledge about commuting patterns

Knowledge of residents to do mobility during the tsunami disaster was helped by the presence of 4 instructions for evacuation routes that directed the population to the northern part of the beach, namely Sainem Gumuk. The time the community has to evacuate is at least 5-10 minutes. This time duration is expected to direct residents to the correct evacuation location if panic conditions can be controlled. At the time of the 1994 tsunami disaster, the community’s assumption to save themselves was that if a very short time could not be maximized for evacuation it was holding objects that could easily float until they were carried to the back estuary of the river. The second assumption is to try to save yourself by running towards a relatively high location with a distance of 5 km from the place of residence but at risk of many incidents of accidents due to increased community panic.

The attitude of adaptation to community preparedness is not only focused on local knowledge, but also the other capacity support. Capacity can be divided such as policies, guidelines for disaster response conditions, early warning systems, and resource mobilization capacity (Giyarsih, 2013[23]). Assessment toward community adaptation capacity in Sumberagung Village, especially at Pancer Hamlet quite well. This condition is based on the knowledge factor about the potential of local disasters. Furthermore, community adaptation were influenced through intensive education and information provided, directed community organizations, and efforts in evacuation activities. In addition, knowledge and understanding of disasters will reduce disaster risk because it helps in taking disaster mitigation actions (Irawan, Sumarmi, and Rosyida 2016[24]).

Community adaptation strategies is an effort to reduce the impact of exposure to the tsunami disaster can be categorized as good enough. Process assessing by considered sufficient knowledge of the residents regarding the tsunami disaster. This adaptation strategy can be predicted to take place maximally if disaster related education is also applied in educational institutions such as schools and tutoring around. This needs special attention that the ability to understand the local conditions of the region is generally elderly people who, 25 years ago, consciously experienced direct contact with tsunami waves.

In-depth knowledge related to the tsunami disaster became a trauma for residents, so that they who were never told the history of the tsunami events to next generation. The results of in-depth interviews with the community, until 2019 there was no disaster management directly touched disaster education schools, especially for primary and secondary education. Therefore, one of the adaptations and preparedness strategies that need to be realized is the tsunami in schools within the Pesanggrahan District.

Prior deep trauma felt by the local people who experienced the events of the 1994 tsunami caused them to be unable to tell in detail to their future generations. The community understands very well about the high vulnerability which at any time a tsunami disaster can recur with a period that is
difficult to predict. These conditions lead to pessimistic perceptions of citizens who are more resigned to existing environmental conditions. The public's perception that despite efforts to train and empower communities in responding to disasters, the tsunami disaster will still come and cause damage to their environment. This certainly illustrates that the coastal communities of Sumberagung Village already have a good understanding of tsunami disaster mitigation but have not yet indicated adequate preparedness. Therefore, optimistic efforts need to be established at all ages from formal and non-formal education and infrastructure improvements such as more communicative roads and evacuation boards so that the culture of adaptation can be applied by the community.

4. Conclusion

A holistic assessment of a tsunami disaster risk needs to be done comprehensively by analyzing the hazard, vulnerability/exposure, coping capacity, to risk of a disaster. The 1994th tsunami struck Pancer Bay Coastal Area had given great loss and damage. Twenty-five years after the tsunami, the community has been gaining risk-reduction knowledge, comprehension, and action of a tsunami disaster. The community coping capacity gradually increases within rapid information about tsunami disaster management. Such a condition affects the community's awareness and preparedness to face a tsunami disaster that needs to be elevated in areas with high vulnerability to a tsunami disaster.

