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Disaster Risk Index in Disaster Prone Area of Simeulue District Province of ACEH

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Abstract: This study aims to know the threats, vulnerabilities and capacity in the reseach study and how the disaster risk index of this area. The study was analysis by descriptive and followed by hazard analyze, vulneribility and capacity, make a table, map, disaster history and counted Disaster Risk Index. From 8 regions in Simeulue were evenly distributed dissemination potential capacity with an average score for the ability to anticipate threats of 1063, organizing ability and the ability of a solution of 889 monitoring and evaluation of 470. Region and the highest level of anticipation were East Simeulue and Alafan. From 8 regions in Simeulue were worrying spread of potential vulnerability with an average score of between disaster index, economic variable conditions of 3843, the physical condition of the building has a score of 7848 and the condition of vulnerable 2880. Region and the highest level of vulnerability were Alafan and Salang. From 8 regions in Simeulue were evenly distributed dissemination potential capacity with an average score for the ability to anticipate threats of 1063, organizing ability and the ability of a solution of 889 monitoring and evaluation of 470. Region and the highest level of anticipation were Simeulue Timur and Alafan. From the above calculations it can be concluded that the level of disaster risk highest were Alafan and Salang.

Key words: Disaster risk index, simeulue, hazard, vulnerability, capacity

INTRODUCTION

Indonesia is a country with a highly potential for disaster. There are several potential disasters include natural disasters such as earthquakes, volcanic eruptions, floods, landslides and others. Potential disasters in Indonesia can be classified into two main groups, namely the potential main hazard and the collateral hazard. The main potential hazards can be seen, among others, on the map of potential earthquake in Indonesia which indicates that Indonesia is a region with earthquake zones prone, landslide potential maps, maps of potential catastrophic volcanic eruptions, catastrophic potential map tsunami, flood potential maps and others. From the above indicators can be concluded that Indonesia has high potential major hazards (main hazard potency). This is certainly very unfortunate for the country of Indonesia. Besides the high potential major hazards, Indonesia also has the potential collateral hazard potency (IDEP, 2007).

A disaster is defined a serious disruption and functioning of society, causing widespread human, material or environmental losses which exceed the ability of an affected society to cope using only its own resources (EEA, 2006). Disaster is defined as a serious disruption of the functioning of a society, causing widespread loss of human life in terms of material, economic or environmental and are beyond the ability of the society to cope using their own resources. By UN definition (Cardona, 2005), the risk of losses is a function of three components: hazard, element at risk and vulnerability. In the case of risk of human losses, the element at risk is the exposed population. The hazard occurrence refers to the frequency of returning period at a given magnitude whereas the vulnerability is the degree of loss to each element should a hazard of a given severity occur.

Disaster Risk Reduction is a series of activities before, during and after a disaster is done to prevent, reduce, avoid and recover from disasters. According

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to ISDR (2002) is a preparedness measures that enable governments, organizations, communities and individuals to be able to respond a disaster situation quickly and appropriately. Included in the preparedness action is the preparation of disaster management plans, maintenance resources and personnel training. Preparedness activities focused on the development of plans to respond to disasters quickly and effectively. Preparedness, efforts are being made to anticipate disasters, through the appropriate steps to organizing and efficient (Latief, 2008).

Simeulue Island categorized proneness since they often experience an earthquake and tsunami, the Regional Disaster Management Agency (BPBD) Simeulue district note Simeulue has strong earthquake and tsunami occurred in 190. Furthermore, on November 2, 2002 an earthquake reaching 9.3 on the Richter Scale (SR), December 26, 2004 reached 9.1 magnitude and tsunami reached 30 m, March 3, 2005 earthquake reaching 9.1 magnitude, February 20, 2008, 5 April 2009, August 18, 2009 and December 19, 2009. January 16, 2011 an earthquake of 5.9 magnitude, January 18, 2011 the power of the SR 5.7, 5 April 2010 with the strength of 7.2 Richter. On October 17, 2011 in Simeulue earthquake occurred again with a magnitude of 5.2 SR and January 11, 2012 with a strength of 7.1 SR and April 2012 with a strength of 8.5 Richter. On October 5, 2010 a cyclone hit West Teupah Subdistrict 5 and damaging homes and on March 30, 2011 back hurricanes in Central Simeulue and damaging three houses. So, it can be concluded that this district is an area that is prone to disasters. From the description of the history of this disaster Simeulue included in disaster-prone areas (TDMRC, 2011) and have been socialized in Aceh Province.

