

Conference Paper

Adaptation of the Spatial Pattern of a Settlement to Disaster in Simeulue Regency, Aceh Province

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Abstract

This study aims to find out how the spatial pattern of settlements in disaster areas adapt to earthquake and tsunami disaster in Simeulue Regency, Aceh Province. The research used a qualitative approach and descriptive method Data collection technique used literature study and field observation., Data analysis used the Delphi method. The study result showed that the influential factors that save many Simeulue people from earthquake and tsunami disaster occurred on Sunday, 26 December 2004 is the spatial pattern of settlement which is very suitable to tsunami disasters such as geographical condition in the form of the pattern of human settlements, vegetation formation, condition of topography and morphology. The geographical condition was beneficial where people can save themselves to highland when a tsunami occurs. The implication of the spatial pattern of settlement in Simeulue Regency is very friendly for tsunami disaster mitigation.

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Received: 24 May 2019

Accepted: 25 July 2019

Published: 4 August 2019

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Selection and Peer-review under the responsibility of the ISTECS 2019 Conference Committee.

Keywords: Spatial Pattern of Settlement, Disaster Adaptation

1. Introduction

Simeulue Islands is one regency effected by tsunami disaster on Sunday, 26 December 2004, and tsunami had destroyed a various building, infrastructures and other public facilities exist in Simeuleu Regency. There are more than 1.700 houses swapped by a tsunami that occurred in Aceh in 2004 in whole areas of Simeuleu Regency were around 80% of building in the coastal area of Simeulue in the sea level. Despite the severe destruction, it did not cause a high number of deaths, which only seven people of Simeulue Regency found died caused by this disaster [1–4].

That phenomena in Simeulue Regency did not happen in other regencies exist in Aceh Province. The severe destruction occurred in some regencies located in the east coastal area and west coastal area of Aceh Province. Sri Mulyani said to state that

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houses and building which are destroyed as a result of earthquake and tsunami achieve 1.3 million units in Aceh Province [5]. The impact occurred as a result of the tsunami on 26 December 2004 in Aceh Province destroy not only the building but also cause the deaths and missing people and significant financial loss. The death toll in Aceh earthquake and tsunami was more than 237.448 people, while it is predicted that total more than 300.000 people died [1, 6–8].

After tsunami occurred in Aceh Province, people raise the big question of what kind of power existed in Simeulue Regency which can save around 78.129 people of Simeulue island [1–4, 9]. The low number of deaths in Simeulue Islands is very influenced by two main factors, namely First, non-physical factor in the form of local wisdom “smong” exists among people of Simeulue Regency. Second, physical factor (scope in this study) in the form of geographical factor is physical condition of Simeulue Regency such as a spatial pattern of settlement and population distribution among Simeulue people, topography condition and morphology condition of Simeulue Regency, and vegetation formation condition exist in all coastal area of Simeulue Regency.

Several previous studies that [1] discussed The Smong Wave From Simeulue, A Wakening and changing, post-tsunami strategic development of Regency Of Simeulue. Then, [10] discussed Recognizing Indigenous Knowledge for Disaster Management: Smong, Early Warning System from Simeulue Island Aceh. [11] discussed the Value of Local Wisdom Smong in Tsunami Disaster Mitigation in Simeulue Regency, Aceh Province. It can be concluded no research examines the spatial pattern of settlement contained in Simeulue. Therefore, the author is interested in conducting the study on “Spatial Pattern of Settlement in Disaster Adaptation in Simeulue Regency, Aceh Province.” Then, this study aims to find out how the spatial pattern of settlement is very friendly to mitigate tsunami disaster in Simeulue Regency, Aceh Province.

2. Research Method

The research method used in this study is descriptive. A qualitative approach using descriptive methods used in this study. The object in this study is the physical environment in the Simeulue District of Aceh Province, such as the spatial pattern of settlement and population distribution among Simeulue people, topography condition and morphology condition of Simeulue Regency, and vegetation formation condition exist in all costal area of Simeulue Regency. Data collection technique used literature study to obtain secondary data then field research using field observation and survey

technique exist in Simeulue Regency, Aceh Province. Finally, data analysis using the Delphi method.

3. Result and Discussion

Based on observation result in the field, the one of influential factor which makes many people of Simeulue Islands save from tsunami (smong) disaster is a geographical factor in Simeulue Island. It is as contained in the message in the poetry of smong namely "Maheya mihawali (hurry, find a place), Fano me singa aktaek (the highland to save your life)." There are elements of the geographical condition mentioned by the ancestors of Simeulue people to save a life when tsunami (smong) occurs namely go to the highland which is higher than coastal area [1–3, 10, 11]. So it can be concluded that the ancestors of Simeulue people had known well the safe place to save a life from tsunami (smong) disaster. Among people of Simeulue Islands, smong is the other name for tsunami disaster, and linon is the other name for earthquake disaster [1–4][10][11].