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Reference

[1]. Shohaya, J. N., Chasanah, U., Mutiarani, A., Wahyuni, L., & Madlazim, M. (2013). Survey dan Analisis Seismisitas Wilayah Jawa Timur Berdasarkan Data Gempa Bumi Periode 1999-2013 sebagai Upaya Mitigasi Bencana Gempa Bumi. Jurnal Penelitian Fisika dan Aplikasinya (JPFA), 3(2), 18-27.
[2]. Sili, P. D. (2013). Penentuan Seismisitas dan Tingkat Risiko Gempa Bumi. Universitas Brawijaya Press.
[3]. Satake, K., Nishimura, Y., Putra, P. S., Gusman, A. R., Sunendar, H., Fujii, Y., ... & Yulianto, E. (2013). Tsunami source of the 2010 Mentawai, Indonesia earthquake inferred from tsunami field survey and waveform modeling. Pure and Applied Geophysics, 170(9-10), 1567-1582.
[4]. Kumar, K. A., & Achyuthan, H. (2006). A record of palaeo-tsunami in the Indian Ocean. Marine Geodesy, 29(4), 253-263.
[5]. Sunarto, M. M., & Mardiatno, D. (2010). Multirisk assessment of disasters in Parangtritis coastal area.
[6]. Sunarto, S., & Marfai, M. A. (2012, July). Potensi Bencana Tsunami dan Kesiapsiagaan Masyarakat Menghadapi Bencana Studi Kasus Desa Sumberagung Banyuwangi Jawa Timur. In Forum Geografi (Vol. 26, No. 1, pp. 17-28).
[7]. Fujii, Y., & Satake, K. (2006). Source of the July 2006 West Java tsunami estimated from tide gauge records. Geophysical Research Letters, 33(24).
[8]. Tsuji, Y., Imamura, F., Matsutomi, H., Synolakis, C. E., Nanang, P. T., Harada, S., ... & Cook, B. (1995). Field survey of the East Java earthquake and tsunami of June 3, 1994. In Tsunamis: 1992–1994 (pp. 839-854). Birkhäuser Basel.
[9]. USGS Earthquake (2107). Earthquake Tectonic Images Java Tsunami 1990-2016. (Online). (https://earthquake.usgs.gov/earthquakes/tectonic/images/java_tsum.pdf) accessed on June 1, 2019.
[10]. Maramai, A., & Tinti, S. (1997). The 3 June 1994 Java tsunami: A post-event survey of the coastal effects. Natural Hazards, 15(1), 31-49.
[11]. Kusumasari, Bevaola. (2014). Manajemen Bencana dan Kapabilitas Pemerintah Lokal.
Yogyakarta: Gava Media

[12]. Quarantelli, E.L. 2001. Statistical and Conceptual Problems In The Study of Disaster. Disaster Prevention and Management. 10(5), 325-338

[13]. Cronstedt, M. (2002). Prevention, preparedness, response, recovery-an outdated concept?. Australian Journal of Emergency Management, The, 17(2), 10.

[14]. Samsulhadi, D. S. (1997). Aspek lingkungan tsunami di pantai selatan Banyuwangi: studi kasus Tsunami 3 Juni 1994 (Doctoral dissertation, Pascasarjana-UI).

[15]. Ina-Risk BNPB. 2017. Dokumen Kajian Risiko Bencana Kabupaten Banyuwangi Tahun 2017-2021. (Online). (http://inarisk.bnpb.go.id/) accessed on 30 May, 2019.

[16]. Ina-Risk BNPB. 2017. Dokumen Kajian Risiko Bencana Kabupaten Banyuwangi Tahun 2017-2021.

[17]. Westen, C.J. van, D. Alkema, M.C.J Damen et al. 2011. Multi-hazard Risk Assessment (Distance Education Course). United Nation University: ITC School on Disaster Geoinformation Management

[18]. Cresswell, J. W. (2010). Research Design: Pendekatan Kualitatif, Kuantitatif and Mixed. Edisi Ketiga. Yogyakarta: Pustaka Pelajar.

[19]. Hamzah, Amir. (2019). Metode Penelitian Kualitatif: Rekonstruksi Pemikiran Dasar serta Contoh Penerapan Pada Ilmu Pendidikan, Sosial, dan Humaniora. Batu: Literasi Nusantara

[20]. Badan Pusat Statistik (2018). Kabupaten Banyuwangi Dalam Angka 2018. Pemerintah Daerah kabupaten Banyuwangi

[21]. Hizbaron, D. R. (2008). Analisa Kerentanan Sosial Lingkungan Kota Jakarta. Jurnal Kebencanan Indonesia, 1(2008).

[22]. Hizbaron, D. R., Rijanta R, Baiquni M. 2014. Modal Sosial dalam Manajemen Bencana. Yogyakarta: Gadjah Mada University Press

[23]. Giyarsih, Sri Rum. 2013. Aspek Sosial Banjir Lahar. Yogyakarta: Gadjah Mada University Press

[24]. Irawan, L Y., Sumarmi., Rosyida, F. (2016). Urgency of Disaster Education to Enhance Preparedness of School Community Learning (Case Study: Elementary School Around Kelud Volcano). Seminar Nasional III - S2 PKLH FKIP UNS (1-5)

[25]. Nandi, D.S Rohman. 2017. Spatial modelling of tsunami inundation zone in the southern coastal area of West Java Indonesia, J of Engineering Science and Technology. Special Issue on AASEC 2016, October, 34 – 41.