Based on Silbert reseach, noted the importance of economic development to reduce vulnerability to disasters. Vulnerability analysis should take into account vulnerable groups such as women, the poor and small island in developing countries. According to Twigg (2009), there is have five thematic area that listed on Hyogo Frame Work Action, governace, risk assessment, knowledge and education, risk management and vulnerability reduction and disaster preparedness and response.

Based on the National Agency for disaster management stating that Simeulue District is the third city with the highest disaster risk index in Aceh, the history of disaster and implemented policies and respect to disaster risk management, the main problem of this reseach: What are the the threats, hazards, vulnerability and capacity in the study area and how is the disaster risk index of this area?

MATERIALS AND METHODS

The Reseach was done in June 2012 to 2013. The research location is determined by purposive sampling, Sudjana (1997), the disaster proneness areas in the province of Aceh, Simeulue. Collecting data do in three ways, literate study, questionnaire, dan field obsevation. The method of analysis used to define the results of the exploration problem is a descriptive study. To complement the descriptive explanation of some of the test that is: analyze the hazard, vulneribility and capacity do with make a table, disaster history and Disaster Risk Index with the formula (IDEP, 2007):

$$\text{Disaster Risk (DR)} = \frac{\text{Hazard (H)} \times \text{Vulnearibility (V)}}{\text{Capability (C)}}$$

In this study, researchers lowered these variables into a few factors and sub-factors in order to obtain the weighted value of each variable threats, vulnerabilities and capabilities. The following diagram decrease variables into a few factors based on a review of studies and the results of focus group discussions in Simeulue community. Sample amount 393 people was determined using formula slovin. To know the formula risk value of threat (hazarad), vulnerability and capacity (Chen *et al*., 2003; Israel, 1992):

$$\Sigma F \times S \times I$$

Where:
F = Frequency
S = Score
I = Impact

RESULTS AND DISCUSSION

Based on disaster management act to calculate the level of risk of disaster risk, it can be seen from three variables, namely threat or hazard, vulnerability and capability. According to Awatona (1997) reseach components of threat factors (dangers) can be known from the type, frequency, location. Beside that the component of the vulnerability factors include the social, economic, buildings and areas. Other factors associated with disaster is the capacity which is the positive aspects of the existing situation. Therefore, it is necessary for disaster risk assessment in order to provide information about the dangers and disasters where and when needed and can develop mitigation strategies and technologies.

Table 1: Frequency and threat assessment scores

	Score			Frequency and impact score															
				Teupah Selatan		Simeulue Timur		Teupah Barat		Simeulue Tengah		Teluk Dalam		Salang		Simeulue Barat		Alafan	
Variables	Anticipation	Impact	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores
Tsunami	1	8	9	1	72	0	0	1	72	0	0	1	72	0	0	1	72	1	72
Earthquake	5	9	9	12	972	15	1215	13	1053	12	972	12	972	12	972	13	1053	14	1134
Bushfire	4	5	5	5	125	8	200	4	100	4	100	4	100	4	100	5	125	5	125
Lanslide	5	3	3	1	9	1	9	1	9	2	18	2	18	1	9	1	9	4	36
Hurricanes	5	4	3	1	12	1	12	2	24	0	0	0	0	1	12	1	12	2	24

Main analysis data, 2013

Value threat (Hazard): Threats are rare or extreme events of the environment due to human activity or natural because that adversely affect human life, property or activity to the level that caused the disaster (UNDP, 2009). From the observation and data analysis of the obtained multiple threat picture in this disaster-prone areas. Basic concept to know the threat like identifying the hazards assessing the vulnerabilty of settlemant and evaluating the risk. Value is calculated observation researchers threat while in the study by determining the location of impact and the weight of values were then calculated by multiplying the frequency of occurrence.