The geographical condition in Simeulue Islands very supports and ease Simeulue people to do tsunami disaster mitigation correctly and appropriately. As for geographical elements which support disaster mitigation are people settlement, the morphology form of Simeulue Islands, the topography form of Simeulue Islands and the vegetation formation exist in a coastal area of Simeulue Islands [1, 4].

First, in general, the pattern of settlement in Simeulue Island can be classified into 2 groups, namely 1) Centralized settlement pattern, as a result of settlement area around the mountains and certain housing areas; 2) lengthened settlement pattern both which follow road path and which follow coastal line exists along coastal area of Simeulue Islands [4]. These settlement patterns are distributed in whole regions of Simeulue Regency and also influenced by morphological condition and topographical condition in Simeulue Islands.

The settlement pattern is strongly related to the number of population and the occupation of people who live in Simeulue Regency. The population in Simeulue Regency is 88.335 people consist of 45.307 male and 43.028 female with sex ratio is 105 people (2015). The population growth in the last five years (2010-2015) is 9.87%, and population density in 2015 is 48.48 people/Km². The total width of Simeulue Regency is 1.838.09 Km² or 183.809 Ha. Majority occupation in Simeulue Regency works as peasant/farmer and fisherman, so it is very reasonable if many people who live in Simeulue follow the road paths and coastal area and centralized settlement. It aims to ease people go to their work both in the mountain (plantation) and sea. Prioritize

on access to a network, social environment, facilities, and services also affordability to working are a common reason to choose the settlement area [12, 13].

Second, the influential factor which causes many Simeulue people to save from tsunami (smong) disaster is the morphology form of Simeulue Islands [1, 4]. The morphology of the Simeulue Islands consists of a sloping path, such as flat, slope, hilly, and mountainous. That morphology condition exists in all regions of Simeulue Regency. For more clarity, the map of morphology condition in Simeuleu Islands (see Figure 1). Based on the observation in Simeuleu Regency, people housing exist in Simeulue Regency generally located in flat and slope area, only a few houses which are located in hilly and mountainous areas. Most of those areas still function as dense forest which had not been used. But, most areas with flat and slope morphology had been used for people housing, school, mosque, governmental office, and other supporting facilities. There are also areas which are used for plantation and farming.

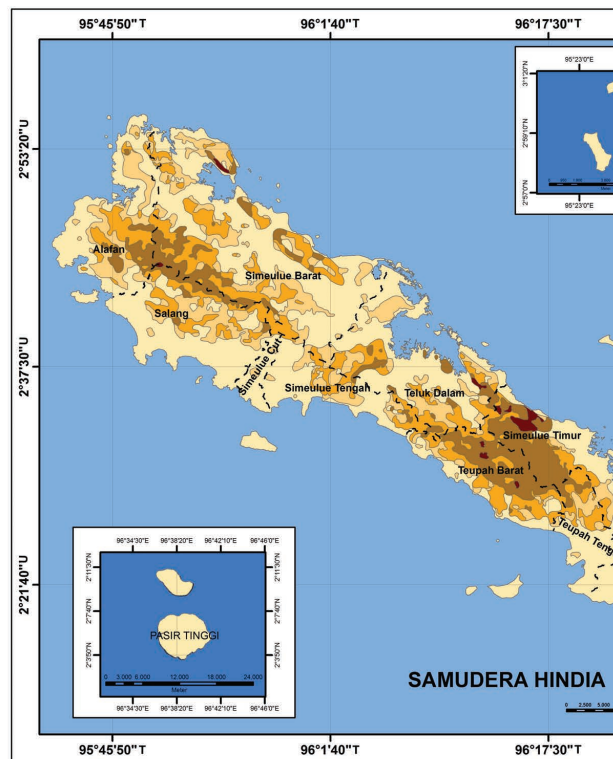


Figure 1: The map of morphology in Simeulue Islands.

Third, the influencing factor which makes many Simeulue people save from tsunami (smong) disaster in 2004 is the topography form of Simeulue Islands [1, 4]. Based on topography condition in Simeulue Islands, according to the map of earth surface with scale 1:250.000 (BAKOSURTANAL), the lowest point of Simeulue Islands is located in 0 MDPL (meter above sea level), whereas the highest point is located in 600 MDPL (meter

above sea level). Most areas are located in the height of 0 – 300 MDPL (meter above sea level) and the rest is hilly areas with the slope under 180o situated in the middle of islands [7]. That topography condition occurs in all regions of Simeulue Regency. For clarity, the map of topography in Simeulue Islands (see Figure 2).