From the observation threat value calculated while research location by determining the impact of the value score then calculated by multiplication of the frequency of occurrence (Chen *et al*., 2003). Value threats in Simeulue district can be seen in Table 1.

From the results, we can conclude that from 8 regions in Simeulue are evenly spread of potential threats. With above average scores index disasters, earthquakes pose a threat variables with the highest frequency as many as 103. Then bushfires, landslides, hurricanes and tsunamis, respectively 39, 13, 8 and 1. Scores for each indicator that the tsunami disaster threat of 360, Earthquake of 8343, amounting to 975 fires, landslides by 117 and hurricanes by 96.

The highly risk threat is Alafan this was due to the earthquake epicentrum point located at coordinates 3.316° North latitude and 95.85° East longitude with a depth of 30 km and approximately 250 km South of Banda Aceh and ±50 km from Alafan region so that the vibrations are stronger than other regions. Position Simeulue is near the line between the Indian Australian plate and Eurasian plates. This consistent by Natawidjaya reseach which states the position of Simeulue District between the Indian Australian Plate and the the Eurasian plate while the other plate is under the Indian Ocean. Limit the collision of two plates can be observed in the form of lines deep ocean trenches to the West of Sumatra to the Andaman Islands. In the collision region, the Indian Plate under Sumatra 50''60 cm rock^{-1} mass above referred to as the contact area of a subduction zone.

The second highest threat region is the district East Simeulue. This is because the region as the capital of East Simeulue sub-district is a densely populated area. At the time of the earthquake is easy there is a risk of fire because the stove fell, candles and fall short of current flow occurs. Triggers another fire building construction material of wood. Mitigation of earthquake made hereditary society is making a house with basic materials so that the board is not too risky when the earthquake happened but on the other hand is more combustible material than brick building material.

Value vulnerability: According to the ministry of research and technology of the republic of Indonesia, the vulnerability is a condition of a community or society that leads or has an inability in the face of threats. Society is said to have vulnerabilities if they are not able to anticipate and survive a threat. The vulnerability arises because the pressure acts of individual or community.

The forms of vulnerabilities that exist in society seen from indicators of economic conditions, the physical condition of the building and the condition of the vulnerable population. This is consistent with Peduzzi *et al.* (2009) research, conducting reseach on disaster risk index and assess hazard and vulnerability which measures the vulnerability from socio-economic parameters. Vulnerability values calculated through observation while on-site research study by determining the impact and value weights are then calculated by multiplying the frequency of occurrence. Value threats in Simeulue District can be seen in Table 2.

Sub-district Alafan is the most vulnerable region from other regions. Physically this area directly facing the Indian Ocean with no obstacles. Alafan region includes areas that have economic resources low and limited access to transportation either by land or sea.

Land access many disconnected because a lot of damaged roads and bridges, the network exit is also very limited because there is no port, so that when disaster strikes the area is extremely vulnerable to food aid, medicines and other. Access to communication and electric lighting is also inadequate in this area because

Table 2: Frequency and vulnerability assessment scores

				Frequency and impact score															
	Score			Teupah Selatan		Simeulue Timur		Teupah Barat		Simeulue Tengah		Teluk Dalam		Salang		Simeulue Barat		Alafan	
Variables	Anticipation	Impact	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores
Economic	3	7	9	15	945	10	630	6	378	5	315	4	252	6	378	7	441	8	504
Building phsysical	4	8	9	30	2160	15	1080	9	648	7	504	12	864	11	792	13	936	12	864
Vulnerable population	3	8	8	7	448	5	320	8	512	4	256	5	320	7	448	4	256	5	320

Table 3: Frequency and capacity assessment scores

				Frequency and impact score															
	Score			Teupah Selatan		Simeulue Timur		Teupah Barat		Simeulue Tengah		Teluk Dalam		Salang		Simeulue Barat		Alafan	
Variables	Anticipation	Impact	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores	F-values	Scores
Threats ancipate ability	7	9	7	17	1071	19	1197	18	1134	17	1071	15	945	15	945	16	1008	18	1134
Solution organize ability	5	8	7	16	896	18	1008	14	784	15	840	15	840	15	840	16	896	18	1008
Monitoring evaluation capabilities	7	8	5	12	480	12	480	11	440	12	480	11	440	11	480	13	520	11	440

Main analysis data, 2013

there is no telecommunication networks and information that goes into this region. This is consistent with the findings by Silbert which states geographically small islands are vulnerable to disasters. Communities that are vulnerable to disaster risk are those living in areas of high risk of disasters, low economic capacity and living in small islands.

The second highest vulnerable region is the district Salang because this area is not hilly like many other areas, so they have to run far enough to reach the hill. But when the 2004 tsunami happened community can still save themselves for the hills because the distance to the area is still quite safe. Results interview mentioned that knowledge about Smong has been acquired to save themselves from generation to generation to save himself and family members, do not remember the others but continue to run to reach the hill. This is consistent with Sanny (2007) which states that local knowledge of culture Smong from generation to generation in Simeulue community about self-rescue disaster can safe them from tsunami in December 26, 2004.

Rated capacity: Ability is a combination of strength and existing resources within a community, social or organization reduces the level of risk or the impact of disasters (ISDR, 2002). Existing capabilities in an environment can not be separated from the power of the parties therein (Ministry of Research and Technology of the Republic of Indonesia). From the observation and data analysis of the obtained several images in capacity of disaster-prone areas. Rated capacity is calculated through observation while on-site research study by determining the impact and value weights are then calculated by multiplying the frequency of occurrence. Rated capacity in Simeulue District can be seen in Table 3.

From Table 3 results, we can conclude that 8 regions in Simeulue are evenly distributed dissemination potential capacity. With an average score for the ability to anticipate threats of 1063, organizing ability and the ability of a solution of 889 monitoring and evaluation of 470. Region and the highest level of anticipation is East Simeulue and Alafan. Alafan have a high threat to the community in managing the risk of tsunami and earthquakes should be to greater capacity such as in anticipation, community organizing, monitoring and evaluation. Although, this indicator is to adopt disaster risk management system from the outside but this indicator has been applied to the public, for example, people have been ble to anticipate early on in the event of an earthquake and tsunami. When an earthquake is high then the village elders (customary village head and dean) immediately ascertain whether a tsunami through the receding sea water and dry well. If such symptoms occur they immediately announced to go up into the hills. For monitoring indicators and the solution is usually done by the village elders to ensure that all citizens have gone up a hilltop and traditional elders have been able to make further plans after they were evacuated for example a search team go to the forest and fine food sources for people who evacuated to the mount and security team to ensure that the condition of the village safe.

East Simeulue community is high capacity region because after the 2004 tsunami many NGOs are in so local knowledge is getting applied and coupled simulation

in addition to the preparedness is further enhanced by the presence of an early warning system of the community in the form of wind chimes that have been applied. At the time of the 2004 tsunami Eastern Simeulue relatively safer, harmful effects in an earthquake collapsed many houses but communities in East Simeulue has the capacity to anticipate the event of an earthquake with the development board. This is in consistent with Lindell and Hwang (2008) which stated the importance of the ability of capacity to manage the dangers, gender and ekonomic. A low understanding of hazards, risk information will influence public perception.

Disaster risk index: By using this formula then when there are no vulnerabilities and threats, risks resulting value is 0 but on the contrary if a region has a value of >100 disaster risk, this means that the region has a high risk of disaster. Results obtained from observation through interviews and focus group discussions, grouped by the disaster areas in Simeulue District can be seen in Table 4.

Figure 1 was obtained from the conversion of the value set by the Disaster Management Act is equal to 100. From the above calculations it can be concluded that the level of disaster risk is highest in Alafan and Salang. The same thing was concluded by Bappeda Simeulue (2012) in mapping disaster risk index Simeulue island with a GIS (Geographic Information System) that the District Alafan and Salang are the most risk areas on the island.

Alafan and Salang is the highly risk index area than the other this was due to the earthquake epicentrum point located at coordinates 3.316° North latitude and 95.854° East longitude with a depth of 30 km and approximately 250 km South of Banda Aceh and ±50 km from Alafan region so that the vibrations are stronger than other regions.