In detail, the height of Simeulue Islands consist of 5 categories, namely category 0 until 50 mdpl (meter above sea level), grade 50 until 100 mdpl, grade 100 until 200 mdpl, grade 200 until 300 mdpl, and the last is category > 300 mdpl. However, most areas located in the height of 0 until 300 MDPL and the rest are hilly areas with the slope under 1802 situated in the middle of islands [7]. Based on the result of observation conducted in Simeulue Regency, the areas which have the height between 0 until 50 mdpl mostly used as people housing or settlement, governmental office and another facilities and infrastructure, even used as a plantation, rice field, and farm.

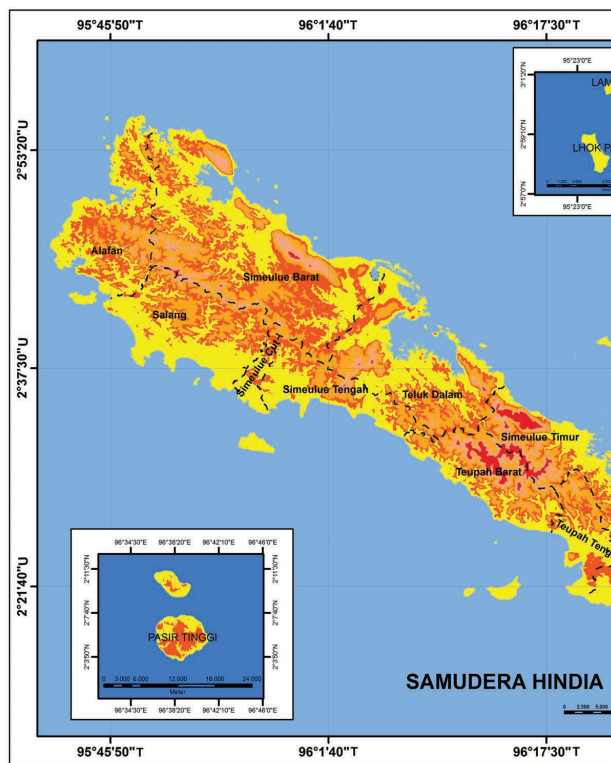


Figure 2: The map of topography in Simeulue Islands.

Based on the result of observation when the study was conducted in all Simeulue Islands, and corroborated by the map of topography, the map of morphology, the map of human settlement pattern, and the map of land use in Simeulue Regency. Later, the group of the settlement pattern exists in all areas of Simeulue Islands which consist of 3 (three) main category as follow: first, the areas which include the beach, rice field, mountain, and hill. Second, the areas which include beach, human settlement, rice

field, mountain, and hill. Third, the areas which consist of the coast, human settlement, mountain and hill, rice field, mountain and hill [4, 11].

In the following, the researcher will display on Figure 3 shows one form of natural appearance and settlement pattern in Simeulue Regency. Based on Figure 3 about the shape of (settlement pattern) in Simeulue Regency, it is seen the object of the coast, people settlement, road network, rice field and plantation, mountains and hilly in the form of dense forest. Based on that figure, it is seen the plants grow in the coastal area which protect people settlement. This natural appearance becomes the last influential factor which makes Simeulue people can save when the tsunami occurred in 2004.

Forth, the influential factor which makes Simeulue people can save from tsunami disaster is the formation of plants grow in Simeulue Islands [1, 4][11]. Based on the result of observation in the field, it can be concluded that there are plants formation in all areas of Simeulue Islands, such as mangrove located in the seashore, coconut tree, shrub and bush, and other plants which mostly exist in a surrounding coastal area of Simeulue Islands (see Figure 3). The vegetation formation also has a significant advantage in tsunami disaster mitigation. It is because of vegetation formation capable of protecting people settlement when a tsunami occurs. That vegetation formation will block the tsunami water which will hit human settlement, and finally, the water of tsunami wave will decrease in its energy and height. It happened in Simeulue Regency when the tsunami occurred in 2004.

This vegetation formation is very beneficial for Simeulue people because when tsunami wave move toward people houses and coastal area, it should pass vegetation formation and Simeulue people can use that time to save themselves by going to highland. Vegetation formation also becomes the right step of disaster mitigation as said by [14] that tsunami mitigation in a coastal area can be done among others by understanding the efforts of mitigation both structural and non-structural.