Alafan Physically this area directly facing the indian ocean with no obstacles. Alafan region includes areas that have economic resources low and limited access to transportation either by land or sea. Land access many disconnected because a lot of damaged roads and bridges, the network exit is also very limited because there is no port, so that when disaster strikes the area is extremely vulnerable to food aid, medicines and other. Access to communication and electric lighting is also ineffective in this area because there is no telecommunication networks and information that goes into this region it make difficult to communicate out of the island of Simeulue. Salang is the second highly risk cause there is no close hill around for evacuated place. The people must be run for 30 min to reach the hill.

Table 4: Main analysis data disaster risk index

	Research variables			
Districts	Threats	Vulnarabilities	Capacity	Disaster risk index
Teupah Selatan	1190	1688	2447	82
Simeulue Timur	1436	1618	2685	87
Teupah Barat	1258	1538	2358	82
Simeulue Tengah	1090	1075	2391	49
Teluk Dalam	1162	1436	2225	75
Salang	1093	2030	2265	98
Simeulue Barat	1271	1633	2424	86
Alafan	1391	3553	2582	191

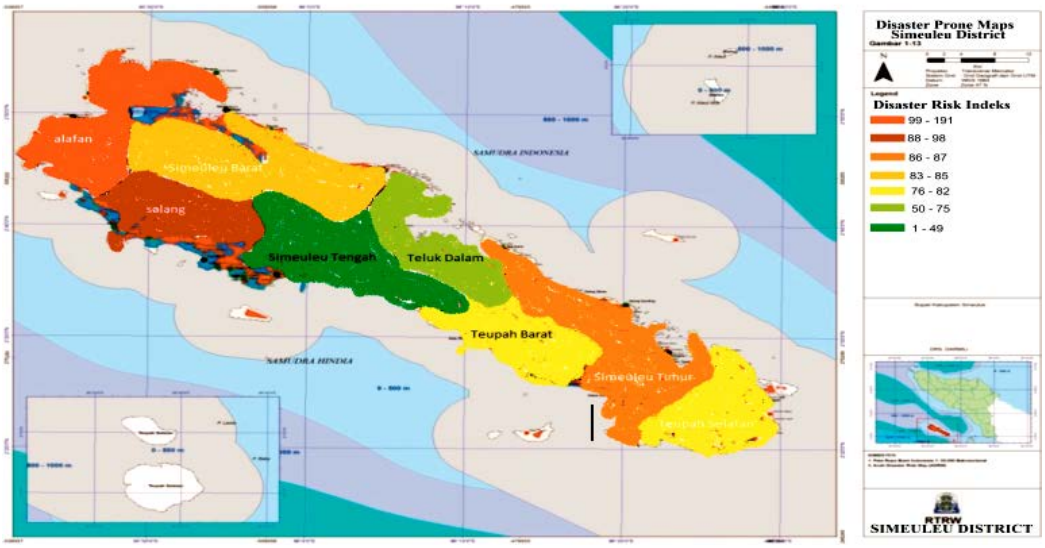

Fig. 1: Main analysis disaster risk index, 2013

CONCLUSION

From 8 regions in Simeulue were evenly distributed dissemination potential capacity. With an average score for the ability to anticipate threats of 1063, organizing ability and the ability of a solution of 889 monitoring and evaluation of 470. Region and the highest level of anticipation were Simeulue Timur and Alafan. From 8 regions in Simeulue were worrying spread of potential vulnerability. With an average score of between disaster index, economic variable conditions of 3843, the physical condition of the building has a score of 7848 and the condition of vulnerable 2880. Region and the highest level of vulnerability were Alafan and Salang. From 8 regions in Simeulue were evenly distributed dissemination potential capacity. With an average score for the ability to anticipate threats of 1063, organizing ability and the ability of a solution of 889 monitoring and evaluation of 470. Region and the highest level of anticipation were Simeulue Timur and Alafan. From the above calculations, it can be concluded that the level of disaster risk highest were Alafan and Salang. It can be seen from the disaster risk index Alafan shown 191 score and Salang area 98 score.

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