[15, 16] For tsunami disaster mitigation, it is broadly divided into two categories namely natural and artificial measures. Natural measures include coastal vegetation plantation, preservation, and protection of beaches and coral reefs, while the artificial measures include the construction of breakwaters, seawall and concept adoption of adaptation by the development of elevated coastal infrastructure. The elevated infrastructures mean the arrival tsunami wave will not reach the infrastructure or at least the infrastructure will be secure enough and safe when facing a tsunami.

These four factors which had been mentioned and explained above have significant contribution and influence in saving 78.129 people of Simeulue Regency in 2004 when a tsunami (smong) disaster occurred on Sunday, 25 December 2004. Then these four



Figure 3: The shape of (settlement pattern) in Simeulue Regency.

factors can be made as a spatial pattern of settlement which can be adapted to tsunami prone-areas as in Simeulue Regency. It is because the pattern of settlement, morphology form, topography form, and vegetation formation exist in the life of Simeulue Islands people. So it can be concluded that the spatial pattern of settlement in Simeulue Islands is tsunami disaster-friendly particularly in the effort of adaptation to disaster in Simeulue Regency, Aceh Province.

The morphology form, topography form and plants formation are helping people of Simeuleu Islands to save themselves when tsunami disaster occurs. The distance between people settlement to a higher area (such as mountain or hill) is very close around 100 until 200 meters or behind people house or settlement. Tsunami mitigation also can be done through some following steps [15, 17]:

Up to now, science and technology have not been able to predict when, where and how big the magnitude of the earthquake is going to happen. Therefore, to assess the possibility of earthquake-tsunami and its impacts in the future numerical stimulation is used when with several approaches and scenarios. 1) Earthquake-tsunami scenarios. 2) Topographic-bathymetric data. 3) Numerical Model Setup. 4) Simulation Results.

Through this simulation, the potential inundation area and the propagation time at the study area can then be estimated.

Simeulue Regency is surrounded and dominated by the coast, mountain or hill. The existence of mountain and hill in Simeulue Island is the result of a geological condition in Indonesia. The intersection of three plates causes the pressure on a lower layer of the earth which cause the region of Indonesian country has mountainous morphology and relatively rough [18]. Simeulue people have been very familiar with the natural condition of their region. It is because of the many benefits obtained by Simeulue people from this natural condition. People can utilize well various natural resources contained in the beach, mountain and hill in all regions of Simeulue Islands.

People also can utilize mountain or hill as a place to save themselves immediately when a tsunami disaster occurs. It is because the mountain or hills had been used by them to become a farm. [19] Knowing well the evacuation path will help people to find a safer place when tsunami disaster occurs. Unconsciously, Simeulue people had done the steps in the simulation of tsunami disaster mitigation.

Focusing on the last point, one way to provide people with knowledge on safe route and destination is by conducting regular evacuation drills. However, the training is expensive to be carried out, and it is challenging to enable many residents to take part [20]. People had memorized and known well the fastest route and road which should be passed to go to the mountain or hill even in a rush as when tsunami (smong) disaster occurred on Sunday, 26 December 2004. Besides, practicing regularly and knowing the evacuation path is very useful when a disaster happens to avoid panic [21–24].

Tsunami mitigation activity in coastal area environment can be done among others by 1) Understanding the characteristic of natural disaster and destruction occurs in coastal area; 2) Understanding the level of risk and vulnerability of coastal area region to disaster; 3) The increase of institutional capacity and law enforcement, and 4) factor which guarantee the continuity. It is parts of action done by people in tsunami disaster mitigation [14, 25, 26]. All actions done by people Simeulue people had reflected the part which should be done in the effort of tsunami disaster mitigation. The initiative and action also supported by the existence of local wisdom smong among Simeulue people, and the spatial pattern of settlement in Simeulue Regency which is very suitable for tsunami disaster adaptation. So, it is very reasonable that only seven people died because Simeulue people have acquired the knowledge about tsunami disaster and the natural condition of Simeulue Island is also tsunami disaster-friendly.

4. Conclusion

Simeulue Regency is earthquake and tsunami disaster-friendly. A physical factor influences it in the form of human settlement pattern, topography condition, morphology condition and vegetation formation in all regions of Simeulue Regency. These are two factors which cause 78.129 Simeulue people to save from earthquake and tsunami disaster occurred on Sunday, 26 December 2004. It can be concluded that Simeulue Regency is successful in the effort of tsunami disaster mitigation because it can minimize the number of deaths only seven people. Expected to people who are in other areas to take advantage of the natural state of the environment around the well to reduce the number of victims who died in the tsunami occurred in the community.

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